

SPINAL ANAESTHESIA IN CHILDREN: A PROSPECTIVE STUDY

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ABSTRACT

BACKGROUND

Even after a vast safety record, the role of spinal anaesthesia (SA) as a primary anaesthetic technique in children remains contentious and is mainly limited to specialized paediatric centers.

The aim of the study was to evaluate the success rate, complications and hemodynamic stability related to paediatric spinal anaesthesia.

MATERIALS AND METHODS

60 paediatric patients aged 6 months to 5 years posted for elective below umbilical general surgery were included in study. Spinal anaesthesia was received with Bupivacaine 0.5%, 0.4 mg/kg body weight. These patients were kept immobile with inhalational anaesthesia using Sevoflurane. Demographic data, vital parameters, supplemental sedation, number of attempts for lumbar puncture, sensory-motor block characteristics, and complications were noted.

RESULTS

There was no significant change in the mean value of systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation after subarachnoid block at all time periods in study. Pulse rate showed a significant increase (12%) after 5 min of subarachnoid block as compared with baseline. After 10 min of block 58 (97%) patients achieved desired peak sensory level of T10 and Bromage score of 3. In successful spinal cases, mean peak sensory level after 10 min of block was $T 6.23 \pm 1.21$ (T4-T8) and the median was T6. Mean sensory level at the end of surgery was $T 8.22 \pm 1.39$ (T6-T10) and the median was T8. In all successful blocks the modified Bromage score was 3, which was seen in 58 (97%) patients. Mean time to two segment regression was 43.91 ± 9.9 (30-70) min. Mean time to return Bromage to 0 was 112.31 ± 21.11 (70-160) min. Sensory and motor block recovery was complete in all the patients. Shivering was seen only in 2 (3%) patients intraoperatively. No other complication was noted.

CONCLUSION

Paediatric spinal anaesthesia is a safe and effective anaesthetic technique for lower abdominal and lower limb surgeries of shorter duration (<90 min) with high success rate.

KEYWORDS

Paediatric Spinal Anaesthesia, Bromage Scale, Peak Sensory Level.

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BACKGROUND

Spinal anaesthesia is a useful technique in infra umbilical and lower limb surgeries. Infants and children are at increased risk for GA related complications. Spinal anaesthesia in infants has been associated with decreased incidence of hypotension, hypoxia, bradycardia or postoperative apnoea as compared to GA; therefore, providing a high degree of cardiovascular and respiratory stability. An important limiting factor for neonatal spinal anaesthesia is duration which can be prolonged by addition of opioids.^{1,2}

Spinal anaesthesia though gaining popularity in infants and children, the misconceptions regarding its overall safety, feasibility, and reliability can only be better known with greater use and research. There is no published study from India that highlights the experience of spinal anaesthesia in children regarding its safety, success rate, and complications. This made us design this study in which we had prospectively analysed the success rate, complications, and hemodynamic stability-related to spinal anaesthesia in paediatric patients aged 6 months to 5 years.

MATERIALS AND METHODS

The study comprised of sixty patients of either sex with ASA Grade I and II and age varying between 1 and 5 years. They were posted for elective below umbilical general surgery.

The patients received spinal anaesthesia with Bupivacaine 0.5%, 0.4 mg/kg body weight. These patients were kept immobile with inhalational anaesthesia using Sevoflurane.

Routine pre-anaesthetic check-up, including examination of spine and laboratory investigations, BT, CT

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were done. A written consent was obtained according to hospital ethical committee. Patients were prepared, without food or drink for 4-6 hours prior to surgery. Apart from the usual contents, the spinal set included a 26-gauge disposable spinal needle, two ml disposable syringe and 0.5% bupivacaine heavy 4 ml ampoule. All emergency drugs like atropine, mephentermine, adrenaline and endotracheal tubes and working Laryngoscopes were kept ready. Boyle anaesthetic was checked and kept ready. A pulse oximeter and a NIBP monitor were connected to the patient.

Technique

Prior to spinal anaesthesia, patients were made immobile for better conditions. The patient was induced with Sevoflurane 7-8% and a tidal volume of 10 ml per kg- with a minimum of four litres minute volume. Sevoflurane was cut to 2% as the patient was unconscious and stabilized. Using a 24-gauge canula an IV line was started and Atropine (0.01 mg/kg) was given. All the patients were kept in left lateral position, avoiding flexion of the neck with a small towel under the left cheek to lift the head, and the knees were drawn up over the abdomen. After observing a steady O₂ saturation, under sevoflurane analgesia patients were kept immobile during the procedure of spinal anaesthesia.

With aseptic conditions after confirming the free flow of cerebrospinal fluid (CSF) the drug bupivacaine (0.5%) heavy, 4 mg/kg injected intrathecally. After positioning the patient supine, sevoflurane <1% was administered with the Ayre 'T' piece throughout the surgical procedure. In the study, sevoflurane was selected, as its blood gas solubility is low 0.6 facilitating faster induction and emergency when compared to previous halogenated agents. It causes a dose related decrease in myocardial contractility and mean arterial pressures. It has little effect on catecholamines. It does not cause coronary steal. This agent does not cause epileptiform of EEG activity, and also not much renal impairment. Its excretion is predominantly through the lungs.

Following parameters were observed-

The onset of the block was confirmed by relaxation of the abdominal muscles and testing analgesia. For muscle relaxation: observation of the surgeon was taken for assessment.

- Quality of motor block was accessed using Bromage scale:
 - Grade-I Unable to move feet and knee.
 - Grade-II Able to move feet only or big toe.
 - Grade-III Just able to flex the knees
 - Grade - IV Full flexion of the knees and feet.
- Pulse rate and Blood pressure (BP) were noted before the procedure, immediately after the block, then every 5 minutes for 15 minutes and then every 15 minutes till the completion of the surgery.
- Oxygen saturation was recorded using pulse oximeter.
- Duration of motor block was noted as interval between injection drug and the reappearance of toes or limb movements.

- Duration of analgesia was accessed by the behavior of child for feeling of pain.
- Any side effects of spinal anaesthesia were noted.

Postoperatively vital parameters were noted carefully, and all the patients were observed for immediate usual post spinal anaesthesia complications like Nausea, vomiting, shivering, restlessness, bradycardia, hypotension due to sympathetic block, respiratory depression, post lumbar puncture headache, urinary retention

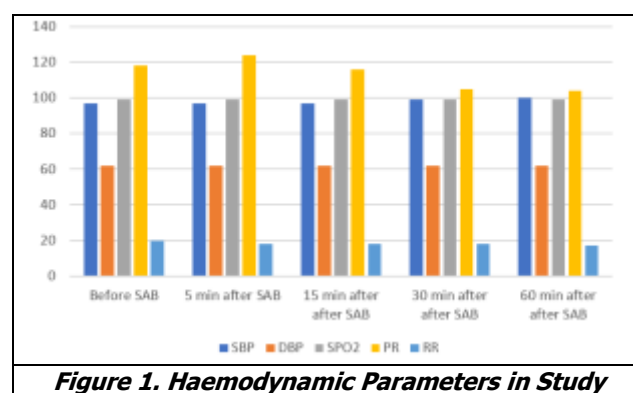
RESULTS

Age group involved in study are 1-5 yrs. are with weight 11.83 kgs. Forty-five (75%) patients were males and only 15 (25%) were females. Mean weight of the patients was 18.42 ± 7.57 (5-35) kg. Spinal anaesthesia was provided for a variety of surgeries Mean duration of surgery was 53.5 ± 15.16 (20-95) min.

Type of Surgery	Number of Patients	Percentage
Herniotomy	30	50
Appendicectomy	6	10
Genitourinary Surgeries	15	25
Lower Limb orthopaedic Surgeries	9	15

Table 1. Type of Surgery in Study

Mean fasting hours were 5.92 ± 0.89 h. Injection atropine 0.01 mg/kg was given as premedication. At the time of entering the operation theatre al, patients were conscious and crying. On the operation table, almost all the patients received sedative drug to prevent any untoward movement during surgery. Most of the patients were given ketamine either alone or with midazolam. Other drugs used were diazepam and fentanyl.



There was no significant change in the mean value of systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation after subarachnoid block at all time periods. Pulse rate showed a significant increase (11%) after 5 min of subarachnoid block as compared with baseline. This can be attributed to atropine and ketamine, which were used for premedication and sedation,

respectively. However, afterwards mean pulse rate showed no significant change from baseline. Only 2 (1.5%) patients had a single episode of hypotension after 10 min of SAB, which was successfully managed.

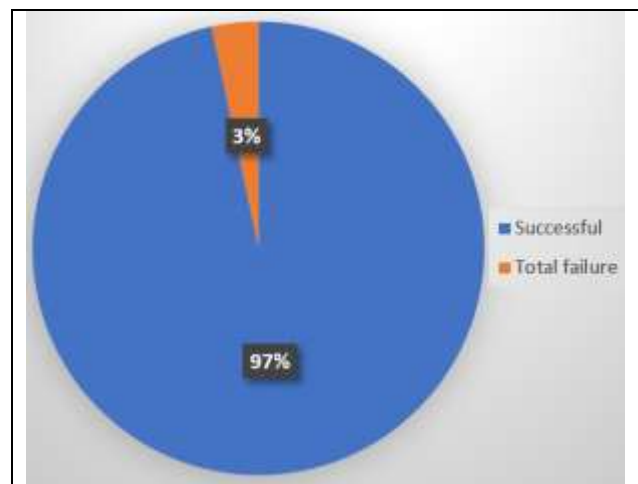


Figure 2. Outcome of Subarachnoid Block

After 10 min of block 58 (97%) patients achieved desired peak sensory level of T10 and Bromage score of 3. Surgery was completed in all these cases without anaesthetic supplementation. The success rate of the study was 97%. Remaining 2 (3%) cases were classified as a failure and were given GA.

Sensory Block	
Mean Peak Sensory Level (T4-T8)	T 6.23+ 1.21
Mean Sensory Level at The End of Surgery	T 8.22+1.39
Time to Two Segment Regression (Min)	43.91+9.9 (30-70)
Motor block	
Modified Bromage Score Of 3	100%
Time to Return to Bromage 0	112.31+21.11(70-160)

Table 2. Block Characteristics (n=58)

In successful spinal cases, mean peak sensory level after 10 min of block was T 6.23 ± 1.21 (T4-T8) and the median was T6. Mean sensory level at the end of surgery was T 8.22 ± 1.39 (T6-T10) and the median was T8. In all successful blocks the modified Bromage score was 3, which was seen in 58 (97%) patients. Mean time to two segment regression was 43.91 ± 9.9(30-70) min. Mean time to return Bromage to 0 was 112.31 ± 21.11 (70-160) min. Sensory and motor block recovery was complete in all the patients

Shivering was seen only in 2 (3%) patients intraoperatively, which was treated with tramadol 2 mg/kg. Intraoperative hypotension (>20% fall in systolic blood pressure) was seen only in 1 (1.5%) patients which was treated with fluid and 3 mg mephentermine. No other complication such as bradycardia, nausea/vomiting, or post-dural puncture headache was noted.

DISCUSSION

This prospective study was done to evaluate the perioperative haemodynamic changes, feasibility and safety of spinal anaesthesia in paediatric patients of 6 months to 5 years of age. In many studies it was shown that spinal anaesthesia in children is safe, cost effective & ideal for day case subumbilical surgeries and also very useful in limited resources. As compared to general anaesthesia decreased stress response & recovery is very fast following spinal anaesthesia. Since the children are uncooperative, crying during any invasive procedure adequate premedication in the form of analgesia & sedation is very important for smooth regional procedures. Thus, to make the child sedated, calm and thus cooperative during lumbar puncture.

In our study 2 (3%) patients in our study were not given any sedation before Subarachnoid block because they were comparatively older in age (>10 years) and cooperative. During the intraoperative period sedation was maintained using propofol infusion (50-75 mcg/kg/min) in all patients. Low dose sedation does not mask the failure of the block. It is better to provide supplemental oxygen during sedation.

In our study during induction we used ketamine 1 mg/kg as sedative; while 0.5 mg/kg was used intraoperatively. The failure of block is not masked by low dose of sedatives. It is better to provide supplemental oxygen during sedation. To prevent infant from reaching on to the sterile field, a loose soft constraint may be applied to the wrists. Ketamine induces dissociative anaesthesia causing functional dissociation between cortical and limbic system. During sedation a protective airway reflexes are maintained. Ketamine is a suitable drug for sedation in the neonatal period having a high therapeutic index. Decreased afferent conduction to reticulo-thalamocortical projection pathways which reduces the excitability and the arousal of brain is the presumed mechanism for sedation after SAB. The sedative effect of subarachnoid block was documented by Hermanns et al.³ (2006) who conducted a study to evaluate sedation during spinal in neonates. The presumed mechanism for sedation after SAB is a decreased afferent conduction to reticulo-thalamo-cortical projection pathways which reduces the excitability and the arousal level of brain. Lumbar puncture was performed in all the patients in lateral position. During lateral or sitting position the neck should be in extension as cervical flexion does not provide any benefit in children and in fact, may obstruct the airway during the procedure.⁴

In a study conducted by Verma D⁵ 102 paediatric patients aged 6 months to 14 years undergoing infraumbilical and lower extremity surgery, Lumbar puncture was successful in first attempt (60 (58.82%)) or 2nd attempt (42 (41.18%)). There was no significant change in vital parameters.

In a study conducted by Blaise and Roy⁶ on paediatric patients aged 7 weeks to 13 years, 4 of 34 patients required GA due to failure of lumbar puncture after two attempts. Sedation prevents movement of the children during lumbar puncture and might have been an important factor for better results of our study.

In our study, there was no significant change in vital parameters and sensory level of T10 was achieved in 58 (97%) patients after 10 min of SAB, and they were considered as successful spinal block. Whereas in 2 (3%) patients, T10 level was not achieved and GA was given, and these were considered as failed spinal block. Mean sensory level at the end of surgery was $T 8.22 \pm 1.39$ (T6-T10) and the median was T8. In all successful block the modified Bromage score was 3, which was seen in 58 (97%) patients. Mean time to two segment regression was 43.91 ± 9.9 (30-70) min. Since the level of surgery was below T10 in all the patients, adequate dermatomal level was present until the end of surgery. Thus, none of the patients required supplemental anaesthesia during surgery in our study.

In study done by Verma D et al⁵ the desired sensory level of T10 was achieved in 98 (96.1%) patients after 10 min of SAB. Whereas in 4 (3.9%) patients. The mean peak sensory level was $T 6.35 \pm 1.20$ and the median was T6. Mean time to two segments regression was 43.97 ± 10.72 (30-70) min. Ahmed et al., (2010)⁷ conducted a study on 78 children aged between 2 and 6 years undergoing different type of surgery in the lower part of the body and reported that sensory block showed wide variation of height from T1 to T7, and the median was T4.

In a study conducted by Kokki and Hendolin (2000)⁸ to compare hyperbaric bupivacaine 0.5% in 0.9% and 8% glucose solutions for spinal anaesthesia in 7-18 years old children, motor block was complete in 53 (96%) patients in group bupivacaine-0.9% glucose solution (n = 55), whereas it was complete in 52 (100%) patients in group bupivacaine-8% glucose solution (n = 52).

Shivering was the most frequent complication in our study, which was 2 (3%) patients intraoperatively, which was treated with tramadol 2 mg/kg. Intraoperative hypotension (>20% fall in systolic blood pressure) was seen only in 1 (1.5%) patients which was treated with fluid and 3 mg mephentermine. No other complication such as bradycardia, nausea/vomiting, or post-dural puncture headache was noted.

In study done by Verma D et al⁵ which was seen in 3(2.9%) patients and Hypotension was seen in 2 (2%)

patients. Ahmed et al., (2010) conducted a study to evaluate characteristics of spinal anaesthesia on 78 children aged between 2 and 6 years and reported that shivering occurred in five patients and vomiting occurred in one patient. Two patients suffered from hypotension, which was treated with ephedrine and bradycardia was seen in one patient, which was treated with atropine.

CONCLUSION

Spinal anaesthesia has been found to be effective as sole anaesthetic agent in neonates. The drugs and equipment required are much less and the length of hospital stay is short. Spinal anaesthesia has a remarkable safety record in paediatric population in the hands of an experienced anaesthetist, proper patient selection, drugs and dosages, giving high success rate and very low complication rates.

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