MUCH TO GAIN IN PAIN

EARLY AND INITIAL PAIN MANAGEMENT IN TRAUMA PATIENTS IN PREHOSPITAL AND HOSPITAL BASED EMERGENCY CARE

SIVERA BERBEN

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Curiosity is, in great and generous minds, the first passion and the last.

Samuel Johnson (1709 - 1784)

Dedicated to my parents

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chapter 1

Introduction and outline of the thesis

Early and initial pain management

Adequate pain management in trauma patients in (prehospital) emergency care can be very problematic. Less than a generation ago, the prevalent attitude towards acute pain management was a widespread acceptance that pain was inevitable, and frequently professionals were often indifferent to a suboptimal approach.[1] Nowadays, adequate pain management is understood to be a fundamental human right and integral to the ethical, patient-centred practice of modern medicine.[2] Furthermore, long-lasting acute pain can have a deleterious effect on the patients' physical and emotional recovery and can ultimately lead to chronic complaints.

This thesis addresses the problems of early and initial pain management in trauma patients in (prehospital) emergency care. Injury and accidents at home leading to acute pain, can be the personal experience of many of us. Although ambulance personnel (further referred to as paramedics) and emergency nurses are often the first contacts for trauma patients in pain, all members of the trauma team are responsible for adequate pain management. Therefore, early and initial pain management in this thesis concerns ambulance personnel, emergency nurses and physicians, and (orthopaedic) trauma surgeons in emergency care.

The topics in this thesis are reflected upon from a nursing perspective, which can be considered to be unique in a multidisciplinary team approach. Nurses, contrary to doctors, are focused on maintaining health and the care of patients, rather than on the cure of injuries or diseases.[3] It therefore offers an additional input towards pain management during a decision making process of professionals for a person in pain.

What is pain?

A definition of pain developed by the International Association for the Study of Pain (IASP) describes pain as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage'.[4]

Acute pain is defined as 'pain of recent onset and probable limited duration. It usually has an identifiable temporal and causal relationship to injury or disease'. Chronic pain 'commonly persists beyond the time of healing of an injury and frequently there may not be any clearly identifiable cause'.[5] As this thesis is focused on early and initial treatment of acute pain in trauma patients in emergency medicine, the transition from acute to chronic pain will not be discussed further.

Pain is considered to be a functional warning sign. By producing a reflexive retraction from the painful stimulus, and tendencies to protect the affected body part, the body's "defence system" tries to avoid (future) harmful situations and damage.[6]

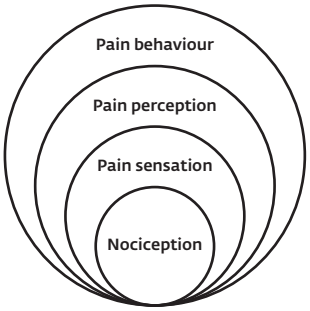
This biomedical model of pain describes the neuro-physiological processes following (potential) tissue damage. Extreme mechanical, thermal and chemical stimuli result in so-called noxious stimuli that are produced by peripheral nociceptors. These ensuing processes, whereby noxious stimuli are transmitted, modulated, encoded and processed, are all described by the term 'nociception'.[7] This nociceptive information is transmitted to the spinal cord. Here, after extensive modulation and being of adequate intensity, it can reach the more central parts of the nervous system. Following even more complicated central processing of this information, emotions, memories and cultural background can finally shape the individual pain experience.

Pain models

Two pain models are frequently cited in order to outline the complexity of the problem.

According to Loeser's biopsychosocial model of pain,[8] pain is initially evoked by nociception, and subsequently the stimulus is recognized as pain, the so-called pain sensation. Furthermore individual aspects such as cognition and emotions influence the pain sensation, resulting in the subjective experience of pain. Finally, the personal experience results in verbal expression, posture and limited activities, resulting in an observable pain behaviour. This model can be used by a multidisciplinary team approach and presents a holistic perspective of pain (Figure 1.1).

Figure 1.1 Pain model of Loeser



Another multidimensional model of pain, by Melzack & Casey, describes pain in terms of three dimensions.[9] The sensory-discriminative dimension of pain refers to the intensity, location, quality and duration of the pain. The affective-motivational dimension represents unpleasantness and the urge to escape from this unpleasantness. The cognitive-evaluative dimension of pain covers cognitions such as appraisal, cultural values, distraction and hypnotic suggestion.[9] All these dimensions can interact. For instance, an increased anxiety is positively related to an increased pain intensity rating.[10]

Melzack and Casey hypothesized that cognitive activities can influence the intensity (sensory dimension) and unpleasantness (affective motivational dimension) of pain and vice-versa.[9]

In line with these theories, pain management frequently requires a differentiated and multimodal approach.

Trauma and acute pain

Trauma can generally be defined as 'damage inflicted on the body as the direct or indirect result of an external force, with or without disruption of structural continuity'.[11] Trauma patients have (potential) injuries, due to mechanisms of blunt or penetrating forces, falls, explosions, heat/cold or chemical toxicants.[12,13] The patients are involved in home and leisure accidents, sports or occupational-related traumas, road and traffic accidents, violence-related injuries, assaults, or actions of self-mutilation.[14]

Acute pain and trauma seem to be inevitably related to each other, since trauma induces noxious stimulation due to tissue damage. Acute pain is one of the activators of a complex neurohumoral and immune response to injury. It leads to inflammation, hyperglycaemia, protein catabolism, increased free fatty acid levels (lipolysis) and changes in water and electrolyte flux.[15,16] Local and widespread neurophysiological changes give rise to an increased response described as hyperalgesia. Furthermore, cardiovascular effects of increased sympathetic activity and diverse effects on respiration, coagulation and immune function can be present.[16] Also, peripheral and central injury responses have a major influence on acute pain mechanisms. Thus, the subjective experience of pain is related to trauma, although it very frequently bears a variable relationship with tissue damage. Also, the duration and intensity of the pain experience is not necessarily related to the extent of the tissue damage. Another complicating factor is that injuries frequently occur unexpectedly and are accompanied by anxiety and stress, both of which can increase the intensity of pain. In exceptional cases the pain experience can either be absent or delayed as a result of severe neurological

damage (brain trauma, spinal cord lesions) or absent due the urge for survival and massive endorphin release.

Pain in trauma patients interferes with recovery and cure and likewise it affects all aspects of a patient's life. When the interaction between pain and the injury is severe and prolonged, the injury response itself can become counterproductive and have adverse effects, such as a delayed wound healing and recovery.[17,18] Furthermore, psychological changes can be associated with inadequately relieved pain such as increasing anxiety, inability to sleep, loss of control, and inability to think and interact with others. Persistent unrelieved pain eventually may alter the pain perception and prior painful stimuli or inadequately treated pain lower the pain threshold in subsequent painful experiences.[2]

Patients with chronic pain often relate the onset of it to an acute injury. This stresses the need to prevent a possible progression from acute to chronic pain.[19] During follow-up, 63% of the trauma patients report chronic pain one year after major trauma.[20] Patients with minor trauma describe an ongoing level of moderate pain after discharge of the emergency department (ED).[21] The last group frequently visits a general practitioner following discharge, in order to obtain further analgesia related to their injuries.

Prevalence of trauma in emergency care

In 2009, Dutch ambulance Emergency Medical Services (EMS) performed 1,041,966 emergency responses,[22] of which 67 percent (n=693,881) concerned (very) urgent emergency care requests. The latter responses involved patients with serious risks regarding their vital signs (urgency level A1) or health status (urgency level A2). Approximately one third of the (very) urgent responses (n=231,293) involved trauma patients.[22]

In the Netherlands, 3.1 million people needed injury treatment due to an accident each year, and 830,000 patients visited EDs for this purpose. A total of 110,000 patients had such severe injuries, that they needed to be admitted to the hospital for further medical treatment.[23]

Pain management in trauma in emergency care

In general, pain management covers a variety of interventions. However, initial systematic assessment of pain by validated instruments for adults, such as the Visual Analogue Scale or the Numeric Rating Scale,[24] is necessary. Re-assessment of it, and monitoring of outcome and (potential) adverse effects are necessary interventions to tailor adequate pain management for each unique patient.

Various possibilities exist to diminish pain following trauma: blockade of the

nociceptive input leading to a painful stimulus is provided with analgesics,[25] for instance Non-Steroidal Anti-Inflammatory Drugs (NSAID) and opioids.

A part of multimodal pain management is represented by the generic term 'non-pharmacological pain treatment'. This approach can also focus on the sensory-discriminative dimension of pain (e.g. elevation of injured body parts or splintage of fracture sites), the emotional affective dimension of pain (e.g. anxiety relaxation strategies), or can be concentrated on the cognitive dimension of pain (e.g. provision of information). Based on the model of Loeser,[8] attention interventions influence the experience of pain.[26] Other cognitive processes (e.g. memory/learning, thought processing, beliefs, mood), behavioural responses and interactions with the person's environment can also affect the pain experience.[27]

Pain management in trauma patients specifically needs to be integrated into the methodological principles of (prehospital) trauma care management.[20,28] This systematic approach for the care of trauma patients has been widely implemented and is based on the principles 'treat first what kills first' and 'do no further harm'. Furthermore, it advocates that the lack of a definitive diagnosis and a detailed history should not lead to a delay in the application of an indicated treatment for a life-threatening injury. The most time-critical interventions should be performed at an early stage. Pain can be seen as the fifth vital sign,[29] although pain assessment according to the methodological principles of trauma care is part of the secondary survey and has been described under the alphabetical heading of 'G': giving comfort. Early and initial pain management in trauma patients requires effective, but also safe treatment options for patients with (presumed) hypovolemia or other comorbidities. Otherwise, conflicts may arise between providing patient comfort (by timely pain control) and patient safety, due to the possible adverse effects of the analgesics.

Pain management in prehospital EMS

Pain is considered to be the major complaint of patients in emergency care. In a general population of EMS patients the prevalence of pain varies between 31% and 54%.[30-33] The prevalence of pain in the specific population of trauma patients in EMS is unknown. Significant deficiencies in prehospital EMS pain management have been described, such as the need for adequate pain assessment,[34] and (timely) administration of analgesia.[30,35-38] Therefore, relief of discomfort (including pain) is a priority condition in prehospital emergency care (research).[39,40] A lack of adequate pain assessment and administering of analgesics in the prehospital

field results in further analgesic delays in the emergency department.[34,36,37] This suggests that ineffective prehospital pain management has an adverse effect on pain management in the chain of emergency care.

In the Netherlands, pain management for trauma patients in prehospital EMS has been regulated by a national EMS analgesia protocol for paramedics.[41,42] This protocol is based on best practices and literature and focuses on pharmacological treatment. The effect of pain management according to this protocol on pain relief in trauma patients has not been studied yet.

Pain management in the ED

The prevalence of pain in the ED varies from 52 to 79% in heterogeneous patient groups.[43-46] As in the EMS situation, the prevalence of pain in the specific group of trauma patients in the ED is unknown. Pain is shown to be undertreated in the ED.[47-49] Triage with the Manchester Triage System (MTS) includes a systematic pain assessment. At the same time, the outcome of this pain measurement is an indicator for the assigned urgency level. The (potential) effect of the implementation of systematic triage in the ED on the improvement of pain management has not been studied yet.

A recent study of Gaakeer et al.[50] showed that 66 (out of 108) EDs in the Netherlands possess a pain protocol. More than half of these protocols did not address adults, and protocols turned out to be rather conservative regarding pharmacological pain management: seventy-three percent of the protocols required a diagnosis before pain relief. The effect of current pain management in the Netherlands on pain relief in trauma patients is unknown.

Pain management in the chain of emergency care

Most studies in emergency care are focused on pain management within a specific setting (prehospital EMS or ED). Insight into the continuity of pain management in the chain of emergency care is generally lacking. Several barriers for effective pain management in the ED have been identified, such as ethnicity,[51] anxiety,[52] reluctance to report pain from the patients' perspective,[53] and insufficient knowledge of professionals.[54-56] Factors that hinder or facilitate pain management in the chain of emergency care, have not been identified yet.

While many studies described deficiencies in pain management, we hardly found any information on the state of the art of the performance in the early and initial management of pain for trauma patients in the chain of emergency care.[1,57,58] Clinical guidelines on acute pain management in general can possibly provide

building blocks for recommendations on improvement of pain management in the chain of emergency care. These building blocks can be used in the development of a tailored guideline for pain management in trauma patients in the chain of emergency care.

Aim of the thesis

The overall aim of this thesis is to give insight into pain management for evaluable and adult trauma patients in emergency care, and to gain knowledge that could contribute to the improvement of pain management for these patients in this specific setting.

In order to achieve this purpose, we answered several study questions addressing early and initial pain management in the chain of emergency care in the Netherlands.

Study questions

1. What is the prevalence of pain in trauma patients in prehospital EMS in the Netherlands? Furthermore, what is (the effect of) current pain management, and what are possible gaps in management and relief of pain in trauma patients in prehospital EMS?
2. What is the prevalence of pain in trauma patients in the ED? Furthermore, what is (the effect of) current pain management, and what are possible gaps in the management and relief of pain in trauma patients in the ED?
3. To what extent does a relation exist between the implementation of the MTS in Dutch EDs and the systematic improvement of pain management and pain relief in trauma patients?
4. What are facilitators and barriers for pain management in trauma patients in the chain of emergency care?
5. Which evidence-based clinical guidelines on acute pain can be identified, and serve as a basis for the development of a (tailored) clinical guideline on pain management in trauma patients in (prehospital) emergency care?
6. Which recommendations on the state of the art performance of pain management in the chain of emergency care in the Netherlands can be developed?

Outline of the thesis

Chapter 2 describes the prevalence of pain in trauma patients in prehospital ambulance EMS in the Netherlands. The retrospective document study of paper and digital patient files reports on the amount of patients having pain, the intensity of pain and the treatment that is provided by the paramedics. It answers the question whether pharmacological treatment according to the national EMS analgesia protocol has a positive effect on pain relief, and what are possible gaps in pain management.

Chapter 3 concerns a prospective observational study on pain management in the ED. In this study we followed trauma patients 24 hours per day / 7 days a week, whereby pain was measured on admission and at discharge of the ED. Furthermore, (non)pharmacological pain management was observed. The study addresses the prevalence of pain, current pain treatment in trauma patients and the effect of pain management on pain relief in the ED. Furthermore, possible gaps in pain management in EDs in the Netherlands are discussed.

Chapter 4 reports on the potential effect of the implementation of systematic triage in the ED on pain management and pain relief in trauma patients. In this study with a before/after design we analysed whether the implementation of MTS and the systematic improvement of pain management and pain relief are related. The study was performed in an academic hospital (level I trauma centre) and a regional teaching hospital (level II trauma centre). As the implementation of MTS in both institutions has been effectuated in different time periods, data between hospitals were not compared.

Chapter 5 includes a qualitative study on facilitators and barriers in pain management in the chain of care. We invited paramedics, emergency nurses and physicians in focus groups to share their thoughts on assisting and hindering factors in pain management for trauma patients in the chain of emergency care. Furthermore, medical and nursing management positions were interviewed regarding this topic. The discussions were qualitatively analysed after saturation had been reached. The study describes whether there are similarities or differences between the EMS and ED groups, and the (general) topics regarding facilitators and barriers in pain management in emergency care.

Chapter 6 describes a systematic review of guidelines on acute pain management. We critically appraised guidelines on acute pain management using the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. Which guidelines can be (strongly) recommended according to the AGREE-criteria? What is the content of the guidelines regarding to pain management, and what could be building blocks for the development of a tailored guideline for trauma patients in the chain of emergency care? These questions will be answered in chapter 6.

Chapter 7 focuses on the state of the art of the performance of pain management in the chain of emergency care. This study describes the development of a Dutch national tailored guideline on pain management in trauma patients in the chain of emergency care. We developed a national guideline together with thirteen (scientific) occupational societies of professionals (in emergency care). Five central questions had to be answered by the literature review and consensus procedure. What can be recommended regarding validated pain assessment? What are influencing factors on pain and if necessary, how can a professional take these into account? What is considered to be effective (non)-pharmacological pain management? What can be recommended regarding the organization of acute pain management in trauma patients in the chain of emergency care?

Chapter 8 discusses the relevance and context of the main findings of this thesis. Furthermore, we elaborate on the conceptual and methodological considerations of issues and give recommendations for practice education, implementation and future research.

Chapter 9 summarizes the findings of this thesis. Chapter 10 describes a summary of findings in Dutch.

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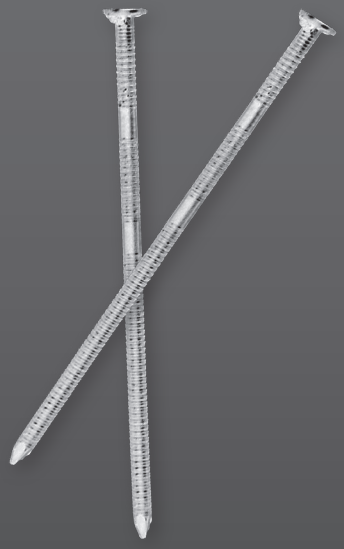

chapter 2

Prevalence and relief of pain in trauma patients in Emergency Medical Services

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Abstract

Objective

The aim of this study was to give insight in the prevalence of pain, and the (effect of) pain management according to the national Emergency Medical Services (EMS) analgesia protocol in trauma patients in the Netherlands.

Methods

The retrospective document study included adult and alert trauma patients. Data collection concerned patient characteristics, prevalence of pain, and the (effect of) pain management. Actual pain management was compared to the national EMS analgesia protocol for paramedics. Pain relief was defined as a decrease on the Numeric Rating Scale (NRS).

Results

One thousand four hundred seven trauma patients were included. A report on pain was missing in 28% of the patients (n=393), 2% of the patients (n=34) reported no pain, and the prevalence of pain was reported by 70% patients (n=980). Of the patients in pain, 31% (n=311) had a systematic pain assessment (Numeric Rating Scale) at the scene of accident and the median pain score was 6 (IQR= 3-8). Pharmacological pain treatment was administered to 42% of the patients in pain (n=410), and consisted mainly of intravenous fentanyl. Non- pharmacological pain treatments were cleaning of wounds (n=189), and application of splints or immobilizing bandages (n=130). Pain relief on arrival in the emergency department could only be evaluated in 15% of the patients in pain (n=149).

Discussion

Prevalence of pain in trauma was high, and without consistent 'objective' reporting of pain it is difficult to evaluate the effectiveness of pain management, despite the adherence to clinical practice guideline or protocol. Paramedics need to elicit and report validated pain measurements.

Introduction

Acute pain and trauma are often closely related to one another, as pain is induced by noxious stimuli at the site of tissue damage.[1] Consequently, pain is one of the major complaints of trauma patients in emergency medical care[2,3] and professionals in emergency medical services (EMS) are often the first point of care for trauma patients in the prehospital field. Several studies[4-9] described significant deficiencies in EMS pain management. Furthermore, a failure to acknowledge pain and administer analgesics in the prehospital field even resulted in further analgesic delays in the emergency department (ED).[6-8] Sixty-three percent of the patients reported chronic pain 1 year after major trauma,[10] and minor trauma patients described an ongoing level of moderate pain after discharge of the ED.[11] The last group frequently visited a general practitioner to obtain further analgesia related to their injuries following discharge. Therefore, adequate prehospital pain management seems to be important.

The prevalence of pain in prehospital emergency care in a general population of EMS patients varies between 31% and 54%,[5,12-14] however, the prevalence of pain in the specific population of trauma patients in EMS is unknown. We assume that trauma patients in EMS have a higher prevalence of pain than earlier EMS studies showed. This assumption is based on the results of a prospective study on prevalence of pain in trauma patients in the ED[2] where 91% of the patients reported pain on admission. Therefore, we studied the prevalence of pain in trauma patients and the effect of pain management in prehospital EMS in the Netherlands. Prehospital emergency medical care in the Netherlands is taken by paramedics and is regulated by national protocols, which include a protocol for pain management in trauma patients (Figure 1).[15,16]

The aim of this study is to give insight in the prevalence of pain in trauma patients in prehospital EMS in the Netherlands. Furthermore, the study is focused on (the effect of) current pain management according to the national EMS analgesia protocol, and at last is designed to identify possible gaps in pain relief.

Materials and methods

Design

We carried out a retrospective study of EMS runs for trauma patients. The regional committee on research Involving Human Subjects waived the need for review of the study because we only included patient files and did not observe patients directly.

Setting and Population

In the Netherlands, 25 ambulance organizations provide out-of-hospital emergency care. Paramedics are qualified as emergency medical technician-4 (national training program) and are registered nurses, as this is the mandatory training for paramedics in the Netherlands. The national EMS analgesia protocol incorporates 3 pharmacological treatment options, while the assessment of pain is not defined (Figure 2.1). The protocol is focused on pharmacological treatment with a fixed 50% nitrous oxide/oxygen mixture as first step, and intravenous use of fentanyl, esketamine and diazepam as subsequent steps.

We selected all trauma patients assessed at the scene of accident by the EMS GelderlandZuid (RAV GelderlandZuid) from December 2006 until June 2007. The region of EMS GelderlandZuid consists of a mixed suburban/rural population of 500,000 people, with an annual emergency transport volume of approximately 15,000 emergency runs of which approximately 4000 runs concern trauma patients.

Trauma patients were defined as: patients with (suspected) injuries, due to mechanisms of blunt or penetrating forces, falls, explosions, heat/cold or chemical toxicants.[17]

Patients were included by two reviewers (SB, TM) using a standard inclusion procedure. Patients were included when they met the following inclusion criteria:

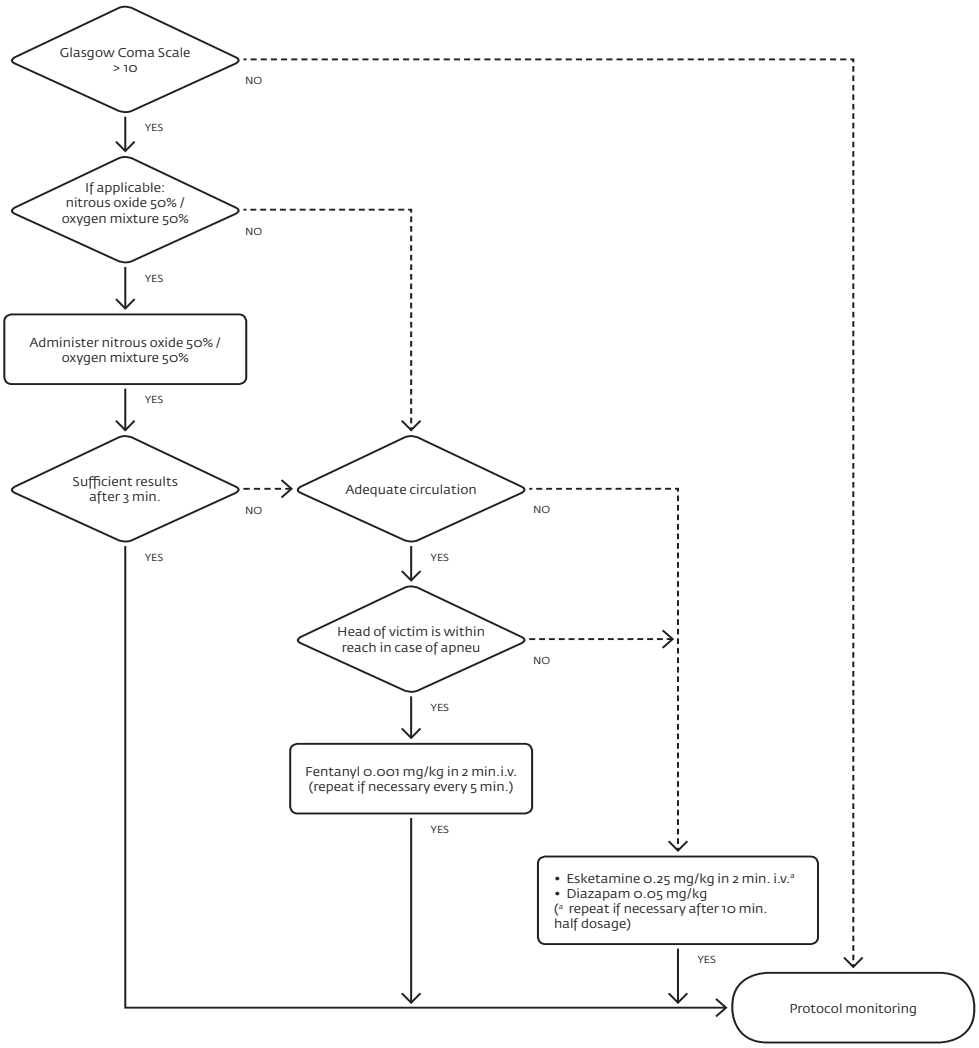
- In need of care due to a recent trauma that is trauma that occurred or was identified <1 hour ago,
- Primary emergency transports,
- Age ≥16.

Patients were excluded when they met one of the following criteria:

- Who were not able to give a valid verbal report on pain, namely: patients with endotracheal tube, unresponsive patients (neurotrauma), patients with a cognitive disability or severely confused, and patients who did not understand

or speak Dutch, German or English,
- With an attempted suicide,
- Who were nearly drowned.

Figure 2.1 Dutch national EMS analgesia protocol for trauma patients (September 2003, LPA 6: number 16.25)



Protocol instructions:
The protocol allows combined use of nitrous oxide 50% / oxygen mixture 50% (if applicable) with fentanyl, or nitrous oxide 50% / oxygen mixture 50% with esketamine and diazepam. The next pain reducing drug(s) can be used successively, when the previous step of the protocol had insufficient effect.

(adapted with permission from the National Dutch Ambulance Care Organization (Stichting LAMP))

Data collection, definition of variables and key outcome measures

Data were drawn from the digital EMS data system and the run sheets on paper and data collection was done according to a standardized protocol.

The nature of trauma was classified into unintentional and intentional, and was further refined in the categories: home and leisure, sport, road and traffic, occupational, and violence.[18] We classified the mechanisms of injury into the categories: fall, collision, abuse/violence, burns and other mechanisms. A high energy trauma was defined according to the Prehospital Trauma Life Support criteria.[16] Observed injuries were classified into 13 categories (Table 2.1). As prehospital distinction between a luxation and fracture is not always reliable and valid, we chose to present the injuries: fracture, luxation, sprain/strain, and contusion in 1 group.[19] Pain was defined according to the definition of the International Association for the Study of Pain.[20] Paramedics could use the 11-point verbal Numeric Rating Scale (NRS)[21,22] for the assessment of pain at 3 time-points (T1-T3). T1 represents the time of arrival at the scene of accident, T2 represents the time after initial treatment, and T3 is the time of arrival in the ED. Pain could also be reported in the free text notes. We categorized these free text notes by using the 5-item Verbal Rating Scale,[23] when a description of the severity of pain was lacking, we classified 'pain'.

The prevalence of pain was identified by the number of patients in pain. Pain was considered present when at least one of the following items was reported: (1) pain score (NRS >0); (2) report on pain in free text notes; or (3) administration of pain medication.

We used the framework of the national EMS analgesia protocol for the description of the pharmacological pain treatment. The effect of pain management could only be analyzed for patients with repeated pain measurements, and was calculated by the change in pain score on the NRS.

Data analysis

Data were analyzed using descriptive statistics and the Statistical Package for Social Sciences (SPSS-16). The Kolmogorov-Smirnov test showed that values of the pain intensity were not normally distributed. We used the Mann Whitney U-test and a χ^2 test to compare different groups, and a p value of ≤ 0.05 was considered as statistically significant.

Results

Characteristics of study population

During the study period 1641 EMS runs for emergency trauma patients were performed, of which 1407 were included in the study. The remaining 234 cases were excluded for the following reasons, patients were: younger than 16 years (n=161); intubated (n=6); unresponsive (n=35); cognitively disabled or confused (n=21); unable to communicate because of language difficulties (n=4); and injured due to a suicide attempt (n=7). In Table 1, demographic and clinical characteristics are described. The mean age was 54 years (SD 24), and 52% of the sample was female (n=734) (Table 2.1).

Table 2.1 Patient characteristics (n=1407)

Age, mean (SD) in years		54 (24)
Gender, female, n (%)		734 (52)
Nature of trauma, n (%) *Unknown n=124*	**Unintentional** Home & Leisure accidents Sport accidents Road & Traffic accidents Occupational accidents **Intentional** Assault /violence	 509 (40) 108 (8) 544 (42) 62 (5) 60 (5)
Mechanism of injury, n (%) *Unknown n=55*	Fall Collision Abuse / Violence Other	841 (62) 400 (30) 49 (4) 62 (4)
Observed Injury[a], n (%)[b]	Two or more observed injuries **Head, skull** Fracture Commotio or contusio cerebri **Thoracic, abdominal, pelvic region & spine** Fracture/distortion Thoracic or abdominal injuries (including pneumothorax) Hip fracture/luxation **Upper extremities** Fracture/luxation/sprain-strain **Lower extremities** Fracture/luxation/sprain-strain **Miscellaneous** Open wounds Superficial wounds / haematoma Burns Intoxication Injury due to cold Other traumatic injuries Total	345 (25) 95 (7) 42 (3) 306 (22) 43 (3) 390 (28) 213 (15) 270 (19) 196 (14) 131 (9) 10 (1) 22 (2) 11 (1) 90 (6) 1819[b]

[a] more than one observed injury per patient is possible
[b] percentage is calculated by dividing the number of injuries through the population n, as a consequence the total amount of percentages exceeds 100%

The nature of trauma was mainly unintentional, and most traumas occurred on the road and in traffic (42%, n=544) or at home and during leisure activities (40%, n=509). Sixty-two percent of the patients (n=841) had a fall accident and 30% (n=400) were involved in a collision. Eleven percent of the patients (n=150) had a high-energy trauma reported, and 8% (n=113) used alcohol or drugs. Paramedics observed more than one injury in 25% of the patients (n=345). Observed injuries concerned hip fractures or luxations (28%; n=390), injuries of spinal, thoracic, abdominal or pelvic region (22%; n=349), fracture or injuries of lower extremities (19%; n=270), and of the upper extremities (15%; n=213).

Prevalence of pain

A report on pain was missing in 28% of the patients (n=393), 2% of the patients (n=34) reported no pain, and the prevalence of pain was reported by 70% of the patients (n=980) (Table 2.2). In cases where information on pain was present (n=1014), the pain intensity was scored with the NRS in 311 patients (31%), of which 23 patients (7%) reported no pain, and most patients (n=233, 75%) reported an NRS≥4. The median pain score on the NRS at T1 was 6 (IQR=3-8; n=311). At T2 the median pain score was 4 (IQR=2-6; n=218), and at T3 the median pain score was 3 (IQR=2-5; n=149).

Narrative report gave no information on the pain intensity in 492 patients (49%). Another 72 patients (7%) received pharmacological pain treatment without any report on pain.

Table 2.2 Prevalence of pain (n=1,407)

No report on pain in run sheets (missing values)	**393**
Report on presence of pain (n=1,014)	
No pain	**34**
Numeric Rating Scale = 0	23
Narrative report description: no pain	11
Pain	**980**
1 Assessed with Numeric Rating Scale:	288 (total)
0 < NRS <4	55
NRS ≥4	233
2 Narrative report:	620 (total)
Mild pain	9
Moderate pain	5
Severe pain	113
Unbearable pain	1
Pain	492
3 Pharmacological pain treatment, however no report on pain	72 (total)
Total	**1,407**

[a] More than one observed injury per patient is possible, # percentage is calculated by dividing the number of injuries through the population n, as a consequence the total amount of percentages exceeds 100%.

Pharmacological pain management according to the national EMS analgesia protocol

Pharmacological pain treatment was administered to 42% of the trauma patients (n=410) in all grades of pain (n=980, Table 2.3). The treatment consisted of fentanyl (n=339), followed by anesthetics (fixed 50% nitrous oxide/oxygen mixture, n=37) and esketamine (n=37) (Table 2.3). Fentanyl and esketamine were administered according to the recommended doses in the national EMS analgesia protocol. In accordance with this protocol, paracetamol or non-steroidal anti-inflammatory drugs were not administered. Most patients received single drug pain treatment (n=357, 87%). Paramedics reported that 5 patients refused pharmacological pain treatment. In 7% of the patients (n=25), paramedics administered drug (combinations) that were not in accordance with the national protocol. In general, paramedics did not follow the outline of the protocol. The first step, administration of fixed 50% nitrous oxide / oxygen mixture, was generally skipped and most patients (n=327, 80%) received fentanyl as the first step of their pain treatment.

Table 2.3 Frequency of pharmacological pain treatment and injury treatment with a possible pain reducing effect (n=1407)

Pharmacological treatment according to national EMS analgesia protocol [a]	No supplementary steps	Fentanyl, as supplementary step	Esketamine, as supplementary step	**Total**
1 Start step 1 Fixed 50% Nitrous oxide / oxygen mixture	24	12	1	37
2 Start step 2 Fentanyl	312	-	15	327
3 Start step 3 Esketamine (and possibly diazepam)	21	-	-	21
4 Other pain medication	25	-	-	25
				410
Injury treatment with a possible pain reducing effect (n) [b]				**Total**
Cleaning of wounds or application of dressings (including compression bandage)				189
Application of splints or immobilizing bandage				130
Reduction of fractures				16
Ice packs/cooling				17

[a] Frequency of pharmacological pain treatment in recommended order according to the Dutch national EMS analgesia protocol.
[b] More than one injury treatment per patient is possible.

Non-pharmacological pain management

Treatment of the injury itself (Table 2.3), which could have resulted in pain relief, was performed on a regular basis. Non-pharmacological pain treatment in this group consisted mostly of cleaning and dressing of wounds (including compression

bandage) (n=189) and the application of splints or immobilizing bandages (n=130). Non-pharmacological pain interventions, such as anxiety reduction were not reported.

Effect of pain management

At T2 (n=218) the pain score decreased with a median two points (IQR= decrease 0-4) on the NRS compared to the pain intensity at T1. At T3 (n=149) the pain score decreased with a median 3 points (IQR= decrease 1-5.5) on the NRS compared to the pain intensity at T1. In general, we observed no change in pain score between T2 and T3 (n=142), statistical analysis showed a median decrease of 0 points (IQR = decrease of 0-1.25) on the NRS.

Discussion

This retrospective study shows that prevalence of pain in trauma patients in prehospital EMS was high (70%) and a small group reported no pain (2%), however, for a quarter of the patients (28%) we found no information on pain at all. A systematic pain assessment with the NRS was done in one-third of the patients in pain. For these patients, the median pain intensity was 6 points (NRS) on arrival at the scene of accident. Pharmacological pain treatment consisted merely of intravenous fentanyl, which is step two in the national EMS analgesia protocol. In most cases paramedics did not follow the outline of the national EMS analgesia protocol, as the first step of the protocol was generally ignored. Pain relief could only be evaluated in 15% of the patients with pain, for this group pain effectively decreased with a median 3 points on the NRS at the time of arrival in the ED. The results of this study confirm our assumption that the prevalence of pain in trauma patients in prehospital EMS is higher than earlier studies have identified. Furthermore, validated pain assessment, and pain relief need further systematic improvement.

To appreciate our results some aspects need to be discussed. First, our study shows a higher prevalence of pain (70%) than earlier studies in EMS, where the prevalence of pain varied between 31% and 54%.[5,12-14] Comparison of these results to our findings is difficult, because samples differed,[13,14] pain was measured on arrival in the ED,[12] or a large number of missing values was reported.[5] As we considered the missing values in our study (n=393) to represent a negative report on pain, 70%

cannot be considered to be an overestimation of the actual prevalence of pain.[24]

Second, we found that pain was not systematically assessed with validated instruments; in 77% (n=1085) of the patients the NRS was not used at all. Possibly, a systematic pain assessment was lacking because the NRS was not integrated in the national EMS analgesia protocol, and as such was not mandatory. In addition, Jones and Machen[25] found that paramedics tend to doubt the validity of patients' pain descriptions. Possibly, this attitude is also present amongst paramedics in the Netherlands. In contrast, the pain experience of the patient under prehospital emergency conditions is a complex phenomenon. Therefore, a valid and robust pain assessment is essential for an early recognition of pain and start of effective initial pain management in trauma patients in EMS, as we know that an absence of pain scale documentation in trauma patients is associated with absence of analgesic administration.[26]

Third, we found that paramedics in the Netherlands administered more analgesics (41%) than reported in earlier studies (1.8–26%).[4,7,9,27] Possibly, the defined pain medication options without consultancy of a physician at the ambulance station, the nursing background and clinical (anesthesia) expertise of paramedics had a positive effect on administration of analgesics. In contrast, our study shows less use of non-pharmacological pain treatment such as ice packs, which were used in 1.7% of the patients, whereas White et al.[9] reported the use of ice packs in 17% of the patients.

Fourth, we found that the national EMS analgesia protocol was poorly used. The protocol is possibly flawed by the lack of clear indicators for the start and evaluation of pain treatment by a validated pain assessment. Furthermore, it only describes drug possibilities for inhalation or intravenous routes. Possibly, the first step of the protocol, the fixed 50% nitrous oxide/oxygen mixture, was generally skipped, because it can only be used in indoor spaces with a scavenging mask, which is not regularly in use in the Dutch EMS services. In addition, the use of rather safe, simple, and effective analgesia, such as (intravenous) paracetamol, was not included. Finally, the impact of interventions described in the national EMS analgesia protocol on pain scores is rather limited, for instance due to the rather low recommended dosage of fentanyl. To prevent adverse events such as a respiratory arrest, the national EMS analgesia protocol balances between the efficacy of pain management and patient safety precautions. In our study, we found no adverse events related to prehospital pain management. Breeman[28] studied protocol adherence of paramedics in the Netherlands and showed medication failures and non-compliance related to the national EMS analgesia protocol. Paramedics described the Dutch national EMS analgesia protocol

options for trauma patients to be very limited for daily practice. Further study on protocol deviation of paramedics on the national EMS analgesia protocol is advised, to gain insight in why paramedics do not follow the protocol.

Fifth, we found limited systematic evaluation of the effect of pain treatment in our study. Consequently, our effect analysis on pain relief only refers to a small patient group. One could question whether the positive effect of pain management in this group is representative for all the patients in pain that received pain medication. However, the statistically significant decrease of pain with a median 3 points on the NRS at arrival in the ED (n=149) for the small group can be considered as clinically relevant.[29]

Limitations

Finally, our study has several limitations. The data collected by EMS GelderlandZuid were not primarily gathered for research purposes, also the reliability of the pain report could be discussed.[30] For instance reports on intoxication, or the use of alcohol and drugs were not mandatory fields in the patient run sheets. We know that these factors can influence pain perception and pain management. However, we were not able to correct for the influence of alcohol or drugs, because information about these factors was not available for a large number of patients. In addition, we have no insight in the number of patients that used self-medication before the paramedics arrived. In contrast, as the aim of our study was to gain insight in current practice, we may argue that the report in the run sheets was not flattered in favor of research purposes.

We were not able to measure non-pharmacological pain treatment, such as provision of comfort, psychological control of pain, relief of anxiety, and the gain of patients' trust. We advise further study to gain insight in the use of psychological interventions in prehospital EMS, described as 1 of the 3 major weapons 'to fight the battle against pain'.[31]

Although this study showed serious lacks in adherence to the national EMS analgesia protocol, possible barriers or facilitators in the use of the national EMS analgesia protocol by paramedics remain unclear.

Conclusion

In conclusion, this study shows a higher prevalence of acute pain in trauma patients, as in the general EMS patient population. Furthermore, there were

serious lacks in current initial pain management practice. Therefore, we advise prehospital emergency care providers to elicit and to report robust, validated and appropriate pain measurements. Without consistent 'objective' reporting of pain, it is very difficult to evaluate the effectiveness of pain management, despite the adherence to clinical practice guideline or protocol. Furthermore, we recommend to study barriers regarding the use of the Dutch national EMS analgesia protocol, to improve effective pain management in prehospital EMS.

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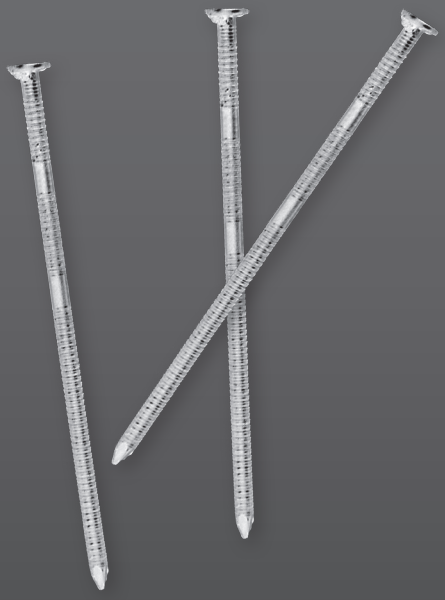

chapter 3

Pain prevalence and pain relief in trauma patients in the Accident & Emergency Department

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Abstract

Background
Acute pain in the A&E department (ED) has been described as a problem, however insight into the problem for trauma patients is lacking.

Objective
This study describes the prevalence of pain, the pain intensity and the effect of conventional pain treatment in trauma patients in the ED.

Methods
In a prospective cohort study of 450 trauma patients, pain was measured on admission and at discharge, using standardized and validated pain instruments.

Results
The prevalence of pain was high, both on admission (91%) and at discharge (86%). Two thirds of the trauma patients reported moderate or severe pain at discharge. Few patients received pharmacological or non-pharmacological pain relieving treatment during their stay in the ED. Pain decreased in 37% of the patients, did not change at all in 46%, or had increased in 17% of the patients at discharge from the ED. The most effective pain treatment given was a combination of injury treatment and supplementary pharmacological interventions, however this treatment was given to a small group of patients.

Conclusions
Acute pain in trauma patients is a significant problem in the EDs. Pain itself does not seem to be treated systematically and sufficiently, anywhere in the cycle of injury treatment in the ED.

Introduction

Yearly, one million people in the Netherlands require medical aid in an Accident & Emergency department (ED) due to an injury.[1] The average rate of hospital admissions due to injuries (or rather discharges) in the European Union (EU) is about 1500 per 100,000 residents.[2] International comparison is difficult, because national health care systems differ and the accessibility of the EDs varies over countries, and furthermore different definitions of trauma are used in international databases. In our study we defined trauma as: damage inflicted on the body as the direct or indirect result of an external force, with or without disruption of structural continuity (definition 'wounds and injuries' thesaurus Medline 2006). Trauma in this definition concerns patients involved in accidents in and around the house, sports- or work related traumas, road traffic accidents, violence related injuries, assaults, or actions of self-mutilation.

Acute pain is closely related to trauma and is induced by the injury of body tissues and the activation of nociceptors at the site of tissue damage.[3] Pain, as defined by the International Association for the Study of Pain,[4] interferes with recovery and cure and likewise it can affect all aspects of a patient's life. Although pain is generally known to be the main complaint of patients in the ED, we found only four studies describing the prevalence of pain in the ED.[5-8] These studies, focused on heterogeneous patient groups, reported a pain prevalence in the ED ranging from 52 to 79%, however, a detailed insight into the pain in trauma patients based on these data was not possible.

Several studies[9-14] have described the administration of analgesics in the ED and have concluded that there is an undertreatment of acute pain in the ED, even though it is known that acute pain can often be simply alleviated and reduced.[15,16] However, several barriers in effective pain management exist, such as ethnicity,[17] anxiety,[18] reluctance to report pain from the patients' perspective,[19,20] and insufficient knowledge of professionals.[21-23]

The aim of the article is to describe the prevalence, intensity, location, and course of pain in trauma patients. Additionally, we describe and classify the effect of conventional pain treatment policy performed by the staff. Although the prevalence of acute pain is supposed to be a problem in clinical practice, it has never actually been studied in a broad group of trauma patients in the ED.

Patients and methods

A prospective, observational study was conducted in two EDs in the Netherlands, in a 3-month period in 2004. The regional committee on research involving human subjects approved of the study and patients were included after informed consent.

Sample

Data collection took place in a level one trauma centre; the Radboud University Nijmegen Medical Centre, further referred to as 'trauma centre', and a nearby regional teaching hospital; the Canisius Wilhelmina Hospital, further referred to as 'teaching hospital'. Both hospitals have a continuously 24 h, accessible ED for 456,000 people in the direct region of Nijmegen and annually treat 18,000 (trauma centre) and 24,000 (teaching hospital) patients in the ED, which is a middle range number of ED admissions compared to other hospitals in the Netherlands (Dutch range of admission rates at the EDs is 10,000-50,000 per year). Neither of the EDs in the study used a standardized pain protocol for trauma patients at the time of measurement.

The sample consisted of all the trauma patients admitted to the EDs during several 24h periods. Twenty-eight measurement days (14 for each centre) were selected on the basis of availability of the research team. Trauma patients were followed from admission to discharge from the ED. Each weekday was represented twice in the sample (i.e. two Fridays, two Saturdays, ...), so that work related or sports related accidents were normally represented. There were no measurements on national or school holidays.

Instruments

Patients were interviewed using validated pain instruments. We used the 11-point Numeric Rating Scale (NRS), which proved to be a valid and reliable one-dimensional method for self-evaluation of acute pain intensity in the ED.[24,25] Location of pain was measured by a modified version of the validated Dutch McGill Pain Questionnaire.[26-28] Specific items on pain management, such as: standardized pain measurement, patient information on pain management, injury treatment, pharmacological and non-pharmacological pain treatment, were added to the questionnaire. Face validity on these items was received by members of the Pain Expertise Centre of the Radboud University Nijmegen Medical Centre and the National Nursing Pain Network Group in the Netherlands. Data on pharmacological treatment and medical diagnosis were derived from patient records and the medical registration.

Study procedure

Trauma patients were selected on the basis of in and exclusion criteria. Inclusion criteria were: (1) injuries due to a trauma, (2) fluency in speaking Dutch, (3) age ≥ 16 years, (4) stabilized condition regarding Airway, Breathing and Circulation,[29] and (5) Glasgow Coma Scale score >13. Only patients with at least one trauma diagnosis (i.e. International Classification of Diseases version 9, numeric code: 800 up to inclusive 999) were eventually accepted in the study. The exclusion criteria were: (1) intubation, (2) continuous need for intensive medical care, (3) injuries due to attempted suicide, (4) documented cognitive disability, (5) uncooperative patients who sighted signs of verbal or physical aggression or (6) no informed consent.

Patients were interviewed on admission (T1) and at discharge (T2). When immediately initial treatment was necessary on admission, the first measurement took place as soon as the treatment enabled it.

The research team consisted of two primary investigators (SB, TM), three researchers and five bachelor student nurses in their last year of training. The research team was especially trained to interview the patients in the ED. The training consisted of role plays with emotions or circumstances directly related to trauma (i.e. distress, anxiety, anger), which might influence valid and reliable answers from the patient to the questionnaire. Further attention was paid to close guidance of the patients through different stages of their treatment in the ED. During days of the study the team worked according to a schedule in 9h shifts, 24h a day, in order not to miss any of the trauma patients admitted to the ED.

Data analysis

Data were statistically analyzed using SPSS for Windows version 12.1, and were described by frequencies, means and standard deviations. In order to find significant and relevant differences between both EDs, the data of the trauma centre and teaching hospital were compared. When no significant differences were found, data were pooled. Relevant subgroup analyses were performed using two-tailed Student's t-test and χ^2-test; a significance level of 0.05 was used for all tests. Additionally, for the benefit of the analysis, we classified the pain intensity into four categories: no pain (0 on the NRS), mild pain (1-3 on the NRS), moderate pain (4-7 on the NRS) and severe pain (8-10 on the NRS).

Results

In total 760 trauma patients were seen, and eventually 450 patients were included in the study. 300 Patients were not included for the following reasons: missed by the research team (n=8); excluded on the basis of exclusion criteria (n=252); no trauma diagnosis confirmed (n=16; and no informed consent (n=34). The 252 excluded patients were: children under 16 years (n=196); cognitively impaired or confused elderly (n=19); non fluent in Dutch (n=15); suicidal (n=8); intubated or had a GCS <14 (n=7); excluded for ethical reasons (abuse or sexual course of trauma) (n=4), non cooperative, aggressive patients (n=3).

There were no significant differences between the trauma centre or the teaching hospital regarding age or gender of the patients (Table 3.1). Alert poly trauma patients with an ISS>15 were only seen in the trauma centre. Furthermore this centre admitted significantly (χ^2=12.0, df=1, p<0.01) more patients with more than one trauma diagnosed. Patients suffered mostly from fractures (28%), contusions (22%), open wounds (18%) and sprains/strains (15%). The mean length of stay was 86 min in both EDs.

Trauma patients reported a high prevalence of pain on admission (T1=91%) and discharge (T2=86%). There were no differences between the two centres. The mean pain intensity for both EDs was 5.9 (SD=2.2) at T1, and 5.0 (SD=2.7) at T2. A subgroup of five alert, poly trauma patients, reported a high mean pain score of 8.6 (SD=1.3, median=8, range 7-10) at T1. Their mean pain score changed to 7.4 (SD = 2.4, median=6, range 5-10) at T2.

Pain was mostly located in the extremities (91%). We found a statistically significant difference (χ^2=9.16, df=1, p<0.01) between the EDs, regarding pain located in more than one body part (24% in the trauma centre and 19% in the teaching hospital). Nineteen percent of all the patients reported pain in the head or neck. Another 8% indicated abdominal pain or pain in the pelvis and 6% of the patients reported thoracal pain. Pain in the pelvic and abdominal region was more common in the trauma centre than in the teaching hospital (χ^2=8.05, df=1, p<0.01).

The conventional pain treatment in the EDs did not consist of standardized, validated pain measurements. At T2 49% of the trauma patients reported information on pain management. Sixty-three percent of the patients received injury treatment with possible pain reducing effects (i.e. plaster, (compression) bandage, fixation, splints, removal of neck collar, etc.). Two-thirds of this group reported an increase in pain during treatment. A few non-pharmacological pain interventions were found such as cooling (by ice packs or shower) (n=7),

repositioning of body posture (n=20) and elevation of extremities using a stretcher, footstool or otherwise (n=91).

Table 3.1 Variables of the population

	Total n=450	Trauma centre n=188	Teaching hospital n=262	Difference between groups
Demographic variables				
Age: mean (SD) in years	39 (18)	38 (18)	40 (18)	NS [a]
Gender: number (%) Male	260 (58%)	105 (56%)	155 (59%)	NS [a]
Length of stay in the ED				
Stay in the ED: mean (SD) in minutes	86 (55)	80 (59)	90 (52)	NS [a]
Poly trauma patients				
Alert with an ISS > 15: number (%)	5 (1%)	5 (3%)	-	NA [b]
Trauma diagnosis				
Patient level Two or more trauma diagnosis: number (%)	51 (11%)	32 (17%)	19 (7%)	p<0. 01
Population level Trauma diagnoses in the population: number (%)				
1. Fractures (ICD code 800-829)	143 (28%)	66	77	NS [a]
2. Dislocations / subluxations (ICD code 830–839)	21 (4%)	6	15	NS [a]
3. Sprains/strains (ICD code 840–848)	76 (15%)	29	47	NS [a]
4. Contusions (ICD code 920–929)	113 (22%)	56	57	NS [a]
5. Wounds (ICD code 870–897)	92 (18%)	34	58	NS [a]
6. Nerve injuries (ICD code 950-957)	9 (1%)	7	2	NA [b]
7. Burns (ICD code 940-949)	8 (1%)	6	2	NA [b]
8. Superficial injuries (ICD code 910-919)	27 (5%)	19 (4%)	8 (2%)	p<0. 01
9. Commotion cerebra + intracranial injury (ICD code 850–854)	8 (1%)	5	3	NA [b]
10. Miscellaneous (ICD code 860-869; 900-909; 930-939; 958-999)	22 (2%)	11	11	NA [b]
Total [c]	519	239	280	

[a] NS = not statistically significant
[b] NA = not applicable
[c] sum of trauma diagnosis is larger than 450, some patients have more than one trauma diagnosed

Some patients (19%, n=83) received pharmacological pain treatment (Table 3.2). Forty percent of this treatment consisted of local anaesthesia (n=33), for suturing or repositioning of fractures. The other 60% (n=51) received systemic pain medication. The effect of pharmacological pain treatment was evaluated in 42% of cases: 38% of patients reported that the staff did not evaluate the effect of the pharmacological treatment, and for the other 20% the time between administration and interview was too short for evaluation. Physicians and nurses equally distributed systemic medication, while physicians gave mostly local anaesthesia.

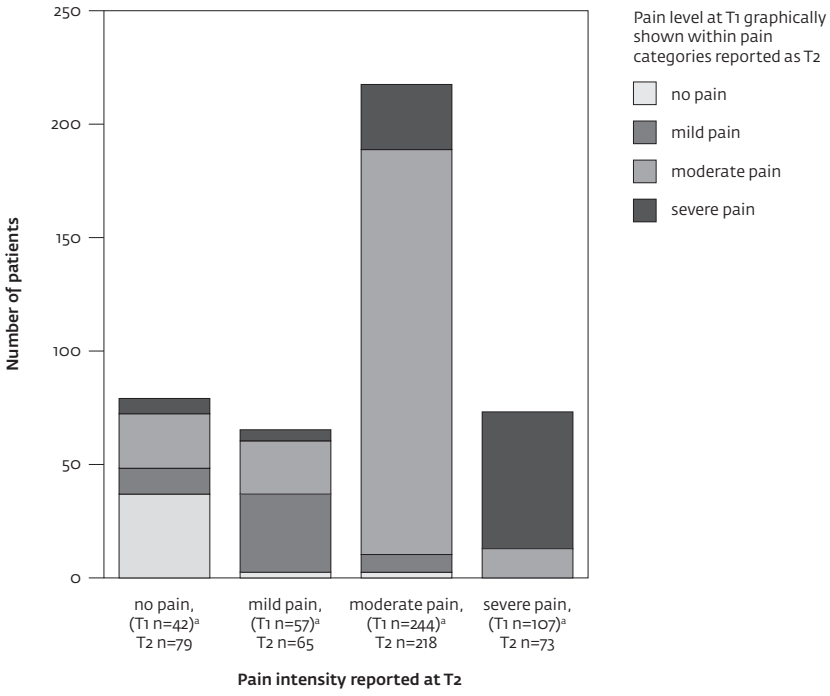
Table 3.2 Pharmacological pain treatment

	Total n=435	Trauma centre n=181	Teaching hospital n=254	Difference between groups
Pharmacological pain treatment				
Total number of patients (percentage) [a]	83 (19%)	42 (23%)	41 (16%)	NS [b]
Systemic medication, number of patients				
1. NSAID's [a]	8	4	4	NA [c]
2. Paracetamol [a]	19	12	7	p<0.05
3. Opioids [a]	19	14	5	p<0.05
4. Benzodiazepine [a]	8	1	7	NA [c]
Systemic medication (1-4) [a]	51	28	23	p<0.05
Local anaesthesia				
Number of patients [a]	33	14	19	NS [b]
Administration of medication (n=80)				
Number of patients (percentage)				
1. Physician	36 (45%)	15	21	NS [b]
2. Nurse	40 (50%)	20	20	NS [b]
3. Physician and nurse	4 (5%)	4	0	NA [c]

[a] Some patients received pharmacological pain treatment out of more than one group, therefore it is not applicable to sum up between groups
[b] NS = not statistically significant
[c] NA = not applicable

The course of pain was evaluated by the change in pain score between T1 and T2 and we found no differences for the two EDs (Graph 3.1). In Graph 3.1, the frequency of the pain categories: no pain, mild pain, moderate pain and severe pain at T1 is shown in the vertical columns for the reported pain categories at T2. Two thirds of the patients reported moderate (n=218, 50%) or severe (n=73, 17%) pain at T2. The graph demonstrates that the pain level at T2, within the pain categories, did not greatly differ from the pain level reported at T1. At discharge, we found the following shifts in pain level: nearly half of all the trauma patients (n=200, 46%) reported no change in pain. A third (n=162, 37%) perceived a decrease of pain during stay in the ED, and a sixth of the patients (n=73, 17%) reported an increase in pain at T2.

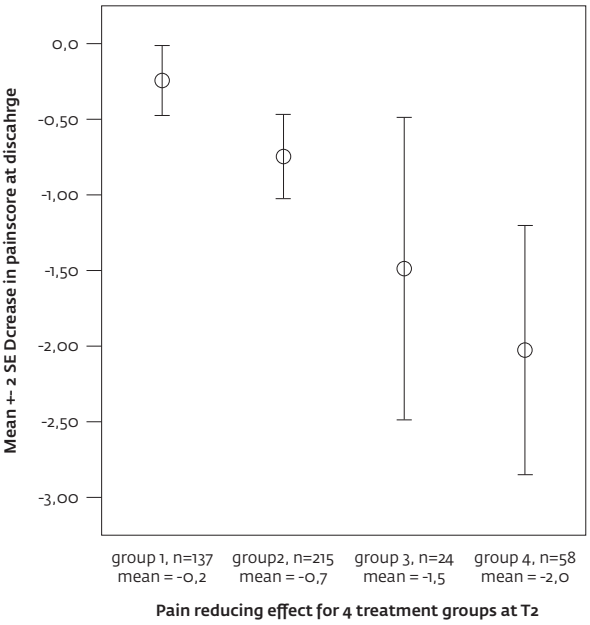
Graph 3.1 Course of pain at discharge from the emergency department



[a] the total number of patients, that reported pain intensity in different categories on admission is not graphically shown

The effect of the conventional pain treatment was evaluated for four treatment groups (i.e. Group 1: no injury treatment or pharmacological pain treatment, Group 2: only injury treatment, Group 3: only pharmacological pain treatment, Group 4: injury treatment combined with pharmacological pain treatment). The effect of pain treatment is expressed by a mean pain reduction at T2, charged by the pain score on T2 deducted from the pain score on T1 (Graph 3.2). Patients of Group 3 indicated statistically significant more mean pain reduction (mean -1.5) with supplementary pharmacological pain treatment compared to patients of Group 1 (mean -0.2). Patients of Group 4 described a statistically significant greater pain reduction (mean -2.0) with supplementary pharmacological pain treatment compared to patients of Group 2 (mean -0.7).

Graph 3.2 Pain reducing effect of conventional pain treatment at T2



Group 1 no injury treatment or pharmacological pain treatment
Group 2 only injury treatment
Group 3 only pharmacological pain treatment
Group 4 injury treatment combined with pharmacological pain treatment

The relation between the nature of injury and the intensity of pain (Table 3.3) was analyzed for three sets of common trauma diagnoses (n=408), (i.e. Group A: fractures and dislocations/subluxations; Group B: sprains/strains and contusions; Group C: wounds and superficial injuries). Some patients had more than one injury diagnosed, therefore we composed and compared dichotomous groups. For instance, Group A (n=140) consisted of patients with fractures and/or dislocations/ subluxations at T1, and the comparison group consisted of patients with other injuries (n=268) at T1 (Group B and C). We found that Group A and B showed statistically significant higher mean pain scores as the comparison groups at T1. Group B reported also a significant higher ($p<0.01$) mean pain score at T2. Group C reported significantly lower ($p<0.01$) mean pain intensities than patients with other injuries, both at T1 and T2.

Table 3.3 Pain intensity for three groups of common trauma diagnosis

	Group A: Patients with fractures and/or dislocations/subluxations		Comparison group: Patients with other injuries		Difference between groups
	N	Mean (SD)	N	Mean (SD)	
T1	140	6.3 (2.0)	268	5.8 (2.1)	p<0.05 2-tailed
T2	136	5.0 (2.8)	258	5.0 (2.7)	NS[a]

	Group B: Patients with sprains/strains and/or contusions		Comparison Group: Patients with other injuries		Difference between groups
	N	Mean (SD)	N	Mean (SD)	
T1	175	6.2 (1.9)	233	5.8 (2.2)	p<0.05 2-tailed
T2	174	6.0 (2.1)	225	4.3 (2.9)	p<0.01 2-tailed

	Group C: Patients with wounds and/or superficial injuries		Comparison group: Patients with other injuries		Difference between groups
	N	Mean (SD)	N	Mean (SD)	
T1	93	5.0 (2.4)	315	6.2 (2.0)	p<0.01 2-tailed
T2	92	3.7 (3.0)	302	5.5 (2.4)	p<0.01 2-tailed

T1 = on admission

T2 = at discharge

[a] NS = not statistically significant

Discussion and conclusion

The main finding of this study is that pain in trauma patients is a significant problem in EDs. Pain itself does not seem to be treated sufficiently since most patients reported both moderate or severe pain, on admission and at discharge. Nearly half of the patients described no change in pain, and even a sixth of the patients reported an increase in pain during treatment in the ED. The conventional treatment policy in the ED consisted mainly of purely 'anatomical' injury treatment. There seemed to be very little pharmacological or non-pharmacological pain treatment. The most effective pain reduction was a result of injury treatment and supplementary pharmacological pain treatment. However, this combined treatment was given to only a small group of trauma patients.

Previous studies[5-8] on pain prevalence in the ED partially support our findings, although comparability is limited due to differences in the studied populations. The retrospective document study of Cordell et al.[5] gave insight on the prevalence

of pain in 1665 ED patients charts. Emergency staff described pain for 61% of the study population, whereas only 19% of their population were trauma patients. Tanabe and Buschmann[7] prospectively studied the pain prevalence in 203 adult ED patients and found a pain prevalence of 78%. Tcherny-Lessenot et al.[8] studied a consecutive sample of 726 ED patients, of which 78% reported pain on admission. Data on trauma patients could not be derived from these studies. Johnston et al.[6] studied 286 adult non critical emergency patients, of which one group concerned patients with musculoskeletal problems. This group reported comparable results to our study, namely a mean pain score of 5.8 on admission and 4.6 at discharge. The population in our study is comparable to other EDs populations in the Netherlands.

A limitation of our study is the exclusion of children under the age of 16 and the exclusion of poly trauma patients who were unable to answer the pain questionnaire. We choose not to examine the interobserver reliability during the actual study, in order to minimize possible disturbance of the emergency treatment, however this could be seen as a limitation. We tried to maximize the accuracy and minimize the bias of measurements, by the use of validated instruments and an intensive training in preparation of the study. Furthermore, we tested the questionnaire in a small pilot study.

We found different pain scores for three groups of common trauma diagnoses. Patients with sprains/strains and contusions reported a statistically significant higher pain level at discharge than patients with other injuries (Table 3.3). A possible explanation for this difference could be the painful diagnostic procedures performed in the ED, specifically for this group. In the past, pain was regarded as an important clinical sign, which should not be blunted in order not to mask the clinical diagnosis. We speculate that this attitude has gradually changed but still could be an important factor in the underassessment and undertreatment of pain.

As we know from the literature, physicians and nurses give statistically lower pain reports than patients themselves[30,31] and also appropriate pain assessment is a critical issue.[32] At the same time a recent study of Bijur et al.[33] showed, that emergency physicians and nurses do not primarily base their decision about pain management on the pain intensity reported by patients, as was recommended by expert panels. Therefore, we speculate that in our study the pain management was merely guided by the staff's own estimation of pain in trauma patients. This could have influenced the severe underestimation and undertreatment we observed in our study. The fact that the trauma centre distributed significantly more opioids and paracetamol could possibly be explained by the larger amount of patients with multiple injuries they treat compared to the teaching hospital.

In the literature[34-36] there is discussion as to whether the observed changes in pain level are of clinical relevance to the patient. We choose to follow the results of Farrar et al.[34] to judge the effect of pain treatment in our study. In his validation study, Farrar found the best cut-off point on the NRS scale, that is best associated with clinically important difference, to be: either an absolute difference of 2 points in pain intensity, or a relative difference of 33% in pain intensity. We strongly recommend physicians in the ED to use the simple and validated cut-off points, defined by Farrar et al., to evaluate and determine a clinically, relevant changes in pain level.

Possible barriers in current pain management in the ED could be workload, attitude of staff, knowledge deficits and misconceptions on the need of effective pain management. Furthermore, we found it remarkable that simple, non invasive and non-pharmalogical pain treatments, such as ice packing and elevating body parts, were hardly seen, although they are effective in pain relief. The message from our findings is clear: acute pain in trauma patients in the ED has to be addressed systematically by using standardized and validated pain instruments (for instance the NRS) and should be treated pharmacologically and non-pharmacologically as early as possible.

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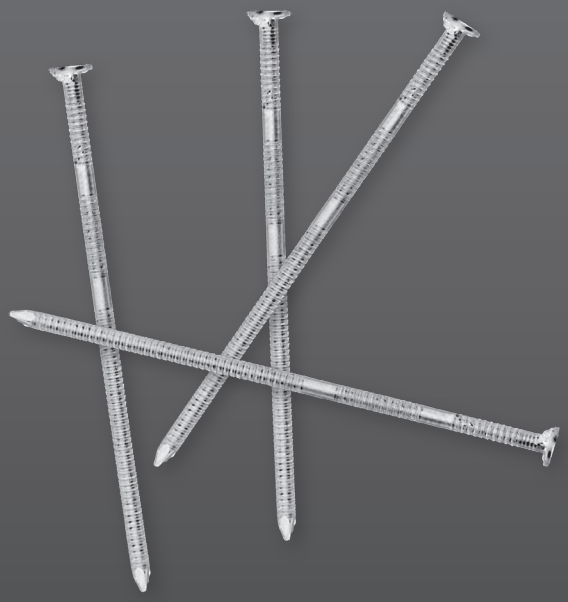

chapter 4

Implementation of Manchester Triage System and pain relief in trauma patients in the Emergency Department

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Submitted

Abstract

Objective

The aim of the study was to examine the effect of implementation of Manchester Triage System (MTS) in the Emergency Department (ED) on the improvement of pharmacological pain management and pain relief in adult trauma patients in the Netherlands.

Methods

The study had an uncontrolled before after design, and was performed at EDs of a level one trauma centre and a regional teaching hospital. The samples consisted of trauma patients admitted to the EDs between 8.00 AM and 11.00 PM. Patients were interviewed using a structured pain instrument, which included the validated Numeric Rating Scale. Baseline differences between samples, and differences between the pre-test and post-tests within the hospitals were tested with ANOVA and χ^2-test. A significance level of 0.05 was used for all tests.

Results

In total 1,192 trauma patients were included in the study. In the trauma centre we observed no differences between pre-test and post-tests. Whereas the teaching hospital showed that the percentage of patients who received analgesia doubled from 17-21% (pre-tests) to 43% (post-test) after implementation of MTS ($p<0.000$). However, we were unable to demonstrate statistically significant or clinically relevant improvement of pain scores in trauma patients following MTS implementation.

Conclusions

We conclude that implementation of MTS showed mixed results on the improvement of pain management in trauma patients in the ED. MTS did not facilitate pain relief, as it did not result in clinically and statistically significant changes in pain.

Introduction

Emergency departments (EDs) are facing an increasing number of patients seeking emergency medical care. At the same time, emergency staff and other resources are limited in the ED. As a result, there is need for an assessment tool to assign clinical priorities. EDs in Australia, and European countries widely use the Manchester Triage System (MTS) for this purpose.[1-5]

The main outcome of MTS is a clinical priority, assigned to the patient based on reductive reasoning.[6] Key discriminators together with a series of flowcharts of patient presentations assist the emergency staff in the assignment of the clinical priority. The clinical priority is categorized in five triage codes and colours: immediate care needed (red), very urgent (orange), urgent (yellow), standard (green), and non urgent (blue). The MTS proved to be reliable for adult patients in need of urgent care, although results for less urgent categories showed lower agreement and accuracy.[3] Van der Wulp et al.[7] concluded that inter-rater reliability of the MTS is "moderate" to substantial, and test-retest reliability is high. An Australian reliability study on MTS showed a median kappa of 0.63 in the ED.[2] Furthermore, MTS showed a greater inter and intra-observer agreement than the Emergency Severity Index (another triage system).[5]

Pain is one of the key discriminators of the MTS and has a central place in the assessment of the patient on admission. The MTS development group put a strong emphasis on pain assessment and pain relief as an element of the triage method. Patients with severe pain are prioritized with the code very urgent. Effective pain reduction in patients with severe pain, that results in moderate pain leads to a lower priority code (yellow).[6] As the MTS group stressed the importance of adequate assessment and management of pain, we expected that implementation of MTS presumably would lead to an increase in pharmacological pain management and as a result in more pain relief in the ED. However, the MTS does not give a protocol or specific recommendations for pain relief in the ED.[6]

Following a previous study on the prevalence of pain and pain relief in adult trauma patients in Dutch EDs,[8] we were interested in the effect of the implementation of MTS on pain management and pain relief. This previous study showed that 69-80% of the trauma patients reported moderate to severe pain on admission to the ED, and pain relief was only effectuated in 37% of the patients in pain. Our study hypothesis was that implementation of MTS possibly could be a facilitator for pain

management and pain relief in the ED. This assumption was not studied before and was not described in previous studies on improvement of pain management in the ED.[9-12]

Objective

The aim of the study was to examine the effect of implementation of MTS in the ED on pharmacological pain management and pain relief in adult trauma patients in the Netherlands.

Methods

The study had an uncontrolled before after design, and was performed at two EDs (Table 4.1). We carried out a pre-test (T0) and two post-tests (T2, T3) in ED-1, and performed two pre-tests (T0, T1) and one post-test (T2) in the ED-2.

Table 4.1 Uncontrolled before after design

	Pre-test		Implementation MTS	Post-test	
ED-1 Trauma centre	T0		X	T2	T3
ED-2 Teaching hospital	T0	T1	X	T2	

Setting and population

Data collection took place in two EDs in the Netherlands: a university medical centre and level one trauma centre (ED-1),and a regional teaching hospital (ED-2). None of the EDs used a standard pain protocol for trauma patients at the pre-test(s), the teaching hospital introduced a pain protocol with the implementation of the MTS system.

The convenience samples consisted of all the trauma patients admitted to the EDs between 8.00 AM and 11.00 PM. For each pre-test and post-test, fourteen measurement days were selected based on the availability of the research team. Each weekday was represented twice in each sample (i.e. two Fridays, two Saturdays ….), so that work related or sports related accidents were normally represented. There were no measurements on national or school holidays. Trauma patients were followed from admission to discharge from the ED.

Data Collection Tools

Patients were interviewed using a structured pain instrument. This instrument addressed the topics of general demographic variables, pain intensity, injuries observed and pharmacological pain management.

For the self-evaluation of acute pain intensity in trauma patients we used the validated 11-point Numeric Rating Scale (NRS).[13] The MTS pain ruler itself was not used in this study, because this instrument was only tested on validity in a paediatric population.[14] Data on pharmacological pain management were derived from the medical records and categorized as analgesics, benzodiazepines and local anaesthesia, according to their pharmacological properties. Data concerning actual identified injuries at the ED were additionally collected after the measurement periods in the ED, to check whether we specifically included trauma patients. Only patients with at least one trauma diagnosis (i.e. International Classification of Diseases 800 up to inclusive 999) were included in the study.

Study Procedure

The regional committee on research involving human subjects waived the need for approval of the study, because the pain assessment required for the study was seen as usual care. However, all patients were asked for informed consent. Trauma patients were eligible when they gave permission and met the in- and exclusion criteria. Inclusion criteria were: (1) (potential) injuries due to a trauma, (2) fluency in speaking Dutch, (3) age ≥16 years, (4) Glasgow Coma Scale score >13, and a (5) stabilized condition regarding Airway, Breathing and Circulation. The exclusion criteria were: (1) intubation, (2) continuous need for intensive medical care, (3) injuries due to attempted suicide, (4) previous cognitive disability, and (5) patients being very upset or aggressive.

Patients were interviewed at two moments: on admission and at discharge in order to explore the course of pain.

The research team consisted of two primary investigators (SB, TM), and a team of researchers and bachelor student nurses in their last year of training. The research team was especially trained to follow and interview the patients through different stages of their treatment in the ED.

Data Analysis

Data were statistically analyzed using SPSS for Windows version 16. As MTS (the intervention) was implemented at different points in time on the two EDs, we could not compare the results regarding pain relief between hospitals. Therefore, data were analyzed for the samples (pre-tests and post-tests) within hospitals.

We described patient characteristics, pain intensity on admission, pharmacological pain management and pain relief using frequencies (values and percentages), means and standard deviations (SD). Baseline differences between samples (patient characteristics and pain intensity on admission) were tested with ANOVA for continuous variables (such as the pain intensity), and with crosstabs and χ^2-test for nominal and ordinal variables.

Pain relief in each sample was calculated as the difference between the pain intensity on admission subtracted from the pain intensity at discharge, whereby a negative outcome represents a decrease in pain. A pain relief of two points on the NRS or a relative decrease of 30% on the NRS was considered to be clinically significant.[15] For the trauma centre we tested differences in outcome for T0-T2-T3, and for the teaching hospital for T0-T1-T2. We used crosstabs and χ^2-test for pain management, and ANOVA for differences regarding pain relief. A significance level of 0.05 was used for all tests.

Results

Patient characteristics and pain on admission

In total 1,192 trauma patients were included in the study. Four-hundred-ninety-nine patients were seen in the trauma centre and 693 patients visited the teaching hospital. In general, the EDs treated more male than female patients (the male percentage was 58 -59%), and the mean age of the patients was 40-41 years (Table 4.2). We observed no significant differences regarding demographic variables between the patient groups within the hospitals. Also, the identified trauma diagnoses were comparable within these groups at pre-test(s) and post-test(s). The trauma centre treated more patients with multiple injuries (18%) compared to the teaching hospital (5%).

The trauma patients reported moderate to severe pain in 69-80% of the admissions. Within the hospitals we observed no statistically significant differences between pre-test(s) and post-test(s). Furthermore, on admission the mean pain intensity ranged from NRS 5.0 to 5.7, with no statistically significant differences observed between the pre-test(s) and post-test(s) in both EDs.

Table 4.2 Demographic variables and pain on admission

	T0 Pre-test	T1 Pre-test	T2 Post-test	T3 Post-test	Differences between groups
ED-1 Trauma centre	n=173		n=179	n=147	
Gender, male; number (%)	94 (54)		116 (65)	83 (57)	NS[a]
Age; mean (SD) in years	39 (18)		41 (17)	41 (19)	NS[b]
One trauma diagnosis; number (%)	146 (84)		145 (81)	114 (76)	NS[a]
Trauma diagnosis at sample level[cd]					
Fractures	60		53	51	
Dislocations/sub luxations	6		4	5	
Sprains/strains	27		25	26	
Contusions	44		44	44	
Wounds	32		38	36	
Nerve injuries	7		20	9	
Burns	6		4	2	
Superficial injuries	14		20	8	
Commotio cerebri/cranial injury	4		12	5	
Miscellaneous	8		3	3	
Percentage patients with moderate-severe pain on admission	74		69	75	NS[a]
Mean pain intensity (SD) on admission	5.4 (2.9)		5.0 (2.8)	5.4 (2.6)	NS[b]
ED-2 Teaching Hospital	n=248	n=216	n=229		
Gender, male; number (%)	148 (60)	128 (59)	133 (58)		NS[a]
Age; mean (SD) in years	40 (17)	41 (18))	43 (18)		NS[b]
One trauma diagnosis; number (%)	230 (93)	210 (97)	217 (95)		NS[a]
Trauma diagnosis at sample level[a]					
Fractures	75	66	66		
Dislocations/sub luxations	14	6	9		
Sprains / strains	42	37	32		
Contusions	44	58	53		
Wounds	55	44	51		
Nerve injuries	2	1	4		
Burns	2	5	8		
Superficial injuries	8	3	9		
Commotio cerebri / cranial injury	3	2	1		
Miscellaneous	8	0	7		
Percentage patients with moderate-severe pain on admission	80	77	81		NS[a]
Mean pain intensity (SD) on admission	5.4 (2.6)	5.6 (2.6)	5.7 (2.4)		NS[b]

[a] NS = not statistically significant, χ^2-test,
[b] NS = not statistically significant, ANOVA
[c] total n of observed injuries > population n, because some patients have more than one injury observed
[d] ICD codes: fractures, code 800-829; dislocations/sub luxations, code 830-839; sprains/strains, code 840-848; contusions, code 920-929; wounds, code 870-879; nerve injuries, code 950-957; burns, code 940-949; superficial injuries, code 910-919; commotio cerebri/cranial injury, code 850-854; miscellaneous (code 860-869; 900-909; 930-939; 958-999)

Pharmacological pain management

The pharmacological pain management in the EDs consisted of paracetamol, Non Steroidal Anti Inflammatory Drugs (NSAIDs), opioids, benzodiazepines (for repositions or luxations) and local anaesthesia (for suturing or wound cleaning). The frequency of administered analgesics is presented in Table 4.3. This table shows that the number of administered pain medication in the trauma centre did not increase after implementation of MTS. On the other hand, the number of patients that received pharmacological pain management after implementation of MTS differed statistically significantly ($p<0.001$) compared to the pre-tests in the teaching hospital. (Table 4.3).

Table 4.3 Pharmacological pain management in the EDs

	Pre-test		Post-test		Differences between tests
ED-1 Trauma centre[a]	T0 (n=173)		T2 (n=179)	T3 (n=147)	
Pain medication (number)					
Paracetamol	11		7	6	
NSAIDs	3		11	5	
Opioids	12		11	9	
Benzodiazepines	1		2	2	
Local anaesthesia	14		16	16	
Percentage of patients that received analgesia (%)	23		27	28	NS[b]
ED-2 Teaching hospital[a]	T0 (n=248)	T1(n=216)	T2 (n=229)		
Pain medication (number)					
Paracetamol	7	10	30		
NSAID	4	9	21		
Opioids	6	3	14		
Benzodiazepines	7	1	1		
Local anaesthesia	20	19	23		
Percentage of patients that received analgesia (%)	17	21	43		χ^2-test p<0.001

[a] number of patients that received the classified analgesia/anaesthesia, some patients received analgesics of more than one group
[b] NS = not statistically significant

Pain relief

At discharge from the EDs, an average of 10-19% of the patients reported no pain. However, 59-70% of the patients still reported moderate to severe pain at discharge from the ED, with no statistically significant differences observed between pre-test(s) and post-test(s) within the hospitals. The mean pain relief at all pre-tests showed to be less than one point on the NRS (Table 4.4). Whereas the post-tests in the trauma centre showed no improvement in pain relief (less than one point on the NRS), the post-test in the teaching hospital demonstrated a mean pain decrease of 1,25 point on the NRS at discharge. The teaching hospital presented a positive trend towards improvement of pain relief after implementation of MTS. However, in both EDs we found no clinically or statistically significant improvement of pain relief for the pre-test(s), nor for the post-test(s) (Table 4.4).

Table 4.4 Change in pain at discharge

	Pre-test		Post-test		Differences between tests
ED-1 Trauma centre Mean change in pain (SD)[a]	T0 (n=168) -0.68 (2.1)		T2 (n=166) -0.66 (2.2)	T3 (n=143) -0.62 (2.1)	NS[b]
ED-2 Teaching hospital Mean change in pain (SD)[a]	T0 (n=243) -0.92 (2.3)	T1 (n=212) -0.82 (2.3)	T2 (n=209) -1.25 (2.5)		NS[b]

[a] a negative value represents a decrease in pain
[b] NS = not statistically significant, ANOVA

Discussion

Implementation of MTS in the EDs showed inconclusive results in the improvement of pharmacological pain management for trauma patients. In the trauma centre we observed no differences between pre-test and post-tests, whereas the teaching hospital showed that the percentage of patients who received pain medication doubled after implementation of MTS. Although the use of pain medication doubled after the introduction of MTS in one of the EDs, we were unable to demonstrate statistically significant or clinically relevant improvement of pain scores in trauma patients following MTS implementation.

Before we can draw conclusions from this study, some aspects need to be discussed.

The assumption underlying this study was that implementation of MTS could have a positive effect on pain management and pain relief in trauma patients in the ED. This was based on two pillars. First, MTS requires a systematic assessment of pain. As more attention for pain improves the administration of analgesics in the ED,[16] we therefore assumed that systematic pain assessment due to the MTS would result in better pain relief. Second, severe pain, assessed by the MTS pain ruler, is an indicator for the assignment of a high triage priority (code orange, waiting time for consult of an ED physician is 10 minutes maximum). Since we assumed that assigning a lower triage code was desirable, we expected the staff to administer more analgesics which presumably could lead to more pain relief.

Both underlying thoughts could not be confirmed in our study. First, during the post-tests of the study, we noticed that triage nurses did not systematically assess pain on admission with the MTS pain ruler. This observation was confirmed by a study of van der Wulp et al.[17] They showed that pain assessments according to the MTS guidelines should have been conducted in 86.1% of the patient presentations, where it was only assessed in 32.2% of the patients. Furthermore, their study identified that triage nurses skipped the pain assessment because they thought it would result in over-triage. Second, our study showed mixed results on the improvement of pharmacological pain management after implementation of MTS. Whereas the trauma centre showed no significant increment in analgesic use, the ED of the teaching hospital used an increasing amount of analgesics. This could possibly be explained by the introduction of a pain protocol in the teaching hospital between the second pre-test (T1) and the post-test (T2). We think it is reasonable to suppose that the ED staff in the teaching hospital had an increased awareness of the importance of adequate pain management related to the

implementation of MTS, and was triggered to optimize this by the introduction of a pain protocol. Another study on triage systems in the ED (no MTS) and waiting times for administration of analgesics showed that many patients with moderate to severe pain received no analgesics during their ED stay.[18] On the other hand other studies on the effect of the introduction of pain protocol in the ED showed that pharmacological pain management increased after the introduction of a protocol.[16,19,20]

Another point of discussion is the pain assessment with the MTS pain ruler.[6] We did not use the MTS pain ruler for study purposes because the instrument was not tested on reliability, and (construct) validity for adult patients in the ED. Furthermore, the composed scale combines patient's self reported pain, descriptions on the nature of pain, and observations of patients' impairment due to pain. We noticed during our study, that the observed impairment was more related to the potential injuries observed, than to the reported pain intensity by the patients. This contrasting finding might also have influenced the observations and thereby inadequate 'treatment' by the nurses during the implementation process. As the MTS pain ruler gives room for the interpretation of the patients' pain report by the triage nurse, it could turn out to be a hindering factor instead of a facilitating factor for adequate pain relief. Another study on pain management in the ED showed that physicians and nurses give statistically significantly lower NRS pain ratings than those reported by the patients.[21] We therefore question the additional value of the MTS pain ruler in the field of pain management and would advise a valid and reliable tool for pain measurement proven to be useful for the ED.[13] Additionally, we think that pain assessment should not be intertwined with the assignment of the level of urgency of emergency complaints, in order to obtain valid pain assessments and adequate pain relief.

A final point of discussion is that patient preferences can also influence the use of pain management by analgesics, and therefore they could possibly have affected our outcome. Singer et al.[12] showed that half of the patients in pain declined pain medication in the ED, so it should be asked more explicit whether they want any pain relief by analgesics.

Limitations

This study has some limitations. The pre-test/post-test design did not provide control groups for the pre-tests, as for example in a quasi-experimental design. Neither was the research team blinded during the data collection and the data analysis. As this prospective study was conducted in a time interval of four years,

the research team changed over time too. However, two senior researchers (SB, TM) supervised all tests and trained the research team thoroughly . In all tests we strictly followed the standardized study procedure and data collection method. In order to gain insight in changes of pain management that were not directly related to the implementation of MTS we performed two pre-tests in the teaching hospital, and two post-tests in the trauma centre. Due to problems in the introduction phase of MTS in the Netherlands, the teaching hospital started more than a year later with the implementation of this system in the ED. As a result pre-tests and post-tests between hospitals were no longer comparable.

Another limitation of this study is that we did not study the quality of the implementation process of MTS in itself. Potentially, there could be differences regarding the implementation process between the EDs , as the hospitals have a different scope and organization model. These differences could also have affected our outcome. However, the research team did not observe a different approach towards MTS between the two EDs. Therefore, we think that this issue was of negligible influence on the observed outcome of our study.

Conclusion

We conclude that implementation of MTS showed mixed results on the improvement of pain management in trauma patients in the ED. MTS did not result in clinically and statistically significant more pain relief in the ED, and its use did not facilitate pain relief in trauma patients in the ED.

We advise ED staff to systematically measure pain with a validated pain assessment tool (e.g. Visual Analogue Scale (VAS), NRS), and to use a pain protocol at triage and thereafter. Finally, we recommend further studies on facilitating and hindering factors regarding pain management and pain relief in trauma patients in the ED.

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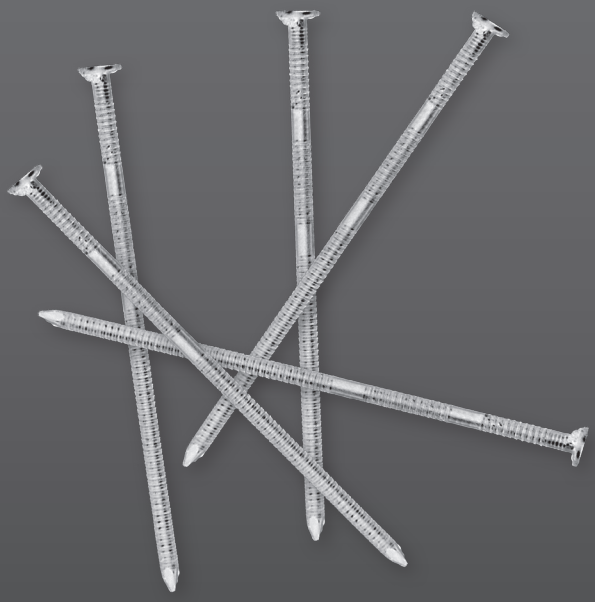

chapter 5

Facilitators and barriers in pain management for trauma patients in the chain of emergency care

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Abstract

Introduction

The aim of the study is to give insight into facilitators and barriers in pain management in trauma patients in the chain of emergency care in the Netherlands.

Patients and methods

A qualitative approach was adopted with the use of the implementation Model of Change of Clinical Practice. The chain of emergency care concerned prehospital Emergency Medical Services (EMS) and Emergency Departments (EDs). We included two EMS ambulance services and three EDs and conducted five focus groups and ten individual interviews. Stakeholders and managers of organizations were interviewed individually. Focus group participants were selected based on availability and general characteristics. Transcripts of the audio recordings and field notes were analyzed in consecutive steps, based on thematic content analysis. Each step was independently performed by the researchers, and was discussed afterwards. We analyzed differences and similarities supported by software for qualitative analysis MaxQDA.

Results

This study identified five concepts as facilitators and barriers in pain management for trauma patients in the chain of emergency care. We described the concepts of knowledge, attitude, professional communication, organizational aspects and patient input, illustrated with quotes from the interviews and focus group sessions. Furthermore, we identified whether the themes occurred in the chain of care. Knowledge deficits, attitude problems and patient input were similar for the EMS and ED settings, despite the different positions, backgrounds and educational levels of respondents. In the chain of care a lack of professional communication and organizational feedback occurred as new themes, and were specifically related to the organizational structure of the prehospital EMS and EDs.

Conclusion

Identified organizational aspects stressed the importance of organizational embedding of improvement of pain management. However, change of clinical practice requires a comprehensive approach focused at all five concepts. We think a shift in attitudes is needed, together with constant surveillance and feedback to emergency care providers. Implementation efforts need to be aimed at the identified barriers and facilitators, tailored to the chain of emergency care and the multi-professional group of emergency care providers.

Introduction

Acute pain and trauma are closely related, as noxious stimuli are transmitted from the injured areas to the nociceptor pathway, which results in pain perception.[1] Pain is also the main complaint of patients seeking help in emergency care.[2] However, it has shown to be undertreated, in prehospital ambulance Emergency Medical Services (EMS)[3,4] as well as in the emergency department (ED).[5,6] As a consequence, patients suffer pain unnecessarily, and adverse physiological and psychological effects occur.[7] Furthermore, chronic pain is reported in 63% of the patients one year after major trauma.[8,9]

In the Netherlands, there is no appropriate systematic approach to acute pain management in trauma patients in prehospital EMS and EDs. As a result, pain management is sometimes not started, is not continued consistently or is sometimes even conflicting. Besides the development of a clinical guideline on this topic,[10] we studied the literature on barriers and facilitators in pain management in emergency care. Furthermore we were interested in the continuity and the follow-up of pain management between the EMS and the EDs: "the chain of emergency care".

In general, several barriers for effective pain management have been studied separately within the EMS or ED setting. From the patients' perspective, ethnicity,[11] reluctance to report pain,[12] and refusal of pharmacological treatment have been reported.[13] Knowledge deficits[14] and the need for change of attitudes of emergency physicians have been identified.[15] Facilitating factors were the implementation of a pain protocol,[16] a quality control programme for emergency medicine,[17] high triage scores in the ED,[13] and education of emergency nurses.[18]

Although several barriers and facilitators have been described in general, it is not clear what specifically hinders or facilitates pain management in 'trauma patients' in 'the chain of emergency care'. The aim of this study is to give insight into facilitators and barriers in pain management in trauma patients in the chain of emergency care (EMS and ED) in the Netherlands. With this insight, tailored implementation strategies for change of clinical practice can be explored and developed.

Patients and methods

Theoretical Model of the problem

Changes of clinical practice are not self-implementing. Pain management in the chain of emergency care will only improve with implementation efforts aimed at barriers and facilitators. In this study, we used step 2 of the model of Grol et al.[19] This implementation model of change of clinical practice consists of five steps: step 1 involves the development of targets for improvement (recommended care); step 2 analyses the target group and setting - both current practice and the barriers and facilitators are explored in this step; step 3 concerns the development of the implementation strategy and measures to change practice; step 4 and 5 subsequently apply, evaluate and adapt the implementation plan. Step 1 has been carried out by another study focused on the development of a national evidence-based guideline.[10]

Study design

A qualitative approach with the use of individual interviews and focus groups meetings was adopted. This study focused on the professional and organizational perspective.[19] Based on the study protocol, the regional committee on research involving human subjects waived the need for a review of the study.

Setting

In the Netherlands, paramedics provide emergency care in EMS ambulance services. Following a national training course, they are qualified as emergency medical technicians level 4. All paramedics receive preparatory training as Registered Nurses, as this is the mandatory level to become a paramedic. Their competencies in trauma and pain management are regulated by national protocols, as they work autonomously and mostly unassisted in the prehospital setting.

Dutch EDs work with multidisciplinary teams. Not all EDs have emergency physicians available for 24h a day, 7 days a week. Although final medical accountability is shifting towards emergency physicians, most EDs are controlled by the surgical department. A recent study revealed that 56% of the Dutch EDs do not have a protocol for pain management in adults.[20]

Selection of Participants

Two EMS ambulance services (EMS GelderlandMidden & EMS GelderlandZuid) and three EDs were included in the sample. For the EDs, we selected an academic

trauma centre (Radboud University Nijmegen Medical Centre), a teaching hospital (Canisius Wilhelmina Hospital), and a regional general hospital (Hospital Bernhoven).

Five focus group interviews were conducted with staff responsible for the actual pain management (Table 5.1). Four to six people were invited for each focus group. All staff members received an invitation by e-mail with a short introduction to the study as well as the procedure of confidentiality. Professionals who were willing to contribute replied to the researchers. We selected the sample based on availability of the respondents for the potential interview dates. We further selected the respondents for a variety in general characteristics such as gender, professional background and years of experience. With this mix we aimed to include a representative sample for both settings. Due to changes in acute shifts and other work-related problems, five selected respondents (EMS n=2, ED n=3) did not participate. Table 5.1 shows the number of interviewed persons.

We decided to explore the perspectives of managers through individual interviews, because their hierarchical positions regarding the staff could hinder other participants in saying what they thought or felt. Furthermore, the number of managers was too small to compose a separate focus group (Table 5.1). In addition, stakeholders of the national EMS analgesia protocol were not invited to the focus group of paramedics, because they had rather advanced levels of expertise compared to the paramedics. Participants who were interviewed individually were not included in the focus groups discussions.

Table 5.1 Overview of participants in individual and focus group interviews

	Individual interviews	Focus group interviews
EMS	Medical managers (n=2) Stakeholders national EMS analgesia protocol (n=2)	Focus group 1: (n=4) Paramedics Focus group 2: (n=4) Paramedics
ED	Medical managers (n=3) Nurse managers (n=3)	Focus group 1 (n= 4) Emergency nurses, emergency physician, physician not in training for a specialty Focus group 2 (n=6) Emergency nurses, emergency physician, orthopaedic trauma surgeon resident Focus group 3 (n=5) Emergency nurses, emergency physician, trauma surgeon resident
Total	n=10	n=23

Methods of Measurement

We developed specific questioning routes for the individual interviews and focus groups.[21] General topics in each interview or discussion included attitude towards

pain management, pain assessment, pain treatment, and facilitators & barriers in pain management.

We used independent moderators (with a medical background) for the interviews and focus groups. These moderators were well-trained with respect to moderator skills. All the interviews and focus group meetings were audio recorded and the moderators took field notes. Every meeting was prepared, organized, and debriefed with the researchers (SB, TM). Individual and focus group interviews were typed out verbatim by the moderator of that particular meeting.

Primary Data Analysis

The transcripts and field notes were analyzed in consecutive steps,[21] using thematic content analysis. Each researcher selected the quotes and coded these text parts with keywords. We used an inductive approach to identify themes, and analyzed interrelationships in the data. Recurrent themes were clustered and linked to transcending concepts. Each step was performed independently, and discussed with the other researcher(s) afterwards. We discussed disagreements in such a way that the next step in the analysis was based on consensus. We used the analytic framework of identifying key concepts and constant comparatives: to discover core ideas, to understand how participants viewed the topic, and to identify patterns or trends.[21] The process of analysis was supported by software for qualitative analysis (MaxQDA).

As the interviews had been conducted and analyzed in Dutch, the translation of the transcripts were verified by a translator.

Results

We identified five concepts in the chain of emergency care: knowledge, attitude, professional communication, organizational aspects and patient input. Table 5.2 presents an overview of these concepts, and indicates which aspects were seen as facilitators or barriers. Furthermore, the overview describes whether the themes occurred in the chain of care. In this paragraph we describe the different themes of the five concepts, illustrated with quotes from the interviews and focus group sessions.

Knowledge: Barriers

Respondents reported uncertainty in effective pain management in trauma

patients based on 'knowledge deficits'. In general, there was limited attention for pain management during the initial training and in the advanced curriculum of emergency physicians, paramedics and nurses. They reported knowledge deficits regarding the physiological relationship between trauma and pain, the consequences of inadequate pain treatment, and the effect of pain management on recovery and healing of the patient. In addition, the negative effects of inadequate pain management were reported to be unknown.

Table 5.2 Overview of facilitators and barriers in the chain of emergency care

Concepts[a]	EMS	ED
1. Knowledge		
Knowledge deficits on adequate pain management	-	-
Pain assessment based on expert opinion	-	-
Pain treatment based on experience, not on protocols	-	-
Fear for adverse events when administering opioids	-	-
Knowledge on physiology of pain, new developments, and effect of undertreatment	+	+
Pain assessment based on validated instruments	+	+
2. Attitude		
Pain is not life-threatening for the patient	-	-
Pain is 'part of the deal' and a minor priority in trauma care	-	-
Resistance to the use of validated pain assessments	-	-
Doubts on the validity of patients' pain experience	-	-
Pain does not influence the choice of injury treatment	-	-
3. Professional communication		
Inadequate multidisciplinary communication on pain	.	-
Professional feedback on pain management	+	+
4. Organizational aspects		
Organizational feedback is lacking	-	-
National EMS analgesia protocol is inadequate	-	.
Protocol is not in use in the ED, or not evaluated	.	-
Triage assessment and pain assessment in the ED are intertwined, high pain scores result in inadequate urgent triage outcomes	.	-
No consensus shared perspective on pain management	-	-
Lack of follow-up in the chain of emergency care	.	-
ED culture is not primarily focused on patient comfort	.	-
Role model: surgeon is mainly focused on injury treatment	.	-
Role model: the emergency physician in the ED is a facilitator	.	+
One guideline on pain management for the chain of emergency care	+	+
5. Patient input		
Patient refuses pharmacological pain treatment	-	-
Patient input enhances effective pain management	+	+

a facilitators are presented as '+'
barriers are presented as '-'
absence of facilitators or barriers is presented as '.'

'Pain assessment' was often based on clinical observations and expert opinion and not on the use of validated pain instruments. Also, 'pain management' was based more on expert opinion and previous experiences than on available pain protocols. There was a 'fear for adverse effects' of administration of opioids. Respiratory depression was seen as a potential threat to patients' safety. Therefore, some paramedics did not administer fentanyl (prescribed in the national EMS analgesia

protocol), or administered a low (less effective) dose during emergency transport. Further, emergency nurses were reluctant to give intravenous opioids when the physician was not present in the ED.

> 'What is passed on is mostly technical knowledge on pain management rather than other things that affect pain reduction as well. During the training we were asked how much we administer, but they never question why and how'. (EMS, paramedic)
> 'During my career I administered less of these substances (fentanyl and ketamine), than my colleagues who worked in an intensive care unit or in anaesthesiology…they are more into the intravenous syringes… I notice a difference there, I see much more obstacles than they do…'. (EMS, paramedic).

Knowledge: Facilitators

'Adequate knowledge' was generally seen as a facilitator for improvement of pain management. Professionals in the chain of emergency medicine wanted to be educated on physiology of pain, new developments, the effect of insufficient treatment and discussions on case reports. Managers and stakeholders of the national EMS analgesia protocol discussed how research could play an important role in the development of a body of knowledge.

Attitude: Barriers

All respondents emphasized that the treatment of trauma patients was focused on 'treat first, what kills first'. 'Pain is not life threatening' and it was perceived as 'part of the game'. Some respondents considered systematically validated pain assessments as a 'minor priority', which was in contrast to the opinion of managers in emergency care. Furthermore, 'pain did not primarily influence' the decision-making process of professionals on 'injury treatment'.

Practicing emergency care providers expressed a general 'resistance to use validated pain scales' for trauma patients. They expressed that validated pain assessment is not necessary.

Some respondents expressed 'doubts about the patients' pain experience', and they questioned the patient's honesty when reporting pain.

> 'In cardiology, of course pain has consequences for the treatment. But when the arm of a trauma patient is at an angle, well then that needs to be fixed and it does not matter whether the pain score is eight or four, because that is of no importance for the injury treatment' (ED, physician).

'To be honest, I hardly ever ask for a VAS-score. What I do ask is: what has happened, where does it hurt?' (ED, physician)

'…But if the patient says eight; I sometimes find that highly exaggerated! (Other focus group member: 'but that is your own interpretation, based on what you see'.) 'But, when a person is lying in the ambulance and I ask for a pain score and he says eight, which is unbearable pain, but he is smiling…'. Well, then I think: 'get lost!'. (EMS, paramedic)

Professional communication: Barriers

'Inadequate inter- and multidisciplinary communication' on pain hindered adequate pain management. Paramedics felt that interdisciplinary communication on pain management at the ambulance station was lacking. In the ED, there was a lack of communication between members of the multidisciplinary team who had different responsibilities and perspectives regarding pain management in trauma patients.

'I do not know whether it is wise to have a patient completely pain free, because then you run the risk that he will be too active once he is at home' (ED, physician). 'It would be nice though, if patients could leave the ED pain free' (ED, nurse). 'You mean completely pain free? (ED, physician). 'If I was a patient, I would prefer that' (ED, nurse).

Professional communication: Facilitator

All respondents mentioned 'professional feedback' as a strategy to improve professional communication and adequate pain management.

Organizational aspects: Barriers

All respondents reported a 'lack of organizational feedback' on pain management. Respondents in the EMS setting reported that adherence to the national EMS analgesia protocol and problems with the current protocol were not structurally monitored and evaluated. Paramedics brought up that the 'national EMS analgesia protocol was inadequate': it did not offer sufficient and adequate pharmacological options and gave limited room for the professional expertise of the paramedics. Medical managers and stakeholders of the national EMS analgesia protocol did not agree on this perspective and questioned the paramedics in the underpinning of protocol deviation.

There was no national protocol regarding pain management for the ED setting, although two out of three departments used a pain protocol for trauma patients. Although these protocols were introduced some time ago, the (implementation

of the) 'ED protocols had not been evaluated' or structurally monitored.

'Triage assessment and pain assessment in the ED are intertwined' and respondents of the ED reported that they did not want high pain scores to result in high triage scores. A high pain score in the Manchester Triage System (MTS) results in high priority codes for the patients, whereas these patients may have lower urgency levels based on their clinical signs. Furthermore, when the ED was overcrowded and the workload was high, a systematic pain assessment and triage by MTS were both omitted.

In general, there was no 'consensus on a shared perspective regarding pain management'. There was discussion in the focus groups on the optimal level of pain reduction that could or should be achieved. Neither professionals nor organizations had a shared perspective. All respondents agreed that there was a 'lack of follow up in pain management in the chain of emergency medicine'.

The 'ED culture was not primarily focused on patient comfort'. Respondents of the ED characterized their environment as a stressful place, where traumatic and painful experiences for patients were regularly seen and were perceived as quite normal. Team members who were more patient centred were not easily heard or accepted. As coordinators of trauma care, trauma 'surgeons were mainly focused on injury treatment' and not on pain management.

> 'I find the consecutive steps in the national EMS analgesia protocol inadequate. We have either nothing... or opioids. ...Such steps are simply too big'. (EMS, paramedic)

> 'A patient with a broken wrist gives a pain score of ten. All right, you should not generalize, but a pain score of ten gets triage code orange (ed. very urgent). Naturally, that never happens. These patients mostly get the yellow code (ed. triage code urgent)'. (ED, triage nurse)

> 'The major trauma patients mostly received fentanyl in prehospital EMS and they arrive pain free at the ED. However, that only has a short-term effect. ... I believe we are waiting too long with adequate pain medication for the follow-up. We work with inexperienced physicians in the ED...' . (ED, physician)

> 'I have a patient with a fracture, and we are waiting for the orthopaedic surgeon... When I call him, he says: 'I first want to see the patient'. This causes a delay of at least 10 -15 minutes, which later on forces me to give extra analgesia'. (ED, nurse).

Organizational aspects: Facilitators

'One pain guideline for the chain of emergency care' was seen as a facilitator of effective pain management. For the ED setting, professionals suggested that an 'ED protocol with prescribed nurse initiated pain medication' could serve as a facilitator in pain treatment in an early stage of diagnosis and treatment in the ED.

The 'emergency physician' was generally seen 'as a facilitating factor' for the improvement of pain management in the ED. In the Netherlands, the role of the emergency physician is changing towards a more central role as coordinator of the ED management. The emergency physician was seen as more focused on the over-all perspective of the patient.

Patient input: Barriers

All respondents described that sometimes 'patients refused to accept pharmacological pain treatment'. This input was experienced as a frustrating and delaying factor in adequate pain management. Professionals suggested that the cultural background, the individual perspective, and the fear of patients for unnecessary use of medication were possible reasons for the rejection of analgesia.

> 'Do you need anything against the pain? If they (ed. patients) say no, then I accept that. And, although I think I should say more often, I do not advise them to take medication after all'. (ED, nurse)

Patient input: Facilitator

All respondents referred to the 'patient input as a facilitator' for the improvement of pain management. The patient's perspective on adequate pain relief, for example, through the use of the systematic pain score (NRS or VAS), could play an important role in the systematically validated evaluation of pain treatment from an individual and a subjective perspective.

Discussion

This study identified five concepts as facilitators and barriers in pain management for trauma patients: knowledge, attitude, professional communication, organizational aspects, and patient input. We found that the three concepts: knowledge, attitude and patient input, covered shared themes in the chain of care, despite the different positions, backgrounds and educational levels

of respondents. The two concepts, organizational aspects and professional communication, concerned barriers and facilitators that were specifically related to the organizational structure of the prehospital EMS and EDs. Before we further elaborate on the improvement of pain management in the chain of emergency medicine, some topics need to be discussed.

First, although barriers and facilitators within the concepts of knowledge, attitude and patient input have been described before,[12,13-15,18] it was not clear that similar themes were also present in the EMS and ED setting. Professional as well as organizational feedback have previously not been identified as strategies for the improvement of pain management in emergency care. Organizational aspects identified in our study and previous literature[7,15-17,20] stress the importance of embedding implementation plans for the change of clinical practice in the organizational structure of the EMS and the ED. In our opinion, these insights together create new possibilities for tailored implementation strategies for pain management in trauma patients in the chain of emergency care.

Second, barriers and facilitators that were only identified within the EMS or ED setting were closely related to the organizational and the national context of these settings, for instance the facilitating role of the emergency physician in the EDs in the Netherlands.[22] It remains to be seen whether these concepts should, and could, be addressed in the chain of emergency medicine. Knowing that effective pain management in prehospital EMS enhances early ED pain management,[23] a combined strategy for the EMS and ED setting in the chain of emergency care could possibly result in a triple positive effect regarding pain management.

Third, although the five concepts in the 'Results' section were presented solitarily, it is obvious that there are inter-concept relationships. Barriers and facilitators can be improved, strengthened or accelerated by other concepts depending on the nature of the underlying relationships. Due to the interrelated nature of the five concepts, we suggest that a tailored implementation strategy will have to address all concepts together in order to improve pain management in the chain of emergency care.

Fourth, better education, implementation of guidelines, and systematic feedback are important strategies to improve pain management in the chain of emergency care. However, the fact that health care providers do not believe patients who claim to be in pain, is alarming. On the one hand, professionals appear to be uncomfortable with providing narcotic analgesics; on the other hand, they freely deviate from protocols or guidelines, because they think they know better. Curiously, they report that the guidelines are not working even

though they are adhering to them. Therefore, we think that a dramatic attitudinal shift is needed, together with constant surveillance and feedback to healthcare providers on adherence to the evidence based guidelines.

Limitations

This study has some limitations in the context of the theoretical model of Grol.[19] Due to the qualitative approach chosen, we gained insight into perceived barriers and facilitators, although the frequency and impact of these barriers was not quantitatively addressed.

Another limitation of the study is the issue of the selected sample and the related question on whether we reached adequate saturation. We decided to invite ED respondents from many different professional groups together in one focus group, because they are all involved in pain management and we were interested in the multidisciplinary perspective on pain management. In order to attain feasible and representative respondents for these focus groups within the timeframe of the study, we opted for the selective sampling.

We cannot fully assure that we reached saturation on all themes. Especially the input of (orthopaedic) trauma surgeons was limited, due to the small number of representatives in the focus group. We tried to optimize the variety of reflections of participants by choosing well-trained and independent moderators and planned three focus groups. An analysis of the meetings showed recurrent ideas, and many concepts that emerged were also described in the literature before, so they partially confirm a certain level of saturation.

We advise further study to gain insight into differences between groups, for instance, the attitudes of emergency physician residents and senior physicians. This study should be repeated in other regions in the Netherlands in larger groups in order to solve the (potential) saturation problem and confirm that no issues have been missed.

Finally, one could question the external validity of this study. Whilst the interdisciplinary discussion gave new insight into barriers and facilitators in the chain of emergency care and the follow-up of pain management, the general application of results in other settings could be discussed.

In order to develop an implementation strategy on a national level or in other countries, a quantitative study on the frequency and impact of identified themes and concepts in this study would be recommended.

Conclusion

This study identified five concepts as facilitators and barriers in pain management for trauma patients. Knowledge deficits, attitude problems and patient input were similar for the EMS and ED setting, despite the different positions, backgrounds and educational levels of respondents. The lack of professional and organizational feedback occurred as new themes. Identified organizational aspects stressed the importance of the organizational embedding of the improvement of pain management. Change of clinical practice requires a comprehensive approach at different levels. However, we think a shift in attitudes is needed, together with constant surveillance and feedback to healthcare providers on adherence to the evidence based guidelines. Strategies to improve pain management need to be tailored to the chain of emergency care and the multi-professional group of emergency care providers.

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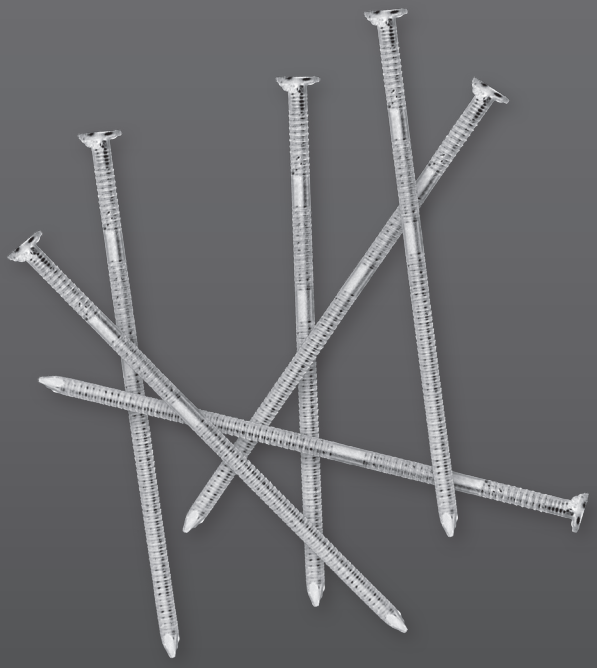

chapter 6

A systematic review of clinical guidelines on acute pain, focused on pain management in trauma patients in (prehospital) emergency medicine

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Submitted

Abstract

Background

Pain in trauma patients in (prehospital) emergency medicine has been shown to be undertreated. We have searched the literature for recommendations on the early and initial pain management of this patient group.

Aim

To identify clinical guidelines and recommendations on the acute pain management of trauma patients in (prehospital) emergency medicine.

Literature search methods

This systematic review is based on a search in Medline, Cochrane, CINAHL, and professional sites at the world wide web. For each bibliographic database a specific search strategy was developed, with thesaurus terms and free text. Guidelines published between 2002-2008 (updated to 2010) were included, and subsequently critically assessed with the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. Only (strongly) recommended guidelines underwent a content analysis focused on pain management in trauma patients in emergency medicine.

Results

Our study showed six (strongly) recommended evidence-based guidelines on the management of acute pain, according to the AGREE instrument. The number of recommendations and topics covered varied as much as the breadth of the scope of these guidelines. One-dimensional pain scales were advised for assessment of pain (intensity). A selection of recommended analgesics was summarized according to their pharmacological properties. Also non-pharmacological treatment was discussed. Analysis showed that specific recommendations regarding (prehospital) emergency medicine were scarce.

Conclusions

At present there is no 'single best' evidence-based guideline, however the six guidelines found could provide the 'building blocks' for the development of a tailored guideline on pain management in trauma patients in (prehospital) emergency medicine.

Introduction

Acute pain is induced by activation of various nociceptors at the site of tissue damage. Trauma and pain are, therefore, frequently inextricably related to one another.[1] Pain acts as a functional warning sign in order to initiate escape or protective behavior.[2] In case of severe neurological damage such as in patients with neurological lesions, the pain experience itself can be altered and the behavioural responses are even more complex.

Several studies have shown significant undertreatment of pain in trauma patients in prehospital Emergency Medical Services (EMS)[3,4] and in emergency departments (ED).[5-8] Initial pain management of trauma patients by paramedics, emergency physicians and emergency nurses still appears to be suboptimal.

Guidelines are considered to be one of the most important aids for introducing new insights aimed at achieving an optimal level of care for patients.[9] We searched for evidence-based guidelines on pain and trauma in (prehospital) emergency medicine, and found two guidelines.[10,11] One guideline focused on pain management in patients with acute blunt thoracic trauma,[11] and mainly described recommendations on epidural anaesthesia. This specific treatment performed by the anaesthesiologist is considered to be an advanced pain treatment. Since our study focused on initial and early treatment of acute pain in emergency medicine this guideline did not match our purpose. The other guideline focused on procedural sedation in the ED,[10] where pain treatment was directly related to a painful procedure. Although well trained emergency physicians seem to be able to safely perform these interventions, this guideline focuses on a relevant but limited element of initial pain management in emergency medicine.

Since guidelines on initial and early management of pain in emergency medicine are not available, we searched databases for guidelines on the management of acute pain. We hypothesized that the mechanisms involved in acute trauma and surgical pain are comparable from a biomedical point of view. Rapid hemodynamic changes due to large blood loss and uncontrolled tissue damage in trauma patients is not comparable to blood loss by controlled surgical interventions, but we were unable to find other major differences in the pathophysiological mechanisms concerning tissue trauma and pain.[1,12-14] This suggests that guidelines for the treatment of surgical pain may also be used in the emergency trauma situation.

The aim of this study is to identify evidence-based clinical guidelines on acute pain, that could serve as a basis for the development of a (tailored) clinical guideline on pain management in trauma patients in (prehospital) emergency care.

Literature search methods

A systematic review was conducted, concerning evidence-based clinical guidelines on acute pain management.

Study questions

Our study questions were:

1. Which evidence-based clinical guidelines on acute pain can be identified in the literature and the world wide web?
2. What guidelines can be recommended regarding the quality of their guideline development process, based on an assessment with the validated Appraisal of Guidelines Research and Evaluation (AGREE) instrument?
3. What are the general characteristics of these guidelines: scope, definition of pain, patient groups, professionals involved, structure, and number of recommendations?
4. What is the content of these guidelines, and which recommendations can be used for trauma patients in emergency medicine regarding:
   a) pain assessment, (nurse initiated) (non) pharmacological pain treatment, pain evaluation and outcome,
   b) implementation and organizational aspects?

Search strategy

Two reviewers (SB, HK) independently searched for guidelines published from 2002 until 2008 in the English and Dutch language. We chose a period of six years, as guidelines should be reassessed every three years,[15] and the Scottish Intercollegiate Guidelines Network group described the guideline development process to take approximately 28 months.[16] The search on the world wide web was focused on guideline databases, and professional websites on trauma, emergency medicine, and pain (see Table 6.1).[9,17-20] Subsequently, an electronic database search in Medline, Cochrane, and CINAHL (Cumulative Index of Nursing and Allied Health Literature) was performed. We searched the websites using the search terms 'practice guideline', 'clinical guideline' and 'pain'. For each electronic

bibliographic database a specific search strategy with thesaurus terms and free text was developed.

We used the definition of clinical practice guidelines as developed by the American Institute of Medicine: 'Clinical practice guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances'.[21] Pain was defined according to the definition of the International Association of the Study of Pain (IASP)[22] and trauma according to the Medline thesaurus term 'wounds and injuries'.[23]

Selection criteria

Selection of the guidelines using in- and exclusion criteria was independently performed by two reviewers (SB, HK) and included two levels. The first level of screening was general selection criteria. Guidelines were included if they met all three criteria: 1. published in the period 2002-2008; 2. focused on adult patients (≥16 years); 3. guidelines addressed initial acute pain management. The second level of screening was a critical appraisal of the quality of the guideline development process with the validated Appraisal of Guidelines Research and Evaluation (AGREE) instrument.[24-26] Two extra pairs of reviewers (research students) performed a critical appraisal with the AGREE instrument in such a way that the included guidelines were similarly assessed by four persons, as advised in the AGREE manual.

The AGREE instrument consists of 23 criteria, divided into six domains covering the key elements of a guideline development process. These six domains are: 1. scope and purpose, 2. stakeholder involvement, 3. rigor of development, 4. clarity and presentation, 5. applicability, and 6. editorial independence. Concordance between reviewers was achieved by means of consensus. Disagreements were solved by discussion with the supervisor (LS).

The AGREE instrument training manual[25] defines four levels of recommendation: strongly recommended, recommended, would not recommend, and unsure. If the guideline rates high on the majority of the items and most domain scores are 60% or above, the advice is 'strongly recommended'. If the guideline rates high or low on a similar number of items and most domain scores are 30%-60%, the guideline is labelled 'recommended'. When the guideline rates low on the majority of items and most domain scores are 30%, the guideline development process has serious shortcomings and the guideline is 'not recommended'. If the guideline provided

insufficient information to enable assessment of its quality, the recommendation is 'unsure'. We have used these AGREE recommendation levels.

Finally, we checked to see whether the selected guidelines had been updated between 2008 and 2010. The guideline of the ANZCA was updated in 2010,[27] and had equal domain scores on the AGREE instrument. We used this version for data extraction.

Data extraction and analysis

Guidelines that were assessed as (strongly) recommended according to AGREE, underwent data extraction and subsequent data analysis, using a standardized template developed and pre-tested by the reviewers (SB, HK). In the content analysis, we used the latest updated version of the selected guidelines.

The first part of the template focused on general characteristics of the guidelines such as scope, definition of pain, patient groups, professionals involved, structure of the guideline and number of recommendations. The second part focused on data on pain management, which included pain assessment, pain treatment and outcome. Pharmacological and non-pharmacological interventions were categorised. The third part of the template described organisational aspects and implementation (tools) of the guidelines. Similarities and differences in acute pain management between the guidelines were studied.

Results

Search strategy

The systematic search of websites (Table 6.1) and bibliographic databases resulted in two Dutch and nineteen English clinical guidelines on acute pain. Eight of these guidelines were beyond the scope of this study, focusing on neuropathic pain,[28,29] older adults,[30] treatment of burns,[31,32] general postoperative management,[33] the perioperative setting,[34] and epidural anaesthesia,[11] and were excluded from further analysis. The remaining thirteen guidelines were assessed with the AGREE instrument. [10,27,35-45]

Table 6.1 Data sources for evidence-based guidelines: guideline database

Guidelines websites	
Australian National Health and Medical Research Council [9, 20]	www.nhmrc.gov.au
Canadian Clinical Practice Guidelines [17]	www.canadianguidelines.com
Evidence-based Medicine Guidelines (Wiley Interscience) [20]	ebmg.wiley.com/ebmg
Guidelines-International-Network [20]	www.g-i-n.net/
Institute for Clinical Systems Improvement [17]	www.icsi.org
New Zealand Guidelines Group [9, 20]	www.nzgg.org.nz
NHS National Institute for Clinical Excellence [9, 20]	www.nice.org.uk
NHS UK guidelines finder[a]	www.library.nhs.uk/guidelinesfinder
Scottish Intercollegiate Guidelines Network (SIGN) [9, 20]	www.sign.ac.uk
TRIP database for Evidence-Based Practice [17]	www.tripdatabase.com
U.S. Agency for Healthcare Research and Quality [20]	www.ahrq.gov
U.S. National Guideline Clearing House [9, 19]	www.guideline.gov

Professionals websites on trauma care and emergency medicine	
American Association for the Surgery of Trauma [b]	www.aast.org
American College of Physicians [20]	www.acponline.org
American College of Emergency Physicians [b]	www.acep.org
American Medical Association [17]	www.asahq.org
American Society of Anesthesiologists [b]	ama-assn.org
American Trauma Society [b]	www.amtrauma.org
Australian College of Emergency Medicine	www.acem.org.au
Australian Trauma Society [b]	www.atsoc.com.au
British Trauma Society [b]	www.trauma.org/bts
British College of Emergency Medicine	www.collemergencymed.ac.uk
Canadian Medical Association [19]	www.cma.ca
Canadian Association of Emergency Physicians	www.caep.ca
Eastern Association for the Surgery of Trauma [b]	www.east.org
Emergency Nurses Association [b]	www.ena.org
European Association for Trauma and Emergency Surgery [b]	www.eates.info
International Trauma Anesthesia and Critical Care Association [b]	www.itaccs.com
Joanna Briggs Institute Australia [a]	joannabriggs.edu.au
Panamerican Trauma Society [b]	www.panamtrauma.org
Registered Council of Nurses UK [b]	www.rcn.org.uk
Faculty of Emergency Nursing (Royal College of Nursing UK)	www.fen.uk.com
Royal Australasian College of Surgeons [b]	www.acem.org.au
Royal College of Physicians [17]	www.rcplondon.ac.uk
Royal College of Surgeons of England	www.rcseng.ac.uk
Society of Trauma Nursing [b]	www.traumanursing.org
Trauma Association of Canada [b]	www.traumacanada.org
Trauma Care UK [b]	www.trauma.myzen.co.uk
Trauma Care International (ITACS) [b]	www.itaccs.com/about/
Trauma Nurse [b]	www.traumanurse.org
Turkish Association for Trauma and Emergency Surgery [b]	www.travma.org
Western Trauma Association [b]	www.westerntraumaassociation.org

Professional websites on pain	
American Academy of Pain Medicine	www.painmed.org
American Pain Society	www.ampainsoc.org
American Society of Regional Anesthesia and Pain Management	www.asra.com
Australian Pain Society	www.apsoc.org.au
American Pain Society	www.ampainsoc.org
British Pain Society	www.britishpainsociety.org
Canadian Pain Society	www.canadianpainsociety.ca
International Association of the Study of Pain	www.iasp-pain.org
New Zealand Pain Society	www.nzps.org.nz
World Institute of Pain	www.worldinstituteofpain.org

Guideline databases (national level: the Netherlands)	
Dutch Institute of Quality in Healthcare	www.cbo.nl
Dutch Evidence Based guidelines	www.ebm-richtlijnen.nl

Professional websites on trauma care, (emergency) medicine, and nursing (national level: the Netherlands)	
Netherlands Centre for Excellence in Nursing	www.levv.nl
Dutch Physicians and Pharmacy	www.artsenapotheker.nl
Dutch College of General Practitioners	www.nhg.artsennet.nl
Netherlands Society for Emergency Physicians	www.nvsha.nl
Dutch Society for Emergency Nurses	www.nvshv.nl
Dutch Ambulance Protocols	www.ambulanceprotocol.nl
Netherlands Trauma Society	www.trauma.nl
Netherlands Trauma Nursing Foundation	www.trauma-nursing.nl
Netherlands Pain Platform	www.pijnplatform.nl
Netherlands Society of Anaesthesiology	www.anesthesiologie.nl

Database sources adapted from [9, 17, 19, 20] and:
[a] Graig J, Smyth R. The evidence-based practice manual for nurses. 2002 Churchill Livingstone, London
[b] Internet trauma care site, http://www.trauma.org

Quality of development according to the AGREE instrument

In general, there were few disagreements among reviewers on AGREE scores, and all disagreements were resolved after discussion with the supervisor.

Seven of the thirteen guidelines on acute pain scored 'not recommended' (Table 6.2).[35-39,41,42] Most of their domain scores were under the 30% due to lack of systematically gathered scientific evidence underpinning the recommendations. Items not specifically addressed were: the use of systematic methods in search of evidence, clear criteria for selecting the evidence, consideration of health benefits and side effects or risks, and an explicit link between recommendations and supporting evidence.

Table 6.2 Overview of identified clinical guidelines on acute pain

Not recommended according to AGREE [a] appraisal	1. ASPAN pain and comfort clinical guideline. American Society of PeriAnesthesia Nurses, United States of America, 2003 NGC [b] number 3757 2. Best practice statement: postoperative pain management. National Health Services UK, United Kingdom, 2004 SIGN [c] 3. Pain control in day surgery: SIAARTI [d] guidelines. Commission on Day Surgery, Italy, 2002 4. Guideline for the management of pain in adults. The College of Emergency Medicine, United Kingdom, 2004 5. Pain management. The John A. Hartford Foundation Institute for Geriatric nursing, 2003. United States of America, NGC number 2740 6. Pain management guideline. Health Association of New Jersey, United States of America, revised 2006. NGC number 5217 7. Pharmacological pain guideline. Dutch College of General Practitioners, the Netherlands, 2005 (in Dutch)
(Strongly) recommended according to AGREE appraisal	1. Acute pain management Scientific Evidence. Australian and New Zealand College of Anaesthetists and Faculty of Pain Management, Australia and New Zealand, 2010 2. Assessment and management of acute pain. Institute for Clinical Systems Improvement, United States of America, revised 2006. NGC number 4884 3. Assessment and management of pain. Registered Nurses Association of Ontario, Canada, 2002. NGC number 5960 4. Clinical policy: procedural sedation and analgesia in the emergency department. American College of Emergency Physicians, United States of America, 2005. NGC number 4068 5. Clinical practice guideline for the management of postoperative pain. Veterans Health Administration, Department of Defense, United States of America, 2002 6. Postoperative pain management. Netherlands Society of Anaesthesiology, the Netherlands, 2003 (in Dutch)

[a] AGREE = Appraisal of Guidelines Research and Evaluation
[b] NGC = National Guidelines Clearinghouse
[c] SIGN= Scottish Intercollegiate Guidelines Network
[d] SIAARTI=Societa Italiana di Anestesia Analgesia Rianimazione e Terapia Intensiva (Italian Society of Anaesthesia, Analgesia, Reanimation and intensive Care).

The remaining six guidelines scored (strongly) recommended and were included.[10,27,40,43,45] Table 6.3 presents the domain scores and the overall quality assessment on the AGREE instrument of these guidelines.

In order to promote readability of the results section we further describe the guideline of the American College of Emergency Physicians as ACEP, the guideline of the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine as ANZCA, the guideline of the Institute for Clinical Systems Improvement as ICSI, the guideline of the Netherlands Society of Anaesthesiology as NVA, the guideline of the Registered Nurses Association of Ontario as RNAO, and the guideline of the Veteran Health Administration as VHA.

Table 6.3 Quality of guideline development process according to AGREE

Appraisal of Guidelines Research and Evaluation Domain	ACEP [a]	ANZA [b]	ICSI [c]	NVA [d]	RNAO [e]	VHA [f]
Scope / purpose (%)	89	44	67	78	56	67
Stakeholder involvement (%)	50	67	75	50	75	67
Rigour of development (%)	62	95	43	71	67	62
Clarity / presentation (%)	75	75	100	67	100	75
Applicability (%)	0	67	11	44	56	0
Editorial independence (%)	0	50	100	0	100	0
Overall quality assessment of the guideline	Recommended	Strongly recommended	Recommended	Recommended	Strongly recommended	Recommended

[a] American College of Emergency Phycisicans (ACEP);
[b] Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine (ANCZA);
[c] Institute for Clinical Systems Improvement (ICSI);
[d] Netherlands Society of Anaesthesiology (NVA, abbreviation in Dutch);
[e] Registered Nurses Association of Ontario (RNAO);
[f] Veteran Health Affairs (VHA).

Characteristics of guidelines

The number of recommendations in the guidelines varied as much as the breadth of the scope of the subject. In total we identified 711 recommendations on initial acute pain management, of which 501 were potentially applicable in emergency medicine based on the assumption that acute surgical and acute trauma pain are comparable. Table 6.4 presents an overview of the characteristics of the guidelines. Most of the recommendations came from the ANZCA guideline (n=199), followed by the VHA guideline (n=155), the RNAO guideline (n=78), the NVA guideline (n=60), and lastly the ACEP guideline on procedural sedation (n=9). The ICSI guideline did not explicitly grade the recommendations.

Pain Management

Pain assessment

In general, pain assessment requires a multi level approach. In Table 6.5 we summarize the different aspects of pain assessment as described in the guidelines. Assessment of pain was not mentioned in the guideline for procedural sedation (ACEP). As the intensity of pain is a personal and subjective experience, all the other guidelines primarily recommended the use of a patient self-report on pain. One-dimensional scales used were the Visual Analogue Scale (VAS), the Numeric Rating Scale (NRS), and the Verbal Description Scale (VDS (ANZCA, ICSI, NVA, RNAO, VHA)), whereby the VAS and NRS were validated for trauma patients (ANZCA, ICSI). The NRS correlated well with the VAS (ANZCA). One-dimensional scales could be used in elderly patients in the acute pain setting although the VDS might be more reliable in the hospital setting (ANZCA, VHA). Pain measurements by the VDS were reported to be less sensitive for pain treatment outcome than measurements with the VAS (ANZCA). Only the RNAO guideline described documentation of and communication on pain assessment. The ANZCA guideline advised that EDs should adopt systems to ensure adequate assessment of pain.

Pharmacological pain management

All guidelines covered the area of acute pain management with drugs. A summary of analgesics that can be used in acute pain management and trauma is given in Table 6.5. In this overview we present a selection of analgesics according to their pharmacological characteristics: paracetamol, NSAIDs, weak opioids, opioids and adjuvant / other analgesic drugs for the use in trauma patients are described.

Table 6.4 Characteristics of guidelines and content regarding pain assessment

	ACEP [a]	ANZCA [b]	ICSI [c]	NVA [d]	RNAO [e]	VHA [f]
Definition of pain[g]	-	+	+	-	-	-
Focus of guideline	Procedural sedation in ED[h]	Acute pain	Acute pain	Post-operative pain	Acute & chronic pain	Post-operative pain
Specific adult patient groups addressed	Procedural sedation in ED[h]	Prehospital patients, Patients in the ED ... Other groups	-	-	Elderly patients	-
Professionals involved	Emergency physicians	Multi professionals[i]	Multi professionals[i]	Multi professionals[i]	Nurses	Multi professionals[i]
Content regarding pain assessment	-	Medical history, physical examination, pain history, one dimensional pain scale	Medical history, physical examination, pain history, one dimensional pain scale	One dimensional pain scale	Physical examination, pain history, one dimensional pain scale	Medical history, physical examination, pain history, one dimensional pain scale
Content regarding non-pharmacological pain management	-	+	+	-	+	-
Other topics	Risk assessment	Education, General requirements regarding pain, Organization of acute pain service	Prevention	Organization of acute pain service	Education, Organization of pain management, Policy development	-

[a] American College of Emergency Phycisicans (ACEP)
[b] Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine (ANZCA)
[c] Institute for Clinical Systems Improvement (ICSI)
[d] Netherlands Society of Anaesthesiology (NVA, abbreviation in Dutch)
[e] Registered Nurses Association of Ontario (RNAO)
[f] Veteran Health Affairs (VHA)
[g] International Association for the Study of Pain (IASP) definition of pain
[h] emergency department = ED
[i] physicians (of different specialties), nurses (of different specialties), anaesthesia assistants, physician assistants and students
- = not present
+ = present

Table 6.5 Pharmacological treatment options for early initial treatment of acute pain in adult trauma patients

	Paracetamol	NSAIDs	Weak opioids	Opioids	Adjuvant drugs
Doses	Paracetamol 500 -1000 mg Perfalgan® IV 1000 mg	Acetylsalicylic acid 600 – 1200 mg Ibuprofen 200-600 mg Diclofenac 50-100 mg Piroxicam 20-40 mg Naproxen 200 – 500 mg	Codeine 10-60 mg Tramadol 75-150 mg	Morfine IV 0.1 mg/kg (<60 years) initial bolus 1-2 mg Fentanyl IV 1-2 µg/kg initial bolus in 5-10 min.	Nitrous oxide/oxygen mixture 50%/50% (Es)ketamine IV 0.25 mg/kg in 2 min. titrated
Route	Oral, (rectal) and intravenous	Oral, rectal (intramuscular, intravenous, transdermal)	Oral, rectal, intravenous	Oral, subcutaneous, intramuscular, intravenous, intranasal	Inhalation agent[a] Intravenous[b]
Side effects	-	Many: • Gastro-intestinal • Renal impairment • Increased risk of (severe) bleeding • Cardiovascular side effects	• Nausea • Drowsiness • Fatigue • Transpiration • Dry mouth • (Vomiting)	• Sedation • Cardiovascular depression • Respiratory depression • Nausea / vomiting • Impaired gastro intestinal motility • Urinary retention • Pruritis	• Exposure to doses less than 6 hours are harmless[a] • Dissociation (by administration of high and low doses)[b] • Hallucinations, paranoia, vivid dreams or delusions, delirium and floating experiences[b,c]
Contra-indication	Active alcohol related liver diseases	Many: • Aspirin-exacerbated respiratory disease • Renal impairment • Hypovolemia and/or hypotension • Use of nephrotoxic agents and ACE inhibitors • Cardiovascular diseases • Age > 60-70 years	• Liver or renal impairment • Epilepsy • Treatment with Monoamine Oxidase Inhibitors	• Hypovolemia • ABC unstable	• Neurological brain injuries[a] • Emphysema[a] • Thoracic injuriesa • Pregnancy[a] • Intoxication (alcohol – drugs)[a] • Prehospital or clinical situation where hypertension or tachycardia is seen as an adverse event[b]
Advantage	• Rapidly absorbed • Good bioavailability • Incidence of adverse events is comparable to placebo	• Integral component of multimodal analgesia in healthy patients • NSAIDs are opioid-sparing and reduce opioid-related side effects	• Less risk of cardiovascular or respiratory depression • Less impairment of gastrointestinal motor function compared to other opioids • Components of multimodal analgesia	• Potent analgesic agents • Side effects on respiratory depression can usually be avoided by careful titration of the dose against effect	• No loss of consciousness[a] • Relative weak anesthetic effect no muscle relaxant effects[a] • No respiratory depression[a] • No cardiovasculair depression[b] • Potent analgesic agent[b]
Disadvantage		• Inadequate as sole agent in severe acute pain • Significant adverse effects • Side effects can also occur by use of single doses • Limited availability of agents for IM or IV route	Equi analgesic doses tramadol : morfine = 10:1	• Risk of respiratory depression • Intranasal administration of opioids, without IV access • May be unable to treat cardiovascular side effects	• Administer with scavenging mask, to prevent side effects for caregivers[a] • Anaesthetic agent requires specialized knowledge and training of health care providers before administration [b]

Overview of pharmacological treatment options is based on Macintyre PE et al.[27]

[a] characteristics of Nitrous oxide/oxygen mixture 50%/50%,

[b] characteristics of (Es)ketamine,

[c] Weimann J. Toxicity of nitrous oxide. Best Pract Res Clin Anaesthesiol. 2003;17(1):47-61.

Effectiveness of analgesic agents

Paracetamol (= acetaminophen)
Single doses of paracetamol were effective in the treatment of mild to moderate acute pain, whereas the incidence of side effects were comparable to placebo (ANZCA ICSI,NVA).

NSAIDs
NSAIDs (single doses) were effective in the treatment of pain after surgery and low back pain for patients with mild to moderate (trauma) pain (ANZCA, NVA). There was no evidence that one NSAID agent was more effective than another. Adjuvant administration of paracetamol in combination with NSAIDs increased the analgesic effect (ANZCA, ICSI, NVA). Severe postoperative pain could not be effectively treated with single doses of NSAIDs.

Weak opioids
For the group of weak opioids, evidence of codeine as an effective agent when administered as a single dose treatment was conflicting, although a combined treatment of codeine with paracetamol was considered to be effective (ANZCA, NVA). On the other hand, tramadol proved to be effective as a single doses treatment in moderate pain (ANZCA). Tramadol in combination with paracetamol was more effective than either one of the two administered agents alone (ANZCA).

Strong opioids
For the treatment of severe acute pain single doses of morphine and fentanyl proved to be effective (ANZCA, ICSI). One opioid was not superior to another regarding effectiveness, although there can be an interindividual difference in some patients (ANZCA). Intravenous titration of (relatively) high doses of opioids, frequently led to the best improvement in cases of severe pain (ANZCA). In adults, patient age rather than weight was considered to be a better predictor of opioid requirements, although there was a large interpatient variation (ANZCA, NVA). Adjuvant administration of paracetamol in combination with opioids significantly reduced the opioid requirements by 20 to 30% (ICSI, NVA). This was also described for NSAIDs (ANZCA, NVA).

Adjuvant / other analgesic drugs
Of the adjuvant drugs, nitrous oxide was proven to have some effect (ANZCA) when it was administered as an inhalation agent for procedural sedation and

analgesia. Ketamine appears to improve analgesia in patients with severe acute pain who poorly responsed to opioids, although evidence was conflicting (ANZCA). In the ED, ketamine used to treat severe trauma pain had a significant morphine-sparing effect without a change in pain scores (ANZCA).

While most guidelines described and recommended the use of paracetamol, NSAIDs and (weak) opioids according to the analgesic ladder of the World Health Organization (WHO),[46] the guideline on procedural sedation (ACEP) mainly described the use of opioids and adjuvant drugs by the intravenous route or inhalation. This was related to the specific aim of this guideline, namely to diminish the level of consciousness of the patient in order to provide optimal pain relief during emergency procedures.

The RNAO guideline explicitly described recommendations for the nursing profession regarding pain treatment and did not specify the pharmacological properties of the analgesic drugs.

In total 371 recommendations on pharmacological pain management, adverse events and route of administration were potentially applicable to emergency medicine. Specific recommendations on nurse or paramedic initiated pharmacological pain treatment were not found.

Non-pharmacological pain treatment

Four guidelines (ANZCA, ICSI, RNAO, VHA) described recommendations on non-pharmacological pain treatment, that included patient education, relaxation and attention strategies, massage therapy, and cold packs or ice. Evidence for benefits from local cooling with cold packs or ice were mixed, while some studies described significant reductions in opioid consumption and pain scores, other studies did not show these reductions (ANZCA).

The ANZCA, ICSI and RNAO guidelines illustrated the importance of elevation and splintage for injuries specifically for trauma patients, and also in the setting of the ED (ANZCA). Furthermore, information on the cause of pain and its likely outcome was described to diminish anxiety (ANZCA). Psychological techniques such as imagery or hypnosis (ANZCA, ICSI) could also be of value in the ED. In general, the non-pharmacological approaches had lower grades of evidence supporting the recommendations.

Major outcome of the intervention

All the guidelines mentioned pain relief and evaluation of pain treatment as major outcomes. Five guidelines (ACEP, ANZCA, ICSI, NVA, RNAO) reported outcome measures on patient safety and adverse effects of medication. The ANZCA guideline described multiple outcome measures related to the complexity of the pain experience itself and mentioned physical functioning disability scales, quality of life measurements and emotional functioning as outcome measurements. Finally, the RNAO guideline mentioned specific outcome measures on patient satisfaction with pain management.

Implementation/dissemination and organizational aspects

Four guidelines (ANZCA, ICSI, NVA, RNAO) reported on implementation strategies or materials. The ANZCA guideline advised dissemination through an independent organization, namely the National Health and Medical Research Council of Australia, where all working parties in the national health service (including the government and consumers) are brought together. The NVA guideline provided general recommendations for implementation, while the ICSI guideline presented implementation tools for quality measurement such as clinical algorithms, pocket guides and reference cards. A specific toolkit for implementation was added to the RNAO guideline. The other guidelines did not provide implementation tools.

Pain management organization was addressed in three out of six guidelines (ANZCA, NVA, RNAO). Their focus varied from general requirements (ANZCA) and policy recommendations (RNAO), to the organization of the acute pain service (ANZCA, NVA). The last service is applicable to hospital based EMS with a large number of ED visits.

Discussion and conclusion

Summary of findings

This systematic review resulted in six evidence-based guidelines that could be (strongly) recommended, according to the AGREE instrument, for use in the early and initial pain management in trauma patients. Based on our hypothesis that the pathophysiology of acute pain in trauma is comparable to pain in surgery and "controlled" tissue damage, these guidelines contained 711 recommendations of which 501 are potentially applicable in emergency medicine.

Analysis showed a wide variety of general characteristics and the content of guidelines was diverse, due to their different focuses and frameworks. Five guidelines advised the assessment of pain using self reporting by patients. Although evidence is lacking that this is the best approach, most guidelines advised the use of the WHO analgesic ladder[46] for the choice of analgesics. In general, studies regarding the effectiveness of analgesics did not compare effectiveness of agents between the different analgesic groups. The recommendations on pain management with analgesics had a higher level of evidence compared to the smaller number of recommendations on non-pharmacological treatments e.g., patient education, relaxation and attention strategies, massage therapy and cold packs or ice. Advice on implementation and dissemination tools, and recommendations on organizational aspects were retrieved and summarized. There were few recommendations on acute pain management in trauma patients in prehospital emergency medicine.

Limitations

Our study has several (methodological) limitations. First, only two guidelines are 'strongly recommended' and four guidelines are 'recommended' based on the overall scores of the AGREE assessment. One could dispute the validity and reliability of the interpretation of the overall scores according to the AGREE manual.[25] The manual broadly defines the cut off points on 'recommended' and 'strongly recommended' classifications, thus giving room for individual interpretation.[47] Another difficulty with the overall interpretation is that all AGREE domains receive an equal weight, while some domains are covered by seven items (methodological quality) and others by two items (editorial independence). Harpole et al. also discuss a lack of rules to assist the weighting of the AGREE domains.[48] Although domain scores may be useful for comparing guidelines, some authors argue that in their opinion it is impractical to set limits for the domains of AGREE to mark a 'good' or 'bad' guideline.[49]

Another limitation of the critical appraisal of the quality of the development process of guidelines by AGREE is that this process is not as objective as it might seem.[50] In our study, we found that the assessment of the first guideline with the AGREE instrument influenced our critical appraisal of the second guideline, since unintentionally and inevitably comparisons were made between guidelines thereafter.

A final limitation of this review is that we have identified potentially relevant recommendations on pain management, implementation and organization, but did not verify the accuracy of the underpinning evidence. We did not compare the evidence levels between guidelines. This in-depth methodological content analysis was considered to be the first step of a future study: the development

of a tailored guideline for pain management in trauma patients in emergency medicine, taking into account that guideline groups use different systems to grade the recommendations and levels of evidence.[51-54]

A major point of criticism of our analysis is that our assumption that acute postoperative pain and acute pain in trauma are comparable from the biomedical point of view. Pain is a subjective experience with various (sensory, affective, cognitive) dimensions and the direct relationship to the amount of tissue damage and pain severity is variable at best.[22] Due to the presence of psychological aspects such as anxiety or stress there is an inherent difference between acute traumatic and "planned" postoperative pain. This was not taken into account in this review. As a consequence, we suggest that adequate anxiety reduction in both circumstances should be an inevitable component of pain treatment. From this (balanced biological and psychological) perspective, an additional literature review on anxiety reducing interventions in trauma patients can be recommended for the development of a tailored guideline.

The use of NSAIDs in early and initial pain management in trauma patients can be discussed, although the guidelines described NSAIDs as potent analgesic agents for relief of moderate pain. Although many analgesic techniques that work in hospital environments have been transcribed to the prehospital environment, these do not always comply with the ideal of simplicity, safety and effectiveness when used in the field.[27] The extensive list of contra-indications and side effects of NSAIDs could complicate the applicability of these agents in (pre)hospital emergency conditions. When there is little time for appropriate assessment, and in patients with (presumed) hypovolemia the administration of NSAIDs may be contra-indicated. Conflicts may arise between providing patient comfort by timely pain management and patient safety due to the possible adverse effects of the analgesics. Therefore, prehospital based use of NSAIDs by paramedics for early and initial pain treatment in trauma patients does not seem advisable.

Most guidelines recommend the use of the WHO analgesic ladder as a flowchart for the administration of pharmacological treatment although this instrument was originally developed for the treatment of pain in cancer patients in developing countries.[46] Besides the severity of pain, the (potential) injuries and the patient preferences, the best (reliable and safe) route for administration of analgesia should be considered in the choice of analgesic, for example in patients with presumed hypovolemia.

We suggest that the WHO analgesic ladder could also be used in reverse i.e., 'stepping down' by starting with opioids / or adjuvant drugs, followed by paracetamol etc. in cases of severe pain. This might be more useful in these situations.

Conclusion

At present there is no 'single best' evidence-based guideline on acute pain management in trauma care. The six guidelines may provide the "building blocks" for the development of a tailored guideline on pain management in trauma patients in emergency medicine. This review found a broad range of recommendations on pain management that are potentially useful for improving early and initial treatment of acute pain in trauma patients in emergency medicine. In a future review we aim to search for specific evidence regarding (pre) hospital pain assessment, management, anxiety reduction and nurse initiated pain management under emergency conditions.

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chapter 7

Guideline 'Pain management in trauma patients in the chain of emergency care'

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Abstract

Background
Pain management for trauma patients is a neglected aspect in the chain of emergency care in general practices, ambulance services, mobile medical trauma teams and in hospital emergency departments.

Objective
The aim of the guideline 'Pain management for trauma patients in the chain of emergency care' is to provide pain management recommendations for trauma patients in the chain of emergency care and thereby improve the assistance that patients receive.

Methods
A multidisciplinary working group, consisting of representatives from 13 professional (scientific) organizations, developed key questions and recommendations according to evidence-based principles.

Results
Paracetamol is the treatment of first choice, if necessary with additional use of NSAIDs or opioids; NSAIDs can be administered in the absence of contra-indications, but should be avoided in cases where the patient history is unknown; fentanyl and morphine can be given for severe pain during emergency care, esketamine can be considered in patients with severe pain and hypovolemia.

The guideline contains 3 algorithms for measuring pain and for its pharmacological treatment in the chain of emergency care.

Implementation of the algorithms requires an alternative working procedure; pain scores must be documented, and general practitioners and nursing staff may administer opioids intravenously.

Introduction

Pain in trauma patients is undertreated in the chain of emergency care. Trauma patients suffer from an acute (potential) injury due to an accident, violence or self-mutilation, sometimes without visual tissue damage. Injuries due to trauma are a frequent occurrence in the chain of emergency care. In the Netherlands, 870,000 trauma patients receive injury treatment at the emergency department (ED) every year, and 231,293 trauma patients (with urgency code A1 and A2) are treated by ambulance Emergency Medical Services (EMS) every year. Approximately half of all the emergency flights of the Helicopter Emergency Medical Services (HEMS) concern trauma patients. In the Netherlands, the number of trauma patients with emergency complaints that were seen by a general practitioner (cooperatives) (GP(C)) every year is unknown.

Pain, and especially severe or long-lasting pain, can have an adverse effect on the outcome of the treatment, and leads to a delay in wound healing and a longer period of recovery. It can also increase anxiety, cause sleeping problems and lead to a loss of control. Inadequately treated pain causes a lower pain threshold in future pain experiences. Patients with minor traumas report continued moderate pain after discharge of the ED, which leads them to frequently visit a GP(C). 63 Percent of poly trauma patients reports chronic pain one year after the occurrence of trauma.

Several Dutch studies indicated that emergency care professionals recognize pain insufficiently, and therefore treat pain inadequately. Other barriers are beginning pain assessment (too) late, professional procedures which are not evidence-based, and the absence of pain protocols in nearly half of all the EDs. Pain management in the chain of emergency care, consisting of GP(C), ambulance EMS, HEMS and the ED, does not connect well to one another. To summarize, one commonly shared standard for early and initial pain management in trauma patients in the chain of emergency care is lacking. The development of a guideline for pain management for this patient group in the chain of emergency care is an important vehicle to improve clinical practice.

Aim

This article discusses the development of the guideline, the pharmacological recommendations, and two algorithms for early and initial pain management in adult and evaluable trauma patients in the chain of emergency care. The intended users of this guideline are all professionals involved in trauma care in the chain of emergency care.

Guideline development

The guideline was developed by a multidisciplinary working group, with authorized delegates from thirteen national (scientific) professional organizations. The working group used the guideline for guideline development of the Dutch Council for the Quality of Healthcare, and was methodologically supported by the Dutch Institute for Healthcare Improvement (CBO in Dutch) and the Netherlands Centre for Excellence in Nursing (LEVV in Dutch). On the basis of a systematic review, consultation of professionals in the field and a Delphi method, we formulated five key questions that were answered in the guideline (Table 7.1). A Delphi method is a structured communication technique, where experts answer questionnaires in two or more rounds on a on a specific topic. By providing an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments, ultimately the process results in consensus on the topic.

We searched relevant articles in PubMed, CINAHL and Embase, and of the 1,843 unique publications, 71 articles were eventually included. Assuming that acute postoperative pain is comparable to pain related to trauma, we used scientific evidence out of four guidelines on acute pain management under the headings 'further considerations'.

In the final phase of the development, we presented the guideline to experts of the professional organizations for feedback.

Table 7.1 Key questions for the guideline

Key questions for the guideline 'Pain management in trauma patients in the chain of Emergency care'
1. What is the most reliable, valid and useful method for pain measurement?
2. To what extent are different procedures required in pain management for patients with anxiety or stress, under the influence of alcohol or drugs, or based on factors such as ethnicity, sex or age?
3. Which nonpharmacological treatment options are effective?
4. Which pharmacological treatment options are effective?
5. How should pain management be organized within the chain of emergency care and what are necessary conditions regarding communication?

We developed 81 recommendations on early and initial pain management in the chain of emergency care. These recommendations have been summarized and underpinned and described per chapter, based on the key questions of the guideline. The multidisciplinary working group selected nine key recommendations and developed accompanying indicators (see example, Table 7.2).

Table 7.2 Key recommendation and indicator of paracetamol

Key recommendation	Administering of paracetamol
Description	Paracetamol is the agent of first choice for the treatment of acute pain within all organizations in the chain of emergency care
Type of indicator	Process
Numerator	Number of trauma patients receiving paracetamol
Denominator	Number of trauma patients with an initial pain score ≥4

The methodological institutions CBO and LEVV critically appraised the guideline development based on the Appraisal of Guidelines Research and Evaluation (AGREE) criteria and have recommended the guideline. V&VN Dutch Nurses Association legitimated the guideline for the nursing profession.

Pharmacological pain treatment

Most of the articles we found described pharmacological pain treatment. There are but a few articles that compare drugs with each other regarding their effectiveness, and research was mostly performed within a part of the chain of care, for example in ambulance EMS or at the ED.

Paracetamol

Although we only found one article on the use of paracetamol in the ED, we did find a lot of evidence on the safety and effectiveness of paracetamol in (postoperative) acute pain management. On the basis of these considerations, the working group is of the opinion that paracetamol is the agent of first choice in the treatment of moderate and severe pain for all organizations in the chain of emergency care. Due to the shown opioid sparing effect, paracetamol is recommended intravenously in case of severe pain, with additional opioids or other drugs.

Non Steroid Anti Inflammatory Drugs (NSAIDs)

Several articles describe the effectiveness of NSAIDs in oral, gel or intravenous applications. When there are no contraindications for the use of NSAIDs and partially based on the literature in the guidelines on acute pain, the working group recommends using NSAIDs in case of moderate pain (preferably diclofenac

or ibuprofen). However, when the patient history is unknown, as is the case in the prehospital emergency care of ambulance EMS and HEMS, the use of NSAIDs is not recommended.

Opioids

In the literature, the use of opioids has been described for both prehospital emergency care and the ED. Fentanyl and morphine are effective for the treatment of severe pain in emergency care. The working group advises to administer the opioids intravenously, and to titrate the drug in order to monitor (adverse) effects. Fentanyl is the agent of first choice for the treatment of moderate to severe pain in prehospital emergency care (including the GP(C)), when an effective and short-time working drug is needed. Fentanyl is contraindicated in case of hypovolemia, or when the airway or breathing cannot be supported or secured.

Other drugs

As the literature showed mixed results on the effectiveness of entonox®, the working group formulated no conclusions on the effectiveness of this agent, which is used in the current national ambulance EMS analgesia protocol for pain management in trauma patients in ambulance emergency care.

Likewise, on the basis of the literature, we could not formulate conclusions on the effectiveness of esketamine for initial pain management. Even so, the effectiveness of esketamine is shown in case of procedural sedation and analgesia. However, procedural sedation and analgesia by non anaesthesiologists has been described in a different Dutch guideline. On the basis of 'further considerations', the working group is of the opinion that administering esketamine can be considered in case of severe pain in combination with hypovolemia.

Algorithms for use in (prehospital) practice

The working group developed three algorithms for the measurement and pharmacological treatment of pain in the chain of emergency care. The algorithms for the use in GP(C) and the ED, as well as the ambulance EMS are shown in figures 7.1 and 7.2. The algorithm for pain management by the HEMS includes both initial and advanced pain treatment. Although the sequence of actions of ambulance EMS providers and HEMS members is similar, the dosage of medications administered by HEMS members is higher.

Figure 7.1 Algorithm for pharmacological pain management in ambulance EMS

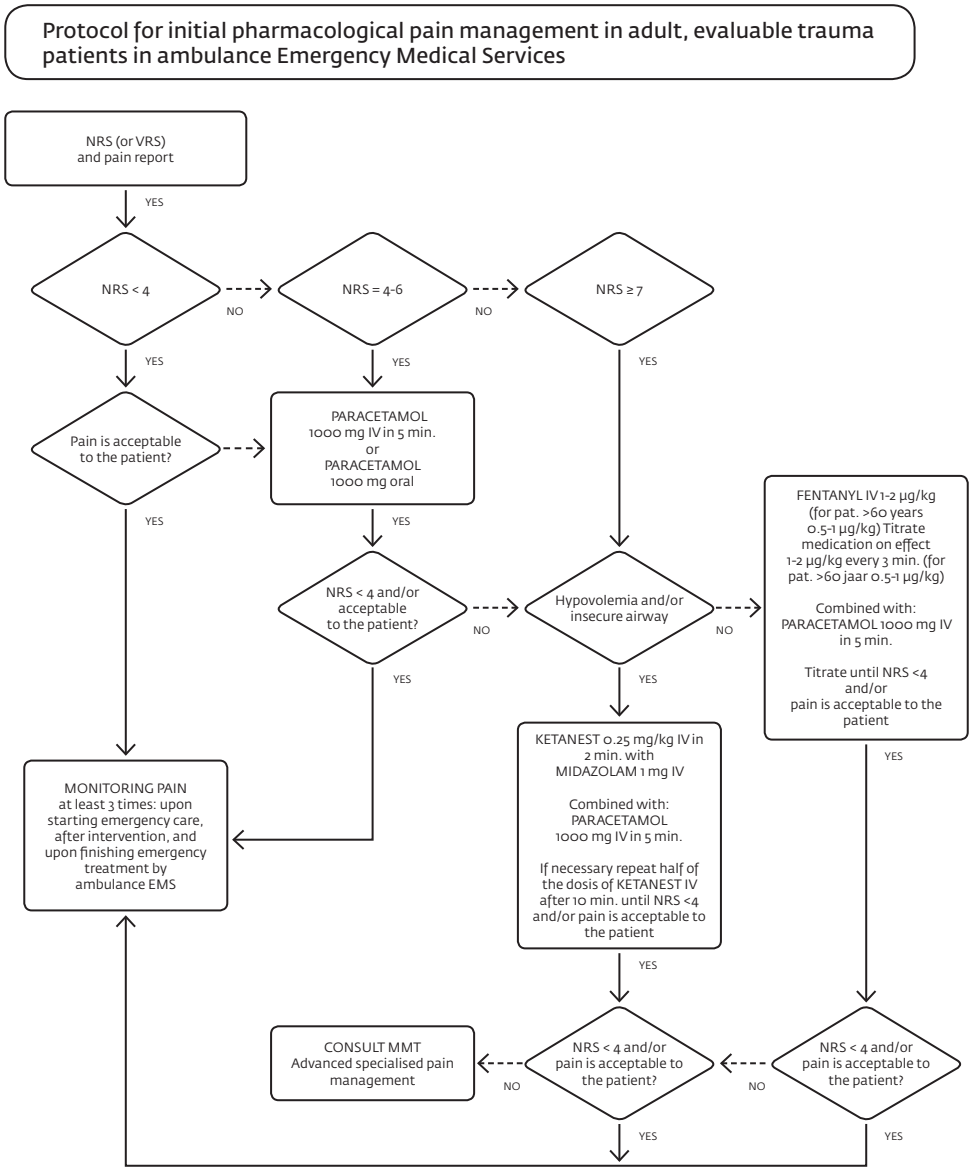
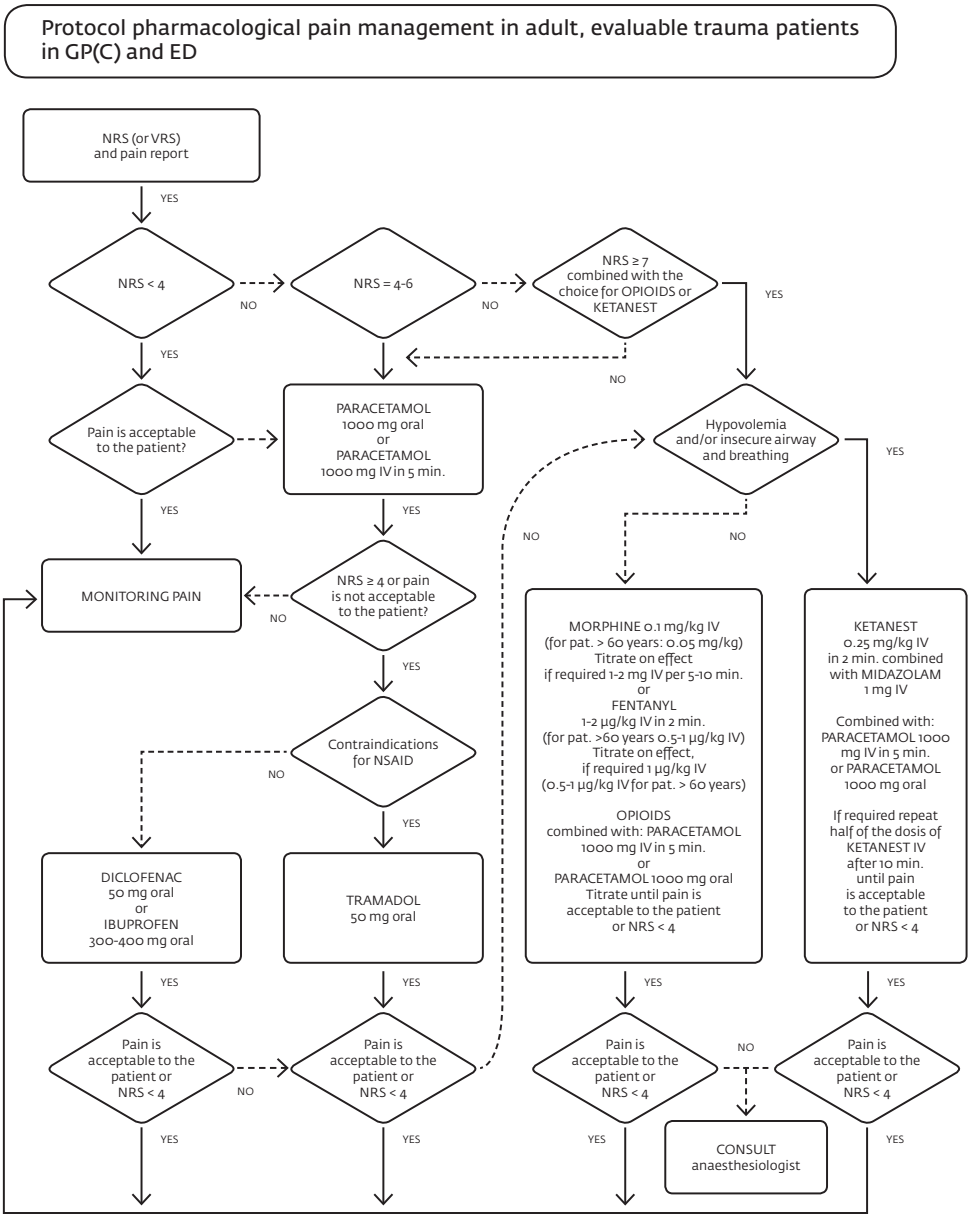


Figure 7.2 Algorithm for pharmacological pain management in GP(C) and ED



Two regional ambulance EMS and three EDs tested the utility of the algorithms in prehospital and clinical practice. The algorithms proved to be effective, but the advice to administer paracetamol in case of severe pain, before titration of opioids or esketamine, turned out not to be effective. The algorithm was adjusted with a combined administering of paracetamol and opioids or esketamine, in line with the recommendations from the guideline. A test of the utility of these algorithms by GPC and HEMS has been planned.

Discussion

Limitations

The guideline has been developed for adult and evaluable trauma patients, which means that pain in other patient groups in emergency care, such as children, patients with acute abdominal pain, and unconscious (trauma) patients, is not addressed. We recommend developing evidence-based guidelines for these patient groups in emergency care as well. Another point at issue is that the indicators of the guideline have not been tested yet, because this did not lie within the range of the guideline development process. It is advisable to further study the utility and reliability of the developed indicators, and to study their sensibility for the measurement of a change in pain management in the chain of emergency care.

We found only a few studies on pharmacological pain management in the chain of emergency care with a robust study design. Additional search strategies did not result in more studies that could be included. In addition, we used evidence from acute pain guidelines that were qualitatively well developed under the headings 'further recommendations'.

Implementation

The new algorithms for pain management (see figures) lead to an important change in the current operating procedures of GP(C)s, HEMS, ambulance EMS and EDs, who are not working with a pain protocol at the moment. The structural measurement and registration of a pain score is not yet a standard procedure in all organizations of the chain. Also, the intravenous route for administering opioids by GP(C) providers and emergency nurses has not yet been widely established. In the pilot test and the expert round for feedback, nurses and physicians report their need to be educated in this area.

In ambulance EMS the combined use of analgesia is not common practice at all. Although paramedics are motivated to give additional paracetamol, they report that it is difficult for them not to be able to evaluate its (long-term) effect. From the pilot test we also received tips for implementation, such as the development of a digital education programme, adaption of the registration regarding pain management for motor ambulance EMS, and the insertion of pain management in the handover towards the ED.

If adequately implemented, a guideline can be an important vehicle for the improvement of current practice. A previous study on facilitators and barriers in pain management in ambulance EMS and the ED showed the following implementation issues: knowledge deficits regarding adequate pain management, attitude problems, organizational aspects and the development of nationally authorized protocols.

Implementation of the guideline in the chain of emergency care requires specific strategies. Early and initial pain management in the ED is receiving more attention these days, due to the prioritizing of pain management by the national Safety Management System (VMS in Dutch) and The Health Care Inspectorate (IGZ in Dutch). Still, pain does not yet serve as an indicator for the quality of care in prehospital emergency care. Also, professionals do not prioritize pain management during injury treatment. The guideline aims at achieving a shared evidence-based approach, but this also requires a change in the behaviour of professionals. In order to facilitate the implementation of the guideline, further study on facilitators and barriers on guideline compliance and guideline implementation is recommended.

Conclusion

The guideline provides clear recommendations for early and initial pain management in adult, evaluable trauma patients in the chain of emergency care, based on actual knowledge and insights. The trauma patient needs to benefit from this.

This guideline has made the improvement of pain management possible. However, improvement of prehospital and clinical practice requires a change of behaviour: therefore, control and feedback mechanisms, as well as indicators can be helpful tools.

Availability of the guideline

The guideline can be downloaded from the website of the CBO http://www.cbo.nl/Downloads/1307/Richtlijn%20Pijnbehandeling%20bij%20traumapatienten%20in%20de%20spoedzorgketen.pdf.[1]

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Reference

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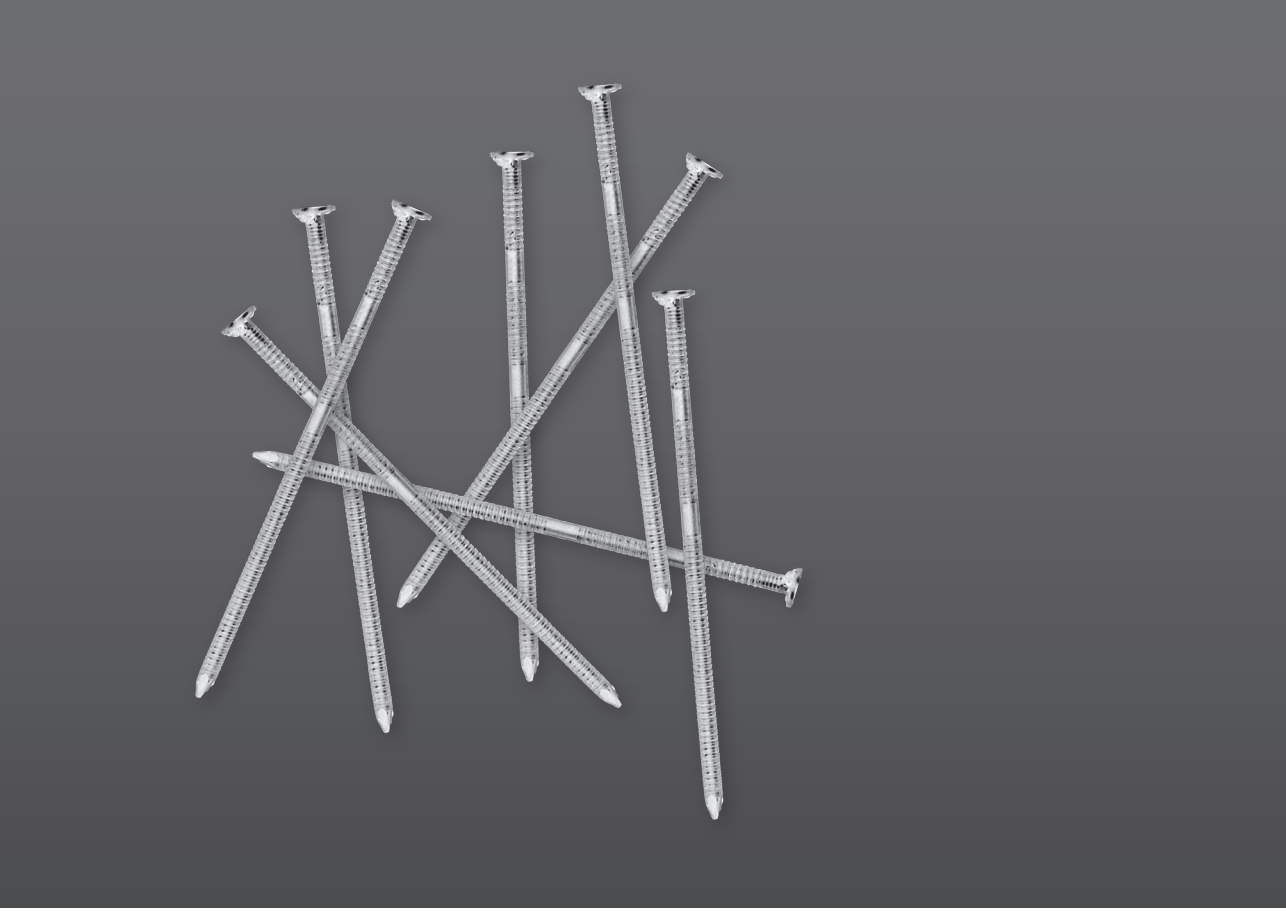

chapter 8

General discussion

Introduction

In the introduction to this thesis we described the importance of early and initial pain management in trauma patients in prehospital Emergency Medical Services (EMS) and the emergency department (ED). Our studies gave insight into the prevalence of pain and current pain management for these patients in the Netherlands. Furthermore, we gained knowledge on the effect of the implementation of the Manchester Triage System (MTS) and which facilitators and barriers were present regarding pain management in trauma patients in emergency care. Finally, we developed recommendations on the state of the art of the performance of pain management in the chain of emergency care.

In this general discussion we will put our findings in the perspective of current knowledge, and further elaborate on conceptual and methodological issues concerning the patients' perspective of pain, the chain of emergency care and the implementation of the guideline on pain management in emergency care. Finally, we draw our main conclusions, describe the implications for clinical practice and education, and formulate recommendations for future research.

Discussion of the main findings

Prevalence

Current literature describes the prevalence of pain in the general emergency care populations and subgroups of trauma patients in emergency care (for example for patients with long bone fractures). In chapter 2 and 3 we reported on the prevalence of pain in trauma patients and showed that this prevalence was higher in trauma patients than in other patients in emergency care.[1-4] The results of chapter 2 are not conclusive on the identified prevalence rate: possibly, the actual prevalence of pain in trauma patients in prehospital EMS is even higher than had been identified, as pain was not reported by paramedics for 27% of the trauma patients in our EMS study.

Current pain assessment, pain management and pain relief

The study on current pain management in prehospital EMS in the Netherlands showed a lack of systematic and validated pain assessment (chapter 2). This was in accordance with findings of other international studies on pain management in prehospital EMS.[2,5,6] Paramedics in our study administered more analgesics

to trauma patients than had been reported in previous studies in ambulance EMS.[7-10] Furthermore, we provided some insight into nonpharmacological pain management. The EMS study showed that pain relief could only be evaluated in a small patient group, because the effect of pain treatment was not systematically measured. Although paramedics in the Netherlands have more legally supported responsibilities for adequate pain treatment than colleagues in other countries, adequate pain relief in our study was only reported in a small group of trauma patients.

For the ED, insight into pain assessment by emergency nurses and physicians could not be identified (chapter 3 and 4), because pain measurements in the studies of chapter 3 and 4 were carried out by our research team. Other studies on pain in a general ED population showed that pain was underassessed in the ED.[11-15] Van der Wulp et al. illustrated that for 86% of patient presentations in Dutch EDs, pain should have been assessed, while it actually was assessed in only 32 % of these patients.[16] Also, our study on barriers and facilitators (chapter 5) showed that ED staff did not regularly measure pain using validated instruments, such as a visual analogue scale (VAS) or a numeric rating scale (NRS). In contrast to our findings in prehospital EMS, trauma patients in the ED (chapter 3) received a rather limited amount of analgesics. This finding was confirmed by other international studies in the ED.[14,17-19] From the perspective of a multimodal approach to pain management (an approach that affects different dimensions of pain), the nonpharmacological interventions in emergency care need to be studied more in-depth, for instance with a more qualitative approach. Pain relief in the ED was only present in a third of the patients. Remarkably, we noticed a new finding: a small group of patients left the ED with a higher pain intensity than they had on admittance.

In general, we showed that inadequate pain relief was an important and frequent problem in emergency care in the Netherlands. Furthermore, it raised the following question: "what facilitated or hindered pain management in the chain of emergency care?"

Facilitators and barriers in pain management

One of the facilitators of pain management in the ED was supposed to be the implementation of systematic triage by the MTS (chapter 4). The MTS system requires a mandatory pain assessment with the 'MTS pain ruler' for all trauma patients, with the exception of trauma patients with unstable vital signs. Although our study only included evaluable and alert trauma patients, we found inconclusive results on the improvement of pain management and no statistically significant difference in pain relief after the implementation of MTS. In line with

our findings, another study on MTS and pain assessment showed that pain assessments at triage with MTS were conducted infrequently.[16] A possibly related problem regarding pain assessment with the MTS pain ruler is that the instrument used has only been validated for paediatric patients and not for adults.[20] Because the outcome on the severity of pain is intertwined with the assignment of the level of urgency, nurses frequently overrule the patients' perspective on pain (chapter 5).[16] However, a study on other triage systems and the waiting time to receive analgesia also showed that all studied EDs (n=20 Canadian and American EDs) and the two systems (Canadian Triage and Acuity Scale and the Emergency Severity Index) demonstrated unacceptably long times to analgesic provision. Many patients with moderate to severe pain received no analgesic during their ED stay.[21] Since we found no relationship between the implementation of MTS and an improvement of pain relief in trauma patients in the ED, this raised the following question: "which factors facilitate or hinder pain management in emergency care?"

Our study on barriers and facilitators in pain management in trauma patients in emergency care (chapter 5) showed five concepts that influenced adequate pain management: knowledge, attitude, professional communication, organizational aspects and patient input. Professional and organizational feedback as strategies for the improvement of pain management in emergency care had not been described previously in the literature. The organizational aspects we found were specifically related to the different organizational structures of the prehospital EMS and the ED in the Netherlands. Other facilitators, such as a protocol that enhances pain management,[22,23] and barriers, such as knowledge deficits,[24] problems in the attitude of professionals,[25] overcrowded EDs,[26] and patients refusing pain medication despite prescription,[27,28] had been previously mentioned in the literature and confirmed our results. Although we identified facilitators and barriers in general, we did not identify the impact of these aspects in clinical practice, due to the qualitative study design. Therefore, this aspect needs further study.

Guideline development on initial acute pain management

After we identified factors that hindered or facilitated pain management in trauma patients, we decided to develop a national guideline to improve pain management for this patient group in emergency care.

Since there was a paucity of studies on acute traumatic pain, we hypothesized that pain in trauma patients was comparable to the more elective postoperative acute pain, from a bio-somatic point of view. We could not find literature on the differences and similarities between postoperative and trauma pain, and we think

it would be relevant to study these concepts and their relationship more in-depth in order to improve the multimodal pain management approach (an approach that affects different dimensions of pain) in emergency care. As a result the aspect of fear and anxiety, frequently associated with the unexpected occurrence of trauma, could not be taken into consideration in our studies.

If pain in trauma and postoperative pain are comparable, as we suggested in chapter 5, other findings from the postoperative literature could also be adapted and studied in emergency care. So far, we only studied initial pain management.

We developed a national guideline for the management of pain in trauma patients in the chain of care. The literature review, performed to address the key questions of the guideline, showed a limited amount of studies of good methodological quality on the (non)pharmacological management of pain in emergency care. Therefore, the recommendations of guidelines on acute pain and expert opinions were additionally used to develop a guideline for the management of acute traumatic pain.

As the guideline has been developed for the situation in the Netherlands, this could be a limitation for its international use. However, this is the first evidence-based guideline on pain management in trauma patients in emergency care, and provided many new insights. Issues that have not been addressed before were, for instance, the efficacy of alternative analgesics, and the efficiency and safety of innovative non-invasive routes of administration (e.g. as intranasal opioids) for adult patients. Also, the immediate effect of cooling on acute pain in patients with soft tissue injuries was not studied in the emergency literature. It showed to have an effect on the reduction of the swelling only. Consequently, these issues need to be studied in the future to further improve evidence-based pain management in emergency care.

Conceptual and methodological considerations

Patients' perspective of pain

In this thesis we used the IASP (International Association for the Study of Pain) definition of pain as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage'.[29] 'Pain is whatever the experiencing person says it is, existing whenever the experiencing person say it does' (McCaffery and Beebe) is another perspective that

we used in our studies.[30] Both definitions point to the fact that pain is much more than tissue damage triggering a response from the nervous system. We chose the patients' perspective as the only valid determination of its intensity and presence.

In our view, it is incorrect to adapt the patients' pain score to a lower level, when professionals think that patients are exaggerating their experience. On the other hand, in current ED practice where MTS triage is used, triage nurses frequently 'correct' higher pain scores to a lower level, because these lower pain scores correlate better with the assigned urgency level of injury treatment based on the clinical presentation of the patient (chapter 4 and 5).[16] One could question the arguments of the triage nurse concerning this decision,[31] and whether this decision respects the patients' perspective of pain.[32] Furthermore, it is debatable whether logistic factors, such as dealing with a lack of clarity in the MTS guidelines[16] or an error in the building blocks of the triage system, lead to these decisions. Or, do individual human factors, such as attitude and personal beliefs, play a part in these decision making processes?[25,32] We suggest that the conceptual link between the measurement of pain and the systematic assignment of the level of urgency by MTS should be detached, in order to obtain validated pain scores based on the patients' perspective.

The outcome of pain measurement based on a patient's own report on pain is difficult to interpret for professionals. Since there is no direct relation between the amount of tissue damage and reported pain intensity, a pain score of eight does not mean comparable tissue loss. The emergency care professional needs to identify a (potential) need for pain treatment depending on the height of the reported pain intensity. Furthermore, individual pain scores are necessary for the evaluation of the effect of the pain management.

Pain, seen from the patient's perspective, is an individual and relative concept. One could question whether it is appropriate to make calculations with the outcomes on pain measurements as if they represent absolute values. We felt that it was appropriate and important to provide an overview of pain perception and pain relief in trauma patients in subgroups and at a population level, in order to identify gaps in current practice or to measure (side) effects of implemented interventions. Therefore, we used the relative pain scores of the individual trauma patients to identify trends in their group (chapter 2–4).

Chain of emergency care

Although most chapters in this thesis focus on pain management in ambulance EMS and the ED, the chain of emergency care in the Netherlands is defined more

broadly,[33] also including the general practitioner (GP) and the GP cooperative services (GPC), which provide out-of-hours primary care.[34] Self-referred patients with emergency complaints can either visit the GP(C) or the ED.[35] In the prehospital field, the Helicopter Emergency Medical Services (HEMS) also provide early, initial and advanced pain management in trauma patients. In fact, early and advanced pain management is one of the criteria to call for HEMS assistance in case of an accident.[36]

General insight into the prevalence of pain and pain relief in the group of adult trauma patients in GP(C) and the HEMS is lacking. Only HEMS support on paediatric pain management[37] or pain management with fentanyl for trauma patients treated by the HEMS were described.[38,39] For the GP(C) we assume that the prevalence of pain in patients suffering minor trauma is comparable to the prevalence of pain measured in the ED, although it is likely that a selection bias for these patients exists.

Possibly, patients with minor traumas visiting the GP(C) have a lower mean severity of injury compared to patients with minor trauma who visit the ED, assuming that the GP(C) group includes more patients with contusions and distortions, and less with fractures. In order to gain insight into current practice and to evaluate future improvements in pain management and pain relief, further study in the field of GP and HEMS care seems advisable.

Coordination and continuity of trauma care requires an adequate communication and information flow.[40,41] In the Netherlands, management of trauma pain is not a mandatory aspect of a standardized handover in the chain of emergency care between the GP(C) and the paramedic, GP(C) and the ED, or paramedics and trauma team in the ED. Even so, the HEMS team frequently questions the paramedics on whether they provided adequate pain management. Vital patient problems are considered more important than a written handover. This problem has also been identified for other patient groups in emergency care, such as patients with chest pain.[42]

For ambulance EMS, HEMS and the ED, the MIST methodology (Mechanism of Injury, Injuries observed, Signs and symptoms, Treatment given) is generally accepted and widely used as a uniform concept for communication on emergency trauma care.[43,44] GPs, on the other hand, use their own 'SOAP' approach (Subjective data; Objective data; Assessment, Plan for patient management).[45] In the MIST methodology, there is currently no room for the assessment, treatment and evaluation of pain. We therefore suggest that pain could be added as the fifth vital sign to the 'T' of treatment given, as this could improve communication and information on pain management in the chain of emergency care.

Due to improved insight into the importance of pain management in the chain of emergency care, our last study was no longer solely delineated to the prehospital ambulance EMS and the ED. The development of the guideline for the management of pain in trauma patients was focused on the chain of emergency care and also included the GP(C) and HEMS.

Implementation of the guideline

After the development of the guideline, a new and challenging task awaits us: the implementation of the guideline. Guidelines are not-self implementing, and especially multidisciplinary guidelines require tailored implementation strategies.[46] In the Netherlands, the Safety Management Programme provides recommendations for the implementation of pain management programmes within hospitals.[47]

Although many international studies reported undertreatment of pain in prehospital EMS and the ED, we have not found studies or best practices that used multifaceted strategies for the implementation of pain guidelines in the chain of emergency care. Because we did not study insight into specific barriers or facilitators related to pain management in GP(C) and HEMS care in chapter 5, an in-depth study on barriers and facilitators in the chain of emergency care, including new issues such as the guideline characteristics, the GP(C) and the HEMS seems advisable.

In this paragraph on implementation we would like to focus on the problems we already noticed in chapter 5. The various aspects and suggestions for improvement are described here.

Knowledge

The first concept that needs to be addressed by implementation strategies is knowledge. Education is a necessary strategy to improve pain management in emergency care, as professionals explicitly asked for it (chapter 5). However, we recommend using education as a part of other multifaceted interventions, as we know that education as a single strategy is not effective in the long run.[46,48,49] Furthermore, there is some evidence that small-scale and interactive education may be more effective than large-scale educational meetings, such as conferences.[50] In line with this finding, we are convinced that regional meetings in the emergency health care network can facilitate knowledge improvement. As the Dutch regional centres for trauma and acute care have the task to coordinate and improve quality in the chain of care, this educational task fits their purpose well.

Attitude

The study on barriers and facilitators showed many aspects related to a negative attitude towards pain management, such as doubts on the patient's honesty in reporting pain and reservations on the importance of evidence-based pain measurements and protocols. Therefore, we think that an important attitudinal shift is needed in emergency care. Attitude shifts can be moderated by changing perspectives of professionals and the use of role models, key figures and opinion leaders in emergency care. We involved role models from professional organizations in emergency care, early in the development of the guideline. Also, critical discussion of patient cases in interactive, multidisciplinary settings facilitates the change of the professional mind-set.

Professional communication

Incorporation of pain (management) as the fifth vital sign in the handover enhances professional communication on pain management. However, we realise that a change in handover and report also requires a change of behaviour of professionals. This should be incorporated in discussions on patient cases and best practices of pain management in emergency care. Professionals also mentioned feedback at the ambulance station and in the ED team as a strategy for the improvement of pain management.

Organizational aspects

The guideline provides evidence-based recommendations for organizational interventions. The (future) development and measurement of quality indicators for trauma patients in the chain of emergency care could probably provide a framework for the systematic measurement of adequate pain management and benchmarking. Pain is already an important indicator for patient safety and patient comfort in hospitals at a national and international level.[47,51] De Vos et al. showed that effective implementation strategies for quality indicators exist, although they found a considerable variation in used methods and the level of change achieved.[51] We recommend that it will also become an indicator for the quality of prehospital emergency care. Furthermore, the registration of reports on the indicators should be supported by ICT.

Another strategy for the implementation of the guideline could be the use of organizational feedback and reminders. Also, the use of protocols (which we provided based on the recommendations in the guideline) enhances adequate pain management. We tested the protocol in several (pre)hospital emergency practices on its utility for the field of emergency care, and based on the feedback

we made some practical changes to the protocol.

Patient input
Although professionals indicated that patient input could be an important facilitator for the improvement of pain management, it is difficult to develop patient mediated interventions for pain management in emergency care. However, we think that the emergency care professionals could play an important part in supporting the patient to provide an active input in (decision making) in pain management. For instance, improvement of lay knowledge on pain management by distributing patient information folders in the waiting room, could enhance the input of patients regarding pain management during injury treatment in the GP(C) and the ED.

Conclusion

The prevalence of pain in trauma patients in prehospital EMS and the ED is high. In the Netherlands, current pain management practices in ambulance EMS and the ED require important systematic improvements regarding standardized pain assessment, (non)pharmacological pain treatment and evaluation of pain relief.

A systematic triage, i.e. MTS, does not lead to an improvement in pain relief in trauma patients in the ED. Barriers and facilitators for the improvement of pain management in emergency care are the concepts of knowledge, attitude, professional communication, organisational aspects, and patient input. Strategies to improve pain management need to be tailored to the chain of emergency care and the multi-professional group of emergency care professionals.

Five guidelines on acute pain are (strongly) recommended for use in clinical practice, and provided building blocks for the development of a guideline for pain management in trauma patients in the chain of emergency care. The national evidence-based guideline on pain management in the chain of emergency care describes recommendations on the state of the art of the performance of pain management specifically for trauma patients in the chain of emergency care, based on the literature and on expert opinion.

On the basis of the findings of this thesis and the discussion we formulated

recommendations for emergency care practice, education and research.

Recommendations for emergency care practice

- Assess and treat pain as the fifth vital sign. We recommend adding the P-initial to the trauma methodology A-B-C-D leading to A-B-C-D-P (Airway, Breathing, Circulation, Disability and Pain). Furthermore, pain (management) should be included in the MIST methodology under the T of Treatment.
- Early and initial pain management in emergency care should be provided according to the evidence-based recommendations of the clinical guideline.
- Adequate pain management should become an indicator for the quality of care for all prehospital organizations involved in emergency care (GP(C), ambulance EMS, HEMS) rather than for hospital based emergency departments only.
- For the implementation of the clinical guideline in the chain of emergency care a multifaceted strategy needs to be developed including education, a shift in attitudes, organizational and professional feedback, organizational interventions and patient input.

Recommendations for education

- Early and initial pain management in emergency care should be included in bachelor, master and resident programmes for general practitioners, paramedics, HEMS teams, emergency nursing, trauma and emergency physicians and in the advanced specialist programmes for these professionals. In (inter)national courses like the TNCC® and ATLS®, attention should be paid to pain as an additional vital sign.
- Centres for trauma and acute care should be role models for professionals in order to improve the quality and continuity of pain management in emergency care.

Recommendations for research

- We recommend further study on pain prevalence and management in trauma patients in prehospital EMS, in GP(C),in HEMS care and the ED.
- We advise the study of the effects of (non)pharmacological pain management interventions, such as the efficacy and efficiency of different analgesics, including innovative non-invasive routes of administration, such as intranasal opioids for adult patients. Also, the immediate effect of cooling on acute pain as a primary outcome in patients with soft tissue injuries needs to be studied.
- We recommend studying the effect of adding pain as the fifth vital sign to the (digital) handover in the chain of emergency care on the improvement of pain

management and pain relief.

- We advise an in-depth study on barriers and facilitators in the chain of emergency care, which builds on our previous barriers and facilitators study and includes new issues such as identifying barriers and facilitators related to the guideline characteristics, the GP(C) and the HEMS. We advocate the development of a multifaceted implementation strategy and testing the implementation with these strategies in a cluster randomized trial.
- We recommend the study of pain management in emergency care for specific patient groups, such as patients with chest pain, children or patients with an acute onset of abdominal pain, because we assume that pain is a general problem for patients in emergency care.

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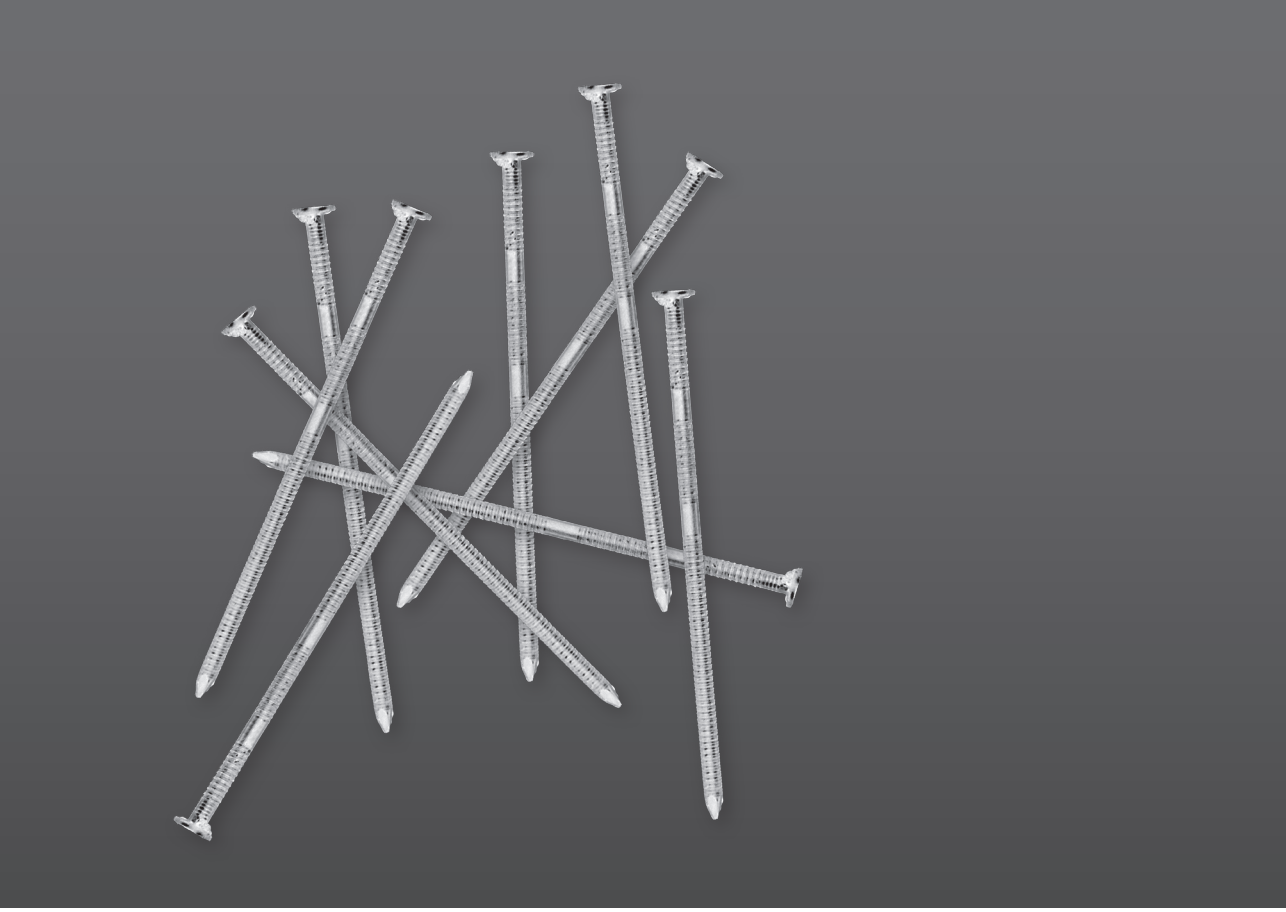


chapter 9

Summary

Introduction

Adequate pain management for trauma patients in (prehospital) emergency care is a complex problem. The overall aim of this thesis was to give insight into early and initial pain management for evaluable adult trauma patients in emergency care. Furthermore, we aimed to gain knowledge that could contribute to the improvement of pain management by professionals for this particular patient group in emergency care.

The thesis comprehends six studies. These studies focus on the following themes: the prevalence of pain, the (effect of) current pain management and factors that influence adequate pain management in ambulance Emergency Medical Services (EMS) and the emergency department (ED). Furthermore, we developed recommendations for early, initial pain management in the (prehospital) chain of emergency care. This summary recapitulates the results of each study and provides an overview of the main findings of the thesis.

Summary of chapters

Chapter 1 described the background and nursing perspective of this thesis. We elaborated on the interrelationship between acute pain and trauma, and on the question why early and initial pain management was relevant for physicians and nurses involved in emergency trauma care. The pain models of Loeser and Melzack & Casey were presented in this chapter to emphasize the importance of an integrated and structured approach to pain management, focused on different aspects of pain, such as nonpharmacological and pharmacological pain treatment. Adequate and early pain management for trauma patients in emergency care is a fundamental human right.

Chapter 2 explored the prevalence of pain and (the effect of) current pain management of paramedics in prehospital EMS in the Netherlands. In our document study, with 1,407 included patient files, we analyzed the assessment and treatment of pain performed by paramedics and pain relief in trauma patients. The results showed that, although the prevalence of pain in trauma patients in prehospital EMS was high (70%), systematic pain assessment with a validated instrument was not common practice. The first step of the national Dutch EMS analgesia protocol was generally ignored by paramedics. Pain relief could not be

evaluated in 85% of the patients with pain, but for the other 15% pain treatment resulted in a statistically, significant reduction of pain and this was also clinically effective. However, when paramedics do no consistently ask for pain scores and do not report them, it is impossible to evaluate the effectiveness of prehospital EMS pain management.

Chapter 3 concerned the prevalence of pain and (the effect of) current pain management in trauma patients in the ED in the Netherlands. In this prospective study, we interviewed 450 trauma patients on admission to and at discharge from the ED, during all shifts in a period of two weeks, and we studied their acute pain complaints. The results showed that the prevalence of pain was high on admission (91%) and at discharge of the ED (86%). Most patients left the ED with moderate to severe pain still present. Medical and nursing staff in the ED gave little (non)pharmacological pain treatment. A third of the patients reported adequate pain relief, nearly half of the patients experienced no difference in pain, and a small group reported a more intense pain. As we observed important gaps in current practice, this study recommended further systematic improvement of pain management in trauma patients in the EDs in the Netherlands.

Chapter 4 showed the relationship between the implementation of systematic triage and a (potential) relief of pain in trauma patients in the ED in the Netherlands. The hypothesis was that the implementation of the Manchester Triage System (MTS) would be a facilitator for pain management and pain relief in the ED. In an uncontrolled before/after design, we interviewed 1,192 trauma patients on admission to and at discharge from the ED, using a standardized pain measurement instrument. This instrument included the Numeric Rating Scale. The Numeric Rating Scale is a scale from 0 to 10, whereby '0' is no pain and '10' represents unbearable pain. The study showed mixed results on the improvement of pain management after implementation of MTS. Furthermore, systematic triage by MTS had no statistically significant effect on pain relief in trauma patients in EDs in the Netherlands. On the basis of this study, we suggested that the implementation of MTS needs to be supported by the development and implementation of a pain protocol in the ED. We consider such a protocol to be a systematic intervention for the improvement of pain management.

Chapter 5 described barriers and facilitators for adequate pain management in the chain of emergency care (prehospital ambulance EMS and the ED). We adopted a qualitative approach using the Implementation Model of Change of Clinical

Practice. Five focus group sessions and ten personal interviews were held with staff and managers in the chain of emergency care. Analysis showed that five concepts emerged as facilitators and barriers for the management of pain in the chain of emergency care. The concepts of knowledge, attitude and patient input were similar for the EMS and the ED setting. Professional and organizational feedback occurred as new themes, and were specifically related to the different organizational structures of the prehospital EMS and the ED. We recommend to development comprehensive strategies focused on all five concepts, in order to improve pain management for trauma patients in the chain of emergency care.

Chapter 6 identified evidence-based clinical guidelines on acute (postoperative) pain that could be used for retrieving recommendations on pain management in emergency care. The study method was a systematic review and we used bibliographic databases and professional websites on the World Wide Web. The study showed six evidence-based guidelines on pain management, that could be (strongly) recommended based on a critical assessment with the Appraisal of Guidelines Research and Evaluation (AGREE) instrument. The number of recommendations in these guidelines varied, as did the topics that were covered. Specific recommendations regarding (prehospital) emergency care were scarce, and there was no 'single best' among the six guidelines for use in emergency care. We suggested that the six identified guidelines could provide "building blocks" for the development of a tailored guideline on pain management in trauma patients in (prehospital) emergency medicine. Additionally, we suggested a specific systematic literature search be performed on the effectiveness of (non) pharmacological pain management in emergency care.

Chapter 7 presented the development of a national evidence-based guideline on pain management in trauma patients in the chain of emergency care. The target group for this guideline consisted of physicians and nurses in ambulance EMS and the ED, furthermore, the guideline focused on general practitioners (cooperatives) (GP(C)) and team members of the Helicopter EMS (HEMS). Thirteen professional organizations participated in the development process. Two national Dutch expertise centre's for the development of guidelines (Dutch Institute for Healthcare Improvement CBO and Netherlands Centre for Excellence in Nursing LEVV) provided methodological advice. Following the Evidence-Based Research development (EBRO) methodology, we formulated of five key questions and 81 recommendations. These recommendations concerned: pain assessment, influencing factors on pain perception such as the use of alcohol and drugs, (non)

pharmacological pain management, and the organization of pain management in the chain of emergency care. The working group developed nine indicators for the systematic (improvement of) pain management. As we know that guidelines are not self-implementing, we recommended the development of a tailored implementation strategy for this guideline, based on the barriers and facilitators identified in chapter 5.

Discussion and conclusion

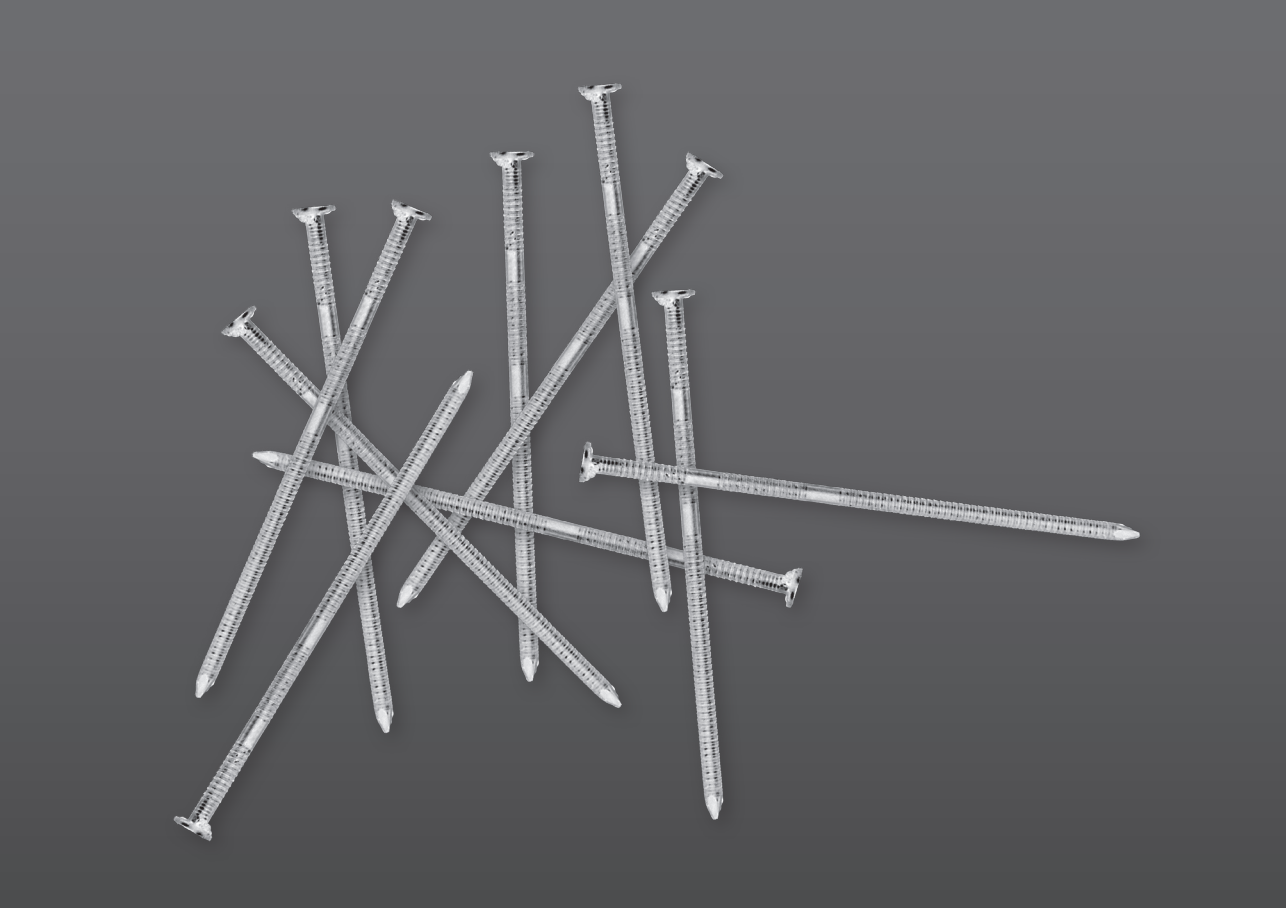
Chapter 8 described our discussion on the findings regarding pain prevalence, current pain management and pain relief in prehospital EMS and EDs in the Netherlands, and put them in the context of the previous literature. Furthermore, we described issues related to the implementation of MTS in the ED, and argued on barriers and facilitators in pain management in the chain of emergency care. We debated on the building blocks we found for the development of a new clinical guideline, based on a review of existing evidence-based acute pain guidelines. We finally considered the (limitations of) the emergency care literature, that we used for the development of the evidence based guideline on pain management in the chain of emergency care.

Furthermore, we elaborated on the conceptual and methodological considerations of three issues. First, we discussed aspects related to the patients' perspective on pain. As pain is a personal experience, we discussed how professionals can tune the pain treatment, based on relative outcomes of pain measurement. Second, we debated on the communication and coordination in the chain of emergency care, which involves more organizations than only prehospital ambulance EMS and the ED. Finally, we described thoughts on the implementation of the clinical guideline in the chain of emergency care, including GP(C) and HEMS.

The first conclusion of this thesis was that the prevalence of pain in trauma patients in prehospital EMS and the ED was high, while pain relief was limited. Therefore, current pain management practices require important systematic improvements. Second, we concluded that the implementation of systematic triage by MTS was not a facilitating factor for pain relief in the ED. Identified barriers and facilitators for the improvement of pain management in emergency care concerned knowledge, attitude, professional communication, organizational

aspects, and patient input. Third, we concluded that six guidelines on acute and postoperative pain could provide building blocks for the development of a guideline for pain management in trauma patients in the chain of emergency care. We developed a national evidence-based guideline on pain management in the chain of emergency care. In this guideline, we described the state of the art of the performance of pain management specifically for trauma patients in the chain of emergency care, based on the literature and on expert opinion.

Finally, based on the discussion and these conclusions, we provided several recommendations for emergency care practice, education and (new) research.



chapter 10

Samenvatting

Inleiding

Adequate pijnbehandeling voor traumapatiënten is een complex probleem in de (prehospitale) spoedzorg. Met dit proefschrift willen we inzicht geven in de vroegtijdige, initiële pijnbehandeling voor aanspreekbare traumapatiënten in de ambulancezorg en op de spoedeisende hulp (SEH). Daarnaast beogen we kennis te ontwikkelen, die kan bijdragen aan de verbetering van pijnmanagement door hulpverleners in de spoedzorg.

Het proefschrift omvat een zestal studies. Deze studies behandelen de thema's: prevalentie van pijn, (het effect van) de huidige pijnbehandeling en factoren die van invloed zijn op adequate pijnbehandeling in de ambulancezorg en op de SEH. Tot slot ontwikkelen we aanbevelingen voor vroegtijdige initiële pijnbehandeling in de (prehospitale) spoedzorgketen. Deze samenvatting geeft een overzicht van de resultaten van iedere studie en de algemene bevindingen van dit proefschrift.

Samenvatting hoofdstukken

Hoofdstuk 1, de introductie, schetst de achtergrond van het proefschrift en het verpleegkundig perspectief van waaruit de studies zijn uitgevoerd. We werken de relatie uit tussen acute pijn en trauma. Verder bediscussiëren we waarom vroegtijdige initiële pijnbehandeling relevant is voor artsen en verpleegkundigen werkzaam in de traumatologische spoedzorg. De pijnmodellen van Loeser en Melzack & Casey worden in dit hoofdstuk gepresenteerd om het belang van een geïntegreerde en structurele benadering van pijnmanagement te benadrukken. Deze benadering gaat in op verschillende aspecten van pijn, zoals non-farmacologische en farmacologische pijnbehandeling. Non-farmacologische pijnbehandeling omvat interventies die pijnreductie geven zonder toediening van pijnmedicatie, zoals informatievoorziening en het immobiliseren of hoogleggen van aangedane lichaamsdelen. Adequate en vroegtijdige pijnbehandeling voor traumapatiënten in de spoedzorg kan gezien worden als een fundamenteel menselijk recht.

Hoofdstuk 2 beschrijft de prevalentie van pijn en (het effect van) de huidige pijnbehandeling in de ambulancezorg in Nederland. In onze dossierstudie, die 1407 patiëntendossiers betreft, analyseren we de beoordeling en de behandeling van pijn door de ambulanceverpleegkundigen en kijken we naar de pijnvermindering

bij traumapatiënten. De resultaten van deze studie laten zien dat de prevalentie van pijn bij traumapatiënten hoog is (70%). Een systematische beoordeling van pijn met een gevalideerd meetinstrument is geen algemene praktijk. De eerste stap van het landelijk ambulance protocol voor pijnbestrijding bij traumapatiënten bestaat uit de toediening van een mengsel van lachgas en zuurstof. Deze behandeloptie wordt doorgaans genegeerd door de ambulanceverpleegkundigen. Pijnvermindering kan niet geëvalueerd worden in 85% van de patiënten met pijn. Voor de overige 15% vermindert de pijn effectief als gevolg van behandeling door ambulanceverpleegkundigen. Voor de laatste groep is de pijnafname niet alleen statistisch significant, maar kan deze ook als klinisch relevant beschouwd worden. Daarentegen is het onmogelijk om de effectiviteit van de pijnbehandeling te evalueren als ambulanceverpleegkundigen niet consequent vragen naar pijnrapportages van de patiënt en deze rapporteren.

Hoofdstuk 3 geeft inzicht in de prevalentie van pijn en (het effect van) de huidige pijnbehandeling voor traumapatiënten op de SEH in Nederland. In deze prospectieve studie interviewden we gedurende twee weken, in de dag, avond- en nachtdiensten, 450 traumapatiënten over acute pijnklachten bij opname en bij ontslag van de SEH. Resultaten laten zien dat de prevalentie van pijn hoog is bij aankomst op de SEH (91%) en bij vertrek van de SEH (85%). De meeste traumapatiënten verlaten de SEH met matige tot ernstige pijn. De medische en verpleegkundige staf op de SEH geeft weinig (non-) farmacologische pijnbehandeling. Een derde van de patiënten rapporteert adequate pijnvermindering bij ontslag van de SEH. Bijna de helft van de patiënten ondervindt geen verschil in pijn en een kleine groep rapporteert een toename van pijn bij ontslag of overplaatsing van de SEH. We observeren belangrijke hiaten in de huidige praktijk en daarom geeft deze studie de aanbeveling voor een verdere systematische verbetering van pijnbehandeling voor traumapatiënten op de SEH's in Nederland.

Hoofdstuk 4 laat de relatie zien tussen de implementatie van een systematische triage en een (potentiële) vermindering van pijn bij traumapatiënten op de SEH. De veronderstelling was dat implementatie van het Manchester Triage Systeem (MTS) een bevorderende factor zou zijn voor pijnbehandeling en pijnvermindering. In deze ongecontroleerde voor/na studie interviewen we 1192 traumapatiënten met een gestandaardiseerde pijnvragenlijst bij opname en ontslag van de SEH. Deze vragenlijst bevat de Numeric Rating Scale. De Numeric Rating Scale is een schaal van 0 tot 10, waarbij '0' geen pijn en '10' de ergst denkbare pijn weergeeft. De studie laat gemengde resultaten zien ten aanzien van de verbetering van

pijnbehandeling na implementatie van MTS. Bovendien geeft systematische triage met MTS geen statistisch significant effect op pijnvermindering bij traumapatiënten op de SEH. Op basis van deze studie geven we de suggestie dat implementatie van het MTS ondersteund dient te worden met de ontwikkeling en implementatie van een pijnprotocol op de SEH. Een dergelijk protocol zien we als een systematische interventie voor de verbetering van pijnmanagement.

Hoofdstuk 5 beschrijft belemmerende en bevorderende factoren voor pijnbehandeling in de ambulancezorg en op de SEH. We gebruiken in deze studie een kwalitatieve benadering en het Implementatie Model voor Verandering van de Klinische Praktijk. De gegevens zijn verzameld aan de hand van vijf focusgroepbijeenkomsten met de medisch en verpleegkundige staf en tien persoonlijke interviews met managers in de spoedzorgketen. Analyse laat zien dat vijf concepten genoemd worden als belemmerende en bevorderende factoren voor pijnmanagement in de spoedzorgketen. Voorbeelden van de concepten kennis, attitude en patiënteninbreng komen overeen voor de ambulancezorg en de SEH. Professionele en organisatorische feedback blijken nieuwe thema's te zijn en ze zijn specifiek gerelateerd aan de verschillen in organisatorische opbouw van de ambulancezorg en de SEH. Om de klinische praktijk van pijnmanagement in de spoedzorgketen te verbeteren, bevelen we aan verschillende strategieën voor implementatie te ontwikkelen, gericht op alle vijf de concepten.

Hoofdstuk 6 identificeert evidence based richtlijnen voor acute (postoperatieve) pijn, die gebruikt kunnen worden om aanbevelingen voor pijnmanagement in de spoedzorg te vinden. Evidence based richtlijnen, zijn richtlijnen waarbij wetenschappelijke bewijs gebruikt is voor de formulering van aanbevelingen. De studiemethode betreft een systematische review en hiervoor gebruiken we bibliografische databases en professionele websites op het 'World Wide Web'. De studie laat zien dat zes evidence based richtlijnen over acute pijnbehandeling (sterk) aanbevolen kunnen worden op basis van een kritische beoordeling met het Appraisal of Guidelines Research and Evaluation (AGREE) instrument. Het aantal aanbevelingen in de gevonden richtlijnen varieert, net als het aantal onderwerpen dat ze behandelden. Specifieke aanbevelingen voor de (prehospitale) spoedzorg zijn schaars en geen van de zes richtlijnen is aangemerkt als de 'allerbeste' voor gebruik in de spoedzorg. We stellen voor dat elk van deze zes geïdentificeerde richtlijnen bouwstenen kunnen leveren voor de ontwikkeling van een op maat gesneden richtlijn voor pijnbehandeling bij traumapatenten in de (prehospitale) spoedzorg. Aanvullend adviseren we specifiek, systematisch literatuuronderzoek

te verrichten naar de effectiviteit van (non-)farmacologisch pijnmanagement in de spoedzorg.

Hoofdstuk 7 presenteert de ontwikkeling van een landelijke evidence based richtlijn voor pijnbehandeling bij traumapatiënten in de spoedzorgketen. De doelgroep voor deze richtlijn omvat niet alleen de artsen en verpleegkundigen werkzaam in de ambulancezorg en op de SEH, maar ook de hulpverleners op de huisartsen(post) en van het mobiel medisch team. Dertien professionele organisaties participeren in de richtlijnontwikkeling. Twee Nederlandse expertisecentra voor de ontwikkeling van richtlijnen (Kwaliteitsinstituut CBO en Landelijk Expertisecentrum Verpleging en Verzorging (LEVV)) geven methodologisch advies. Volgends de Evidence Based Richtlijn Ontwikkeling (EBRO) systematiek formuleren we vijf centrale uitgangsvragen en 81 aanbevelingen. Deze aanbevelingen betreffen pijnbeoordeling, beïnvloedende factoren op pijnperceptie zoals het gebruik van alcohol en drugs, (non-) farmacologisch pijnmanagement en de organisatie van pijnbehandeling in de spoedzorgketen. De werkgroep heeft negen indicatoren ontwikkeld voor de systematische (verbetering van) pijnbehandeling.

We weten dat richtlijnen zich niet vanzelf implementeren, daarom bevelen we aan in vervolg op de richtlijnontwikkeling een op maat gesneden implementatiestrategie te ontwikkelen en te gebruiken, gebaseerd op de bevorderende en belemmerende factoren beschreven in hoofdstuk 5.

Discussie en conclusie

Hoofdstuk 8 beschrijft onze discussie over de resultaten van de studies naar de prevalentie van pijn, de huidige pijnbehandeling en de pijnvermindering in de ambulancezorg en op de SEH. Ook plaatsen we de bevindingen van deze studies in de context van de literatuur. Daarnaast beschrijven we problematiek rondom de implementatie van MTS op de SEH en argumenteren we over belemmerende en bevorderende factoren voor pijnbehandeling in de spoedzorgketen. We debatteren over de bouwstenen voor de ontwikkeling van een nieuwe klinische richtlijn, gebaseerd op de review van bestaande evidence based richtlijnen over acute pijn. Tot slot beschouwen we (beperkingen van) de spoedzorgliteratuur, die we gebruikt hebben voor de ontwikkeling van de evidence based richtlijn voor pijnbehandeling in de spoedzorgketen.

Verder werken we in dit hoofdstuk een aantal conceptuele en methodologische

reflecties uit aangaande drie kwesties. Allereerst bediscussiëren we aspecten gerelateerd aan het patiëntenperspectief op pijn. Pijn is een individuele ervaring. We debatteren hoe professionals hun pijnbehandeling kunnen afstemmen, gebaseerd op relatieve uitkomsten van pijnmetingen. Ten tweede discussiëren we over de communicatie en de coördinatie van zorg in relatie tot pijnbehandeling in de spoedzorgketen. Tot slot, beschrijven we onze gedachten over de implementatie van de klinische richtlijn in hele spoedzorgketen, niet alleen binnen de ambulancedienst en op de SEH, maar ook binnen de huisartsen(post) en voor het mobiel medisch team.

De eerste conclusie van dit proefschrift is dat de prevalentie van pijn hoog is bij traumapatiënten in de ambulancezorg en op de SEH, terwijl de pijnvermindering voor deze patiëntengroep beperkt is. Daarom behoeft de huidige praktijk van pijnbehandeling in de spoedzorg belangrijke, systematische verbetering. Ten tweede concluderen we dat de implementatie van systematische triage met MTS geen bevorderende factor is voor pijnvermindering op de SEH. Belemmerende en bevorderende factoren voor de verbetering van pijnbehandeling in de spoedzorg betreffen kennis, attitude, professionele communicatie, organisatorische aspecten en patiënteninbreng. Ten derde concluderen we dat zes richtlijnen over acute (postoperatieve) pijnbehandeling bouwstenen kunnen leveren voor de ontwikkeling van een richtlijn die toegesneden is op pijnbehandeling bij traumapatiënten in de spoedzorgketen. We hebben een nationale evidence based richtlijn voor pijnbehandeling in de spoedzorgketen ontwikkeld. Hierin beschrijven we de 'state of art' uitvoering van pijnbehandeling specifiek voor traumapatiënten in de spoedzorgketen, gebaseerd op literatuur en expert opinion. Tot slot geven we in dit hoofdstuk meerdere aanbevelingen voor de praktijk van de spoedzorg, het onderwijs en (nieuw) onderzoek.

List of abbreviations

List of abbreviations

ABC	Airway, Breathing, Circulation
ABCD	Airway, Breathing, Circulation, Disability
ABCDP	Airway, Breathing, Circulation, Disability, Pain
ACE inhibitor	Angiotensin-Converting Enzyme inhibitor
ACEP	American College of Emergency Physicians
AGREE	Appraisal of Guidelines for Research and Evaluation
ANOVA	Analysis of variance
ANZCA	Australian New Zealand College of Anaesthetists and Faculty of Pain Medicine
ATLS®	Advanced Trauma Life Support
CBO	Dutch Institute for Healthcare Improvement
CINAHL	Cumulative Index to Nursing and Allied Health Literature
DF	Degrees of Freedom
ED	Emergency Department
EMS	Emergency Medical Services
EMT-4	Emergency Medical Technician-level 4
EU	European Union
GCS	Glasgow Coma Scale
GP	General Practitioner
GPC	General Practitioner Cooperatives
HEMS	Helicopter Emergency Medical Services
IASP	International Association for the Study of Pain
ICD	International Classification of Diseases
ICT	Information and Communication Technology
IGZ	Health Care Inspectorate
IQR	Interquartile Range
ISS	Injury Severity Score
MaxQDA	Professional Software Tool for Qualitative Data Analysis
MIST	Mechanism of injury, Injuries observed, Signs and symptoms, Treatment given
MTS	Manchester Triage System
NGC	National Guidelines Clearinghouse
NRS	Numeric Rating Scale
NSAID	Non-Steroidal Anti-Inflammatory Drugs
NVA	Netherlands Society of Anaesthesiology
LEVV	Netherlands Centre for Excellence in Nursing

MTS	Manchester Triage System
NSAID	Non-Steroidal Anti-Inflammatory Drugs
PHTLS®	Prehospital Trauma Life Support
RNAO	Registered Nurses Association of Ontario
SD	Standard Deviation
SE	Standard Error
SIAARTI	Societa Italiana di Anestesia Analgesia Rianimazione e Terapia Intensiva (Italian Society of Anaesthesia, Analgesia, Reanimation and intensive Care)
SIGN	Scottish Intercollegiate Guidelines Network
SOAP	Subjective, Objective, Assessment, Plan
SPSS	Statistical Package for Social Sciences
VHA	Veteran Health Administration
VAS	Visual Analogue Scale
VDS	Verbal Description Scale
VMS	Safety Management System
V&VN	Dutch Nurses Association
WHO	World Health Organization
χ^2-test	Chi Square test
ZonMw	Netherlands Organization for Health Research and Development

List of publications

List of publications

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Synergy is the highest activity of life; it creates new untapped alternatives; it values and exploits the mental, emotional, and psychological differences between people.
Stephen Covey, CEO General Electric

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Curriculum Vitae

Curriculum Vitae

Sivera Berben was born on the 7th of April 1963 in Overasselt, the Netherlands. She grew up in Balgoy, among the fruit orchards, at the riverside of the Maas. After graduating from high school in 1980 and finishing pre-university education in 1982, she started the education and training program for Registered Nurses at the Catholic School of Nursing in Nijmegen. In 1986 she obtained her bachelor's degree in nursing.

She started her work as a nurse at the Orthopaedic Department of the Radboud University Nijmegen Medical Centre (1987-1995). From 1990-1991 she was posted as a senior nurse (educator) in Armenia (former Soviet Union), employed by the International Red Cross and Red Crescent Societies in Geneva. In Yerevan, she supervised and trained Armenian and Russian nurses in the (outpatient) care for patients with spinal cord injury as a result of earthquake or other trauma.

After returning to the Netherlands, Sivera continued her career in the Radboud University Nijmegen Medical Centre, were she is still working. Concurrently to the nursing work, she started to supervise and coach multidisciplinary teams in quality measurement and improvement. As a project manager in quality improvement, she worked for the departments of Internal Medicine, Paediatrics and Intensive Care (1992-1995). In 1994, she successfully graduated as Innovator in Healthcare at the HAN University of applied Sciences.

In 1995 Sivera continued her career as a project manager in Intensive Care, Surgical Departments, and the Emergency Department, where she was responsible for the implementation of the nursing process (nursing diagnosis, clinical reasoning, outcome measurement). At the same time, she studied Health Care Sciences, at the Faculty of Health, Medicine and Life Sciences at the University of Maastricht (1998-2003). Sivera graduated as master in Health Sciences 'with honourable mention' (2003). During her master study she became Health Policy Advisor of the Cluster of Surgical Departments. From 2002 to 2006, she was responsible for the development, implementation and outcome measurement of multidisciplinary Clinical Pathways and indicators for healthcare improvement for surgical patients with cancer. In this period she started her first study on pain in trauma patients in the Emergency Department, with a grant from the Radboud University Medical Centre.

Subsequently, she moved to a research position in the Emergency Department (2006-2008). As the studies of this thesis were performed in close collaboration with the department of Critical Care at the HAN University of Applied Sciences, she became a Member of the Circle of Knowledge in Critical Care of the HAN University. Sivera is Scholar of the European Academy of Nursing Science. During her research position in the Emergency Department, she was actively involved in congress committees on emergency care, as editor of Triage (the Journal of the Netherlands Society of Emergency Nurses), and she was chairman of the PhD council of the Nijmegen Centre of Evidence Based Practice.

As from 2009, she holds a position as coordinator of the Research Group of the Regional Emergency Healthcare Network. Here, she finished her PhD thesis, supported by a grant of ZonMw, the Netherlands Organization for Health Research and Development, in the program Emergency Care. Sivera is currently responsible for several grant applications and research projects in emergency care, such as the regional, longitudinal research on (pre)hospital trauma care and outcomes.

Sivera Berben is married to Louis Wesel, and together they have a son Vincent and two foster children Zilan and Suna. They live in Bemmel, the Netherlands.