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The lower effective dose of isobaric bupivacaine spinal anesthesia with least level motor block for perianal surgery

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Abstract

***Background and objective:** Spinal anesthesia is type of regional neuraxial anesthesia that is used for lower abdominal, lower limb, and perianal surgeries. The aim of this study is to evaluate the lower effective isobaric bupivacaine dose in spinal anesthesia for perianal surgery that produces the least level motor blockade.

*** Patients and methods:** Fifty-seven patients were enrolled in this study in Baqubah Teaching Hospital between 10th of February 2017 to 15th of September of the same year, all of them underwent perianal surgeries under spinal isobaric bupivacaine anesthesia. They were classified into three groups according to isobaric bupivacaine dose from 10 mg (2 ml) to 5 mg (1 ml) by decreasing 2.5 mg (0.5 ml) in each group. Lumbar puncture was done at the L4-L5/L5-S1 midline intervertebral space with spinal needle G22 Quincke type and isobaric bupivacaine dose was injected in sitting position then immediately turned the patient to supine positioin. A successful block was defined as one that was sufficient to proceed with surgery without any supplementation other than premedication.

***Results:** Different doses of isobaric bupivacaine spinal anesthesia result in different levels of spinal blockade(sensory and motor) which proportionates directly to the dose, while 10 mg isobaric bupivacaine causes spinal blockade up to T12 dermatome, 5 mg dose causes blockade just to L3 dermatome in most cases. 5 mg isobaric bupivacaine spinal anesthesia provides adequate surgical analgesia , good muscle relaxation, absence of reflexes to surgical stimuli with least level motor spinal block over sacral nerves that innervate perianal area.

Conclusion: 5 mg isobaric bupivacaine is the lower effective dose in spinal anesthesia that provides good operating conditions, rapid recovery, early discharge, no postoperative anesthetic complications with most lower level motor blockade.

Keywords: isobaric bupivacaine, spinal anesthesia, perianal surgery

Introduction

Spinal anesthesia offers distinct advantages over general anesthesia, minimal airway manipulation, forbearance of anesthetic drugs with cardiopulmonary depression, decreased postoperative nausea and vomiting, superior postoperative pain control, and reduced intraoperative and postoperative narcotic requirements responsible for causing postoperative pulmonary complications continue to uphold spinal blockade as a preferred anesthetic for compromised individuals**(1).** Spinal anesthesia is generally suitable for surgical procedures involving the lower abdominal area, perineum, and lower extemeties **(2).** Local anesthetic solution injected into the intrathecal space impedes conduction of impulses along all nerves it comes in contact with including motor, sensory, autonomic**.** An optimal anesthetic would provide excellent operating conditions, rapid recovery, early discharge, no postoperative side effects, and high patient satisfaction, in addition to the high quality and low costs of the anesthetic services(3). Peri-analsurgeries are commonly performed on day care basis under saddle block anaesthesia. To reduce hospital stay, anesthetic medications should be kept at minimum possible level which permit early mobilization without pain and residual complications of anaesthesia. Although saddle blocks at different low doses of bupivacaine have been used previously for minor perianal surgeries (4,5,6)., the optimal effective dose is yet to be determined

Patients and Methods

This study was carried out in Baqubah Teaching Hospital between 10th of February 2017 to 15th of September of the same year and informed consent was obtained from all patients about spinal anesthesia for their surgeries. Total fifty-seven patients from either sex , with ASA (American Society of Anesthesiologist) physical status 1, 2 aged between 17 and 72 years prepared for perianal operations: hemorrhoidectomy, fistulectomy, fissurect- omyand perianal abscess drainage were enrolled in this study.

Exclusion criteria

included patient's refusal to participate in the study, coagulopathy, anticoagulation therapy, presence of cutaneous infection at the site of the planned puncture, or systemic infection, untreated hypovolemia, progressive cardiomyopathy> class III, chronic renal failure receiving hemodialysis, peripheral neuropathy, autonomic dysfunction, history of lumbar surgery making needle puncture impossible, grossly deformed vertebral column, increased intra-abdominal girth secondary to an expanding tumor, a mass or ascites, pregnancy, and allergy to local anesthetics. Those patients were divided into 3 groups according to given dose of isobaric bupivacaine(0.5%) intrathecally. Group H: received high dose (10 mg), Group M: received medium dose(7.5 mg), Group S: received smallest dose(5mg).After monitoring, pre anesthetic hydration which consisted of 10mL/kg of a crystalloid solution was infused over 20–30min via a 18-gaugecannula.

1 to 2 mg of midazolam was given intravenously as a premedication. Soon after proper sterility and disinfection, dural puncture was performed using midline approach in the sitting position, in the L4-5 or L5-S1 interspace with G 22 Quincke spinal needle (G 25 spinal needle carries low risk for post lumbar puncture headache but it is not available in my hospital due to unstable conditions in our country) with the tip heading toward the head (cephalad). A clear-constant flow of cerebrospinal fluid (CSF) leakage from spinal needle indicates a correct position of needle tip in the subarachnoid space. In all patients, 0.5% isobaric bupivacaine dose was injected with barbotage in the speed of 0.2 mL/sec. Immediately after the injection, the patients were turned back to the horizontal supine position and a pillow was placed under the head. Analgesia, defined as the loss of sharp sensation to pin prick with the blunt tip of 27-guage short needle at the midclavicular line beginning from the feet in cephalad direction bilaterally was assessed every 2 minutes until onset of surgery. The onset of analgesia was defined as the time to achieve the highest sensory block. Monitoring of sensory block postoprtatively was done every 5 minutes until discharge from the recovery unit and every 15 minutes until two segments regression from the maximum block. Motor blockade of the lower limbs was assessed on the Bromage scale: 0=no paralysis(full flexion of knees and feet),1=inability to raise the extended legs(just able to move the knees),2=inability to flex the knees(able to move feet only),3=inability to flex ankle joints (unable to move the knees or feet)(7). Assessment of motor blockade was recorded 5 minutes after the patient was placed in the supine position, then every 10-minutes intervals.

Results

A total patients were fifty-seven, 3 patients were dropped from the study because of failure of block and conversion to general anesthesia, a remaining patients underwent perianal surgeries:hemorrhoidectomy 33(61.1%), fistulectomy 10(18.5%), fissurectomy 6(11.1%), drainage of perianal abscess 5(9.2%) (*Table 1*), under spinalanesthesia they received different doses of isobaric bupivacaine 0.5% then onset, duration of sensory and motor block for each dose were recorded, maximum level of spinal block over sacral nerves also was written down.

Table(1):Distribution of cases according to operations and gender

Operations	Total No.	Male		Female	
		No.	%	No.	%
Haemorrhoidectomy	33/54(61.1%)	28/33	84.8	5	15.5
Fistulectomy	10/54(18.5%)	9/10	90	1/10	10
Fissurectomy	6/54(11.1%)	6/6	100	0	0
Perianal absecess drainage	5/54(9.2%)	4/5	80	1/5	20
Total	**54/54**	**47/54**	**87.03**	**7/54**	**12.96**

Sensory and Motor Blockade:

The measured sensory blockade and motor blockade are the onset and duration (*Table 2).* The onset of sensory blockade was significantly faster in Group H (1 min.) when compared to Group M (2 min.) and Group S (3 min.).Duration of sensory block was the time measured from the time of highest block to the regression of two dermatomes, which is significantly longer in Group H (100 min.) compared to Group M (95 min.) and Group S (90 min.). The onset of motor block was little bit faster in Group H (2 min.) than Group M (4 min.) or Group S (7 min.), while the duration of motor block, the time measured from the achievement of Bromage 1 until regression to Bromage 0, was longer in Group H (192 min.) when compared to Group M (145 min.) and Group S(120 min) ***(Table 2)***. Cephalad spread of sensory blockade, assessed by pinprick, was higher with Group H (T12-S5 55.5%) than Group M (L2-S5 44.4%) or Group S (L3-S5 66.6%). The highest level of dermatome block was in T12, while the lowest was in L 3. More patients in Group H had sensory block at T12 than in Group M (L2) and Group S (L3). The majority of blocks level was in T12, L 1 in Group H, while Group S produced lower blockade (L 3) ***(Table 3)***.

Table (2):Distribution of cases according to block characteristics

Onset(min.)		**Group H**	**Group M**	**Group S**
	Sensory	1	2	3
	motor	2	4	7
Duration(min.)	Sensory	100	95	90
	motor	192	145	120

Table(3):Distribution of cases according to level of block

Groups	Level of block			
	T12-S5	**L1-S5**	**L2-S5**	**L3-S5**
Group H	10/18(55.5%)	5/18(27.7%)	2/18(11.1%)	1/18(5.5%)
Group M	5/18(27.7%)	3/18(16.6%)	8/18(44.4%)	2/18(11.1%)
Group S	1/18(5.5%)	2/18(11.1%)	3/18(16.6%)	12/18(66.6%)
Total	**16**	**10**	**13**	**15**

Adverse Events.

There were several hypotensive events within 5 to 20 minutes after the injection of local anesthetic solution, which are comparable in three groups, and were not clinically significant responded just to I.V. crystalloid fluids.

Hypotension occurred more in patients of Group H (12%) than Group M (23%) or Group S (1%), while the other adverse events (bradycardia and nausea) are comparable for all groups. Post puncture headache occurred in one patient of Group H (0.01%) and he was responding to rest, hydration and caffeine-containing analgesia ***(Table4).***

Table(4):Distribution of cases according to adverse effects

Side effects	Group H	Group M	Group S	Total
hypotenion	12/18(66.6%)	8/18(44.4%)	3/18(16.6%)	**25**
bradycardia	10/18(55.5%)	6/18(33.3%)	2/18(11.1%)	**18**
nausea	2/18(11.1%)	1/18(5.5%)	1/18(5.5%)	**4**
Postpuncture headache	1/18(0.05%) 1/54(0.01%)	0	0	**1**

Discussion

This study was performed to compare different doses of spinal isobaric bupivacaine which provides adequate anaesthesia and reduces the time of stay at hospital. Very low doses may be associated with poor anaesthesia and patient discomfort during surgery. On the other hand, high doses of bupivacaine are associated with dense motorblock, prolonged recovery and urinary retention and can reduce patient satisfaction**(8).** Bupivacaine is the most commonly used local anaesthetic for spinal anaesthesia (SA).There are two forms of commercially available bupivacaine; isobaric bupivacaine (IB): a formulation with a specific gravity or density equal to cerebrospinal fluid, and hyperbaric bupivacaine (HB): a formulation with density heavier than cerebrospinal fluid. Our study showed that 5 mg isobaric bupivacaine is the lower effective dose of spinal anaesthesia with least motor block for perianal surgery. In other study published in Ain-Shams Journal of Anesthesiology2015, 08:265–268Roshdi R Al-Metwalli showed that the minimal effective dose of spinal hyperbaric bupivacaine for saddle block for perianal surgery in50% (ED50) of patients is 1.9 mg, but in this study there is two differences from our study 1st is use hyperbaric bupivacaine rather than isobaric, 2nd is keeping all patients in sitting position for 10 min. after injecting the spinal dose while in our study all patients immediately turned to horizontal position**(9).**Our study also showed that isobaric bupivacaine produced more rapid onset of anesthesia and longer duration of action when compared to hyperbaric bupivacaine) which is consistent with previous studies**(10, 11,12, 13, 14).** Spinalanesthesia (SA) allows for an effective intraoperative anaesthesia with good surgical conditions for surgeries on the lower abdomen, pelvis, lower extremity and perianal areas.SA is performed by injecting a local anaesthetic (LA) into the cerebrospinal fluid(CSF) in the subarachnoid space. This produces a rapid onset, intense, sensory and motor blockade, as well as sympathetic blockade. It is a simple technique that requires a small dose of local anesthetic to provide surgical anesthesia which produces rapid, intense and reliable block without missed segments **(15).** Bupivacaine is a local anesthetic that is largely used for spinal anesthesia, mainly as a hyperbaric or plain (isobaric) solution **(16,17,18).**

The diffusion pattern determines the effectiveness, spread (dermatome height or block height) and side-effect profile of bupivacaine**(19).**Several trials have shown that hyperbaric bupivacaine (HB) appears to cause more predictable sensory blockade than isobaric bupivacaine (IB)**(20).** On the other hand, IB has been found to produce a longer duration of SA**(21,22).** The ideal local anesthetic solution for intrathecal use has rapid onset and reliable duration, with less incidence of adverse events. Selective spinalanesthesia (spinal block with minimal effective doses for a specific type of surgery) has become a very popular technique **(23).** for some orthopedic and gynecological surgeries**(24-30).** Controversy exists regarding the predictability of the levels of analgesia achieved with isobaric solution when compared to hyperbaric. Virtually local anesthetics used for spinalanesthesia are mostly available as hyperbaric solutions and it is well established that the addition of dextrose to increase the specific gravity of the solutions alters the anesthetic profiles. Position of the patient and baricity or density of the local anesthetic solution injected as determinants of distribution are so closely related that one cannot be discussed without the other. Barbotage (mixing of CSF with local anesthetic before injecting to subarachnoid space) has the advantage of shortening time for spread to highest dermatome and the time for to onset of complete motor block. The sitting position is frequently used for induction of spinal anesthesia. Hyperbaric solutions, under the influence of gravity, would be expected to spread caudally, whereas isobaric solutions would be expected to distribute rostrally.

Density varies inversely with temperature. The actual change in density with temperature cannot be predicted with different solutions. The temperature of local an aestheticrapidly equilibrates with the core temperature of the CSF(37-38°C). In order to determine accurately the baricity that dictates the spread of local anaesthetic, the density of CSF and the density of the local anaesthetic must be measured at37-38∘C. In determining whether to use this type of neuraxial anesthesia, a couple of vital factors influencing the distribution of a spinal anesthetic must be examined (ie, baricity of the local anesthetic and patient position during and post subarachnoid injection). These, in congruence with the clinical circumstance, and in combination with an individually tailored anesthetic goal, may govern whether a spinal anesthetic is appropriate. Based on the principle of the uptake of spinal anesthetics being greatest at the area of highest concentration in the cerebrospinal fluid, and decreased caudal and cephalad respectively, the amalgamation of baricity of the local anesthetic solution and patient position determine allocation of the spinal blockade . By selecting local anesthetic of appropriate density relative to the position of the patient, the dispersion of anesthesia can be controlled. Baricity possesses an important role in predicting the movement of a local anesthetic solution in the subarachnoid space and is equal to the density of the local anesthetic divided by the density of the cerebrospinal fluid at 37°C. Also, rooted in the basic law of gravity, physical arrangement will influence dissemination of the local anesthetic as well. A delicate patient population with various comorbidities may not have the physiologic capability or tolerance for remaining stable in a particular position for an extended period of time. This could present difficulties with using a spinal anesthetic in an otherwise appropriate patient and procedure. Fortunately, in instances when intrathecal block is deemed the safest anesthetic option, the positioning challenges could potentially be overcome by the use of an isobaric spinal solution. The baricity of an isobaric solution is equal to 1.0 and patient posture does not affect the expansion of the local anesthetic. Injection can be administered in any position, and following injection, the patient may remain in the original stance for the duration of the surgery. Unlike with hypobaric (density less than CSF density) or hyperbaric local anesthetics, gravity does not play a role in the spread of isobaric solutions. Thus, an isobaric spinal blockade may indeed prove to be an advantageous approach for a patient wit hlow biological endurance with regard to remaining fixed in a specific position throughout the course of surgery. An ideal anesthetic technique for anal surgery on an outpatient basis should permit early mobilization without pain or residual complications of anesthesia.

Nerve supply to anorectal area (31, 32, 33 ,34)

Nerve supply is mixed, somatic and autonomic, common with other pelvic structures. Sympathetic supply comes from sympathetic chain to hypogastric plexus (getting branches from L1–L5) and celiac plexus(Th11–L2), and sympathetic nerves proceed to pelvic plexuses. Parasympathetic supply comes from ventralrami of S2–S4 and forms the pelvic splanchnic nerves. These join the sympathetic plexuses to then relay in tiny end – organ ganglia. Functionally, parasympathetic fibers provide rectal and bladder motor function, inhibit sphincteric muscle and cause genital vasodilatation. Sympathetic fibers inhibit visceral motor function and provide contraction of sphincteric muscle. Somatic nerve supply to the pelvic floor and external sphincters comes from sacral plexus (L4–L5 and S1–S4 segments). Coccygeal zone gets nerve fibers from S4, S5 and Co1**.**Peri-anal surgeries are commonly performed on day care basis under saddle block anaesthesia. To reduce hospital stay, anesthetic medications should be kept at minimum possible level which permit early mobilization without pain and residual complications of anaesthesia. Studies show that short peri-anal surgeries can be performed successfully at low doses . Low intrathecal dose causes confined blockade, less hemodynamicin stability, less chances of post operative shivering and urinary retention. As a result patients stay for less time in recovery room and can be discharged without fear of complications**.**

Conclusion

Low dose spinal saddle block anesthesia(5mg) in our study offers definite anesthesia for perianal surgeries with paralysis of the anal sphincter making anal dilatation more easy for the surgeon, and partial lower limb paralysis so as patient can move himself with little assistance, or appreciable drop in systolic blood pressure from baseline. It has high levels of patient cooperativeness and willingness to do operation.

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