ORIGINAL ARTICLE

Accuracy of High Resolution Computed Tomography in Pre-Operative Acquired Cholesteatoma

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ABSTRACT

Objective: To determine the accuracy of high resolution computed tomography (HRCT) for diagnosis of acquired cholesteatoma using histopathological finding as gold standard.

Materials and Methods: This cross section study of 61 patients, males and females with ages between 10- 35 years was carried out in the department of radiology, Dr Ziauddin Hospital Karachi, from November 2008 to April 2009. Patients clinically diagnosed as having cholesteotoma were referred for scanning. They were selected according to inclusion criteria. Patients were scanned using HRCT technique. Non dependent soft tissue density attenuation mass associated bony erosion in the middle ear/external ear was considered as radiological positive case of cholesteatoma while dependent soft tissue attenuation mass without bony erosion was considered radiologically negative case for Cholesteatoma. Keratinized stratified squamous epithelium with keratin debris and an underline sub-epithelial fibro connective tissue associated bone resorption in it were considered histopathologically positive case for cholesteatoma and without bony resorption were considered negative.

Results: Out of 61 patients of clinically diagnosed acquired cholesteatoma 37(60.7%) were males and 24(39.3%) were females. 34(55.5%) patients showed right sided and 27(44.2%) left side temporal bone involvement. Mean age of patients was 22.93 years (SD±8.29). Sensitivity of HRCT technique was 96.4 %, specificity of 80%, positive predictive value of 98.18% and negative predictive value of 67 %.

Conclusion: High resolution computed tomography (HRCT) technique is found to have accuracy for diagnosis of pre-operative acquired cholesteatoma using histopathological finding as gold standard.

Key Words: Temporal Bone, Acquired Cholesteatoma, Diagnosis, Accuracy, Computed Tomography.

INTRODUCTION:

Cholesteatoma is a cystic structure lined by keratinized type of stratified squamous epithelium resting on fibrous stroma of variable thickness in which crystals of cholesterol, desquamated tissue debris, keratin and bacteria are embedded[1]. The expanding cystic cavity that may involve the mastoid and ossicles, erodes surrounding bone. Cholesteatoma are histologically benign, though biologically invasive lesions that arise as mentioned from the migration of squamous epithelium of the ear. Cholesteatoma can form in the middle ear in three ways[2]. A perforation of the eardrum occurring because of a chronic infection or direct trauma can lead to a cholesteatoma. The skin over the outer surface of the eardrum can start to grow through the perforation and into the middle ear. Some patients are born with small remnants of skin which become entrapped within the middle ear (congenital cholesteatoma) or petrous apex (Petrous apex epidermoid).These are classified as acquired or congenital respectively[3]. A separate and unusual type is the canal cholesteatoma. Congenital cholesteatoma is usually diagnosed in children of pre-school age and may arise in the middle ear or within the tympanic membrane[4]. It present as a white or pearly mass medial to the anterior-superior quadrant of an intact tympanic membrane[5]. Acquired cholesteatoma is usually diagnosed in older children and adults with a previous history of middle ear disease[6]. Acquired cholesteatoma are subdivided in to primary acquired and secondary acquired cholesteatoma[7]. Several pathologic mechanisms have been proposed to explain the formation of acquired cholesteatoma, with no single process being accepted as the mechanism for the development of such cases. The common factor of all acquired cholesteatoma is that the keratinizing squamous epithelium has grown beyond its normal limits[8]. Cholesteatoma if left undiagnosed or untreated can cause serious complications. Erosion of the ossicles or bones behind the ear drum can lead to a conductive hearing loss. The bones over the facial nerve can be destroyed and a facial paralysis can result. The inner ear is composed of bony labyrinth which can also be partially destroyed. This can lead to sensori-neural hearing loss and dizziness. The infection can also spread into the veins carrying blood from the brain to the heart. The infection can also spread to the covering of the brain and cause meningitis[9]. In rare circumstances, brain abscess can result[10]. Cholesteatoma is usually diagnosed in adults with a previous history of middle ear disease at least 8-10 weeks duration. Interpretation of finding always depends on the experience of the physician. The false-negative rate with plain film is high[11]. Computed Tomography of the temporal bone with high spatial resolution is an established standard examination technique for cholesteatoma[12]. Diagnostic quality images on CT are obtained in two different planes coronal and transverse acquisition[13]. CT offers high resolution images with a section thickness of 2.0mm, which allow for good visualization of the bony anatomy, ossicular and inner anatomy. On CT good

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contrast is demonstrated for bone, soft tissue and air[14]. On CT acquired cholesteatoma presents as a non-dependant soft tissue attenuation mass associated with bony erosion of adjacent structures in the middle or external ear[15]. CT scanning is used to establish the surgical procedures needed in each patient of cholesteatoma[16]. CT imaging of Pre-operative radiological evaluation provide clinically pertinent information from the images obtained[17]. The aim of this study is to determine the value of non-invasive high resolution computed tomography (HRCT) technique in the diagnosis of acquired cholesteatoma. There is a paucity of local data on this topic, which prompted the need to conduct this study.

Materials and Methods:

Clinically diagnosed cases of acquired cholesteatoma that is patients presenting with ear discharge, pain and conductive deafness of 6 months to 1 year aged 10-35 years, either gender were included in this study. History of trauma to middle ear, post surgical patients and patients who were previously diagnosed to have congenital anomaly were excluded. Patients were examined using HRCT technique. Non dependent soft tissue density attenuation mass associated bony erosion in the middle / external ear was considered as radiologically positive case for cholesteatoma. Dependent soft tissue attenuation mass without bony erosion was considered radiologically negative case for Cholesteatoma. Keratinized stratified squamous epithelium with keratin debris and an underline sub-epithelial fibro connective tissue associated bone resorption in it were considered histopathologically positive case for cholesteatoma and without bony resorption were considered negative. The interpretation of the images was done by trained radiologist. The findings were entered on specially designed performa.

RESULTS:

Total 61 patients presenting with history of ear discharge, pain, and conductive deafness of 6 months to 1 year duration were referred for HRCT scan of the temporal bone. Clinically they were suspected cases of acquired cholesteatoma. There age ranged from 10-35 years with mean age of 22.93years + 8.29 S.D. Clinical findings in our series showed that middle ear cholesteatoma was more common in male patients 37 cases (60.7%), 24 patients (39.3%) were female. (Table1).

Table 1

Gender Distribution

	Frequency	Percent
Male	37	60.7
Female	24	39.3
Total	61	100.0

34 (55.7%) patients showed right sided temporal bone involvement, 27 (44.2%) left sided involvement. Acquired cholesteatoma are characterized on CT by the presence of a non dependent, homogenous soft tissue mass with a focal area of bone destruction. This soft tissue density had mass like features were homogenous, polypoidal, non-dependent and expansile. The mass sub totally occupied the middle ear antrum in 13 cases. Soft tissue densities had totally filled the whole middle ear cavity in 27 cases, involving middle and external ear in 15 cases. Sensitivity of HRCT technique of temporal bone for cholesteatoma was 96.4%, specificity 80%. Positive predictive value for cholesteatoma detection on HRCT was 98.18% and negative predictive value 67%. 2 patients were false negative, 1 had granulation tissue and 1 had polyp, they had associated cholesteatoma. 01 patient who was false positive had effusion. Four patients were true negative on radiology and histopathology. (Table 2).They had chronic suppurative otitis media without cholesteatoma mass.

Table 2

Patient Distribution Histopathology

	Disease Positive (+VE)	Disease Negative (-VE	
HRCT+ve	TP a 54	FP b 1	
-ve	FN c 2	TN d 4	
	56	5	61

TP (True positive), FP (False positive)
FN (False negative), TN (True negative)

$$\text{Sensitivity} = \frac{a}{a+c} \times 100 = 96.4\%$$

$$\text{Specificity} = \frac{d}{b+d} \times 100 = 80\%$$

$$\text{PPV} = \frac{TP}{TP+FP} \times 100 = 98.78\%$$

$$\text{NPV} = \frac{TN}{FN+TN} \times 100 = 67\%$$

DISCUSSION:

The diagnosis of cholesteatoma is usually made on examination of ear by ENT specialist[18]. In case in which the diagnosis is in doubt, computerized tomography can be employed. Cholesteatoma can be accurately diagnosed by the HRCT scan in vast majority of cases. Mafee[19] has reported in his series of 48 patients with cholesteatoma that 46 of them were diagnosed correctly with the pre-operative CT scan. In our case 54 out of 61 patients were correctly diagnosed. Our sensitivity of 96.4% and specificity of 80% correlated with O`Reilly et.al[20] and positive predictive value of 98.18% and negative

predictive value of 67%. Acquired cholesteatoma is most commonly encountered in the middle ear cavity. It is a rear disease entity, accounting for 0.1 to 0.5% of new otolaryngology patients in external auditory canal[21]. A soft tissue seen in the external auditory canal with adjacent bone erosion on HRCT is typical finding of external auditory canal cholesteatoma. With use of high resolution CT scan, Heilburn[22] reported that 7 of their 13 patients with external auditory canal showed a soft tissue mass with adjacent bone erosion and intramural bone fragments. In our case 6 patients out of 61 were found to have external auditory canal cholesteatoma. Years of experience with HRCT have clearly demonstrated its superiority for the evaluation of temporal bone, particularly utilizing the thin section, high resolution techniques. HRCT provides a more precise definition of the anatomic extent of the disease of the middle ear and the relationship of these cholesteatoma masses to the contiguous structures. High resolution CT (HRCT) with bone window settings is considered the method of choice for examination of the middle ear structures. It provides excellent contrast between osseous structures, ear and soft tissues, together with a high spatial resolution. In most cases, HRCT can differentiate between inflammatory changes, cholesteatoma and tumor. The high spatial resolution of HRCT technique allows demonstration of subtle osseous details and provides good identification of erosion of the ossicles, delineation of the tegmen and bony labyrinth and enables reliable evaluation of the tympanic segment of facial nerve. Therefore, HRCT remains the primary examination tool for the evaluation of suspected cholesteatoma and, more importantly, its extension. After clinical examination, otoscopy and diagnosis of cholesteatoma, CT scan determines its extent by revealing a soft tissue mass and bone erosion, with 80% specificity[23]. In our case specificity was 80%. This study was conducted on a single-detector row CT with high spatial resolution. The technique for examination of temporal bone cholesteatoma is axial and coronal planes. We have also followed the same technique. (Figure1 and 2).

Figure 1
Coronal views temporal bone

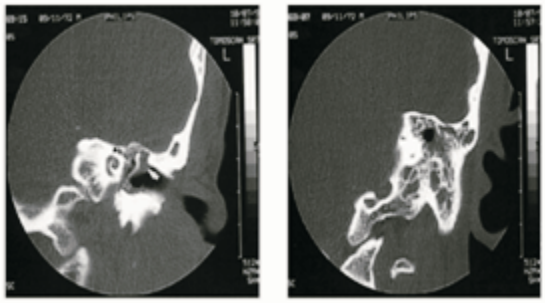
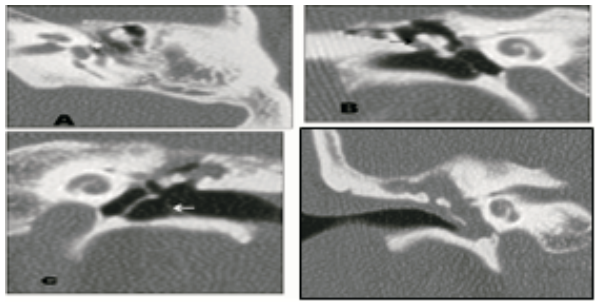


Figure 2
Cholesteatoma



However in future with the addition of multi-detector row CT there will be much more improvement in detection of cholesteatoma and its complications using HRCT technique[24]. Also the role of HRCT early in the course of disease can potentially reduce the risks of late complications associated with under diagnosed cholesteatoma. CT imaging has proven to be an accurate method of depicting the characteristic finding of middle and external ear cholesteatoma, including the extent and complications[25].

Thus close collaboration between radiologist and an otologist sufficiently flexible to tailor surgical management according to radiological finding is the ideal. Advantages of scanning will then include: (1) A visual aid to pre-operatives counseling of the patient, (2) Avoidance of unnecessary surgery owing to its high degree of sensitivity / specificity to middle ear disease.

(3) A prediction of the anatomy, ease of surgical access and extent of disease all of which guide surgical approach, (4) Anticipation of complications of chronic suppurative otitis media[26].

CONCLUSION:

High resolution computed tomography (HRCT) technique is found to have accuracy for diagnosis of pre-operative acquired cholesteatoma using histopathological finding as gold standard.

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