Research Article

Reversal of Bupivacaine 0.5% Epidural Anesthesia Using Epidural Saline Washout

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Abstract

Background: Prolonged motor and sensory block following epidural anesthesia has been associated with patient dissatisfaction. Administration of epidural crystalloids in patient who had received bupivacaine 0.75% and lidocaine 2% epidural anesthesia. However, bupivacaine 0.5% is commonly used in our institutional and the effectiveness of bolus of NS in non-obstetrical patients undergoing 0.5% bupivacaine epidural anesthesia has not been investigated. The objective of this study was to determine the relationship of normal saline (NS) epidural flush volume to the recovery of motor and sensory block and its hemodynamic stability (blood pressure and heart rate) in non-obstetrical patients undergoing epidural anesthesia using 0.5% bupivacaine. **Methods**: Following surgery, subjects with T6 dermatome level of sensory, were randomized to 2 treatment groups. Group 1 (control, n = 11) received 1-mL epidural normal saline (NS). Group 2 (experimental, n = 11) received an epidural bolus of 30-mL NS. Assesment of motor and sensory block was performed at 15-minute intervals until complete motor and sensory recovery. Hemodynamic stability (blood pressure and heart rate) between two groups were also monitor every 15-minutes and determined. **Results**: Times to full motor recovery were significantly faster in the epidural bolus of 30-mL groups than in the control group (69 ± 19.66 vs 95 ± 11.83; p = 0.0017).). **Conclusions:** A more rapid recovery of motor block in patients undergoing 0.5% bupivacaine epidural anesthesia can be achieved with the use of 30-mL NS epidural washout, with hemodynamic stability.

Keywords: Anesthesia techniques, Epidural, Local anesthetic, Bupivacaine 0.5%, Reversal.

INTRODUCTION

Epidural anesthesia offers many potential advantages compared with general anaesthesia in numerous surgical procedures. A major disadvantage of this technique is the time necessary for postoperative recovery of motor and sensory function. Improving patient acceptance of epidural anesthesia by allaying fears of prolonged motor and sensory block may be attainable by increasing the speed of recovery from epidural anesthesia.

Neural block in vitro can be readily reversed by washout of local anesthetic from isolated nerve preparations using crystalloids.[1] In vivo, reversal of bupivacaine epidural anesthesia in obstetrical patients using intermittent epidural boluses of Ringer's Lactate (RL) or 0.9% Normal Saline (NS) resulted in shortened motor block without changes in sensory block.[2] A more rapid recovery of motor and sensory block in gynecologic or obstetrical patients undergoing 2% lidocaine with epinephrine epidural anesthesia can be achieved with 30 mL NS epidural washout.[3] Rapid recovery of motor and sensory block in outpatient patients undergoing 2% prilocaine epidural anesthesia may be achieved by an epidural washout with either bolus or infusion of 45 mL NS or RL.[4]

Thus, studies have shown benefits of epidural washout with crystalloid boluses or infusion, but the effectiveness of bolus of NS in non-obstetrical patients undergoing 0.5% bupivacaine epidural anesthesia has not been investigated. We designed this study to determine the relationship of the epidural NS bolus to the recovery of motor and sensory block and hemodynamic stability (blood pressure and heart rate) in non-obstetrical patients undergoing epidural anesthesia using 0.5% bupivacaine.

Johnson et al were the first to demonstrate that epidural motor block could be reversed by epidural injections of crystalloid solutions (RL and NS). Their study of 27 obstetrical patients undergoing epidural anesthesia with 0.75% bupivacaine for elective cesarean section delivery, three 15-mL crystalloid solution boluses each separated by 15 minutes were administered postoperatively. Times to regression of sensory and motor block in treated subjects were compared with control subjects. There was no difference in dermatomal sensory regression time among groups. However, full motor function recovery of the lower extremities took twice more faster in the crystalloid groups than in the control groups (RL = 84 ± 44 min, NS = 70 ± 38 min, control = 178 ± 70 min; P = 0.01) .

Brock-Utne et al further demonstrated not only epidural NS following epidural anesthesia could result in faster motor function recovery, but a more rapid motor recovery of the lower extremities resulted in shorter PACU stay with a potential for positive economic impact. Twenty subjects undergoing elective knee arthroscopy in an ambulatory surgical setting received epidural anesthesia with 2% lidocaine without

epinephrine. Subjects were randomized to receive either 1 mL or 20 mL of NS epidural bolus following surgery. Patients receiving 20 mL epidural NS experienced significantly faster motor function recovery (83 ± 8 min vs 110 ± 8 min; P < 0.01). Additionally, patients who received 20 mL epidural NS were discharged from the surgical facility an average of 40 minutes earlier than control group patients, result in potential institutional savings of $25.30 per patient. [5]

Using a dose-response, cross-over study design in eight volunteer subjects, Chan et al evaluated the effects of 1, 20, and 40 mL NS epidural flush volume on recovery from 2% plain lidocaine epidural anesthesia. Their data showed that epidural administration of 40 mL NS facilitated recovery of both motor and sensory block, whereas an NS volume of 20 mL did not (P = < 0.05).

METHODS

1. Study design.

This study was an experimental research type with randomized controlled group design.

2. Population and Sample

To ensure 80% power at p=0.05, we prospectively enrolled 22 adult patients. All female, American Society of Anesthesiologist (ASA) physical status I or II, adult patients (aged 18-65 years old) who underwent lumbar epidural anesthesia for elective gynecologic procedures. Patients were required to be able to understand the possible local anesthetic-related complications and study protocol.

Exclusion criteria included any contraindication to epidural anesthesia block, pregnant patient, morbid obese (BMI > 40 kg/m^2), last intact sensory blockade below T6, postoperative hypotension (BP ≤ 20% of baseline)

Anesthesia plan (epidural anesthesia) and postoperative saline washout were explained and a written informed consent was obtained. Epidural anesthesia was produced with 0.5% Bupivacaine (Astra USA, Westborough, MA). The epidural bupivacaine was administered in sufficient volume to obtain an analgesic level to T4 in all subjects.

At the conclusion of surgery, only those with a last sensory level at T6 dermatome were included. For patients whose last sensory block was at the T4 dermatome, regression to T6 sensory level will be awaited prior epidural saline flush. All of 22 subjects were included and randomized into 2 groups. Using a table of random numbers, each subjects was randomly assigned to receive a bolus of 1mL (n = 11) or 30 mL (n = 11) of normal saline at a rate of 10 mL/min during the two study periods. To ensure proper blinding of both subjects and investigators, the saline syringes were masked by a towel during injection.

3. Study Variable

Variable dependent: flush epidural with 1 ml or 30 ml normal saline.

Variable independent: time to resolution of motor block, time to

resolution of sensory block, hypotension and bradycardia

4. Operational Definition Of Variable

The level of motor block of the lower extremities was assessed using a modified Bromage scale for motor block in the lower extremities (3 = complete motor block; 2 = hips and knees blocked with intact ankle flexion; 1 = hips blocked with intact knee and ankle flexion; 0 = intact hip, knee, and ankle flexion). When there was a difference between extremities, the extremity with the higher Bromage score was reported.

Bilateral dermatomal sensory level was assessed using sensation to pinprick. The time will be measured from the time of epidural flush administration, until sensory recovery to the S2 dermatome and motor recovery to modified Bromage score 0. Hypotension was defined as a decrease in systolic and/ or diastolic blood pressure by greater than 20 mmHg. Bradycardia was defined as a heart rate less than 50 beats per minute.

5. Study Instruments

Assesment of motor block, sensory block, blood pressure and heart rate were performed in the PACU at 15-minute intervals following completion of epidural washout by an independent investigator blinded to subject group assignment.

6. Data Analysis

Data analysis was performed using STATA version 9 statistics program. Dispersion of sensory and motor resolution was determined using Mann-Whitney test. Blood pressure and heart rate were determined using Mann-Whitney test and Fisher's exact test. A p value < 0.05 was considered to be statistically significant.

RESULT

There were no significant differences in subject demographic and clinical data between the 2 groups with respect to weight, height, surgical time, total volume of bupivacaine use, time from final bupivacaine administration to NS washout (Table 1). Mean age of subjects receiving epidural NS 30-mL vs control group was 48.55 ± 2.04 vs 40.27 ± 1.80. Using t-test, there is sufficient evidence to conclude that there is significant difference in mean age between 2 groups with p = 0.0065.

Table 1.Subject Demographic and Clinical Data

	Groups		
	Control (n = 11)	NS 30-mL (n = 11)	P-value
Age (yrs)	48.55±2.04	40.27±1.80	0.0065

Weight (kg)	57.63±3.61	55.18±6.62	0.293
Height (cm)	156.09±3.36	156.45±3.17	0.7968
ASA I/II	4/7	2/9	
Hypertensive			
Yes	4 (36.36%)	2 (18.18%)	0.635
No	7(63.64%)	9 (81.82%)	
Surgical time (min)	166.36±54.64	177.73±67.87	0.7418
Total volume of bupivacaine (mL)	29.09±4.37	28.64±4.52	0.813
Time from final bupivacaine bolus to NS washout (min)	43.27±12.56	49.45±10.20	0.2352

NOTE. Data are mean±SD. Most all between group comparison are not significant, except age.

Abbreviation: NS, normal saline (0.9% NaCl).

Times to complete motor recovery were decreased in those subjects receiving epidural NS 30-mL compared with the control group. (Fig.1). Subject receiving epidural NS 30-mL achieved full motor recovery 26 minutes faster than control group subjects receiving epidural NS 1-mL (69 ± 19.66 vs 95 ± 11.83; p = 0.0017)(Table 2).

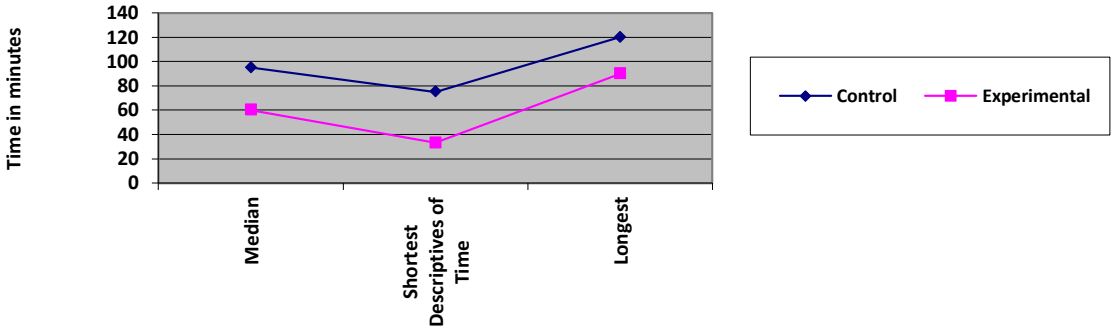

Figure 1. Time to Regression of Motor Block Between the Two Groups

Times to resolution of sensory block from the T6 dermatome to complete resolution of the sensory block did not differ between epidural NS 30-mL and control groups (142.36 ± 31.85 vs 154.55 ± 17.10; Fig.2). There is

no sufficient evidence to conclude that there is significant difference in dispersion of sensory resolution between the 2 groups with p = 0.2616 (Table 2). There is probably equal time of sensory resolution between the two groups.

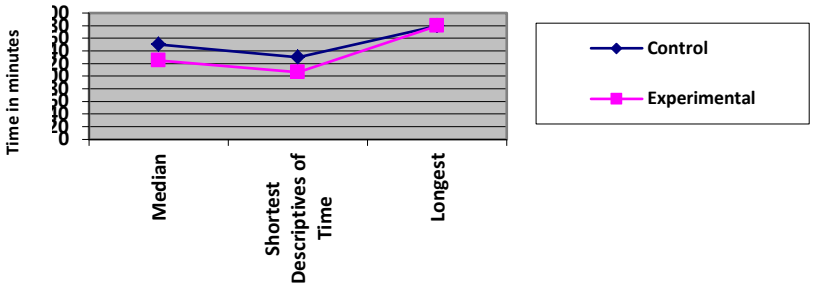

Figure 2. Time to Regression of Sensory Block Between the Two Groups

Table 2.Comparison of the Time Regression (in minutes) Between the Two groups

	Groups		P-value
	Control (11)	NS 30-mL (11)	
Sensory block			
mean±sd	154.55±17.10	142.36±31.85	0.2616
range	130-180	106-180	
median	150	125	
Motor block			
mean±sd	95.0±11.83	69.36±19.66	0.0017
range	75-120	33-90	
median	95	60	

There was 2 subjects (18.18%) with more than 20% decrease in systolic BP from baseline among those in subjects receiving epidural NS 30-mL. There is no one subject (0%) with more than 20% decrease in systolic BP from baseline among those in control group (receiving epidural NS 1-mL). There is no sufficient evidence to prove that there is statistical difference in the proportions of those with more than 20% decrease in systolic BP from baseline between 2 groups, with p = 0.238 (Table 3).

Table 3. Comparison of the Decrease in Systolic BP Between Two groups

	Groups		P-value
	Control (11)	NS 30-mL (11)	
With 20% decrease in systolic BP			
Yes	0 (0%)	2 (18.18%)	0.238
No	11 (100%)	9 (81.82%)	

No subjects had 20% decrease in diastolic BP from baseline between 2 groups and no subjects had bradycardia (HR < 50 bpm) following epidural saline flush between 2 groups. No subject develop complications from the epidural injection (i.e. headache, persistent back pain, nausea and vomiting).

DISCUSSION

Several studies have shown the benefits of epidural washout with boluses or infusion of crystalloids solution following epidural anesthesia using a short acting local anesthetic. Thus, we wanted to investigate the effectiveness of washout technique by bolus method following epidural anesthesia using a longer acting local anesthetic, 0.5% bupivacaine and to investigate its hemodynamic profile (Blood pressure and heart rate). This study demonstrates that epidural normal saline washout can be used to hasten the recovery of motor, without compromising sensory function following epidural anesthesia using 0.5% bupivacaine in a manner that is clinically significant. This is similar with study by Johnson et al that unwanted motor blockade due to epidural anesthesia can be reversed by epidural injections of crystalloid solutions (Johnson 1990).

The mechanism of altering neural blockade in epidural injection of crystalloid solutions has been defined previously. Intensity of epidural blockade may lessen because crystalloid solutions dilute local anesthetics in or adjacent to the epidural space, decreasing the concentration of unbound drug at neuronal sites of action. Dilute solutions of bupivacaine would be expected to more effectively block sensory than motor nerves, thereby resulting in preferential sensory blockade as observed in our study.

In contrast with our study, studies by Chan et al, Sitzman et al and Katircioglu et al, showed that sensory block regression could also be enhanced with epidural saline flush. The difference in the magnitude of effect is perhaps caused by the use of a shorter acting local anesthetic (lidocaine or prilocaine versus bupivacaine).

Saline injection into the epidural space appears to augment both secretion and clearance of CSF, and may therefore enhance elimination of

local anesthetic from the subarachnoid space.

In our study, 30-mL volumes of NS were given over 3 min, none complained of pain, stiff neck, or headache. This is similar to the experience with epidural blood patches, which involves injection of 15-20 mL of blood (less diffusible than NS owing to greater viscosity) over 1-2 min without complications related to pressurization of the epidural space. [6] and study by Chan et al, which involves injection of 40-mL of normal saline over 10-mL/min.[7]

There were no significant change in systolic, diastolic blood pressure and heart rate.

No complications were observed in our study. A potential problem with rapid fluid injection into the epidural space is that such injection can abruptly increase CSF pressure. [8][9] (Gissen 1985, Higuchi 2005), decrease spinal cord blood flow, increase intracranial pressure, and pose a risk of spinal or cerebral complications. Sudden increases in intracerebral pressure may cause headache, cerebral hemorrhage, or isolated hemorrhage in a small vessel, such as a retina vessel.[10] Headache is commonly reported if epidural solutions are injected rapidly (Clarket 1961). Rodriguez et al. reported 1 case of intracranial hypertension after the injection of 55 ml of saline into the epidural space. [11]

A potential limitation of this study is that there was a significant difference in mean age between 2 groups. This could be happened due to small sample size. A large sample size will provide a better randomization. Second limitation in this study is that the subjects were all gynecological patients, which need hospitalization. If rapid resolution of the motor and sensory block is an important clinical consideration, then why not use cases with shorter time procedure, like herniorraphy? Unfortunately, in our institution even patients who underwent short time procedure such as herniorraphy, would also be hospitalized despite the shortness of surgery, therefore, we used gynecological cases in this study.

CONCLUSION

Postoperative bolus injection of 30-mL normal saline via epidural catheter markedly shortened the duration of motor blockade resulting from epidural anesthesia with bupivacaine (0.5%) used for non-obstetrical procedure. Although these injections attenuated motor blockade, they did not significantly shorten duration of sensory anesthesia.

Hemodynamic profile (blood pressure and heart rate) were not significantly different with 30-mL or 1-mL injections of a crystalloid solution via epidural catheter.

RECOMENDATIONS

We would like to recommend: (1) a larger sample size to provide a

better randomization; (2) a study in outpatient procedure like herniorraphy; (3) a study about reversal of local anesthetic with morphine epidural anesthesia using crystalloids washout.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in this study.

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This study is self-funded.

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