The Effects of Spinal Anesthesia on Erythrocyte Sedimentation Rate

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ABSTRACT

The aim of this study was to investigate the effect of spinal anesthesia on erythrocyte sedimantation rate (ESR). After approval by the local ethics committee and written informed patient consent, patients between the ages between the ages of 18-65 and American Society of Anesthesiologists (ASA) physical status classification, Class I-II scheduled for ilioinguinal and anorectal surgery under spinal anesthesia were included in the study. Six patients in whom adequate anesthesia level could not be obtained were excluded from the study. Investigation was completed with the remaining 54 patients (12 female, 42 male).

Blood samples were obtained just before spinal anesthesia and after the onset time of sensory blockade for surgery. ESR was measured within two hours with automated Sed Rate Greener device parallel to Westergreen method. Mean ESR values were found to be 7.54±6.35 in the first blood samples and 7.37±6.25 in the second blood samples. There was no statistically significant difference between the two ESR values.

In conclusion, we suggest that spinal anesthesia does not lead to a significant alteration in ESR, which may be accounted for the low amount of local anesthetics used in this technique and the low peak plasma concentrations of those were reached in the blood.

Key Words: Erythrocyte sedimentation rate, Spinal anesthesia

ÖZET

Spinal Anestezinin Eritrosit Sedimentasyon Hızına Etkisi

Bu çalışmanın amacı spinal anestezinin eritrosit sedimentasyon hızı üzerine etkisini araştırmaktır. Etik kurul izni ve bilgilendirilmiş hasta oluru alındıktan sonra, spinal anestezi ile ilioinguinal ve anorektal cerrahi planlanan 18–65 yaş arası, Amerikan Anestezistler Derneği (ASA) fiziksel durum sınıflaması, Klas I-II hastalar çalışmaya alındı. Cerrahi için yeterli anestezi düzeyi elde edilemeyen 6 hasta çalışma dışı bırakıldı. Geriye kalan 12 kadın, 42 erkek toplam 54 hasta ile araştırma tamamlandı.

Hastalardan spinal anestezi için girişim yapılmadan ve cerrahi için duyusal blok başlama zamanından sonra kan örneği alınıp en geç 2 saat içinde eritrosit sedimentasyon hızı, Westergren metoduna paralel otomatize Sed Rate Screener cihazı ile ölçüldü. Ortalama ESR değerleri; 1. kan örnekleri için 7.54 ± 6.35, 2. kan örnekleri için ise 7.37 ± 6.25 mm/saat bulundu. Ancak bu iki değer arasında anlamlı bir fark tespit edilemedi.

Sonuç olarak, bu anestezi tekniğinde kullanılan düşük miktardaki ilaç ve bunun kanda ulaşabildiği düşük konsantrasyon nedeniyle spinal anestezinin ESR de önemli bir değişikliğe yol açmadığını düşünüyoruz.

Anahtar Kelimeler: Eritrosit sedimentasyon hızı, Spinal anestezi

INTRODUCTION

The event called erythrocyte sedimentation occurs due to the interaction between shape and surface characteristics of erythrocytes and some plasma proteins. The amount of this sedimentation in 1 hour in mm units is defined as erythrocyte sedimentation rate. Under normal circumstances, ESR is usually used for the diagnosis and monitorisation of the changes in plasma proteins as they occur more frequently than the changes in erythrocytes themselves.

Anesthetic agents bring about important changes both in the membrane structure of the cells and the electrolyte balance.[1,2] Studies demonstrated that general anesthesia decreases ESR.[3,4] It is thought that the effect of anesthetic agents on erythrocytes may be responsible for this decrease in ESR.[3,4]

Spinal anesthesia is a quite old and common method of regional anesthesia. Low amount of anesthetic agents administered to subarachnoid region produces sensory and motor blockage at varying levels depending upon the site of administration, dose and the position of the patient. They have specific side effects apart from side effects of general anesthesia.[5] Although, various effects of drugs used in spinal anesthesia on blood cells and bacteria have been shown6, as far as we know, there is no information on the probable effect of this anesthesia on ESR. The aim of this study was to investigate whether spinal anesthesia has any effect on ESR.

MATERIALS AND METHODS

After approval by the local ethics committeee and written informed patient consent, ASA I-II sixty patients scheduled for ilioinguinal and anorectal surgery under spinal anesthesia were included in the study. Exclusion criteria included allergy to local anesthetics, coagulopathy, impaired hepatic or renal function, morbid obesity (calculated BMI >35 kg/m^2) and contraindication to subarachnoid block.

Patients were taken into operating room without premedication. Before the procedure, a 18-gauge cannule was placed, followed by routine monitoring that consisted of electrocardiography (ECG), heart rate, and peripheral oxygen saturation (SpO_2) were monitored continuously and noninvasive arteriel blood pressure was measured at 5-min intervals (Drager®, Julian Plus Vitara 8060, Germany). In each case, 500 ml of intravenous (IV) isotonic saline was administered over ten minutes as preload.

Under full aseptic conditions, spinal anesthesia was performed at the L3-4 interspace with the patient in sitting position by using a 25-gauge Quincke needle. Free flow of cerebrospinal fluid was verified before and after injection of 3 ml Levobupivacaine % 0.5 (Chirocaine® %0.5, Abbott, Turkey). All patients remained in the sitting position for 2 min after the injection and were then placed in prone or supine position for the operation. Blood pressure, heart rate, and SpO_2 were recorded at every five minutes until the end of operation. In addition, sensory and motor blockade were assessed with the pinprick stimuli and a modified Bromage scale, respectively. These tests were performed every 2 min for up to 30 min after spinal anesthesia.

The onset time of sensory or motor blockade was defined as the interval between intrathecal administration and time to achieve sensory block of T 10, or a Bromage score of 3, respectively. The surgical procedure was started 30 min after spinal anesthesia. If the level of analgesia was inadequate after this time, patients were excluded from the study and then general anesthesia was given.

Blood samples were obtained just before spinal anesthesia (sample 1) and after the onset time of sensory blockade (sample 2) and collected in the vacuum tubes with Sodium Citrate 3.8%. ESR was measured within 2 hours using automated Sed Rate screener device (Greiner-Bio-One GmbH Solingen, Germany) parallel to Westergreen method.

The values obtained were compared using paired t test. The ESR values of male and female were compared using Mann-Whitney U-test. The relation between ESR values and second sampling time was examined using Pearson correlation analysis. A value of $p < 0.05$ was considered as significant.

RESULTS

Sixty patients were enrolled in the study. Patient characteristics and onset time of spinal block were given Table 1. Six patients in whom adequate level of anesthesia could not be obtained for surgery were also excluded from the study. Study was completed with the remaining 54 patients (12 female, 42 male) aging 18-65 (36.28±15.49).

Table 1. Patient characteristics and onset time of spinal anesthesia

Variables	Data
Age (years)	36.28 ±15.49
Weight (Kg)	74.80 ± 13.66
Height (m)	1.71 ±0.09
Gender (male/female) (%)	42 (77.8%) / 12 (22.2%)
ASA I / II (%)	24 (44.4%) / 30 (55.6%)
Onset time of sensory blockade (min)	10.31 ±3.30
Onset time of motor blockade (min)	9.63 ±3.93

Data are presented means ± SD and numbers or percentage as indicated.

ASA, American Society of Anesthesiologists Physical Status Classification

The time between sample 1 and sample 2 was 10.31±3.29 min. ESR values of the first blood samples were 7.54±6.35 mm/h and second blood samples were 7.37±6.25 mm/h, (Table 2). However, the difference was not statistically significant (p=0.619). The time to achieve sensory block of T 10 that is, time of second sampling, was not the same in all patients (4-18 min), but in statistical analysis no relation was found between the duration of this period and the values in sample 2 (r= 0.265; p= 0.053) and the difference between the two values (r= -0.078; p= 0.577). In 43 of 54 cases, the ESR results were same. In sample 2, decrease was seen in 5 cases (1-10mm/h) and increase in 6 cases (1-10 mm/h). Although first ESR values of female (11.50±8.26 mm/h) were significantly higher than values of male (6.40±5.29 mm/h) (p= 0.020), the differences in two measurements (sample 1 and sample 2) between male and female were not significant (p= 0.095) (Table 2).

There were no any significant hemodynamic changes in the patients. In addition, none of the patients developed complications and side effects.

DISCUSSION

Erythrocytes produce rouleau formation sediment in plasma with the effect of gravity. Some plasma proteins including agglomerins help the stabilisation of this structure. In this process, while the structure of erythrocytes triggers rouleau formation, some membrane glycoproteins mediate the attachment of agglomerins to cells. After injection of a local anesthetic agent and exposure of a given nerve to its effect, the agent diluted in the extracellular fluid and taken up by capillaries. Ultimately all of

Table 2. ESR values Sample 1 and Sample 2 (mm/h) and the time between them (min)

	Sample 1	Sample 2	Difference	The time between Sample 1 and 2
Female (n: 12)	11.50±8.26*	9.75±7.37	1.75±3.72	11.75±4.00
Male (n: 42)	6.40±5.29	6.69±5.81	0.29±1.76	9.90±2.99
Total (n: 54)	7.54±6.35	7.37±6,25	0.17±2.45	10.31±3.29

* Significantly higher than male's values (p= 0.02)

Data are means ± SD

the agent enters the bloodstream. On absorption into vascular compartment, significant binding to plasma proteins and to erythrocytes occurs.[6] Many anesthetic agents, by virtue of their nature, influence cell membranes markedly. They also cause changes in cell electrolyte balance as well as changing physical and chemical characteristics of the membranes.[1,7]

In the present study, we showed that spinal anesthesia did not cause any changes in ESR. As ESR values of the individuals included in the study were usually within normal range, the highest value being 28 mm/h, effect on high values could not be completely evaluated. However, in view of the data we obtained, we do not think a significant change would occur in high values. In the study of Caglayan et al, general anesthesia led ESR values within normal range to decrease. We believe that this difference may be attributed to the difference in anesthesia techniques.

The systemic absorption of local anesthetic agents is related primarily to the site of injection, dosage, and relative vasodilator properties of the individual local anesthetic drug and the presence or absence of a vasoconstrictor in the anesthetic solution. The highest blood levels are obtained after intercostal nerve followed, in order, by caudal, lumbar epidural, brachial plexus, subarachnoid, sciatic, femoral and subcutaneous administration.[6]

Systemic uptake after subarachnoid injection is believed to occur predominantly after passage of drug across the dura into the more vascular epidural space, as well as from blood vessels within the spinal space, in the pia mater, and in the cord itself. Extensive diffusion into epidural space would be expected to result in sequestration in fat, thereby retarding the absorption of the longer-acting agents to a greater extent than the shorter-acting ones.[8]

Veering et al. reported that detectable plasma concentration of unlabeled bupivacaine were present in all samples collected beginning 5 minutes after subarachnoid administration. The peak plasma concentration of bupivacaine was reached approximately 85 minute after spinal injection of 15 mg hyperbaric 0.5% bupivacaine solutions.[9]

Zakowski et al. demonstrated that the maximum plasma bupivacaine concentration (47.7 ± 4.4 ng/mL) after subarachnoid administration occurred at 30 min in the plain (12 mg hyperbaric 0.5% bupivacaine) group.[10] In a study using 0.5%bupivacaine, when 20 mg dose was administered to subarachnoid space, this peak level was only 52 ng/ml.[11]

Pharmacokinetic parameter values of levobupivacaine and bupivacaine in patients administered the drugs epidurally and for brachial plexus block were similar. Peak levels in blood were reached approximately 30 minutes after epidural administration, and doses up to 150 mg resulted in mean Cmax (Peak plasma concentration) levels of up to 1200 ng/mL.[12]

Local anesthetic agent we used in the study was administered at the dose of mean 15 mg 0.5% levobupivacaine. This amount is quite below that used in other central and multiple peripheral blocks. In addition, drug administered to CSF passes into blood circulation after 5 minute[9,13] and reaches peak level in 20-30 minutes.[6,10,13]

In the present study, the time between sample 1 and 2 is withdrawn is 10.31±3.29 min, which is not sufficient to reach peak plasma levels. If we examine our data in view of this effect, it may be stated that blood level of the drug reached in the first 10 minutes of spinal anesthesia is not high enough to change ESR.

The time of second sampling may be changed, taking the time needed for passage of local anesthetic agent to CSF into account. In this way, whether peak level of anesthetic agent administered to subarachnoid space leads to a measurable change in ESR may be investigated. However, keeping this period too long may cause the surgical procedure to interfere in the process. In addition, the amount of drug passing into circulation may always be lower than that which may exert a considerable effect.

In conclusion, we suggest that spinal anesthesia does not lead to a significant alteration in ESR, which may be accounted for by the low amount of drug used due to the nature of this type of anesthesia and low concentrations reached in the blood by this drug.

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