Original Paper

SPINAL ANAESTHESIA IS IT SAFE IN YOUNGER CHILDREN ?

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Abstract

The characteristics of spinal block including ease of performance, efficacy, adverse effects and complications were evaluated in 78 children aged between 2-6 years undergoing different types of surgery in lower part of body. Spinal block was performed in sedated children with 0.5% hyperbaric bupivacaine at a dose of 0.25 mg/kg. Haemodynamically patients were stable in most of the cases. In general pulse rate was increased by 9.8% while systolic and diastolic blood pressures were reduced by 6.8% and 8.7% respectively from baseline level after 15 min of block, which didn't warrant any active management. One patient was treated with injection atropine for bradycardia (<60 beats/min). Two patients had clinically significant hypotension (reduction of systolic blood pressure >20% from baseline level) and were easily managed with injection ephedrine hydrochloride. Two patients had insignificant sinus arrhythmia during operation and three required temporary supplemental oxygen support by mask to maintain oxygen salutation >94%. Motor block was complete in all but two cases. Sensory block showed wide variation of height, from first thoracic to seventh thoracic (4th thoracic). Time of two segment regression of block was 74 min (range 30-190 min). Mean time of giving rescue analgesic after spinal block was 118 min (range 59-240 min). One patient vomited and five had shivering in the recovery room. There was no incidence of systemic toxicity of bupivacaine (urinary retention, post dural puncture headache or any other neurological complication). Spinal block was observed to be easier, safer and very effective anaesthetic technique even in younger children.

Key words: Spinal anaesthesia, children, complication.

Introduction

It is a common trend of Anaesthesiologists of Bangladesh to avoid spinal anaesthesia (subarachnoid block) in younger children due to variety of practical reasons like lack of monitoring equipment, inadequate postoperative facilities, etc. Over the past few years a renaissance has developed in this field. As children are not small adult modification of several principles of technique and management can bring substantial benefits of this regional anaesthesia in this tender age group. However, it is preferable to perform spinal anaesthesia in children sedated or if required in combination with general anaesthesia.

Materials and Methods

This prospective observational study was approved by departmental ethics committee and conducted at Combined Military Hospital, Dhaka over a period from July 2008 to May 2009. The study was conducted on 78 children of American society of Anaesthesiologists (ASA) grade-I and grade- II, age ranged from 02 years to 06 years. Patients with a known contraindication to spinal puncture such as increased intracranial pressure, coagulopathies or infection at puncture site were excluded. Children with a neurological disorder or allergy to bupivacaine or other local anaesthetics were also excluded. Informed written consent was obtained from parents of each patient.

Children were not allowed to take solid food or milk products for 04 hours before anaesthesia. Clear fluids were allowed up to 02 hours before anaesthetic procedure. No overnight premedication was given. In operation theatre after establishing intravenous line all were preloaded with injection Hartmann's solution 10 ml/kg.

Basal parameters like pulse, non invasive blood pressure, peripheral arterial oxygen saturation (SPO_2), 3 lead electrocardiogram (ECG), Ventilatory frequency of all children were recorded and continued during and after operation till patient leaves recovery room as follows:

t_0 = before giving Subarachnoid block (SAB) (baseline)
t_1 = 05 min after SAB
t_2 = 15 min after SAB
t_3 = 30 min after SAB
t_4 = 60 min after SAB
t_5 = 120 min after SAB

Before lumbar puncture (LP) all children were sedated

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with intravenous injection diazepam 0.2 mg/kg and injection ketamine hydrochloride 1mg/kg mixed with injection atropine hydrochloride 0.01 mg/kg. After all aseptic precaution lumbar puncture was performed in sitting position using a midline approach at lumbar 4th-5th or 3rd-4th interspace. Standard 25 gauge 8.8 cm long Quincke type of spinal needle was used for spinal puncture. Spinal anaesthesia was performed by injecting injection hyperbaric (8% glucose) bupivacaine 0.25 mg/kg. Extension of sensory block was assessed using pin prick method and motor block intensity was assessed by using a modified bromage scale, recording the Kid's ability to flex the ankle, knee and hip (0=no motor block, 3 = complete motor block of the legs and feet) when the child is awake. Regression of sensory block by two segments was also monitored every 10 min and the time was recorded.

Appropriate treatment was planned if systolic blood pressure (SBP) reduces more than 20% of baseline or heart rate reduced to less than 60 beats/min or SPO_2 falls below 94%. Demographic data, type and duration of surgery were noted. Any manifestations suggestive of neurological injury, delay of motor recovery, systemic toxicity of bupivacaine, in addition to any other complications related to anaesthesia like vomiting, shivering, post dural puncture headache (PDPH) were also recorded. Urine retention was considered if retention was more than 06 hours postoperatively.

All parents were asked to report if any neurological abnormalities were noticed in children during the first two weeks after leaving hospital. After collecting all data statistical analysis was carried out using appropriate test.

Results

Amongst 78 patient studied 63 were male and 15 were female. Mean age was 4.62 + 0.84 years, while mean weight of the patients was 15.36 + 4.17 kg. Sixty seven patients were of ASA grade-I and 11 were of ASA grade-II because of minor ailments (table-I).

Table-I : Demography of patients (n=78).

Variables	Unit	Findings
Sex (Male/Female)	Number	63/15
Mean Age	Years	4.62±0.84
Mean Weight	Kilogram	15.36± 4.17
ASA grade (I/II)	Number	67/11

Circumcision was performed in 31 patients (39.7%) while herniotomy was done in 12 patients (15.4%). Other surgeries performed were tendon repair/surgical toileting (14.1%), rectal polypectomy (10.2%), orchidopexy (8.9%), abscess drainage (7.7%) and appendectomy (3.8%) (table-II). Haemodynamically patients were stable in most of the cases. Pulse rate was increased by 9.8% from baseline level at 15 min after SAB. Only one patient was treated with injection atropine hydrochloride (HCl) for bradycardia. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) after 15 min of SAB reduced by 6.8% and 8.7% respectively which didn't warrant any active management. Only two patients had clinically significant hypotension during operation and treated with injection ephedrine HCl.

Table-II : Distribution of patient as per type of Surgery (n=78).

Name of surgery	Number	Percentage
Circumcision	31	39.7
Herniotomy Tendon repair/	12	15.4
surgical toileting	11	14.1
Rectal polypectomy	08	10.2
Orchidopexy	07	08.9
Abscess drainage	06	07.7
Appendectomy	03	03.8

Three patients required supplemental oxygen support by ventimask to maintain SPO_2 > 94%. Two patients had insignificant sinus arrhythmias during operation lasting for few minutes (table-III).

Table-III : Perioperative vital parameters (n=78).

Time	Heart rate/min	SBP (mm of Hg)	DBP (mm of Hg)	SPO2 (%)	ECG
t_0	102± 6.7	88±4.8	46±6.1	99±0.8	SR
t_1	114±5.9	90±6.4	46±4.7	99±0.2	SR
t_2	112±8.1	82±6.7	42±5.2	98±0.6	SR
t_3	102±6.3	84±4.9	42±6.1	98±0.4	SR
t_4	096±7.4	88±5.8	44±4.2	98±0.6	SR
t_5	98±8.2	86±6.2	42±5.4	99±0.2	SR
% of change from t_0 to t_2	±9.8%	-6.8%	-8.7%	-	-

❒ **SR** = Sinus rhythm

Characteristics of block showing wide variation of cephalic spread of sensory block, first thoracic to seventh thoracic (T_1-T_7). Time of two segment regression of block was 74 min (range 30-190 min).

Table-IV : Characteristics of block (n=78).

	Height of block (dermatome)	T4 (T_1-T_7)
Sensory Block	Time of two segment regression of block (min)	074 (30-190)
	Time of 1st dose of rescue analgesic (min)	118 (59-240)
Motor Block	Complete (number)	076 (97.4%)
	Some movement (number)	002 (2.6%)

Rescue analgesic (1st dose) had to be given after 118 min of SAB (range 59-240 min). Motor block was complete in 76 cases (97.4%) while 02 (2.6%) had some

limb movements. Six patients had nausea and one vomited in the recovery room. Five patients had shivering during or immediately after surgery. There was no incidence of systemic toxicity of bupivacaine, urinary retention or PDPH.

Table-V : Complications of SAB (n=78).

Complication	Number	Percentage
Nausea/Vomiting	6/1	8.9
Shivering	05	6.4
Hypotension	02	2.6
Bradycardia	01	1.3
PDPH	00	-
Urine retention	00	-
Neurological complication	00	-

There was also no catastrophic neurological complication like spinal/epidural abscess, haematoma followed by paresis or plegia. But one patient had unexplained bilateral calf muscle pain which subsided within three days with mild analgesic (paracetamol).

Discussion

This study tried to evaluate the efficacy and safety of SAB in younger children keeping in mind, their anatomical, physiological and psychological perspective. Although indications and contraindications of SAB are similar to adult it is preferably chosen in patients with history of prematurity and very low birth weight infants in order to avoid general anaesthesia related respiratory depression and its obligatory postoperative mechanical ventilation and its related problems[1]. In this group of patients spinal cord ends at 3rd lumbar and dural sac ends at 3rd sacral level. So block is safer if performed below fourth lumber (L_4) to avoid neural injury. In this study, it was found that mean duration of block was 74 min which is much less than adult counter part as supported by other study[2]. It is because of the larger cerebrospinal fluid (CSF) volume in relation to body weight in infants and children and compared to adult, in addition to the more rapid turnover of the CSF in children, the injected local anaesthetic become more diluted and this may explain the early motor recovery and limited duration of the block in infants[3]. Duration of SAB in children can be doubled by adding clonidine (1 mcg/kg) or hydrophilic opioid with bupivacaine. But it has got the risk of developing hypotension and postoperative apnoea[4]. To ensure postoperative analgesia it can also be given in conjunction with epidural and caudal block with catheter in situ as in adult. As similar to other studies better cardiovascular stability in this age group of patients due to dominance of parasympathetic nervous system and lesser volume of peripheral venous system in this age group were observed [4-7].

Children don't tolerate operation being awake and holding still in scary operating room even their block is adequate for surgical procedure. So children, specially young children, require deep sedation or general anaesthesia in order to accept placement of block and to keep them calm during surgery. Minimal movement of patient during the procedure can lead to misplacement of needle and neural injury or failed block. The advantages of being awake to complain the symptoms of systemic toxicity earlier and assessment of block which can always be unreliable or misleading in this age group. So many paediatric anaesthesiologist believe that regional anaesthesia must be performed in sedated or anaesthetized children[8]. For sedation benzodiazepine, propofol, thiopentone, ketamine and volatile anaesthetic can be used. Use of light sedation can not mask the failed block. Sedation also helps easy separation of children from their parents while taking them to operating room. In sedated patient special emphasis to be given to monitor respiration by pulse oxymetry and if feasible by measuring end tidal carbon dioxide using a nasal adaptor. It has been recommended that SPO_2 should remain >94%[9] and it is safe to give oxygen by mask in all sedated children with SAB. As spinal anaesthetic several agents like tetracaine, lidocaine, bupivacaine, amethocaine, levobupivacaine, ropivacaine have been tried, Till to date bupivacaine proved to be most effective. Both hyperbaric (with glucose 8% or 0.9%) or isobaric solution 0.5% bupivacaine are good. But success rate and predictability of block is better in hyperbaric (96%) than isobaric bupivacaine (82%)[10]. Kokki et al demonstrated 0.3 mg/kg of hyper baric bupivacine (8% or 0.9% glucose) produced median sensory block to T_4 with median duration of 80-85 min. But the extent of the block was variable with different concentration of glucose[10,11].

In a study of morbidity associated with paediatric regional anaesthesia, it was reported that 6 out of 24,409 (0.024%) patients had an intravascular injection of local anaesthetic and 4 of these 6 patients experienced systemic toxicity. Two patients had seizure and 2 had transient cardiac dysrrhythmias[12]. Unlike epidural block, risk of systemic toxicity is low in SAB as minimal amount of local anaesthetic agent is used. Assessment of sensory block preferably to be done by transcutaneous electrical nerve stimulation (TENS) or with pin prick method[10]. As ligamentum flavum is very soft in younger children distinct point of puncture (POP) is not well felt, even then lumbar puncture is technically easier in these patients, specially when they are sedated or anaesthetized.

Franco Puncuh et al evaluated the efficacy of SAB with hyperbaric bupivacine in 1132 children aged between 06 months to 14 years. Incidence of PDPH was 5, backache 9 and hypotension 17. There was no neurological complication[13]. Incidence of PDPH in children is lesser than adult even after frequent puncture for spinal tap[14] and there was no difference of incidence using different

type (Quincke, Whitcre)[15] and size (25G or 29G) of needle[16]. But this is also true that diagnosis of PDPH in this age group is very difficult. As spinal block impairs central thermoregulatory control extended block can produce hypotension and shivering specially in neonates and infants[17]. It is evident from this study that conventional use of hyperbaric (8% glucose) bupivacaine (0.5%) is not only very effective but also technically easier and safer than in adult counterpart and supported by other studies. Complications can occurs but do so rarely when anesthesiologists adheres to the basic principles of vigilance and skill.

Conclusion

Spinal anaesthesia has been used in children over 100 years and in the last decade its popularity for infants and toddlers has increased but there are still few unanswered questions with the technique which will definitely clear off in time with more detailed study and clinical practice.

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