ORIGINAL ARTICLE

Role of Multislice CT Imaging in Predicting Visibility of Round Window during Cochlear Implantation

KAILASH KUMAR DASEJA[1], SUSHMA QADIR[2], BHAGWAN DAS[3], IMRAN KHAN MEMON[4], PIRYA NANGDEV[5], SHAIQ HUSSAIN[6]
[1]Assistant Professor,
[3]Assistant Professor & Head of Radiology, Chandka Medical College Hospital, Shaheed Mohtarma Benazir Bhutto Medical University/ Larkana
[2]Senior Registrar, Department of Radiology, Isra University & Hospital, Hyderabad
[4]Assistant Professor, Department of Radiology, Ghulam Muhammad Mahar Medical College, Sukkur
[5]Lecturer, Department of Anatomy, Bilawal Medical College/Liaquat University of Medical & Health Sciences, Jamshoro
[6]Assistant Professor, Department of Radiology, Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat
Correspondence to Dr. Kailash Kumar Daseja, E-mail: daseja_1@yahoo.com Cell: +923337536002

ABSTRACT

Aim: To envisage the visibility of round window nichein pediatric cochlear implantation by using computed tomography.
Study design: Retrospective study
Place and duration of study: Department of Radiology, Chandka Medical College Hospital, Larkana from 1st July 2021 to 31st March 2022.
Methodology: Fifty five patients underwent the procedure of unilateral-cochlear implantation. Slices of round window niche and round window membrane were selected for visualization through HRCT imaging. The temporal bone imaging through high resolution computed tomography scans; before and after the operation were examined in detailed and scored. Each round window membrane and round window niche was then visualized for its visibility. The sensitivity as well as specificity of high resolution computed tomography imaging in prediction of round window membrane visuality were calculated.
Results: The comparison of predictive values showed that the positive-predictive value of RWM was 73.1% and negative as 91.2%. The sensitivity as well as the specificity of HRCT identification in prediction difficulty in visualizing RWM was 79% and 87% respectively.
Conclusion: Pre-operative high resolution computed tomography was proved helpful in visualization of detecting round window niche.
Key words: CT scan; Cochlear implantation; Round window niche; Pediatrician

INTRODUCTION

Tympanotomy is considered as a primary surgical approach for accessing the middle ear structures and diagnosis. It is extensively used in cochlear implantation and to expose round window niche (RWN)[1,2]. It is recognized otologic method that was first documented in 1958 by Jansen which is achieved by opening of triangular space medially covered by mastoid segment of facial nerve, superiorly by the incudal fossa and laterally by another nerve named chorda tympani nerve and this space is defined as facial recess[3-6].

Visualization of round window membrane (RWM) and round window niche through facial recess is a primary surgical procedure to properly diagnose and localize scala tympani which helps in locating and representing optimal target for electrode insertion. Sometimes, variations in round window position occur and cause hurdle in visualization of round window membrane. This could also be hindered due to various other factors including abnormal positioning of facial nerve and cochlea rotation in axial or even in parasagittal planes[7-11]. Various other methods have been proposed for the imagining of round window niche.

Present study has been designed to predict a simple surgical approach for the better accessibility and visualization of RWN by racial recess through high resolution computed tomography.

MATERIALS AND METHODS

This retrospective study conducted at Department of Radiology, Chandka Medical College Hospital, Larkana from 1st July 2021 to 31st March 2022 and 55 patients were enrolled. There radiological imaging as well as surgical record was completely analyzed after ethical clearance of study and gaining informed consent from each patient. After clinical assessment each patient underwent the procedure of unilateral-cochlear implantation. Slices of RWN and RWM were selected for visualization. The temporal bone imaging through CT scans; before the operation was examined in detailed and scored. The initial scanning was kept blind from the

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difficulties being scored during surgery. Further the High resolution CT scans (HRCT) of temporal bone were conducted (slice-thickness was kept as 1.0mm) at 120 Kvp and 250 milli Amperes. The imaging-matrix was taken as 512×512. The images of the CT gained were then viewed on the standardized bone-window setting. Those slices which were having the maximum visibility were then opted for determination of RWM shape. In cases where the bony-overhang shielding the RWM was completely closed as well as circular constituting the concamerata region was named as O shaped RWM. O shaped RWM was either merely visible or invisible. If the region of concamerata presented as a bony-overhang which was incomplete then it was named as C shaped RWM with visible RWM. Each RWN was then visualized for its visibility. The sensitivity as well as specificity of HRCT imaging in prediction of RWM visuality was calculated through 95% confidence Interval using SPSS software version 25.0. p value <0.001 was taken as significant.

RESULTS

There were 67.27% those with radiologically classified as with visible "C-shaped RWN," while 32.7% were those with barely visible "O-shaped RWN. Majority of the patients were males 58.81%. The mean age of the patients was 45.4±2.3 years (Table 1).

During the surgery it was seen that 39 cases such as 70.9% had visible RWM through posteriorly tympanotomy. There were around 33(60%) such patients which showed similar results as of HRCT (C shaped RWM). There were 22 (40%) those patients which were identified O shaped RWN on imaging. While the intra operative findings it was suggested that 17(30.9) patients had mere visibility and 5 (9.09%) were invisible (Table 2). The sensitivity as well as the specificity of HRCT identification in prediction difficulty in visualizing RWM was 79% and 87% respectively (Fig. 1).

The comparison of predictive values showed that the positive-predictive value of RWM was 73.1% with a confidence interval (CI) as 55.7-87.2% and negative-predictive value was 91.2% with a CI value as 82.1%-96.8% (Table 3).

Table 1: Distribution of age, gender and shape of RWM (n=55)

Variable	No.	%age
Age (years)	45.4±2.3	
Gender		
Male	32	58.18
Female	23	41.81
RWN shape		
C-shaped RWN	37	67.27
O-shaped RWN	18	32.7

Table 2: Surgical Findings of RWM shape (n=55)

Surgical Finding	No.	%age
Inter Surgical Findings		
Visible RWM	39	70.9
C shaped RWN	33	60
O shaped RWN	22	40
Intra Surgical Findings		
Mere visibility	17	30.9
No visibility	5	9.09

Table 3: Predictive Value at 95% CI

Predictive Value	%	95% CI	P value
Positive Predictive	73.1	55.7-87.2%	<0.001
Negative Predictive	91.2	82.1%-96.8%	

Fig. 1: HRCT identification in prediction difficulty in visualizing RWM
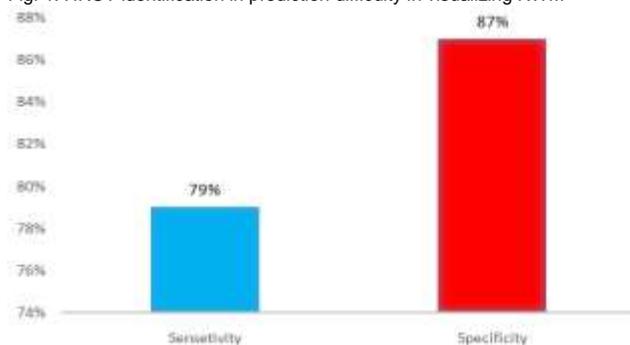
DISCUSSION

Tympanotomy is one of the primary surgical approach used for the cochlear implantation and for the exposure of round window niche. On the basis of RWN conformation in HRCT, we can predict its shapes and configuration. If RWN was in C shapedduring HRCT, its orifice would be in lied in oblique vertical plane and orifice faces postero-laterally, then visualization through posterior tympanotomy would be possible. Contrary, if RWN was in O shaped conformation, it indicates its position in horizontal plane and its orifice faces inferiorly, then its visualization would be difficult. Therefore, it can be used as a radiological sign in visualization of round window niche[12-15].

Prior prediction of visualization difficulty in round window niche through HRCT indicates certain modifications in surgical procedure such as deeper drilling into facial recess or highlights the need of combinatorial approach through external auditory canal[7,16]. Various studies have attempted to find the accurate way to predict prior visualization difficulty to avoid any hindrance during tympanotomy or any other ontological techniques. They reported better prediction with preoperative computed tomography[17,18]. Furthermore, another study used oblique sagittal CT of temporal bone for the accessibility of tympanotomy by using round window membrane approach. Significant relation was found in their study results[19].

Result of the present study indicates that, high resolution computed tomography is recognized a s a better way for prior prediction of imagining difficulty during surgical procedure that can effectively resolved during tympanotomy method.

CONCLUSION

Pre-operative high resolution computed tomography was proved helpful in visualization of detecting round window niche. Statistically, it proved clinically useful tool for better visualization of RWM during surgery as clearly indicated through posterior tympanotomy.

Conflict of interest: Nil

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