Unilateral Spinal Anesthesia with Hyperbaric Bupivacaine Versus Hyperbaric Articaine in Out-Patient Knee Surgery

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✔ Hemodynamic alterations due to sympathetic blockade during spinal anesthesia should be minimized. Restriction of sympathetic blockade during unilateral spinal anesthesia causes minimal hemodynamic alterations. The aim of this study was to compare the effect of hyperbaric bupivacaine and hyperbaric articaine on hemodynamic parameters and the level of sensory blockade for unilateral spinal anesthesia in outpatient knee arthroscopy.

Twenty-seven patients undergoing elective lower extremity arthroscopy were included in this study. After spinal anesthesia in the lateral decubitus position, 15 patients in the bupivacaine group (Group B) were given 2 ml 0.5% hyperbaric bupivacaine and 12 patients in the articaine group (Group A) were given 1 ml 0.5% hyperbaric articaine. After the lateral position was maintained for 10 min, the final segmental blockade level and the degree of motor blockade on both the operated and unoperated sides were evaluated. Hemodynamic alterations and complications were also noted.

There was no statistical difference between the groups with regards to hemodynamics, maximum sensorial blockade level, complications and number of patients in whom third degree motor blockade was achieved. However, two patients in the articaine group required general anesthesia due to inadequate surgical analgesia.

In conclusion, unilateral spinal anesthesia could not be achieved with both of these techniques. However, both of these techniques can be safely used in outpatient arthroscopy for hemodynamic stability.

Key words: *Anesthesia, spinal, unilateral; local anesthetics, bupivacaine, articaine; knee arthroscopy; outpatient.*

✔ **Ayaktan Gelen Diz Cerrahisi Hastalarında, Hiperbarik Bupivakain ve Artikain ile Yapılan Tek Taraflı Spinal Anestezinin Karşılaştırılması**

Spinal anestezi sırasında sempatik bloğa bağlı olarak gelişen hemodinamik değişiklikler minimal olmalıdır. Tek taraflı spinal anestezi, sempatik bloğun daha sınırlı bir bölgede sağlanması sonucunda çok az hemodinamik değişikliklere neden olmaktadır. Bu çalışmanın amacı, ayaktan gelen ve diz artroskopisi planlanan hastalarda tek taraflı spinal anestezi uygulamasında hiperbarik bupivakain ve hiperbarik artikain kullanılmasının hemodinamiye ve bloğun seviyesine olan etkilerini karşılaştırmaktır.

Alt ekstremite elektif diz artroskopisi planlanan 27 hasta çalışmaya alındı. Lateral dekübitus pozisyonda spinal anestezi yapılarak, bupivakain grubundaki (Grup B) 15 hastaya 2 ml %0.5 hiperbarik bupivakain ve artikain grubundaki (Grup A) 12 hastaya 1 ml %0.5 hiperbarik artikain olarak verildi. Hastalar bu pozisyonda 10 dk bekletildikten sonra, maksimum sensoryal blok seviyeleri ve motor blok dereceleri her iki bacakta ayrı ayrı değerlendirildi. Hemodinamik değişiklikler ve komplikasyonlar kaydedildi.

Hemodinamik değişiklikler, maksimum sensoryal blok yüksekliği, 3.derecede motor blok sağlanan hasta sayıları ve komplikasyonlar bakımından gruplar arasında fark sap-

tanmadı. Ancak, artikain grubunda 2 hastada yetersiz cerrahi analjezi nedeniyle genel anestezi uygulandı.
Sonuç olarak, her iki yöntemle tek taraflı spinal anestezi sağlamanın mümkün olmadığı, ancak ayaktan gelen artroskopi hastaları için hemodinamik stabilite sağlaması nedeniyle güvenli yöntemler olduğu kanısına varıldı.
Anahtar kelimeler: *Anestezi, spinal, unilateral; lokal anestezikler, bupivakain, artikain; diz artroskopisi; günübirlik hastalar*

BACKGROUND AND OBJECTIVES

Ambulatory surgery requires anesthesia methods that allow rapid recovery and safe discharge of the patient. For minimal hemodynamic consequences, and faster recovery and discharge it would be optimal to limit the spread of spinal anesthesia only to the area, which is necessary for surgery. High dose local anesthetics change the hemodynamic stability and prolong the motor blockade time and discharge of the patient from hospital[1].

The aim of this study was to compare the effects of the use of hyperbaric bupivacaine (2 ml, 0.5%) and hyperbaric articaine (1 ml, 5%) on the hemodynamic stability, sensorial and motor blockade and postoperative analgesia in unilateral spinal anesthesia.

METHODS

With the written approval of the local Ethics Committee, twenty-seven patients (ASA I-II), aged 20-40 years, scheduled for elective knee arthroscopy were recruited to the study after obtaining informed consent. None of the patients were given premedication, intravenous solution and prophylactic vasopressors before the intrathecal injection. Patients were assigned to one of the two groups: bupivacaine and articaine groups.

After electrocardiographic monitorization, patients were placed lateral flexed decubitus position. Using the midline approach, lumbar puncture was performed between L3-4 or L4-5 interspaces through the anesthetized skin (2-3 ml 2% lidocaine) using a 25-gauge spinal needle.

In all patients, the lumbar punctures were performed by the same anesthesiologist. After free flow of cerebrospinal fluid was obtained, the patients were assigned to receive either 2 ml 0.5% hyperbaric bupivacaine (Group B, n=15) or 1 ml 5% hyperbaric articaine (Group A, n=12). The time of the spinal injection was noted. The patients were kept in the lateral flexed decubitus position for 10 minutes, operation side undermost and were turned supine and 30 degree head-up position during the operation.

The systolic and diastolic arterial pressures, heart rates and oxygen saturation were recorded before and 5, 10, 15, 20, 25, 30 min after spinal injection. Hypotension and bradycardia were treated with intravenous fluids, vasopressors or atropine as appropriate. Maximum decrease in systolic and diastolic pressures and its timing were also recorded.

The final segmental level of the subsequent block by pinprick test and motor block by bromage scale (0=no motor block; 1= hip blocked; 2= hip and knee blocked; 3= hip, knee, and foot blocked) were tested at 15 min after spinal injection on both operated and unoperated sides.

During the operation, oxygen was administered at flow rate of 2 L/min via a mask. Pain and discomfort were treated with intravenous midazolam, fentanyl or general anesthesia.

The patients were observed in the recovery room for 2 h. The motor blockade time (the time span extending from spinal injection to the return of finger movement), the first analgesic requirement time and complications were recorded.

Successful unilateral spinal block was defined as surgical anesthesia (loss of pinprick sensation > T12 and complete motor block) on the operated side only, while the nonoperated side maintained both somatic sensibility to the pinprick test and motor block less than first degree.

Statistical analysis was performed using Mann Whitney-U test for quantitative data and the Chi square test for qualitative data. $p>0.05$ was considered as significant.

RESULTS

The two groups were well matched for age and weight (Table I).

Table I. Physical Charactheristics and Duration of Operation in Groups (Mean±SEM).

	Group B	Group A
Age (year)	29.08±3.56	28.20±2.08
Weight (kg)	74.00±2.41	76.93±3.48
Sex (F/M)	12/3	11/1
Length of operation (min)	34.64±6.45	25.22±3.84

Table II shows heart rate, blood pressure and oxygen saturation. There were no significant differences between the groups ($p>0.05$). All patients remained cardiovascularly stable throughout the operation. The cardiovascular effects of the spinal anesthesia are presented in table III.

The final segmental levels of blockade in the groups are shown in table IV. The height of blockade in the bupivacaine group was T9-10 (40%) on operated side and below T12 (53.3%) on unoperated side. In the articaine group, the mean height of blockade was T5-6 (25%) on operated side, below T12 (41.6%) on unoperated side. The differences between the groups were not significant ($p>0.05$).

Table V shows percentages of patients who reached complete motor blockade at 15 min after spinal injection. Complete motor blockade was obtained in 73.3% and 91.6% on operated side, and 30% and 50% on unoperated side at 15 min after spinal injection in the bupivacaine group and the articaine group, respectively. There were no statistically significant differences between the groups ($p>0.05$).

In the articaine group, two patients (17.8%) required general anesthesia because the sensorial blockade time was shorter than the surgical time, and ten patients required additional analgesic during surgical procedure.

Table II. Distrubition of Systemic Hemodynamic Data in Groups.

		Preop.	5 min	10 min	15 min	20 min	25 min	30 min
Group B	SBP (mmHg)	118.7±6.4	110.0±6.4	111.6±6.8	114.1±5.2	115.0±5.9	114.1±5.4	112.1±5.2
	HR (bpm)	74.7±3.9	69.7±3.4	65.9±4.1	67.7±3.6	69.4±4.0	65.7±3.5	64.7±2.5
	SaO2	98.1±0.2	97.5±0.2	97.9±0.1	97.4±0.4	97.0±0.5	97.4±0.3	97.6±0.3
Group A	SBP (mmHg)	116.5±4.4	115.5±4.2	114.6±3.6	112.6±3.9	115.0±3.8	114.0±3.9	113.0±3.8
	HR (bpm)	83.2±3.7	81.8±3.1	80.6±2.4	79.0±2.5	75.9±2.8	75.4±2.6	76.5±3.2
	SaO2	97.8±0.2	97.6±0.1	97.5±0.1	97.3±0.2	96.5±1.0	96.2±1.1	96.6±1.2

SBP: systolic blood pressure, HR: heart rate, SaO2: peripheric oxygen saturation, bpm: beats per minute

Table III. Distribution of Cardiovascular Effects in Groups.

	Group B	Group A
Mean (±SEM) decrease in systolic arterial pressure from initial value (%)	12.9±2.5	13.9±1.6
Mean (±SEM) decrease in diastolic arterial pressure from initial value (%)	16.6±1.9	18.8±5.2
Mean time from spinal injection to maximum decrease in systolic arterial pressure (min)	11.1±2.9	11.8±2.3
Bradycardia requiring atropine (%)	–	8%

Table IV. Distribution of Heigth of Blockade.

	Group B				Group A			
	Operated side		Unoperated side		Operated side		Unoperated side	
	No.	%	No.	%	No.	%	No.	%
T3-4 or above	–	–	–	–	1	8.3	–	–
T5-6	–	–	–	–	3	24.9	2	16.7
T7-8	4	26.7	2	13.3	2	16.7	1	8.3
T9-10	6	40	3	20	2	16.7	4	33.3
T11-12	2	13.3	2	13.3	2	16.7	–	–
Below T12	3	20	8	53.4	2	16.7	5	41.7
Mean heigth of blockade	T9-10		Below T12		T 5-6		Below T12	

Table V. Motor Blockade Scores 15 min after Spinal Injection in Groups.

Score	Group B				Group A			
	Operated side		Unoperated side		Operated side		Unoperated side	
	No.	%	No.	%	No.	%	No.	%
0	–	–	3	20	–	–	3	25
1	–	–	5	33.4	1	8.4	6	50
2	4	26.6	4	26.6	–	–	1	8.3
3	11	73.4	3	20	11	91.6	2	16.7

The duration of motor blockade and first analgesic requirement time were shown in Table VI. There were no statistically significant differences in the two study groups ($p>0.05$).

Although one patient in the articaine group required atropine 0.5 mg during the operation, but no vasopressors were used.

Table VI. The Duration of Motor Blockade and First Analgesic Requirement Time (Mean±SEM)

	Group B	Group A
Duration of motor blockade	95.6±5.4	82.2±10.1
First analgesic requirement time	384.5±51.4	281.6±97.8

There was no statistically significant difference in complications. No serious side effects and headache was noticed on postoperative period in both groups.

DISCUSSION

Our study indicates that for unilateral spinal anesthesia in lower extremity operations, the administration of 2 ml 0.5% hyperbaric bupivacaine and 1 ml 5% hyperbaric articaine solutions and keeping the patients for 10 min in the lateral flexed decubitus position were found to be safe. However, it was found that duration of the blockade in the articaine group was lower than the bupivacaine group. The blockade was more intense and prolonged with bupivacaine as two patients in the articaine group needed supplemented analgesic or general anesthesia because of pain. It is suggested that, only quicker onset time favors articaine over bupivacaine[2].

The unilateral distribution of spinal anesthesia is advantageous in surgical procedures involving one leg because the hemodynamic effects of spinal anesthesia are reduced[3,4]. Casati et al.[5] found that 8 mg 0.5% hyperbaric bupivacaine in unilateral spinal anesthesia provided minimal effects on cardiovascular homeostasis. Similarly, in our study, with the exception of one patient in the articaine group, all patients remained cardiovascularly stable throughout the operation. The extremely low incidence of hypotension and bradycardia noted is probably related to this relatively restricted sympathetic blockade coupled with the localized anesthetic technique.

We failed to achieve pure unilateral sympathetic blockade in any patient by injection either 2 ml 0.5% bupivacaine or 1 ml 5% articaine and keeping the patient in the lateral decubitus position for 10 minutes postinjection. Various studies have failed to demonstrate the feasibility of unilateral blockades[6,7]. Pittoni et al. showed a strict correlation between the dose of anesthetic used and lateralization of sensory blockade[4]. It was also suggested that the extreme reduction of the dose and flow rate are the critical factors and a dose of bupivacaine less than 0.05 mg/cm of patient height was associated with a high incidence of unilateral sensory blockade[4]. In the present study, very small doses of local anesthetics and low-flow injection techniques were not used. In addition, keeping the patients for 10 minutes in the lateral decubitus position might have been short for achieving pure unilateral spinal anesthesia. It was found that the use of 2 ml 0.5% hyperbaric bupivacaine solution for operations above the knee and 1.5 ml 0.5% hyperbaric bupivacaine solution for operations below the knee and than keeping the patients for 10 minutes in the lateral decubitus position is appropriate[8]. To the best of our knowledge, unilateral spinal anesthesia with articaine was not reported in the literature.

In our study, two patients in the articaine group needed general anesthesia because the duration of operation was longer than spinal anesthesia. Cowan[9] suggested that quality of articaine is not good enough compared with lidocaine, mepivacaine and prilocaine for the same dosage and areas. Hauenschild[10] found that, advantages of articaine in spinal anesthesia include very short time of onset and low toxicity. Articaine is a good and reliable analgesic in only short operations but in operations longer than one and a half hours catheter techniques of longer duration ought to be used.

In conclusion, unilateral spinal anesthesia could not be achieved with both of these techniques. However, both of these

techniques can be safely used in outpatient arthroscopy for hemodynamic stability. Further studies are needed to investigate whether smaller volumes of articaine and bupivacaine and slow rate injection techniques achieve unilateral spinal anesthesia.

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