Pain management in older persons with hip fractures
Dedication

To patients with hip fractures
Pår Wennberg

Pain management in older persons with hip fractures
Abstract


The overall aim of this thesis was to evaluate the preoperative management of pain from the perspectives of a literature overview, emergency medical service pain management, an intervention with a fascia iliaca compartment block and the association between cognitive status and the treatment of pain. Paper 1 is an integrative review of the literature on emergency care in patients with hip fractures or suspected hip fractures. Pain is a major problem for patients suffering a hip fracture when waiting for surgery and it is challenging for health care to provide sufficient pain relief. Listening to the patient’s narrative and the mandatory use of pain scales and pain documentation are necessary to deepen our understanding of individual patients’ needs. Paper 2 is a prospective observational study that explored the prehospital pain levels in 1,426 patients with suspected hip fractures. Furthermore, this study evaluated prehospital pain management. At the site of the injury, patients with hip fractures are often in substantial pain. Seventy-five per cent of the patients received pain relief from the emergency medical service (EMS) care providers and the pain relief was often effective. Several of the patients that did not receive prehospital pain relief had moderate to severe pain. Paper 3 is a randomised placebo-controlled double-blind trial (RCT) of 127 patients waiting for surgery. This RCT evaluated the effect of fascia iliaca compartment blocks (FICB) in relation to pain and medical pain relief, when added to regular preoperative analgesia. FICB improved pain relief when compared with regular analgesia alone (p=0.002). Paper 4 examined whether preoperative pain management with FICB could have an effect on cognitive status in the same 127 patients that were included in Paper 3. No impact on cognitive impairment was proven in this study. Patients with severe cognitive impairment received significantly lower doses of prehospital morphine than patients with higher cognitive status. Prehospital and hospital pain management need to improve. Pain management is especially challenging in persons with cognitive impairment.

Keywords: Pain, Pain management, Hip fractures, Cognitive status, Nerve blocks, Emergency medical services

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Original papers

This thesis is based upon the following original papers:


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<td>CRF</td>
<td>Case Report Form</td>
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<td>EMS</td>
<td>Emergency Medical Services</td>
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<td>FICB</td>
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<td>NRS</td>
<td>Numerical Rating Scale</td>
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<td>Short Portable Mental Status Questionnaire</td>
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1. Introduction

When working as a nurse anaesthetist in a hospital in Oslo back in 2006, I reflected over differences in patients with hip fractures when they arrived at the operating theatre. Some patients appeared to be in relatively good shape, smiling, in a well-made bed with well-managed pain. Other patients appeared to be having the worst time of their life – scared, in pain, delirious and unable to find any resting position in their beds. In my discussions with colleagues about nerve block, an idea came up: patients would probably benefit from a nerve block at an early stage after the injury – perhaps even in the ambulance. The levels of pain that patients in the ambulance experience and the treatment of pain before arrival in hospital was insufficiently evaluated and documented. The literature covering preoperative pain management among patients with suspected hip fractures did not provide sufficient answers.

After carrying the nerve block idea for a while, a plan developed. If nerve blocks, together with standard pain relief, were introduced, many patients might benefit from improved pain management. However, this kind of intervention had to be studied.
2. Background

Patients with hip fractures

An older person who falls and suffers from a hip fracture is in a vulnerable position. Patients with hip fractures are mostly old and fragile, have a low tolerance of opioids and paradoxically their tolerance of pain is also low [1]. Insufficient pain relief increases the risk of confusion, pressure ulcers and a prolonged period of hospitalisation [2, 3].

The fall with the subsequent suspected hip fracture starts a chain of events, from the injury until the time of operation or, alternatively, X-ray, if no fracture is present. The need for help is urgent, but patients sometimes have to wait for hours [4]. When help arrives, in most cases the emergency medical services (EMS), the person is usually suffering from severe pain – especially when the person attempts to move. This means that lifting the person onto a stretcher, transporting the person to the ambulance and driving on a bumpy road to the hospital generates many situations with severe pain [5]. Many patients with hip fractures express high levels of satisfaction with prehospital emergency care [6]. Patients have reported on the effectiveness of the procedures, since the prehospital process often gives the impression of an experienced ambulance staff [7]. Other patients have unfavourable experiences of the same type of care [8].

At the hospital, an X-ray examination is required to confirm a fracture – a procedure that can be painful to patients with hip fractures. If a fracture is confirmed, the patient is not allowed to eat or drink and preoperative procedures, such as a preoperative wash, are carried out. This procedure differs between countries; in Sweden, the preoperative wash is performed up to three times [9]. Waiting for surgery is often an unpredictable state which might create anxiety and the sudden pain when moving may increase these negative feelings [10, 11]. The patients often describe their situation with feelings such as solitude, pain and loss of control [12]. Moreover, patients experience fear, despair and confusion [13]. As a result, many patients suffering a hip fracture are characterised as frail, as they experience losses in the physical, psychological and social domains of human functioning [14].

Patients with hip fractures run an increased risk of developing delirium and cognitive impairment [1]. Cognitive impairment is a collective term for several conditions in which the patients suffer from cognitive reduction, which is defined as a disturbance in the patient’s mental processes related to thinking, reasoning and judgement [1]. Cognitive impairment can be
manifested as dementia or delirium (a state of acute confusion) [15]. Delirium and dementia often co-exist and the risk of developing delirium also increases in the presence of dementia [16-18]. The reported incidence of perioperative delirium in patients with a hip fracture ranges from 38% to 62% and increases with age, co-morbidity and reduced preoperative cognitive status [19, 20]. Many patients suffering dementia have difficulty self-reporting pain after a hip fracture [21, 22] and they often lack an insight into their situation and their need for help. Cognitive status is defined as a person’s behavioural and cognitive function and it is essential to screen cognitive status in patients with suspected or confirmed hip fractures [23-25].

**Hip fractures**

A hip fracture is defined as a fracture of the proximal femur and can be classified into three categories, medial, trochanter and sub-trochanter [26]. Older persons who fall and fracture a hip constitute a worldwide, growing challenge for emergency health care. By 2050, the total number of victims worldwide is expected to grow up to six million patients a year [27]. In Sweden, the current number of patients suffering a hip fracture is approximately 18,000 annually. Predictions calculate that the number will be 36,000 by 2050 [28]. Patients with hip fractures account for approximately 25% of the orthopaedic hospital beds in Sweden. The majority of these patients are females with an average age of 82 years and the majority have a history of co-morbidity [29]. Globally, the cost of the care for a person with a hip fracture is $43,669. The total cost of hip fracture care in Sweden is 1.5 billion SEK [29, 30]. In an effort to improve the management of patients with hip fractures in Sweden, the Swedish National Registry of hip fracture patient care was established in 1988 [29].

In order to reduce perioperative complications, there are strong indications that surgery should be undertaken within 24 hours after the hip fracture [31]. Some reports even suggest surgery within 12 hours after the event [32, 33]. The median waiting time for an operation after a hip fracture in Sweden is 19 hours [29]. Waiting times in other countries in Europe and North America range between 27 and 48 hours [34-39].

**Pain**

The US Human Services (HHS) and the Institute of Medicine recognise pain as a significant public health problem and encourage pain research, pain care and pain education [40]. Pain is defined by the International Association for the Study of Pain (IASP) as “An unpleasant sensory and emotional
experience associated with actual or potential tissue damage, or described in terms of such damage” [41]. Pain can be explained in terms of physical, psychological and social dimensions. Physical pain can be referred to as nociception – the sensory nervous system is equipped with nerve cell endings that respond to harmful or potentially harmful stimuli. Nociception is divided into chemical, mechanical or thermal stimuli. The nociceptors transmit a signal through thin myelinated or non-myelinated nerve fibres via the spinal cord to the brain [42]. Pain warns us of threats and potentially harmful situations – without pain we would not survive as individuals; pain is essential [43]. Nociception is associated with chemicals in the form of neurotransmitters. Neurotransmitters are released at both peripheral and central level, as well as several inflammatory mediators in the tissue. These chemical responses to pain tend to make the individual even more sensitive to new pain stimuli [44].

The way the processes of physical and psychological pain overlap each other is complex [45]. A present pain problem is exacerbated by muscle contraction and the activation of the sympathetic nervous system caused by stress and anxiety. Equally, relaxation will reduce the activity of these factors and thereby limit the pain [46]. In order to understand how pain affects a person, health-care providers must be aware of the psychological and social factors that are involved in the experience of pain [47, 48].

**Pain assessment**

Pain is a subjective experience and it is primarily assessed by the person experiencing it. An assessment by a health-care provider is primarily communicated with words from the patient expressing the character, the severity and other dimensions of the pain [49]. Health-care providers can assess pain with pain assessment scales developed to quantify the experienced pain [50]. Typical scales are the visual analogue scale (VAS) or the numerical rating scale (NRS) [51].

The visual analogue scale (VAS) is a 100-millimetre (mm) Likert scale used by the patient to describe the experienced pain. The VAS is a scale that has been used in pain research over the years. It consists of a line with the endpoints defining extreme limits with ‘no pain at all’ at one end and ‘the worst imaginable pain’ at the other end. The patient marks his or her experienced pain level on the line between the two endpoints. The distance in mm from ‘no pain at all’ to the pain mark reflects the intensity of the patient’s experienced pain [52].
The numerical rating scale (NRS) is an eleven-grade scale ranging from 0 (no pain) to 10 (worst imaginable pain). The NRS is used by the patient for the self-assessment of pain. It appears that most patients find the NRS scale easier to use and prefer it to the VAS [53]. Both the VAS and NRS are valid, reliable and appropriate tools for use in clinical practice. Values rated with the VAS or NRS over time are comparable and VAS and NRS values are interchangeable [54-56].

When a patient is unable to express his/her pain experience due to cognitive impairment or a lack of language knowledge or any other reason, the assessment is dependent on observing the patient’s behaviour [21]. Scales for the quantification of the patient’s pain by his/her behaviour have been developed [57]. The behaviour related scale (BRS) is a three-category scale categorising pain from the patients’ behaviour. The three categories are: 1 (BRS 0-3) – no pain or mild pain, 2 (BRS 4-7) – moderate pain and 3 (BRS 8-10) – severe pain (Figure 2). The BRS was developed at the Stockholm South General Hospital [58]. There are other pain scales for evaluating and interpreting patients’ behaviour. They include the PAINAD and Abbey Pain Scale [59]. Due to limited evidence, no specific observational pain scale has been recommended [60-62].

In order to ensure an understanding of patients’ pain experience, it is important that health-care providers assess pain. This includes quantifying pain for documentation [63]. The quantification of pain is also necessary in order to evaluate the effect of a single intervention which requires the observation of an eventual change. The quantification of the patient’s pain is also necessary in order to evaluate the eventual effect of new interventions for the relief of pain in research [48].

Assessing and treating pain in older patients suffering from a hip fracture is an especially challenging task, as these patients have high co-morbidity and needs that are imminent and urgent [64]. The insufficient treatment of pain in patients with hip fractures increases the risk of confusion, postoperative complications and death, which are common complications after a hip fracture [65, 66]. Vigilant nursing assessments and timely interventions are important to prevent complications [67]. Pain in patients with hip fractures can be evaluated both on movement and at rest, which is standard when the Cochrane Collaboration evaluates pain and pain treatment in studies of persons with hip fractures [5]. It is important to assess pain on movement, as the long waiting time for surgery leaves the patient in a state in which he/she is exposed to unexpected and sudden pain on every movement. However, pain at rest is also important to assess, as it describes the “baseline” or the pain...
“most of the time” during the wait for surgery. Pain at rest is also referred to as static pain, while pain on movement is referred to as dynamic pain.

**Pain treatment**

The treatment of pain is considered to be a human right and it should be provided to citizens as a part of their right to health protected by international human rights law [68, 69]. Nurses and physicians have a responsibility to relieve pain as well as the suffering it causes. The responsibility for pain management covers a professional, ethical and human domain for health-care professionals [70, 71]. Especially vulnerable patients who cannot speak for themselves, such as small children or patients suffering cognitive impairment with observable discomfort, which they are unable to verbalise, need special attention [72].

Pain relief can be provided through non-pharmacological interventions, such as warm or cold temperature appliances, a calming and relaxing attitude, breathing control, humour, distraction and repositioning [73]. In the ambulance, positioning of the patient on the stretcher, immobilising a fractured limb or holding a hand to comfort are examples of non-pharmacological pain relief.

The opportunity for prehospital medical pain treatment can vary due to variations in staff skills. In Sweden, the pain treatment of patients with suspected hip fractures starts with the care provided by the EMS. Prehospital emergency nurses (PENs) in the ambulance are able to administer intravenous medicines, fluid resuscitation and oxygen treatment and this treatment is regulated by the Swedish National Board of Health and Welfare [74]. These drugs have a general prescription and are administered on demand through nurse-initiated medication. Examples of drugs available from the PEN in the Swedish EMS include morphine, esketamine, ketamine, alfentanil, midazolam and diazepam [75]. In other parts of Europe, ambulance staff may include a registered nurse or paramedic who is able to administer drugs [76].

On hospital wards in Sweden, pain medication (morphine and/or paracetamol) is prescribed by physicians and administered by nurses, usually on patient demand. This procedure can generate some obstacles in pain treatment [77, 78]. At the hospital, special pain treatments, such as nerve blocks to patients with hip fractures, can be offered [79]. A nerve block as preoperative pain treatment has become more frequent and is now fairly widespread in some countries and the available literature on the subject has increased [5, 80].
**Fascia iliaca compartment block**

Nerve blocks can provide analgesia to patients with hip fractures [81-84]. Several techniques for administering a nerve block for the femoral nerve are available. Examples include a traditional femoral nerve block, a three-in-one block or a fascia iliaca compartment block (FICB) [85].

The FICB given to patients with hip fractures have proved to be a simple and safe method [86-92]. The FICB is a high-volume, low-tech nerve block administered to the affected hip through a perpendicular injection with a two-pop technique. The insertion point is projected by drawing a line between the spina iliaca anterior superior (SIAS) and the os pubis, 1 cm lateral to the conjunction of the two thirds closest to the SIAS. The insertion is made by loss of resistance; first when passing the fascia lata and then the fascia iliaca (two pops). When in position, 30 ml of the fluid is injected. The fluid then follows the fascia iliaca down to the femoral nerve (Figure 1). The FICB was first described by Dalens in 1989 [93] as a development of the three-in-one nerve block first described by Winnie in 1973 [94]. The frequency of reported complications to FICB is low. General complications that have to be taken into account with regional analgesia are block failure, neural injury and local anaesthetic toxicity and intravascular injections causing hypotension and bradycardia [95]. Three reviews reported no serious adverse events [5, 96, 97].

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**Figure 1. Figure showing the landmarks for FICB. (a). Puncture site, (b). Anatomy of the fascia iliaca compartment: 1 fascia lata, 2 fascia iliaca, 3 N. femoralis, 4 N. cutaneous femoris lateralis, 5 V and A. femoralis, 6 M. pectinale, 7 M. psoas (figures with permission from Hoeg A., Strat Traum Limb Recon (2008) 3:65–70).**
Traditionally, anaesthetist specialists administer most forms of nerve blocks in conjunction with the operating theatre, in a high-tech environment with every kind of imaginable support. When FICB has been evaluated, it has proven to be easy to learn even for non-anaesthetists, easy to perform, safe for the patient and highly accessible also in “primitive” environments due to low-tech equipment use. All these features make FICB feasible in a prehospital environment or a general ward where medical supporting functions are limited or an emergency room where the tempo tends to be high [86, 97, 98].

The FICB has been used in prehospital emergency care and it has been administered by nurses [84, 99]. The FICB has been reported to be suitable for prehospital use because it is safe and easy to learn. However, more research on its efficacy when compared with systemic opioids is needed [97].

The FICB and other nerve block methods have been scarcely evaluated in patients with cognitive impairment. Only three per cent of previous randomised clinical trials (RCTs) on patients with hip fractures report results including cognitively impaired patients, despite the fact that they represent at least one third of the hip fracture population [100].

**Challenges in pain management**

There are clinical challenges relating to all three dimensions of pain management: assessment, treatment and reassessment.

Assessment: pain is reported as a symptom in 49% of the patients in prehospital emergency care but the pain intensity is only recorded in 32% of the patients’ medical records in prehospital emergency care among the patients with pain [101]. The highest proportion of patients with moderate to severe pain is found among patients with diseases of the musculoskeletal system and injuries in a prehospital setting [102].

Pain treatment may be insufficient and untreated pain may result in unwanted psychological and physiological side effects that may increase morbidity and increase the incidence of chronic pain [103, 104]. Pain management has improved in the last few years, but pain in emergency departments and among patients who call for an ambulance is still often inappropriately assessed and treated [101, 105].

The reassessment of pain after the initial treatment is important in order to evaluate the effect of an intervention. However, reassessments are non-existent in emergency care. Assessment and reassessment therefore need to be mandatory in documentation systems [106, 107].
Rationale
People who suffer a hip fracture are old, they suffer from co-morbidity and are often cognitively impaired. The literature describes insufficient pain management and cognitive impairment distressing patients with hip fractures and yet a conclusive study of the problem in the preoperative phase is lacking.

Emergency health care starts with the EMS, but there is no comprehensive description of the course of pain among patients with suspected hip fractures from the injury to surgery experience. There is also a knowledge gap when it comes to the effectiveness of pain management within the EMS in patients with hip fractures.

Nerve blocks appear to have the potential to improve pain management in patients with hip fractures. There are indications that cognitive status may benefit from pain relief with nerve blocks, but more evidence is required.

To summarise, the reasons given above clearly indicate that our knowledge of the preoperative management of pain among patients with hip fractures needs to improve.

Studying and establishing the extent of the pain problem among patients with hip fractures can create a platform from which pain management may be improved in the future. Furthermore, exploring the impact of nerve blocks on cognition is also important.
3. Aims

The overall aim of this thesis was to evaluate the preoperative management of pain in patients with hip fractures from the perspectives of a literature overview, emergency medical service pain management routines, a particular intervention with a fascia iliaca compartment block and the association between cognitive status and the treatment of pain.

The specific aims of the papers included in this thesis are as follows.
- To review the available evidence throughout the chain of emergency care for patients with a suspected hip fracture after falling, with the emphasis on the patients’ pain (Paper 1)
- In the prehospital setting among patients with a suspected hip fracture, to describe a) reported dynamic and static pain and b) the use of pain-relieving drugs and its association with pain relief (Paper 2)
- To evaluate whether, after hospital admission, supplementation with a low-dose FICB, in addition to preoperative analgesia, compared with a placebo, would improve pain relief in patients with hip fractures (Paper 3)
- Among patients with a hip fracture, to examine 1) the impact of a preoperative FICB on cognitive status until the first postoperative day and 2) the association between cognitive status and the amount of analgesia given in the preoperative phase (Paper 4)
4. Materials and Methods

**Designs**

The characteristics of the subsequent papers are summarised in Table 1.

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<td>Integrative literature review</td>
<td>38 papers with a total of 6492 patients</td>
<td>Systematic literature search</td>
<td>Inductive content analysis</td>
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<tr>
<td>2</td>
<td>Prospective observational study</td>
<td>1426 patients with suspected hip fractures</td>
<td>Pain assessment and drug consumption in prehospital care</td>
<td>Descriptive statistics, analysis, Wilcoxon's test, Kruskal-Wallis test, chi-square test</td>
</tr>
<tr>
<td>3</td>
<td>Randomised controlled trial</td>
<td>127 patients with confirmed hip fractures</td>
<td>Pain assessment and drug consumption before surgery</td>
<td>Descriptive statistics, Mann-Whitney U test, chi-square test, Fisher's exact test, Wilcoxon's signed rank test</td>
</tr>
<tr>
<td>4</td>
<td>Randomised trial</td>
<td>127 patients with confirmed hip fractures (same as Paper 3)</td>
<td>Assessment of cognitive status before and after surgery</td>
<td>Descriptive statistics, Mann-Whitney U test, chi-square test</td>
</tr>
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**Paper 1**

An integrative review of the literature on emergency care in patients with hip fractures or suspected hip fractures. This design includes all the possible evidence relating to what could contribute to the current state of the literature.

**Paper 2**

A prospective observational study that explored the assessed pain levels in patients with suspected hip fractures when first meeting the EMS and at hospital admission was conducted. This study also evaluated prehospital pain management in the investigated EMS.
Papers 3 and 4
A double-blinded, randomised, placebo-controlled clinical trial (RCT), from which the data collection was undertaken. The intervention group received an FICB with ropivacaine and the control group received an FICB with saline (placebo).

Paper 3 evaluated the effect of FICB in relation to pain and medical pain relief, when added to regular preoperative analgesia. The primary endpoint was the change in reported pain on movement from admission to the ward until two hours after FICB administration.

Paper 4 examined whether preoperative pain management with FICB could have an effect on cognitive status.

Settings
Paper 1
The literature on the emergency care of patients with hip fractures or suspected hip fractures, from the time of the injury to the time of surgery

Paper 2
A prehospital environment with EMS care in the region of western Sweden. At the time of the study, the region had a population of 1.6 million inhabitants and the EMS had a total fleet of 123 ambulances [108]. The investigated timeline was from the site of injury until admission to the receiving hospital.

Papers 3 and 4
An orthopaedic ward at a university hospital in central Sweden. The patients were examined with X-rays directly from EMS care. After fracture confirmation, patients were admitted directly to the ward by the EMS. The studied timeline was from admission to the ward after fracture confirmation by X-ray to six hours after FICB.

Participants
The population studied in this thesis were older persons with hip fractures or suspected hip fractures. Accordingly, the review (Paper 1) was conducted on articles relating to patients with hip fractures from the injury to surgery.
Inclusion criteria

Paper 1

Eligible original research articles were included if they had been published between 1998 and 2017 and if they described the chain of emergency care for patients with hip fractures after falling. Studies were excluded if they focused on a nursing process other than emergency care, e.g. postoperative care, or if they did not cover the time before surgery at all. Review audits, study protocols, case reports and routine descriptions were excluded. The literature search and screening processes are characterised by four steps: Identification, Screening, Eligibility and Inclusion (figure 2).

![Diagram of literature search and screening processes]

Figure 2. Literature search and screening processes.
Paper 2
Patients with a suspected hip fracture aged 65 or older were consecutively included. A suspected hip fracture was defined as pain in the hip area, the inability to stand or lift the injured leg after a fall and/or a shortened outward rotated leg. Inclusion and data collection are described in Figure 3.

![Flow chart of dynamic pain and pain assessment scales. NRS = numerical rating scale, BRS = behaviour related scale, SD = standard deviation, iqr = interquartile range.](image)

**Figure 3. Flow chart of dynamic pain and pain assessment scales.** NRS = numerical rating scale, BRS = behaviour related scale, SD = standard deviation, iqr = interquartile range

Papers 3 and 4
1) A radiographically confirmed hip fracture; 2) age > 64 years; 3) a fascia iliaca compartment block administered within one hour of admission to hospital; 4) consent to participate; 5) single hip fracture; 6) trauma less than 12 h prior to inclusion; 7) no hypersensitivity to local anaesthetics; 8) no infection in the injection area; 9) no neurovascular problems in the affected leg and 10) patients assessed as not being at risk of complications from the FICB due to health status. The inclusion and randomisation process is presented in Figure 4.
Sample size calculation

Paper 1
Not applicable

Paper 2
Consecutively included participants, no power calculation was made.

Paper 3
A sample size calculation was performed using data from Candal-Couto [91]. It was proposed that, using a visual analogue scale (VAS), the pain score on movement would be reduced from 7.2 (SD 1.8) prior to injection to 3.6 (SD 2.4) one hour after the injection. In the control group, we expected a reduction in pain score on movement from 7.2 (SD1.8) to 5.5 (SD2.4) using a VAS. This would give a power of 90% at a significance level of 0.05 using a two-sided Mann-Whitney U test if there were 70 patients, 35 in each arm.

Paper 4
No power calculation was made for Paper 4.

Figure 4. Flow diagram (CONSORT 2010) showing the inclusion and analysis process of the RCT.
**Procedure**

**Paper 1**

The integrative review comprised a five-stage methodology: problem identification, literature search, data evaluation, data analysis and presentation of results [109].

The problem identification revealed unsatisfactory evidence on emergency care for patients with a suspected hip fracture after falling, with the emphasis on the patients’ pain.

A comprehensive literature search, in line with the PRISMA guidelines [110], was carried out using five databases: PubMed, CINAHL, Scopus, Web of Science and The Cochrane Library. The search was limited to research in the English language and peer-reviewed qualitative and quantitative research articles from the years 1998 to 2017. The literature search was repeated as new literature appeared during the work, so the final literature search was carried out in March 2017. Complementary manual searches were undertaken from the included literature reference lists. Screening from titles to abstract-read-through were the words “fractured neck of femur” or “hip fractures” and one or more of the following words and terms: pain, pain relief, emergency, prehospital, nerve block, opioids, cognition, outcome and/or preoperative. The search expertise of an experienced librarian provided guidance and support.

**Paper 2**

Prior to study start, the operational managers of the five EMS organisations in the region gave permission for the study to be conducted. As the pain scoring was mandatory and made a part of the medical records, there had to be an agreement in all organisations. Furthermore, all five prehospital medical consultants in the region gave their approval to the pain assessment procedure. In order to facilitate the appropriate documentation of the patients’ assessed pain, the medical records system was reprogrammed.

All EMS care providers in the region attended an educational programme focusing on methods for the assessment of pain. More than 500 health care providers took part in the educational programme. The EMS care providers were periodically updated on the progress of the study throughout the data collection period.

**Papers 3 and 4**

The 34 physicians who performed the FICBs underwent training, consisting of theory and practice relating to FICB under supervision. The physicians were also educated in the patient inclusion procedure. All health-care providers were educated in pain assessment with the Stockholm South General
Hospital Pain Instrument (SSGHPI), filling out case report forms (CRF) and the randomisation and blinding procedure according to the study protocol. An external monitor was engaged for surveillance of the study’s compliance with the protocol.

A fast-track protocol was established at the hospital where the RCT was conducted. This meant that the prehospital emergency nurse (PEN) made an assessment at the site of the injury and diagnosed suspected hip fractures. Typical symptoms were assessed, including classical clinical signs such as an outwardly rotated, shortened leg, severe hip pain, inability to lift the leg and a history of falling prior to the hip pain. Pain medication was provided and the patient was transported to the X-ray department (the PEN routinely made a call to prepare the X-ray department). The X-ray examination confirmed or rejected the suspicion of fracture.

Patients were consecutively included in the study on the orthopaedic ward. The ward nurse in charge informed the patient of the opportunity to participate in the study. Inclusion and randomisation were commenced less than one hour after hospital admission, as the FICB had to be performed within one hour of hospital admission in order to fulfil the inclusion criteria. After inclusion, a sealed opaque envelope with instructions was opened by a nurse not connected to the study, who prepared a syringe with 30 ml of 2mg/ml ropivacaine or 30 ml of placebo (saline), depending on allocation to the intervention or control group. The needle used was a regular sharp needle for intramuscular injections (Braun Sterican® 0.8x60mm). The patient, the physician performing the FICB and the nurses performing tests and filling out CRFs were blinded to the administered substance. Randomisation and preparation were carried out by a statistics expert not involved in the evaluation of the study. Randomisation was carried out using the Statistical Package for the Social Sciences for Windows, Version 14.0.1, and information about the study intervention was sealed in envelopes. The envelopes were numbered and stacked in numerical order; the code number matched the consecutive inclusion of patients.

**Measurements**

**Paper 2**

A numerical rating scale (NRS) was the first choice to assess the patients’ pain. If the patient was not able to provide an NRS score, a behaviour-related scale (BRS) was used by the EMS care providers.

Pain scores were synthesised into the largest comparable format. This meant that NRS scores were converted into three corresponding categories
according to the BRS (see Figure 5). Intervals of NRS scores were converted to a total pain score (TPS) as follows:
  TPS 1 corresponds to NRS 0 to 3 or BRS 0-3 and
  TPS 2 corresponds to NRS 4 to 7 or BRS 4-7 and
  TPS 3 corresponds to NRS 8 to 10 or BRS 8-10.

Figure 5. Numerical Rating Scale (NRS) and Behaviour Related Scale (BRS). Visualisation of conversion of NRS scores and BRS scores to total pain score (TPS).

Paper 3
The primary endpoint was the change in reported pain on movement after FICB administration and two hours after FICB.
  The secondary endpoints were:
  - the change in pain scores on movement 15 min and 6 h after the FICB
  - the change in pain scores at rest, 15 min, 2 h and 6 h after the FICB
  - pain relief among patients with cognitive impairment
  - analgesic consumption
  - length of hospital stay
The SSGHPI was used for pain assessment (Figure 6). The SSGHPI is a combination of self-rating scales: a visual analogue scale (VAS), a numerical rating scale (NRS) from 0 to 10, a verbal rating scale (VRS) and a behaviour related scale (BRS) [58]. The patient used one of the first three scales that he or she found most appropriate. The fourth scale, the BRS, was used by the health-care providers only when the patients were not able to assess and describe their own pain. In order to compare pain measurements with the different scales, a synthesis of the scales was made; NRS and VRS scores were converted to the VAS. From this point, the VAS will be referred to the synthesis of the scales as “generalised VAS”; this is presented as VAS in the results with a scoring range from 0 to 10. For a comparison of all patients regardless of cognitive function, the “generalised VAS” was converted into the three BRS categories in the following way (Figure 6): 0-3.0 = 1; 3.1-7.9 = 2 and 8.0-10 = 3 [58].

Other collected variables were age, gender, ASA score, type of fracture and waiting time for surgery.
Figure 6. Stockholm South General Hospital Pain Instrument: visual explanation of the translation of the four scales. The three categories are separated by the lines in the figure, categories represented by the numbers. All four possible versions of pain assessment using the Stockholm South General Hospital Pain Instrument: visual analogue scale (VAS), verbal rating scale (VRS), numerical rating scale (NRS) and behaviour related scale (BRS). The latter was used by the health-care providers to assess pain in patients who were unable to use any of the other scales.

Paper 4
Cognitive screening was carried out with the Short Portable Mental Status Questionnaire (SPMSQ). The SPMSQ is also known as Pfeiffer’s test [111] and is used in the Swedish National Registry of hip fracture patient care [29]. The SPMSQ is a 10-item questionnaire that can be administered verbally and shows good sensitivity and specificity [112]. The SPMSQ consists of the following questions: 1. What date, month and year is it?; 2. What day
of the week is it? 3. What is the name of this place? 4. What is your phone number? 5. How old are you? 6. When were you born? 7. Who is the current prime minister? 8. Who was the prime minister before him? 9. What was your mother’s maiden name? 10. Can you count backwards from 20 in 3s? Every correct score gives one point. Mother’s maiden name is scored as correct if it is not the same as the patient’s surname. The scores on the SPMSQ were divided into four groups 0-2; 3-5; 6-7; 8-10. A score of 0-2 is regarded as severe cognitive impairment; 3-5 and 6-7 are regarded as moderately or mildly impaired and 8-10 is regarded as cognitively intact [34].

Other collected variables were age, gender, type of fracture, analgesia, pain and diagnosis of dementia.

**Data collection**

**Paper 1**

After inclusion the quality of the articles selected for full text review was critically appraised. Quality in this context was the appraised methodological evidence quality according to the chosen quality appraisal tool.

Quantitative papers were appraised with Grading of Recommendations Assessment, Development and Evaluation (GRADE) [113, 114]. Qualitative papers were appraised using the Qualitative Assessment and Review Instrument (QARI) [115].

Reading the full-text paper was followed by a comprehensive quality review using the chosen appraisal system. Quantitative papers were quality appraised using the GRADE checklist provided by the Swedish Agency for Health Technology Assessment and Assessment of Social Services [116]. This checklist considers risk of bias (in four components: study design, study quality, consistency and directness), effect size and dose response. For qualitative papers, quality was appraised regarding methodology, theoretical location, participant representation, trustworthiness and ethical considerations.

After appraising the quality components of each paper, a conclusion on the overall quality level was determined in the levels of high, moderate, low or very low.

**Paper 2**

Patients were included consecutively from 1 September 2015 to 31 August 2016. All data were recorded prospectively in the patients’ electronic medical records by the PEN in charge of the patient. The collected data consisted of pain, type and dosage of medication during prehospital care, duration of
prehospital care, patients’ age and gender. Data were extracted digitally from the electronic medical records database for analysis.

The assessment of pain in patients with a suspected hip fracture was performed by PENs according to the following routine: dynamic and static pain were first assessed at the place of injury when examining the patient, before the administration of pain relief. The second assessment of dynamic and static pain took place upon admission to hospital. Data on the assessment of pain and the use of medication were documented in each patient’s electronic medical records by the PEN in charge of the patient.

Papers 3 and 4
The CRF was filled out by the ward nurses, who also conducted the assessment of the study patients. Patient characteristic data and data on medical pain relief were retrieved from the patients' medical records.

Paper 3
Data on the patients’ pain at movement (dynamic pain) and at rest (static pain) were collected before FICB and 15 minutes, two hours and six hours after FICB. Pain data were recorded on a CRF.

Paper 4
Cognition data were recorded using the SPMSQ on a CRF. Data were collected before FICB and on the first postoperative day.

Data analysis

Paper 1
Inductive content analysis was used to identify patterns and relationships in the text. First, the text was read through to obtain an understanding of the data as a whole. Text segments that related to the study aim were identified by open coding. These text segments were compared to find differences and similarities. Subsequently, categories and subcategories were generated from the text segments. Finally, three core elements were generated and synthesised to the most abstract understanding of the content.

After a preliminary analysis, discussions were held between the authors to validate the final results. Core elements, categories and subcategories were discussed by the authors before a consensus solution was reached.

Paper 2
Descriptive statistics were used to summarise socio-demographic and clinical characteristics. Pain prevalence before and after treatment was presented in frequencies and proportions and the distribution of pain ratings was presented in terms of mean and standard deviations or median and quartiles.
Since the explored variables were ordinal, a non-parametric test – Wilcoxon’s test – was used for comparisons within groups over time and the Kruskal-Wallis test was used for comparisons between groups. After the classification of “pain change” after treatment into three categories (reduced, increased and unchanged pain level), cross-tables and the chi-square test were used to compare the distribution of patients according to the category of pain change between different subgroups. A p value of < 0.05 was regarded as statistically significant. The statistical analyses were conducted using the Statistical Package for Social Services Version 22 [117].

Paper 3

Continuous variables were presented as the mean, standard deviation, median and range. Categorical variables were presented as percentages. For comparisons between the intervention group and the control group, the Mann-Whitney U test was used for continuous variables, the Mantel-Haenszel chi-square test was used for ordinal categorical variables, Fisher's exact test was used for dichotomous variables and the Pearson chi-square test was used for non-ordinal categorical variables. Changes in pain score from baseline to 15 min, two hours and six hours were compared between the intervention and the control group. Mean differences in changes between the intervention and control group were given, together with a bootstrapped 95% confidence interval for the VAS in the tables.

Adjustments for differences in baseline variables were made using covariance analysis (ANCOVA) for continuous variables. An adjusted mean difference with 95% confidence intervals was calculated in the ANCOVA analyses. Changes within groups were analysed with Wilcoxon’s signed rank test for continuous variables and with the sign test for ordered categorical variables. All significance tests were two-sided and conducted at the 5% significance level. All statistical analyses and tests were carried out using IBM SPSS Statistics Version 22 [117].

Paper 4

Descriptive statistics such as means, standard deviations (SD), median, range and proportions were used to summarise socio-demographic and clinical characteristics. For comparisons between the two groups with respect to categorical data, the chi-square test was used. When comparing groups with respect to morphine dose, skewed distributions deviating from normal distribution were used and non-parametric tests were used (Mann-Whitney’s test). After establishing a classification of SPMSQ change from admis-
sion to postoperative period in three classes (decreased, increased and un-
changed level), the chi-square test was used to compare the distribution of
the classified categories between the two groups.

Ethical considerations

Ethical approval was received for the prehospital observational study (Paper
2) from the Regional Ethics Board in Gothenburg, Dnr. 205-15. All the pa-
tients received oral and written information about the study and they were
given the option of declining participation without affecting the care that
they received. The procedures that were undertaken were in accordance
with the ethical standards of the responsible committee on human experi-
ments and the Helsinki Declaration.

For the RCT (Papers 3 and 4), ethical approval was granted by the Re-
gional Ethics Board in Uppsala, Dnr. 2008/172. The study was pursued in
accordance with the ethical standards of the responsible committee on hu-
man experiments and the Helsinki Declaration. Approval was also given by
the Swedish Medical Products Agency, Dnr. 151:2008/60682, trial registry:
EudraCT number 2008-004303-59. Written consent was obtained from the
patients. Patients who were unable to give their consent were included fol-
lowing presumed consent. Patients were included on presumed consent
when they were assessed as not having the capacity for consent at the time
of inclusion. This assessment was made by the including physician, together
with the nurse responsible for the patient. The SPMSQ was used to support
the decision of inclusion on presumed consent. Presumed consent was given
with the support of the regional ethics board in Uppsala, as supported by
Swedish law. The FICB was given in addition to the regular analgesia that
all patients received. In order to find evidence of whether or not an FICB is
of real benefit to patients with hip fractures, blinding was necessary.
5. Results

Paper 1 gives a description of the available evidence throughout the chain of emergency care for patients with suspected hip fractures. Thirty-four quantitative and four qualitative articles were included in this integrative review. A range of methods were represented, from double-blind, randomised, controlled trials to qualitative interview studies. Overall, the studies included material from 6,492 patients. All articles had pain and/or pain management as the main topic of concern. According to the literature, preoperative pain is the main problem for patients with hip fractures and the pain experience is closely connected to cognitive impairment. As a result, pain management in patients suffering a hip fracture is one of the greatest challenges to health care and cognitive impairment makes pain management even more challenging.

The data analysis of the included literature generated the subsequent subcategories: collection of symptoms and signs; attention paid to and observation of patients’ experiences; support and enhancement of patient participation; improved chain of emergency care; measurements and ongoing dialogue with the patient; and follow-up of outcome measurements. Examples from the text-generating subcategories are presented in Table 2.

The subcategories in their turn generated the categories of observation of need for care; implementation and improvement; and measurement and verification.

Finally, three core elements, identification, intervention and evaluation, were abstracted.
A synthesis of the results from primary sources generated a conceptual evidence-based model of the process driving the chain of emergency care for patients with suspected hip fractures after falling (Figure 7). In this model, the chain of emergency care includes the prehospital phase and the inpatient phase until admission to surgery or alternatively until X-ray.

Table 2 Summary of categories and subcategories according to their content, with examples from the text explaining the origin of the subcategories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Examples from text</th>
<th>Content in article</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation of need for care</td>
<td>Collection of symptoms and signs</td>
<td>Pain, impaired cognition</td>
<td>All articles</td>
</tr>
<tr>
<td></td>
<td>Attention paid to and observation of</td>
<td>Worry, resignation, fear, thirst, hunger, waiting</td>
<td>Articles no. 35-38</td>
</tr>
<tr>
<td></td>
<td>patients’ experiences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation and improvement</td>
<td>Support for and enhancement of</td>
<td>Patient information, Attention to patients’ specific</td>
<td>All articles except no. 30</td>
</tr>
<tr>
<td></td>
<td>patient participation</td>
<td>needs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved chain of emergency care</td>
<td>Improve pain relief, Current and new methods for pain</td>
<td>All articles except no. 23,24,31,32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>relief, Communication between health care providers</td>
<td>and 38</td>
</tr>
<tr>
<td>Measurement and verification</td>
<td>Measurements and ongoing dialogue</td>
<td>Pain scales, Asking questions, Cognitive status</td>
<td>All articles</td>
</tr>
<tr>
<td></td>
<td>with the patient</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Follow-up of outcome measures</td>
<td>Time to surgery, Length of hospital stay, Pressure</td>
<td>All articles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ulcers, Infections, Costs</td>
<td></td>
</tr>
</tbody>
</table>
Figure 7. The emergency care model for patients with suspected hip fractures after falling, presenting the chain of care that includes the prehospital phase and the inhospital phase until admission to surgery or alternatively until X-ray.

Paper 2 describes pain and pain management in 1426 patients with suspected hip fractures in a prehospital environment. The mean age was 83.1 (SD 9.0) years and 995 patients (70%) were women.

On first EMS encounter, the median dynamic NRS pain score was eight and 84% of the patients had severe or moderate dynamic pain according to the BRS (Table 3).
Table 3. Reported dynamic and static pain scores on EMS arrival and at hospital admission

<table>
<thead>
<tr>
<th>Pain score</th>
<th>Pain</th>
<th>EMS arrival</th>
<th>Admission</th>
<th>Pain decrease</th>
<th>p-value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRS Dynamic</td>
<td>Median (iqr)</td>
<td>8 (5-10)</td>
<td>5 (3-7)</td>
<td>2 (0-4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total n</td>
<td></td>
<td>520</td>
<td>503</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRS Static</td>
<td>Median (iqr)</td>
<td>3 (1-6)</td>
<td>2 (1-3)</td>
<td>1 (0-2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total n</td>
<td></td>
<td>501</td>
<td>480</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRS Dynamic n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>144 (16)</td>
<td>361 (39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>394 (43)</td>
<td>451 (49)</td>
<td>405 (45)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>8-10</td>
<td>368 (41)</td>
<td>111 (12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total n</td>
<td></td>
<td>906</td>
<td>923</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRS Static n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>614 (68)</td>
<td>775 (84)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>231 (26)</td>
<td>125 (14)</td>
<td>188 (21)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>8-10</td>
<td>53 (6)</td>
<td>19 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total n</td>
<td></td>
<td>898</td>
<td>919</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NRS= Numerical Rating Scale; BRS= Behavior Related Scale; iqr = inter quartile range. a) Change over time, Wilcoxon’s test.

On admission to hospital, the median dynamic NRS pain score was reduced to five and 45% of the patients had reduced dynamic pain according to the BRS. Of all 1,426 patients, 679 (48%) had reduced pain according to the TPS. The median static NRS score on the first EMS encounter was three and at hospital admission it was two. Of the patients who scored pain with the BRS, 32% had moderate to severe static pain on EMS arrival and 21% of the patients had reduced static pain scores on hospital admission. According to the TPS, 37% of the patients had moderate to severe static pain on EMS arrival and 25% of the patients had reduced static pain at hospital arrival (Table 4).
Table 4. Reported dynamic and static pain scores on EMS arrival and at hospital admission for all patients, presented in categories.

<table>
<thead>
<tr>
<th>Pain score</th>
<th>Category</th>
<th>EMS arrival</th>
<th>Admission</th>
<th>Pain decrease n (%)</th>
<th>p-value a</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRS Dynamic</td>
<td>0-3</td>
<td>144 (16)</td>
<td>361 (39)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-7</td>
<td>394 (43)</td>
<td>451 (49)</td>
<td>405 (45)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>8-10</td>
<td>368 (41)</td>
<td>111 (12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRS Static</td>
<td>0-3</td>
<td>614 (68)</td>
<td>775 (84)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-7</td>
<td>231 (26)</td>
<td>125 (14)</td>
<td>188 (21)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>8-10</td>
<td>53 (6)</td>
<td>19 (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRS Dynamic</td>
<td>1</td>
<td>51 (10)</td>
<td>146 (29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>179 (34)</td>
<td>271 (54)</td>
<td>274 (53)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>290 (56)</td>
<td>86 (17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRS Static</td>
<td>1</td>
<td>267 (53)</td>
<td>373 (78)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>169 (34)</td>
<td>91 (19)</td>
<td>168 (34)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>65 (13)</td>
<td>16 (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPS Dynamic</td>
<td>1</td>
<td>195 (14)</td>
<td>507 (36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>573 (40)</td>
<td>722 (50)</td>
<td>679 (48)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>658 (46)</td>
<td>197 (14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPS Static</td>
<td>1</td>
<td>881 (63)</td>
<td>1148 (82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>400 (29)</td>
<td>216 (15)</td>
<td>356 (25)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>118 (8)</td>
<td>35 (3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BRS= Behavior Related Scale; NRS= Numerical Rating Scale; TPS= Total Pain Score (all patients). The TPS is a synthesis of the BRS and NRS. Pain decrease is the number of patients that reported a reduction in pain from a higher to a lower category. a) Change over time, Wilcoxon’s test

The NRS was judged to be feasible and was used for pain assessment in only 36% of all patients. A larger number of different drugs administered for pain relief per patient was associated with a decrease in dynamic pain scores (Table 5). In all, 1,074 (75%) patients received medication for prehospital pain relief.
Table 5. Number of drugs grouped according to change in dynamic pain (TPS) from EMS first encounter until admission to hospital.

<table>
<thead>
<tr>
<th>TPS change</th>
<th>Drugs, n a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced pain (n=679)</td>
<td>Mean (SD) 1.6 (0.9)</td>
</tr>
<tr>
<td></td>
<td>Median (iqr) 2 (1-2)</td>
</tr>
<tr>
<td>Unchanged pain (n=731)</td>
<td>Mean (SD) 0.9 (0.9)</td>
</tr>
<tr>
<td></td>
<td>Median (iqr) 1 (0-2)</td>
</tr>
<tr>
<td>Increased pain (n=16)</td>
<td>Mean (SD) 0.7 (1.1)</td>
</tr>
<tr>
<td></td>
<td>Median (iqr) 0 (0-1)</td>
</tr>
</tbody>
</table>

TPS change=change in total pain score from EMS first contact until hospital admission; iqr=inter quartile range

a) Number of pharmaceutical drugs per patient (p<0.001)

More reduced pain scores were reported in patients with a longer duration of prehospital care. The number of drugs administered for pain relief per patient increased with the duration of prehospital care, but there was no difference in the mean doses of the administered drugs (Table 6).

Table 6. Types, dosages and number of drugs in relation to the duration of prehospital care

<table>
<thead>
<tr>
<th>Time in EMS care</th>
<th>≤ 40 min (n=412)</th>
<th>40 - 60 min (n=646)</th>
<th>≥ 61 min (n=368)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>5.1 (2.2), 193</td>
<td>5.2 (2.5), 414</td>
<td>5.7 (2.8), 268</td>
</tr>
<tr>
<td>Alfentanil</td>
<td>0.7 (0.9), 63</td>
<td>0.6 (0.5), 143</td>
<td>0.6 (0.4), 74</td>
</tr>
<tr>
<td>Ketamine</td>
<td>27 (13), 5</td>
<td>33 (19), 31</td>
<td>30 (12), 29</td>
</tr>
<tr>
<td>Esketamine</td>
<td>15 (7), 30</td>
<td>16 (7), 92</td>
<td>6 (8), 69</td>
</tr>
<tr>
<td>Midazolam</td>
<td>1.6 (1.2), 41</td>
<td>1.5 (1.0), 125</td>
<td>1.3 (0.9), 100</td>
</tr>
<tr>
<td>Diazepam</td>
<td>2.8 (1.2), 25</td>
<td>2.7 (1.4), 52</td>
<td>2.5 (1.6), 42</td>
</tr>
<tr>
<td>Drugs a</td>
<td>0.9 (0.9)</td>
<td>1.3 (0.9)</td>
<td>1.6 (1.0)</td>
</tr>
</tbody>
</table>

Drug doses are presented as the mean (SD), n. All doses are in milligrams (mg).

a) Number of pharmaceutical drugs per patient (p<0.001)

A reduction in pain was more frequently represented in patients that received medication for pain relief (Table 7). A combination of an analgesic drug and a benzodiazepine, as well as a combination of alfentanil and morphine, was associated with frequent pain decrease.
Table 7. Description of medication ranked on pain-relieving effect. Medication may be a combination of drugs or a single drug.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Medication</th>
<th>Pain decrease, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Morphine + ketamine + benzodiazepine (n=157)</td>
<td>110 (70)</td>
</tr>
<tr>
<td>2</td>
<td>Morphine + benzodiazepine (n=102)</td>
<td>68 (67)</td>
</tr>
<tr>
<td>3</td>
<td>Ketamine + benzodiazepine (n=82)</td>
<td>54 (66)</td>
</tr>
<tr>
<td>4</td>
<td>Morphine + alfentanil (n=169)</td>
<td>110 (65)</td>
</tr>
<tr>
<td>5</td>
<td>Alfentanil (n=87)</td>
<td>49 (56)</td>
</tr>
<tr>
<td>6</td>
<td>Other (n=53)</td>
<td>29 (55)</td>
</tr>
<tr>
<td>7</td>
<td>Morphine (n=424)</td>
<td>208 (49)</td>
</tr>
<tr>
<td>8</td>
<td>None (n=352)</td>
<td>51 (14)</td>
</tr>
<tr>
<td></td>
<td>Total n=1,426</td>
<td>n=679</td>
</tr>
</tbody>
</table>

There was no difference in pain intensity scores regarding different district zones or the patients’ age or the patients’ gender.

Paper 3 showed that the effect of adjuvant treatment with FICB given as a complement to routine preoperative analgesia improved pain management in one in four patients with a hip fracture. This RCT comprised 127 patients who were randomised to either intervention (n=66) or control (n=61). Their average age was 85 years and two of three patients were female.

The change in dynamic pain from admission to two hours after FICB (the primary endpoint) improved in the intervention group compared with the control group. The mean VAS score for dynamic pain decreased by 1.0 (SD 1.9) in the intervention group from admission until two hours compared with an increase of 0.5 (SD 2.8) in the VAS score in the control group (p=0.002). When looking at the change in dynamic pain according to the BRS score from admission to two hours after FICB, there was a significant difference between the two groups in favour of the intervention group (p=0.01) (Table 8).

There was no significant improvement in the VAS score for static pain. The change in static pain according to the BRS score differed significantly in favour of the intervention group (p=0.03).

Pain relief had a rapid onset after the FICB; many patients experienced a reduction in pain within 15 minutes. The effect of the FICB was significantly reduced within a six-hour period.
Table 8. Change in the VAS and BRS from admission to two hours, test between groups and bootstrapped 95% CI (all patients)

|                  | Intervention group (n=63) | Control group (n=58) | p-value* (adj. p-value**) | Mean change (95% CI)  
|------------------|---------------------------|-----------------------|---------------------------|-----------------------
| Change VAS Dynamic | -1.0 (1.9)                 | 0.5 (2.8)             | 0.002 (0.09)              | 0.002 (-2.5; -0.4)    |
|                  |                           | 0 (-6; 2)             |                           |                       |
|                  |                           | n=39                  |                           |                       |
| Change VAS Static | -0.6 (2.6)                 | 0.4 (2.0)             | 0.07 (0.13)               |                       |
|                  |                           | 0 (-7; 6)             |                           |                       |
|                  |                           | n=40                  |                           |                       |
| Change BRS Dynamic | Decrease 13 (21.0%)          | 6 (10.7%)             | 0.01                      |                       |
|                  | Equal 44 (71.0%)            | 36 (64.3%)            |                           |                       |
|                  | Increase 5 (8.1%)           | 14 (25.0%)            |                           |                       |
| Change BRS Static | Decrease 20 (31.7%)          | 7 (12.1%)             |                           |                       |
|                  | Equal 39 (61.9%)            | 46 (79.3%)            | 0.03                      |                       |
|                  | Increase 4 (6.3%)           | 5 (8.6%)              |                           |                       |

For continuous variables, the mean (SD) is presented at the top and the median (min; max) and n are presented below. For categorical variables, n (%) is presented.

* Test between groups, intervention change vs. control change ** Adjusted p-values are given for variables that differ significantly (p<0.05) at baseline between the intervention and control group. *** Difference between groups. Calculation of confidence interval for continuous variables is based on bootstrapping of 10,000 replicates picking the 2.5 and 97.5 percentiles of the 10,000 mean differences as the confidence interval. Outlined values represent the primary endpoint.

According to a sub-analysis of patients included on presumed consent (n=45), there was no significant difference in the change in reported pain at two hours after FICB between the intervention group (n=23) and the control group (n=22) (p=0.39). Furthermore, no difference was found in the amount of administered morphine or paracetamol or the length of stay (LOS) in hospital between the groups. No serious adverse events due to the FICB were reported.
Paper 4 investigated the effect of FICB on cognitive status in patients with hip fractures. The SPMSQ scores were obtained at hospital admission and on the first postoperative day. There was no difference between the intervention group and the control group regarding the distribution of patients in SPMSQ categories at hospital admission. Nor was there any difference in the distribution of patients in SPMSQ categories on the first postoperative day. Both groups had an increased proportion of patients in the SPMSQ 0-2 group on the first postoperative day, representing patients with severe cognitive impairment (Table 9).

**Table 9. Cognitive status on admission to hospital and on the first postoperative day**

<table>
<thead>
<tr>
<th>Group</th>
<th>SPMSQ category on admission to hospital (n=127) (p=0.6)</th>
<th>Postoperative SPMSQ category (n=125) (p=0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2  3-5  6-7  8-10</td>
<td>0-2  3-5  6-7  8-10</td>
</tr>
<tr>
<td>Intervention,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>14 (21) 7 (11) 7 (11) 38 (58)</td>
<td>19 (29) 2 (3) 12 (18) 32 (49)</td>
</tr>
<tr>
<td>Control, n (%)</td>
<td>11 (18) 9 (15) 10 (16) 31 (51)</td>
<td>15 (29) 4 (7) 7 (12) 34 (57)</td>
</tr>
</tbody>
</table>

The p-value refers to the difference in the distribution of patients according to SPMSQ scores between the intervention and control groups.

There was a slight improvement in patients’ cognitive status assessed with SPMSQ scores in the intervention group, but this difference was not significant (Table 10). Most of the patients had an unchanged cognitive status.

**Table 10. Change in SPMSQ category between groups from admission to first post-operative day (n=125) (p=0.3)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Decrease</th>
<th>Unchanged</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention, n (%)</td>
<td>4 (6)</td>
<td>48 (74)</td>
<td>13 (20)</td>
</tr>
<tr>
<td>Control, n (%)</td>
<td>8 (13)</td>
<td>43 (72)</td>
<td>9 (15)</td>
</tr>
</tbody>
</table>

When comparing doses of morphine, there was no difference in the mean prehospital dose of morphine between the three groups, 8-10, 6-7 and 3-5. However, when comparing the three groups and the 0-2 group, patients in the 0-2 group received significantly lower morphine doses (Table 11). An analysis of the number of patients treated with morphine by the EMS showed that there was no difference when comparing cognitively intact patients with those with a cognitive impairment.
Table 11. Morphine administered in mg by SPMSQ group (n=127)

<table>
<thead>
<tr>
<th>Morphine administration</th>
<th>SPMSQ on arrival to hospital</th>
<th>n</th>
<th>Morphine dose in mg</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Median (min-max)</td>
</tr>
<tr>
<td>Prehospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>25</td>
<td>2.5</td>
<td>4.02 (2.37)</td>
<td>4.0 (0-9.5)</td>
</tr>
<tr>
<td>3-10</td>
<td>102</td>
<td>6.43</td>
<td>6.75 (0-25)</td>
<td></td>
</tr>
<tr>
<td>0 - 2h</td>
<td>25</td>
<td>1.70</td>
<td>1.5 (0-6)</td>
<td>0.20</td>
</tr>
<tr>
<td>3-10</td>
<td>102</td>
<td>2.38</td>
<td>2.00 (0-18)</td>
<td></td>
</tr>
<tr>
<td>2 - 6h</td>
<td>25</td>
<td>1.14</td>
<td>0 (0-5)</td>
<td>0.58</td>
</tr>
<tr>
<td>3-10</td>
<td>102</td>
<td>0.95</td>
<td>0 (0-7)</td>
<td></td>
</tr>
</tbody>
</table>

0-2 h = interval from hospital admission to two hours after FICB; 2-6 h = interval from two to six hours after FICB
6. Discussion

Research shows that pain is the main problem for patients suffering a hip fracture. The overall aim of this thesis was to evaluate the preoperative management of pain from the perspectives of a literature overview, emergency medical service pain management routines, an intervention with a fascia iliaca compartment block and the association between cognitive status and the treatment of pain.

The current literature was reviewed in an integrative literature review. The EMS pain management routines were described in an observational cohort study. The pain relieving effect of preoperative FICB and the association between cognitive status and the treatment of pain was investigated in a double-blinded RCT. The core components in this thesis are pain, pain assessment, pain treatment.

Pain assessment

Pain has been a known problem among patients with hip fractures (Paper 1) and Papers 2 and 3 confirm that pain is still a problem for these patients. It proved feasible to use the BRS when needed, especially in patients with hip fractures, as two thirds of the patients were assessed using the BRS. This means that the commonly used VAS and NRS should be accompanied by the BRS (Paper 2). Follow-up questions on the patients’ pain in addition to pain scales are recommended, as they give the pain assessment a further dimension and an understanding of the patients’ needs [21].

According to previous research, enhanced pain assessment would extend the treatment and improve the relief of pain [63, 67]. In spite of this, other studies claim that increasing the assessment of pain will increase pain treatment without improving patient satisfaction [118]. Our studies (Papers 2 and 3) do not support the assumption that increased pain assessment will improve the management of pain. In fact, the results showed that 25% of the patients with suspected hip fractures did not receive pain medication from the EMS (Paper 2). Several of these patients had reported severe pain both on their first encounter with the EMS and on arrival at hospital. One immediate suggestion would be to administer pain-relieving drugs to all patients with suspected hip fractures, as suggested by the local EMS guidelines, if not contraindicated [75].

Interventions to reduce pain can be regarded as modest when looking at the mean morphine doses that were given (Paper 3). The median dynamic VAS pain scores were 7 at two hours and six hours after admission. This is
a fairly high pain score, considering that care providers had assessed and documented pain. Being aware of the patients’ level of pain must be the first step toward improved and sufficient pain relief and high pain scores require a distinct intervention. The next step for the care provider must be to trust the result of the pain assessment and then act accordingly. In situations in which the patients are unable to communicate their pain experience, pain should be anticipated, expected, prevented and treated thereafter [21].

**Pain treatment**

The effect of pain relief in prehospital care was statistically significant (Paper 2) and the effect of dynamic pain relief was significant in favour of FICB (Paper 3). In spite of this, the concept of what can be regarded as good or clinically significant pain relief can be challenging to determine [119, 120]. One option is that dynamic pain and static pain could have different aims with regard to pain relief, considering the different nature of the two.

There was a two-step decrease in dynamic NRS scores at hospital admission (Paper 2) and a mean difference in the change in dynamic VAS scores of 1.5 two hours after FICB (Paper 3). Dynamic pain is more challenging to reduce and, to be regarded as clinically significant, pain should be reduced by one step on the NRS or VAS, but an NRS or VAS score below four can also be the estimated minimum for a clinically significant effect [119, 120]. Both the results relating to dynamic pain relief could be regarded as clinically significant.

Static NRS scores showed a median NRS score of two on hospital admission (Paper 2) and the median static VAS score was three in Paper 3. Static pain is more predictable in character and an aim of NRS or VAS scores (on a scale from zero to ten) below four is a relevant aim which can be regarded as clinically significant [119, 121]. The result relating to static pain in both studies could also be regarded as clinically significant.

Having said this, it must be remembered that the evidence behind the term “clinical significance” is limited and research on this topic is therefore warranted.

**Obstacles to the treatment of pain**

Twenty-five per cent of the patients did not receive any pain relief, which means that there are obstacles to providing pain relief within the EMS (Paper 2). Why the PENs did not treat pain in every fourth patient could be explained by attitudes such as a fear of adverse effects and complications following treatment with opioids or modest goals in terms of the relief of
pain [122]. According to Jakopovic [123], PENs want to meet the patients’ needs for pain relief and thus want to relieve the pain effectively. Healthcare providers’ attitude to pain and opioids affects the decision to administer pain medication more than the assessed pain score [122, 124].

Obstacles to the treatment of pain can include both the care-providers’ and the patients’ attitude to the relief of pain [125]. Pain management is a professional responsibility, meaning that nurses and physicians are obliged to relieve pain and the suffering that it causes [70, 71]. Reports of patients’ experiences of hip fracture care range from positive to negative and have been described as a state of oscillation between satisfaction with and enduring a new and demanding situation [7].

Patients who were in EMS care for more than an hour received almost double the number of pain-relieving drugs compared with those in EMS care for less than 40 minutes (Paper 2). This means that more than 20 minutes’ longer care within the EMS is associated with double the amount of administered pain relief. The reason for this was not investigated, but it is reasonable to assume that the shorter period of care within the EMS may be explained to some extent by other priorities, such as documentation, communication with the receiving hospital and assessment of the patient’s status. This may lead to the prioritisation of tasks other than pain relief. In spite of this, 75% of the patients received medical pain relief, which is a relatively high figure compared with studies by Pfrunder [126], who reported pain treatment in 50% of the patients in a similar setting in Sweden. Another prehospital pain management study in a different setting showed that only 28% of patients with hip fractures received medical pain relief [127].

Not all the patients on the orthopaedic ward waiting for surgery who had scored severe pain received additional pain relief (Paper 3). Research has stated that poor communication between the prescribing physician and the nurse is one reason for poorly treated pain [128]. This was not a valid explanation in our study, as the patients had general prescriptions for pain relief on the ward. It is reasonable to assume that the same reasons for not giving additional pain relief as mentioned earlier apply. Perhaps many other tasks prevent the ward nurses from administering effective pain relief. One option to resolve the attitude issue could be education to improve effective pain relief [67, 124]. Examining the dynamic pain scores, it appears that nurses may not trust the pain scores given by the patients. Perhaps increased knowledge, an explicit aim of pain management and a change in attitudes
to the management of pain could improve pain treatment – this remains to be investigated.

**Multimodal pain medication**

We found several drug combinations in EMS care and our results indicate that a combination of potent analgesics in combination with benzodiazepines is successful in relieving pain (Paper 2). Combining two or more drugs was associated with more marked pain relief than the use of single drugs. A multimodal pharmacy for pain relief is recommended at general level by several anaesthetist organisations [129, 130]. The drug combinations in Paper 2 could be expected to be more common if the patient had more severe initial pain. However, this assumption was not confirmed and the best drug combinations and the most optimal doses for pain relief remain to be investigated. Recommendations for multimodal perioperative pain treatment, such as combinations of opioid and non-opioid drugs [131], are somewhat vague and recent research also encourages responsible opioid prescription and the avoidance of excessive reliance on opioids [132, 133]. There is limited evidence relating to the preoperative pain management of patients suffering from pain before surgery [134] and this may explain vague recommendations in the preoperative management of pain.

A multimodal pharmacy should not be misinterpreted as being the same as polypharmacy, which means the prescription of more drugs than are medically necessary and which is strongly related to negative clinical consequences [135, 136].

**FICB**

The current literature recommends that FICB should be part of the preoperative pain management in patients with hip fractures [5, 133]. The place and the provider of FICB should be evaluated and implemented where health care finds it most appropriate [121]. An FICB can be administered by orthopaedic physicians in a safe manner in a setting with reduced patient monitoring (Paper 3). The administration of FICB in a prehospital environment should be considered; two pilot studies have examined this, but more research is needed to confirm whether this is a good clinical pathway [84, 99]. A variety of health-care providers including non-medical practitioners are potential candidates for using FICB [80]. Paper 3 showed significant pain relief in line with previous research, so it is safe to say that preoperative FICB in patients with hip fractures is here to stay.
There was no significant difference between the intervention group and the control group in terms of administered morphine to two hours after an FICB (Paper 3) and these results are in line with most previous blinded studies [81, 137, 138]. Another blinded study reported a reduction in administered morphine [83]. However, several clinical studies that were not blinded and related to the administration of a preoperative FICB indicate a reduction in administered morphine [83, 86-92, 139-141]. Evidently, there are some contradictions between the research results from studies that are blinded and not blinded.

The dose of ropivacaine proved to be safe, as no serious adverse events were reported. Due to limited patient monitoring when administering the FICB, a dose reduction was required by the Swedish Medical Products Agency for safety reasons.

Nerve blocks is considered to be effective and safe as preoperative pain relief in patients with hip fracture and provides pain relief without being limited by patients’ communication skills, gender or cognitive status [90, 96]. Some criticism has levelled against single-injection nerve blocks due to their short duration and the use of catheters was suggested [35]. However, when comparing catheter-FICB with single dose FICB no improved effect was detected [137]. This means that investigations have to be made regarding nerve blocks, when it comes to both techniques and longer-lasting medication, as the waiting time for surgery exceeds the duration of an FICB.

No adverse side-effects with FICB were reported in our study, which is in line with the reviewed literature which includes several studies on altogether 1,492 patients who received a nerve block. There are two reported cases on the side-effect of intravascular injection and in both cases a full recovery was reported [142]. There is also one report on intraneural injection, where the patient made a full recovery [143]. Regarding nausea and vomiting, FICB has fewer side-effects than morphine treatment [137].

**Cognitive impairment**

The PENs administered lower prehospital morphine doses to patients with severe cognitive impairment (Paper 4). It appears that cognitive status affects the given dose of morphine more than the morphine dose affects cognitive status. This imbalance persisted at the hospital, as the accumulated morphine dose during the six first hours in hospital was not corrected by the health-care providers, indicating the inadequate treatment of pain among patients with impaired cognition. One reflection when examining
patients’ medical records is that nurses appear to administer morphine routinely – the same dose was repeated fairly often by the same nurse. Morphine titration on demand to treat pain is a skill that is learned from experience. Prescription of morphine by the physician was often in the interval 2.5-5 mg i.v. on demand. The method of on-demand titration requires time, knowledge, presence and dedication by the administering care providers [144]. Furthermore, severe cognitive impairment often requires more time for pain assessment and lack of time is common in the everyday health-care situation [21].

Patients with severe cognitive impairment have difficulty communicating their pain and asking for pain relief [145-147] and they could therefore benefit a great deal from an FICB, as these patients received lower doses of morphine (Paper 4).

**Methodological considerations**

As the majority of the studies in Paper I relate to high-income countries, the opportunity to generalise the results of this study to fit the circumstances in international settings of other kinds may be limited. Furthermore, the internal validity of the integrative review is possibly subject to both selection and publication bias, as some of the reviewed literature had a limited evidence level. The method developed by Whittemore [109] constitutes a framework that is becoming more frequently used and offers a systematic pathway to review literature using different methods. Whittemore describes the evaluation of the quality of differing designs as complex and states that there is therefore no golden standard for quality appraisal [148]. Whittemore encourages the inclusion of all the literature that is found, regardless of its quality, but he points out that literature of low rigour and relevance should contribute less to the analytical process [109].

**Challenges of pain assessment**

The scales used for the self-assessment of pain in this thesis are well described and validated in the literature and they are well established in clinical pain assessment and research [50, 51, 54-56, 149]. Reducing the number of evaluation steps to three categories makes BRS blunt compared to a scale ranging from 0 to 10 like the VAS or NRS. This means that smaller variations may remain undetected. Moreover, the BRS is only validated once [58]. One advantage of the BRS compared with other behavioural pain instruments in this setting is that the BRS is not dependent on filling out forms. This explains why the BRS is compatible with the swift nature of emergency...
health care. Review literature has suggested that the Abbey Pain Scale is a potentially suitable pain instrument for prehospital use [150, 151], but no clinical study supports this statement. The majority of patients in Paper 2 were assessed using the BRS, which highlights the picture of a complex situation with frail, vulnerable patients who require a delicate assessment and treatment. The first choice for pain assessment was the NRS in Paper 2, while two thirds of the patients were assessed with the BRS. This reflects the fact that the NRS is not suitable in all situations. For example, in a patient who is lying on the floor with a suspected hip fracture in obvious severe pain, an assessment with the BRS may be more appropriate. In an extensive study exploring all types of prehospital pain, only 32% of the patients had undergone a measurement and documentation of its intensity with the NRS or VAS [101] – which is the same percentage as the NRS scores found in Paper 2. When relating the administration of pain medication to the choice of instrument for its assessment (NRS or BRS), there was no difference and this finding suggests that the choice of pain scale did not affect the treatment of pain. The BRS has only been validated once with acceptable agreement between the VAS and BRS and the validation is published in Swedish, which may be regarded as a limitation.

Conversion of pain assessment scales
A synthesis of the NRS and BRS was made by conversion to the TPS in order to be able to compare the overall results including all patients. A similar synthesis was made in Paper 3 using the VAS and NRS by converting to a “generalised VAS”. The VAS and NRS can be regarded as interchangeable and well correlated for comparison and both the VAS and NRS can be reported from zero to ten [54, 55, 77]. The “generalised VAS” was converted into three categories corresponding to the BRS – in the same way as the TPS was synthesised in Paper 2. There is a risk that small variations will not be detected with this conversion, but, nonetheless, converting the VAS or NRS scores into larger categories is not uncommon [149, 152]. When comparing the results in Paper 2 for the change in dynamic pain before and after conversion, differences between the NRS and BRS are fairly small. This is not an agreement test, but it can be regarded as a positive trend and an encouragement to carry out a full agreement test of the scales.

Internal loss of data
In Paper 3, a complete set of data required two pain observations in each patient. There was some internal loss of data in Paper 3 and the results must
be interpreted with some caution. There was a slight imbalance between the two groups at baseline regarding pain according to the VAS for pain on movement, which may have affected the results.

**General analgesia and FICB**

Eighty-five percent of the patients in Paper 3 received prehospital analgesia. This is in contrast to most previous studies where no analgesia had been administered before the FICB [83, 86-91]. This may have influenced outcome of our study.

On the hospital ward, some nurses may have administered morphine prior to procedures, such as a preoperative shower, to prevent pain as a matter of routine. Before the study, it was not anticipated that patients would receive preventive morphine and some patients may have received “unnecessary” morphine – this could explain the absence of a difference in morphine doses between the two groups.

**Assessment of cognitive impairment**

Cognitive function was evaluated according to the SPMSQ; it might have been an advantage to have registered the incidence and prevalence of delirium in addition to SPMSQ scores. In order to obtain confirmatory results, Paper 4 would have needed 275 patients in each arm to obtain sufficient power.

**Ethical discussion**

Patients were included without discriminating their ability to understand the study information. When the planning of the RCT was conducted, ethical questions arose regarding the inclusion of patients with cognitive impairment. Finally, these discussions resulted in a decision to include patients with cognitive impairment, since they constitute a large percentage of the patients with hip fractures. It would have been unethical to exclude the patients that needed extra care and attention. Most studies have excluded these patients [145], despite the fact that participation in clinical studies may also be beneficial for these patients [153]. It was decided to use the pain treatment that was clinical practice at the time when the RCT was performed. This decision was made in order to ensure that the RCT did not impair the opportunity for pain relief for the patients who received placebo.
7. Conclusion

Pain is a major problem for patients suffering from hip fracture and current research shows that clinical practice in emergency care is struggling with pain management and improved pain relief has great potential in patients with hip fractures.

Most patients with suspected hip fractures suffer from considerable pain before arrival at hospital. The PENs’ administration of pain relief on demand as nurse-initiated analgesia provides substantial pain relief to many patients with suspected hip fractures, but there is still room for considerable improvement in prehospital pain management.

Treatment with FICB improved pain relief when added to standard pain relief. In spite of this, high dynamic pain scores were reported even after arrival at hospital, which means that pain treatment at hospital needs to improve further.

Pain management is especially challenging in persons with cognitive impairment, which was confirmed by significantly lower doses of prehospital morphine administration to patients with severe cognitive impairment. The addition of an FICB did not improve the patients’ cognitive status compared with standard pain relief alone.

CLINICAL IMPLICATIONS

Listening to the patient’s narrative and using pain scales enhances pain assessment. A mandatory pain assessment and documentation are needed.

Behavioural pain assessment tools, like the BRS, are feasible alternatives to numerical scales. The BRS should be used in any situation in which the NRS is not appropriate.

All patients with suspected hip fractures should receive medication for pain relief. The treatment of pain could be complemented with an FICB.

FUTURE RESEARCH

The most appropriate timing for the administration of an FICB in emergency care for hip fractures should be considered in future investigations. Furthermore, investigations have to be made on longer-lasting medication, as the waiting time for surgery exceeds the duration of an FICB.

Future investigations should examine the nature of on-demand and nurse-initiated analgesia drug choice; i.e. why do nurses choose to treat pain or not. The best drug combinations and doses for pain relief must also be further evaluated in randomised clinical trials.
Patients with severe cognitive impairment received less pain medication before arrival in hospital than their lucid counterparts. Cognitively impaired patients in particular may benefit from improved pain control and with FICB, but this needs to be further investigated.

Sammanfattning på Svenska

De flesta personer som faller och bryter höften är äldre och har en eller flera sjukdomar sedan tidigare. Dessa personer är vanligtvis utsatta för betydande smärta i väntan på operation. Medianväntetid på operation efter höftfraktur är 19 timmar i Sverige. Flera av dessa patienter är kognitivt nedsatta redan innan frakturen och många riskerar att drabbas av delirium. Nedsatt kognition ökar risken för att få undermålig smärtbehandling och även drabbas av postoperativa komplikationer. Det övergripande syftet med denna avhandling var att undersöka preoperativ smärtbehandling utifrån perspektivet av: en litteraturöversikt, smärtbehandling i ambulans, smärtbehandlingsintervention med fascia iliaca compartment blockad på vårdavdelning och samband mellan kognitiv status och behandling av smärta.


Delarbete 2 är en kvantitativ observationsstudie där smärta undersöktes hos 1426 patienter med misstänkt höftfraktur som vårdats i ambulans. Även prehospitala smärtbehandlingsrutiner utvärderades i denna studie. Smärta skattades först vid ambulanspersonalens ankomst till patienten,

Delarbete 3 är en kvantitativ randomiserad kontrollerad dubbelblind placebostudie som undersökte effekten av fascia iliaca compartment blockad (FICB) då den gavs i tillägg till vanlig smärtlindring innan operation på ortopedavdelningen. I studien inkluderades 127 patienter med höftfraktur. Smärta skattades innan blockaden lades, primärt utfallsmått var smärta två timmar efter blockad. Andra variabler var kön, ålder, ASA-grad, vårtdid och administrerade morfindoser. Resultatet visade att de patienter som fick aktivt medikament (ropivacain) i sin FICB hade signifikant bättre smärtlindring jämfört med de som fick placebo. Detta motsvarade detta förbättrad smärtlindring hos en fjärdedel av patienterna.


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Ola Wennberg, for your words ringing in my ears “How to eat an elephant?”
References


Preoperative pain management to patients with a hip fracture


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