

A preliminary study of endoscopic acoustic stapedial reflex in chronic otitis media

Munahi M. Al-Qahtani, MBBS, KSUF, Abdulrahman A. Hagr, MBBS, FRCS(c).

ABSTRACT

الأهداف: البدء باستخدام التنظير الداخلي للمنعكس الركابي السمعي (EASR) كطريقة لاختبار حركة الركاب عند الإصابة بالتهاب الأذن الوسطى المزمن (COM).

الطريقة: لقد تم إجراء هذه الدراسة الاستطلاعية خلال الفترة من فبراير 2008م إلى فبراير 2009م حيث قصد المرضى المصابين بالتهاب الأذن الوسطى المزمن عيادة الأذن في مستشفى جامعة الملك عبدالعزيز، الرياض، المملكة العربية السعودية. لقد تم فحص الأذن الوسطى عند المصابين بواسطة منظار الأذن الداخلي الصلب لمعاينة وتر عضلة الركاب وقاعدة عظمة الركاب، و يحصل المنعكس الركابي عند سماع المؤثر الصوتي ذو النبضات. لقد تمت معاينة اهتزاز عضلة الركاب وحركة عظمة الركاب وذلك عند تعرض نفس الأذن المختبرة وكذلك الأذن الأخرى غير المختبرة للمؤثر الصوتي.

النتائج: لم يكشف قياس الطبلية الاعتيادي عن أي منعكس ركابي في أي من المرضى العشرة إلا أنه تم معاينة منعكس سمعي ركابي في كل المرضى. لم تتحرك عظمة الركاب عند مريض واحد وذلك بالرغم من معاينة اهتزاز عضلة الركاب وقد تم تحويله إلى قسم الجراحة لإجراء عملية ترميم الركاب. لقد تجاوب كل المرضى مع الاختبار من دون مضاعفات أو آثار جانبية.

خاتمة: تم عمل تنظير داخلي للمنعكس السمعي الركابي لأول مرة. يكثر استخدام اختبار المنعكس الركابي نظراً لقيمته، كما أنه يوفر طريقة آمنة ومُعتمدة لتقييم حركة الركاب.

Objectives: To introduce the endoscopic acoustic stapedial reflex (EASR) as a technique for assessing stapedial mobility in ears with chronic otitis media (COM).

Methods: This prospective study was performed from February 2008 to February 2009, patients with COM presented to the Otology Clinic, King Abdul-Aziz University Hospital, Riyadh, Kingdom of Saudi Arabia were examined with a rigid ear endoscope to visualize the stapedius tendon and the head of stapes. The reflex is elicited by pulsed sound stimuli. The stapedius muscle contraction and the mobility of the stapes are visualized

during exposure ipsilaterally, and contralaterally to sound stimuli.

Results: Conventional tympanometry did not detect a stapedial reflex in any of the 10 patients. Acoustic stapedial reflex was detected in all ears. Despite a visible stapedial muscle contraction, one patient did not demonstrate stapes movement, and was confirmed to have stapes fixation at surgery. All patients tolerated the test with no complications, or side effects.

Conclusion: The EASR was introduced for the first time. In addition to the well-known value of the stapedial reflex testing, it provides a safe, and reliable method for assessment of stapes mobility.

Saudi Med J 2010; Vol. 31 (8): 900-903

From the Department of Otolaryngology and Head and Neck Surgery (Al-Qahtani), Riyadh Military Hospital and Department of Otolaryngology (Hagr), King Abdul-Aziz University Hospital, Riyadh, Kingdom of Saudi Arabia.

Received 25th May 2010. Accepted 12th July 2010.

Address correspondence and reprint request to: Dr. Munahi M. Al-Qahtani, Department of Otolaryngology and Head and Neck Surgery, Riyadh Military Hospital, PO Box 102000, Riyadh 11665, Kingdom of Saudi Arabia. Tel. +966 505214374. Fax. +966 (1) 4738100. E-mail: munahi_alqahtani@hotmail.com

Acoustic stapedial reflex (ASR) is an important diagnostic test in otology practice.¹ It provides quick objective information of the status of the middle ear, cochlea, cochlear nerve, brainstem, and facial nerve. Contraction of the stapedius muscle increases the stiffness of the ossicular chain and tympanic membrane. This minor increment of impedance is recorded during

Disclosure. This study was funded by the College of Medicine Research Center, King Saud University, Riyadh, Riyadh, Kingdom of Saudi Arabia (Grant No07-601).

immittance audiometry. However, ASR cannot be measured with this method in the ears with chronic otitis media (COM) because of the presence of tympanic membrane perforations or severe retractions. Middle ear endoscopy (MEE) is commonly used as an adjunct in the diagnostic evaluation of patients with suspected middle ear conditions.² It increases the accuracy of pre-surgical diagnosis in conductive hearing loss.² Exploratory surgery of the middle ear may be avoided, or definitive procedures may be planned better based on endoscopic findings.³ In these above-mentioned studies, the stapes have been assessed either by inspection only or by palpation. However, the stapes mobility could not be tested by inspection only and the stapes palpation is a subjective testing, which may traumatize the inner ear. In this study, we introduce a technique for measuring the stapedial reflex in previously untestable ears using MEE.

Methods. The Research Ethics Committee of King Saud Medical College, Riyadh, Saudi Arabia approved the study. Patients aged ≥ 16 years with COM were included in this study. The study took place in the Otolaryngology Clinic of King Abdul-Aziz University Hospital, Riyadh, Kingdom of Saudi Arabia between February 2008 to February 2009. All of the consent was obtained prior to the procedure. None of the patients reported a history of dead ear, surgical intervention for ear disorder, or facial nerve paralysis. All patients had tympanic membrane perforation and/or severe retraction. Patients underwent standard pure tone audiogram and tympanograms followed by endoscopic examination. The procedure is performed by inserting the endoscope along the floor of the ear canal; care was taken not to touch the skin of the ear canal. The endoscope was advanced until a satisfactory view of the stapedial tendon and stapes were obtained (Figures 1 and 2). The middle ear was directly visualized by the endoscope connected to a video camera and monitor in the ENT clinic. Patients were excluded from the study if visualization of the stapes and/or the stapedius tendon was not achieved. A Barany's noise box was used to provide repeated pulsed noise stimuli on each ear separately during the examination of the diseased ear. The EASR was considered to be positive if there is a clear detectable contraction of the stapedius tendon in response to the noise stimuli. Stapes mobility is confirmed if the stapedius muscle tendon contraction was seen to move the stapes head.

Results. Ten patients (10 ears) were included in the study; 7 males, and 3 females with an age range of 16-40 years (mean 26 years). All patients had conductive

hearing loss in the diseased ear with type B tympanograms (Table 1). Five patients had bilateral and 5 had unilateral COM. Five ears of the bilateral cases were excluded because of previous ear surgery in 2 ears and due to failure of identifying the stapedius tendon in 3 wet ears. In all patients, the EASR with ipsilateral and contralateral stimulation were detected and video recorded. The contractions of stapedial tendon and stapes movement are synchronous with the noise stimuli. All patients had stapes movement detected using this technique except one patient who had stapes fixation (confirmed intraoperatively). The patient had a chronic suppurative otitis media (CSOM) with foci of tympanosclerosis near the stapes footplate (Figure 3). Three patients with a mobile stapes underwent middle ear surgery and stapes mobility was confirmed intraoperatively. All patients tolerated this test with no complications and patients were willing to undergo this test again.



Figure 1 - Endoscopic view obtained from a 25-year-old male with zero degree endoscope shows subtotal perforation of tympanic membrane. The endoscopic acoustic stapedial reflex is present with mobile stapes.



Figure 2 - Endoscopic view obtained from 24-year-old male with zero degree endoscope. Adhesive otitis media. Note the head of stapes, stapedial tendon, handle of malleus and only the body of the incus is present. The endoscopic acoustic stapedial reflex present with mobile stapes.

Table 1 - Results of the investigations.

Patient No.	Diagnosis	Examined ear	Average right ear (dB) [*]		Average Left ear (dB) [*]		Ipsilateral EASR	Contralateral EASR	Stapes movement
			BC	AC	BC	AC			
1	Bilateral CSOM	Right	20.0	49.0	26.0	54.0	+	+	+
2	Right adhesive OM Left CSOM	Left	17.5	54.0	11.0	21.0	+	+	+
3	Left CSOM	Left	15.0	15.0	24.0	59.0	+	+	+
4	Bilateral CSOM	Right	17.5	42.5	17.5	45.0	+	+	-
5	Left CSOM	Left	26.0	26.0	29.0	55.0	+	+	+
6	Left CSOM	Left	14.0	14.0	14.0	45.0	+	+	+
7	Bilateral adhesive OM	Right	42.5	79.0	52.5	91.0	+	+	+
8	Right CSOM	Right	19.0	76.0	22.5	22.5	+	+	+
9	Bilateral CSOM	Left	7.5	31.0	6.0	34.0	+	+	+
10	Right CSOM	Right	10.0	39.0	20.0	20.0	+	+	+

CSOM - chronic suppurative otitis media, OM - otitis media, EASR - endoscopic acoustic stapedial reflex, dB - decibel, BC - bone conduction, AC - air conduction. ^{*}0.5,1,2,3 kHz



Figure 3 - Endoscopic view obtained from a 35-year-old male with zero degree endoscope. Tympanosclerotic foci were present anterior to the footplate. No stapes movement occurred, although stapedial muscle tendon contraction did, during endoscopic acoustic stapedial reflex.

Discussion. Endoscopes yield extraordinary views of the middle ear, and eustachian tube, an advantage for diagnostic examinations.⁴ However, ear endoscopic procedures entail several disadvantages. The major drawbacks of its uses are the cost, and rare dizziness due to heating of the middle ear.³ Also, the endoscopic images are not 3-dimensional, requiring the cooperation of the patient, and therefore may not be suitable for all patients specially children. However, in the hands of experienced otologists, this technique is extremely useful in the assessment of the external auditory canal, tympanic membrane, and middle ear, as these drawbacks are minor compared with the advantages gained by this

simple procedure.⁴ Recently, Kakehata et al,³ concluded that the transtympanic endoscopic procedure using laser-assisted myringotomy is a direct and reliable preoperative diagnostic method for conductive hearing loss that offers better surgical indications and patient consultation. They reported precise evaluation of the condition of the ossicular chain, particularly around the incudostapedial joint and the stapes, which helped in the preoperative counselling of patients. However, stapes mobility cannot be assessed by inspection only. Karhuketo et al,⁵ used ear endoscopes to increase the diagnostic accuracy in conductive hearing loss. They relied on direct palpation of stapes to evaluate its mobility based on the experience of the examiner, which is a subjective testing, technically difficult and runs a risk of trauma to the ossicular chain that may carry a risk of sensorineural hearing loss. We introduce here an objective and safer technique with less chance of causing trauma that give additional information on central pathways. The EASR provides an objective, minimally invasive, reliable, and quick tool to study the movement of the stapes in cases of COM. The pre-surgical diagnosis of stapes fixation may offer better surgical planning, and patient counseling. Patients with a mobile stapes can be treated with a single-stage tympanoplasty. On the other hand, patients with stapes fixation and TM perforation may require a 2-staged procedure. Restoration of hearing in patients with stapes fixation carries the risk of dead ear, and limiting surgery to myringoplasty may worsen the conductive hearing loss. Therefore, many patients get hesitant to undergo tympanoplasty with the chance of 2 surgeries, or risk of dead ear. Intra-operative testing

for stapes mobility is a subjective testing, and it carries a risk of sensorineural hearing loss especially in ears with tympanosclerosis. These problems make it difficult to predict the outcome. The EASR may be utilized for locating the level of lower motor facial palsy in the presence of perforated TM where the conventional sound probe method cannot be used. The technique may also provide a direct examination for the contraction of stapedius muscle in patients with stapedius myoclonus. This will help the patient to understand his/her disease and get more involved in the management since proper preoperative counseling and selection of patients is very important to minimize surgical complications as well as high patient satisfaction. Likewise, this technique can be used intra-operatively to check the stability of ossicular reconstruction during ossiculoplasty.

The limitation of this study is the sample size, and we recommend more studies in this field with larger sample size. Moreover, other researchers to include some other interesting potential applications for the EASR may extend this study. A quantitative measurement of the acoustic reflex threshold and acoustic reflex decay could be studied using this technique, which may yield interesting findings.

We propose this test to be the method of choice in the evaluation of stapes fixation in most patients with CSOM and should be used as a primary indicator for stapedectomy in these patients. It may be useful to detect the threshold of this reflex and avoid the high noise of Barany's box, which theoretically could cause

permanent threshold shift, although recommendations for testing level vary due to a lack of published data. However, this technique for acoustic reflex holds promise for predicting the outcome of middle ear surgery, and studies of middle ear pathology.

In conclusion, endoscopic ASR has not been reported before. It is a safe and effective method for determining the presence of the acoustic reflex. It is particularly useful in ears with tympanic membrane perforation, or retraction when immittance cannot be measured. It can detect the presence of a reflex even in the presence of ossicular fixation.

Acknowledgment. *The author would like to thank the Medical Center of King Abdul-Aziz University Hospital, Riyadh, Saudi Arabia and the patients who participated in the study.*

References

1. Keefe DH, Fitzpatrick D, Liu YW, Sanford CA, Gorga MP. Wideband acoustic-reflex test in a test battery to predict middle-ear dysfunction. *Hear Res* 2010; 263: 52-65.
2. Fritsch MH. Endoscopy of the inner ear. *Otolaryngol Clin North Am* 2009; 42: 1209-1222.
3. Kakehata S, Futai K, Kuroda R, Shinkawa H. Office-based endoscopic procedure for diagnosis in conductive hearing loss cases using OtoScan Laser-Assisted Myringotomy. *Laryngoscope* 2004; 114: 1285-1289.
4. Koch M, Mantsopoulos G, Iro H, Zenk J. Mini-endoscopy in the head and neck region. *HNO* 2010; 58: 325-332.
5. Karhuketo TS, Puhakka HJ, Laippala PJ. Tympanoscopy to increase the accuracy of diagnosis in conductive hearing loss. *J Laryngol Otol* 1998; 112: 154-157.