



Original article

Efficacy, pain, and overall patient satisfaction with pediatric upper arm fracture reduction in the emergency department



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ABSTRACT

Introduction: Immediate closed reduction and cast immobilization performed under sedation in the emergency room is the mainstay management for most isolated displaced or angulated upper limb fractures in children. We aimed to determine if this approach is safe, effective and if patients, parents and staff are satisfied with this approach. Our working hypothesis was this management provides a high satisfaction rate.

Patients and methods: Between January 2017 and October 2017 we included 118 children presenting with upper arm fractures amenable to closed reduction under our institutional analgesia protocol. Children received 0.4 mg/kg of Oramorph oral solution, they were then evaluated 40 minutes later, and if their Face Legs Activity Cry Consolability (for children under 16 years-old) and/or Visual Analog Scale (for children over 6 years-old) were under 4, they underwent closed reduction by an orthopaedic resident under Nitrous oxide. If their pain assessment scale was above 4, they received an extra 0.4 mg/kg of Oramorph oral solution and underwent closed reduction 40 minutes later under nitrous oxide. These children were managed without hospitalization, as outpatients. Children > 6, families and nursing staff were also given a visual satisfaction scale (using a 1–10 score) just before being discharged from the ER in order to evaluate their experience.

Results: Closed reduction in the ER was judged satisfactory from an orthopedic point-of-view in 115 cases (97.6%). Parents, children and the nursing team gave the experience in the ER an average satisfaction score of 9 out of 10.

Conclusion: ER reduction is not only safe and effective but is also associated with a high satisfaction rate amongst children, their families and the nursing staff.

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1. Introduction

Upper limb fractures are among the most frequently encountered orthopedic injuries encountered in the pediatric Emergency Room (ER), accounting for nearly 75% of all pediatric fractures [1,2]. Immediate closed reduction and cast immobilization is the mainstay management for most isolated displaced or angulated upper limb fractures [3–5]. This can be performed in the operating room (OR) under general anesthesia or in the ER under sedation. Several reports have shown that, in most cases, closed reduction performed in the ER under sedation offers satisfactory results [6,7]. We aimed to determine how patients, parents and staff evaluated their experience with ER closed reduction. Our working hypothesis was this management provides a high satisfaction rate.

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2. Patients and methods

Between January 2017 and October 2017, we included 118 patients presenting with upper arm fractures amenable to closed reduction under sedation in the ER. Reduction was performed under our institutional analgesia protocol.

Children received 0.4 mg/kg of Oramorph oral solution, they were then evaluated 40 minutes later, and if their Face Legs Activity Cry Consolability (for children under 16 years-old) and/or Visual Analog Scale (for children over 6 years-old) were under 4, they underwent closed reduction by an orthopaedic resident under Nitrous oxide. If their pain assessment scale was above 4, they received an extra 0.4 mg/kg of Oramorph oral solution and underwent closed reduction 40 minutes later under nitrous oxide.

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Reduction was then stabilized by a plaster of Paris cast and arm sling also performed by the resident in the ER. Quality of reduction was then assessed by X-ray in the radiology department. The cast comprised 2 jerseys, no cotton layer (to limit the risk of secondary displacement) and there was no systematic splitting. Supracondylar fractures without displacement were treated with plaster cast whilst those with displacement were treated according to the Blount technique.

Children were evaluated for pain using the Face, Legs, Activity, Cry, Consolability scale also known as the FLACC scale, as well as the Visual Analog Scale for children >6 years of age, at several moments during ER management by the attending nurse: at admission, after oral sedation/analgesia, during closed reduction, after closed reduction as the cast was placed, and on discharge. Children >6, families and nursing staff were also given a satisfaction scale (using a 1–10 score) just before being discharged from the ER in order to evaluate their experience. This is a subjective visual scale, like the VAS scale, with numbers from 0 to 10, with 10 being the most satisfied possible and 0 the most unsatisfied possible.

Parents and children aged >6 were asked to use this scale. Efficacy of reduction was evaluated radiologically before discharge. On day 10, children and parents were seen during the routine post-reduction check-up in the outpatient clinic. Reduction of the fracture was evaluated radiologically whilst they were also questioned about how they remembered their experience in the ER, whether the child experienced nightmares, and general attitude toward carers. Results are expressed as mean \pm standard deviation.

3. Results

Mean age was 8 ± 4 years (range: 2–16). Type of fracture included: 33.7% distal fractures of the forearm, 39.3% diaphyseal fractures of the forearm, 27% supracondylar fractures of the humerus (Gartland type 2). There were only posterior displacements and no translations, as anterior displacements and/or fractures with an overlap were always managed in the OR.

As expected the maximum pain was experienced during reduction with a mean FLACC score of 4.2 ± 2.9 (range: 0–10), but as soon as the arm was immobilized, the children had no more pain. Closed reduction in the ER was judged satisfactory from an orthopedic point-of-view in 115 cases (97.6%). Three patients, one supracondylar and two diaphyseal fractures underwent reduction under general anaesthesia because of unsatisfactory reduction ($> 15^\circ$). For the supracondylar fracture, there was severe edema and insufficient reduction. For one of the diaphyseal fractures, initial displacement was 25° , after reduction there was overcorrection (ulna 10° and radius 15°), which was then managed by Elastic Stable Intramedullary Nailing (ESIN). For the second case, initial angulation was 30° , control X-ray showed insufficient reduction at 15° , which was then followed by reduction under general anaesthesia in the OR and casting.

The mean satisfaction scores were 8.1 ± 2.3 for children aged >6 (range: 7–10), and 8.4 ± 1.9 (range: 7–10) for parents. There was no statistical correlation between pain intensity on FLACC score and satisfaction score though this might be a spurious correlation, especially since using nitrous oxide causes a certain degree of amnesia which influences results. The nursing team, originally wary of the protocol also judged the experience positively (9.5 ± 0.9).

82 patients were seen in our outpatient setting on day 10. Out of these, 9 patients (11%) presented secondary displacement that did not require further management (less than 15°), and 3 (4%) presented secondary displacements requiring correction under general anaesthesia. The first case was a distal diaphyseal fracture

with satisfactory initial reduction, followed by secondary compression, splitting of the cast and secondary displacement, which was managed by ESIN. The second was a distal fracture, with a cast that had become weak by day 10 postreduction, thus leading to secondary displacement, managed by reduction under GA, and casting. The third case was a distal fracture with proper initial reduction, secondary displacement, reduction under general anaesthesia, and casting.

Out of 33% of children who had spontaneously talked about their experience in the ER, 81% recounted the experience positively. 96% of children seemed unafraid during follow-up when seeing the physician. The main advantages the parents found in ER reduction of fractures was avoiding general anaesthesia and avoiding hospital stay.

4. Discussion

First-line management of upper limb fractures in children should always be conservative. The excellent remodeling potential in children, the cost-effectiveness of non-surgical treatment, and the avoidance of general anaesthesia are all strong arguments for conservative treatment. However, though orthopedic surgeons, anesthetist and emergency physicians might already be convinced of the advantages of conservative management, it is important to know how children and families rated their experience and determine whether this option is not performed at the expense of excessive pain and discomfort.

In our department reductions are performed by an orthopedic resident with satisfactory results as demonstrated by previous authors [7,8]. In a recent report, Natarajan et al, for instance noted a 95.3% success rate for reduction performed by orthopedic residents [8]. Our cut-off for judging reduction inadequate was 15° which is comparable with other series [9,10]. Attempts at reduction and immobilization may be compromised by inadequate analgesia or the depth of sedation which is why we developed with our anaesthesia team our own protocol for analgesia during reduction. We do not use sedatives such as Propofol or Ketamine which can induce hypoventilation and require longer surveillance periods. Analgesia is correctly obtained with the oramorph and the nitrous oxide provides mild anaesthesia and amnesia. The overall satisfaction was high, both in patients and families and in nursing staff. The general experience was judged positively at follow-up also.

The limitations of our study are that it was not comparative, therefore comparisons to OR fixation and reduction are based on current results but not our own control group. The questionnaire used is not a validated questionnaire.

One of the strength of our study is having the satisfaction rate of children and families, associated with pain evaluation. There was no statistical correlation between pain intensity on FLACC score and satisfaction score; however the relationship between these two parameters cannot be demonstrated clearly by this study. Indeed, these are two separate evaluations done at different times and under different conditions. Using nitrous oxide causes a certain degree of amnesia which certainly influences results. So though some patients, who objectively experienced pain, were satisfied with the choice of conservative management we cannot confirm whether this is because they were prepared to accept a certain amount of pain if it means less hospital stay and less risk of general anaesthesia or whether it was due to the relative amnesia the sedation protocol induces. However, what can be said is that the main advantage our patients and families found in the ER reduction, when asked, was the avoidance of general anaesthesia and hospitalization.

In conclusion, this study indicates that ER reduction is not only safe and effective but that it is associated with a high satisfaction rate amongst children, their families and the nursing staff. Including the patient and family's evaluation of our treatment is an important step towards patient-centered outcome.

Disclosure of interest

The authors declare that they have no competing interest.

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Authors' contribution

A Delgove: contributed to: study design, data acquisition and analysis, and approved the final version of the manuscript.

L. Harper: contributed to: data analysis and writing the manuscript.

S. Berciaud: contributed to: study design and approved the final version of the manuscript.

A. Lalioui: contributed to: study design, data acquisition and approved the final version of the manuscript.

A. Angelliaume: contributed to: study design, data acquisition and approved the final version of the manuscript.

Y Lefevre: contributed to: study design, data acquisition and analysis, participated in writing the manuscript and approved the final version of the manuscript.

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