INTRODUCTION

Cholesteatoma has been known as an expansile-destructive lesion of temporal bone and skull base which may result in destruction of main structures of these areas [1]. This process may have major complications, such as: scutum and ossicular chain erosion, involvement of facial nerve canal, inner ear damage, brain abscess, and meningitis [2].

Diagnosis of cholesteatoma and evaluating the extent of disease and complications is crucial in approaching these patients and decreasing morbidity related to these complications. Although this is a clinical diagnosis but different imaging modalities has been very helpful in management of cholesteatoma. Temporal bone HRCT is one of the most useful imaging studies for this purpose because it has good accuracy visualizing bony structures. CT scan usually shows bony erosion, possible complications, and somewhat disease extension in a reasonable accuracy.

However, there are some negative points with CT scan; most importantly, radiation. As the scanners are faster and more precise, patients are exposed to more radiation with thinner slices which is crucial to evaluate delicate anatomy of middle ear and temporal bone. Also, although CT scan machines have improved significantly, still they may not be able to show accurate anatomy and disease involvement in the middle ear [3-5].

Cone-beam CT scan (CBCT) has been known as an imaging study with high accuracy over recent years [6]. It’s already in routine clinical use in dental and maxillofacial imaging [7]. In CBCT imaged area can be restricted to the clinically relevant site, to decrease radiation to adjacent and unnecessary tissues. Also, CT dose index (CTDI) is lower in comparison to HRCT. These differences make it a better choice in children or in cases that need repeated imaging. CBCT machine is less space occupying and it is much easier to set up. Due to the way that the image matrix is obtained, CBCT has the ability to produce quite fine cuts as thin as 0.1 mm [8,9].

Regarding to the importance of cholesteatoma and probable advantages of CBCT, this study was performed to investigate applicability of CBCT in these patients group [10-17].

MATERIALS AND METHODS

In this cross-sectional study, patients diagnosed with cholesteatoma who were candidate for surgery were included (2016-2017). Patients underwent Cone-Beam CT scan as the pre-op evaluations. CBCT was done using New Tom Cone Beam...
imaging unit (QR SLR), vertical generation, with axial thickness of 0.3 mm and 0.3 mm voxel size.

An expert radiologist in otology reviewed imaging studies. Surgical observations were considered as gold standard for evaluation of sensitivity, specificity, positive predictive value, negative predictive value and accuracy of imaging study.

Patients who were unlikely to do imaging studies and whom with previous history of temporal bone surgery were excluded from this study.

Nine variables (Existence of cholesteatoma, labyrinthine fistula, Facial nerve dehiscence, Erosion of ossicles, scutum, tegmen tympani, tegmen mastoideum, sinus tympani, Existence of cochlear fistula) were evaluated in pre-op imaging and findings were compared with findings during surgery as the gold standard. Statistical package for social sciences (SPSS) version 18 was used to analyze data [10-12].

RESULTS

Patients

There were 46 patients included. The mean age was 37.1 years (SD=9.4). Female to male ratio was 2.5/1.

Complications

There were 3 cases with lateral semicircular canal erosion seen within surgery. There weren’t any posterior or superior semicircular canal or cochlear erosion. Erosion of the scutum was seen in 41 patients (Table). CBCT sensitivity and specificity to diagnose lateral canal erosion were 1 (95% CI: 0.29-1.00) and 1 (95% CI: 0.85-1.00) respectively.

Ossicular chain

Erosion in incus was present in 42 patients. According to pre-op imaging the sites of involvement were 2 case in the body, 26 cases in long process, 4 cases in long process and short process and 9 cases with the entire incus erosion (Figure).

Malleus erosion was present in 19 patients; 5 of them in handle, 7 of them in the head, 1 in both head and handle and 6 of them had complete destruction.

Involvement in stapes was seen in 16 patients.

Accuracy data is shown in the Table by comparing imaging and intra-op findings.

Extent of disease

There were 3 cases with mastoid tegmen erosion and 5 cases with tympanic tegmen involvement.

No jugular bulb dehiscence or posterior and superior semicircular canal involvements were seen in this study.

DISCUSSION

The only ways to stop the progressive growth of cholesteatoma is to clear the pathology by surgery. Estimation of the expansion of the disease and involved structures with an imaging is an advantage for the surgeon prior to the operation. Knowing the involvement of vulnerable structures like semicircular canals, tegmen, cochlea, jugular bulb and ossicles as reasons of the complications such as sensory neural deafness, vestibular problems and intraoperative bleeding is of great value.

The aim of this study was to evaluate the accuracy of Cone-Beam Computed Tomography in assessment of cholesteatoma extension before surgical intervention and to evaluate eligibility of CBCT as an adequate imaging tool in this context. A few numbers of studies have discussed the use of CBCT in temporal bone in the literature [13,16,17]. The present study shows an excellent preoperative radiologic evaluation of temporal bone cholesteatoma by CBCT.

High resolution CT scan is very helpful in showing bony anatomy and pre-op evaluation of patients with chronic ear disease [12], but it has the risk of high dose of radiation especially if fine sections are needed. However, the technology of simultaneous rotation of the x-ray and detector has led to decrease the received radiation dose level by patients far lower than HRCT in different protocols [13,14,15].

Cone beam CT scan has been shown to provide good quality while decreasing the radiation dose significantly. Other major benefit of this technology is ability to acquire finer sections. This is a great advantage in studying delicate middle ear anatomy and ossicular chain.

On the other hand, it seems that lower dose of radiation in CBCT makes differentiation of soft tissues much more difficult,
and this may be more important in the border lines between soft tissue and bone [10].

In this research we showed that sensitivity, specificity, negative predictive value, positive predictive value and accuracy indexes in detecting involvement of ossicular, jugular bulb, tegmen, scutum, and external auditory canal are reasonably good in CBCT and comparable to HRCT when cholesteatoma is visible in otoscopic examination.

Specifically, our data shows that CBCT has high (84% to 100%) negative predictive value in detecting lateral canal fistula and good specificity in ossicular chain erosion.

CONCLUSIONS

Our study shows that CBCT is a proper imaging tools for the preoperative assessment of temporal bone cholesteatoma. CBCT could be a good substitute for high radiation dose HRCT that is used routinely in numerous clinics but further studies are needed to uphold this based on data of higher quality studies.

The limitation of our study was the few number of patients which caused absence of a number of complications and structural involvements among these patients.

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and is approved in Tehran University of Medical Sciences Ethical committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

REFERENCES


