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Observational study

Predictors of chronic neuropathic pain after scoliosis surgery in children

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HIGHLIGHTS

- Our study aimed to characterize chronic pain after paediatric scoliosis surgery.
- Incidence of chronic pain was 52.8%, incidence of neuropathic pain was 48.2%.
- Risk factors were: morphine consumption at day 1 and persistent preoperative pain.
- Patients with preoperative pain should be referred to specialized pain teams.

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ABSTRACT

Background: Numerous publications describe chronic pain following surgery in both adults and children. However, data in the paediatric population are still sparse and both prevalence of chronic pain after surgery and risk factors of this complication still undetermined.

Methods: We prospectively evaluated the prevalence of chronic pain and its neuropathic pain component at 1 year following correction of idiopathic scoliosis in children less than 18 years of age. Pain was defined as the presence of pain (numerical rating scale – NRS ≥ 4), the presence of signs of neurologic damage within the area of surgery and the presence of the neuropathic symptoms as a DN4 (Douleur Neuropathique 4) questionnaire ≥ 4. Factors investigated as potentially associated with the presence of a persistent neuropathic pain were: age, weight, the presence of continuous preoperative pain over the 3 months before surgery, surgical characteristics, pain scores during the first five postoperative days, and DN4 at day 3. Statistical analysis employed univariate analysis and a multivariate logistic regression model.

Results: Thirty six patients were included in the study. Nineteen (52.8%) had pain at one year after surgery. Among them 17 (48.2%) had neuropathic pain. Logistic regression found continuous pain over the 3 months preceding surgery and day 1 morphine consumption ≥ 0.5 mg kg^{-1} as independent predictors of persistent chronic pain with a neuropathic component. The overall model accuracy was 80.6 and the area under the curve of the model was 0.89 (95% confidence interval 0.78–0.99).

Conclusions: The present study found a high proportion of paediatric patients developing chronic persistent pain after surgical correction of scoliosis diformity. It allows identifying two factors associated with the occurrence of persistent chronic pain with a neuropathic component: the presence of persistent preoperative pain during the 3 months preceeding surgery and postoperative opioid consumption at day 1 ≥ 0.5 mg kg^{-1}.

Implication: Patients scheduled for spine surgery and presenting with preoperative pain should be considered at risk of chronic pain after surgery and managed accordingly by the chronic and/or acute pain team. Postoperative opioid consumption should be lowered as possible by using multimodal analgesia and regional analgesia such as postoperative epidural analgesia.

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1. Introduction

Postoperative pain is a concern for both clinicians and patients [1], and is one of patients' greatest concerns in the perioperative period, both in adults and children [1].

Good postoperative pain management can be considered an indicator of perioperative management quality and is an ethical responsibility for caregivers. Recent studies have found acute postoperative pain to be a major risk factor for sensitization and/or hyperalgesia that impact upon future pain experiences, especially in children and infants [2,3]. Furthermore, acute postoperative pain is associated with chronic postoperative pain [3].

A growing body of evidence strongly suggests persistent chronic pain after surgery is a public health problem. Ten to 20% of all adult surgical patients are estimated to suffer from chronic pain [4–11]. High risk surgeries (amputation, thoracotomy, breast cancer surgery, and craniotomy) and predictive factors (early postoperative pain, psychological factors) are being defined in adult populations [8]. Chronic pain is technically difficult and more costly to treat than acute pain, largely due to the requirement of multidisciplinary teamwork [12–14]. In addition, it is associated with important impairment in quality of life [10,15]. This is especially well documented in neuropathic pain, the most frequent form of chronic pain after surgery [8,16]. As a result, identifying patients at risk of chronic pain is important.

Although many risk factors have indeed been identified for chronic pain in children (extensive surgery, preoperative anxiety and persistent pain 15 days after surgery), data are still lacking for both incidence and risk factors [8–10,17,18]. In addition, chronic pain in children and adolescents is even more challenging to treat given limited evidence in this population [10] and carry important long-lasting psychological consequences [10,15]. The main objective of this study was to evaluate the prevalence of chronic pain after surgery, and more specifically the presence of a neuropathic component, one year after scoliosis surgery in children and to identify its risk factors.

2. Material and methods

We designed the prospective collection of data in patients undergoing surgical correction of idiopathic scoliosis from January 2014 to May 2014. This study was approved by our institutional IRB (Comité d'Evaluation de l'Ethique des projets de Recherche Biomédicale (CEERB) Robert Debré; # 2013/007). Informed written consent was obtained for all patients and parents.

2.1. Inclusion and exclusion criteria

Inclusion criteria were: age <18 years, single stage posterior fixation spinal surgery, idiopathic scoliosis, absence of contraindication to the use of analgesics used by protocol in our institution for scoliosis surgery: paracetamol, NSAIDs, nefopam, opioids, gabapentin. Exclusion criteria were: secondary surgical intervention for infection or other surgical complications, thoracoplasty, anterior release or fixation, sacral fusion, inability to understand French or English languages and absence of consent to participate to the study.

Inclusion was performed during the preoperative consultation (a preoperative consultation is performed systematically in the 5 week preceding the scheduled date of surgery) and consent of patients and parents were obtained at this time.

2.2. Perioperative anaesthesia

Anaesthesia was standardized and follows our protocol for the management of scoliosis surgery, the anaesthesia protocol published in a previous article [19]. Preoperative anaesthesia and surgical preparation included standardized recombinant Erythropoietin administration and iron supplementation, intraoperative antifibrinolytic agent administration (tranexamic acid) and intraoperative red blood cell salvage. In addition, all patients were given oral Gabapentin 1200 mg before surgery that was continued at a daily dose of 600 mg until day 5. Anaesthesia protocol was as follows: preoxygenation for 3 min, then induction using sevoflurane (6% in a 50% mixture of O_2/N_2O) or intravenous propofol (5–7 mg kg^{-1}). Maintenance involved sevoflurane at 0.8 minimal alveolar concentration. Intraoperative analgesia was in the form of sufentanil boluses (0.2 μg kg^{-1} when heart rate or mean arterial pressure increased by more than 20% of preoperative values) and intrathecal morphine (0.5 μg kg^{-1} after incision performed under visual control by the surgeon). All patients were intubated with a non-depolarizing muscle relaxant. Muscle relaxation was systematically reversed at the end of surgery. Patients were operated upon in the prone position on a Jackson frame. A minimum of two venous cannula were inserted and Ringer's Lactate solution (RL) administered at 2 ml kg^{-1} h^{-1}. Further vascular filling was administered according to oesophageal Doppler measured stroke volume and intravenous fluid load response. Filling solutions were initially RL, then hydroxyethylstarch (130/0.4, Voluven®, FRESENIUS KABI FRANCE, Sevres, France) following consecutive failure of two 10 ml kg^{-1} crystalloid boluses. Arterial pressure and heart rate were

Table 1
Descriptive statistics. PACU: postoperative acute care unit; NRS: numerical rating scale; DN4: douleur neuropathique 4 scale.

Factors	Mean ± sd (and median [range]) or *N* (%) [95% confidence interval]
Age	15 ± 2
Weight (kg)	50 ± 9
Female	31 (86.1%)
ASA I & II	100%
Preoperative NRS	3 ± 3; 3 [0, 9]
Continuous pain over the 3 months preceding surgery	16 (44.4% [28.4%–60.4%])
Opioid administration over the 3 months preceding surgery	0 (0%)
Duration of anaesthesia (min)	267 ± 67
Duration of surgery (min)	188 ± 53
Intraoperative sufentanil administration (μg kg^{-1})	1.4 ± 0.5
Number of level fused	10 ± 3
Duration of PACU stay (h)	18 ± 4
Total morphine in PACU (mg kg^{-1})	0.5 ± 0.2
Total cumulative morphine at day 1 (mg kg^{-1})	0.6 ± 0.2
Total morphine at day 3 (mg kg^{-1})	1.4 ± 0.8
Total morphine at day 5 (mg kg^{-1})	1.1 ± 0.7
Maximal NRS score in PACU	4 ± 3; 4 [0, 9]
Pain in PACU (NRS ≥ 4)	22 (61.1% [45.1%–77.1%])
Maximal NRS day 1	5 ± 2; 5 [0, 8]
Maximal NRS ≥ 4 during postoperative day 1	29 (80.6% [67.6%–93.6%])
Maximal NRS at day 3	5 ± 2; 5 [2, 9]
Maximal NRS ≥ 4 during postoperative day 3	32 (88.9% [78.9%–98.9%])
DN4 at day 3	2.78 ± 2; 3 [0, 7]
DN4 ≥ 4 during postoperative day 3	12 (33.3% [18.3%–48.3%])
Neuropathic pain at day 3	12 (33.3% [18.3%–48.3%])
Maximal NRS day 5	4 ± 2; 4 [0, 8]
Maximal NRS ≥ 4 during postoperative day 5	22 (61.1% [45.1%–77.1%])
NRS at 1 year	3 ± 2; 4 [0, 7]
NRS ≥ 4 at 1 year	19 (52.8% [36.8%–68.8%])
DN4 at 1 year	3 ± 2; 3 [0, 9]
DN4 ≥ 4 at 1 year	17 (47.2% [31.2%–63.2%])
Neuropathic pain at 1 year	17 (47.2% [31.2%–63.2%])

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