

CASE REPORT

Noise through Bone Conduction—Differential Diagnosis for the Type of Hearing Loss

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ABSTRACT

Aim: The study aims to assess the threshold shift in sensorineural acuity level (SAL) test and bone conduction speech recognition threshold (BC_{SRT}) in mixed and sensorineural hearing loss.

Background: The diagnosis of moderate mixed hearing loss and sensorineural hearing loss is unclear when the air-bone gap (ABG) is at 15 to 20 dB. The study was designed to arrive at the accurate diagnosis of moderate mixed hearing loss and sensorineural hearing loss.

Case description: The study includes five participants diagnosed with bilateral normal hearing ($n = 1$), bilateral conductive hearing loss ($n = 1$), bilateral sensorineural hearing loss ($n = 1$), and those with bilateral moderate loss with an ABG of 15 to 20 dB ($n = 2$). Conventional pure tone audiometry, speech audiometry, immittance, reflexes, and distortion product otoacoustic emission were administered.

Conclusion: The BC_{SRT} was almost the same in confirmed normal hearing and conductive hearing loss participants because their BC sensitivity was within the normal limit. BC_{SRT} was high in individuals with sensorineural hearing loss and mixed hearing loss. In addition, the amount of threshold shift in SAL was taken into consideration for the diagnosis.

Clinical significance: The amount of threshold shift in the SAL test with accompanying BC_{SRT} concludes that the presence and absence of infection in the middle ear thereby lead to an accurate diagnosis.

Keywords: Bone conduction speech recognition threshold, Mixed hearing loss, Sensorineural acuity level.

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BACKGROUND

Many a time diagnoses of moderate mixed hearing loss and sensorineural hearing loss (SNHL) are confusing if a patient's air-bone conduction gap (ABG) is at 15–20 dB with A-type tympanogram. The possible reason is the variability of pure tone thresholds which accounts for 5–10 dB.¹ Most often to lessen confusion, other diagnostic tests such as otoacoustic emission and reflex thresholds are administered. But, these test results may show absence due to hearing loss. Even then confusion is still being present but administering these tests to the test battery merely adds up unnecessary clinical expenses and increases in clinical time. Considering cost and time factors, it is imperative to use a sensorineural acuity test. In the SAL test, narrowband noise is presented through the bone conduction at the forehead. The difference between masked and unmasked thresholds is calculated. The shift in threshold after introducing a noise gives an idea of the origin of the problem in the auditory pathway. It is a well-established fact that bone conduction is a test to assess the acuity of a sensorineural component. Thus, it is assumed that sensorineural acuity level may accurately diagnose patients with having either SNHL or mixed hearing loss, especially for patients who have an ABG of 15–20 with A tympanogram. It is hypothesized that if a patient is suffering from SNHL, then the shift between the unmasked and masked threshold would be less than in a patient suffering from mixed hearing loss. In addition, to validate SAL, the bone conduction speech recognition test (BC_{SRT}) was also administered. The following objective is utilized to assess the threshold shift in SAL (at 500 Hz, 1 and 2 kHz) and BC_{SRT} from the participants of the study.

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CASE DESCRIPTION

A total of five participants were involved to determine the threshold shift in SAL and BC_{SRT} from the study participants. Conventional pure tone audiometry,² speech audiometry,³ immittance, and reflexes⁴ were administered on these five participants. In addition, if required, distortion product otoacoustic emission (DPOAE) was administered. The results of audiological evaluation revealed that the participants had confirmed bilateral normal hearing sensitivity (hereinafter AB), bilateral moderate conductive hearing loss (hereinafter AC), and bilateral moderate sensorineural hearing loss (hereinafter AD) (Fig. 1). However, the other two participants had bilateral moderate loss with ABG of 15 to 20 dB with A-type tympanogram, absent reflexes, and absent DPOAEs in them. These audiological findings in them were unable to be accurately diagnosed. Thus, SAL and BC_{SRT} were performed. The complete audiological profile of all five participants is represented in Table 1.

Table 1: Audiological findings from participants of the study

Particulars	AB	AC	AD	AE	AF
Age (years)	25	40	55	49	53
Complaints	—	Blocking sensation	Reduced hearing	Blocking sensation and reduced hearing	Unable speech in noise and reduced hearing
PTA (dB HL)	10	55	50	53.3	56.3
Average ABG (dB) (from 0.25 to 2 kHz)	—	40	5	20	20
SRT (dB)	10	45	45	50	45
SIS (%)	100	100	96	96	96
Tympanogram	A	B	A	A	A
Reflexes	Ipsi- and contra-present	Ipsi- and contra-absent	Ipsi- and contra-elevated	Ipsi- and contra-absent	Ipsi- and contra-absent
DPOAEs	Present	Absent	Absent	Absent	Absent
Provisional diagnosis	Hearing sensitivity within the normal limit	Conductive hearing loss	SNHL	??	??

PTA, pure tone threshold; SRT, speech recognition threshold; SIS, speech identification score; DPOAE, distortion product otoacoustic emission; ABG, air-bone conduction gap

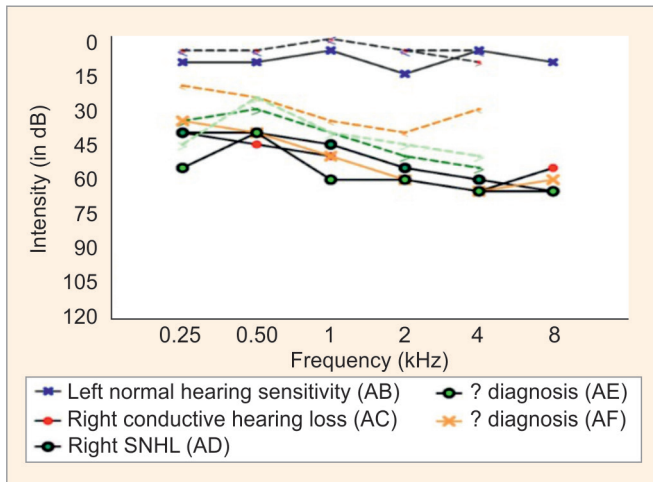


Fig. 1: Hearing thresholds of subjects

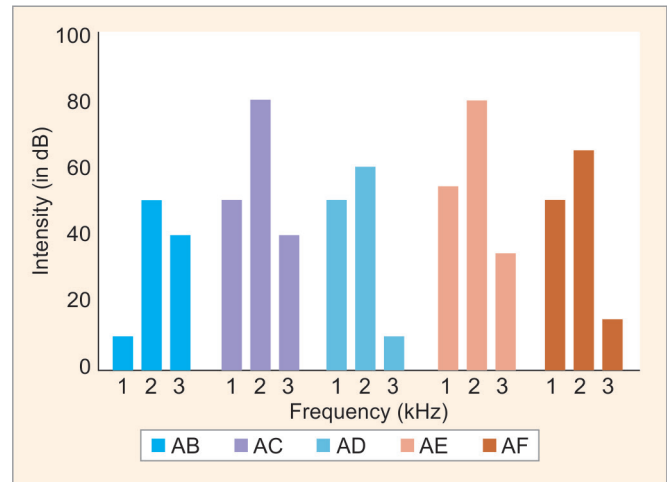


Fig. 2: Results of SAL test

Sensorineural Acuity Level Test

The procedure given by Jerger and Tillman⁵ was adopted to assess the sensorineural acuity level. Initially, air conduction pure tone threshold for frequencies 0.25 to 2 kHz (in octaves) was obtained through bracketing method (-10 and +5 dB).⁶ A bone vibrator was positioned at the forehead and a circumaural headphone was placed on each participant’s ears. A narrowband masking noise corresponding to a pure tone was delivered through a calibrated bone vibrator at a maximum level of 55 dB. Masked air conduction pure tone threshold for frequencies 0.25 to 2 kHz in octaves was obtained. A threshold shift was calculated by taking the difference between masked and unmasked thresholds (Fig. 2).

BC_{SRT}

The bone vibrator was positioned at the test-ear mastoid. Three spondees were presented at +12 dB above the best BC. If two or three spondees were repeated correctly out of three, then the

intensity was reduced by 5 dB. If only one spondee or unable to repeat it correctly out of three, then the intensity is increased by 10 dB. With this bracketing method, a low-intensity level at which at least 2/3 responses were obtained was considered as BC_{SRT}. To derive genuine BC_{SRT} in the target test ear, a masking noise was presented to the contralateral ear through an insert receiver. The level of noise delivered was the AC threshold of the contralateral ear and its ABG (Fig. 3).

DISCUSSION

The threshold shift in the SAL test for each frequency and BC_{SRT} from study participants was descriptively analyzed. The results of the SAL test for 1 kHz and BC_{SRT} from the study participants are depicted in Figure 1. The markings of 1, 2, and 3 in Figure 1 represent an unmasked threshold, masked threshold, and a threshold shift, respectively, for 1 kHz from the SAL test for each participant.

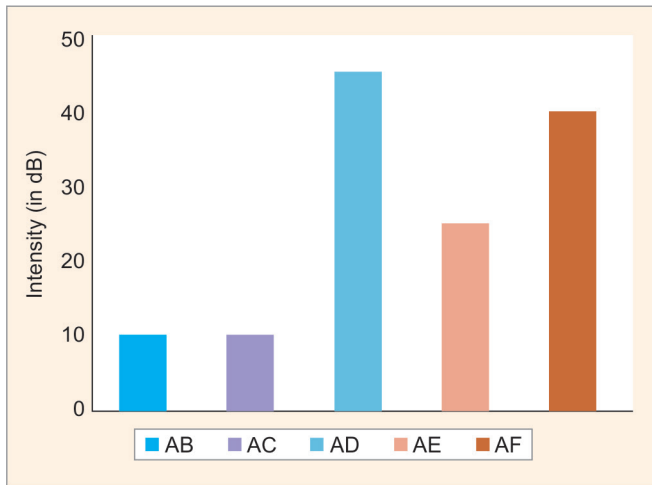


Fig. 3: Results of BC_{SRT}

The BC_{SRT} was almost the same in confirmed normal hearing (AB) and conductive hearing loss (AC) participants because their BC sensitivity was within the normal limit. However, BC_{SRT} was obtained at 45 dB in confirmed cases of SNHL (AD). In the case of SNHL, the cochlea is affected and the destiny of the BC pathway at the peripheral level is the cochlea. In SNHL, the cochlea is damaged; thus, the level required for BC_{SRT} was high. The BC_{SRT} for AE and AF were 25 and 45 dB, respectively. The results BC_{SRT} gives are the notion that in both cases the cochlea is affected but a relatively higher damage might be in the case of AF than AE which was reflected in the BC_{SRT} test.

CONCLUSION

The amount of threshold shift in the SAL test with accompanying BC_{SRT} concludes the presence and absence of infection in the middle ear, thereby leading to an accurate diagnosis.

CLINICAL SIGNIFICANCE

The results of the SAL test on these dilemma cases of the present study throw light on accurate diagnosis. It gives a sign of infection if present in the middle ear to the otolaryngologist for further management.

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