International Emergency Nursing 57 (2021) 101012

Contents lists available at ScienceDirect

International Emergency Nursing

journal homepage: www.elsevier.com/locate/aaen

Fascia iliaca compartment block (FICB) as pain treatment in older persons with suspected hip fractures in prehospital emergency care – A comparative pilot study

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ARTICLE INFO

Keywords:
Hip fractures
Pain
Pain measurement
Nerve blocks
Fascia iliaca compartment block
Emergency medical services

ABSTRACT

Background: Older persons with a suspected hip fracture and suffering considerable pain are common patients in the emergency medical services (EMS). Pain treatment needs to be improved and fascia iliaca compartment block (FICB) can be one option. The purpose of this paper was to analyse prehospital pain in patients with a suspected hip fracture under EMS care and to compare standard treatment and FICB.
Methods: An evaluation of a retrospective case-control study comprising 135 patients from a pilot project with FICB in an EMS organisation in Sweden. The control patients were matched with FICB patients. Pain was assessed on the arrival of the EMS and on arrival in hospital.
Results: In all, 27 patients received FICB and 108 had standard pain treatment. There was a significant reduction in pain in both groups. However, there was a more marked reduction in pain among patients who received FICB than in the control group. So, for static pain, 56% experienced a reduction in pain in the FICB group versus 30% among controls ($p < 0.01$). The corresponding values for dynamic pain were 85% and 59% ($p < 0.01$).
Conclusion: FICB can be a good supplement to standard prehospital pain treatment in patients with suspected hip fractures.

1. Introduction

Older patients with a suspected hip fracture are common in prehospital emergency care (PEC) and require effective pain management [1]. Hip injuries are painful and cause static and dynamic pain, the latter especially in conjunction with movement and displacement before surgery take place [2]. The yearly incidence of hip fractures in Sweden is around 18,000, the mean age is over 80 years [3] and it has been predicted that this number will increase to 30,000 annually by 2050 [4]. To provide professional care and prepare the patients for hospitalisation, ambulances are crewed by a prehospital emergency nurse (PEN).

The prehospital guidelines (PG) recommend pain relief through the administration of intravenous opioids [5], but this treatment has a limited effect on dynamic pain (pain on movement) compared with static pain (pain at rest) [6]. For patients that are worried or frightened, a combination of opioids and sedatives is often needed to enhance pain relief [7,8]. However, this regimen can have adverse effects on respiration, especially in the elderly patient [9]. Several studies describe problems with inadequate or no pain relief at all in prehospital emergency care [7,10–13]. Patients report higher dynamic pain levels when lifted from the floor to the stretcher than from the injury fall [14]. Furthermore, they received insufficient pain relief [2,5,12].

Dynamic pain is more intense than pain at rest (static pain) [6] and an adequate assessment is important to enable healthcare providers to understand the severity and nature of the patients' experience [15]. For elderly patients, a numerical rating scale (NRS) is recommended [16] and, if the cognition is impaired with a reduced ability to express their pain, a behaviour rating scale (BRS) should be used [15].

Progress has been made with interventions transferred from hospital to prehospital emergency care and previous studies describe effective pain relief with fascia iliaca compartment block (FICB) for patients with suspected hip fractures [17–20]. This is a safe and low-tech nerve block

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https://doi.org/10.1016/j.ienj.2021.101012
Received 8 February 2021; Received in revised form 9 April 2021; Accepted 12 April 2021
Available online 19 June 2021

that anaesthetises n. femoralis, n. cutaneus femoris lateralis and n. obturatorius [21]. In the presence of a hip fracture, it is mainly these nerves that cause pain. It is indicated that this type of nerve block is a good option for treating pain at the scene of the injury, reducing side-effects with opioids/sedatives and maintaining pain relief [22].

Older persons with suspected hip fractures risk insufficient pain relief [5,23] and the current recommendations with the administration of opioids and sedatives have shown limited pain relief which causes unnecessary suffering [9]. As hip injuries are very painful, it is important to increase PENs' competence and skill in adequate pain management [17]. New methods are needed and FICB appears to be a suitable option for improving the pain management of static and dynamic pain and, in addition, reducing opioid and sedative administration [22,24,25]. However, there is a knowledge gap regarding the outcomes in pain relief with FICB compared with PG for patients with suspected hip fractures, which is the rationale for this study.

2. Aim

The aim of this study was to analyse pain relief among patients with a suspected hip fracture in prehospital emergency care by comparing fascia iliaca compartment block (FICB) with treatment according to prehospital guidelines (PG).

3. Methods

3.1. Design

This study was a pilot study with a retrospective comparative design. To compare the pain-relieving effect of the two methods, a case-control method, where the control patients were matched and randomised, was used.

3.2. Population, setting and sample

The patients in this study had suspected hip fractures and were cared for in the PEC. 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 recruited control patients were treated according to PG and selected from a database created for a larger study in the region where patients' pain had been registered [5]. There were 631 eligible control patients in the database.

Inclusion criteria were

1) patients 65 years or older with suspected hip fractures who had been under care in the ambulance services and,
2) patients had received pain relief according to PG alone or with the addition of FICB and,
3) patients had their static and dynamic pain assessed at the site of injury and at hospital admission

The study area was western Sweden, covering different geographical areas – from remote rural and coastal areas to urban environments. The total population in the study area was 700,000 inhabitants and the ambulance services had 26 ambulances [26].

The recruited patients were treated according to PG and the 27 patients receiving an FICB were categorised as cases. The reference group was generated by matching each case patient with four control patients who had only received PG. The matching was carried out with the assistance of an expert in biostatics. The groups were matched by the variables of age, gender and pain assessment scale used. If there were more than four eligible controls for each case, the controls were sampled by randomisation. The group of control patients is referred to as the reference group.

3.3. Study preparations

The EMS personnel treating patients in this study attended an educational programme on methods for the assessment of pain prior to this study as part of a larger observational study [5]. The EMS personnel administering the FICB were educated in a special programme with lectures and practical procedures in the hospital led by the EMS medical lead.

3.4. Pain management

The management of pain includes assessment, treatment, re-assessment and a final evaluation of pain treatment. In both groups, medication for pain relief was given on demand, as nurse-initiated analgesia to patients with suspected hip fractures, and drug dosages were guided by prehospital guidelines.

The guidelines provided a range of opportunities regarding the choice of medication for the relief of pain. Intravenous morphine, alfentanil, ketamine and benzodiazepines were valid alternatives for prehospital administration. The medication administered to each patient was selected with the support of PG guidelines, combined with the PENs' clinical experience. The final decision on drug administration is made by the PEN – this routine is defined here as standard pain treatment (SPT).

3.5. Data collection

All the data were recorded in the patients' electronic medical records by the PEN in charge of the patient; this documentation was compulsory. The data were then extracted digitally and coded from the underlying database of the patients' records system for analysis. The variables that were collected were the type of pain assessment scale that was used, pain scores and the type of medication during prehospital care, the patients' age and gender. Data were collected from 2015 to 2017.

3.6. Measurements

Self-assessments of pain were made using a numerical rating scale (NRS), if feasible. The NRS is an eleven-grade scale ranging from zero = no pain to ten = worst imaginable pain. The NRS has its limitations; one such limitation is when the patient does not understand the NRS due to cognitive impairment or the situation does not enable the PEN to ask for a pain score.

If the use of the NRS was judged not to be feasible, the behaviour-related scale (BRS) with three categories was used (Fig. 2). The BRS consists of three categories where the first includes patients who do not signal any or only mild pain, the second includes patients whose behaviour reflects moderate pain and the third category includes patients whose behaviour reflects severe pain. The BRS has been developed and validated by the Stockholm South General Hospital [27]. The BRS has been reported to be used in 64% of the patients with hip fractures in prehospital care [5].

To be able to compare pain scores between the different scales in the data analysis, a synthesis of the NRS and the BRS was made. This was done in accordance with the validation of the BRS [27]. The pain scores were 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. It is not uncommon to categorise NRS scores in this way [28–31]. The TPS has previously been used in clinical research [5,10]. 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.
The assessment of pain in patients with a suspected hip fracture was

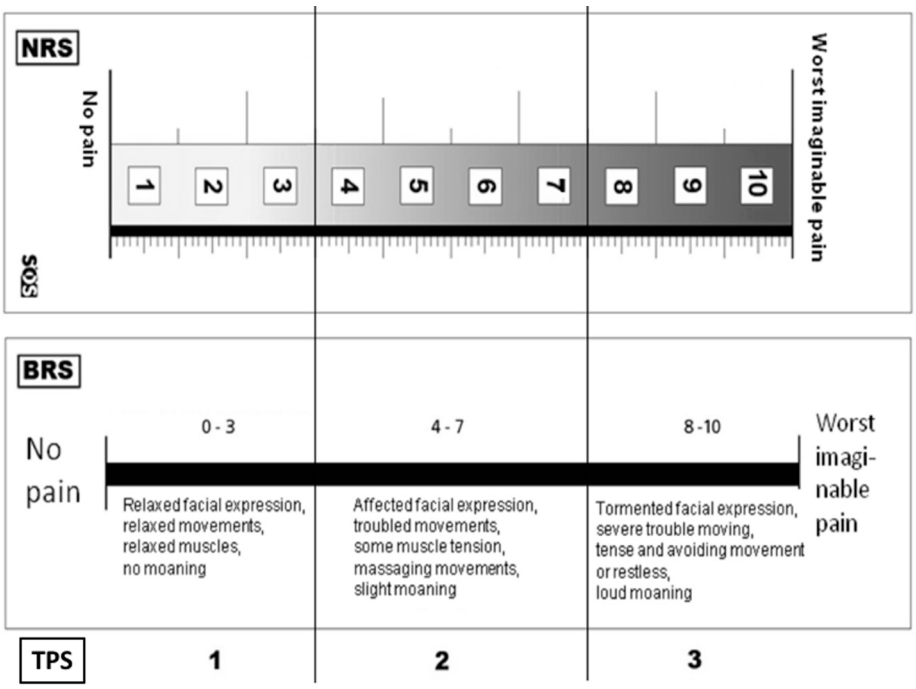

Fig. 1. Visual presentaion of the pain scales used for pain assessment and the synthesis of NRS and BRS in to TPS.

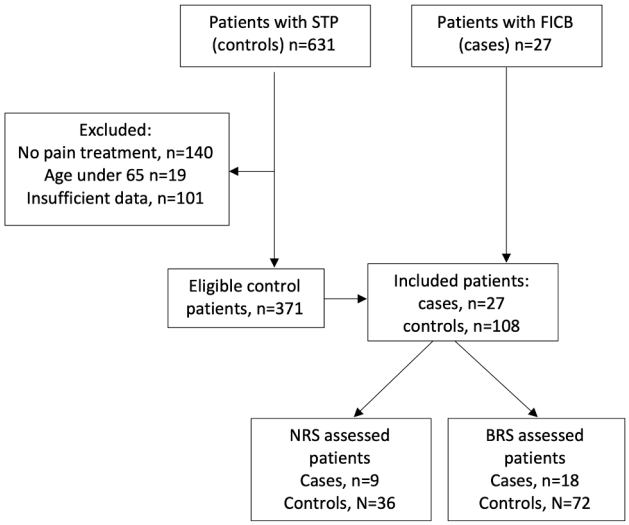

Fig. 2. Flowchart of the inclusion patients in the study.

performed by PENs according to the following routine: static and dynamic 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 the hospital. 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 [6]. The 15 degree leg lift was carried out as part of the routine examination of the patient according to current guidelines or as part of other necessary movement to provide care to the patient.

3.7. Statistical analysis

First, the selected pain data were analysed within groups determined by the pain assessment scale use, i.e. the NRS group and the BRS group. Second, in order to compare and analyse the total material, the TPS was used, where a synthesis of the NRS and BRS results was made.

Descriptive statistics were used to summarise sociodemographic and clinical characteristics. Student's *t*-test was used to analyse differences in age between the reference group and the FICB group. Pain prevalence before and after treatment was presented in frequencies and proportions and the distribution of pain ratings was presented in terms of the mean and standard deviations or the median and quartiles. To compare differences between the groups regarding the variables of gender, pain scale and medication, the chi-square test was used. Regarding the TPS, 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. The explored variables were ordinal and a non-parametric test – Wilcoxon's test – was used for comparisons within groups over time. 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 25).

3.8. Ethics

All patients received oral and written information about the data collection and they were given the option of declining participation with their data without affecting the care that they received. The data on the patients were downloaded under code from the underlying databases of the patients' records system. The data on the control patients had already been collected and deidentified in a database for a previous study [5]. The Regional Ethics Board in Gothenburg approved the present study. All 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.

4. Results

Of 658 patients assessed in prehospital emergency care due to a suspected hip fracture, 260 (39.5%) were excluded for the following reasons; no pain treatment, insufficient data to follow up and age below 65 years. As a result, 398 patients fulfilled the inclusion criteria. Of these patients, 108 were randomised to the reference group for comparisons of

pain relief with 27 patients in the FICB group. In all, 135 patients were therefore included and followed up (Fig. 2).

The groups differed in that a smaller proportion of patients received morphine in the FICB group compared with the reference group, 26% vs. 86% (p = 0.01). Chirocain was only administered in the FICB group and nine of 27 patients in this group only received Chirocain without any other medication. No significant differences between the groups were observed for gender, age or use of pain scale (Table 1).

4.1. Comparison of pain relief between FICB and only PG

Pain assessments were carried out with the NRS in 45 patients and with the BRS in 90 patients. According to the NRS, both static and dynamic pain were significantly reduced from the scene of the injury to arrival in hospital both in the FICB group and in the reference group (static pain, p = 0.02, dynamic pain, p < 0.01 respectively, p < 0.01 and p < 0.01). However, there was a larger pain reduction in the FICB group on the 0–10 pain scale compared with the reference group, static pain from 3 to 1 vs. 3.5 to 2 and dynamic pain from 10 to 4 vs. 8 to 4.

Moreover, among the patients with pain assessed by the BRS, both the static and the dynamic pain were significantly reduced in both the FICB group and the reference group (static pain, p = 0.02, dynamic pain, p = < 0.01 respectively, p < 0.01 and p < 0.01). Furthermore, a larger proportion of patients experienced a reduction in dynamic and static pain, assessed by the BRS, in the FICB group compared with the reference group (61% vs. 26% and 83% vs. 58% respectively) (Table 2).

The synthesis of the NRS and the BRS is presented as the TPS. There was a significant reduction in pain in both groups – in both dynamic pain and static pain. In addition, there was a significantly larger pain reduction in the FICB group compared with the reference group. Static pain was reduced in 56% of the patients in the FICB group vs. 30% in the reference group (p = 0.01). Dynamic pain was reduced in 85% of the patients in the FICB group vs. 59% in the reference group (p < 0.01) (Table 3).

Twelve different PENs administered FICBs. The number of FICBs carried out per PEN ranged from one to nine (Fig. 3).

A subgroup analysis of the nine patients receiving only FICB without any other medication showed that eight of nine (89%) had reduction in dynamic pain according to TPS.

No side-effects were reported as a result of the administered FICB.

5. Discussion

This study compared the relief of pain in the prehospital setting among patients with a suspected hip fracture between 1) a standard routine with intravenous drugs and 2) an FICB when using a case-control method. The FICB routine as well as the standard routine showed a significant pain reduction from arrival on the scene to hospital admission. However, the FICB routine showed superiority in the reduction of pain in all types of assessment. This indicates that FICB could be an appropriate complement to the standard routine in the prehospital treatment of pain among these patients. Furthermore, the study provides information indicating that FICB appears to be a safe method for pain relief in the prehospital setting with non-physicians performing the procedure. These results are in accordance with previous research [17,18].

The FICB group and the control group were comparable in terms of

Table 1
Patient characteristics and type of medical pain treatment in the FICB group and the reference group.

FICB (n = 27)	*Reference(n = 108)*		*p-value*
Gender			
Female, n (%)	19 (70)	76 (70)	1,00
Male, n (%)	8 (30)	32 (30)	
Age			
Mean (SD)	84 (±7,1)	85 (±6,0)	0,57
Min-max	69–98	66–98	
Pain scale			
NRS, n (%)	9 (33)	36 (33)	0,60
BRS, n (%)	18 (67)	72 (67)	
Medication, n (%)			
Morphine	7 (26)	86 (80)	<0,01
Alfentanil	4 (15)	16 (15)	0,78
Ketamine	0 (0)	1 (0,9)	0,62
Esketamine	10 (37)	36 (33)	0,45
Midazolam	9 (33)	38 (35)	0,34
Diazepam	1 (4)	14 (13)	0,52
Chirocain	27 (100)	0 (0)	<0,01

Table 2
Comparison of pain according to the NRS and BRS within the FICB group and the reference group before and after pain treatment and change in pain.

Scale	At the scene of the injury	At the hospital	Pain reduction	p-value
NRS *FICB group (n = 9)*				
Static pain, median (iqr)	3 (1,5–7)	1 (1–1,5)	2 (0,5–5,5)	0,02
Dynamic pain, median (iqr)	10 (8,5–10)	4 (1,5–5)	6 (3–8)	<0,01
Reference group (n = 36)				
Static pain, median (iqr)	3,5 (2–7)	2 (1–3)	1 (0–2,75)	<0,01
Dynamic pain, median (iqr)	8 (6–10)	4 (3–6)	3 (1,25–4)	<0,01
BRS *FICB (n = 18)*				
Static pain, n (%)				
0–3	4 (22)	14 (78)		
4–7	12 (67)	3 (17)	11 (61)	0,02
8–10	2 (11)	1 (6)		
Dynamic pain, n (%)0–3				
4–7	0 (0)	7 (39)		
8–10	5 (28)	9 (50)	15 (83)	<0,01
	13 (72)	2 (11)		
Reference group (n = 72)				
Static pain, n (%)0–3				
4–7	43 (60)	58 (81)		
8–10	25 (35)	13 (18)	19 (26)	<0,01
	4 (6)	1 (1)		
Dynamic pain, n (%)0–3				
4–7	4 (6)	25 (35)		
8–10	33 (46)	38 (53)	42 (58)	<0,01
	35 (49)	9 (13)		

Iqr = inter quartile range.

Table 3
Comparison of pain scores according to the TPS in the two groups before and after pain treatment and a comparison of reduced pain between the groups.

TPS	At the scene of the injury	At the hospital	p-value	Pain reduction	p-value between groups
Static pain	n (%)	n (%)		n (%)	
FICB					
1	9 (33)	23 (85)			
2	15 (56)	3 (11)	<0,01	15(56)	0,01
3	3 (11)	1 (4)			
Reference group					
1	61 (57)	88 (82)			
2	38 (35)	17 (16)	<0,01	32(30)	
3	9 (8)	3 (3)			
Dynamic pain					
FICB					
1	0 (0)	11 (41)			
2	6 (22)	14 (52)	<0,01	23(85)	<0,01
3	21 (78)	2 (7)			
Reference group					
1	6 (6)	35 (32)			
2	47 (44)	61 (57)	<0,01	64(59)	
3	55 (51)	12 (11)			

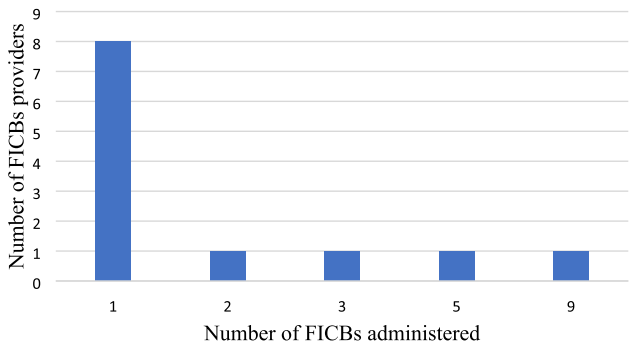

Fig. 3. FICBs carried out per PEN.

age and gender, but the initial level of pain was slightly higher in the FICB group. This study shows that many older patients who have been cared for due to a suspected hip fracture in the ambulance had a high level of dynamic pain before treatment. This is in agreement with previous research [22].

Pain was assessed using the BRS in 67% of all the patients who were included in the study. Behaviour-related pain scales should be used when the patient's cognition is impaired [32] and when patients lack the ability to describe their own pain or when some other pain assessment is impractical [27]. In cases where the patient is in a compromised situation at the scene of the injury, pain assessment can be challenging for the EMS nurse [33]. A compromised situation can be an outdoor environment or in a narrow toilet with the patient on the floor. The patients may often have been in compromised situations of this kind where the BRS was the easiest way to assess pain.

Patients receiving an FICB for pain treatment reported more pain relief on arrival in hospital compared with patients in the control group. The fact that patients in the FICB group required less morphine lends further support to the effectiveness of this mode of pain treatment. The combination of less morphine and improved pain relief may create conditions for less cognitive impairment during follow-up, which has been reported to be common among these patients [34,35].

5.1. Differences in static and dynamic pain in the FICB group compared with the reference group

The most obvious difference between the compared groups can be seen in the reduction in pain, a finding that is supported by in-hospital randomised trials [6,10]. Patients in the FICB group were more often in dynamic pain category 1 according to the TPS on arrival in hospital compared with the control group. This finding is in agreement with previous research [25,36,37]. Morphine alone may not be sufficient to relieve pain in a significant proportion of patients with a hip fracture [6]. When comparing FICB with morphine, greater morphine consumption was reported in non-FICB patients [25,36].

We found that nine patients in the FICB group did not require any additional drug treatment and still experienced a significant reduction in pain. This is in line with research by Fujihara [38].

This study implies that FICB can be a good adjunct to regular pain treatment among patients with hip fractures, in agreement with the findings of Wennberg [10]. In the United Kingdom, national guidelines recommend nerve block administration to patients with hip fractures either when paracetamol and morphine are insufficient or just to reduce morphine consumption [39].

One of the advantages of FICB is that it provides quick pain relief that lasts for many hours [38,40]. Even a low-dose FICB can provide significant pain relief for several hours [41]. Earlier studies have reported a high level of patient satisfaction with pain treatment through FICB and that patients would like to have FICB again if needed [37].

5.2. Pain assessment after pain treatment

With regard to static pain, there were only small differences between groups in the assessed pain on arrival at hospital. One reason for this could be a fairly low pain level and the fact that patients with hip fractures usually experience the dynamic pain as more severe, which has also been concluded in other research [17]. However, all the pain levels were lower in the FICB group, which is also the conclusion in other studies [6,10,25,37]. The results appeared similar when looking separately on the nine patients who received FICB without additional medication.

5.3. FICB may reduce drug-related side-effects

A significantly larger proportion of the patients in the control group received morphine than in the FICB group. The data in this study imply that morphine consumption can be reduced with FICB and at the same time improve pain relief, a finding that is supported by other research [36,42]. This means that the risk of drug-related side-effects can be avoided [6,37].

There were no reports of adverse events after FICB or any of the other drugs that were used in this study. Adverse events reported with FICB in other research have been limited to haematoma at the injection site [34,43]. There is one report of an anaphylactic reaction to the local anaesthetic [33]. Many studies claim that FICB is a safe method [44–46].

5.4. Clinical implementation of prehospital FICB

The use of FICBs in EMS care appears to be an attractive alternative among patients with a presumed hip fracture, as we found that the patients who received this treatment experienced greater pain relief than the control group in terms of both dynamic and static pain. This may indicate less discomfort for the patient during transport. The administration of an FICB does not require long medical experience, is quick to learn and is a relatively simple procedure to perform [42,47]. A study of paramedic personnel agreed on the simplicity and suitability of the method for pain treatment in patients with hip fractures [33]. The number of FICB's administered by each PEN varied between one and nine. The improvement of pain relief with addition of FICB to common pain relief suggest that the administered FICB's were successful in most cases, although the PENs in this study was inexperienced FICB providers. The same conclusion has been described in previous research [18].

6. Strengths and limitations

This is a retrospective study, which can be regarded as a limitation, where a randomised, prospective study might have been preferred. Having said this, the randomised matching of controls with the cases can be regarded as a strength, considering the circumstances. Another limitation could be that the study only included 27 patients who were offered FICBs and the generalisability can therefore be regarded as limited. The guidelines followed in the control patients are in accordance with the Swedish national prehospital guidelines, so part of the results can be generalised to some extent [48]. Pain levels at baseline were higher in the FICB group and they therefore had the potential for more marked pain relief. Pain is a subjective experience [49] and this study is unable to explain the baseline difference between the two groups. Similar baseline differences have previously been observed in randomised trials [6,10]. The TPS is not a validated instrument but a model for comparing pain scores where different scales have been used in order to include the full spectrum of patients with a presumed hip fracture [10].

7. Future research

Future studies of any type on prehospital nerve blocks as prehospital

pain treatment should be prospective and randomised and should also evaluate long-term effects such as cognition, postoperative complications, length of hospital stay, patient satisfaction and early mobilisation, as these are outcomes of importance for patients suffering a hip fracture [2,5,34,50–53].

8. Conclusion

Both FICBs and the standard pain treatment methods produced a significant pain reduction in the prehospital setting among patients with suspected hip fractures. However, FICBs produced a more marked pain reduction than standard treatment. As a result, more patients had reduced pain and there was also a larger reduction in pain. In some cases, FICBs could be provided without supplementary drug therapy with good effect, indicating the potential to avoid undesirable side-effects from opioids. The ambulance nurses proved to be able to administer FICB safely. However, this is a pilot study and more research is needed.

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, D. no. 1131–18/2019–00853.

Funding source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Pär Wennberg: Conceptualization, Data curation, Methodology, Writing - review & editing. **Thea Hillberg Hörnfeldt:** Data curation, Writing - original draft. **Susanna Stål:** Data curation, Writing - original draft. **Johan Herlitz:** Writing - review & editing. **Joakim Björås:** Conceptualization, Resources. **Glenn Larsson:** Writing - review & editing, Methodology.

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.

Acknowledgements

The research was performed in the emergency medical service departments of the western Swedish region and we would like to thank Anna-Lena Emanuelsson Loft for administrative support and Salmir Nasic for statistical support.

All the authors have read and approved the final manuscript.

We hereby attest to the original nature of the material; the paper has not been published elsewhere and is not under consideration by any other publication.

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