Paediatric neuraxial anaesthesia asleep or awake, what is the best for safety?

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Abstract

The target of this prospective randomized double blind study was to evaluate the safety in asleep paediatrics.Patients and methods: Children were randomly assigned into two equal groups. In one group (the epidural group) combined lumbar epidural analgesia and general anaesthesia was given, while in the second group, spinal anaesthesia was given (spinal group). In both groups the neuraxial block were given in lateral position in asleep paediatric patients after complete aseptic technique.Results: asleep neuraxial block revealed no major complications in the form of spinal cord haematoma, epidural abscess, paraplegia, parathesia, or systemic local anaesthetic toxicity in paediatric patients subjected to neuraxial block.Conclusion: We can conclude that,neuraxial anaesthesia in asleep paediatrics patient may be safer and easier than in awake children provided that an expertise anesthesiologist adheres to these principles.

INTRODUCTION

The basics of the technique of neuraxial regional anaesthesia were applied mainly for adults. Recently paediatric neuraxial anaesthesia especially spinal anaesthesia is appearing to gain more popularity than before. in awake patients, feeling of parathesia during needle placement, pain during drug injection, in addition to catching of the early manifestations of systemic local anaesthetic toxicity is one of the important protective symptoms to avoid these neuraxial anaesthetic complications. Although neuraxial anaesthesia is rarely used as a single anaesthetic technique for surgical procedures in paediatric patients, it is now being commonly used in combination with general anaesthesia. The concept of this combination is the reduction of the total amount of both intravenous and /or inhalational anaesthetic agents which decrease their side effects, help in rapid recovery, and emergence from anaesthesia in this fragile group of patients. Also regional anaesthesia provides analgesia for the postoperative period which is very advantageous. The target of this study was to evaluate the degree of neurological injuries or systemic toxicity complications of neuraxial anaesthesia in asleep paediatrics.

PATIENTS AND METHODS

After approval of the study protocol from the responsible authorities and a written informed consent taken from parents, 120 paediatric patients (age 2-8years) admitted to Urology and Nephrology Center, Mansoura University for various infraumblical urologic procedures (expected time less than 2 hours) classified ASA 1 and 2 were included in this Study. Contraindications for neuraxial anaesthesia were respected and considered as exclusion criteria to this study. Children were randomly assigned into two equal groups using computer generated randomized test. In one group (the epidural group) combined lumbar epidural analgesia and general anaesthesia was given, while in the second group, spinal anaesthesia was given (spinal group). In both groups the neuraxial block were given in lateral position in asleep paediatric patients after complete aseptic technique.

In the waiting area and immediately before shifting them to the operation room, all children were given sedation by administration of intravenous midazolam 20 microgram per Kg, atropine sulphate 10 microgram per Kg and ketamine .25 mg per Kg.On arrival to the operation room all children were monitored with peripheral oxygen saturation, noninvasive arterial blood pressure measurement, and 5 leads ECG. In addition to measurement of the endtidal carbon dioxide tension in the epidural group.

In the spinal group sedation was maintained with minimal concentration of isoflorane ~0.2% that was administered through air enriched/oxygen face mask. After complete aseptic technique and local anaesthetic lidocaine 1% skin infiltration, spinal anaesthesia was given using the trocar of

22 G IV catheter over needle . 0.5% hyperbaric bupivacaine (0.4 mg /Kg) was injected into L4-L5 or L5-S1 space.

In the epidural group, propofol 1.5mg/Kg, fentanyl 0.5 microgram/Kg and vecuronium 0.1 mg/kg was administered for induction of anaesthesia and facilitation of endotracheal intubation. Anaesthesia and muscle relaxation were maintained with isoflurane in a concentration~1% ,in addition to vecuronium increments. All patients were mechanically ventilated with air enriched oxygen with target of an entidal carbon dioxide tension around 35 mmHg uisng low-flow closed circuit . After induction of anaesthesia children were placed in lateral position and lumbar epidural analgesia was achieved using a “single shot” injection of a mixture of isobaric bupivacaine 0.25% (0.8 mg/kg) and fentanyl (0.8 µg/kg), into lumbar 4-5 or 3-4 interspaces, Epidural space was detected by loss of resistence test, using 20 G IV catheter over needle. Inadvertent intravascular catheter placement was excluded by the use of epidural test dose of epinephrine (0.4 microgram/Kg) as well as negative aspiration test. Increased heart rate more than 10 beats/minute within one minute after epidural epinephrine test dose injection ,compared to basal, was considered positive and an indication to redirect needle placement.

Demographic data, type of operation, duration of anaesthesia were recorded. Mean arterial blood pressure was recorded basally, 10, 20, and at 30 miutes after both inhalational induction and spinal injection in both groups. Any manifestations suggestive of neurological injury, delay of motor recovery , systemic local anaesthetic toxicity in addition to any other complications which may be anaesthesia-related were recorded in a flow sheet by the postanaesthesia care unit and ward nurses who were unaware about the group assignment . Urine retention was considered if retention more than 6 hours postoperatively (if no foley catheter was placed) or more than 6 hours after foley catheter removal. All parents were asked to call us if any neurological abnormalities were noticed during the first two weeks after hospital discharge. Also the managing urologists were asked to call us for any neurological abnormalities during their follow up of the operated patients.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 17). While intergroup parametric data were compared by the independent sample-t test. Intragroup parametric data were compared by two tailed paired sample-t test. Significance level was set at $P < 0.05$. Incidence of neuraxial anaesthesia–related complications was done using the absolute number of cases and their percent %.

RESULTS

In this prospective randomized double blinded study, asleep neuraxial block revealed no major complications in the form of spinal cord haematoma, epidural abscess, paraplegia, parathesia, or systemic local anaesthetic toxicity in paediatric patients subjected to neuraxial block.

The two groups were evenly divided, with 60 patients in each group. Patients, who were excluded from the study, were replaced according to their randomization. In the epidural group, one case of inadvertent intravascular puncture and one case of inadvertent dural puncture occurred during attempted lumbar epidural block, the two cases were managed by changing the lumbar epidural space according to the protocol and the block was tried again. In the spinal group, failed spinal occurred once and general anaesthesia was given, and according to the study protocol, this case was excluded and replaced according to its randomization and group assignment.

There was no significant difference in the mean age ($p=0.52$), mean body weight ($p=0.11$), and mean duration of anaesthesia ($p=0.25$) between the two groups (table I). In 56 procedures, spinal anaesthesia and sedation with 0.2% isoflorane concentration provided satisfactory operating conditions; in 4 cases, addition of incremental dosage of intravenous ketamine around the end of the surgery was necessary.

One case (1.6%) of postoperative urine retention in the spinal group and two cases (3.3%) in the epidural groups were managed by urinary catheterization for voiding and then catheter was removed. 4 cases (6.6%) with postoperative nasal itching in the epidural group with no reports in the spinal group were recorded. Itching was mild, and managed by parent's assurance. There were no reports of postdural puncture headache in both groups. The incidence of postoperative vomiting was 12 cases (20%) in the epidural, versus 8 cases (13.3%) in spinal groups (table III).

Basal mean arterial blood pressure (MABP) revealed no significant changes between the two groups. Mean arterial blood pressure readings at 10, 20, and 30 minutes postintubation (epidural group) and post spinal injection (spinal group) were recorded. Using independent sample t-test, there was no significant difference in the basal mean blood pressure between the two groups (P-value 0.12), however there was a significant statistical reduction of the

mean arterial blood pressure at 10, and 20 minutes with P-values 0.001, and 0.003 respectively. Using the Paired sample t- test, there was no significant change in the MABP at 10, 20, and 30 minutes in the spinal group, compared to their basal MABP with the P-values 0.6, 0.3, and 0.7 respectively. However, epidural group revealed significant statistical reduction of the MABP at 10, and 20 minutes compared to their basal MABP, with the P-value 0.001.(figure 1)

Figure 1

Table 1:Demographic data and operative time in both spinal and epidural groups. Values for age and weight are mean (Range) and for sex represented by number of cases.

	Spinal group	epidural group
Age (yr)	5.3 (2-8)	4.8 (2-8)
Weight (kg)	21.9 (13-35)	20.3 (13-31)
Operative time	75.5 (50-113)	83.2 (51-110)
Sex	55 M 5 F	54 M 6F

M=male, F=female

Figure 2

Table 2: operation list in both groups

Operation list	spinal group	epidural group
Hypospadius repair	41	39
Urethrocutaneous fistula repair	4	3
Orchiopexy	8	7
EUA and orchiopexy	1	2
Cystoscopy and proceed	4	5
Pandoscopy and proceed	2	4

EUA=examination under anaesthesia

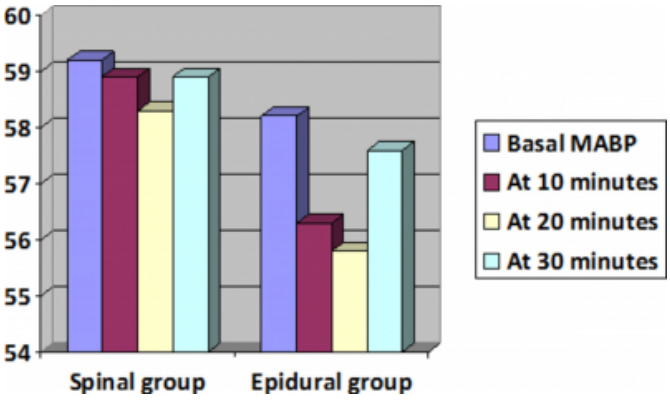
Figure 3

Table 3: neuraxial anaesthesia related-complications in both spinal and epidural groups represented by the absolute number of cases

Complications	spinal group	epidural group
Paraplegia	0	0
Parathesia	0	0
Epidural haematoma	0	0
Epidural abscess	0	0
CVS collapse	0	0
Nasal itching	0	4
Urine retention	1	2
Vomiting	8	12
Postdural puncture headache	0	0

Figure 4

Figure 1: Mean arterial blood pressure (MABP) measurements in both the spinal and the epidural group



DISCUSSION

The results of this study clearly demonstrated absence of any postoperative manifestations suggestive of major neurological complications, or delay of motor recovery related to neuraxial anaesthesia. Intraoperatively, there were no cardiovascular signs suggestive of systemic local anaesthetic toxicity in the two groups. We considered the epidural test dose positive if the heart rate increased ≥10 beats/minute ,as it is reported that the direct intravenous administration of epinephrine failed to cause an increase in heart rate more than 10 beats per minute in both halothane and sevoflorane anaesthetized children ([1,2]) .Atropine and ketamine premedication in paediatric patients was very helpful in separation from parents easily in addition to their

sedation and induction with isoflorane despite of the known irritant effect of that agent ([3]).This may explain the absence of the Pungent odour and irritant effect of this agent on airways in the spinal group.

Regional anaesthesia in paediatrics is gaining more and more popularity especially in premature and in the very low birth weight infants in order to avoid the general anaesthesia related respiratory depression and the obligatory postoperative mechanical ventilation and its related problems.

Because of the larger cerebrospinal fluid (CSF) volume in relation to body weight in infants and children compared to adults, in addition to the more rapid turnover of CSF in children, the injected local anaesthetic become more diluted and this may explain the early motor recovery in this group of patients which could explain the absence of any case of delayed motor recovery in our study ([4]).The safety of epidural administration of fentanyl in paediatrics was documented, in this study, fentanyl was mixed to the bupivacaine in order to improve post operative epidural analgesia ([5,6]) The dominance of the parasympathetic nervous system in this age group, could explain the haemodynamic stability after spinal anaesthesia in the spinal group, and this was confirmed by Webester AC and his colleagues who reported that spinal anaesthesia done in high risk neonates for inguinal hernia repair was associated with haemodynamic stability ([7,8]). The statistical (but not clinical) significant reduction of mean blood pressure in the epidural group (combined with general anaesthesia) compared to the spinal group could be explained by the known vasodilating and hypotensive effect of the inhalational anaesthetic agent isoflorane which was used in a concentration ~1% (~5 times more than that used for sedation in spinal group), in addition to the known hypotensive effect of propofol.

The absence of any reports associated with postdural puncture headache in both groups may be explained by the difficulty in diagnosis such type of headache in such group of patients as well as the small number of patients in each group.

In this study A 20 G IV cannula (catheter over needle cannula) was used for single shot epidural which is our practice many years ago in both paediatric patients, and underweight adults undergoing single shot lumbar epidural analgesia and we have not had any related complications because of this technique at all, our concept is that, if an expert anesthesiologist used this technique, it may be less traumatic and the incidence of postdural puncture headache or epidural haematoma if inadvertent dural or epidural veins puncture occurred, may be low compared with the use of Tuohy needle. We are using Tuohy needle for either single shot epidural block or for epidural catheter insertion in adults and older group of patients.

In one year prospective survey of the French language society of paediatric anesthetists about the morbidity of regional anaesthesia in children. The study([9]) which included 21,409 regional blocks(central blocks accounted for 60% of all regional blocks) reported no death or neurological sequale at all, only 2 cases of postdural puncture headache, 2 cases of convulsions and cardiac arrhythmias due to an inadvertent intravascular injections. In a retrospective study among 220 children received neuraxial regional anaesthesia with the target of early extubation, Peterson et al recommended that, regional anesthesia was safe and effective in the management of pediatric patients undergoing cardiac surgery ([10]). In this study it could be concluded that, neuraxial anaesthesia in asleep paediatrics patient may be safer and easier than in awake children provided that an expertise anesthesiologist adheres to these principles. Paediatric patients may require sedation or anaesthesia before spinal or epidural techniques . To be more conclusive, more studies and increased sample size may be needed.

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