Cumhuriyet Tıp Derg 2010; 32: 334-339
Cumhuriyet Med J 2010; 32: 334-339

Original research-Orijinal araştırma

Effects of spinal needle size on hearing functions in endoscopic urological operations

Endoskopik ürolojik girişimlerde spinal anestezide kullanılan iğne kalınlığının işitme fonksiyonlarına etkileri

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Abstract

Aim. The aim of this study was to determine whether any hearing loss occurs in the patients who undergo endoscopic urological operations after spinal anesthesia and to investigate whether the size of the needle affects the risk of this complication. **Methods.** The study was approved by ethical committee and informed consent was obtained from all patients. 30 patients were divided into 2 groups randomly. Spinal anesthesia was performed via L3-4 or L4-5 interspaces with 10 mg 0.5% hyperbaric bupivacaine by using 22 G Quincke needle in Group I patients, and by 26 G Quincke needle in Group II patients. Pure Tone Audiometry and plasma osmolarity calculation of venous blood were done preoperatively and at the 48th hour postoperatively. Systolic blood pressure, diastolic blood pressure, heart rate were recorded with 5 minutes intervals intraoperatively and for 12 hours postoperatively. The patients were evaluated about headache and the other side effects postoperatively. **Results.** There were no differences between groups about demographic data, hemodynamic parameters and plasma osmolarity ($p>0.05$). Subclinical hearing loss was observed in 10 patients of Group I (66.6 %) and in 4 patients of Group II (26.6 %). The rate of hearing loss in Group I was statistically higher than in Group II ($p<0.05$). Headache was seen in 7 patients of Group I and 2 patients of Group II. **Conclusion.** Finally, it was concluded that dural puncture and cerebrospinal fluid leakage due to big sized spinal needles increase the hearing loss and headache.

Key words: Spinal anesthesia, spinal needle size, post spinal hearing loss, audiometry

Özet

Amaç. Bu çalışmanın amacı ürolojik endoskopik cerrahi geçiren hastalarda, spinal anestezi sonrası işitme kaybı oluşup oluşmadığı ve kullanılan farklı çaplarda spinal iğnelerin bu komplikasyon üzerine etkisinin olup olmadığının araştırılmasıdır. **Yöntem.** Etik Kurul ve hastaların onayı alındıktan sonra çalışmaya dahil edilen 30 hasta rastgele 2 gruba ayrıldı. Grup I'de 22 G Quincke iğne, Grup II'de 26 G Quincke iğne kullanılarak L3-4, L4-5 aralığından 2 mL %0,5 hiperbarik bupivakain ile spinal anestezi uygulandı. Hastalara preoperatif ve postoperatif 48. saatte Pure Tone Odyometri uygulandı ve venöz kan örneklerinden serum ozmolaritesi hesaplandı. Sistolik kan basıncı, diastolik kan basıncı, kalp atım hızı intraoperatif 5 dakika aralıklarla ve postoperatif 12 saat boyunca kaydedildi. Postoperatif dönemde hastalar baş ağrısı ve diğer yan etkiler yönünden değerlendirildi. **Bulgular.** Gruplar arasında demografik veriler, hemodinamik parametreler ve serum ozmolaritesi yönünden fark saptanmadı ($p>0,05$). Grup I'de 10 hastada (%66,6), Grup II'de 4 hastada (%26,6) subklinik işitme kaybı gözlendi. Grup I'deki işitme kaybı Grup II'ye göre istatistiksel olarak daha fazlaydı ($p<0.05$). Grup I'de 7 hastada, Grup II'de 2 hastada baş ağrısı gelişti. **Sonuç.** Sonuç olarak, geniş çaplı spinal iğnelerle oluşan dural yırtığın ve BOS sızıntısının işitme kaybını ve baş ağrısını artırdığı kanısına varıldı.

Anahtar sözcükler: Spinal anestezi, spinal iğne çapı, postspinal işitme kaybı, odyometri

Geliş tarihi/Received: June 8 2010; **Kabul tarihi/Accepted:** October 4 2010

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Introduction

Spinal anesthesia is a common, effective and economic regional anesthesia technique. In spite of all advantages of spinal anesthesia technique, it has frequent side effects like hypotension, bradycardia and less common but serious side effects like headache, meningitis, visual impairment and transient hearing loss [1].

Hearing loss occurs after spinal anesthesia. However, the incidence rates reported varied between 3% and 92% [2, 3]. Many studies have described a variable incidence of transient hearing loss after subarachnoid block, especially in the low-frequency range [4, 5]. Despite many reports, few anesthesiologists appear to be aware of the possibility of this complication.

The hearing loss may be a result of cerebrospinal fluid (CSF) leakage even when the CSF loss is insufficient to cause a post dural puncture headache (PDPH). The size of the needle used for dural puncture appears to play a role in postspinal anesthetic hearing impairment via CSF loss [1]. The size of dural puncture depends on the size of spinal needle. The finding that the degree of hearing impairment is correlated with the size of the spinal needle further supports the theory that postspinal hearing loss and PDPH share a common etiology: leakage of CSF from the subarachnoid space [6, 7].

The purpose of this investigation was to determine whether any hearing loss occurs in the patients which goes under endoscopic urological operations after spinal anesthesia and whether the size of the needle affects the risk of this complication.

Materials and methods

After obtaining informed consent from patients and approval of the local ethics committee, 30 ASA physical status I and II patients scheduled for elective endoscopic urological surgery with spinal anesthesia were enrolled in the study. Age range was between 40-60 years. The following were the exclusion criteria: patients with ASA II or above, a history of hearing disorders, headache, a previous head trauma, intensive care treatment within the last 3 month, spinal anesthesia within the last year, chronic smoking and the inability to cooperate during audiometry. The patients were randomly divided into two groups. Group I (n=15) patients received spinal anesthesia through a 22-gauge (G) Quincke spinal needle (Egemen Ltd Şti, İzmir), Group II (n=15) patients received the same through a 26-G Quincke spinal needle (Egemen Ltd Şti, İzmir). They were monitored by SpO2, electrocardiogram and noninvasive blood pressure. Spinal anaesthesia was performed via the L3–4 or L4–5 interspaces, with 10 mg hyperbaric bupivacaine (Marcaine Heavy, 0.5% Astra Zeneca, Lüleburgaz, Edirne) intrathecally in all groups. Spinal anesthesia was performed by the same anesthesiologist with a midline approach and with the patient in the left lateral position. Only one dural puncture was allowed in each patient; if an additional puncture was necessary, the patient was excluded from the study. Ten minutes after spinal injection, the maximum height of the block was assessed by pin-prick testing and was monitored at 5-min intervals for 30 min. Level of sensory block, heart rate, pulse oximeter values and noninvasive blood pressure were recorded every 5 min. 0.05 mg kg^{-1} intramuscular midazolam (Dormicum, Roche Basel Switzerland) was used for sedation. All patients received intravenous (i.v.) Lactated Ringer's solution at 10 mL kg^{-1} h^{-1} before spinal anesthesia. The infusion was continued

at 4 mL kg^{-1} h^{-1}, and a total of 3 l of balanced electrolyte solution (Isolyte-S; Eczacibasi-Baxter, Istanbul, Turkey) or 0.9% isotonic NaCl was administered over the 24 h perioperative period. If necessary, intravenous ephedrine was given to maintain systolic blood pressure (SBP) above 90 mmHg. During postoperative days 2, all patients were visited by an anesthesiologist who was blinded to the size of spinal needle. Patients were interviewed about postoperative complaints such as PDPH, vertigo, nausea–vomiting, tinnitus, transient neurological symptoms and major neurological deficits.

Pure tone audiometry was performed with Clinical Audiometer AC 40 by the same audiologist 1 day before and 2 days after surgery with the ascending technique at frequencies of 250 to 6000 Hz in a noise-free audiometry laboratory. The audiologist was blinded to cases. The difference between preoperative and postoperative hearing thresholds of each ear was recorded. If the difference between hearing thresholds was above 25 dB it was recorded as clinically significant hearing loss, if the difference was between 10-25 dB it was recorded as subclinical hearing loss.

Blood serum levels of sodium, potassium, BUN and glucose were analyzed preoperative and postoperatively and serum osmolarity was calculated with the following Formula;

Osmolarity=2Na + 2K + BUN/2.8 + Glucose/18

(mosm/lt =mEq/lt + mEq/l t+ mg/dl+mg/dl)

Patients developing hypotension or headache after the spinal anesthesia that was severe enough to require treatment and those unable to cooperate in pure tone audiometric examination were excluded from the study.

Statistical analysis of demographic data was made by using Student's t-tests, comparison of variations in hearing thresholds with frequencies by Mann-Whitney U-tests, and comparison of cases found to have hearing loss >10 dB by Chi-square tests. $P < 0.05$ was considered significant.

Results

There were no significant differences in patient data or operation times ($P>0.05$; Table 1). The preoperative and intraoperative blood pressure and heart rate values in all groups were similar ($P>0.05$).

Table 1. Patient Characteristics and Operation Times.

Groups	Age (year) (Mean±SD)	Sex (n) (M/F)	Operation Time (min) (Mean±SD)
Group I (n=15)	47.93±13.40	13 / 2	31.33±10.60
Group II (n=15)	52.53±11.95	13/ 2	31.33±10.08

The differences between preoperative and postoperative day 2 hearing thresholds in each frequency for each ear are reported in Tables 2-3. There were no differences when the two groups were compared for mean change in hearing between the preoperative level and that on postoperative day 2, for right ear ($p>0.05$; Table 2). The differences between preoperative and postoperative day 2 measurements at 250 and 500 Hz frequencies were significantly higher at Group I for left ear ($p<0.05$; Table 3). No patient complained of clinical hearing loss in any groups. Subclinical hearing loss was seen in 10 patients and 4 patients in group I and group II, respectively. 7 patients in Group I and 2 patients in Group II had PDPH and this difference was statistically significant ($p<0.05$; Table 4).

Hipoosmolarity was seen 3 and 2 patients in group I and II, respectively and there were no statistically significance ($p>0.05$). There was subclinical hearing loss in 2 of 3 patients which had hipoosmolarity in group I and no patients of group II but this difference was not statistically significant ($p>0.05$). Two patients of each group had tinnitus and 1 of

each had subclinical hearing loss (p>0.05; Table 5). Nausea and vomiting were seen in 2 patients in each group. No patient complained of side effects like hypotension, bradycardia and TUR syndrome.

Table 2. Preoperative and postoperative hearing threshold differences of right ear (dB) (Means±SD).

	Group I (n=15)	**Group II (n=15)**
250 Hz	3.00±3.68	3.66±4.57
500 Hz	3.66±4.57	3.00±3.16
1000 Hz	2.00±3.08	1.33±1.29
2000 Hz	1.66±1.75	2.00±3.87
4000 Hz	3.00±2.53	2.33±2.28
6000 Hz	3.00±4.92	2.33±1.29

Table 3. Preoperative and postoperative hearing threshold differences of left ear (dB) (Means±SD).

	Group I (n=15)	Group II (n=15)
250 Hz	4.66±4.41*	2.00±4.14
500 Hz	4.00±3.16*	2.00±3.68
1000 Hz	2.33±2.28	2.00±2.07
2000 Hz	1.66±1.75	2.00±2.80
4000 Hz	3.00±4.60	2.66±3.08
6000 Hz	3.00±6.25	2.66±3.08
*P<0.05 when compared with group II		

Table 4. PDPH presence.

	Present		Absent		Total
	n	%	n	%	n
Group I	7*	46.7*	8	53.3	15
Group II	2	13.3	13	86.7	15
Total	9	13.3	21	75.6	30
*p<0.05 when compared with group II					

Table 5. Tinnitus Presence.

	Present		Absent		Total
	n	%	n	%	
Group I	2	13.3	13	86.7	15
Group II	2	13.3	13	86.7	15
Total	4	8.9	26	91.1	30

Discussion

Our data show that 22 G Quincke spinal needle caused more subclinical hearing loss and PDPH than 26 G Quincke spinal needle at 250 and 500 Hz frequencies. However, no patient complained of clinical hearing loss.

Spinal anesthesia is the most frequently used regional anesthesia technique in surgical procedures; however, rarely it may cause headache and hearing loss [8]. The incidence of subclinical hearing loss after spinal anesthesia is between 9-93% [9]. Although hearing loss after spinal anesthesia has been described, it is not generally considered a common complication of this technique, perhaps because most patients do not notice or report

hearing loss [10]. We also observed that no patient complained of clinical hearing loss in our study.

The size of the needle used for spinal block appears to play a role in postspinal hearing loss. The hearing loss may be a result of CSF leakage even when the CSF loss is insufficient to cause a PDPH. A decrease in CSF pressure following a dural puncture and CSF leak would cause a rapid and similar decrease in perilymph pressure. The endolymphatic system, however, responds much more slowly. Endolymphatic pressure volume adjustments are primarily the result of altered endolymph production at the stria vascularis or altered absorption at the endolymphatic sac. Therefore, an acute drop in CSF pressure could result in endolymphatic pressure sufficiently exceeding that of the perilymph to cause distortions of both Reissner's membrane and the basilar membrane. The consequent disruption in the position of the hair cells results in hearing impairment [11].

That the amount of fluid leakage, and thus the incidence of hearing loss, is related to the diameter of spinal needle used has been reported. Fog et al. [6] reported a 92% incidence of decreased hearing level with the use of a 22-G spinal needle but only a 29% incidence with the use of a 26-G needle. Oncel et al. [7] used pure tone audiometry preoperatively and postoperatively to assess hearing loss. One group received epidural anesthesia. In the other two groups, spinal anesthesia was performed with either a 22- or 25-gauge needle. No hearing impairments were detected in the epidural group. There was significantly greater hearing loss in the 22-gauge group versus the 25-gauge spinal group. None of the study patients developed PDPH. The authors suggested that pure tone audiometry may be a more sensitive indicator of CSF leakage than the presence of PDPH.

Sundberg et al. [12] have suggested that one of the factors influencing the amount of CSF leak is the shape of the needle. In the previous study, 22-gauge Whitacre and Quincke needles were used, with more frequent hearing loss in cases administered spinal anesthesia with the 22-gauge Quincke needles.

We observed that hearing loss was more frequent at low frequencies. Dreyer and Migdal [13] have stated that hearing loss resulting from spinal anesthesia is seen most often at frequencies between 125 and 250 Hz. Olgay et al. [14] and Lee et al. [15] also have found hearing loss after spinal anesthesia unilateral and at 250-500 Hz frequencies. Michel and Brusis [16] have stated that cochlear aqueduct can be unilaterally blocked so hearing loss can occur unilaterally.

Wang et al. [5] have suggested that, in addition to the diameter of needle, the irrigation solution used in transurethral resection is also a factor involved in hearing loss. This solution passes into the blood stream, hence changing the osmolarity between blood and CSF [5]. We found no statistically significant effect of hypoosmolarity on hearing loss.

Erol et al. [17] have stated that the type of spinal needle is one of the risk factors for hearing loss in patients who undergo spinal anaesthesia and they found hearing loss more with quincke needle. We use only different sized quincke needles in our study to evaluate the effect of needle size.

Several authors have suggested an association between PDPH and hearing loss like our study [5, 15, 16], whereas others described hearing loss without associated headache [6, 12].

In conclusion, it seems that the size of spinal needle is an important risk factor for hearing loss in patients who undergo spinal anesthesia for endoscopic urological surgery. Our study suggests that the use of small sized needles reduces hearing loss and PDPH after spinal anesthesia compared with the big sized needles. Small sized needles should be preferred.

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