

ADDENDUM

Since preparation of this article, we have observed the identical syndrome after intraaortic injection of 275 mg of protamine over 4 min in a patient with mitral valve disease. We, therefore, conclude that left sided injection does not confer absolute protection against protamine-associated pulmonary vasoconstriction.

The authors gratefully acknowledge the advice of Tony E. Hugli, Ph.D., Scripps Research Foundation, La Jolla, California, and Jerrold H. Levy, M.D., Department of Anesthesiology, Emory University, Atlanta, Georgia.

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Anesthesiology  
59:473-475, 1983

## Postoperative Dorsal Epidural Analgesia in the Child with Respiratory Disabilities

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Pain after abdominal surgery may cause limitation of respiratory mechanics. Inspiratory capacity may be reduced, resulting in a rapid breathing pattern and limited coughing. All these factors can produce acute respiratory failure, possibly requiring controlled ventilation. Vigorous respiratory physiotherapy can reduce the risk of obstruction<sup>1</sup> but often is followed poorly by a patient who is in pain from abdominal surgery.

Relief of postoperative pain probably will reduce the incidence of severity of respiratory problems. Although administration of narcotics is one possibility, it entails the risk of respiratory depression. The choice of epidural block is another solution. Indications and benefits of this technique have been reported for adults in numerous publications.<sup>2</sup> However, no such data concerning postoperative epidural analgesia in the child have been reported. Furthermore, only caudal analgesia has been performed on infants and children,<sup>3,4</sup> which provides excellent analgesia but at a low level and only for a short period of time. We describe our experience with dorsal epidural analgesia in children undergoing major abdominal surgery.

### REPORT OF SEVEN CASES

The investigational protocol was approved by the Human Investigation Committee of our hospital, and written consent was obtained from the parents of the children.

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Received from the Département d'Anesthésiologie et Clinique Chirurgicale A, C.H.R., 44035 Nantes Cedex, France. Accepted for publication April 15, 1983.

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Key words: Anesthesia: pediatric. Anesthetic techniques: epidural, dorsal.

TABLE 1. Characteristics of the Patients and Analysis of Blood Gases

Patient No.	Age	Weight	ASA Physical Status	Blood Gases (Preoperative)				Blood Gases (48 hrs postoperatively)				Associated Disorders
				pH <sub>a</sub>	P <sub>a</sub> CO <sub>2</sub> mmHg	P <sub>a</sub> O <sub>2</sub> mmHg	BE (mEq/l)	pH <sub>a</sub>	P <sub>a</sub> CO <sub>2</sub> mmHg	P <sub>a</sub> O <sub>2</sub> mmHg	BE (mEq/l)	
1	15 yrs	14 kg	4	7.28	56	45	-8	7.30	56	60	-2	Neonatal anoxic encephalopathy Bedridden
2	15 yrs	15 kg	3	7.37	54	60	0	7.37	52	60	0	Kyphoscoliose
3	12 yrs	13 kg	3	7.31	54	53	-2	7.34	42	65	-2	Trisomy 21 VSD Neurologic underdevelopment
4	18 mo	10 kg	3	7.39	51	55	+1	7.39	42	60	0	No other disorder
5	10 mo	8 kg	3	7.41	37	70	+4	7.40	38	72	+2	Trisomy 21 VSD
6	20 mo	13 kg	3	7.39	39	76	+1	7.41	35	75	+2	Mucoviscidosis
7	6 mo	4.6 kg	3	7.30	49	75	-3	7.31	42	75	0	Malnutrition

The technique was performed seven times in six children weighing between 4.6 and 15 kg and ranging in age from 6 months to 15 years. Surgery was undertaken in five children to correct a hiatal hernia with esophageal reflux or stenosis (Nissen fundoplication) and later presteral coloplasty was performed on one of them. One child had an ileal obstruction. The specific details of each case are summarized in table 1. The patients had the following similarities. All the children had a respiratory disability or insufficiency as indicated by blood gas analysis (table 1). All had major airway obstruction, with rales by auscultation in both lungs. Because of their age or neurologic condition, or both, they were not subjected to respiratory function tests. Metabolic disorders and microcytic anemia were corrected preoperatively by parenteral nutrition and blood transfusion.<sup>5</sup> The anesthetic technique, identical in all seven patients, consisted of halothane, dextromoramide (Palfium®), and pancuronium. A catheter was inserted in the right internal jugular vein to assure postoperative venous access. The epidural block was performed at the end of the operation before awakening from anesthesia. The child was placed in left lateral decubitus. A 18 G epidural minipack (epidural mini-pack 18 G, Portex Division, Wilmington, Massachusetts 011887) was used. A paramedian approach of the T7 epidural space was used and the correct position of the needle was ascertained by using the loss of resistance to saline injection. After two to four milliliters of physiologic saline were injected into the space, the catheter was advanced 1–1.5 cm. The position of the catheter tip in the epidural space was documented by roentgenogram. The child then was put in the supine position, and a test dose of 1 ml of 0.25% bupivacaine without adrenaline was injected, followed by continuous infusion of 0.25% bupivacaine without adrenaline based on 4 mg · kg<sup>-1</sup> · day<sup>-1</sup> dose. The protective dressing for the catheter was not changed during the period of analgesia.

The quality and level of analgesia were difficult to assess. The pinprick test proved unreliable. We then developed a method of pricking the child with an intradermal needle concealed behind a toy to estimate the degree and spread of analgesia. In all seven patients, the upper limit was at the level of the nipples and the lower at that of the umbilicus. The catheter was left in position for 48 h (four patients) or 72 h (three patients) until bowel movements resumed. In six patients, the doses of 4 mg · kg<sup>-1</sup> · day<sup>-1</sup> was adequate; in one patient it had to be increased to 6 mg · kg<sup>-1</sup> · day<sup>-1</sup>. Blood pressure and heart rate showed no significant variations as compared with preoperative values. There were no surgical or medical complications (e.g., allergy or convulsion) attributable to the local anesthetic. There were no cases of urinary

retention. The temperature always remained below 38°C. The volume of crystalloid infused iv was that normally given in such patients with that type of surgery. An active chest physiotherapy easily was accepted by the children who showed no signs of pain, and it enabled all of them to improve their clinical and biologic respiratory condition in the postoperative period as shown by analysis of arterial blood gases on the second postoperative day (table 1). Intubation of the trachea and controlled ventilation were thus unnecessary.

## DISCUSSION

Our experience shows that dorsal epidural block is feasible in the child weighing 4–15 kg. The advantages of the technique are the same as for the adult, which include reduction or abolition of pain that may decrease respiratory function<sup>1,5</sup> and acceptance of active physiotherapy. Technical difficulties may be the reason for not using this method in children. The epidural space is quite limited, and it may be more difficult to position a catheter in the small child. However, we experienced no difficulties in our small series. In fact, there was no vertebral calcification to hinder the passage of the needle, detection of the vertebral interspaces was easy, and penetration into the epidural space was indicated readily. The ease with which the catheter moved up into the space was surprising, requiring only preliminary dilatation of the space using physiologic saline. The limiting factor was needle size, in that the smallest size needle currently available commercially is 18 gauge, but our actual experience demonstrates that use of this needle is feasible in a child weighing more than 4 kg. The two complications that must be avoided during the positioning of the catheter are intrathecal displacement and perforation of the pleura. The former may be recognized by aspiration of spinal fluid and recourse to a test dose; the latter is indicated by roentgenogram after opacification of the cath-

eter. Another risk is the possibility of perforating a vessel during the positioning of the catheter, which fortunately did not happen in our series.

We choose the constant infusion of local anesthetic for children, because intermittent doses would have required injecting very low volumes (0.5–1 ml), thus risking underdose (ineffectiveness) or overdose (toxicity). The basic problem still is the assessment of the efficacy of the method. Pain is a difficult phenomenon to quantify. Its intensity varies for the same type of surgery, and the way in which it is accepted differs from individual to individual. In the adult it is difficult enough to assess the adequacy of analgesia by direct means; in the young or retarded child it is impossible. What seemed remarkable in our series was that the children, when unaware that they were being observed, were calm and showed no particular signs of discomfort. "Blind" pricking with the needle did not in itself provoke crying, although, of course, a child would cry because he or she was immobilized or saw someone approaching. In particular, the child accepted respiratory physiotherapy. Clapping on the back and chest was tolerated, and coughing, when provoked, produced expectation. Breathing rhythm and capacity remained unchanged from what they were before surgery or improved. In our series, the catheter was withdrawn on the second or third day, that is, when bowel movements re-

sumed. At that point, pain intensity for the adult is reduced considerably,<sup>5</sup> from which a similar experience may be extrapolated for the child.

The method of epidural analgesia thus would appear to be reliable in the child with respiratory disability or insufficiency. It represents an interesting alternative to postoperative controlled ventilation, which is often necessary to similar cases. If the risks inherent to this technique seem acceptable, the role of epidural analgesia in the child with no respiratory disorders and undergoing major surgery still remains to be defined.

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Anesthesiology  
59:475–477, 1983

### Hemiparesis Following Dural Puncture

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A known complication of epidural anesthesia is dural puncture, spinal anesthesia, and postlumbar puncture headache. Clinical reports of subdural hematoma, acute and chronic, as well as intracerebral hemorrhage following postlumbar puncture headache have been described.<sup>1–3</sup> Mantia<sup>4</sup> reported a case in which an intracerebral hemorrhage occurred 5 days after development of a postlumbar puncture headache. The following case describes the occurrence of an intracerebral hematoma coincident

with dural puncture with a 19-gauge needle during attempted epidural anesthesia.

#### REPORT OF A CASE

A 37-year-old female physician presented for a left femoral hernia repair. She had no history of medical problems, previous surgery, childbirth, headache, or medications. Routine preoperative studies included chest roentgenogram, complete blood count, and urinalysis, all of which were normal. On admission to the hospital, arterial blood pressure was 100/72 mmHg, heart rate 72 beats/min, and temperature 37.2° C. She was interviewed by an anesthesia resident and after discussing risks and complications, an epidural anesthetic was chosen. The following morning diazepam 10 mg po and morphine sulfate 10 mg im was given prior to arriving in the anesthesia induction room. After being positioned with the left side down, local infiltration was done at the L<sub>2-3</sub> interspace with 2 ml bupivacaine 0.75% using a 30-gauge needle for the skin wheal and 22-gauge 1½-inch needle for deeper infiltration. Three attempts were then made with a 19-gauge Quincke tip spinal needle to locate the ligamentum flavum using a midline approach. During these attempts, a 3-ml syringe of bupivacaine 0.75% with 1:200,000 epinephrine was attached to the needle and

Received from the Department of Anesthesiology, The Mason Clinic, Seattle, Washington. Accepted for publication April 26, 1983.

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Key words: Anesthetic techniques: epidural, lumbar. Complications: paralysis, intracerebral hematoma.