International Journal of Medicine Research
ISSN: 2455-7404
www.medicinesjournal.com
Volume 3; Issue 1; January 2018; Page No. 85-87

A prospective study to evaluate the feasibility of spinal anaesthesia in neonates

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Abstract
Background: Spinal anaesthesia in neonates has been advocated mainly for preterm with associated respiratory complications, with experience we will be acquainted with its safety and technical viability.
Aims and Objectives: The present study was designed to evaluate the success rate, hemodynamic stability and feasibility of spinal anaesthesia in neonate aged 0-28 days.
Material and Methods: The present study was conducted on50 patients in MGM Medical College and M.Y Hospital, Indore. The subjects were of age 0-28 days and were planned for various abdominal and lower limb surgeries. Hyperbaric bupivacaine 0.5%in a dose of 0.5mg/kg in L4-L5space was used to administer spinal anaesthesia after taking all aseptic precautions under ketamine sedation. The following parameters were noted Vitals, number of attempts, sensory-motor block characteristics and complications if any.
Results: The success rate of Spinal anaesthesia was 46(96%) while failure was 4(4%) and was thus taken under General Anaesthesia. In 1st attempt Lumbar puncture was successful in 35(85%) while in second attempt success rate was 15(15%). There was no significant change in vital parameters. Complete sensory and motor blockade recovery was in all patients.
Conclusion: Neonatal spinal is a safe and effective technique with good success rate. It has short duration of action which in itself helps in early recovery, without need of assisted ventilation.

Keywords: neonates, hemodynamic, spinal anaesthesia, lumbar puncture

Introduction

Regional anaesthesia in children was first studied by August Bier in 1899. Since then, Spinal anaesthesia was known to be practiced for several years. In 1900, Brainbridge reported a case of strangulated hernia repair under spinal anaesthesia in infant of three months. After some years, it fell into disuse owing to introduction of various muscle relaxants and inhalation agents. In early 1980, it was reintroduced as an alternative to general anaesthesia especially in high risk and pre term infants [7] and is being frequently used nowadays due to increasing knowledge on pharmacology, Safety information and availability of specialized equipment for regional anaesthetic techniques and monitoring in children [1, 6].

Spinal anaesthesia is a useful technique in infraumbilical and lower limb orthopaedic surgeries. Infant and children are at increased risk for GA related complication. 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.

Although it is being used, the misconception regarding its overall safety, feasibility and reliability can only be known with better research and use. This study was designed to analyse the success rate, feasibility and hemodynamic stability related to spinal anaesthesia in neonates aged 0-28 days.

Material and Methods

After approval from institutional ethics committee, this study was carried out at M.G.M Medical College and M.Y hospital Indore. Informed consent was obtained from parents for participation in the study. 50 neonates 0-28 days of age group posted for surgeries like anorectal malformation correction wiz, colostomy, anoplasty etc., Gastroschisis, Pyloromyotomy, Strangulated hernia etc. were included in this study [5]. All patients under study were subjected to detailed preanaesthetic evaluation. Patients with known contraindication to spinal anaesthesia like thrombocytopenia, parental refusal etc. were excluded from the study.

All patients were kept nil orally and were given breast milk 4 hours before being taken to the theatre.

After establishment of intravenous access, all patients less than 72 hours of age were given 10% dextrose; while those between 3-28 days were put on ringer lactate infusion according to Holiday and Segar formula. In the operating room, standard monitoring including heart rate, oxygen saturation, blood pressure and electrocardiogram were recorded and were noted as baseline values. In addition to these skin temperature sensor were applied and measures were taken to prevent hypothermia. Injection Atropine 0.01mg/kg was given as premedication. All children were sedated on the operating table before subarachnoid block using injection ketamine 1mg/kg to provide an immobile patient for lumbar puncture. All patients received spinal anaesthesia via midline approach with patient in lateral position under aseptic

precautions. Here care should be taken to avoid cervical flexion as it may obstruct the airway during the procedure. Lumbar puncture was performed in L4-L5 space using 27G paediatric quincke needle. After getting free flow of CSF hyperbaric bupivacaine 0.5% in a dose of 0.5mg/kg or 0.1ml/kg (for child less than 5kg) was injected in the subarachnoid space. An additional 0.1-0.2 ml is often given to allow for the dead space volume of the needle and hub. The end of the injection was taken as time zero for further data recording. Sensory level was assessed by lack of response to firm skin pinch to the dermatomal level. Desired peak sensory level was aimed to be T10 for assessing the success rate of spinal anaesthesia. Similarly modified Bromage score (0-free movement of leg and feet with the ability to raise extended legs; 1-inability to raise extended leg and knee flexion decreased; 2-inability to raise or flex knees, flexion of ankle and feet present; 3-inability to raise legs, flex knee or ankle, move toes) was assessed by the same firm skin pinch stimulus given in lower limb (thigh) and modified Bromage score was noted.

After 10 minutes of SAB if the peak sensory level was at least T10and Bromage score 3, surgery was allowed to start. If there was no response to surgical stimuli it was considered as successful spinal block. If the peak sensory level was below T10 and Bromage score 3, then case was classified as failed spinal block. Such patients were given GA with intubation and excluded from the study. All patients received supplementary oxygen thru ventimask. At the end of the procedure, all the patients received paracetamol rectal suppository (20mg/kg) 8 hourly.

The indications, type and duration of surgery and vital parameter were noted. Requirement of supplementary sedation, local anaesthetic dose and number of attempts were noted. Sensory and motor block characteristics were noted. Significant hypotension and reduction in heart rate were defined as decrease of 20% or more from the baseline value.Spo2 less than 90% characterized as systemic desaturation. The patients were monitored until full recovery. The data were recorded on the patient's assessment Performa and analysed.

Table 1

	Indications for surgery
1.	Colostomy
2.	Pyloromyotomy
3.	Gastroschisis
4.	Atresia-jejunal,ileal,duodenal
5.	Exploratory laparotomy
6.	Vesicostomy
7.	Fulgration of posterior uretheral valves

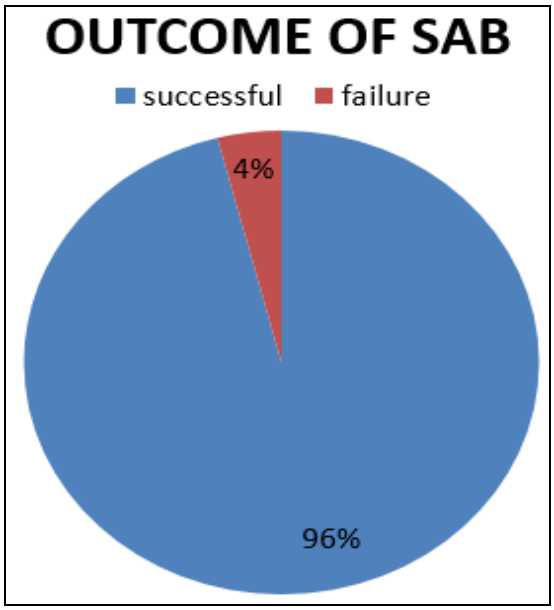

Fig 1

Results

Lumbar puncture was successful in first attempt in 35(85%) patients and remaining 15(15%) required second attempt.

There was no significant change in the mean value of systolic blood pressure, diastolic blood pressure, respiratory rate and oxygen saturation after SAB in the study patients (Fig 2). Pulse rate showed a significant increase after 5 minutes of induction as compared with baseline. This can be attributed to injection atropine and ketamine, which were used for premedication and sedation, respectively.

The success rate of the study was 96%, while remaining 4% were classified as failure (Fig 1) and given GA. Surgery in 96% of patients was completed without anaesthetic supplementation. In all successful SAB the modified Bromage score was 3, which was seen in 96% patients. Sensory and motor block recovery was complete in all the patients.

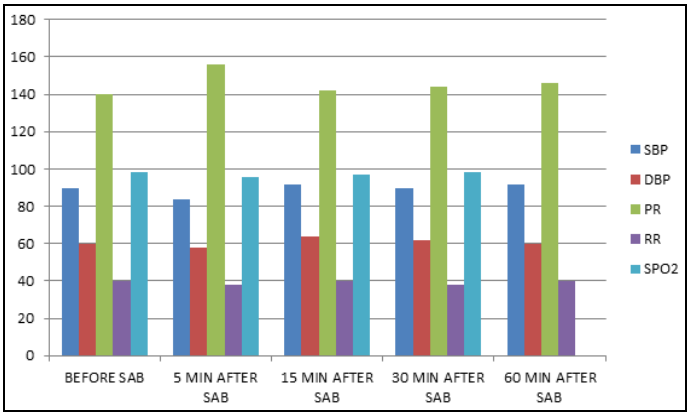

Fig 2

Discussion

This present study was done to evaluate the efficacy and safety of spinal anaesthesia in neonates. Spinal anaesthesia is a cost effective, single shot and safe technique. With good muscle relaxation spinal anaesthesia provides dense and uniformly distributed sensory block with. Spinal anaesthesia shows better stress response to surgery and fast recovery. Although widely used technique in neonates is caudal block, it is mostly used as an adjuvant to GA. But expertise is required for caudal block, more volume of drug is required, block is less dense and takes around 10 to 15 minutes for complete block.

For a smooth regional procedure in neonates adequate premedication is important. To achieve a well sedated child various drugs through different routes are used. In spinal anaesthesia to avoid any untoward movement during lumbar puncture, proper analgesia and sedation is required. Sedation prevents movement of child during lumbar puncture and might have been an important factor for better results of our study as contrast to study by Blaise and Roy [2] who required GA due to failure of lumbar puncture after two attempts.

In our study during induction we used ketamine 1mg/kg as sedative; while 0.5mg/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 constraints may be applied to the wrists. Ketamine induces dissociative anaesthesia causing functional dissociation between cortical and limbic system. During sedation a protective airway reflex are maintained. Ketamine is a suitable drug for sedation in the neonatal period having a high therapeutic index. Decreased afferent conduction to Reticulothalamocortical 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 were documented by Hermanns *et al*. (2006) who conducted a study to evaluate sedation during spinal in neonates [3].

In our study, 1st attempt of lumbar puncture was successful in 35 (85%) patients and 2nd attempt in 15(15%) patients. None of the patients required more than two attempts for lumbar puncture, which shows the ease and feasibility of lumbar puncture technique in the neonatal population.

In comparison to adult cardiovascular changes related to spinal anaesthesia are less common in children. As Children younger than 5-8 years of age have immature sympathetic nervous system and relatively small intravascular volume in lower extremities and splanchnic system which limits the venous pooling in the group.

In present study desired sensory level of T10 was achieved in 46(96%) patients after 5minutes of SAB and they were considered as successful spinal block where as in 4(4%) patients T10 level was not achieved and GA was given, considered as failed spinal block.

Conclusion

Spinal anaesthesia has been found to be effective as sole anaesthetic agent in neonates. The drugs and equipments 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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