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A study of effectiveness of 0.5% bupivacaine for sensory blockade as local anesthesia in epidural and spinal phase

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Abstract

Background: Bupivacaine is a long-acting local anesthetic. Addition of epinephrine is thus rarely required. It blocks initiation and transmission of nerve impulses at the site of application by stabilizing the neuronal membrane.

Objectives: To study effectiveness of 0.5% Bupivacaine for sensory blockade as local anesthesia in epidural and spinal Phase.

Methodology: After obtaining local ethical committee approval and informed consent a total number of 60 patient posted for orthopedic lower limb surgery, under combined spinal epidural were included in the study. They were divided into three groups of twenty patients each randomly. All cases were of the ASA I and ASA II in the age group of 18 to 60 years and randomly grouped in to A, B and C each including 20 cases. Group A: Epidural top up with 10 ml bupivacaine 0.5%**,** Group B: Epidural top up with 10 ml saline. Group C: served as a control and received no injection epidurally, but epidural injection was simulated by manipulating the epidural catheter. ANOVA test used for statistical analysis.

Results: The physical characteristics such as age, height, weight were found to be comparable in all the three groups. Statistically significant rise in sensory blockade was noticed, following administration of epidural drugs [in Group A and Group B] significant higher in group A as compared to those in group. Also it was found that time taken to achieve maximum level of sensory blockade after epidural top-up in group A was greater than that of group B which was found to be statistically significant.

Conclusion: The extension of sensory blockaded induced by an epidural top-up with a local anesthetic in CSF appears to be effected by a dual mechanism. The initial rapid increase was caused by a combination of volume effect and local anesthetic itself. The local anesthetic acts over a longer period of time which explains the prolonged but less rapid increase in level of sensory blockade in the later stages.

Keywords: Bupivacaine, Local Anesthesia, Epidural Phase.

Introduction

Bupivacaine is a long-acting local anesthetic. Addition of epinephrine is thus rarely required. It blocks initiation and transmission of nerve impulses at the site of application by stabilizing the neuronal membrane. The compound is ultimately metabolized in the liver. Depending upon the site of injection and the concentration used, anesthesia usually lasts 2-4 hours. Spinal anesthesia should be attempted only by a person fully trained in the technique and competent to treat possible complications. A "heavy" solution (0.75% bupivacaine in 8.25% glucose) will provide the muscular relaxation required for abdominal surgery. Full aseptic technique must be employed for the injection and the patient must be appropriately tilted to ensure safety and the required level of analgesia.[1]

Bupivacaine hydrochloride is 1-Butyl-2, 6-pipecoloxylidide monochloride, monohydrate, a white crystalline powder that is freely soluble in 95% ethanol, soluble in water, and slightly soluble in chloroform or acetone. The onset of action with bupivacaine is rapid and anesthesia is long-lasting. The duration of anesthesia is significantly longer with bupivacaine than with any other commonly used local anesthetic. It has also been noted that there is a period of analgesia that persists after the return of sensation, during which time the need for strong analgesics is reduced.[2]

Epidural and spinal anesthesia are major regional anesthesia techniques, having much potential advantage over general anesthesia, especially for surgery involving the lower abdomen perineum and lower extremities. However both the technique has disadvantages too: Spinal anesthesia is easy to perform and has rapid onset of action, requires small doses of local anesthetic, gives good muscle relaxation and has reliable surgical anesthesia. The combined spinal epidural technique was introduced by Brownride in 1981[3] to exploit the advantages of epidural and spinal block. He used this technique for caesarean section. He used two separate interspaces. A modification of the technique for orthopedic surgery was reported by Coates[4] and Mumtaz et al[5] in 1982. They used the single space, needle through needle technique, in which a 16 gauge tuhoy epidural needle served as an introducer for a fine 27 G spinal needle. Bromage PR[6] carried out a series of segmental block in the mid-thoracic region by putting mid-thoracic epidural catheters and observed the lower limb reflexes in these patients. In every case, some signs of upper motor neuron involvement appeared within 10-30 min as manifested by increased intensity of knee jerk, ankle clonus and positive Babinski. This strongly suggests penetration of the drug in the subarachnoid space and blockade of the descending pathways. Shah JL[7] measured the pressure in the epidural space with a water manometer in 40 women receiving epidural analgesia for pain relief in labor. He measured cerebrospinal fluid pressure. Injection of a small

volume of fluid in the epidural space produced a positive pressure in all subjects (Range 6.5 to 20 cm H_2O). Pressure varied with posture, respiration, cough and jugular venous compression. He also noticed the variations in the cerebrospinal fluid pressure, parallel to epidural pressure. Peter Brownride[3] introduced combined epidural and spinal analgesia for elective caesarean section. He used to pass an epidural catheter through the upper space and give spinal anesthesia through the lower interspaces. In case of inadequate level of anesthesia from spinal anesthesia, epidural local anesthetics were given to extend the block and were used for continued post-operative analgesia through the catheter. This was found to be very useful in cases of caesarean section. Coates MB[4] applied single space technique of combined epidural and subarachnoid technique using 26 G spinal needle passed through the 16 G epidural needle after confirmation of the epidural space. This technique enables good muscle relaxation and adequate anesthesia with rapid onset of action in cases of lower limb and hip surgeries. In the same year, Mumtaz, Marius and Mariankuz[5] reported that the use of the single space technique gave good muscle relaxation for orthopedic surgeries of the lower limbs, with prolongation of anesthesia through top up doses.

Local anesthesia may be produced by many tertiary amine bases and certain alcohols. All clinically useful agents are either amino-esters or amino-amides. Local anesthetic may provide analgesia by topical application, injection in the vicinity of nerve and instillation within the epidural or subarachnoid spaces.[8] It causes vasoconstriction at lower concentrations and vasodilatation at higher concentration. The regional effect is vasodilatation in the area supplied by blocked sympathetic nerves. It produces sedation and light headedness while sometimes anxiety and restlessness occur. Inhibitory neurons have proved more susceptible than excitatory.[9] Experimentally local anesthetics possess a weak blocking action on cholinergic and adrenergic receptors. The former may account for a bronchodilator effect.[10,11] Hypersensitivity[10] can occur due to membrane stabilizing action in individuals. It is more frequent with ester than amides. It may manifest as local edema, generalized urticaria or as angio-neurotic edema. Anaphylaxis is less common than atopic reaction. Amide local anesthetics are not highly antigenic, through true hypersensitivity to lignocaine and bupivacaine has been reported. The physiological response to local anesthetics is due to autonomic blockade, abolition of somatic pain reflexes, and motor blockade.[12] Sympathetic blockades on an average are two to six segments higher than sensory blockade.[13]

Factors affecting spinal and epidural Blockade: Volume and concentration of local anesthetic: The greater the dosage and concentration, higher is the block and longer it will last. If a fixed amount of drug is given in different volumes the effect is identical but if increasing volumes are given of fixed concentration the spread is more. Posture: the level of analgesic with hypo or hyperbaric spinal analgesia can be controlled by posture. Site of injection: lower space for lower block and higher for higher block.

Age:[10] dose required per segment dropped steadily from the age of 20 years onwards.

Height: for local anesthetic epidurally, height increases the dose requirement.

Pregnancy and intra-abdominal tumors: due to infection vena caval compression, venous return from lower part of the body may be diverted to the vertebral and epidural venous plexuses. Distension of epidural veins will cause extensive epidural spread of local anesthetic: Brabotage: with barbotage, spread increases, level of action is unpredictable. Path specific gravity of the solution: hyperbaric solution spreads according to the gravity and hypobaric solution spreads against gravity. Nerve root size: the S1 root, outstanding thickest; can be resistant to block by epidural route.

This study was undertaken to Study Effectiveness of 0.5% Bupivacaine for Sensory Blockade as Local Anesthesia in Epidural and spinal Phase.

Methodology

After obtaining local ethical committee approval and informed consent a total number of 60 patients were posted for orthopedic lower limb surgery, under combined spinal epidural. These patients were included in the study. They were divided into three groups of twenty patients each randomly. All cases were of the ASA I and ASA II in the age group of 18 to 60 years and randomly grouped into A, B and C each including 20 cases. Patients with cardio-vascular, respiratory disease and with spinal deformities and coagulopathies were excluded from the study. The onset time of maximum sensory blockade was defined as the time from sub-arachnoid injection to the time where the maximum level of sensory blocked was first recorded. When the aspiration of the epidural catheter, patients in,

Group A: Epidural top up with 10 ml bupivacaine 0.5%.

Group B: Epidural top up with 10 ml saline.

Group C: served as a control and received no injection epidurally, but epidural injection was simulated by manipulating the epidural catheter. After epidural injection of drug, time was designated as T=0. Then sensory blockade was measured every five minutes with pin-prick for the next 30 minutes. The onset time of maximum sensory blockade during this place was defined as the time from t=0 to the time when the maximum level of sensory blockade was first recorded and recording was continued till one hour.

Data was recorded for each patient from time to time as per the study parameters. The data was entered in the Microsoft Excel Worksheet and analyzed using means and standard deviation. Student's t test was used

to test the significance. P value of < 0.05 was considered as significant.

Result

Table 1: Age, height, weight distribution of study subjects

	Group A	Group B	Group C	P
Mean age (years)	37.45±10.24	37.60± 10.16	38.68±10.68	NS
Mean height (cm)	164.35±3.64	166.05±5.23	164.60±3.44	NS
Mean weight (kg)	64.80± 7.48	64.80±7.55	64.84±7.22	NS

NS = Not statistically significant

The observed data were analyzed statistically. The physical characteristics such as age, height, weight were found to be comparable in all the three groups.

Table 2: Mean maximum level of sensory blockade in epidural phase

	Group A (n=20)	Group (n=20)	Group (n=20)	P
Mean maximum sensory level	18.0±2.1	16.5±3.7	15.25±2.6	
Onset time in minute	18.75±3.93	9.41±3	-	P < 0.001
Segment increase spinal epidural phase	4.6±1.31	2.1±1.6	0.3±1.6	P < 0.001

The maximum level of sensory blockade following subarachnoid injection of 10 mg bupivacaine heavy (0.5%) and the time taken to achieve the same in all the three groups are shown in Table 2. Statistically significant rise in sensory blockade was noticed, following administration of epidural drugs [in Group A and Group B] significant higher in group A as compared to those in group**.** Also it was found that time taken to achieve maximum level of sensory blockade after epidural top-up in group A was greater than that of group B which was found to be statistically significant.

Table 3: Mean maximum level of sensory blockade in spinal phase

Spinal Phase	Group A (n=20)	Group B (n=20)	Group c (n=20)	P
Maximum level	13.4±2.4	14.35±3.1	14.95±2.6	NS
Onset time in minute	14.75±3.02	15±3.24	15±3.24	NS

Segments counted from S-5 to T-1, taking sacral segment as number 1. NS=Not statistically significant. As seen in the data, no statistically significant difference could be observed between the three groups. After establishment of the maximum level of sensory blockade [defined as (i) no further increase during three consecutive measurement and (ii) >20 minutes after subarachnoid injection] with subarachnoid bupivacaine. Epidurally group A, group B and group C received 10 ml bupivacaine 0.5% 10 ml normal saline and no drug respectively

Discussion

In the present study, after obtaining the approval of the ethical committee of the institution, a total number of sixty patients posted for orthopedic lower limb surgeries were selected. All the patients were of physical ASA I and II status.

Patients in the age group of 18-60 years were selected to counter difficulties in comparison which might give spurious findings. In patients below the age of 18 years there is a wide range of variations in height and weight affect drug dosage and other factors. Also above the age of sixty years dosage of the drugs reduces considerably due to senile changes and high residual epidural pressure.[(5)]

In the present study, there were no statistically significant differences among the three groups regarding age, height and weight.

After the epidural top-ups (epidural phase) the level of sensory blockade increased in all the patient of group A and B. In group A the average maximum increase was 4.6 ±1.31 segments ($p < 0.05$ versus spinal phase).

In the present study, the epidural injection of either bupivacaine 0.5% or saline resulted in a significant increase in the maximum level of sensory blockade.

The epidural injections were administered after the achievement of maximum sensory blockade of the spinal phase. So the significant after segmental sensory blockade increase that was observed in group B, after epidural normal saline is most likely explained by a volume effect as already suggested by Brown DR et al[(14)] and Stienstra R et al[(15)] also, the work done by Atkinson RS et al[(13)] seems to be supportive of this proposition. They had demonstrated that after epidural injection of saline procedure, there is a short lasting increase in epidural and subarachnoid space pressure. The average segment blockade increase in group C was 0.3±0.8 which is statistically non- significant.

Conclusion

The extension of sensory blockaded induced by an epidural top-up with a local anesthetic in CSF appears to be effected by a dual mechanism. The initial rapid increase was caused by a combination of volume effect and local anesthetic itself. The local anesthetic acts over a longer period of time which explains the prolonged

but less rapid increase in level of sensory blockade in the later stages. In the spinal phase all the three routes were having similar blockade effect it seems that the effect mostly attributed due to volume effect rather than drug.

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