Imaging of labyrinthine fistulae caused by middle ear cholesteatoma

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Learning objectives

Labyrinthine fistula is a very common clinical complication of chronic otitis media with cholesteatoma which can result in progressive sensory hearing loss or permanent loss of inner ear function.

The aims of our study are:

- To study the role of high resolution computed tomography (HRCT) and the usefulness of MRI in detecting labyrinthine fistulae (LF) caused by middle ear cholesteatoma (MEC).
- To compare pre-operative imaging findings with per-operative lesions in patients operated for MEC complicated with LF.

Background

Labyrinthine fistula (LF) is a bone defect of the osseous labyrinth causing a direct contact between the cholesteatoma matrix and granulation tissue with an internal membrane of the osseous labyrinth or membranous labyrinth mainly due to middle ear cholesteatoma.

Due to the high incidence of the LF in patients with middle ear cholesteatoma, otologist usually pays close attention to the complication. Given its location close to the antrum, the lateral semicircular canal is the most commonly involved portion of the labyrinth and, as reported by other authors, it accounts for approximately 90% of the cases.

* Classification of LF (fig.1):

- **Type 1**: Destruction of the osseous labyrinthine wall with intact internal layer was found
- **Type 2**: Invasion of the osseous labyrinth internal layer causing direct contact of cholesteatoma matrix with perilymphatic space or membranous labyrinth.
- **Type 3**: both osseous and membranous labyrinthine wall were destroyed by cholesteatoma matrix.

LF is a cause of dizziness, imbalance and hearing loss-any or all of these symptoms can exist. **Vertigo** is not common in this disorder.

Preoperative CT is necessary for the diagnosis LF caused by middle ear cholesteatoma on studying bone labyrinths.
Preoperative MRI shows the extending of cholesteatoma in membranous labyrinths.

Surgical intervention should be performed as early as possible for these cholesteatomatous patients and depends on the type of LF.

Total surgical removal of cholesteatoma and use of the intact canal wall tympanoplasty and mastoidectomy can result in preservation or improvement of hearing and elimination of vertigo.

**Images for this section:**

**Fig. 1:** Figure 1. Schematic of classification of labyrinthine fistula. 1: Cholesteatoma; 2: Periosteum of osseous labyrinth; 3: Osseous labyrinth; 4: Endosteum of osseous labyrinth; 5: Perilymph; 6: Endolymph.
Findings and procedure details

The files of 124 patients, operated for MEC within a period of 10 years were reviewed in a retrospective study. Thirty-four patients with one or more LF confirmed in per-operative were studied. The mean age was 45 years (10-80 years) with a sex ratio $= 1.26$.

Otologic symptoms were recurrent otorrhea in 91%, hearing loss in 90% and vertigo in 50%.

All patients underwent preoperative CT scans and audiometry. HRCT scan imaging was performed using inframillimetric incidences. Ossicular reconstructions were obtained after a triple orientation.

Twelve patients underwent preoperative MRI. MRI protocol included for each patient T2-weighted image, Ciss 3-D, T1-weighted image without fat saturated (axial) and Fat Saturated T1 after Gadolinium sequences (axial).

We compared CT and MRI results with per-operative findings.

LF diagnosis was made before surgery for 27 patients. A LF was misdiagnosed by imaging in 7 patients.

CT showed focal defect of one of different structure of the labyrinthine bone. Fistula was located in the horizontal semicircular canal (SCC) in 24 patients of cases (fig.2) and in the stapes platina in 2 of cases. In one case, LF was located at the superior SCC (fig.3).

CT detected other complications of middle ear cholesteatoma such us: bony erosion of middle ear bony walls in 86% (eroded or blunted scutum, eroded tegmen…) or ossicular erosion in 64% (fig.4a). Eroded facial nerve canal was encountered in 34% (fig.4b).

MRI showed:

- Normal liquids: the inner ear fluids were uniformly hyperintense in 7 cases.
- Segment amputation: localized area, hypointense compared to bone lysis displayed in CT in 3 cases.
- Extensive amputation: the membranous labyrinth fluid signal is attenuated extensively not directly related to bone defect in 1 case.

A pathological enhancement associated acute suppurative labyrinthitis was detected in 1 case (fig.5).
A second fistula was operatively diagnosed in 9% of cases. Surgical intervention showed that the fistulae were located at the teral SCC in 26 ears, at the Superior SCC in 1 ear, at the footplate of the stapes in 5 ears, and at the promontory in 2 ears.

Hearing improved after surgery in 27% of the patients.

Images for this section:

**Fig. 2:** CT multiplanar reconstruction axial (a) and coronal plane (b): Right middle ear cholesteatoma responsible of lysis of the lateral SCC (arrow)
Fig. 3: Coronal reconstruction showed a defect at the lateral SCC (red arrow) and at the superior SCC (blue arrow)
**Fig. 4:** CT multiplanar reconstruction axial (a) and coronal plane (b) : Right middle ear cholesteatoma with: ossicular erosion (a) and eroded facial nerve canal (b)

**Fig. 5:** Ciss 3D sequence (a) and T1 Fat Saturated T1 after Gadolinium sequences (b) : Extensive amputation of the left membranous labyrinth fluid signal (a) , pathological enhancement associated left acute suppurative labyrinthitis (b)
Conclusion

CT and MRI are complementary for the work up of the two types of cholesteatomatous LF - the extensive fistula that erodes both the bony and membranous labyrinths and the bone fistula that affects only the bony labyrinth.

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References


