Title : ANALGESIA AND VENTILATORY RESPONSE TO CO2 FOLLOWING EPIDURAL SUFENTANIL IN CHILDREN

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INTRODUCTION : Epidural morphine is effective for treatment of postoperative pain in children (1). However a major side effect of morphine given epidurally is a prolonged depression of the ventilatory control (1), which may be attributed to rostral spread of this water soluble opioid (2). Sufentanil epidural administration has been proposed for postoperative pain relief in adults (3). The aim of this study was to evaluate analgesia and ventilatory response to CO2 following epidural sufentanil in children.

METHODS : Fifteen children (ASA I or II), aged 7.7± 0.9 yr (mean±SEM) (range 4-12 yr), weighing 27.7±3 kg (range 14-47 kg) were studied. They were scheduled for urologic procedures. This study was approved by the Human Investigation Committee and the parental consent was obtained. They were premedicated orally with diazepam (0.33 mg/kg up to 10 mg) one hour before induction. Anesthesia was induced with thiopental (5 mg/kg) and maintained with 60 % N2O in O2 and isoflurane (1-1.5 %) administered by a mask. A 20g epidural catheter was placed at L3-L4 interspace. One or two ml of 1 per cent lidocaine with epinephrine 1/200,000 was used to test the position of the catheter. At the end of surgery, inhalation anesthesia was discontinued. One hour after the end of surgery when pain and/or discomfort occured, 0.75 µg/kg of preservative free sufentanil in 2 ml of saline were injected in the epidural catheter. All the patients stayed in a 30° head-up position. The onset and duration of analgesia and the side effects were assessed in each patient ; in addition in 8 of the 15 children aged 8.6±0.8 yr the maximum tolerance to periostal pressure was assessed over the distal end of the tibia and of the radius with a calibrated spring-loaded rod, before and 30, 60, 90, 120 and 240 min after epidural sufentanil injection. These same eight children underwent also the following ventilation study. Respiratory rate (RR), minute ventilation ($\dot{V}E$) and end-tidal CO2 tension (PETCO2) were recorded during room air breathing and CO2 stimulation with a mask through a pneumotachograph and a Rudolph non-rebreathing valve. PETCO2 was continuously measured with a calibrated capnograph. Pneumotachograph and capnograph outputs were interfaced to a computer with an analog-to-digital converter. Linear regression equations were computed from $\dot{V}E$ and PETCO2 for each CO2 challenge curve. Respiratory measurements were performed one-half hour before induction of anesthesia, and postoperatively, just before and 30, 60, 120 and 240 min after epidural sufentanil injection. At the same time, plasma sufentanil concentrations were assayed by radioimmunoassay. All values are expressed as mean±SEM ; statistical analysis was performed using ANOVA followed by the use of the t-test for paired data.

RESULTS : The onset of analgesia occured 3.0±0.3 min after epidural sufentanil injection and its duration was 198±19 min (range 90-240 min). We observed a significant periostal analgesia of the tibia at 30, 60, 90 and 120 min and of the radius at 60, 90 and 120 min (figure 1). The side effects were pruritus (3/15), nausea (5/15), urinary retention (1/11) and drowsiness (10/15). Resting RR did not change during the study. Postoperatively Resting $\dot{V}E$ and slope $\dot{V}E$/PETCO2 decreased significantly during 120 min and PETCO2 increased during 60 min. Compared with postoperative preepidural value, the slope $\dot{V}E$/PETCO2 decreased significantly after epidural sufentanil during 60 min and increased at 240 min (table I). The plasma sufentanil concentration are summarized in table I.

DISCUSSION : Epidural sufentanil provides rapid and effective analgesia in postoperative children following urologic surgery ; however the clinical usefulness for postoperative analgesia seems low because of its short duration. The two main side effects were drowsiness and decrease of the ventilatory response to CO2 which may be due to a systemic effect and/or a rostral spread as suggested by the low plasma sufentanil concentration and the rostral spread of periostal analgesia.

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Table I. Respiratory variables and plasma sufentanil concentrations. Mean±SEM. * $p<0.05$, ** $p<0.01$ from preoperative period, † $p<0.05$ from postoperative period before epidural sufentanil.

	Preoperative Period	Postoperative Period				
		Before epidural sufentanil	After epidural sufentanil 30 min	60 min	120 min	240 min
Resting RR (Breaths.min^{-1})	23.7±1.6	23.5±1.3	22.2±1.7	20.4±2.1	20.7±2.0	24.0±2.1
Resting $\dot{V}E$ (l.min^{-1})	6.3±0.5	5.6±0.6*	4.2±0.6*	4.2±0.5*	4.6±0.6*	5.4±0.5
Resting PETCO2 (mmHg)	37.2±0.7	39.9±1.2*	42.5±1.2*	41.1±1.3*	38.9±1.7	39.2±1.3
Slope $\dot{V}E$/PETCO2 (l.min^{-1}.mmHg^{-2})	1.66±0.12	1.10±0.13*	0.68±0.10*†	0.89±0.16**†	1.07±0.07**	1.42±0.06
Plasma sufentanil (ng.ml^{-1})	-	-	0.10±0.01	0.05±0.01	0.08±0.01	0.08±0.01

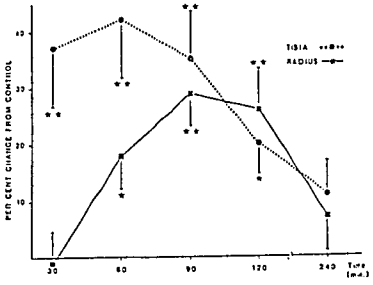

Figure 1. Percent change from control in maximum tolerance to periostal pressure. Mean±SEM, *$p<0.05$ **$p<0.01$ from control.