Vol 4 | Issue 3 | 2014 | 156-161.

e-ISSN 2248 – 9142
print-ISSN 2248 – 9134

International Journal of
Current Pharmaceutical & Clinical Research
www.ijcpcr.com

ISOBARIC ROPIVACAINE VS ROPIVACAINE-CLONIDINE COMBINATION FOR INFRAUMBILICAL SURGERIES IN CHILDREN UNDER SPINAL ANAESTHESIA

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ABSTRACT

Aim of Study: To compare the efficacy of ropivacine alone or in combination with clonidine for spinal anaesthesia in children of 5-12 yrs of age for infraumbilical surgeries. Method: 60 paediatric consented patients of either gender scheduled for infraumbilical surgery were randomised into two groups of 30 each to receive either intrathecal study solution of 0.5% isobaric ropivacaine 0.5 mg/kg body weight (group I) or 0.5% isobaric ropivacaine 0.5 mg/kg body weight with clonidine 1µg/kg body weight (group II). The end point were hemodynamic variability, onset of analgesia , duration of sensory and motor blockade and quality of anaesthesia. The post spinal nausea, vomiting, shivering, respiratory depression, headache and other side effects were also noted. At the end of study, data were systematically compiled and analysed for statistical significance. Result: The intrathecal clonidine accelerated the onset time to achieve sensory blockade and motor blockade. Intrathecal clonidine with ropivacaine prolonged the duration of analgesia. When compared with intrathecal ropivacaine alone. Intraoperative hemodynamic variability showed no statistical significant difference between groups. Conclusion: Intrathecal clonidine as an adjuvant to 0.5% isobaric ropivacaine demonstrated better clinical profile as compared to ropivacaine alone.

Key words: Clonidine, Ropivacaine, Subarachnoid Block, Paediatric Patients.

INTRODUCTION

Since the first half of twentieth century, spinal anaesthesia has been commonly used in paediatric surgeries, because of the better understanding of basic anatomical, physiological and pharmacologically relevant differences between children and adults [1]. With simple guidelines for use, regional anaesthesia is considered as a valuable and relatively safe tool as high quality anaesthesia in paediatric patients [2]. Moreover children experience little or no changes in blood pressure and heart rate following spinal anaesthesia. Spinal anaesthesia reduces the incidence of morbidity that follows general anaesthesia in neonates and preterm infants. It provides all the components of balanced anaesthesia with minimum cardio-respiratory disturbances and post-operative nausea and vomiting (PONV), early ambulation and rapid return of appetite [3],

Many drugs are used in paediatric spinal anaesthesia out of which 0.5% bupivacaine and 0.5% ropivacaine are common and popular. Ropivacaine is a long acting amide local anaesthetic agent and is well tolerated in regional anaesthesia for surgical procedures and for post-operative analgesia [4]. Spinal anaesthesia in children provides

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sensory and motor block for shorter duration, reasons that could be attributed are; increased cardiac output, local vascularity and CSF volume (4ml/kg) which leads to increased systemic absorption of local anaesthetics [5].

To prolong the duration of spinal anaesthesia several adjuvants like epinephrine, morphine, clonidine and sufentanil were added to local anaesthetics. Clonidine an alpha-2 adrenergic agonist prolongs analgesia without significant respiratory depression. The analgesic action of epidurally administered clonidine is due to both alpha-1 and alpha-2 adrenoreceptor agonism with predominant alpha-2 action. It is metabolized in the liver [6].

So far not much research has been done on combination of ropivacaine and clonidine in spinal anaesthesia in paediatric patients. Hence this study was undertaken to compare the efficacy of ropivacaine alone and in combination with clonidine for spinal anaesthesia in children of 5-12 yrs of age for infraumbilical surgeries.

MATERIAL AND METHODS

After approval of institutional ethical committee and informed consent from parents, patients were divided randomly into 2 groups of 30 each, in a double blind manner. Double blinding describes the way of conducting an experiment or study of human subjects; in an attempt to eliminate subjective bias on the part of both experimental subjects and the experimenter. Double blind technique is used to achieve a higher standard of scientific significance.

Group I - spinal anaesthesia with isobaric ropivacaine (0.5%) 0.5 mg/kg body weight.

Group II - spinal anaesthesia with isobaric ropivacaine (0.5%) 0.5mg/kg body weight & clonidine 1µg/kg body weight.

The drug was prepared by an anaesthesiologist not involved in the study and the anaesthesiologist performing the block was blinded to the study drug.

The patients were admitted one day before surgery and kept fasting for 6 hrs before surgery. The volume of drug injected was maintained constant in both the groups by addition of normal saline. Weight of each child was measured; detailed general physical examination and vitals were recorded pre-operatively. Systemic examination was done and routine investigations of blood and urine were carried out.

All the patients were premedicated with intranasal midazolam in the dose of 0.2mg/kg body weight 15 minutes before the start of anaesthesia. EMLA cream was applied at the venipuncture site and lumbar puncture site.

All the parameters including heart rate, respiratory rate, non-invasive systolic blood pressure and diastolic blood pressure, Spo2 were recorded every 5 minutes initially till 30 minutes and then every 10 minutes till the completion of surgery. Subarachnoid block (SAB) was given in lateral position after giving injection propofol 2mg/kg body weight in L3-4/L4-5 space. After giving SAB, patients were turned to supine position and oxygen was given by mask. Intraoperative sedation was maintained with small intermittent doses of propofol when required.

OBSERVATION

Following parameters were observed

Sensory block

Sensory block was assessed by attempting to elicit a grimace or acknowledgement of pain to bilateral pin-prick at each dermatome.

Onset of sensory block- Time of injection of local anaesthetic in subarachnoid space upto the time when patient does not feel the pinprick at the T10 level.

Highest level of analgesia-Highest dermatome showing analgesia.

Duration of analgesia was taken as the interval from subarachnoid administration to regression to S1 dermatome level.

Motor block

Degree of motor block was assessed by modified Bromage scale every five minutes for 30minutes and then every 15 minutes till the end of the surgery.

Modified Bromage scale-

0-Able to raise the whole lower limb at hip.

1-Able to flex the knee but unable to raise the leg at hip.

2-Able to plantar flex the ankle but unable to flex the knee.

3-No movement of lower limb.

Time to reach Bromage 3(motor block in minutes and regression time to Bromage zero; duration of motor block was noted)

Continuous monitoring of heart rate, respiratory rate, non-invasive systolic blood pressure and diastolic blood pressure, Spo_2 was done. Readings were recorded pre-operatively then intra-operatively every five minutes for first 30 minutes there after every 10 minutes till the end of the surgery. Episodes of intra-operative hypotension (decrease in systolic blood pressure by 20% from baseline) were recorded. Hypotension was treated with oxygen, head down position, intravenous fluids and vasopressors. Bradycardia (heart rate<60 beats/minute) treated with injection atropine (0.02mg/kg body weight).Total duration of surgery was noted and analgesia was monitored by using VAS score.

Sedation was assessed every five minutes for first 30 minutes, then every 15mins till the end of the surgery by the following scale.

0 - no sedation

1 - Mild sedation

2 - Moderate sedation

3 - Deep sedation

Quality of surgical anaesthesia as per observation by surgeons, patient's behaviour, complaints, post-operative pain score and rescue analgesia were assessed and graded.

Excellent-No supplementary drugs required.

Good-Analgesia required.

Fair-More than one analgesic dose required.
Poor-General anaesthesia required.

Any supplementary drug given was also noted. Any incidence of nausea, vomiting, bradycardia, hypotension, headache, backache, shivering, vertigo, urinary retention, sedation was recorded for 24hours.

Post-operative follow up was done in all patients for 24hrs and following parameters were seen in the post anaesthetic care unit at an interval of 15minutes for first 2 hours, then 4 hourly till next 12 hours, then 12 hourly till 24 hours. Vital parameters, sedation score, pain assessment according to visual analogue scale, total duration of analgesia that is from anaesthesia to first dose of rescue analgesia was recorded in both groups. Rescue analgesia was given with oral paracetamol (20mg/kg body weight) and oral ibuprofen (5 mg/kg body weight). Time when patient demanded first dose of rescue analgesia was the primary end point of our study. Total number of doses of rescue analgesia was also noted.

Patients were monitored for sensory and motor block, post-operative analgesia, sedation, side effects like nausea, vomiting, headache, backache, shivering, urinary retention, bradycardia, hypotension etc for 24hours. -This was the secondary end point of our study.

STATISTICAL ANALYSIS

Data were analysed using computer statistical software system SPSS (statistical packages for the social sciences). The patient characteristics (non parametric data) were analysed using the 'chi square test' while the intergroup comparison of the parametric data was done using student't' test. The 'p' value was determined to finally evaluate the level of significance. The p value of <0.05 was considered significant at 5% significance level; p<0.01 was considered significant at 1% significant level and a p value of 0.001 was considered highly significant. The blinding was opened at the end of study. Sample size was decided after power analysis taking into account the parameters under observation.

RESULTS

Both the groups were comparable with respect to age, sex, weight, ASA grade, duration and type of surgery and baseline haemodynamic parameters [Table 1].

Table 1 shows two groups were comparable in respect to age, weight and sex ratio without any significant difference (p>0.05)

The mean time of onset of sensory block to T10 dermatome in group II (5.46+/-0.68 min) was earlier than in group I (6.13+/-1.10 min), difference between the two groups was significant (P<0.007). Maximum level of sensory blockade achieved was T6 in 18 patients in group I and 16 patients in group II. Only I patient in group I and 2 patients in group II had sensory blockade upto T_5. Mean time taken to maximum level of analgesia in group II was (6.40+/-0.93 min) which was less as compared to group I (7.90+/-1.74min), difference between the two groups was highly significant (P <0.000). Mean duration of sensory blockade in group II (93.66+/-5.03 min) was more as compared to group I (83.23+/-5.48 min). The difference was statistically highly significant (P<0.000). Mean duration of motor blockade (regression to Bromage zero) in group II (52.06+/-2.4min) was prolonged as compared to group I (50.33+/-2.08min). Difference in two group was statistically significant (P<0.004). Patient remained pain free for longer duration in group II and the requirement of first dose of rescue analgesia was also delayed in group II as compared to group I (Time to request for first dose of rescue analgesia). All the patients in group I required rescue analgesia as compared to group II where 43.33% patients required rescue analgesia, difference is highly significant(P<0.001). The difference in VAS score between the two groups was not significant till the end of surgery as all patients had full surgical analgesia in the post-operative period. VAS score started increasing earlier in group I as compared to group II. Post-operative pain score (VAS score) was more in group I at 0, 10, 20, 30 min and 4, 12, 24 hours than in group II. Difference is highly significant (P<0.05) [Table 2].

Table 2 shows the onset of analgesia, duration of analgesia and duration of motor blockade in both the groups. Onset of analgesia was significantly accelerated by addition of clonidine to ropivacaine in comparison to ropivacaine alone. There was statistically significant difference in duration of analgesia and duration of motor blockade. But there was no clinical significance in requirement of rescue analgesia and duration of surgery.

The spinal anaesthesia was considered to be completely successful if child was assessed as pain free during surgical procedure. Quality of anaesthesia as observed by surgeons was better in group II as compared to group I. In group II 86.67% of patients had excellent quality of anaesthesia as observed by surgeons and 13.33% had good quality of surgical anaesthesia but in group I excellent quality of surgical anaesthesia was observed by surgeons in 36.67% patients and good quality of anaesthesia in 63.33% patients. Difference in quality of anaesthesia observed by surgeons was highly significant (P<0.001).Most of patients remained calm in 90% in group I and 93.33% in group II during the procedure. Restlessness was observed in one patient in group I. Uncooperative patients observed were 2 in both the groups. Sedation was given to restless and uncooperative patients with intermittent doses of propofol.

Haemodynamic parameters remained stable and were comparable in both the groups at all measured intervals. There were no major complications and side effects except sedation. Sedation was observed in 6.67% patients in group II as compared to none in group I. It was statistically significant (P = 0.020).Two patients in group I and three patients in group II had hypotension which was treated by giving fluids intravenously and oxygen. None of

the patient required Ephedrine hydrochloride. Bradycardia occurred in three patients in group I and three patients in group II and was treated with injection atropine (0.02mg/kg). No patient had respiratory depression. Nausea, vomiting, headache and backache developed in 6.67% patients in group I as compared to 3.33% patients in group II. Urinary retention developed in one patient (3.33%) in group I. Shivering developed in 3.33% (one patient) in each group [Table 3].

Table 1. Demographic Data

Parameters	Group I	Group II	p Value
Age (yrs)	8.57±2.47	8.73± 1.74	0.764
Sex (M:F)	24:6	21:9	0.371
Weight (Kgs)	21.23±6.02	24.33±6.73	0.065

Table 2. Discussion

Parameters	Group I	Group II	P Value
Onset of sensory block	6.13±1.10	5.46±0.68	0.007
Maximum level of sensory block	T5 (T5-8)	T5 (T5-8)	0.000
Time taken for maximum sensory block	7.90±1.74	6.40±0.93	0.000
Mean duration of sensory block (upto S1 regression)	83.23±5.48	93.06±5.03	0.000
Mean duration of motor blockade	50.33±2.08	52.06±2.4	0.004
Requirement of rescue analgesia	100%	43.33%	NS
Duration of surgery	40.53±13.73	40.70±5.90	NS

Table 3. Intraoperative and post-operative complications

Parameters	Group I (%)	Group II (%)
Nausea	2(6.67)	1(3.33)
Vomiting	2(6.67)	1(3.33)
Headache	2(6.67)	1(3.33)
Backache	2(6.67)	1(3.33)
Shivering	1(3.33)	1(3.33)
Vertigo	2(6.67)	1(3.33)
Urinary retention	1(3.33)	--
Sedation	--	5(16.67)
Hypotension	2(6.67)	3(10.00)
Bradycardia	3(10.00)	3(10.00)

Above table shows there was higher incidence of nausea and vomiting in group I in compare to group II but difference was not statistically significant. Sedation was statistically significant in Group II as compared to Group I (p =0.02).

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DISCUSSION

The present study has evaluated the clinical efficacy and safety of intrathecal clonidine as an adjuvant to 0.5% isobaric ropivacaine for infraumbilical surgeries in paediatric patients under subarachnoid block.

Spinal anaesthesia produces a reliable, profound and uniformly distributed sensory block with rapid onset and good muscle relaxation, and it results in more complete control of cardiovascular and stress responses than epidural or opioid anaesthesia [7]. It is ideal for day care surgeries and is safe and cost effective. It is cheaper alternative in countries with limited resources, due to rapid recovery and shortened hospital stay. Imbelloni et al documented 54% reduction in cost as compared to GA [8]. There is no additional requirement of any special drug or equipment for the procedure. Because of these benefits, spinal anaesthesia has gained acceptance for children undergoing surgery in the lower part of the body [9].

Children are apprehensive from the thought of parental separation, pain of surgery, and use of needles. It is very important to discuss clearly the advantages of spinal anaesthesia (SA) over general anaesthesia (GA) with parents and older children. They should be explained about the technique in detail [10].

In this study, the intrathecal clonidine with 0.5% ropivacaine was well tolerated and provided clinically effective surgical anaesthesia. The mean duration of sensory analgesia was increased when intrathecal clonidine was added to ropivacaine. All patients showed motor blockade of shorter duration as compared to sensory blockade and more rapid recovery was observed [11]. This dose of clonidine was not associated with hemodynamic changes or respiratory depression.

Intrathecal ropivacaine provided cardiovascular stability with only few episodes of hypotension which were

manageable with rapid intravenous infusion and vasopressors.

Adjuvants like opioids can be used to enhance analgesia and successful spinal anaesthesia due to their synergistic action. Clonidine has been used as an adjuvant to local anaesthetics for the enhancement of analgesia. Study by Rochette et al demonstrated that clonidine doubles the duration of neonatal spinal anaesthesia without any undesirable hemodynamic effects [12]. It also causes bradycardia and apnoea without desaturation for the first 24 hours postoperatively which resolved spontaneously [13]. They also found that duration of block improved with increasing dosages of clonidine and reached statistical significance when 1µg/kg was given.

Gonul et al established the fact that adding different doses of clonidine to ropivacaine in spinal anaesthesia decreases the time of onset of block, increases depth of block and increases duration of analgesia. Adverse effects like nausea, vomiting, bradycardia, hypotension and sedation. Sedation was more pronounced in group of patient with clonidine [14].

Bajwa et al found that addition of clonidine to ropivacaine in caudal block in children provided effective analgesia intra-operatively and prolonged duration of analgesia post operatively [15].

Another study by Arpita laha concluded that addition of clonidine to ropivacaine improved quality of post-operative analgesia compared to plain ropivacaine without causing any significant adverse effects [16].

Although ropivacaine is safe and well tolerated during subarachnoid block but a few adverse effects include hypotension and bradycardia may occur. Hannu kokki et al observed bradycardia in only one patient out of 95 in his study, which was not significant [17].

Sharpe et al concluded that there was an increase in analgesic duration with increasing doses of clonidine administered caudally and arousal time was also prolonged. Light to moderate sedation is commonly observed postoperatively for 1 to 3 hours which is more beneficial than detrimental in paediatric patients [18].

Study by Gentili M concluded that clonidine does not cause urinary retention and may hasten the time to first micturition after spinal anaesthesia [19]. Post dural puncture headache (PDPH) was thought to be rare in children <10 years age, because of low CSF pressure, highly elastic dura and non-ambulation. In study by Kokki et al on 200 children using two different sizes spinal needles of 25G and 29G Quinke found that only 10 had PDPH with no difference regarding the type and size of needle used [20].

LIMITATIONS

Use of regional anaesthesia in children needs special knowledge and continuous training. Caudal, spinal and epidural anaesthesia have gained favour in the recent years. Good anatomical and pharmacological knowledge should be a prerequisite for all anaesthesiologists who use regional anaesthesia procedures. Continuous training and critical analysis are needed for good results. Investigation on a larger number of patients for a longer period should be conducted to address long term effects of spinal clonidine in paediatric as well as newborn group. Sedation is needed in some children for performance of block and despite successful block during the surgery [21]. Lack of co-operation make spinal anaesthesia challenging in this age group patients. Bloody tap and difficultly in aspiration are associated with failure of SA [22]. Also paediatric spinal needles are expensive and may not be freely available. However caudal anaesthesia is also gaining popularity in paediatric age group. Not much work has been done with ropivacaine in paediatric spinal anaesthesia. Further work is required to evaluate the role of ropivacaine for surgical procedures of short to intermediate duration, particularly in the ambulatory setting.

CONCLUSION

Today, more than a century ahead since its inception, although formally established and safe, spinal anaesthesia still remains underutilised in children. Based upon extensive literature review and our own experience we are convinced that spinal anaesthesia is safe, cost effective and technically feasible technique with remarkable safety profile. It has been concluded that ropivacaine in combination with clonidine can be safely used for spinal anaesthesia for paediatric surgical procedures of infraumbilical region. Patients were hemodynamically stable throughout the surgery with no significant change in baseline vitals. Post-operative sedation was observed which is desirable in paediatric age group. There was early onset of analgesia, prolonged duration of analgesia, prolonged duration of sensory and motor block as compared to ropivacaine alone.

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