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The effect of pain management in reducing limb and spine radiography in stable traumatic patients admitted to the emergency department

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Abstract

Introduction: Musculoskeletal pain caused by trauma is one of the common complaints of patients referred to the emergency department. Due to the lack of a proper pain control protocol, doctors and nurses do not pay attention to pain, and physicians may tend to request too many radiographs, many of which will be unnecessary. We aimed to study the effect of pain management by fentanyl in reducing the number of radiographs, reducing hospital costs and increasing satisfaction in the patients on patients with isolated trauma in limbs and spine causing musculoskeletal pain.

Patients and methods: A cohort of patients who were referred to the fast-track emergency department with isolated trauma of the upper and lower limbs or spine and triage levels 3, 4 and 5, were visited twice by an emergency medicine resident – before and after application of a pain management protocol using intravenous fentanyl as the principle analgesic. The primary outcome measure was the reduction in the number of radiographs requested; secondary outcomes included alterations in pain levels and patient satisfaction.

Results: A total of 158 patients were included in the study. The median age was 27.5 years, three quarters were male and 20.88% had a positive history of opium addiction. The number and costs of diagnostic radiography significantly decreased after the administration of fentanyl ($P < 0.0001$), as did pain levels measured on visual analogue scale with a consequent increase in patient satisfaction. There were only six complications resulting from fentanyl administration which were mild and transient. Follow-up after 24–72 h, revealed no missed fractures.

Conclusions: The administration of fentanyl as a strong analgesic as part of an emergency department pain management protocol for trauma patients can be performed with limited minor complications; it can reduce the number of unnecessary X-rays performed, exposure to ionizing radiation and hospital costs as well as improving patient satisfaction without missing fractures.

Keywords

Pain management, fentanyl, diagnostic imaging, trauma

Introduction

Pain is the commonest symptom of patients presenting to the emergency department (ED), is one of the chief complaints following trauma, but is usually suboptimally controlled.[1,2] Patients expect to receive analgesia once they enter the ED,[3] so after the initial assessment, rapid and effective pain management through the timely prescription of analgesics is the aim for all trauma patients.[4,5]

Musculoskeletal injuries are one of the most frequent painful disorders in ED trauma patients and

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X-rays are required to exclude fracture, but ionizing radiation exposure should be limited wherever possible[6]; clinical decision pathways to identify those with a low probability of fracture may reduce the number of unnecessary radiographs.[7,8] Incorporation of a robust pain management protocol, potentially using opioids such as fentanyl, may allow a more accurate assessment of the injury, further reduce unnecessary radiographs and better manage hospital resources.[9,10] Fentanyl is a μ-agonists receptor narcotic with high analgesic potency and faster onset than other analgesics making it well suited to use in the ED for trauma patients.[11]

The aim of this study was to assess the impact of adequate pain management on reducing the number of radiographs and hospital costs and increasing the satisfaction of patients with isolated limb and spine trauma referred to our ED. It also aimed to address the effect of pain management and its relation to the type of injury, mechanism of injury, location and the number of injuries in these patients.

Patients and methods

Study design and protocol

A cohort study on patients with isolated injuries of the upper limbs, lower limbs, or spine, who were referred to the ED of Bahonar academic hospital, Kerman, a Level 2 trauma center in southeastern Iran. On average, 90,000 trauma patients attend the ED each year, of which 84,000 are categorized as emergency triage index 3, 4 or 5.[12] Twelve emergency medicine residents (Post-Graduate Year 3) and nurses in the ED were educated on pain management principles and the implementation of the pain relief protocol in a 3-h course during their regular working shifts but were unaware of the study. Data were gathered by a single resident.

All triage level 3, 4 and 5 trauma patients, who were referred on fast-track to the hospital's ED or were transferred by emergency medical service (EMS), were visited by an emergency medicine resident who decided on which investigations including radiographs would be required, but none were actually performed; the need for radiographs was based mainly on pain severity and other signs such as bruises, scratches and tenderness. After the initial visit, 1 μg/kg IV fentanyl was administered by the nurse and after 30 min, the patient was revisited by the same resident, re-evaluated and all orders and radiographs now deemed necessary were performed. Pain severity was measured using a standard visual analogue scale (VAS) from 0 (lowest severity) to 10 (highest severity),[9,11] before and 30 min after the administration of the drug and if the VAS >4 30 min post-analgesia, a radiograph was requested for the patient.[9,10] Patients were kept in ED until they were alert and hemodynamically stable; those referred to the orthopedic specialist after 24–72 h were then re-assessed and followed up and those who were not referred on were followed up by telephone. Patients were included if they were between 16 and 60 years of age, triage levels at 3, 4 and 5, had isolated trauma of upper or lower limbs or spine, fully alert, no simultaneous use of alcohol and drugs and had been referred to ED less than 1 h after the trauma. Exclusion criteria were multiple trauma patients, critically ill patients (triage levels 1 and 2), outside the 16–60 years age range, loss of consciousness, obvious limb deformities, delayed presentations to ED >1 h from injury, comorbid diseases such as cancer and immunodeficiency and a history of medications such as anticoagulants, psychiatric drugs, corticosteroid and chemotherapy drugs. Written informed consent was given by all the patients before the study, and all information remained confidential with the researcher.

Study outcomes and statistical analysis

After sampling and data collection by the emergency medicine residents, the data were analyzed by SPSS 20. For the description of quantitative variables, mean (±SD) was used, respectively, and for qualitative variables, count and percentage were used. To measure the association between variables, the Chi-Square or Fischer's exact tests were used and the paired t-test for assessing the difference between before and after analgesia.

Results

In total, 278 patients were enrolled in the study, but 120 were excluded as not meeting the inclusion criteria leaving 158 patients with isolated trauma of the upper and lower extremities or spine for analysis (Figure 1). The median age was 27.5 years (range: 16–60); 76.6% were male and 20.88% had a positive history of opium addiction. The most common mechanism of trauma was motorbike related (47.5%) (Table 1).

In these patients, the age, sex, history of opium addiction and the mechanism of injury was not associated with the number of planned radiographs before and after receiving fentanyl. The type of injury, number of injuries and location of them were all significantly associated with a decrease in number of required radiographs ($P < 0.0001$) after administration of fentanyl. In patients with upper and lower extremity injuries, the number of X-rays taken after administering fentanyl reduced considerably, and unsurprisingly the diagnostic radiographic costs significantly decreased after the administration of fentanyl ($P < 0.0001$) (Table 2).

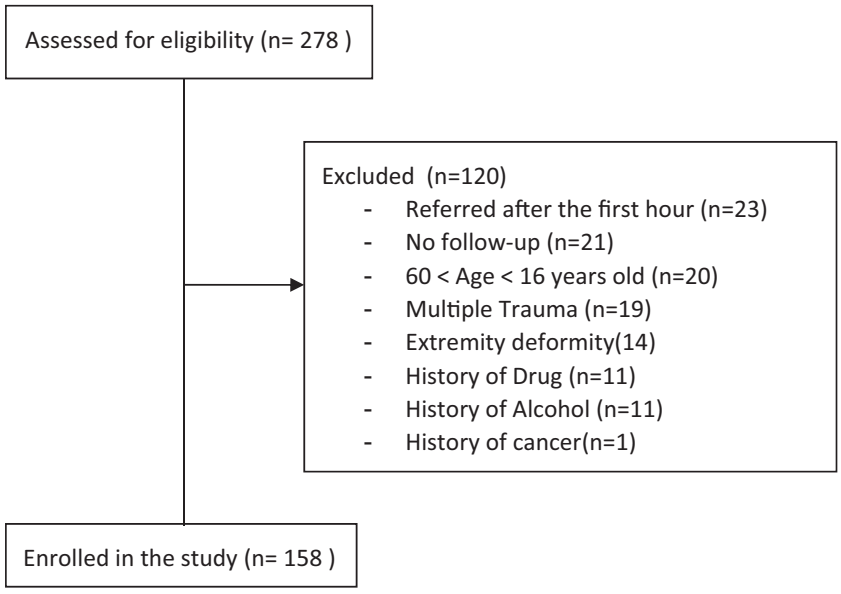

Figure 1. Flow chart showing enrollment of patients.

Table 1. Patient's characteristics.

Variables	N (%)
Median age (range)	27.5 (16–60)
Male/female	121/37 (76.6/23.4)
Opium addiction	33 (20.88)
Mechanism of injury	
Head-on-collision	14 (8.9)
Rear-end-collision	7 (4.4)
Lateral collision	10 (6.3)
Rollover	18 (11.4)
Pedestrian-motor vehicle	34 (21.5)
Motorbike related	75 (47.5)

Decreases in pain according to the VAS were also significant after fentanyl administration ($P < 0.0001$), which corresponded with an increase in patient satisfaction ($P < 0.0001$) (Table 3). There were complications from fentanyl administration in six (3.7%) patients, which were mild and transient (Table 4). The follow-up after 24–72 h either in fracture clinic or by telephone, revealed no missed fractures.

Discussion

Pain is considered the fifth vital sign due to its importance, and there is a need to control it to minimise mortality and complications after trauma from its impact on the body's metabolism such as increases in blood pressure, cardiac ischemia, respiratory, gastrointestinal and renal problems.[13] Acute pain activates the stress response, and inadequate pain management causes psychological stress after trauma, which affects the patients' rehabilitation after trauma and the pain may convert to chronic pain if not treated effectively; hence, adequate analgesia can decrease the adverse effects on the patients' outcome.[14] It is known that unfortunately, acute pain management is often forgotten in the ED[2,15,16] as most physicians and nurses do not believe that controlling pain is a real emergency causing persistent pain in many patients, despite technological improvements and acute and chronic pain services. Inadequate knowledge, crowded EDs, the absence of pain management guidelines, failure to assess primary pain and insufficient treatment of the patients are the known causes.[17–21] Since the nurse is responsible for prescribing pain medication for the patients and considering the key role of the nurses in pain management, their education on this subject is very important.[19] The benefits of proper, appropriate and timely pain management in trauma patients are therefore many and varied: it can reduce the stress response, increase comfort and accelerate patients' recovery with a concomitant reduction in hospitalization time costs. It can also prevent disability and chronic pain, decrease morbidity and mortality and avoid long-term consequences in the patients.[4,5,13,22]

Excellent pain control is a significant contributor to patient satisfaction for a variety of reasons. Good analgesia allows speedier ED management, the need for fewer treatments and shorter hospital stays; shorter ED stay is also associated with improved patient

Table 2. The distribution of patient's characteristics, injury, costs and reduced radiography before/after fentanyl use.

Variables[a]	Radiography n (%)		P	% Reduction in radiography (%)[b]	P
	Before using fentanyl	After using fentanyl			
Age (y)					0.74
≤ 20	129 (66.80)	64 (33.20)	<0.0001	50.38	
21–40	249 (65.70)	130 (34.30)	<0.0001	47.79	
≥41	89 (65.90)	46 (34.10)	<0.0001	48.31	
Sex					0.42
Male	373 (65)	195 (35)	<0.0001	47.50	
Female	94 (67)	45 (33)	<0.0001	52.13	
Opium addiction					0.18
Yes	105 (68.60)	48 (31.40)	<0.0001	54.28	
No	362 (65.30)	192 (34.70)	<0.0001	47.00	
Mechanism of injury					0.19
Head-on-collision	35 (68.60)	16 (31.40)	<0.0001	54.28	
Rear-end-collision	12 (63.20)	7 (36.80)	0.25	41.67	
Lateral collision	24 (70.60)	10 (29.40)	0.01	58.33	
Rollover	55 (72.40)	21 (27.60)	<0.0001	61.82	
Pedestrian-motor vehicle	103 (66)	53 (34)	<0.0001	49.50	
Motorbike related	238 (64.20)	133 (35.80)	<0.0001	44.12	
Type of injury					
Abrasion	196 (66.20)	100 (33.80)	<0.0001	48.97	<0.0001
Laceration	2 (50)	2 (50)	1	0.00	
Swelling	36 (52.90)	32 (47.10)	0.63	11.11	
Tenderness	222 (59.20)	153 (40.80)	<0.0001	31.08	
Number of injury					<0.0001
0 Injury (only pain)	120 (74.50)	41 (25.50)	<0.0001	65.80	
1 Injury	253 (66.90)	125 (33.10)	<0.0001	50.60	
2 Injuries	79 (56.80)	60 (43.20)	0.1	24.05	
3 Injuries	15 (51.70)	14 (48.30)	0.85	6.70	
Location of injury					<0.0001
Upper extremity	118 (71.50)	47 (28.50)	<0.0001	60.16	
Lower extremity	240 (63.50)	138 (36.50)	<0.0001	42.50	
Spine	72 (64.90)	39 (35.10)	<0.0001	45.83	
Costs[c]	467 (66.1)	240 (33.9)	<0.0001	48.60	<0.0001

[a]Chi-square or Fisher's exact test.
[b](number before−number after)/number before × 100.
[c]Based on the number of radiographies.

Table 3. The mean number of radiographs and VAS scale before and after fentanyl use.

	Before using fentanyl	After using fentanyl	P[a]
Radiography (mean ± SD)	3.00 ± 1.73	1.55 ± 1.25	<0.0001
VAS (mean ± SD)	6.20 ± 1.38	3.77 ± 1.46	<0.0001

VAS: visual analogue scale.
[a]Paired t test.

Table 4. Fentanyl side effects.

Fentanyl side effects	N (%)
Vertigo	4 (2.5)
Vertigo + hypotension	1 (0.6)
Nausea	1 (0.6)
None	152 (96.3)

satisfaction.[3,14,22–24] As patient satisfaction is affected by such wide-reaching issues, it is an important criterion of healthcare outcome mapping and can be used as a surrogate marker when trying to improve the quality of pain control.[15] In this study, after starting proper pain management and the implementation of a pain relief protocol, the patients' satisfaction increased, as their pain decreased after receiving fentanyl.[25]

Nevertheless, although painful musculoskeletal disorders following trauma are common and pain management is of great importance, radiographs form an essential part of their investigation as there is a risk of missing a hidden fracture, but adequate knowledge and experience should be exercised to decrease costs and exposure to ionizing radiation, and thereby deliver a better service to the patients.[8] Whilst seemingly self-evident that reducing pain will produce a better patient experience, few studies have demonstrated a clear reduction in the number of radiographs for extremity or spinal injury required after introduction of a simple and effective pain management protocol.[26,27] In this study, the use of fentanyl as a narcotic for pain control significantly reduced the number of requested radiographs, which was the primary aim of the study.

Due to the risk of chronic pain in one-third of the musculoskeletal trauma cases, using an appropriate analgesic is helpful and reasonable[28] and patient satisfaction increases more following the administration of narcotics rather than other analgesics, potentially due to the anxiolytic properties of narcotics, in addition to their high potency analgesic effect.[11,29] The preferred narcotic in our pain management protocol is intravenous fentanyl because of its greater potency and faster onset of action; although a few, limited studies have addressed the efficiency, safety and adverse events of analgesics in ED, no evidence suggests an increased risk of complications following their administration.[1,9,11,30] In our study, the adverse effects were few, mild and transient.

One of the limitations of this study, in common with others, was the non-cooperation of patients who declined to enroll despite the explanations given; likewise the new pain protocol was not applied by the residents and nurses in every potential case and an overcrowded ED led to improper pain management in some cases. Whilst it was a single center study, the high volume of trauma patients admitted to the hospital, which is the only trauma center in the locality, meant that the findings are likely to be reproducible.

Conclusions

The implementation of appropriate pain management with fentanyl can reduce the number of radiographs, reduce hospital costs and increase the satisfaction in patients referred to the ED with isolated limb and spine trauma. The risks of adverse effects following the administration of fentanyl are few, mild and transient.

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Authors' contribution

Study concept, design and supervision: Mehdi Torabi and Ali Mehri; acquisition of data: Ali Mehri; analysis and interpretation of data: Moghadameh Mirzai; drafting of the manuscript, technical and material support: Mehdi Torabi.

Ethical approval

The ethical approval for this study was obtained from the Ethics Committee of the Kerman University of Medical Sciences (IR. KMU. REC. 1395.101).

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Informed consent

Written, informed consent was given by all the patients before the study and all information remained confidential with the researcher.

Guarantor

MT.

Provenance and peer review

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