

a clinical and pharmacokinetic comparison of ropivacaine and bupivacaine for supraclavicular brachial plexus block in patients with chronic renal failure.

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ABSTRACT

Avoiding the hazards of general anesthesia and providing peripheral vasodilatation make brachial plexus block an ideal form of anesthesia for arterio-venous fistula (AVF) creation in patients with chronic renal failure (CRF). Sixty ASA class III patients aged 17 to 61 years were randomized to receive 30 mL of either ropivacaine 0.25% (n = 30; group I) or bupivacaine 0.25% (n = 30; group II) via a supraclavicular brachial plexus block. Both groups were comparable as regards onset time of motor block as well as duration of sensory and motor block. However, the mean onset time of sensory block was more delayed in the ropivacaine group (P= 0.0025). Free bupivacaine concentrations were less than those of ropivacaine at different interval times. There was significantly higher incidence of complications in bupivacaine group especially respiratory distress and Horner's syndrome. Therefore, these results suggest that ropivacaine 0.25% is a better local anesthetic than bupivacaine 0.25% for use in a supraclavicular approach for brachial plexus block in high-risk patients with CRF.

INTRODUCTION

Brachial plexus block is an ideal form of anesthesia for arterio-venous fistula (AVF) creation in patients with end stage renal disease⁽¹⁾. Not only are the hazards of general anesthesia avoided in already compromised patients but also peripheral vasodilatation, due to associated sympathetic blockade⁽²⁾, facilitates a successful surgical outcome⁽³⁾.

Depending on the site of surgery, four approaches for brachial plexus block may be done: interscalene, supraclavicular, infraclavicular and axillary. For any surgery in the upper extremity that does not involve the shoulder, a supraclavicular block (modified Winnie's approach) is preferred⁽⁴⁾. It is associated with rapid onset, reliable anesthesia and proven to be a safe technique as well. When a nerve stimulator is used, a clear response of the fingers in either flexion or extension, obtained at a seeking current, indicates a close proximity to the plexus. This translates into better success rates^(5, 6).

Usually, brachial plexus blocks are performed in ASA status I or II⁽⁴⁾. This study was designed in ASA status III patients with CRF. These patients usually have anemia, diabetes mellitus or cardiac diseases. The anesthetic characteristics of 30 ml of either

ropivacaine 0.25% or bupivacaine 0.25%, in equal doses, as well as their effects on such patients were evaluated.

AIM OF THE STUDY

Comparison of some clinical and pharmacokinetic properties of ropivacaine and bupivacaine for brachial plexus block in patients with CRF.

PATIENTS AND METHODS

After approval from the local ethical committee, sixty ASA class III patients aged 17 to 61 years gave a written, informed consent to participate in this randomized, double-blind trial. All patients were scheduled to undergo supraclavicular brachial plexus block for the creation of AVF in the antecubital region.

Sedatives were not administered in any case. After the placement of a 22-gauge IV cannula, all patients received an infusion of normal saline to keep a patent vein. Standard monitors were used, including noninvasive arterial blood pressure (NIBP), heart rate, and arterial oxygen saturation (Spo2) using HP Anesthesia Viridia 24 (71034 Boebingen, Germany).

Under sterile conditions, a supraclavicular block was performed according to the modified Winnie's approach with the aid of a

nerve stimulator (Stimuplex HNS® 11; B. Braun, Melsungen, Germany)⁽⁵⁾ with a seeking current of 0.3 mA by the same investigator. A short-beveled stimulating needle (Stimuplex® Kanule A, 50 mm; B. Braun) was inserted at the lateral border of sternocleidomastoid just above the clavicle until electrical motor response was elicited in the shoulder, upper arm, or elbow. Patients were randomized to receive 30 mL of either ropivacaine 0.25% (n = 30; group I) or bupivacaine 0.25% (n = 30; group II)⁽⁷⁾.

The onset and duration of sensory and motor blocks were recorded. Peripheral venous blood samples were drawn for assay of ropivacaine and bupivacaine in the nonoperated arm 30 min after the block, at the end of surgery and 2 hours postoperatively. Gas chromatography and mass spectrometry were used to determine free ropivacaine and bupivacaine concentrations [Gas chromatography/mass spectrometry system (Hewlett-Packard, Palo Alto, CA)]⁽⁸⁾. Possible complications were recorded during the operation and thereafter. The patients were monitored for 24 h after surgery. Student's t-test was used for comparison between the two groups.

RESULTS

No significant difference was depicted between the two groups as regards demographic data (age, weight and height) ($P > 0.05$; Table I) and duration of the operation ($P > 0.05$).

The mean onset time of sensory block was 14.01 min in group I and 8.65 min in group II with a significant increase in group I

compared to group II ($P < 0.05$; Figure 1). The duration of sensory block did not differ between the two groups (mean duration 11.1 h and 10.7 h in groups I and II, respectively) ($P > 0.05$; Figure 2). Unlike the onset time of sensory block, there was no significant difference between the two groups as regards the onset time of motor block as its mean was 17.9 min in group I and 16.5 min in group II ($P > 0.05$; Figure 1). The mean duration of motor block was 7.3 h in Group I and 7.2 h in Group II with no significant difference between the two groups ($P > 0.05$; Figure 2).

Free bupivacaine concentrations were significantly lower than those of ropivacaine at different interval times (mean concentration 60.5 ng/mL and 74.7 ng/mL at 30 min after the block; 59.3 ng/mL and 70.3 ng/mL at the end of surgery; and 45.4 ng/mL and 58.2 ng/mL at 2 hours postoperatively, respectively) ($P < 0.05$; Figure 3).

No significant changes in BP, heart rate and Spo2 were observed in either group ($P > 0.05$).

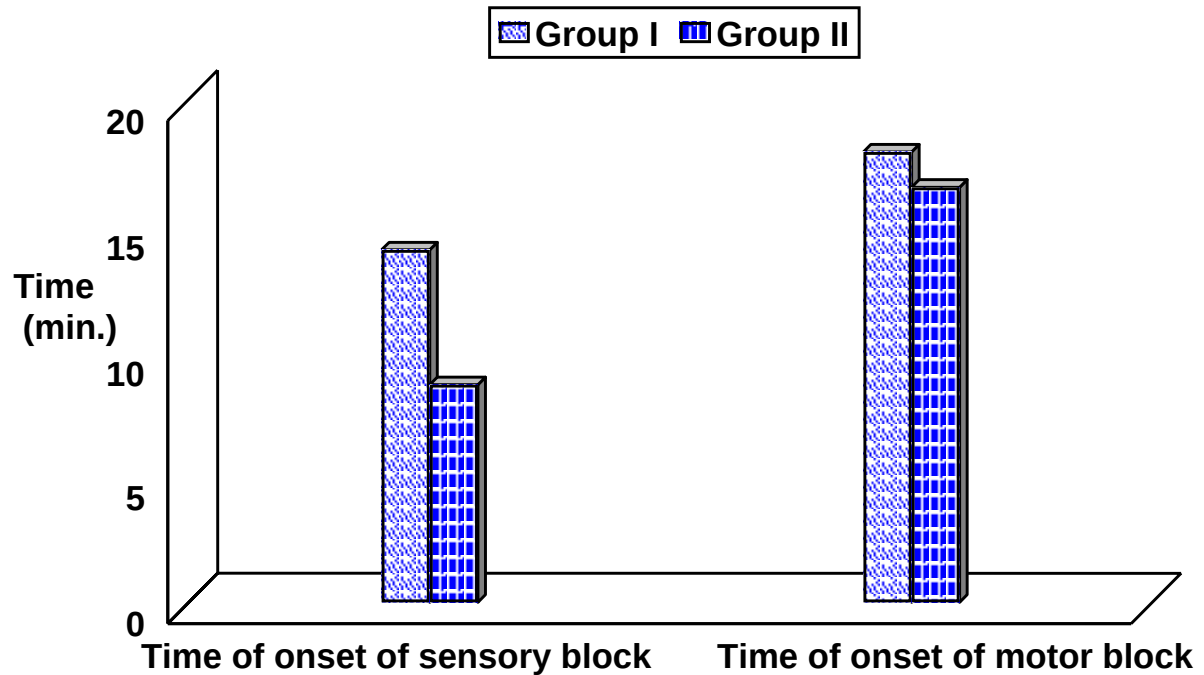
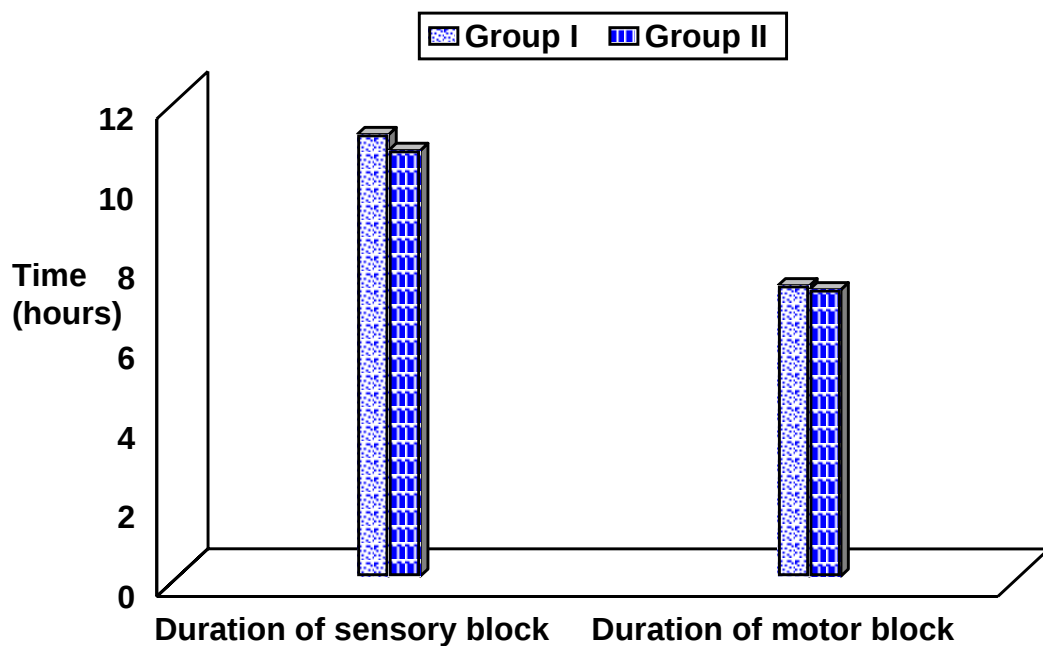
The number of the patients who developed complications is shown in Table 2. Respiratory distress and Horner's syndrome were more common among group II than group I ($P < 0.05$; Table II). Respiratory distress was treated with supplemental oxygen via a nasal mask throughout the surgery, with no further therapy needed. The Spo2 was always $>95\%$ during the operation in the remaining patients. No significant difference between the two groups as regards hoarseness, nausea & vomiting ($P > 0.05$; Table 2).

Table I: Comparison between demographic data of the two studied groups.

	Group I	Group II	p
Age (years)			
Range	27-51	25-52	0.378
Mean	38.5	39.2	
S.D.	7.80	8.74	
Weight (kg)			
Range	54-81	50-85	0.337
Mean	68.6	67.6	
S.D.	7.06	10.37	
Height (cm)			
Range	151-179	150-180	0.471
Mean	164.3	164.5	
S.D.	8.46	8.97	

Table II: Comparison between the two studied groups regarding incidence of complications.

Complications	Group I "n=30"	Group II "n=30"	p
Respiratory distress	2	4	0.05*
Horner's syndrome	3	6	0.042*
Hoarseness	2	2	-----
Nausea/vomiting	1	3	0.19

**Fig 1.** Comparison between the two studied groups regarding mean onset time of sensory and motor block.**Fig 2.** Comparison between the two studied groups regarding mean duration of sensory and motor block.

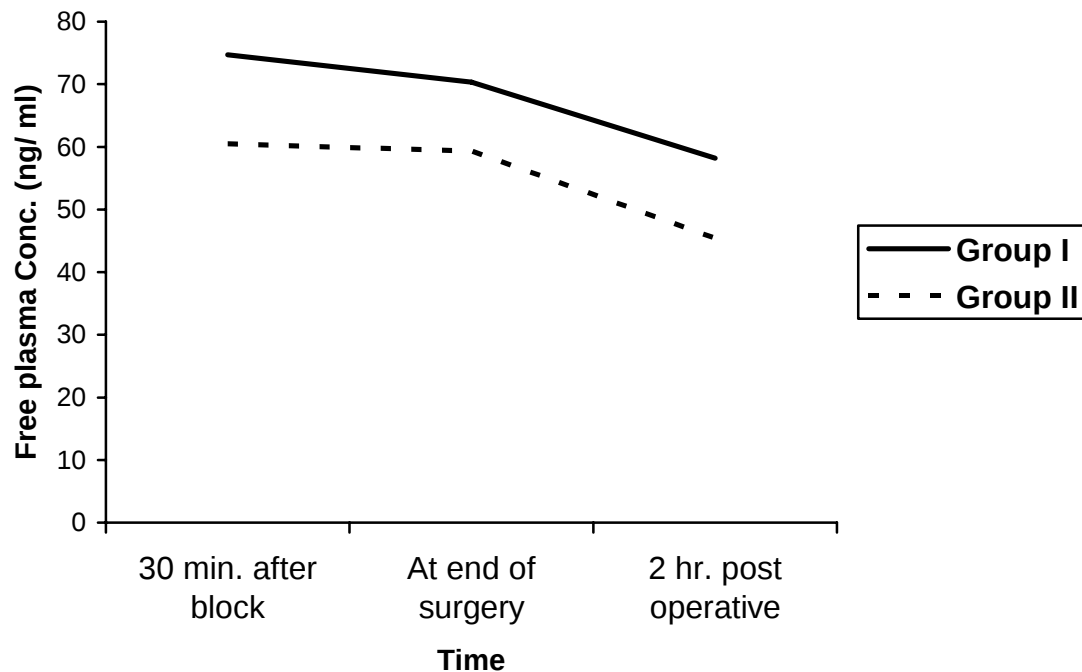


Fig 3. Comparison between the two studied groups regarding plasma concentration of ropivacaine and bupivacaine at different interval times.

DISCUSSION

The anesthetic characteristics of 30 mL of 0.25% ropivacaine and 0.25% bupivacaine in equal doses were compared. In the present study, the onset and duration of the motor block were similar to the results of previous studies^(7, 9-11).

Klein et al.⁽⁹⁾ compared the duration of analgesia produced by 0.5% bupivacaine and 0.5% ropivacaine via an interscalene approach of brachial plexus block⁽⁹⁾. In the present study, the duration of analgesia for both groups was shorter (mean 11.1 and 10.7 hours, respectively) than that found by Klein et al.⁽⁹⁾. This may be attributed to the smaller local anesthetic concentration and the CRF of the patients in our study groups. The hyperdynamic state and acidosis secondary to chronic anemia in patients with CRF increase the elimination rate of local anesthetics and in turn cause a reduction in the duration of analgesia⁽¹²⁾.

In the present study, the success rate of motor block was not 100%, and patients with failed motor block were excluded from the study. This could be explained by an increased elimination rate of local anesthetics in patients with CRF because of

the hyper-dynamic cardiovascular system and acidosis⁽¹²⁾. In addition, we used a lower local anesthetic concentration.

Mild respiratory distress was observed in 6 patients (2 in Group I and 4 in Group II). Spontaneous ventilation was supported by oxygen via a nasal mask throughout the surgery, which always relieved respiratory distress. Horner's syndrome is common after supraclavicular block⁽¹³⁾. In the current study, the incidence of Horner's syndrome was 9 cases (3 in Group I and 6 in Group II). The incidence of respiratory distress and Horner's syndrome was significantly higher in group II compared to group I. Hoarseness associated with supraclavicular block may occur in 1.3% of patients⁽¹⁴⁾. In the present study, hoarseness occurred in 4 cases (2 in group I and 2 in group II). Moreover, Horner's syndrome and hoarseness were observed in a percentage of patients similar to that found by Hickey et al.⁽¹⁴⁾, who studied the effects of a perivascular subclavian brachial plexus block⁽¹⁴⁾.

In the present study, the free plasma concentration of bupivacaine was lower than that of ropivacaine. In conform to our

results, Altintas et al.⁽⁶⁾ found that the free plasma concentration of ropivacaine was larger than that of bupivacaine at 30 and 120 minutes after injection of 30 ml of both drugs (0.33% concentration) for interscalene block in CRF patients. The smaller free plasma concentrations of bupivacaine, despite use of the same dose, may be attributed to more rapid initial distribution in tissues caused by the higher lipid solubility compared with ropivacaine and, thus, the larger volume of distribution of bupivacaine⁽⁶⁾.

There was no clinical evidence of toxicity in any of our patients. In our study, the free concentration of ropivacaine and bupivacaine at these interval times was well below the toxic threshold (80 ng/mL)^(15,16). However, there was more incidence of complications in the bupivacaine group esp. respiratory distress and Horner's syndrome which were significantly higher compared to the ropivacaine group. This can be explained by the fact that bupivacaine has a higher lipid solubility than ropivacaine, with a larger volume of distribution to the tissues⁽⁶⁾.

Therefore, these results suggest that ropivacaine 0.25% is a better local anesthetic than bupivacaine 0.25% for use in a supraclavicular approach for brachial plexus block in high-risk patients with CRF. Although the use of ropivacaine 0.25% is associated with a higher free plasma concentration, it has a lower incidence of complications compared to bupivacaine 0.25%.

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