TITLE

Prescription Of analgesia in Emergency Medicine (POEM) secondary analysis: an observational multicentre comparison of pain relief provided to adults and children with an isolated limb fracture and/or dislocation

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ABSTRACT

Background

Acute pain is a common reason for Emergency Department (ED) attendance. Royal College of Emergency Medicine (RCEM) pain management audits have shown national variation and room for improvement. Previous evidence suggests that children receive less satisfactory pain management than adults.

Methods

POEM (Prescription Of analgesia in Emergency Medicine) is a cross-sectional observational study of consecutive patients presenting to 12 NHS Emergency Departments with an isolated long bone fracture and/or dislocation, and was carried out between 2015 and 2017. Using the recommendations in the RCEM Best Practice Guidelines, pain management in ED was assessed for differences of age (adults vs children) and hospital type (children's vs all patients).

Results

From the total 8346 patients, 38% were children (median age 8y). There was better adherence to the RCEM guidance for children than adults (24% (766/3196) vs 11% (579/5123)) for the combined outcome of timely assessment, pain score and appropriate analgesia. In addition, children were significantly more likely than adults to receive analgesia appropriate to the pain score (of those with a recorded pain score 67% (1168/1744) vs 52% (1238/2361)). Children's hospitals performed much better across all reported outcomes compared to general hospitals.

Conclusions

In contrast to previous studies, children with a limb fracture/dislocation are more likely than adults to have a pain score documented and to receive appropriate analgesia. Unexpectedly, children's EDs performed better than general EDs in relation to timely and appropriate analgesia but the reasons for this are not apparent from the present study.

INTRODUCTION

Good pain management correlates with positive patient experience and clinical outcomes but, worldwide, ED pain management is often inadequate.[1] Similar to Emergency Medicine organisations internationally, the Royal College of Emergency Medicine (RCEM) Best Practice Guidelines 2014[2] (updated for children 2017[3]) describe standards for acute pain management in the Emergency Department (ED). Multiple RCEM national audits[4] have found wide variation in performance and concluded pain management could be improved.

Prior studies have demonstrated that patient age influences pain management after fracture in the ED with children seemingly receiving inferior treatment.[5] In addition, the type of hospital appears to modify the treatment of pain by clinicians.[6] The reasons for these variations are unclear and need investigation.

This study examines the differences in ED pain management for adults and children presenting with isolated limb fracture and/or dislocation across several UK NHS sites. The findings are examined with the aim of improving recommendations for patient care.

METHODS

Study design

This is a pre-planned sub-analysis of a cross-sectional observational study of patients presenting to 12 NHS EDs between 2015 and 2017. Five trauma centres and six trauma units contributed to the final POEM study dataset. A list of participating sites can be found in the online supplementary appendix.

The Berkshire Research Ethics Committee (REC 14/SC/0167) and the Confidential Advisory Group (CAG 3-02(c)/2014) approved the study.

Inclusion/exclusion criteria, the study sample size calculation and data collection are described in Sheehan et al.[7]

Data analysis

The primary outcome was the proportion of patients receiving pain management as per the RCEM Best Practice Guidelines: a pain score recorded within twenty minutes of arrival in the ED and analgesia provided appropriate to the pain score. The secondary outcome was the influence of age and setting on pain management provided in the ED by comparing adults and children (<18y). Chi-squared tests were used to examine associations between variables. All analyses were performed using the R Statistics program (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Participants

Patient characteristics are described in **Table 1**.

Table 1. Patient characteristics

Note: all missing data <2% unless otherwise stated.

Characteristic	Adult	Children (all) (<18y)	p-value[b]	Children at children's hospitals	Children at mixed hospitals	p-value[c]
Number Analysed	5123	3196		1089	2107	
Age (Median (IQR))	64 (43, 80)	8 (5, 12)	<0.001	8 (4, 11)	9 (5, 13)	<0.001
IMD[a] (Median (IQR))	11.6 (2.0, 45.0)	14.1 (0.5, 79.0)	<0.001	33.2 (14.7,50.4)	10.9 (5.7,19.3)	<0.001
Gender			<0.001			0.895
Male	1878 (36.7%)	1915 (60.1%)		656 (60.2%)	1259 (59.8%)	
Female	3222 (62.9%)	1269 (39.9%)		431 (39.6%)	838 (39.8%)	
Ethnicity	642 missing (12.5%)	272 missing (8.5%)	<0.001	49 missing (4.5%)	223 missing (10.6%)	<0.001
White	4251 (83.0%)	2187 (68.4%)		618 (56.7%)	1569 (74.5%)	
Non-white	230 (4.5%)	737 (23.1%)		422 (38.8%)	315 (15.0%)	
Arrival mode			<0.001			0.272
Self presented	2553 (49.8%)	2783 (87.1%)		945 (86.8%)	1838 (87.2%)	
Ambulance (road and air)	2490 (48.6%)	390 (12.2%)		144 (13.2%)	246 (11.7%)	
Other	60 (1.6%)	17 (0.7%)		0 (0%)	17 (1.1%)	
Location after ED			<0.001			<0.001
Home	2977 (58%)	2541 (80%)		898 (84%)	1643 (79%)	
Hospital	2061 (40%)	604 (19%)		166 (16%)	438 (21%)	
Type of injury			<0.001			0.018
Fracture	4495 (88%)	3088 (97%)		1066 (98%)	2022 (96%)	
Dislocation	466 (9%)	71 (2%)		17 (2%)	54 (3%)	
Fracture/ Dislocation	159 (3%)	35 (1%)		6 (1%)	29 (1%)	
Injury location			<0.001			0.159
Upper limb injury	2906 (57%)	2795 (87%)		966 (89%)	1829 (87%)	
Lower limb injury	2205 (43%)	397 (12%)		123 (11%)	274 (13%)	

ED: emergency department; IMD: index of multiple deprivation.

[a]IMD is a numerical score whereby a higher score represents greater deprivation.

[b] statistical test for the difference between adults and children

[c] statistical test for the difference between children at children's hospitals and children at mixed hospitals

A total of 8346 patients attended the EDs with a limb fracture and/or dislocation. Children comprised 38% (3196) of our population (median age 8 years). Children had a male:female

ratio of 60:40, the reverse of adults (37:63). There is little difference in the attendances by day of the week between adults and children (online supplementary appendix). Children had a greater proportion of upper limb injuries (87%) compared with adults (56%) (online supplementary appendix).

Pain assessment and management

Figure 1 summarises the primary outcome data for adults and children. Children were more likely than adults to have an initial assessment (triage) within twenty minutes of arrival (63% (1997/3155) vs 50% (2512/5031); p<0.001). Of those seen within twenty minutes of arrival, 55% (1093/1997) of children and 46% (1145/2512) of adults had a pain score recorded (p<0.001). Irrespective of timings, children were more likely than adults to have a pain score documented (55% (1756/3196) vs 47% (2401/5123); p<0.001).

Children were more likely than adults to receive analgesia appropriate to the pain score (of those with a recorded pain score 67% (1168/1744) vs 52% (1238/2361); p<0.001). The combined outcome of timely assessment and appropriate analgesia also shows better adherence to RCEM guidance for children than adults (24% (766/3196) vs 11% (579/5123); p<0.001).

Children were less likely to have a pain score reassessed than adults (7% (230/3196) vs 11% (545/5123); p<0.001) except in the children's only hospitals (15% (163/1089); p<0.001).

Regardless of pain score, 66% (2112/3196) of children received pharmacological analgesia in the ED compared with 53% (2727/5123) of adults (p<0.001). This proportion was even greater (76% (826/1089)) in children's only hospitals.

Considering the whole patient journey (Table 2), 23.7% (759/3196) of children had 'self-medicated' before ED arrival (vs adults 17.2% (882/5123)). The other marked difference was that almost one third of adults were given a weak opioid, but only 1.5% of children, all of whom attended mixed hospitals.

Table 2. Pain score and Analgesia throughout the patient journey

	Adults (n=5123, %)	Children (n=3196, %)	Children at children's hospitals (n=1089, %)	Children at mixed hospitals (n=2107, %)
Pain Score				
No pain score	2722 (53.1%)	1440 (45.1%)	283 (26.0%)	1157 (54.9%)
No pain (pain score 0)	188 (3.7%)	298 (9.3%)	203 (18.6%)	95 (4.5%)
Mild/moderate pain (Pain scores 1-3/4-6)	1726 (33.7%)	1078 (33.7%)	392 (36.0%)	686 (32.6%)
Severe pain (pain scores 7-10)	487 (9.5%)	380 (11.9%)	211 (19.4%)	169 (8.0%)
Analgesia				
Self-medication	882 (17.2%)	759 (23.7%)	226 (20.8%)	533 (25.3%)
Analgesia given by pre-hospital clinician	1735 (33.9%)	355 (11.1%)	120 (11.0%)	235 (11.2%)
Manipulation	1160 (22.6%)	136 (4.3%)	24 (2.2%)	112 (5.3%)
Sedation	548 (10.7%)	56 (1.8%)	12 (1.1%)	44 (2.1%)
Block	790 (15.4%)	21 (0.7%)	13 (1.2%)	8 (0.4%)
Analgesia given in ED	2727 (53.2%)	2112 (66.1%)	826 (75.8%)	1286 (61.0%)
Mild/moderate potency	1482 (28.9%)	1619 (50.6%)	650 (59.7%)	969 (46.0%)
Severe potency	1192 (23.3%)	478 (15.0%)	176 (16.2%)	302 (14.3%)
Non-opioid: paracetamol	1666 (32.5%)	1513 (47.3%)	611 (56.1%)	902 (42.8%)
Non-opioid: NSAID*	635 (12.4%)	1169 (36.6%)	469 (43.1%)	700 (33.2%)
Weak opioid#	861 (16.8%)	31$ (1.0%)	0 (0%)	31 (1.5%)
Strong opioid∞	1009 (19.7%)	547 (17.1%)	201 (18.5%)	346 (16.4%)
Missing	101 (2%)	32 (1.0%)	1 (0.1%)	31 (1.5%)

*Ibuprofen, diclofenac, ketorolac, naproxen
#codeine, dihydrocodeine, tramadol
$ dihydrocodeine=1, codeine=29, tramadol=1
∞morphine, hydromorphone, diamorphine, fentanyl, alfentanyl, pethidine, oxycodone, methadone

DISCUSSION

Children were more likely to have a pain score recorded within twenty minutes of ED arrival and to receive analgesia appropriate to that pain score than adults. This contrasts with previous literature which found that children fared worse than adults in terms of ED provision of analgesia for fractures.[5,6,8] Potential explanations are that children are frequently accompanied by an adult who can act as an advocate; there may be a different staff response to a child in pain; or perhaps children are less inhibited in displaying their pain which prompts staff to react and provide analgesia.

Much of the difference in our data was accounted for by the children's hospitals which provided the best adherence to the RCEM criteria. This is contrary to the findings of Cimpello et al [9] who found no difference between paediatric and general EM physicians in the provision of analgesia to children with extremity fractures.

The increased provision of analgesia for children when compared to adults extended through the whole patient journey including provision of 'self-medication' or by pre-hospital clinicians. This suggests that the difference is not limited only to the hospital environment. Minimal use of weak opioids in children is probably a response to the UK guidance to avoid codeine in children.[10]

There is an unacceptable proportion of patients who appear not to have been offered some means of analgesia. Both POEM and the RCEM audit data demonstrate similar proportions of children without a recorded pain score (45%). Interestingly, in previous analysis from POEM [7] we showed that patients with a pain score recorded were also more likely to receive analgesia. Repeating this analysis split into adults and children indicates that this is almost entirely an effect in children rather than in adults. Over half of adults received ED analgesia irrespective of whether a pain score was recorded. In children, 61.1% received ED analgesia without a pain score and 70.1% received ED analgesia with a pain score, demonstrating that ED analgesia provision was better in children and further improved by recording a pain score. Reassessment of pain was poorly documented, in line with the RCEM data. We found that children's hospitals reassessed pain most often (15%).

Future work should concentrate on learning from the children's hospitals to improve provision of pain relief to all patients.

Limitations

We are limited by reliance on documentation. We were unable to reliably consider non-pharmacological modalities of pain management such as ice or splints. We have not considered factors such as volume of ED attendances for impact on the ability to provide timely treatment. We have only considered patients with certain injuries and not all causes of pain that present to EDs.

We are unable to determine why there are marked differences in pain management between the children's hospitals and the remaining departments.

CONCLUSION

Children were statistically more likely than adults to have a pain score documented and to receive appropriate analgesia. The two children's hospitals in our study outperformed general EDs for provision of timely and appropriate analgesia to children. It is unclear why this might be, and we recommend this should be explored further to improve pain management for all patients.

What is already known on the subject?

There is mixed evidence for the effect of age on the provision of analgesia in the Emergency Department.

What this study adds:

For patients with an isolated long bone fracture/dislocation, children receive better pain management than adults in the ED. There is a difference in performance between children's hospital EDs and general EDs.

Figure 1: Primary outcomes and other metrics split by age and department type

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Footnotes

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Contributors

LK and JQ conceived the survey. JS was the chief investigator. LK, JQ, MD, SW and Peter Thomas were co-investigators on the protocol. Martyn Ezra drew up the initial statistical strategy and JRD performed the statistical analysis. SB contributed to the entirety of the project together with the other investigators. SW wrote the first draft of the manuscript; all authors revised this draft. All authors read and approved the final version.

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COI disclosure

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: JRD reports personal fees from Royal Berkshire Hospital during this analysis of the study and personal fees from Reading University during the conduct of the study. All remaining authors did not declare any interests.

Patient and Public Involvement (PPI) statement

PPI representatives worked with us to refine the research question and protocol. At the end of the study, the PPI representatives met with the study steering group to review the findings. Their opinion was sought about the interpretation of the results. One of our PPI representatives has read and reviewed the submitted and revised manuscripts.

Collaborators

Stuart Hartshorn, Katy Pettit, Karen Faulkner and Anna Smith (Birmingham Children's Hospital, Birmingham's Women's and Children's NHS Foundation Trust); Rachel Wharton, Sarah Moreton, Denise Maitland and Stephanie Jones (Dorset County Hospital NHS Foundation Trust); Alison Walker and Rachel Worton (Harrogate and District NHS Foundation Trust); Peter Thomas, Antoanela Colda, Charlotte White and Gill Ritchie (Milton Keynes University Hospital NHS Foundation Trust); Melanie Darwent, Sally Beer, Alexis Espinosa, Dominique Georgiou, Louise Findlay, Holly Coles, Jose Martinez, Alex Novak, Amanda Budden, Soubera Rymell, Peter Chater-Lea, Sandy Farrow, Hannah Ward and Neil Dawson (Oxford University Hospitals NHS Foundation Trust–John Radcliffe Hospital and Horton General Hospital); James Sheehan, Liza Keating, Sarah Kempster, Katie Keating-Fedders, Will Orchard, Christina Ambrose, Carys Jones, Justine Loh, Nicola Jacques, Gemma Grimwood, Nyla Haque, Charlotte Philips, Victoria Murray, Carl Evans, Rachel Brooke, Lucie Tesarova and Claire Burnett (Royal Berkshire Hospital NHS Foundation Trust); Alasdair Gray, Mia Paderanga, Adam Lloyd, Kate Easterford, Emma Ward and Rachel O'Brien (Royal Infirmary of Edinburgh); Stuart Gormley, Nick Weatherhill and Shammi Ramlakha (Sheffield

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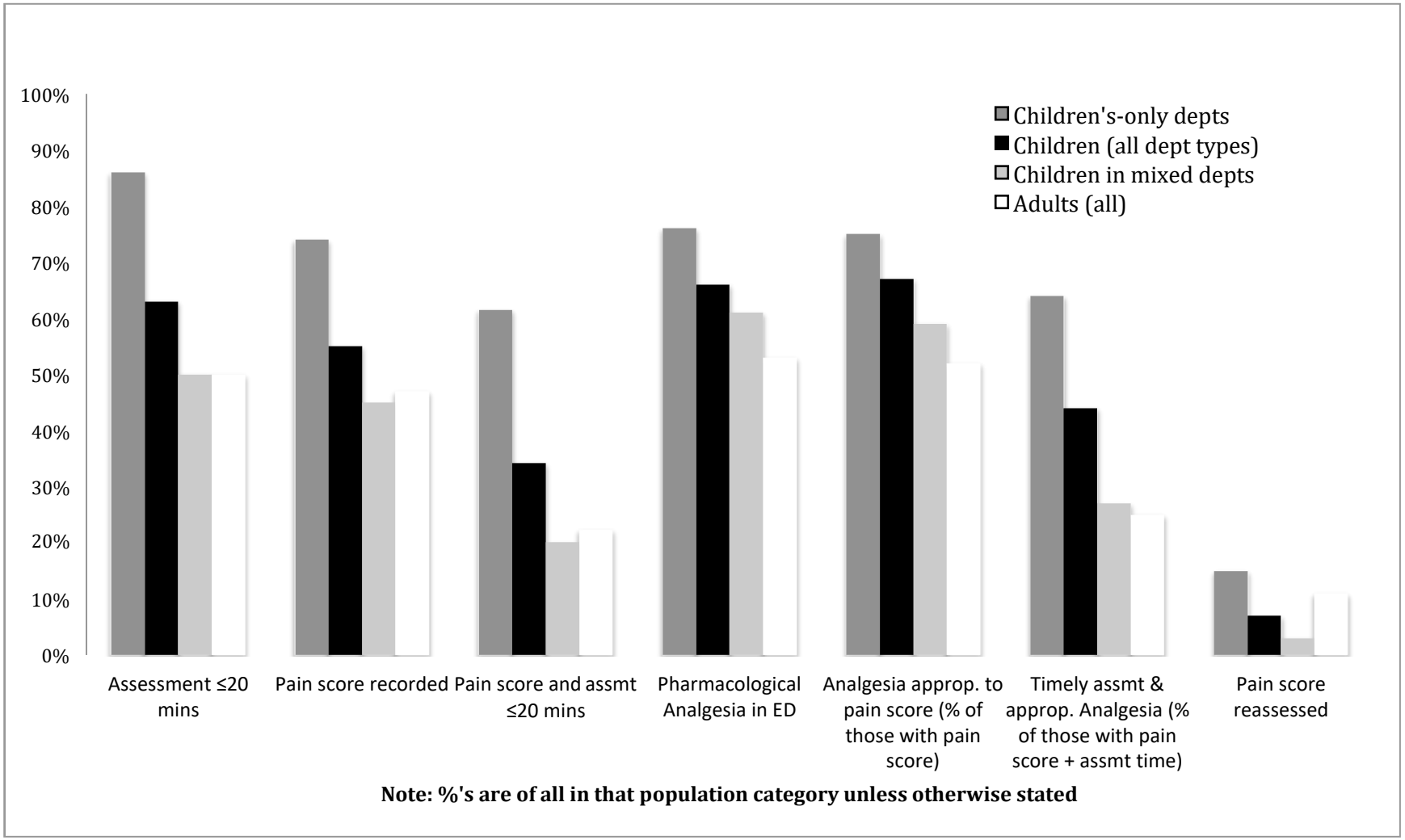
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Children's-only depts
Children (all dept types)
Children in mixed depts
Adults (all)
Assessment ≤20 mins
Pain score recorded
Pain score and assmt ≤20 mins
Pharmacological Analgesia in ED
Analgesia approp. to pain score (% of those with pain score)
Timely assmt & approp. Analgesia (% of those with pain score + assmt time)
Pain score reassessed
Note: %'s are of all in that population category unless otherwise stated

Supplementary Data

Appendix 1: Alphabetical list of participating sites

Birmingham Children's Hospital, Birmingham Women's and Children's NHS Foundation Trust
Dorset County Hospital NHS Foundation Trust
Harrogate and District NHS Foundation Trust
Milton Keynes University Hospital NHS Foundation Trust
Oxford University Hospitals NHS Foundation Trust (John Radcliffe Hospital, Horton General Hospital)
Royal Berkshire Hospital NHS Foundation Trust
Royal Infirmary of Edinburgh
Sheffield Children's NHS Foundation Trust
University Hospitals Plymouth NHS Trust
Wexham Park Hospital, Frimley Health NHS Foundation Trust

Appendix 2: Attendance by day of the week and time of day

	Adults	Children
Arrival in ED (day of week)	2 missing (0%)	1 missing (0%)
Monday	737 (14%)	436 (14%)
Tuesday	722 (14%)	436 (14%)
Wednesday	683 (13%)	409 (13%)
Thursday	694 (14%)	507 (16%)
Friday	650 (13%)	453 (14%)
Saturday	781 (15%)	433 (14%)
Sunday	854 (17%)	521 (16%)
Arrival in ED (time of day)	1 missing (0%)	1 missing (0%)
Midnight to 8am	593 (12%)	65 (2%)
8am to 4pm	2477 (48%)	1488 (47%)
4pm to midnight	2052 (40%)	1642 (51%)

Appendix 3: Bone injured

	Adults	Children
Bone	12 missing (0.2%)	4 missing (0.1%)
Humerus	634 (12%)	476 (15%)
Clavicle	291 (6%)	360 (11%)
Acromioclavicular joint	35 (1%)	5 (0%)
Glenohumeral joint (Shoulder)	301 (6%)	30 (1%)
Sternoclavicular joint	2 (0%)	0 (0%)
Elbow joint	39 (1%)	33 (1%)
Radius	1163 (23%)	1144 (36%)
Ulna	113 (2%)	78 (2%)
Wrist	0 (0%)	0 (0%)
Radius/Ulna	328 (6%)	669 (21%)
Femur	244 (5%)	63 (2%)
Hip joint	101 (2%)	0 (0%)
Knee joint	4 (0%)	2 (0%)
Tibia	167 (3%)	164 (5%)
Fibula	528 (10%)	83 (3%)
Tibia/Fibula	235 (5%)	84 (3%)
Ankle	67 (1%)	1 (0%)
Neck of femur	859 (17%)	0 (0%)