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Evaluation of the intensity and management of pain before arrival in hospital among patients with suspected hip fractures

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ABSTRACT

Background: Pain management needs to be comprehensively investigated in patients with hip fractures, as it represents a fast-growing challenge to emergency care. The purpose of this study was to describe reported pain in patients with suspected hip fractures in a prehospital setting.
Methods: In this observational study, 1,426 patients with a suspected hip fracture were included. Dynamic and static pain were assessed on the arrival of the emergency medical services (EMS) and on hospital admission using the Numerical Rating Scale (NRS), if feasible, and the Behaviour Rating Scale (BRS), if not.
Results: On EMS arrival, the median dynamic NRS pain score was eight and 84% of the patients had severe or moderate dynamic pain according to the BRS. 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. Among all patients, the NRS was judged to be feasible and was therefore used in 36%. Furthermore, there was an association between the decrease in pain and the increase in the number of administered medications, as well as the duration of prehospital care.
Conclusions: Patients with suspected hip fractures suffered substantial pain on EMS arrival. Only half experienced a reduction in pain on hospital admission and only 75% received pain-relieving medication.

1. Background

A growing population of elderly people sustain hip fractures after falling. In the next 30 years, a global increase from two to six million patients a year is predicted [1]. One important task for emergency health care is to assess, treat and evaluate pain in patients with hip fractures, since their need for pain relief is immediate and urgent [2,3]. In Sweden, with 10 million inhabitants, 18,000 people sustain a hip fracture after a fall every year. Most of these patients are females over 80 years of age, suffering from comorbidity, and one third are cognitively impaired [4].

Experiences of pain have a significant damaging impact on the well-being of patients with hip fractures [5]. Pain assessment is recommended using the patients' self-reports and the numerical rating scale (NRS) is recommended in emergency health care [6]. The NRS has proven to be superior to the visual analogue scale due to improved adherence [6,7].

Patient-reported outcome measurements alone are not sufficient to assess pain in all patients. An observational tool might be a necessary and suitable way of assessing pain in some patients who, for a number of reasons, are unable to describe their experiences; one example is cognitive impairment [8]. Cognitively impaired patients risk receiving less medication for pain relief than their lucid counterparts [9]. Older patients with dementia often find it difficult to self-report their pain and they often lack insight into their own situation and need for help [10,11]. Pain is often underdiagnosed and undertreated in cognitively impaired patients, partly due to the underuse of appropriate pain assessment tools to detect pain [12,13]. Older people and persons with cognitive impairments using the emergency medical service (EMS) often require a comprehensive pain assessment. In this context, a comprehensive assessment can involve asking more questions and taking more time to assess pain [11].

By looking for the presence or absence of behavioural indicators, an observer may identify the presence of pain in a patient who has

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problems with communication [14]. Among these patients, behavioural pain assessment tools should be regarded as an essential component of a multifaceted approach to pain assessment [15].

Behaviour-related pain scales have shown moderate to high correlations with self-reported pain [16]. In behaviour-related pain assessment, facial expression, body movement and muscle tone have shown a significant relationship with painful situations, where heart rate, tidal volume and pupil size were stable [17]. In critically ill patients, facial expressions are most frequently activated during pain response in non-communicative patients and can be a valid alternative to self-report ratings [18].

In Sweden, the medical treatment of pain in patients with suspected hip fractures starts before arrival in hospital. Prehospital emergency nurses (PENs) in the ambulances are able to administer intravenous medication, fluid resuscitation and oxygen – as this is a part of guidelines for the treatment of patients with hip fractures. Guideline options for medical pain relief in the studied region were morphine, alfentanil, ketamine, esketamine and the supplementary drugs, midazolam and diazepam. However, there is a lack of knowledge regarding the prehospital evaluation and treatment of pain in patients with suspected hip fractures [3]. The purpose of this study, which took place in the prehospital setting, has thus been:

a) to describe reported dynamic and static pain in patients with suspected hip fractures and
b) to describe the use of pain-relieving drugs and its association with pain relief among these patients.

The following research questions were addressed.

- What level of pain do patients with suspected hip fractures have on their first encounter with the EMS?
- What level of pain do patients with suspected hip fractures report on admission to hospital?
- What kind of prehospital pain medication and what dosages are administered to patients with suspected hip fractures before admission to hospital?
- Does the time duration of prehospital care have an impact on the relief of pain?

2. Methods

2.1. Design

This study was designed as an observational study of the prehospital management of pain in patients with suspected hip fractures.

2.2. Population, setting and sample

The study population comprised patients over 64 years of age with suspected hip fractures. 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. The sample consisted of consecutively included patients with suspected hip fractures, admitted to hospital after transport by the EMS. The study region is an area in western Sweden with different geography – from remote rural and coastal areas to urban environments. 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 [19].

2.3. Study preparations

Before the start of the study, all EMS personnel in the region attended an educational programme focusing on methods for the assessment of pain. Over 500 people took part in the educational programme. The personnel were then periodically updated on the progress of the study throughout the data collection period.

2.4. Prehospital pain management

The management of pain included 1) assessment, 2) treatment, 3) re-assessment and 4) a final evaluation of pain treatment. Medication for the relief of pain was given on demand, as nurse-initiated analgesia to patients with suspected hip fractures and drug dosages were guided by EMS guidelines. The guidelines provided a range of possibilities regarding the choice of medication for the relief of pain. Intravenous morphine, alfentanil, ketamine and benzodiazepines were valid alternatives for prehospital administration. The EMS guidelines, together with the PENs' clinical experience, constituted the basis for the selected medication in each situation.

2.5. Data collection

All the data were recorded prospectively in the patients' electronic medical records. Record keeping was compulsory for the PENs. Since the PENs were all instructed to act accordingly, they could be said to have acted as research assistants. The data were then extracted digitally from the electronic medical records database for analysis. The variables that were collected were pain scores, type and dosage of medication during prehospital care, duration of prehospital care, patients' age and gender. The data were collected for one year, from 1 September 2015 to 31 August 2016.

Pain on movement (dynamic pain) was defined as pain on passive elevation of the injured leg to approximately 15 degrees, while pain at rest (static pain) was defined as pain in the patient's chosen position for best comfort [20]. The movement of the injured leg was undertaken as a part of the initial examination of the patient.

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.

2.6. Measurements

Pain was assessed using one of two scales, either on a numerical rating scale (NRS), with eleven grades between zero and ten, if feasible, or on a behaviour-related scale (BRS) with three categories, if the use of the NRS was not judged to be feasible (Fig. 1).

2.6.1. NRS

The NRS is an eleven-grade scale ranging from zero = no pain to ten = worst imaginable pain. The NRS was used by the patient for the self-assessment of pain. The NRS was not always suitable for pain assessment for a variety of reasons. One such reason was that the patient did not understand the NRS due to cognitive impairment or that the situation did not allow the PEN to ask for a pain score.

2.6.2. BRS

In the light of the consequences of the limited use of the NRS, the investigated EMS district introduced a behaviour-related scale for pain assessment (BRS) when the NRS was insufficient. Accordingly, when it was impossible to obtain a self-assessment, the BRS was used by the PEN to assess pain. The BRS consists of three categories where the first includes patients who do not signal any or only mild pain (BRS 0–3), the second includes patients in whom the behaviour reflects moderate pain (BRS 4–7) and the third category includes patients in whom the behaviour reflects severe pain (BRS 8–10). The BRS has been developed and validated by the Stockholm South General Hospital [21].

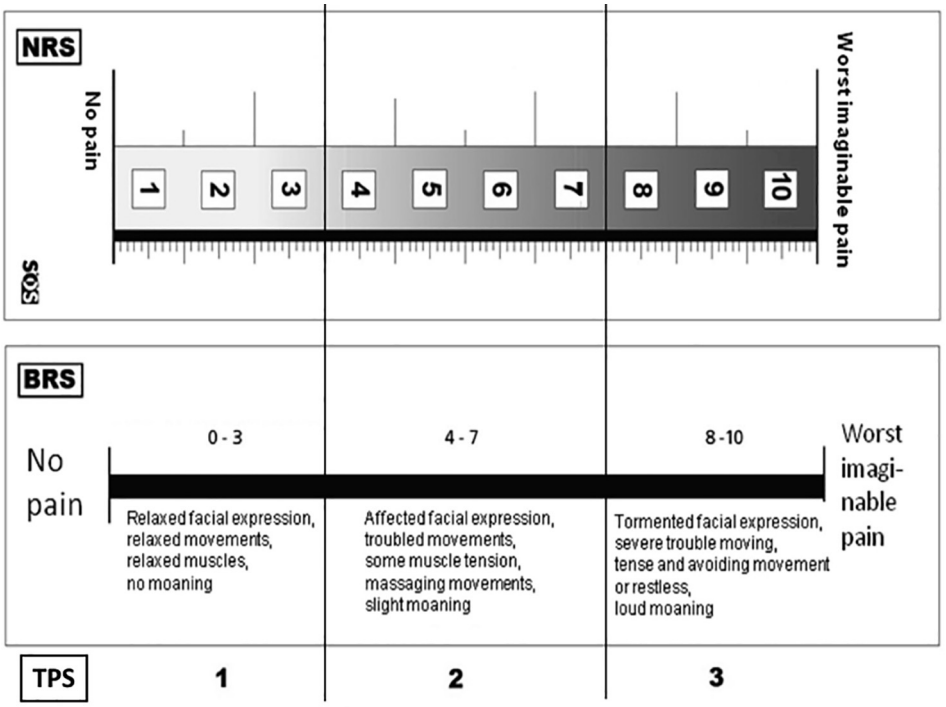

Fig. 1. Numerical Rating Scale (NRS) and Behaviour Rating Scale (BRS). Visualisation of conversion of NRS scores and BRS scores to total pain score (TPS).

2.6.3. Total pain score

In order to compare pain scores between different scales in the data analysis, a synthesis of the scales was made. The synthesis procedure was performed using the same method as the BRS validation [21]. The NRS has previously been categorised into three categories: mild pain, moderate pain or severe pain, on several occasions [22–25]. All the pain scores were then synthesised to produce a total pain score (TPS), where pain scores were divided into three categories. The three TPS categories can be understood as: 1 = mild pain; 2 = moderate pain and 3 = severe pain. The conversion of NRS scores and BRS scores to a TPS was performed in the following way and is visualised in Fig. 1.

TPS 1 corresponds to NRS 0 to 3 or BRS 0–3;
TPS 2 corresponds to NRS 4 to 7 or BRS 4–7;
TPS 3 corresponds to NRS 8 to 10 or BRS 8–10.

2.7. Statistical analysis

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), we also used cross-tables and the chi-square test 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 (IBM SPSS Statistics for Windows, version 22).

2.8. Ethics

All the patients received oral and written information about the study and they were given the option to decline participation without affecting the care that they received. Ethical approval was received from the Regional Ethics Board in Gothenburg. The procedures that were undertaken were in accordance with the ethical standards of the responsible committee on human experimentation and with the Declaration of Helsinki.

3. Results

In all, 1,806 patients were eligible for inclusion during the data collection period, of which 380 (21%) patients declined participation. This study includes the remaining 1,426 patients with a suspected hip fracture (Fig. 2). Their mean age was 83.1 (SD 9.0) years and 995 (70%) were women. Participants and non-participants had a similar distribution of age and gender.

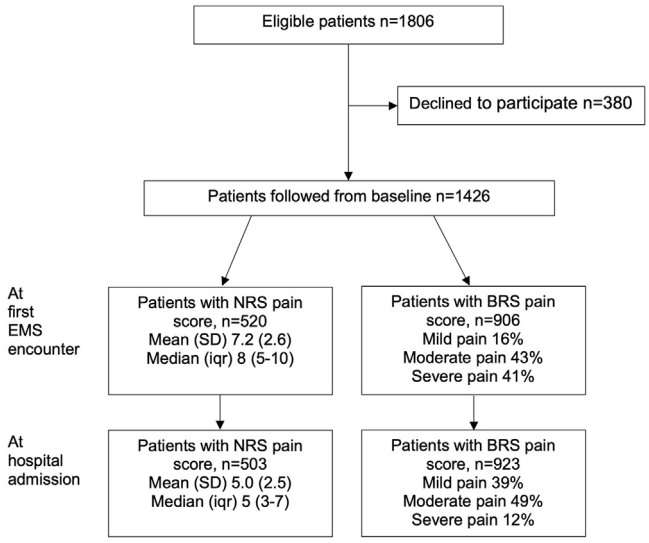

Fig. 2. Flow chart of dynamic pain and pain assessment.

Table 1
Reported dynamic and static pain scores on EMS arrival and at hospital admission.

Pain score		Pain		Pain decrease	p-value [a]
		EMS arrival	Admission		
NRS Dynamic	Mean (SD)	7.2 (2.6)	5.0 (2.5)	2.3 (2.2)	
	Median (iqr)	8 (5–10)	5 (3–7)	2 (0–4)	< 0.001
Total, n		520	503		
NRS Static	Mean (SD)	3.8 (2.7)	2.5 (2.0)	1.3 (2.1)	
	Median (iqr)	3 (1–6)	2 (1–3)	1 (0–2)	< 0.001
Total, n		501	480		
BRS Dynamic,	0–3	144 (16)	361 (39)		
n (%)	4–7	394 (43)	451 (49)	405 (45)	< 0.001
	8–10	368 (41)	111 (12)		
Total, n		906	923		
BRS Static,	0–3	614 (68)	775 (84)		
n (%)	4–7	231 (26)	125 (14)	188 (21)	< 0.001
	8–10	53 (6)	19 (2)		
Total, n		898	919		

NRS = Numerical Rating Scale; BRS = Behaviour Related Scale; iqr = interquartile range. [a)] change over time, Wilcoxon's test.

3.1. Dynamic pain

3.1.1. NRS

The median dynamic NRS pain score was eight on the first EMS encounter and, on hospital admission, the median dynamic NRS pain score was reduced to five (Table 1).

3.1.2. BRS

Before pain treatment, 762 of 906 (84%) patients had moderate to severe dynamic pain according to the BRS. On hospital admission, 405 (45%) patients had reduced dynamic pain (Table 1). The reported dynamic pain scores thus decreased significantly from the time of EMS arrival until the time of hospital admission on both the scales that were used.

3.2. Static pain

3.2.1. NRS

The median static NRS pain score was three on the first EMS encounter and was reduced to two on hospital admission (Table 1).

3.2.2. BRS

Two hundred and eighty-four of 898 (32%) patients had moderate to severe static pain according to the BRS on EMS arrival and 188 (21%) patients had reduced static pain scores on hospital admission (Table 1).

3.3. Total pain score

Before pain treatment, 1,231 of 1,426 (86%) patients had moderate to severe dynamic pain. On hospital admission, 679 (48%) patients had reduced dynamic pain (Table 2), while sixteen (1%) patients had increased dynamic pain (Table 3).

In all, 518 of 1,399 (37%) patients had moderate to severe static pain on EMS arrival and 356 (25%) patients had reduced static pain scores on hospital admission (Table 2).

3.4. Medication for pain

The doses of medication for pain relief did not differ significantly when comparing patients who had reduced pain, unchanged pain or increased pain (Table 3). However, a larger number of drugs for pain relief per patient was associated with a more marked decrease in dynamic pain scores (Table 4). In all, 1,074 (75%) patients received medication for prehospital pain relief (Table 5).

There was no difference in pain medication when the patients' pain assessed with the BRS or NRS was compared.

Table 2
Reported dynamic and static pain scores on EMS arrival and at hospital admission for all patients, presented in categories.

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

BRS = Behavior Rating Scale; NRS = Numerical Rating Scale; TPS = Total Pain Score (all patients). TPS is a synthesis of BRS and NRS. Pain decrease is the actual number of patients that reported reduction in pain from a higher to a lower category. Referring to Fig. 1 and methods section for explanation of pain scores.
[a)] change over time, Wilcoxon's test.

3.5. Duration of prehospital care

Pain scores decreased more markedly in patients with a longer duration of prehospital care (Table 6).

The number of different drugs used increased with the duration of prehospital care (Table 7).

3.6. Other aspects

Pain scores did not differ significantly when mean age and gender were compared. Data on static pain were missing for 27 (2%) of the 1,426 patients. These data were lost in documentation and could not be retrieved for analysis.

4. Discussion

4.1. Dynamic pain

One of the main findings in this study was that patients with a suspected hip fracture, in whom the dynamic pain was assessed with the NRS, had a median score of eight on EMS arrival. The corresponding values for patients in whom the BRS was used showed that 84% suffered from moderate to severe dynamic pain on EMS arrival. This means that an evaluation of the patients' need for pain relief during transport to hospital and pain management should be initiated as soon as possible [26].

Median dynamic pain scores were reduced from eight on EMS arrival to five on hospital admission in the patients who were assessed with the NRS. A reduction of this kind must be regarded as clinically meaningful. When categorising dynamic NRS pain into the three

Table 3
Dosages of drugs grouped according to change in dynamic pain (TPS) from EMS first encounter until admission to hospital.

TPS change (n = 1426)	Morphine	Alfentanil	Ketamine	Esketamine	Midazolam	Diazepam
Reduced pain (n = 679)						
Mean (SD)	5.3 (2.5)	0.6 (0.6)	33.1 (16.6)	15.8 (7.9)	1.4 (0.9)	2.8 (1.4)
n	509	175	46	130	177	79
Unchanged pain (n = 731)						
Mean (SD)	5.4 (2.7)	0.7 (0.5)	27.5 (13.5)	15.8 (5.8)	1.6 (1.2)	2.9 (1.6)
n	363	105	18	60	87	32
Increased pain (n = 16)						
Mean (SD)	5.0 (1.4)	n.a	n.a	13.8 (15.9)	0.8 (0.4)	n.a
n	5	1	1	2	2	0

TPS change = change in total pain score from ambulance first contact until hospital admission, see methods section for further explanation; iqr = inter quartile range. All doses are in milligrams (mg). There were no statistically significant differences between the TPS-groups (all p-values > 0.1).

Table 4
Number of drugs grouped according to change in dynamic pain (TPS) from EMS first encounter until admission to hospital.

TPS change		Drugs, n [a]
Reduced pain (n = 679)	Mean (SD)	1.6 (0.9)
	Median (iqr)	2 (1–2)
Unchanged pain (n = 731)	Mean (SD)	0.9 (0.9)
	Median (iqr)	1 (0–2)
Increased pain (n = 16)	Mean (SD)	0.7 (1.1)
	Median (iqr)	0 (0–1)

TPS change = change in total pain score from ambulance first contact until hospital admission; iqr = interquartile range.
[a)] Number of pharmaceutical drugs per patient (p < 0.001).

Table 5
Change in pain scores (TPS) in relation to the number of drugs used.

Change in pain scores	Number of pharmaceutical drugs per patient n (%)					
	0	1	2	3	4	Total
Increased	10 (62)	3 (19)	2 (13)	0 (0)	1 (6)	16
Unchanged	291 (40)	262 (36)	122 (17)	54 (7)	2 (0)	731
Decreased	51 (8)	259 (38)	246 (36)	121 (18)	2 (0)	679

p < 0.001.

Table 6
Change in TPS (dynamic pain) in relation to duration of care in the ambulance.

Duration of care in minutes	Change in TPS, n (%)			Total
	Increase	Unchanged	Decrease	
≤ 40	4 (1)	240 (58)	168 (41)	412
41–60	5 (1)	319 (49)	322 (50)	646
≥ 61	7 (2)	172 (47)	189 (51)	368

p = 0.007.

categories, a decrease in pain was found in 53% of the patients. This reflects vigilant albeit not optimal management of the pain. As a result, many patients still needed a further reduction of pain.

Dynamic pain scores were reduced in 45% of the patients assessed with the BRS. As with NRS pain scores, the results from BRS pain scores indicate a need for improved management of pain. The findings could be interpreted as a sign of a poor compliance with the local guidelines. Local guidelines encourage the administration of medical pain relief when a patient is in pain or when the patient can be expected to have pain in the subsequent care situations. Moving a patient with a suspected hip fracture on to a stretcher and during transport in an ambulance must result in the expectation of pain. However, when looking at drug doses and drug combinations, this can be part of the reflection on a complex clinical situation where there is a need for individualised care and treatment. The levels of pain that these patients experience, as well as their responses to its treatment, are individual. The trauma, type of fracture, soft-tissue damage, perception of pain, time waiting for help, social situation, comorbidity, mental status and previous medication are all circumstances that influence the success rate of the pain management [2,27–30]. Another factor that may act as a confounder is the healthcare providers' reluctance to give medication for the relief of pain. Furthermore, the results imply that the duration of EMS care has an impact on medical pain relief, which will be discussed later on.

The fact that pain in the majority of patients was assessed with the BRS enhances the picture of an overall complex care situation with frail, vulnerable patients who require delicate assessment and treatment [11]. When relating the use of medication for the relief of pain to the use of an instrument for its assessment, there was no particular association. This finding suggests that the choice of pain scale did not affect the treatment of pain. Furthermore, the choice of pain scale also suggests that the NRS is not suitable in all situations. Situations where the NRS may be less suitable could include a patient who is lying on the floor with a suspected hip fracture and with obvious severe pain. An assessment based on behaviour using the BRS may then be more appropriate. This type of argumentation will most likely be reflected in patients with all types of pain.

A study analysing the EMS's documentation of pain in the same region in which our study was performed showed that, among a large number of patients with different types of pain, only 32% had undergone a measurement and documentation of its intensity with the NRS or VAS [31]. This finding emphasises the fact that a lack of documented pain assessment can be found in the majority of cases in the prehospital setting. A supplementary pain scale, like the BRS, could perhaps improve the assessment and documentation of pain before arrival in hospital.

Total pain scores (TPS) may provide a more comprehensive overall picture of the patients with pain and thereby offer an opportunity to visualise the effect of the relief of pain provided among all patients. TPS may be useful in the exploration of pain-relieving interventions in the future.

4.2. Static pain

The reduction in static pain was not as extensive as the reduction in dynamic pain. This is best explained by the fact that dynamic pain was more severe than static pain on EMS arrival. Other researchers have reported similar results [20].

4.3. Medication for pain

Fifty-five per cent of the patients may have received an adequate amount of pain medication, when the mean number of medications and the degree of pain reduction is considered. This assumption is based on

Table 7
Types, dosages and number of drugs in relation to the duration of prehospital care.

Time	Morphine	Alfentanil	Ketamine	Esketamine	Midazolam	Diazepam	Drugs[a)]
≤ 40 min (n = 412)							
Mean (SD)	5.1 (2.2)	0.7 (0.9)	27 (13)	15.4 (6.6)	1.6 (1.2)	2.8 (1.2)	0.9 (0.9)
n	193	63	5	30	41	25	
41–60 min (n = 646)							
Mean (SD)	5.2 (2.5)	0.6 (0.5)	32.9 (19.1)	15.8 (7.2)	1.5 (1.0)	2.7 (1.4)	1.3 (0.9)
n	414	143	31	92	125	52	
≥ 61 min (n = 368)							
Mean (SD)	5.7 (2.8)	0.6 (0.4)	30.2 (12.4)	15.9 (8.0)	1.3 (0.9)	2.5 (1.6)	1.6 (1.0)
n	268	74	29	69	100	42	

All doses are in milligrams (mg). iqr = inter quartile range.
[a)] Number of pharmaceutical drugs per patient ($p < 0.001$).

the fact that 14% did not have the opportunity to alleviate pain (TPS category 1 on EMS arrival). On the other hand, 25% of the patients with a suspected hip fracture received no medication for pain. There may be patients who are in a physical state that does not comply with the administration of intravenous opioids, but they are exceptions and cannot reflect 25% of the patients in this study. We must assume that these patients will be in pain at some point in the chain of emergency care and the anticipation of pain should encourage its treatment and prevention. These patients should therefore have had some medical treatment and the local EMS guidelines suggest giving at least 2.5 mg of morphine.

We found that the use of a larger number of different pain-relieving drugs was associated with more marked pain relief than the use of a single medication. This indicates that interacting effects from drug combinations have a potential value and thereby a potential improvement in pain relief. This may indicate that emergency care personnel should be liberal with the use of pain-relieving drugs and use drug combinations when indicated. Furthermore, research indicates that educating the EMS crew will enhance the relief of the patients' pain [32–34]. Prospective studies to clarify drug interactions and updates on guidelines are needed.

Eight per cent of patients with pain score reductions did not receive any medication at all. One explanation of this could be that patients highlighted the importance of the feeling of "being cared for" in a precise and structured way by EMS personnel [35]. These factors may influence the patients' experience of pain.

4.3.1. Nurse-initiated analgesia

The on-demand model with nurse-initiated analgesia is well established and works well within the EMS participating in this study, as it has been used for the past few decades. However, there is scope for further improvement. It should be possible to reduce dynamic pain in more than 48% of the patients. The management of dynamic pain is challenging and it can be difficult to provide adequate pain relief with systematic medication alone. Complementary techniques for pain relief (such as nerve blocks) may be an attractive alternative [20].

Two thirds of the patients' pain was assessed with the BRS, although the NRS should be the first choice. One explanation of this could be the swift nature of emergency health care which does not always provide the time or suitable timing to ask for a pain score, even in a lucid patient. Nurses sometimes have to rely on their own assessment and interpretation of the patients' pain [36]. The use of the BRS provides what could be described as a "best option" for the PENs to assess the patients' pain when the NRS is not a suitable option. When using the BRS, it must always be remembered that the sensitivity of the NRS is compromised and that the patient's own assessment is lost. It is a challenge for the nurse to choose the optimal instrument for an assessment of pain.

The assessment and treatment of pain using on-demand medication or nurse-initiated analgesia is sometimes a difficult task which places a high degree of responsibility on the individual nurse in this setting. The nurse is often alone with the decision. This is accentuated by the fact that it is difficult to provide good pain relief on movement for patients with fractures. Healthcare providers' feeling of uncertainty about patients' pain can make them hesitate when it comes to making a decision about pain relief [37,38]. One reason is the difficulty involved in understanding the patients' pain when a cognitive impairment is present. Before this study, the BRS was implemented to adjust for this difficulty, but 25% of the patients still did not receive any medication for pain. It could be that some PENs did not trust the result of the BRS or there could be other obstacles preventing optimal medical pain relief. On the other hand, the PENs in this study administered more analgesia compared with other studies of nurse-initiated analgesia [24,25,39,40]. These referred studies were conducted within the emergency department context and not in the prehospital setting. As a result, guidelines for pain management can differ between different patient groups and contexts.

4.4. Duration of prehospital care

A prolonged duration of prehospital care was associated with lower pain scores on hospital admission and significantly more medication was given to these patients. This was expected, as, in these situations, the PENs had more time for treatment and evaluation of the treatment that was administered, as well as more time for the titration of drugs. This reflects an active pain-relieving strategy, including the assessment, re-assessment and titration of medication during transport. Our general impression is that PENs in the western Swedish region are well trained in the pain management of patients with suspected hip fractures, since more medication for pain relief was administered when compared with previous research [41–46].

4.5. Other aspects

The patients in this study are representative of the Swedish population of patients with hip fractures, since the distribution of age and gender in our study was similar to the distribution in the Swedish National Registry of hip fracture patient care [4]. Other studies that start pain recording and management after admission to hospital report similar numerical pain scores ranging from 7 to 9 before treatment, when using scales that grade the severity of pain from 0 to 10 [20,47–50]. This implies that pain at baseline may be valid for patients in an international setting, as the demographics (i.e. age and gender proportions) of the patients in this study correspond to those of an international population [51,52]. However, cultural differences regarding the experience of pain cannot be completely ruled out.

When comparing our results with previous prehospital research, this investigation indicated that pain relief was given at much higher rates [53]. Even when compared with the treatment of pain in emergency departments (ED) in previous studies, the use of medication for pain relief was far more liberal in this study [41,43]. To investigate a

possible Hawthorne effect, historical data on average pain medication dosages were evaluated for the year prior to this study, but no difference in dosage was found.

Increasing PEN awareness of patients' pain can be regarded as an improvement in patient safety. Patients with suspected hip fractures in the study area undergo a mandatory pain assessment even after the study period. The use of the BRS provides an opportunity for pain assessment and improved pain management in patients unable to provide an NRS score. The study improved the documentation of pain levels in the patients' medical records. This implies that patient safety improves with the use of the BRS for many of the most vulnerable patients, i.e. those with a cognitive impairment and those who have difficulty understanding the Swedish language.

Before the start of the study, more than 500 EMS co-workers throughout the region attended a structured educational programme focusing on methods for the assessment of pain. This action was taken in order to have a similar assessment and reporting of pain in the study group. The method worked well, as the investigators were able to retrieve the data that were required and there was positive feedback from co-workers, indicating satisfaction with the pain assessment routine. The assessment and documentation of pain is now implemented as routine within the EMS. This can be regarded as a strength in this study.

4.6. Limitations

There are several pain scales for the evaluation and interpretation of the patients' behaviour, such as the PAINAD and the Abbey Pain Scale [54]. However, these instruments are dependent on scoring and filling out forms, which the authors felt was not compatible with the swift nature of emergency health care. In the authors' opinion, a simpler instrument was needed. On the other hand, a review of the literature has found that the Abbey Pain Scale is a potentially suitable pain instrument for prehospital use, but validation is needed [55,56]. No single observational pain scale has been recommended, given the current limited evidence relating to reliability and validity [57–59]. There are arguments for and against the use of behaviour-related pain assessment, but this is the way most nurses actually assess pain in order to initiate any intervention, medical or non-medical. This study was intended to reflect and explain a clinical reality.

Research to measure the relationship between patients' behaviour-related and self-reported pain has been conducted [60]. Previous behaviour-related pain assessments have shown a moderate to high relationship with the patients' self-reported pain [61]. Item testing has shown very good agreement in tense muscles and patient sounds and good agreement in frowning and grimacing, which correspond to the items on the BRS [62]. The BRS has been validated with a moderate degree of consistency [21].

This study produced documented pain scores in 65% of the patients who did not provide an NRS score. The reduction in BRS pain scores in 45% of the patients corresponds to the pattern provided by the reduction in NRS scores in 53% of the patients and TPS scores in 48% of all patients.

There was a risk of selection bias. Pain reduction is most marked in patients with the most severe pain. Further evaluations therefore need to be carried out in controlled circumstances and prospective randomised trials are warranted.

When comparing medication in terms of the use of single drugs or a combination of drugs, it is important to remember that the dosages of different drugs were not considered.

The two per cent of missing data on static pain are not regarded as crucial to the results, as the total number of patients is high.

4.7. Clinical implications

Mandatory pain assessment can improve patients' pain management. Behavioural pain assessment tools are feasible alternatives to numerical scales and enhance patient safety. The BRS should be used in any situation when the NRS is not appropriate.

All patients with suspected hip fractures should receive at least 2.5 mg of morphine, as stated in the local EMS guidelines.

5. Conclusion

Patients with suspected hip fractures suffer from considerable prehospital pain. Pain management in patients with suspected hip fractures should start as promptly as possible. PENs' administration of pain relief on demand in the form of nurse-initiated analgesia provides substantial pain relief to patients with suspected hip fractures, but there is still room for improvements in pain management.

Future investigations should examine the nature of on-demand and nurse-initiated analgesia drug choice; i.e. why do emergency care personnel choose to treat pain or not? The effect of drug combinations must also be further evaluated in randomised clinical trials. Other techniques (for example, nerve blocks) for prehospital pain management should also be further investigated.

Ethical statement

The research has been performed in accordance with ethical practice and the STROBE statement. Ethical approval was received from the Regional Ethics Board in Gothenburg, Dnr. 205-15.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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