Review article

Spinal anesthesia causing hearing loss: are we aware?

Hashim HZ[1], Mohamad I[1], Salim R[1], Ali S[2]

Abstract:
Sensorineural hearing loss can be attributed to many factors. Acoustic trauma, noisy environment, genetic syndromes, inner ear infection and tumors are the known well-established causes. Some of them are treatable but many of those are nonreversible. Recent literatures have shown some data that suggest this type of hearing loss also occurring post anesthesia, particularly in spinal anesthesia cases. Others claim that this hearing loss is temporary and clinically not significant.

Key words: hearing loss; anesthesia; spinal

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Introduction

Spinal anesthesia is a common anesthetic technique in surgical interventions involving the hernia, prostate, cervix, uterus and lower limbs. Hearing loss (HL) after spinal anesthesia has been described but it is not a major concern in the daily practice because it is not generally considered a common complication of this technique. Most patients post spinal anesthesia also do not notice or report hearing loss because the loss is usually at the low frequency and the HL after spinal anesthesia often disappears spontaneously[1].

It is believed that spinal anesthesia may lead to auditory dysfunction. Therefore, many authors have investigated HL in patients post spinal anesthesia. Many different attempts have been made to describe the HL related to spinal anesthesia. The auditory dysfunction has been defined as transient sensorineural HL in low frequency[2]. The previously reported incidence of auditory dysfunction after spinal anesthesia ranges between 0.2 and 0.8%, based on the incidence in which patients complained of a major hearing deficit[3].

Hearing Assessment

Many authors use pure tone audiometry (PTA) to assess the hearing level in their study and only few of them use Otoacoustic emissions (OAEs). Pure tone audiometer have been used for nearly hundred years as devices for determining hearing thresholds, which are then compared to established norms at various frequency. The tones were electrically generated. Specifications of the American National Standards Institute are imposed on all audiometers.

Same study by Karatas *et al*, (2006) using OAEs despite of PTA to measure the hearing impairment[4]. Physiologically, OAEs are acoustic signal that can be detected in the ear canal. They are low intensity sounds, generated within the normal cochlea that can be recorded in the external ear canal. They appear to originate from the motile activity of the outer hair cells and reflect the biomechanical processing that underlies the non linear operations responsible for

1. Hasme Zam Hashim, Department of Otorhinolaryngology-Head & Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia.
2. Irfan Mohamad, Department of Otorhinolaryngology-Head & Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia.
3. Rosdan Salim, Department of Otorhinolaryngology-Head & Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia.
4. Saedah Ali, Department of Anesthesiology, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kota Bharu, Kelantan, Malaysia.

Corresponds to: Dr Irfan Mohamad, Department of Otorhinolaryngology-Head & Neck,Surgery, School of Medical Sciences, Universiti Sains Malaysia Health Campus,16150Kota Bharu, Kelantan, Malaysia.
Email: irfankb@usm.my

the cochlea's high sensitivity, sharp tuning and wide dynamic range. OAE are stable, quick to obtain, unaffected by the action of anesthesia and providing frequency specific information about the functional integrity of the outer hair cells, so they are strongly proposed to monitor cochlear damage.

In certain condition OAE is more superior than PTA, such as in hearing screening of newborn infant and in monitoring early effect of ototoxic drugs. With the understanding that spinal anesthesia effecting the CSF and perilymph pressure, not direct to the outer hair cell, we believe that PTA is better than OAEs in the assessment of hearing post spinal anesthesia.

HL after Spinal Anesthesia

The occurrence of HL after spinal anesthesia is frequently associated with the post dura puncture headache (PDPH). PDPH is related with the patient age and on the basis of the hypothesis that patient age might get hearing loss similarly to PDPH, we compared the incidence of HL after spinal anesthesia in the young adult with that in the elderly by use of a standardized spinal needle and anesthetic technique. Gultekin *et al,(*2002) examined the HL after spinal anesthesia in young and old patients and reported higher incidence of transient HL in young patients[5]. However, Gulay *et al*, (2004) unable to show any changes in hearing level post spinal anesthesia in 60 young adult patients[6]. Several other reports are shown in Table 1.

Table 1: Available reports to demonstrate relation between age and post SA HL5-9

Source	Patients, n	Median age	Needle G	Hearing loss frequency	Having hearing loss (%)
Wang et al, 1987	14	65	22	Low	42.9
Lamberg et al, 1997	16	68	22,25	Mid	43
Fog et al, 1990	14, 14	67.4, 70.7	22, 26	Low	93, 29
Gultekin et al, 2002	25, 25	23.5, 67.9	22	Low	52, 16
Gulay at el, 2004	60	35.3	22	-	Nil

Spinal anesthesia (SA) involves the use of small amounts of local anesthetic drug injected into subarachnoid space. It generally produces a reversible loss of sensation and motor function below the umbilicus. SA provides excellent operating conditions for the surgical procedures below the umbilicus such as hernia repairs, genitourinary procedures, orthopedic procedures from the hip down and obstetric/gynecologic procedures of the uterus and perineum. The incidence of hearing loss in patients receiving SA is 10 – 15 %, most of them are low frequency deficit and less than one forth of these patients have a clinical or noticeable hearing loss,[10]. The first case of hearing loss associated with SA was reported by Terrien *et al,* in 1914 but there was no audiometric study done.

Walsted *et al,* (1993) tested 34 patients with audiometry before and after SA. Most of the patients had a small but significant threshold shift at 500 Hz. However, one patient developed a considerable unilateral HL in the low-frequency range, which persisted until an epidural blood patch was performed[11].

Gultekin *et al,* (1998) used PTA to test hearing before and after SA for hernia repair. Fourteen patients (32%), despite being unaware of it, had audiometrically measurable low frequency hearing losses. All SA were performed with 22 gauge (G) Quincke needles and they suggested that hearing loss was less frequent when the anesthetic agent was bupivacaine rather than prilocaine[12].

They suggest that this difference may caused by differences in the osmotic or other physical properties of the two local anesthetic preparations, which affect the cerebrospinal pressures differently.

In a study by Panning *et al* (1984), 100 patients undergoing elective urologic procedures under SA, eight patients experienced noticeable hearing impairment. Audiometry was performed on three of the patients; the timing of the audiometry not reported and revealed a 30dB loss in the low frequency range. Hearing deficits usually resolved within three days to seven month without treatment[1].

The incidence of hearing loss after SA for men less than 30 year of age was compared to that in men over the age of 60 by Gultekin *et al*, 2002[5] Fifty two percent (13 of 25) of the younger and 16% of the older patients had significant hearing losses confined to low frequency range. Mild hearing loss, defined as a loss of 10 to 20 dB at two or more fre-

quencies, occurred three times more often in the younger patients compared with the older men. There were no hearing impairment in the speech frequencies (500-2000 Hz) and higher frequency for either group. No patient aware of a hearing deficit and no patient developed a PDPH. Transient hearing loss was more common in younger patients after SA, perhaps because the CSF leakage after dural puncture is less in the elderly than in the young. This finding is also associated with the infrequent incidence of PDPH in the elderly.

Needle Size and Design

The size of the needle used for dural puncture appears to play a role in post spinal anesthetic hearing impairment. The hearing loss may be a result of CSF leakage even when the CSF loss is insufficient to cause a PDPH. Oncel *et al,* (1992) used PTA at 125Hz preoperatively and postoperatively to assess hearing loss. Three groups of 15 patients were studied. One group received epidural anesthesia. In the other two groups, SA was performed with either a 22 G or 25 G needle. No hearing impairment was detected in the epidural group. There was significantly greater HL in the 22 G group compare to the 25 G spinal group. None of the study patient developed a PDPH. The authors suggested that PTA may be more sensitive indicator of CSF leakage than the presence of PDPH[13].

Needle design may also play a role in hearing impairment following lumbar puncture. Using audiometry, Sundberg *et al*, (1992) compared the effect of 22 G cutting tip (Quincke type) to 22 G pencil-point (Whitacare type) needles on post spinal HL. A hearing loss of at least 10 dB at two or more frequencies below 1 kHz was observed in 6 of 25 (24%) patients in the Quincke group as compared to only 2 of 23 (9%) in the Whitacare group. In addition, of those patients with hearing deficits, the mean hearing level was significantly worse in the Quincke group. This study suggests an association between the design of the spinal needle tip and postoperative hearing dysfunction that is similar to the relationship between the needle types and the incidence of PDPH, implying a similar pathogenesis[14]. We are conducting study using 25 G Quincke type spinal needle because it is commonly used in our set up.

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