

Evaluation and treatment of pain in the pre-hospital setting. A comparison between patients with a hip injury, chest pain and abdominal pain

Carl Magnusson^{a,b,c}, Marie Carlström^c, Nathalie Lidman^c, Johan Herlitz^{a,b,*}, Pär Wennberg^{b,d}, Christer Axelsson^{a,b,c}

^a Institute of Medicine, Department of Molecular and Clinical Medicine, Sahlgrenska Academy, University of Gothenburg, Sweden

^b Prehospiten – Centre for Prehospital Research, University of Borås, Sweden

^c Department of Prehospital Emergency Care, Sahlgrenska University Hospital, Gothenburg, Sweden

^d Research and Development Centre, Skaraborg Hospital, Skövde, Sweden

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ABSTRACT

Background: A large proportion of patients who call 112 in Sweden do so because of pain. The purpose of this study was to compare three of the most common types of pain presented by the patients: chest pain, abdominal pain and hip injury, in terms of initial assessment, intensity, treatment and effect of treatment. The overall rationale was to evaluate whether the early assessment and treatment of pain in the pre-hospital setting is optimal or whether there is room for improvement.

Methods: Observational study during 2016 including 1234 patients triaged to chest pain, abdominal pain and hip injury by the Emergency Medical Services (EMS) in Gothenburg, Sweden.

Results: Severe pain on the arrival of the EMS was described by 39% of patients with a hip injury, 27% with abdominal pain and 15% with chest pain. Analgesics were given to 58% of patients with a hip injury, 35% with chest pain and 34% with abdominal pain. A lower intensity of pain at re-evaluation was observed in 80% of patients with a hip injury, 57% with chest pain and 43% with abdominal pain. Administration of analgesics increased with the duration of pre-hospital care time in all three groups.

Conclusions: Patients with a hip injury had the most severe pain and they received most pain-relieving medication. Overall, a relatively small proportion of patients with pain received pain-relieving medication and there appears to be an extensive room for improvement.

1. Introduction

Pain is a global burden and an increasing health problem [1]. In 1979, the International Association for the Study of Pain (IASP) defined pain as an unpleasant sensory and emotional experience associated with potential tissue damage. This was an important definition, as it described the pain not only as tissue damage but also as something that was experienced in terms of this damage [2].

Pain is a common reason for patients seeking emergency care [3–5]. Common types of pain among these patients are chest pain [6], abdominal pain and pain caused by a hip injury [7]. It has previously been shown that a very large proportion of patients attending the emergency department (ED) due to pain are transported to hospital by the emergency medical service (EMS) [7]. In Sweden, the EMS nurses, who are the first health-care providers who meet the patient, have

excellent opportunities to treat the pain in the most optimal fashion [3,7–9].

In the assessment of the intensity of pain, the EMS nurse often uses different scales from zero (no pain) to ten (the most severe pain that the patient could imagine). In order to simplify the evaluation, the intensity of pain has been categorised on three levels in some previous studies: 1) no or less severe pain (0–3), 2) moderate pain (4–6) and 3) severe pain (7–10) [2,10,11].

As pain is regarded as a subjective and personal experience [7,12], health-care providers' understanding of its severity and its meaning is most probably of the utmost importance for an optimal evaluation and treatment. Furthermore, inappropriate relief of pain in the early phase may increase the risk complications during follow up such as impaired cognition among patients with hip fracture and maybe more extensive myocardial damage among patients with chest pain [13].

* Corresponding author at: Prehospiten – Centre for Prehospital Research, University of Borås, SE-501 90 Borås, Sweden.

E-mail address: johan.herlitz@hb.se (J. Herlitz).

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We have previously reported on the association between the intensity of pain and outcome among patients with acute chest pain [13] and about the intensity and treatment of pain among patients with a suspected hip fracture [11]. However, not much is known about the differences and similarities between different yet frequently seen clinical conditions in the pre-hospital setting in terms of the intensity and treatment of pain.

Patients with acute chest pain, abdominal pain and a hip injury are among the largest groups in which pain is the dominant symptom which the EMS crew encounter before arrival in hospital. In the total study population, patients triaged to chest pain, abdominal pain and hip injury constituted 22% of all triaged patients, with abdominal pain as the most common triage group among patients transported to hospital.

The aim of this study was to compare these three groups in terms of the pre-hospital management of pain. The hypotheses were that 1) they may differ, as one of the three groups represents somatic pain, whereas the other two represent visceral pain and 2) there is room for potential improvement in terms of assessment as well as treatment of the pain in all three groups.

In order to relate the pre-hospital treatment of pain to the treatment of pain in the Emergency Department (ED) the latter was also assessed.

The overall rationale for the study was to, among patients with three common pain conditions in the pre-hospital setting, evaluate whether the early assessment and treatment of pain is optimal or whether there is room for improvement.

2. Methods

2.1. Study design

The present study is a single-centre retrospective observational study where patients with on-scene EMS nurse triage of hip injury, chest pain or abdominal pain were manually reviewed in pre-hospital records (Ambulink) and hospital records (Melior).

2.2. Study setting

The study was performed in the Municipality of Gothenburg, the second largest city in Sweden. The catchment area is 900 km². In 2016, serving 660,000 inhabitants the EMS responded to approximately 82,000 missions, of which 59,000 were primary missions. Within the organisation, there are 18 emergency ambulances, two nurse-staffed single responders, one physician-staffed unit and one on-the-scene commanding unit.

2.3. The EMS system in Sweden

The health care provided in Sweden, including pre-hospital care, is tax funded. The EMS organisation uses regional guidelines. In Sweden it is legislated that RNs are responsible for patient assessment which includes the medication [14,15]. Therefore, each ambulance in Sweden is staffed by at least one registered nurse (RN). The RN often has an additional one-year postgraduate education in pre-hospital emergency care. However, EMS crew set-ups can take the form of two nurses or one nurse and one emergency medical technician (EMT). The educational level of the EMTs in Sweden is a one-year course in pre-hospital emergency care in addition to assistant nurse education. The EMS nurses assess the patient at the scene and have several drugs at their disposal. The EMS nurses are responsible for deciding on the level of care.

Ambulances are dispatched from a dispatch centre with the following priorities: Priority 1: which means life-threatening conditions, priority 2: which means an emergent but not a life-threatening condition and priority 3: which comprises the remaining missions.

2.4. Triage system

The Rapid Emergency Triage and Treatment System for Adults (RETTA-A) is a five-level triage system currently in use in the majority of EDs and EMS organisations in Sweden. RETTA-A is developed, licensed and maintained by a Swedish company (Predicare AB) [16]. The RETTA-A is made up of Emergency Signs and Symptoms (ESS) and vital signs (VS) (respiratory rate/min, oxygen saturation, pulse rate/min, blood pressure/mm Hg, body temperature °C and level of consciousness) containing 58 charts with the most common presentations. The level of severity of both VS and ESS is divided into the colours of red, orange, yellow, green and blue, but blue is not used by the EMS. Triage level red is considered life threatening, orange is potentially life threatening, while yellow and green can wait in the ED without medical risk. Yellow is considered to be more urgent than green. The highest triage level of either VS or ESS becomes the final triage level. The triage system (RETTA) for adults does not incorporate pain scales which gives a certain triage level. However, in different charts patients presenting with pain is considered in the ESS, for example in the chart of 'Abdominal pain' in orange level ESS; 'Ongoing pain and syncope within the last four hours' or 'medium/severe pain in patients with known aortic aneurysm'.

2.5. Patient selection

Eight-thousand patients collected as a consecutive convenient sample evenly distributed from the first records each month during 2016 formed the background population. Patients fulfilling the inclusion criteria were recruited from this database.

Inclusion criteria: Patients assessed by the EMS nurse as requiring hospital assessment and triaged to one of the RETTA chart codes of chest pain (5), abdominal pain (6) and hip injury (34).

Exclusion criteria: 1) <16 years of age, 2) transport between hospitals, 3) duplicates of case record forms, 4) incomplete personal identification number, 5) the patient was dead on the arrival of the EMS, 6) the hospital case record form was not available, 7) the mission was assistance to another ambulance and 8) the patient was assessed by the nurse at the scene as not requiring transport to hospital. An average of 16 patients with hip injury, 43 patients with chest pain and 45 patients with abdominal pain were included each month (Fig. 1).

2.6. Assessment of pain

The following pre-hospital variables were recorded: 1) whether pain was assessed, 2) intensity of pain on EMS arrival, 3) pain-relieving medication given, 4) type of pain-relieving medication given, 5) re-evaluation of pain and 6) pain intensity at re-evaluation of pain.

In the assessment of pain, the following instruments were used: 1) numerical rating scale (NRS), 2) behaviour rating scale (BRS) and 3) evaluation of pain with free words in the text.

The intensity of pain was divided into three levels:

1 = Low intensity of pain. On the NRS and BRS that corresponded to 0–3 and in free words, the text was interpreted as no or only slight pain.

2 = Moderate intensity of pain. On the NRS and BRS that corresponded to 4–6 and in free words, the text was interpreted as moderate pain.

3 = Severe pain. On the NRS and BRS that corresponded to 7–10 and in free words, the text was interpreted as severe pain.

2.7. Treatment of pain

According to the guidelines for the treatment of pain in western Sweden, there are a number of alternatives for pharmacological treatment including paracetamol, diclofenac, antacid (novalucol), acetylsalicylic acid (aspirin), glyceryl trinitrate, morphine, ketamine/esketamine, alfentanil and fentanyl. The guidelines describe the following regarding pain management according to "treatment –

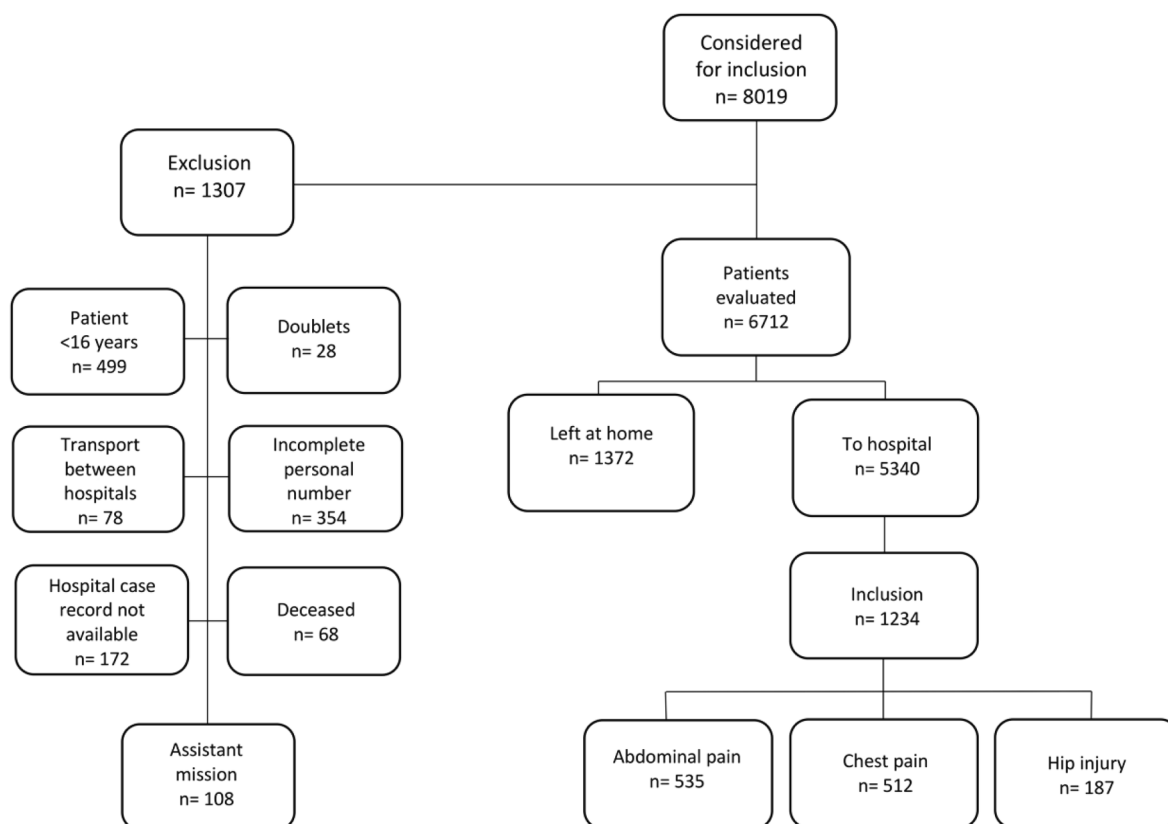


Fig. 1. Flow chart of included patients with assessed abdominal pain, chest pain and hip injury.

standard adult” where it is recommended that the pain should be reduced to a level of ≤ 3 , according to the NRS before arrival in hospital: 1. record the initial pain 2. Pain-relief with Morphine i.v 3. In severe pain or if morphine does not seem to be sufficient give ketamine, fentanyl or alfentanil. 4. Give additional paracetamol p.o. Management of the three patient groups are described in separate sections.

Hip injury. Guidelines recommend immobilisation, and to maintain a pain relieved patient but still conscious patient if administration of esketamine/ketamine.

Chest pain. The guidelines stipulate to be very thorough with the pain anamnesis, intensity, duration, and “standard treatment adult” is recommended with the addition of position the body to reduce cardiac preload, administrate glyceryl trinitrate and acetylsalicylic acid. Before international recommendation of supplemental oxygen in patients with suspicion of acute coronary syndrome supplemental oxygen was recommended in patients with less oxygen saturation than 95%.

Abdominal pain

The guidelines recommend a thorough pain anamnesis, including locality, intensity, duration, deviation, referred pain etc. with guidance on palpation of the abdomen together with recommendations of “Standard treatment adult” with addition of diclofenac i.m if suspicion of renal stone. The guidelines recommend to be careful when administering pain relieving medication of pain without known origin.

2.8. Data analyses

The data in Tables 1–3 were expressed as numbers, percentages or as the median with Inter Quartile Range (IQR). Patients triaged by the EMS nurse at the scene to one of the groups hip injury, chest pain or abdominal pain were compared regarding various actions taken during the pre-hospital care. To test for difference between the three triage groups and variables regarding pain evaluation and pain-relieving treatment Fisher’s exact test was used, except for intensity of pain

where Kruskal-Wallis test was used. For those variables where a significant difference among the three groups were found pairwise post-hoc comparisons were performed using step-down Holm-Bonferroni correction for multiple tests. All tests are two-sided and *p*-values below 0.05 were considered statistically significant. In Table 4, the distribution of time was categorised around the median pre-hospital time (in minutes) from arrival at the scene to handover in the hospital. Data processing and statistical analysis was performed in SPSS version 25 (IBM Corp., Armonk, NY, USA) and Python 3.7 (Python Software Foundation) with the Statsmodels version 0.11.1 package.

3. Results

In all, 5340 patients were transported to hospital. Among these patients, 1234 (23%) fulfilled the inclusion criteria. As a result, 535 were assessed at the scene by the EMS nurse with RETTS triage code no. 6 (abdominal pain), 512 as code no. 5 (chest pain) and 187 as code no. 34 (hip injury). From now on, these three groups will be compared.

3.1. Patient characteristics

Patients with abdominal pain were the youngest and those with hip pain were the oldest. Women were overrepresented among patients with abdominal pain, whereas the distribution of gender was relatively similar in the other two groups.

At the dispatch centre, 73% of the patients with chest pain were given priority 1 as compared with 30% for abdominal pain and only 14% for hip injury. According to the assessment by the EMS nurse at the scene, yellow was the colour which was most frequently given to all three groups. Red was most frequently given to patients with chest pain (12%). Patients with a hip injury most frequently called for the EMS during the day (54%), whereas there was a relatively even distribution in the other two groups with regard to the time of day when they called

Table 1

Characteristics of patients evaluated according to RETTS as hip injury, chest pain or abdominal pain and need for transport to hospital.

	All patients n = 5340	Hip injury n = 187	Chest pain n = 512	Abdominal pain n = 535
Age – years				
Median (IQR)	68 (44–83)	84 (74–89)	69 (53–82)	58 (34–76)
Gender – n (%)				
Female	2763 (51.7)	104 (55.6)	242 (47.3)	324 (60.6)
Dispatch priority – n (%)				
1	2659 (50.0)	27 (14.4)	370 (73.0)	161 (30.2)
2	2444 (46.0)	152 (81.3)	137 (27.0)	350 (65.7)
3	211 (4.0)	8 (4.3)	0 (0.0)	22 (4.1)
Dispatch priority missing	26 (0.5)	0 (0.0)	5 (1.0)	2 (0.4)
Triage level according to RETTS – n (%)				
Red	597 (11.6)	1 (0.5)	64 (12.5)	34 (6.4)
Orange	1854 (35.9)	65 (34.8)	212 (41.4)	134 (25.0)
Yellow	2254 (43.6)	97 (51.9)	225 (43.9)	341 (63.7)
Green	463 (9.0)	24 (12.8)	11 (2.1)	26 (4.9)
Triage level missing	172 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)
Time of day – n (%)				
08–16	2431 (45.5)	100 (53.5)	200 (39.1)	223 (41.7)
16–24	1902 (35.6)	53 (28.3)	195 (38.1)	177 (33.1)
00–08	1007 (18.9)	34 (18.2)	117 (22.9)	135 (25.2)
Actions in hospital – n (%)				
Hospitalised	2631 (49.4)	136 (72.7)	256 (50.0)	206 (38.6)
Home from ED with intervention	774 (14.5)	38 (20.3)	14 (2.7)	77 (14.4)
Home from ED with medication prescription, blood sampling, treatment	1412 (26.5)	5 (2.7)	217 (42.4)	216 (40.4)
Home from ED with clinical evaluation	275 (5.2)	4 (2.2)	8 (1.6)	8 (1.5)
Home from ED assessed by nurse	54 (1.0)	1 (0.5)	0 (0.0)	7 (1.3)
Patient left ED	180 (3.4)	3 (1.6)	17 (3.3)	20 (3.7)
Information on actions in hospital missing	14 (0.3)	0 (0.0)	0 (0.0)	1 (0.2)

IQR = Inter Quartile Range

ED = Emergency Department

for the EMS, although this was slightly less often during the night. Among the patients with a hip injury, 73% were admitted to a hospital ward as compared with 50% for chest pain and 39% for abdominal pain (Table 1).

3.2. Evaluation of pain

In nearly all the cases was the pain assessed in some way in all three scenarios. Among patients with a hip injury, the BRS was the scale that was most frequently used to assess the pain. There was a significant difference in description of pain between hip injury and chest pain, hip injury and abdominal pain, but not between chest pain and abdominal pain. Description of the pain in free words was more frequent among patients with abdominal pain and chest pain (Table 2). There was a significant difference between the groups regarding intensity of the pain

Table 2

Evaluated pain in patients with a hip injury, chest pain and abdominal pain.

	Hip injury n = 187	Chest pain n = 512	Abdominal pain n = 535	P
Evaluated pain ambulance – n(%)				
Yes	180 (96.3)	501 (97.9)	523 (97.8)	0.44
Pain scale used – n(%)¹				
AB ²	61 (33.9)	A 187 (37.3)	B 170 (32.5)	< 0.001
NRS	70 (38.9)	0 (0.0)	0 (0.0)	
BRS	49 (27.2)	314 (62.7)	353 (67.5)	
Pain description in free text				
AB	49 (27.2)	AC 314 (62.7)	BC 353 (67.5)	<0.001 ³
Evaluation of intensity of pain – n(%)				
Synthesis				
High	71 (39.4)	75 (15.0)	141 (27.0)	
Moderate	70 (38.9)	202 (40.3)	248 (47.4)	
Low	39 (21.7)	224 (44.7)	134 (25.6)	
Re-evaluation of pain – n (%)				
AB	119 (66.1)	AC 199 (39.7)	BC 160 (30.6)	< 0.001

¹ Percentage of prehospital pain evaluated patients

² Groups with same letter are significantly different in pairwise post-hoc comparison using step-down Holm-Bonferroni method

³ Ordered intensity of pain used in p-value calculation

Table 3a

Administration of pain relief to patients with a hip injury, chest pain or abdominal pain.

	Hip injury n = 187	Chest pain n = 512	Abdominal pain n = 535	P
Administration of prehospital pain relief – n (%)				
AB ¹	109 (58.3)	A 178 (34.8)	B 180 (33.6)	< 0.001
Administration of prehospital pain relief among patients with moderate to high intensity of pain – n (%)²				
AB	102 (72.3)	AC 150 (54.2)	BC 170 (43.7)	< 0.001
Effect of pain-relieving medication – n (%)³				
AB	87 (79.8)	AC 101 (56.7)	BC 77 (42.8)	< 0.001
Pain-relieving medication in the ED – n (%)				
A	66 (35.3)	AC 78 (15.2)	C 186 (34.8)	0.001
Only pain-relieving medication in the ED – n (%)				
A	32 (17.1)	AC 50 (9.8)	C 118 (22.1)	< 0.001

ED = Emergency department

¹ Groups with same letter are significantly different in pairwise post-hoc comparison using step-down Holm-Bonferroni method

² Percentage of patients evaluated with moderate or high intensity of pain (hip injury n = 141, chest pain n = 277, abdominal pain n = 389)

³ Of patients given pain-relieving medication

Table 3b
Different types of prehospital administrated pain-relieving medication.

	Hip injury n = 109 ¹	Chest pain n = 178	Abdominal pain n = 180
Type of prehospital pain-relieving medication – n (%)²			
Morphine	88 (80.7)	63 (35.4)	111 (61.7)
Glyceryl trinitrate	0 (0.0)	118 (66.3)	1 (0.6)
Diclofenac	0 (0.0)	0 (0.0)	41 (22.8)
Acetylsalicylic acid	0 (0.0)	41 (23.0)	0 (0.0)
Esketamine	32 (29.4)	0 (0.0)	1 (0.6)
Alfentanil	19 (17.4)	0 (0.0)	15 (8.3)
Novalucol	0 (0.0)	10 (5.6)	15 (8.3)
Paracetamol	9 (8.3)	2 (1.1)	13 (7.2)
Levobupivacaine	3 (2.8)	0 (0.0)	0 (0.0)
Fentanyl	0 (0.0)	1 (0.6)	4 (2.2)

¹ Number of patients with administrated pain-relieving medication

² One patient may have been given more than one pain-relieving medication

Table 4
Duration of prehospital care and its association with pain-relieving medication for hip injury, chest pain and abdominal pain.

	Hip injury n = 187	Chest pain n = 512	Abdominal pain n = 535
Arrival at patient's side – arrival in hospital – n (%)¹			
0–30 min	8 (4.3)	14 (2.7)	45 (8.4)
Administration of medication – n (%) ²	2 (25.0)	1 (7.1)	5 (11.1)
31–60 min	52 (27.8)	272 (53.1)	296 (55.3)
Administration of medication – n (%)	20 (38.5)	75 (27.6)	92 (31.1)
61–90 min	91 (48.7)	210 (41.0)	177 (33.1)
Administration of medication – n (%)	59 (64.8)	93 (44.3)	72 (40.7)
> 90 min	35 (18.7)	16 (3.1)	17 (3.2)
Administration of medication – n (%)	28 (80.0)	9 (56.3)	11 (64.7)

¹ Number and proportion of patients within prehospital care interval

² Number and proportion of patients given medication within prehospital care interval

among all three groups. Patients with a hip injury had the most severe pain (39% had severe pain) as compared with abdominal pain (27%) and chest pain (15%). The patients with abdominal pain were most frequently assessed as having pain of moderate severity (47%), whereas patients with chest pain were most frequently assessed as having pain of low severity (45%). The proportion of patients with pain of either high or moderate severity was clearly highest among patients with a hip injury (78%). The frequency of re-evaluation of pain was significantly different between the three groups, and a re-evaluation of pain took place more frequently among patients with a hip injury (66%) compared to patients with chest pain (40%), and abdominal pain (31%) (Table 2, Fig. 2).

3.3. Administration of pain-relieving treatment

Pain-relieving medication was given significantly more often to patients with a hip injury (58%) than to patients with chest pain (35%) and to patients with abdominal pain (34%), whereas there was no significant

difference between chest pain and abdominal pain. Patients given pain-relieving medication when evaluated with moderate to high intensity of pain increased in all three groups, with hip injury significantly more often administrated (72%) than chest pain (54%) and abdominal pain (44%). Among patients who did not receive pain-relieving medication, a small proportion (1.2%) refused or had taken own pain-relieving upon EMS arrival.

A reduction in the intensity of pain before arrival at hospital among the patients who received medication for pain relief was significantly more common among patients with a hip injury (80%) than among patients with chest pain (57%) and abdominal pain (43%) (Table 3a). Among patients with a hip injury, morphine was the drug that was most frequently used, followed in order of frequency by esketamine and alfentanil. Among the patients with chest pain, glyceryl trinitrate was the drug that was most frequently used, followed by morphine and acetylsalicylic acid. Among patients with abdominal pain, morphine was most frequently used, followed in order of frequency by diclofenac, alfentanil, novalucol and paracetamol (Table 3b). The proportion of patients who received pain-relieving medication in the ED but not before arrival in hospital received it for hip injury in 17%, chest pain in 10%, and abdominal pain in 22%. In all, 35% of the patients with a hip injury received pain-relieving medication in the ED, which was significantly more frequent than for patients with chest pain, who only received this treatment in 15% of cases, whereas 35% of patients with abdominal pain received pain-relieving medication in the ED (Table 3a).

3.4. Medication given in relation to the duration of pre-hospital care

The proportion of patients who received medication for the relief of pain increased with an increasing duration of pre-hospital care in all three groups of patients. For example, only 25% of the patients with a hip injury received medication for pain relief if the duration of pre-hospital care was 0–30 min, but the proportion increased to 80% if the duration was >90 min (Table 4).

4. Discussion

The main message is that, among patients who called for the EMS due to a hip injury, chest pain and abdominal pain, those with a hip injury were the ones who were given the lowest priority at the dispatch centre, despite the fact that they had the most severe pain on EMS arrival. Patients with a hip injury were therefore the ones who received most medication for the relief of pain on the arrival of the EMS and it was among them that we saw the most substantial relief of the pain before arrival in hospital.

In all three groups were more medication given with an increasing duration of the pre-hospital care time. Unfortunately, however, the overall proportion of patients who received medication for the relief of pain before arrival in hospital was surprisingly small in all three groups.

4.1. Evaluation of pain

Previous studies have suggested that the intensity of pain does not influence the priority given at the dispatch centre [17–19]. In agreement with these findings, we observed that patients with a hip injury, with more severe pain overall, were given a lower priority than patients with chest pain and abdominal pain. The assumed origin of the pain therefore appears to be of ultimate importance for the assessment and the priority given at the dispatch centre. Factors that may explain these findings include the fact that chest pain is associated with a risk of a time-sensitive condition [20] and that the early treatment of a myocardial infarction, as a cause of chest pain, may save jeopardised myocardium [21]. However, a large proportion of the patients who call 112 for chest pain do not have a time-sensitive condition [22].

Patients with abdominal pain were given a somewhat lower priority at the dispatch centre. There are no such clear-cut triggers for high

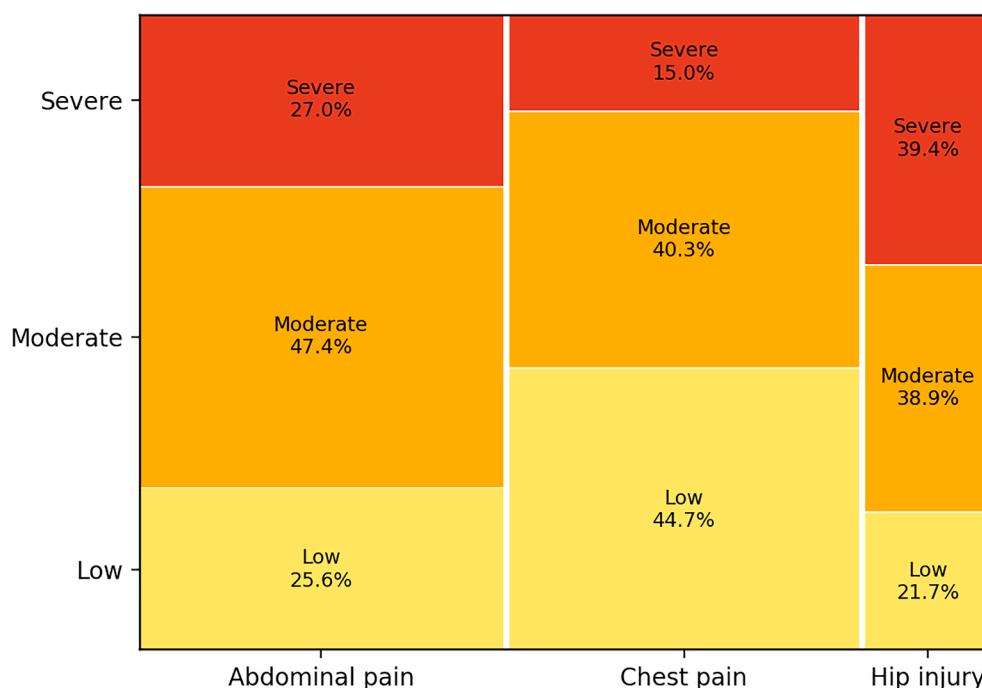


Fig. 2. Pain intensity of patients assessed with abdominal pain (n = 535), chest pain (n = 512) and hip injury (n = 187).

urgency associated with abdominal pain as there are for chest pain, which may explain this finding.

The chance for the patient with severe pain to receive immediate appropriate pain-relieving medication is much higher if the patient receives priority 1 by the dispatcher.

The most reasonable explanation for the observation that patients with a hip injury were given a lower priority at the dispatch centre is central directives, i.e. guidelines. These patients are not believed to be suffering from a time-sensitive condition and are therefore given a lower priority despite the severity of pain. This may create an unnecessarily long waiting time until the treatment of their pain can be started.

In terms of instruments that were used, we found that, among patients with a hip injury, the BRS was used to assess pain in a relatively large proportion of patients. This may be explained by a relatively high occurrence of dementia among these patients, which may create difficulties using the NRS. Similar findings have previously been reported in the evaluation of pain in suspected hip fracture [11]. With regard to patients with chest pain and abdominal pain, the use of any instrument to evaluate pain was fairly low. It is suboptimal that pain was not assessed using an assessment scale more frequently since this is the foundation for continuous assessment and evaluation of treatment of the pain [23]. There were obvious differences between diagnoses in pain assessment. However, the assessment of pain must be carried out regardless of etiology and severity of the pain [24]. The categorisation of numerical scales can be problematic, but there is no obvious better solution to this problem and such a categorisation has previously been carried out on several occasions [11,25–30]. Such a categorisation adds value to the interpretation of the results by creating a possibility to compare all collected information in order to get a relevant overview of the pain situation.

4.2. Treatment of pain

Previous experience suggests that the choice of instrument to assess pain does not influence the treatment of pain [11]. However, previous experience also suggests that the use of any instrument to assess pain will increase the subsequent use of medication for the relief of pain [31]. Furthermore, other research suggests that the re-evaluation of pain after

treatment increases the use of medication for pain relief [32]. This was also found in our study.

Patients with a hip injury more frequently received medication for the relief of pain and they also more frequently showed a reduction in the severity of their pain after treatment had started. Both these observations are best explained by the fact that these patients had more severe pain on the arrival of the EMS. However, it is also possible that simply observing a rotated leg may make it very clear to the EMS staff that this patient has a severe injury and severe pain [33].

Both chest pain and abdominal pain, on the other hand, reflect visceral pain, which may be much more difficult to assess and indirect measurements such as blood pressure, heart rate and respiratory rate may be taken into account [34]. However, the use of medication to relieve pain may also be associated with attitudes among health-care providers, where some are more reluctant to give this treatment than others [32]. Adherence to guidelines may increase the possibility that all patients have equal opportunities of treatment. Factors for adherence have been related to an individual, organisational and external level [35]. Cultural aspects play a role, and colleagues can be a motivator for increased adherence [36]. Furthermore, in a pre-hospital setting where the EMS nurse often provides care alone, thick paper-based guidelines is suboptimal. Therefore, access to and the format of the guidelines remains essential.

Furthermore, there may be situations in which the patients do not wish to receive medication for the relief of pain. One reason for this may be that patients are afraid of becoming drug addicted [37,38].

Reluctance to treat pain can also be based on the myth that patients with abdominal pain should not receive pain-relieving medication before a surgeon has made an evaluation [34]. In our study, only 14% of the patients with abdominal pain received medication which reduced the intensity of their pain before arrival in hospital. However, several studies have clearly shown that giving medication for the relief of pain among patients with abdominal pain does not hamper the diagnostic workup for the physician [37,39,40].

Finally, we are unable to preclude the possibility that some of the patients with chest pain and abdominal pain were free from symptoms on EMS arrival. Visceral pain in particular can come and go in an unpredictable manner.

4.3. Choice of medication

The most frequently used medication for pain relief was morphine. One drawback to the use of morphine is that you need an intravenous or intraosseous line for its administration. This may take some time and, if the ambulance is close to the hospital, this may explain why treatment is postponed. This may also be one of the explanations why glyceryl trinitrate was the most frequently used drug in acute chest pain.

A variety of drugs were used for the relief of pain in the pre-hospital setting. This may indicate a need for better education in how to combine different drugs in the most optimal way and how to take advantage of the existing guidelines in the most optimal fashion.

4.4. Relationship between duration of pre-hospital care and pain-relieving medication

There was a clear increase in the use of medication for the relief of pain when the duration of pre-hospital care increased. This finding is in agreement with previous observations [11].

This finding supports the hypothesis that prioritising duties other than pain relief may sometimes explain why many patients did not receive adequate pain relief before arrival in hospital [41]. Other priorities have also been reported in the ED, where pain management was not considered to be among the core priorities [42], and time to pain-relieving medication from arrival in the ED in patients with extremity fractures up to 70 min have been reported [43]. This stress the importance of using pain scales and pain-relieving medication already in the pre-hospital setting where the EMS nurse have an excellent opportunity in the uninterrupted patient encounter on-scene, despite the duration of pre-hospital care.

4.5. Strengths and limitations

The data are based on a representative and relatively large patient cohort.

However, the study cohort represents an urban area with relatively short distances to the hospital, which may sometimes explain the relatively low use of pain-relieving medication. The data cannot therefore be automatically extrapolated to rural areas. Furthermore, the data are based on retrospective analyses with all their limitations, including information missing for a number of variables for example pain relieving management that did not include pain medication which unfortunately seldom is recorded in the patient notes in our study organisation. Furthermore, diversion may be considered but for how long can diversion persist? What is the purpose of the diversion? Can it be that creating a calm atmosphere and act with a professional appearance towards adult patients with anxiety may reduce pain and therefor be considered a diversion?

4.6. Clinical implications

According to the regional guidelines the patients' pain should be treated if NRS above three. In this study that would correspond to all patients with reported initial pain above "Low" in the synthesized pain assessment. This means that the pain should be treated in 78% of the patients with hip damage, in 74% of the patients with abdominal pain and in 54% of the patients with chest pain. However, the proportion of patients who were given pain relieving medication was much lower. The absolute percentage value differed from 40% (74%–34% i.e. 74% had severe to moderate pain but only 34% received medication) in abdominal pain to 19% (54%–35%) in chest pain. Thus, there is room for improvement in the treatment of pain in all three conditions and a more active early assessment may support such an improvement.

In order to enhance pain-relieving treatment in suspected hip injury, these patients should receive the highest priority already at the dispatch centre and outcome may be improved if they are assessed earlier than in

the current practice.

An improved early management of pain will not only make the patient suffer less in the pre-hospital setting but hopefully also limit the risk of various complications during follow up which in the end will improve cost effectiveness of the early care.

5. Conclusion

Among patients who called for the EMS due to a hip injury, chest pain and abdominal pain, those with a hip injury had the most severe pain and they were also those who received most medication for the relief of pain. Overall, however, a relatively small proportion of patients received medication for the relief of pain before arrival in hospital, regardless of aetiology, and there appears to be scope for a marked improvement.

Ethical statement

This study was approved by the ethical review board, Gothenburg, Sweden, approval no. 970-15. The dataset from the EMS patient registry was anonymised with no link to individual patients. Patients that at the time of EMS contact asked for their data to remain confidential were not included in the retrospective analysis.

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CRediT authorship contribution statement

Carl Magnusson: Conceptualization, Resources, Data curation, Formal analysis, Writing - review & editing. **Marie Carlström:** Investigation, Writing - original draft. **Nathalie Lidman:** Investigation, Writing - original draft. **Johan Herlitz:** Conceptualization, Writing - original draft, Writing - review & editing. **Pär Wennberg:** Writing - review & editing, Supervision. **Christer Axelsson:** Writing - review & editing, Supervision.

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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