Reliability of Diffusion weighted MRI for the diagnosis of residual & recurrent cholesteatoma

A Thesis submitted for partial fulfillment of M.D. degree in
Otorhinolaryngology

By

Ahmed Mohammed Medhat Elshafei
M.B.B.Ch., **M. Sc** ***Otorhinolaryngology***
Ain Shams University

Supervised by

Prof. Dr. Medany Mahmoud Medany
Professor of Otorhinolaryngology
Faculty of Medicine - Ain Shams University

Prof.Dr. Reda Mohammed Sabra
professor of Otorhinolaryngology
Faculty of Medicine - Ain Shams University

Prof.Dr. Ehab kamal hakim
professor of Otorhinolaryngology
Faculty of Medicine - Ain Shams University

Dr. Amr Mohammed Ismaeel sadawy
Lecturer of radiodiagnosis
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
2018

First and foremost, praise is to God, to whom I relate any success in achieving any work in my life.

I wish to express my deepest thanks, gratitude and appreciation to ***Prof. Dr. Medany Mahmoud Medany,*** *for his sincere encouragement, constant advice and valuable guidance throughout the performance of this work.*

I owe special thanks, gratitude and appreciation to ***Prof.Dr. Reda Mohammed Sabra ,Prof.Dr. Ehab kamal hakim*** *for their close supervision, continuous advice and support which gave me the best guidance during different stages of this work.*

I owe special thanks to ***Dr. Amr Mohammed Ismaeel sadawy*** *for his kind care and help throughout this work.*

I would like to thank ***Prof.Dr.Mohamed abelraouf massoud, Cons.Dr.Wael aly alzamel & my colleagues at hearing and speech institute for helping through this work.***

I would like to thank my professors, my family, and my colleagues, for their support and moral encouragement.

Ahmed Mohamed Medhat Elshafei

List of Contents

List of Abbreviations

IJV	Internal jugular vein
ICA	Internal carotid artery
CT	Computed Tomography
LSCC	Lateral semicircular canal
DWI	Diffusion Weighted Images
EPI	Echo-Planar Imaging
TSE	Turbo Spin Echo
HASTE	Half-Fourier Acquisition Single-Shot Turbo Spin-Echo
BLADE	Proprietary name for periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) in MR systems from Siemens Healthcare™
SNR	Signal to Noise Ratio
MS	Multi-Shot
SS	Single Shot
RF	Radio-Frequency
TM	Trademark
ADC	Apparent Diffusion Coefficient
MRI	Magnetic Resonance Imaging
DPI	Delayed postcontrast imaging
ADC	Apparent diffusion coefficient

List of Figures

List of Tables

Introduction

Cholesteatoma is defined as the presence of collections of kertatinized squamous epithelium within a sac in temporal bone & skull base , commonly involve the the middle ear cavity & mastoid cavities.It may be congenital or acquired. Congenital cholesteatomas compose only 2% of middle ear cholesteatomas. ***(Swartz, 1996)***

Cholesteatomas involve Prussak's space and progressively erodes the adjacent structures such as the scutum and the ossicular chain. After growth, the cholesteatoma invades the antrum and the mastoid process, eroding further structures of the middle ear such as the facial nerve canal, the tegmen tympani and the posterior semicircular canal wall. ***(Semaan et al., 2006)***

It can erode and destroy important structures with potential for causing central nervous system (CNS) complications (eg, brain abscess, meningitis) makes it a potentially fatal lesion. **(Gotz et al., 1999)**

It is usually diagnosed on basis of history, otoscopic examination with radiological and audiological assessment.

An understanding of the pathophysiology of aural cholesteatoma is important, due to it's destructive nature which is responsible for the morbidities associated with it's chronic nature. the lack of effective nonsurgical management add importance to

the understanding of this disease , otomicroscopic evaluation is the principal diagnostic tool for acquired cholesteatoma , an inflammatory polyp or granulation tissue might be obscuring the vision on examination by, as recurrent or residual disease is mainly attributed to hidden areas that cannot be seen using surgical microscope. otoendoscopic examination and surgical exploration is other tools to be used for such cases. **(Corrales C.& Blevins NH 2013).**

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 scoring of the anatomical extentsion of the cholesteatoma into the middle ear and mastoid cavity and the status of the ossicular chain and tympanic membrane,selection of the Optimal surgical approach results in Complete disease eradication .these procedures can be classified into canal wall up and canal wall down procedures. **(Li PM et al ,2013)**.

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) . 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. **(Migirov L et al,,2009)**

the incidence of recurrence of the chronic active disease vary from 3 to 18% of all surgical procedures and the failure most importantly attributed to residual or recurrent cholesteatoma with persistent suppuration of middle ear and mastoid.**(Migirov L,et al,2009)**

Residual cholesteatoma occurs as a consequence of growth of a fragmental remnant of the matrix inadvertently left behind at the time of primary surgery. Poor access ,failure to determine disease extent is the major reasons for residual disease, particularly in the sinus tympani (ST) in addition to the tegmen,facial recess ,mastoid tip,hypotympanium and infralabryinthine cells.

Recurrent disease or disease due to de-novo retraction (i.e. retraction pocket cholesteatoma) caused by scutum defects leading to recurrence of the primary pathology

Confirming a diagnosis recurrent or recurrent cholesteatoma through imaging techniques remains a challenge for the otolaryngologist & head and neck radiologist.

Imaging procedures such as high resolution computed tomography (CT) and magnetic resonance imaging (MRI) may

suggest the presence of cholesteatomas within the temporal bone and may be used to complement the clinical examination.

Selection of the appropriate modality of imaging depends on clinical findings as each of them provide different anatomical and pathological information undetectable by the other modality.

High resolution computed tomography (HRCT) is still widely considered to be the primary imaging tool for diagnosing and documenting the extent and potential complications of middle ear cholesteatoma. HRCT provides good information on the presence of associated bony and ossicular erosion as well as on important pre-operative anatomical features, such as the delineation of the tympanic segment of the facial nerve, the tegmen position of dura the sigmoid sinus position,sinus plate ,juglar bulb and the size of the mastoid cell structure and pneumatization aiming for correct surgical planning. ***(Lemmerling , De Foer B., 2004)***

Advanced technology, as multidetector row scanning with submillimeter(0.5mm) section thickness and high rotation(0.5 second per rotation), has reinforced the value of CT scan for detecting temporal bone pathologies ***(schwab SA ,2011)***

Unfortunately many studies have shown that HRCT is inaccurate in detecting post-operative residual and recurrent cholesteatoma, If used alone it can be misleading as it cannot differentiate between cholesteatoma, cholesterol granuloma, granulation, brain or fibrous tissue and mucoid secretion in the

post-mastoidectomy cavities and completely or partially opacified middle ears . 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. (**Migirov L,et al,2009*).***

The MRI has an additional value in patients with prior cholesteatoma resection, particularly when CT findings are equivocal, is mainly due to its capacity to unequivocally confirm the diagnosis of cholesteatoma in cases of clinical doubt. It can distinguish cholesteatoma from other soft tissues, such as fibrosis, granulation tissue, inflammatory changes and cholesterol granuloma. It has the potential to document invasion of the labyrinth and of the intracranial space. ***(De Foer et al., 2008)***

Newer Diffusion weighted imaging(DWI) techniques with thinner section acquisition and decreased susceptibility artifacts allow detection of small lesions. The DWI technique may be used in place of second-look surgery, sparing patients the morbidity of repeat exploration. ***(Schwartz et al., 2011)***

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. ***(Schwartz et al., 2011)***