Journal of Pediatric Surgery 49 (2014) 551–555

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

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

Perioperative epidural analgesia in children undergoing major abdominal tumor surgery — a single center experience

Steven W. Warmann [a,*], Stefanie Lang [a], Frank Fideler [b], Gunnar Blumenstock [c], Barbara Schlisio [b], Matthias Kumpf [d], Martin Ebinger [e], Guido Seitz [a], Jörg Fuchs [a]

[a] Department of Pediatric Surgery and Pediatric Urology, Hoppe-Seyler-Str. 3, 72076 Tuebingen, Germany
[b] Department of Anaesthesiology and Intensive Care Medicine, Hoppe-Seyler-Str. 3, 72076 Tuebingen, Germany
[c] Department of Clinical Epidemiology and Applied Biometry, Hoppe-Seyler-Str. 3, 72076 Tuebingen, Germany
[d] Department of Pediatric Cardiology, Pulmology and Intensive Care, Hoppe-Seyler-Str. 3, 72076 Tuebingen, Germany
[e] Department of Pediatric Oncology, University Hospital Tuebingen, Hoppe-Seyler-Str. 3, 72076 Tuebingen, Germany

ARTICLE INFO

Article history:
Received 26 June 2013
Received in revised form 31 August 2013
Accepted 8 October 2013

Key words:
Pediatric solid tumors
Abdominal surgery
Continuous epidural analgesia
Epidural
Catheter
Pain scores

ABSTRACT

Purpose: The purpose of this study was to assess the use of continuous epidural analgesia in pediatric patients undergoing major abdominal tumor surgery.
Methods: Children undergoing major abdominal tumor surgery at our institution between 2008 and 2012 (n = 40) received continuous epidural analgesia via an epidural catheter. Surgical trauma scores, pain scores, and clinical data of the children were compared to a pair-matched historical control group operated on between 2002 and 2007 without epidural analgesia.
Results: Pain levels in the study group on day 1 and 3 after surgery were lower compared to the control group. The differences did, however, not reach statistical significance ($p = 0.15$ and 0.09). Children in the study group received significantly fewer additional doses of piritramide or morphine (45% versus 82%, $p < 0.001$). Despite significantly higher surgical trauma scores in the study group (p = 0.018), there were no statistical differences regarding clinical parameters, such as mechanical ventilation time, time on intensive care unit, and total hospital stay. There were no catheter-related complications.
Conclusions: Continuous epidural analgesia is beneficial for children undergoing complex abdominal tumor surgery with regard to pain levels, postoperative recovery, and general clinical course. Expertise of the managing team, a careful patient selection, and a continuous quality assessment are essential for success.

Surgery regularly plays a key role in abdominal pediatric tumors. In most of these cases, complete surgical resection has a prognostic relevance for the children [1–4]. Over recent years surgical procedures and techniques have become increasingly complex. Organ-preserving approaches, operations including vascular- or neuro-surgical techniques, reconstructive procedures, and other complex operations are regularly being conducted in order to achieve R_0 resection status in the patients [5–7]. Together with the surgical progress, the perioperative medical care has become more and more demanding. This especially applies to the anesthesiology as well as intensive care management.

Continuous epidural analgesia has been established as part of the perioperative anesthesiology management especially in adults. There is a broad experience with this method in adults including its use in abdominal tumor surgery patients. [8–10]. The use of epidural analgesia for perioperative pain management is increasingly being evaluated in children. In some cases, epidural analgesia has been described as being superior to other methods of pain management. However, only few studies so far have analyzed this method in children undergoing surgery for abdominal tumors; a comparative analysis is lacking. [11–15]. In this study we evaluated the effects of perioperative continuous epidural analgesia in children undergoing major surgical procedures for abdominal solid tumors. We compared children receiving epidural analgesia with patients undergoing the same procedures without this method.

1. Materials and methods

1.1. Patients

As the study group we retrospectively evaluated all patients undergoing resection of an abdominal tumor at our institution between July 2008 and March 2012 in which continuous epidural analgesia was performed via a preoperatively placed thoracic catheter. As an historical control group we analyzed all patients operated on for the same reasons at our institution between April 2002 and June 2008 who were treated without epidural analgesia. For an optimal comparability we performed a pair-matched analysis of the two groups (see statistical analysis). Patient data including clinical

* Corresponding author. Tel.: +49 7071 2986621; fax: +49 7071 294046.
E-mail address: steven.warmann@med.uni-tuebingen.de (S.W. Warmann).

0022-3468/$ – see front matter
http://dx.doi.org/10.1016/j.jpedsurg.2013.10.025

as well as surgery- and anaesthesiology-related data were assessed. The study was approved by the ethics committee of the University of Tuebingen (No. 348/2011A); informed consent was obtained from all parents.

1.2. Surgical trauma score (STS)

A surgical trauma score was established in order to categorize the surgical intervention in both patient groups. This trauma score was formulated according to the surgical complexity, which is associated with a respective expected pain level in the patients. The Surgical Trauma Score (STS) is explained in Table 1.

1.3. Epidural catheter placement

Epidural catheters were always placed using ultrasound guidance, the tip of the catheter being in a thoracic position (Fig. 1) [16,17]. Depending on age and height of the patients, epidural catheters were either placed in awake patients before while sitting upright or after initiation of mechanical ventilation with patients in a lateral position. Catheters were either placed via thoracic insertion or via sacral insertion according to the patients' age. The epidural cavity was punctured using the saline-mediated loss-of-resistance-method [18,19].

Before catheter removal epidural analgesia was discontinued for a sufficient period to verify that patients were manageable otherwise. Furthermore, heparin was stopped before removal according to the guidelines of the German Society for Anaesthesiology and Intensive Care Medicine [20]. All patients with continuous epidural analgesia also received a permanent transurethral urinary catheter for the time the epidural catheter was in place.

2. Pain management and pain scores (PS)

All relevant surgical and anesthesia data were obtained from the clinical charts, surgical reports, and from the documentation of the pain management team.

In the study group the postoperative analgesic management consisted of continuous epidural administration of ropivacaine 0.2% plus sufentanil 0.4 μg/ml together with a fixed administration of oral or i.v. paracetamol (45 mg/kg/d) and metamizole (45 mg/kg/d). In case of persistent pain there were further measures taken in consecutive cadence: pre-ponement of oral/i.v. medication, acceleration of the epidural flow rate, and application of an additional piritramide bolus (0.05 mg/kg).

The pain management concept in the control group consisted of application of i.v or oral paracetamol (45 mg/kg/d), ibuprofen (30 mg/kg/d), and metamizole (4 mg/kg/d). Furthermore, piritramide was applied either as a continuous i.v. infusion (0.3–0.5 mg/kg/d) or as an i.v. bolus via patient (parent) controlled analgesia (PCA). Children below 24 months of age received continuous i.v. morphine instead of piritramide (below 6 months of age: 0.24 mg/kg/d, 6–24 months: 1.2–2.4 mg/kg/d).

All patients with an epidural catheter were assessed three times daily for the occurrence of neurological complications. The level of epidural expansion of the analgesic agents was assessed using the Bromage Scale [21]. Ward rounds by the anesthesia pain management team took place twice daily. In between, the nursing staff on the wards routinely assessed the efficacy of pain management. Pain levels were recorded twice daily using the Numerical Rating Scale (NRS) or the Wong–Baker Faces Pain Rating Scale according to the patients' age [22,23]. If for some reason children were not suited for self-assessment, pain levels were estimated by the parents. For analysis we used the pain levels at the time points 24 h and 72 h after operation.

2.1. Clinical parameters

For all patients the clinical course and relevant clinical parameters were registered and analyzed. Especially those parameters that were possibly related to the pain management were taken into consideration. These variables included data on catheter placement and removal as well as catheter-associated complications. Furthermore, duration of operation and general anesthesia, mechanical ventilation times, duration of stay in intensive care, and total length of hospital stay were assessed. Finally, general factors were analyzed including time for completion of oral feeding or completion of postoperative mobilization.

2.2. Statistical analysis

In order to reduce potential differences between the study and control group we performed a pair-matched composition of the control group. Matching criteria in order of relevance were: diagnosis, age, gender, and surgical procedures. In 4 cases, 2 match-partners were assigned.

Most of the registered variables were right-skewed so the data were logarithmically transformed prior to further processing. Under these circumstances, the two-sample t-test was used for the log-transformed data and results were reported as geometric means with 95% confidence intervals. All analyses were performed using the JMP®9.0 statistical software (SAS Institute, Cary, NC, USA). Statistical significance was assumed for all $p < 0.05$.

3. Results

3.1. Patient data and surgical trauma scores

Patient baseline characteristics are displayed in Table 2. There were 40 children in the study group and 44 in the control group. The two groups showed no statistically significant differences with regard to demographic data.

Surgical procedures included operations for all common abdominal solid tumors in infancy and childhood (Table 3). Analysis of surgical trauma scores within the study group revealed STS1 in 1 case, STS2 in 19 cases, and STS3 in 20 cases. Within the control group there were 9 STS1 cases, 22 STS2 cases, and 13 STS3 cases. Statistical analysis showed significantly higher surgical trauma scores in the study group ($p = 0.018$).

3.2. Surgery- and anesthesiology-related data

Surgical and anesthesiology data are summarized in Table 4. Mean time for placement of epidural catheters was 10.0 minutes (range 8.8–11.5). Catheters were placed in 8 children before intubation and in 32 children after intubation. The epidural catheters were removed after mean 3.9 days (3.1–4.8). Mean anesthetic induction time was

Table 1
Surgical Trauma Score (STS) for categorizing patients of the study group and control group.

STS 1	Tumor growing within a defined capsula without infiltration or encasement of other organs or structures. Example: Resection of an adrenal neuroblastoma or ovarian tumor.
STS 2	Tumor growing within a parenchymatous organ, removable through uncomplicated anatomical resection. Example: Anatomical liver resection for hepatoblastoma or tumor nephrectomy for nephroblastoma.
STS 3	Tumor growing without defined borders with infiltration and/or encasement of abdominal organs, vascular or neuronal structures. Tumor removal requires extensive resection, potentially accompagnied by reconstructive measures. Example: Resection of a bladder rhabdomyosarcoma with bladder reconstruction or resection of a midline neuroblastoma