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The effect of epidural anaesthesia and size of spinal needle on post-operative hearing loss

SEMIH ÖNCEL,* LEVENT HASEGELİ,† M. ZAFER UĞUZ,* SERDAR SAVACI,† KAZIM ÖNAL,* SEMIRAMIS OYMAN† (Izmir, Turkey)

Abstract

Forty-five patients who were to undergo elective urological operations were evaluated. In the pre-operative period and on the third or fourth post-operative day audiometry was performed. Epidural anaesthesia was performed in 15 cases, spinal anaesthesia was performed in 15 cases with 25 G needles, and in 15 cases with 22 G needles. No statistically significant hearing loss was observed in the post-operative period compared to pre-operative period in the epidural anaesthesia group. In the post-operative period, the hearing loss observed in the 25 G-spinal anaesthesia group was significantly ($P<0.01$) less than that seen in the 22 G group. None of the patients had headache after spinal anaesthesia. It was concluded that pure tone audiometry is a more sensitive indicator of cerebrospinal fluid leakage than post-operative headache.

Introduction

Epidural and spinal anaesthesia are used commonly. They are technically simple and if used correctly show very few side effects (Collins, 1976). Cranial nerve lesions following spinal anaesthesia have been reported, especially of the oculomotor, trochlear, abducens, facial and vestibulocochlear nerves. The incidence of vestibulocochlear nerve lesions is 2–3.7 per thousand cases (Panning *et al.*, 1983; Wang, 1986).

The object of this study was to investigate the effects of epidural and spinal anaesthesia on vestibulocochlear dysfunction, using pure tone audiometry performed pre- and on the third or fourth day post-operatively.

Material and methods

Forty-five urological patients (three female and 42 male) in good general health who were given anaesthesia in the State Hospital of Izmir were included in the study. The age distribution of the patients was between 23 and 84 (mean 62). In the pre-operative period the patients were evaluated systemically and any wax in the external ear canal was removed. Patients with severe hearing loss and those who could not co-operate in pure tone audiometry were excluded.

In the pre-operative period the pure tone audiogram was performed in the audiology laboratory of our hospital using AC 5 interacoustic clinic audiometry in a noise-free room.

The patients were randomly distributed into three groups. One hour before operation they were premedicated with 50 mg IM pethidine or 10 mg IM diazepam. After the patients were taken to the operating room at least 500 ml Isolyte-M infusion was given until spinal or epidural anaesthesia was achieved. Spinal anaesthesia and epidural anaesthesia were performed via L3–L4 with 4–5 ml 2 per cent lignocaine and 22–26 ml 2 per cent lignocaine respectively. Special care was taken to make sure that only one dural puncture was made in patients from the spinal anaesthesia group. If there was a doubt about a second dural puncture, the patient was excluded from the study. The systolic blood pressure was measured every five minutes using a non-invasive technique. In the event of a problem with blood pressure, appropriate medication was administered. The level of anaesthesia was determined by pin-prick testing and surgery was permitted only after it had been achieved.

In the post-operative period the patient was followed by the anaesthetist and evaluated for headache and III, IV, VI, VII and VIIIth cranial nerve function. On the third and fourth post-operative days, pure tone audiometry was performed blindly by an audiologist in the same audiology laboratory as in the pre-operative period.

The hearing in both ears was evaluated at frequencies 125 to 8000 Hz. In all groups the pre-operative minus the post-operative hearing levels were compared using the Student's *t* test (Tables I–III). Statistical analysis of the data were performed by Computer Research and Practical Centre of Ege University of Izmir.

Results

In none of the patients were post-operative headache or cranial nerve lesions observed.

In the group which received spinal anaesthesia via a 22 G needle, on the average there is 10 dB hearing loss in both ears at 125 Hz, 250 Hz and 500 Hz. At 1 KHz, 2 KHz, 3 KHz, 6 KHz an average 5–10 dB hearing loss was observed but no change at 8 KHz. (Figs. 1, 2).

From: 1st Department of Otorhinolaryngology* and Department of Anaesthesiology,† State Hospital, Yeşilyurt, Izmir, Turkey.
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TABLE I

CHANGE OF HEARING LEVEL (dB) WITH 18-GAUGE EPIDURAL NEEDLE. (PRE- MINUS POST-OPERATIVE VALUES)

	Frequency (Hz)								
Patient	125	250	500	1000	2000	3000	4000	6000	8000
1 R	0	0	0	+5	+10	0	0	0	−5
L	0	0	+5	0	0	−5	−5	0	0
2 R	+5	0	+5	−5	0	+5	+10	+5	+5
L	−5	0	0	0	0	+5	0	+5	0
3 R	0	−5	+5	0	+5	+10	+10	+5	0
L	0	0	−5	0	0	0	+5	0	0
4 R	+10	+5	0	0	0	+5	+5	0	+5
L	0	0	0	−5	−10	0	0	+5	0
5 R	0	0	0	+5	0	0	−5	0	−5
L	−10	−5	−5	−5	0	0	−5	0	5
6 R	0	−10	0	0	0	−10	−15	−20	−20
L	0	0	0	0	−5	0	+5	+5	+5
7 R	+5	0	0	0	0	0	−5	+5	+5
L	0	0	−5	0	0	+5	−5	−5	+5
8 R	−5	0	0	0	+5	+5	+5	0	0
L	+5	0	+5	0	0	0	0	0	+5
9 R	0	0	+5	+5	0	−5	0	−5	−5
L	+5	+5	0	0	0	0	0	+5	0
10 R	+5	0	0	−5	+5	+5	+10	+10	+10
L	−5	0	0	0	0	0	5	0	0
11 R	0	0	−5	0	0	−5	−5	−5	0
L	5	10	0	0	0	−5	−5	−5	0
12 R	5	0	0	−5	0	+5	+5	0	0
L	0	0	0	−5	0	0	0	−5	−5
13 R	+5	+5	0	0	0	+5	0	+5	0
L	0	0	0	+5	0	−5	0	0	0
14 R	0	+5	+5	0	+5	0	+5	−5	0
L	−5	0	0	0	0	−5	0	0	0
15 R	+5	0	0	0	+5	0	0	+5	0
L	0	0	+5	+5	0	−5	0	+5	0
Mean ± SEM									
R	2.33 ± 0.95	0.00 ± 0.97	0.33 ± 0.76	0.00 ± 0.84	2.33 ± 0.82	1.33 ± 1.33	1.33 ± 1.79	0.00 ± 1.83	−0.67 ± 1.75
L	−0.67 ± 1.08	0.66 ± 0.82	0.00 ± 0.84	−0.33 ± 0.72	−1.00 ± 0.72	−1.00 ± 0.87	−0.33 ± 1.79	0.00 ± 1.83	0.66 ± 0.66

Negative values indicate decreased hearing. Mean hearing loss in right and left ears is shown at each frequency. R, right ear; L, left ear.

TABLE II

CHANGE OF HEARING LEVEL (dB) WITH 22-GAUGE SPINAL NEEDLE. (PRE- MINUS POST-OPERATIVE VALUES)

	Frequency (Hz)								
Patient	125	250	500	1000	2000	3000	4000	6000	8000
1 R	−15	−15	−10	−10	−5	−5	−5	−5	−15
L	−10	−10	−15	−10	−5	−20	−10	−10	−10
2 R	−15	−10	5	−10	−15	−10	0	−5	−5
L	−15	−10	0	−5	−5	−5	0	−5	−5
3 R	−10	−5	−5	0	−10	−10	−15	−10	−5
L	−15	−10	−20	−5	−5	−15	−15	−10	−5
4 R	−5	−10	0	0	−10	−5	−5	−5	0
L	−10	−15	−5	−5	+5	0	−5	−10	−15
5 R	−10	−10	−5	0	+10	5	+5	+10	−5
L	−5	−5	−10	0	−10	0	0	−5	−5
6 R	−10	−5	0	−10	5	+5	0	−5	−5
L	−5	0	−5	−10	−5	+5	+10	0	0
7 R	0	−5	0	0	−10	0	+10	+10	+10
L	10	−5	−15	−10	+5	−10	−5	+5	+10
8 R	+10	0	−5	0	+5	0	+10	0	+5
L	−15	−5	0	+5	+10	−10	−5	−10	0
9 R	−5	−10	0	+10	−5	−5	−5	0	+5
L	−15	−5	−10	+5	−5	−10	−10	+5	0
10 R	−15	−5	0	−10	0	0	0	−10	−5
L	−10	−5	−5	0	+10	+5	+10	0	0
11 R	0	−10	−5	0	−10	+5	0	0	+5
L	−15	0	0	+5	−5	−10	−5	0	0
12 R	−15	−10	−10	−5	0	0	−5	−5	−5
L	−10	−10	−15	−10	−5	−5	−10	−10	−15
13 R	−15	−10	−5	−5	−10	−5	−10	−5	−5
L	−10	−15	−10	−10	−5	−10	−5	−5	0
14 R	−15	−15	−10	−5	−10	−5	−15	−5	−5
L	−15	−10	−10	−15	−5	−15	−15	0	0
15 R	−15	−10	−5	0	+5	0	−10	−5	−5
L	−10	−10	0	−10	−10	−10	−5	−5	0
Mean ± SEM									
R	−9.00 ± 1.96	−8.67 ± 1.03	−3.67 ± 1.14	−3.00 ± 1.45	+4.00 ± 1.96	−2.00 ± 1.27	−3.67 ± 2.15	−2.67 ± 1.53	−2.33 ± 1.61
L	−9.33 ± 1.94	−7.67 ± 1.18	−8.08 ± 1.68	−5.00 ± 1.69	−3.67 ± 1.50	−7.31 ± 1.88	−4.67 ± 1.92	−4.00 ± 1.40	−3.00 ± 1.68

Negative values indicate decreased hearing. Mean hearing loss in right and left ears is shown at each frequency. R, right ear; L, left ear.

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TABLE III

CHANGE OF HEARING LEVEL (dB) WITH 25-GAUGE SPINAL NEEDLE. (PRE- MINUS POST-OPERATIVE VALUES)

Patient	Frequency (Hz) 125	250	500	1000	2000	3000	4000	6000	8000
1 R	−5	0	−10	−15	−5	+5	−5	0	+10
L	−10	−10	−10	+5	+5	+10	+10	+10	+15
2 R	−15	−10	0	−10	+5	−5	0	+5	+5
L	−10	−10	−10	0	+10	+10	+10	+10	+10
3 R	−5	+5	−5	−10	−10	+5	−5	0	+5
L	−15	0	−10	−5	−10	−10	+5	0	−10
4 R	+10	+5	0	+5	+5	+10	−10	0	0
L	+5	+5	−10	−10	0	+5	−10	−5	−5
5 R	−5	−15	−10	−10	−5	+5	+5	0	0
L	−10	−10	−5	−15	−5	+5	−10	0	0
6 R	−15	−10	−10	+5	+5	+10	+10	+5	+15
L	0	+5	−10	0	+5	−10	−10	−5	+5
7 R	−10	+5	0	0	−10	−5	−10	0	0
L	−5	−5	0	−10	0	+5	0	−10	−5
8 R	+5	+5	+10	+5	+5	0	0	+5	−10
L	−5	−10	0	+5	0	−10	+5	−5	−10
9 R	0	+5	0	−10	−5	−10	−10	−5	−15
L	−5	−10	0	+5	−10	+5	0	+5	0
10 R	+5	+5	−5	−10	0	−10	0	0	0
L	+5	−10	−10	−5	−10	−5	+5	+5	+5
11 R	+5	0	+5	0	0	+5	0	−5	+5
L	0	+5	0	+5	−10	0	+5	0	+5
12 R	0	0	0	−5	−10	0	+5	−10	−10
L	−10	−5	+5	0	0	+5	−5	−10	−5
13 R	+5	+5	0	+5	0	0	0	+5	+5
L	0	−10	0	0	0	+5	−10	0	0
14 R	−10	+10	0	+5	+5	+10	0	0	0
L	−10	0	−10	0	0	+5	+5	0	0
15 R	+15	0	+5	0	−10	+5	0	0	0
L	+5	−10	−10	+5	0	−10	+5	0	0
Mean ± SEM									
R	−1.67 ± 2.16	−0.67 ± 1.82	−1.33 ± 1.50	−3.00 ± 1.88	−2.00 ± 1.60	0.33 ± 1.79	−0.67 ± 1.53	−0.00 ± 1.09	−0.67 ± 2.00
L	−4.33 ± 1.68	−5.00 ± 1.62	−5.33 ± 1.42	−1.33 ± 1.65	−1.67 ± 1.53	0.67 ± 1.94	−0.33 ± 1.92	−0.33 ± 1.58	−0.67 ± 2.06

Negative values indicate decreased hearing. Mean hearing loss in right and left ears is shown at each frequency. R, Right ear; L, left ear.

In the group which received spinal anaesthesia via a 25 G needle, at 125 Hz, 250 Hz, 500 Hz and 1 KHz an average of 5 dB unilateral hearing loss was detected. In these cases the hearing loss was most apparent at 125 Hz (Figs. 3 & 4).

In the patients who received epidural anaesthesia, no statistically significant hearing loss was detected at any of the frequencies (Figs. 5 & 6).

In comparing the epidural group and 25 G-spinal anaesthesia group for the average (of two ears) change in pure tone audiometry between the pre- and post-operative periods, there was a statistically significant hearing loss at 125 Hz ($P<0.05$). At other frequencies no statistically significant change was observed. In contrast to this, when the epidural group and 22 G spinal anaesthesia group

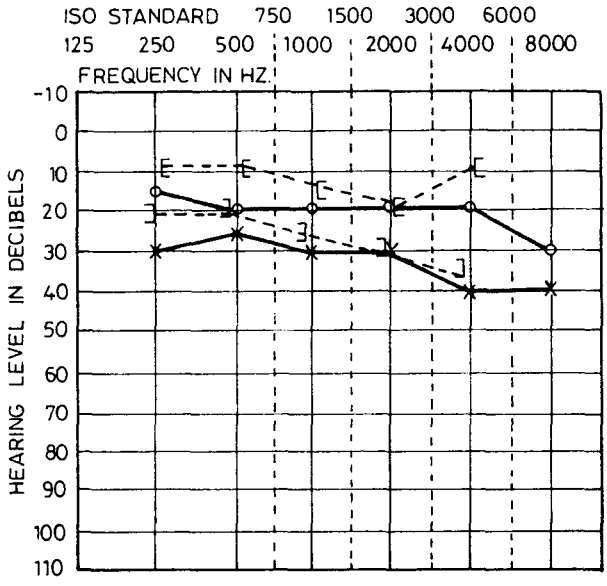

FIG. 1

Pre-operative audiogram of spinal anaesthesia via a 22 G needle, Case 1.

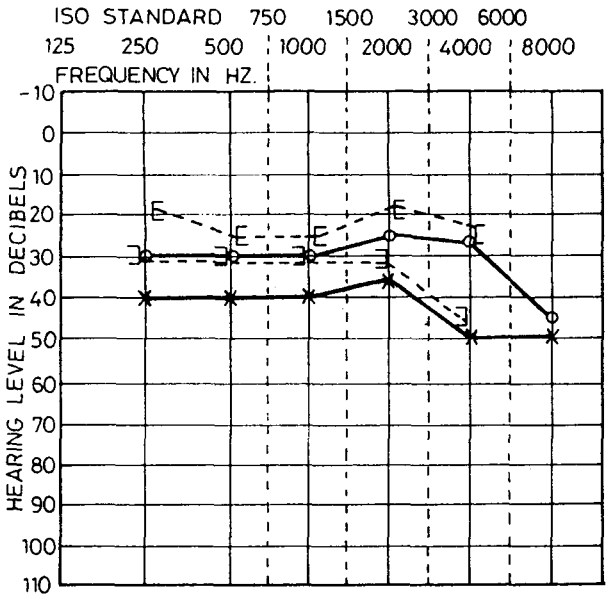

FIG. 2

Post-operative audiogram of spinal anaesthesia via a 22 G needle, Case 1.

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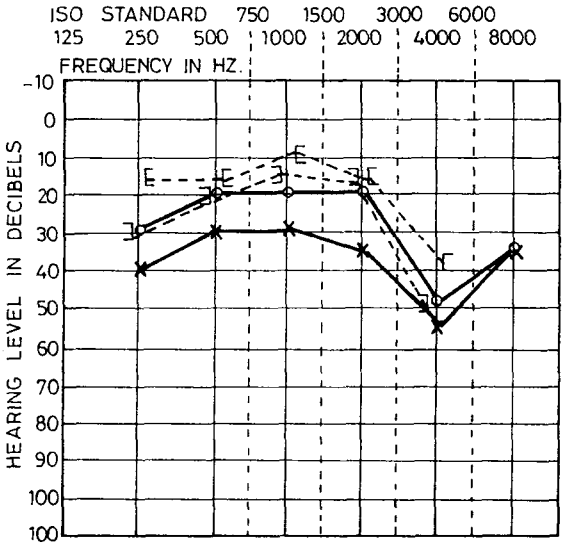

FIG. 3

Pre-operative audiogram of spinal anaesthesia via a 25 G needle, Case 1.

were compared for change in pure tone audiometry, a statistically significant hearing loss was detected at 125 Hz, 250 Hz, 500 Hz, 1 KHz, 2 KHz, 3 KHz, 4 KHz ($P<0.01$) and 6 KHz ($P<0.05$; no statistically significant loss was detected at 8 KHz.

When the 22 G and 25 G group were compared for change in hearing between the pre- and post-operative periods, a statistically significant difference was observed at 125 Hz, 250 Hz ($P<0.01$) and 4 KHz and 6 KHz ($P<0.05$). At other frequencies the difference was insignificant.

When the epidural and 25 G spinal groups where compared for right-sided thresholds, no statistically significant difference was detected at any frequency tested. On the left side a statistically significant change was detected only at 500 Hz ($P<0.01$); at all other frequencies the difference was insignificant.

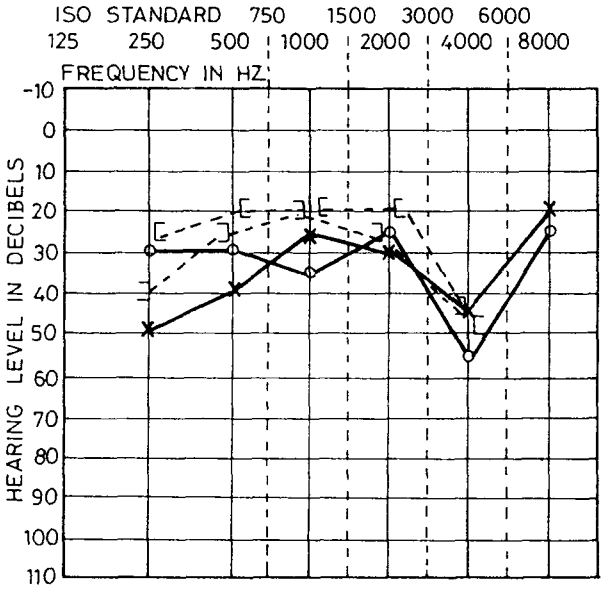

FIG. 4

Post-operative audiogram of spinal anaesthesia via an 25 G needle, Case 1.

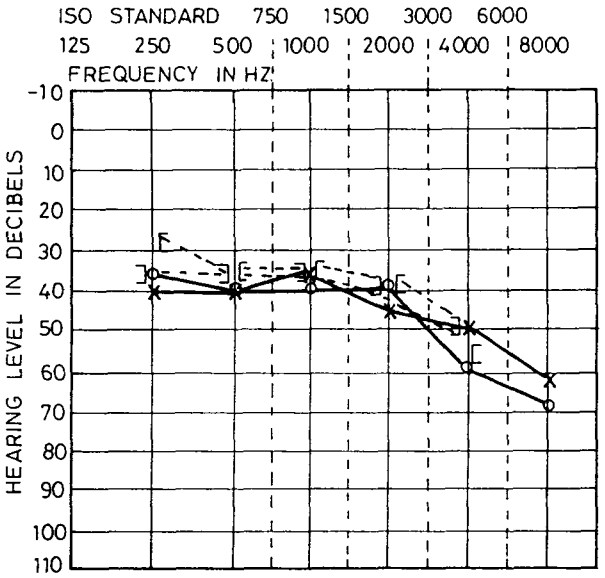

FIG. 5

Pre-operative audiogram of epidural anaesthesia via an 18 G needle, Case 1.

When the thresholds of patients from the epidural and 22 G spinal anaesthesia group were compared, for the right ear a statistically significant difference at frequencies 125 Hz, 250 Hz, 500 Hz ($P<0.01$) and 2 KHz ($P<0.05$) was observed. For the left ear, the significant differences were observed at 125 Hz, 250 Hz, 500 Hz, 3 KHz ($P<0.01$) 1 KHz and 6 KHz ($P<0.05$).

When 22 G and 25 G groups were compared, the right ear showed a statistically significant difference at 125 Hz ($P<0.05$) and 250 Hz ($P<0.01$). At all the other frequencies the difference was insignificant. For the left ear, a significant difference was observed at 3 KHz ($P<0.01$); at all other frequencies the difference was insignificant.

Discussion

Following spinal anaesthesia vestibulocochlear dys-

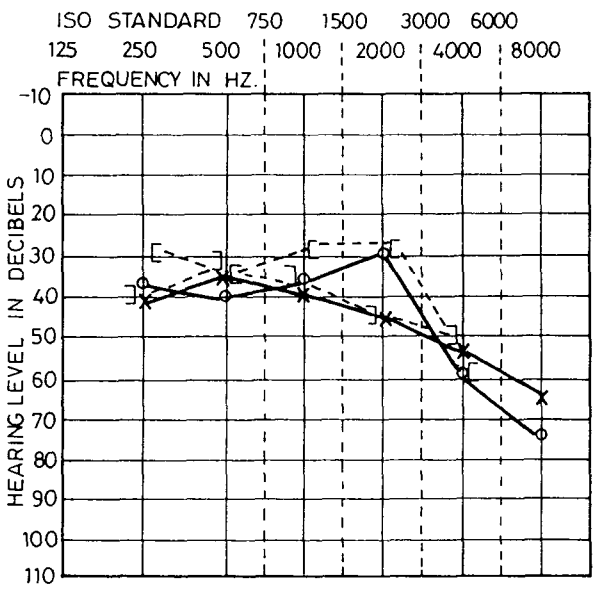

FIG. 6

Post-operative audiogram of epidural anaesthesia via an 18 G needle, Case 1.

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function has been quoted as occurring in 2–3.7 per thousand cases. Furthermore IIIrd, IVth, VIth and VIIth cranial nerve lesions have also been reported after spinal anaesthesia (Panning *et al.*, 1983; Wang, 1986). Usually these cranial nerve lesions are observed between the first and seventh post-operative day and complete recovery takes from 24 hours to 6 months. We have not observed any cranial nerve lesions in our patients.

After spinal anaesthesia, a transient hearing impairment could be observed. Usually recovery takes several months. Significant hearing losses are accompanied by headache (Wang *et al.*, 1987; Fog *et al.*, 1990). In our study an average of 10 dB hearing loss was observed in patients who received spinal anaesthesia with a 22 G needle. This hearing loss was mainly in the low frequencies and there was no reported headache.

The exact aetiology of vestibulocochlear dysfunction after spinal anaesthesia is unknown. Following dural puncture the pressure of the cerebrospinal fluid drops and this in turn could effect the inner ear through the cochlear aqueduct. As a result of decrease in the cerebrospinal volume perilymphatic pressure may drop and allowing endolymphatic volume to increase creating a situation comparable to endolymphatic hydrops (Fog *et al.*, 1990; Lee, 1990). In patients with Menière's disease, the first audiometric finding is hearing loss in the low frequencies. A similar type of hearing loss is observed possibly due to CSF loss after spinal anaesthesia with 22 G needle (Dittmann *et al.*, 1988; Lee, 1990). In the 25 G spinal anaesthesia group no statistically significant hearing loss was detected possibly because CSF loss was minimal. In the literature, no significant hearing loss following epidural anaesthesia has been reported (Wang *et al.*, 1987; Fog *et al.*, 1990). Likewise in our study no statistically significant hearing loss has been observed in cases who received epidural anaesthesia.

In conclusion our results show that pure tone audiometry is a more sensitive indicator of CSF loss than post-operative headache following spinal anaesthesia.

Key words: Anaesthesia, epidural; Audiometry.

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Address for correspondence:
Semih Öncel, M.D.,
Mithatpaşa Caddesi,
No. 424/2,
Izmir, Turkey.