MRI, not CT, to Rule out Recurrent Cholesteatoma and Avoid Unnecessary Second-Look Mastoidectomy

Lela Migirov MD[1], Sigal Tal MD[2], Ana Eyal MD[2] and Jona Kronenberg MD[1]

Departments of [1]Otolaryngology and Head and Neck Surgery and [2]Radiology, Sheba Medical Center, Tel Hashomer and Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Israel

ABSTRACT: **Background:** Aural cholesteatoma is an epidermal cyst of the middle ear or mastoid that can be eradicated only by surgical resection. It is usually managed with radical or modified radical mastoidectomy. Clinical diagnosis of recurrent cholesteatoma in a closed postoperative cavity is difficult. Thus, the accepted protocol in most otologic centers for suspected recurrence consists of second-look procedures performed approximately 1 year after the initial surgery. Brain herniation into a post-mastoidectomy cavity is not rare and can be radiologically confused with cholesteatoma on the high resolution computed tomographic images of temporal bones that are carried out before second-look surgery.

Objectives: To present our experience with meningoceles that were confused with recurrent disease in patients who had undergone primary mastoidectomy for cholesteatoma and to support the use of magnetic resonance imaging as more suitable than CT in postoperative follow-up protocols for cholesteatoma.

Methods: We conducted a retrospective chart review of four patients.

Results: Axial CT sections demonstrated a soft tissue mass in the middle ear and mastoid in all four patients. Coronal reconstructions of CT scans showed a tympanic tegmen defect in two patients. CT failed to exclude cholesteatoma in any patient. Each underwent a second-look mastoidectomy and the only finding at surgery was meningocele in all four patients.

Conclusions: Echo-planar diffusion-weighted MRI can differentiate between brain tissue and cholesteatoma more accurately than CT. We recommend that otolaryngologists avoid unnecessary revision procedures by using the newest imaging modalities for more precise diagnosis of patients who had undergone mastoidectomy for cholesteatoma in the past.

IMAJ 2009;11:144–146

KEY WORDS: cholesteatoma, diagnosis, imaging, surgery, mastoidectomy

Aural cholesteatoma is an epidermal cyst of the middle ear or mastoid and contains the desquamated debris (principally keratin) from the keratinizing, squamous epithelial lining [1]. A cholesteatoma can only be eradicated from the temporal bone by surgical resection and is usually managed with radical or modified radical mastoidectomy. The choice of surgical approach depends upon the extension of the cholesteatoma into the middle ear and mastoid cavity and the status of the ossicular chain and tympanic membrane. Although canal wall-up procedures usually allow restoration of the conductive hearing mechanism after eradication of the cholesteatoma, a major disadvantage of performing them is the narrow surgical field, a feature that is associated with a high rate of residual and recurrent cholesteatomas (35% and 18%, respectively) [2,3]. Excluding the cases in which a typical white mass can be clearly seen under the tympanic membrane, it is difficult to clinically diagnose a cholesteatoma in a closed postoperative cavity. Thus, second-look procedures performed approximately 1 year after the initial surgery are the accepted management in most otologic centers.

Notably, both the initial and the revision procedures can be associated with such postoperative sequelae as infection, bleeding, delayed healing, disequilibrium, taste disturbances, hearing loss and facial nerve paralysis. In addition, both primary and second-look mastoidectomies require general anesthesia with the usual risks of anesthesia-related complications.

High resolution computed tomography of temporal bones is mandatory for the initial preoperative evaluation of the extension of cholesteatoma and for correct surgical planning. CT cannot, however, differentiate between cholesteatoma, cholesterol granuloma, granulation, brain or fibrous tissue and mucoid secretion in the post-mastoidectomy cavity [4]. This was the reason that clinicians sought alternative imaging modalities for better evaluation of the various types of tissues that may be present in ears that had undergone surgery [5-7]. Recent studies on diffusion-weighted magnetic resonance imaging scans reported high rates of sensitivity (85.2%–90%), specificity (92.6%–100%), positive predictive value (92.6%–100%) and negative predictive value (92%) in the diagnosis of cholesteatomatous tissue in patients who had undergone tympanomastoid surgery [8-10]. McMurphy and Oghalai [11] noted that CT alone can be misleading in cases in which the tegmen tympani is thin due to tissue averaging that may hide an intact bony plate. They considered an MRI scan as invaluable for differentiating between granulation tissue, cholesteatoma and brain herniation. Brain herniation in a post-mastoidectomy cavity is actually not rare. Jackson et al. [12] noted that 27 of 35 patients (77%) with temporal lobe encephalocele underwent mastoidectomy in the past. Neely et al. [13] reviewed the literature and reported 82 of 139 (59%) who suffered brain herniation as a result of previous mastoidectomy.

Mosnier and colleagues [14] operated on 50 patients with brain herniation and chronic otitis media: 14 of them (28%) were found to have an encephalocele that was the result of previous mastoid surgery. Their study findings confirmed that a CT scan is the procedure of choice for identifying tegmen erosion and when there is suspicion of an existing encephalocele, but that MRI is essential to differentiate between cholesteatoma, brain herniation and inflammatory tissue.

The awareness of pathology such as a meningocele associated with recurrent cholesteatoma is essential for correct planning of any revision procedure that might require additional surgical approaches for the resection of brain herniation and repair of a dural defect. Since these operations can include a middle cranial fossa approach [11,13-15], appropriate counseling of the patients before the intervention is extremely important.

The aim of the current paper was to present our experience with meningoceles in patients who had undergone mastoidectomy for cholesteatoma in the past and who then underwent what turned out to be unnecessary second-look procedures due to misdiagnosis based on CT findings. We sought to validate the findings of Mosnier et al. [14] by demonstrating the superiority, if not the exclusivity, of MRI in the differential diagnosis of these cases.

PATIENTS AND METHODS

This retrospective chart review enrolled four patients aged 16–53 years with a history of primary mastoidectomy for cholesteatoma that was performed elsewhere. Each of them underwent second-look surgery in our department. The interval between the primary and the revision procedures ranged between 1.5 and 15 years.

RESULTS

One of the four study patients was a 53 year old woman who presented with aural fullness and an aerated ear on otoscopic examination 15 years after undergoing an attico-antrotomy. Axial CT sections of the temporal bones revealed an attico-antral mass suspicious for cholesteatoma. The three other patients were 16, 18 and 19 year old males who had undergone radical mastoidectomies for cholesteatomas, and the external ear canal of the operated ear was closed with a pseudomembrane in each of them. An axial CT demonstrated a soft tissue mass in the middle ear and mastoid in three latter cases [Figure 1]. Coronal reconstructions of CT scans showed a tympanic tegmen defect in two of them [Figure 2], which was not seen on a coronal CT scan of the third patient. Since CT findings failed to exclude recurrence of cholesteatoma in any of these four patients, a second-look mastoidectomy was performed and the sole surgical finding in each of them was a meningocele. Herniated brain tissue did not complicate the postoperative course in these four patients, thus, no procedures for closure of bone defects were performed in any of them.

Figure 1. Axial section of a CT scan showing a soft tissue mass filling the left middle ear and mastoid

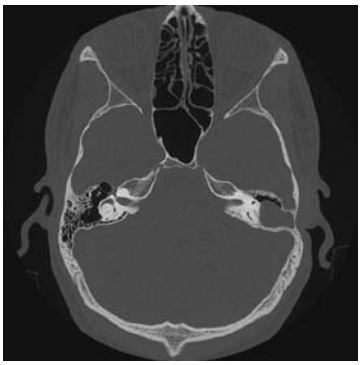
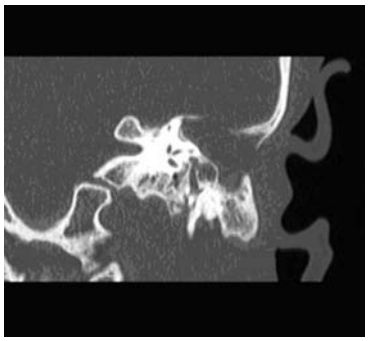


Figure 2. Coronal reconstructions of a CT scan showing a soft tissue mass filling the left middle ear and mastoid with a tympanic tegmen defect



DISCUSSION

In our experience, most cholesteatomas recur within the first 2 postoperative years, with about 60% of recurrences occurring during the first postoperative year. Suspected recurrent cholesteatoma had not been found intraoperatively in our four presented patients, and so the surgical procedures they had undergone based on CT findings were inappropriate in retrospect. On the other hand, echo-planar diffusion-weighted MRI can prevent unnecessary revision surgery in patients who underwent mastoidectomy for cholesteatoma and who are suspected of having recurrent/residual disease.

We are currently conducting an ongoing study on patients who have undergone revision mastoidectomy and whose MRI results are suspicious of recurrent/residual disease but without clinically detectable cholesteatoma. Our preliminary results with EPI-DWI on 19 patients demonstrated one false positive and six true positive interpretations of the images. The MRI diagnosis of cholesteatoma [Figure 3] was confirmed at surgery in each of these six patients. Since cholesteatoma had not been detected in the other 13 patients, they will be scheduled for a repeat MRI 2 years after the first one. It should be noted that MRI has limited value in detecting small cholesteatomas due to image resolution. The advances in MRI techniques are currently changing the preoperative evaluation and the postoperative follow-up protocols for cholesteatoma. De Foer et al. [16] described a non-echo planar base diffusion-weighted sequence (non-EPI-DWI) for the evaluation of a middle ear cholesteatoma. This sequence has no susceptibility artifacts, a higher resolution and thinner slice thickness compared to EPI-DWI. In addition, non-EPI-DWI was found capable of demonstrating middle ear cholesteatomas as small as 2 mm [17]. To date, we recommend performing MRI 1 and 3 years following mastoidectomy.

EPI-DWI = echo-planar diffusion-weighted MRI

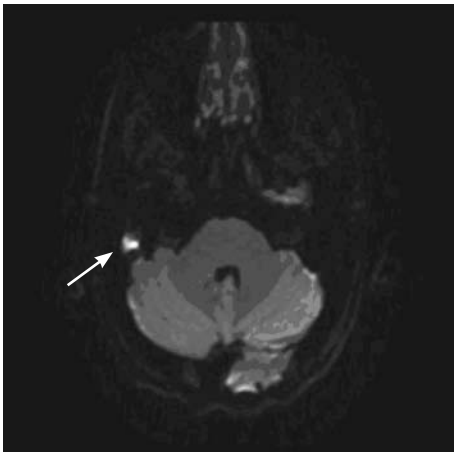


Figure 3. Coronal reconstructions of MRI (EPI-DWI) showing recurrent cholesteatoma in the right ear (arrow)

Whether clinically silent brain herniation in a post-mastoidectomy cavity without the presence of recurrent cholesteatoma should be managed surgically remains open to discussion. In our opinion, asymptomatic brain herniation should be left alone.

Personal communications between our colleagues and both operated patients and parents of operated children revealed that most Israeli ear, nose and throat surgeons currently prefer to perform CT and second-look surgery because of administrative difficulties in obtaining permission to perform MRI in their patients. When the patients and children's parents were questioned, it emerged that they preferred annual MRI to CT irradiation and possible second-look surgery. Application of the current imaging techniques would reduce the rate of second-look surgeries from 50–60% of cholesteatoma cases to 10%. Recently, Brenner and Hall [18] stressed that the widespread use of CT scanning can result in a marked increase in radiation exposure in the population and can be dangerous, especially for children. Those authors recommended reducing the CT-related dose in individual patients, replacing CT with other options, such as ultrasound and MRI when possible, and decreasing the number of CT studies that are prescribed. A discussion on the estimated harm to the patient due to radiation from a CT scanner and of revision surgeries under general anesthesia is beyond the scope of this paper, as is an in-depth analysis of cost-effectiveness of such patient management. Despite the relative costliness of MRI in our country, we hope that it will replace – when appropriate – second-look procedures for suspicious cholesteatomas in the near future.

CONCLUSIONS

We call upon our otolaryngologist and radiologist colleagues to use the newest MRI modalities for monitoring patients who had been operated on for cholesteatoma. Unnecessary second-look procedures can be avoided by use of this more appropriate diagnostic tool.

Acknowledgment

Esther Eshkol is thanked for editorial assistance.

Correspondence:

Dr. L. Migirov

Dept. of Otolaryngology and Head & Neck Surgery, Sheba Medical Center, Tel Hashomer 52621, Israel

Phone: (972-3) 530-2242

Fax: (972-3) 530-5387

email: sabim@bezeqint.net

References

1. Chole RA. Chronic otitis media, mastoiditis, and petrositis. In: Cummings CW, Fredrickson JM, Harker LA, Krause CJ, Schuller DE, eds. Otolaryngology-Head and Neck Surgery. Vol. 4, 2nd edn. St. Louis, Missouri: Mosby-Year Book, 1993: 2823-39.
2. Chinski A. Cholesteatomatous chronic otitis media. *Int J Pediatr Otorhinolaryngol* 1999; 49: S75-9.
3. Nadol JB. Causes of failure of mastoidectomy for chronic otitis media. *Laryngoscope* 1985; 95: 410-13.
4. Williams MT, Ayache D. Imaging in the postoperative middle ear. *Eur Radiol* 2004; 14: 482-95.
5. Vanden Abeele DV, Coen E, Parizel PM, Van de Heyning P. Can MRI replace a second look operation in cholesteatoma surgery? *Acta Otolaryngol* 1999; 119: 555-61.
6. Kimitsuki T, Suda Y, Kawano H, Tono T, Komune S. Correlation between MRI findings and second-look operations in cholesteatoma surgery. *ORL Otorhinolaryngol Relat Spec* 2001; 63: 291-3.
7. Bovo R, Ceruti S, Padovani R, Martini A. Temporal bone brain herniation. *Otol Neurotol* 2006; 27: 576-77.
8. Aikele P, Kittner T, Offergeld C, Kaftan H, Hüttenbrink KB, Laniado M. Diffusion-weighted MR imaging of cholesteatoma in pediatric and adult patients who have undergone middle ear surgery. *AJR Am J Roentgenol* 2003; 181: 261-5.
9. Stasolla A, Magliulo G, Parrotto D, Luppi G, Marini M. Detection of postoperative relapsing/residual cholesteatoma with diffusion-weighted echo-planar magnetic resonance imaging. *Otol Neurotol* 2004; 25: 879-84.
10. Ayache D, Williams MT, Lejeune D, Corré A. Usefulness of delayed postcontrast magnetic resonance imaging in the detection of residual cholesteatoma after canal wall-up tympanoplasty. *Laryngoscope* 2005; 115: 607-10.
11. McMurphy AB, Oghalai JS. Repair of iatrogenic temporal lobe encephalocele after canal wall down mastoidectomy in the presence of active cholesteatoma. *Otol Neurotol* 2005; 26: 587-94.
12. Jackson CG, Pappas DGJr, Manolidis S, et al. Brain herniation into the middle ear and mastoid: concepts in diagnosis and surgical management. *Am J Otol* 1997; 18: 198-205.
13. Neely JG, Kuhn JR. Diagnosis and treatment of iatrogenic cerebrospinal fluid leak and brain herniation during and following mastoidectomy. *Laryngoscope* 1985; 95: 1299-300.
14. Mosnier I, Fiky LEL, Shahidi A, Sterkers O. Brain herniation and chronic otitis media: diagnosis and surgical management. *Clin Otolaryngol* 2000; 25: 385-91.
15. Wootten CT, Kaylie DM, Warren FM, Jackson CG. Management of brain herniation and cerebrospinal fluid leak in revision chronic ear surgery. *Laryngoscope* 2005; 115: 1256-61.
16. De Foer B, Vercruysse JP, Pilet B, et al. Single-shot, turbo spin-echo, diffusion-weighted images versus spin-echo-planar, diffusion-weighted imaging in the detection of acquired middle ear cholesteatoma. *AJNR Am J Neuroradiol* 2006; 27: 1480-2.
17. De Foer B, Vercruysse JP, Bernaerts A, et al. The value of single-shot turbo spin-echo diffusion-weighted MR imaging in the detection of middle ear cholesteatoma. *Neuroradiology* 2007; 49: 841-8.
18. Brenner DJ, Hall EJ. Computed tomography – an increasing source of radiation exposure. *N Engl J Med* 2007; 357: 2277-84.