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Original Research Article

Retrospective analysis of difficulties during mastoid surgeries in tertiary referral center in Nepal

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ABSTRACT

Background: Complications can occur during and following mastoidectomy because of the variation in the temporal bone anatomy and surgical factors. The operating surgeon needs to be aware of potential difficulties and their clinical relevance to avoid the dread complication. This study aims to study various per-operative difficulties and complications encountered during mastoid surgery.
Methods: A retrospective study was conducted, including 152 cases of chronic otitis media squamous type who underwent mastoidectomy from June 2017 to January 2019. Revision cases and cases with missing records on per-operative findings, early postoperative status, hearing assessment were excluded from the study.
Results: Out of 152 cases, there were 80 males and 72 females with a mean of 27.5 years. Dural plate breach was recognized in 19 cases (12.5%) with iatrogenic injury in 16 cases. Breach of sinus plate and exposure of sigmoid sinus was noted in 11 cases (7.24%) and all were iatrogenic. Korner's septum was noted in five cases (3.29%). The facial canal was dehiscence in 25 cases (16.4%) with the majority in the horizontal segment, but the sheath was intact in all cases. Immediate postoperative facial nerve palsy was seen in four cases (2.6%). Fistula in the lateral semi-circular canal was noted in two cases. Taste disturbance was noted in 13 cases. Local complications related to the surgical site was seen in 19 cases.
Conclusions: The anatomic variations and surgical difficulty are common in mastoid surgery. The major complication rate is around 2-3% despite various mastoid variation and difficulties.

Keywords: Mastoidectomy, Anatomic variations, Complications

INTRODUCTION

Chronic otitis media (COM) is defined as the long-standing inflammation of the middle ear and mastoid with ear discharge and tympanic membrane perforation.[1] Squamous type is the unsafe type of COM which is characterised by cholesteatoma and granulation tissue. Cholesteatoma is formed by the keratinizing squamous epithelium with deposition of keratin debris and inflammation.[2] Intracranial and extracranial complication can occur because of the bony erosion caused by the inflammatory mediators, pressure necrosis, osteolysis and enzymatic destruction.[3]

Mastoidectomy with its different variations is used to eradicate the disease in CSOM squamous type. Since the temporal bone anatomical variations are common, the surgeon needs to be aware of these variants before proceeding to surgery.[4] The risks of complications of both facial palsy and dead ear are high (nearly 2%) even with the senior experienced surgeon.[5] Various anatomic, surgical and patient factors are responsible for

postoperative complications which include the distorted anatomy, revision surgery, extensive disease and surgeon experience level. Although computed tomography helps in the preoperative identification of anatomic variants, it occasionally gives the inaccurate results of lateral semicircular canal fistula, tegmen tympani erosion and facial canal dehiscence.[6] The updated knowledge of these common anatomical variants and their clinical significance is essential to avoid serious complications. This study aims to conduct a retrospective chart review of patients who underwent mastoidectomy to identify the per-operative difficulties, the anatomical variations, operative parameters and complications encountered.

METHODS

This retrospective study was conducted from June 2017 to January 2019 in the Department of ear, nose and throat (ENT) - Head and Neck Surgery, Tribhuvan University Teaching Hospital, Kathmandu, Nepal. We included 152 patients based on purposive sampling (total population sampling) of all age groups and gender diagnosed as COM squamous type who underwent mastoidectomies and its modification under general anaesthesia by experienced ENT and head neck surgeons. Cases meeting the above criteria were identified by retrospective chart review. Cases with recurrent or residual disease, lack of proper records of preoperative high resolution computed tomography (HRCT) temporal bone, per-operative findings, early postoperative status and hearing assessment were excluded from the study. Findings from otoscopic examination, pure tone audiometry, HRCT temporal bone, operative and post-operative notes were extracted from record files. Both 'in to out' and 'out to in' techniques were used during mastoidectomy based on the surgeon's choice. Various types and modifications of tympanoplasty were performed depending on ossicular status. Meatoplasty was done in all cases and the cavity was packed with ribbon gauze impregnated with bismuth iodoform paraffin paste. Skin sutures were removed of the7th post-operative day (POD) after inspecting wound for surgical site infections and gap. The ear pack was removed on the 10th POD. Any taste disturbance was enquired, and details of which were noted on the 10th postoperative day. Topical antibiotic and steroid ear drops were given for one month after removal of the ear pack. Patients were followed up on the 4th, 8th, 10th post-operative week for an assessment of the wound and the mastoid cavity. Pure tone audiometry was done after the 10th postoperative week. The data was entered in IBM statistical package for the social sciences (SPSS) statistics version 20.0 and only descriptive study was done. The ethical approval was taken from institutional review board from institute of medicine.

RESULTS

Out of 152 cases, there were 80 males and 72 female. Age of patients included in the study ranged from 5 to 65 years with a mean of 27.5 years (±10 years) with the majority in the group of 15-60 years (Table 1).

Table 1: Characteristics of the patient who underwent mastoidectomy (n=152).

Characteristics	Number	Percentage
Age (years)		
Less than 15	30	19.74
15-60	115	75.65
Over 60	7	4.61
Sex		
Male	80	52.63
Female	72	47.37
Type of COM squamous		
Active	127	83.55
Inactive	25	16.45
Presence of complication		
Yes	3	1.98
No	149	98.02
Types of surgery		
MRM	144	94.74
Atticotomy	5	3.29
Excision of PSRP with tympanoplasty	3	1.97
Type of disease pathology		
Cholesteatoma	37	24.34
Granulation	20	13.16
Both	95	62.5

Majority of the cases had active disease and three cases had associated with complications (one subdural abscess, one mastoiditis with Bezold's abscess, one facial nerve palsy) (Table 1). Modified radical mastoidectomy (MRM) with type III tympanoplasty was done in 77 cases. Majority of the case had both cholesteatoma and granulation tissue. Disease pathology was seen in the attic, mesotympanum and hypotympanum area in 81 cases, in attic, aditus, antrum and mesotympanum in 63 cases, in five cases the disease was found in the attic and in three cases the disease was limited to the posterior superior quadrant of the tympanic membrane. The disease extension was noted in the sinus tympani area in 95 cases (62.5%) (Table 2).

Dural plate breach and exposure of sigmoid sinus was recognized in 12.5%, 7.24% respectively. Korner's septum was noted in five cases (3.29%). The facial canal was dehiscence in 25 cases (16.4%) and immediate postoperative facial nerve palsy was seen in four cases (2.6%). Fistula in the lateral semi-circular canal was noted in two cases (Table 2). Incus was most susceptible to bony erosion, partially necrosed in 85 (60.7%) and absent in 44 (31.4%) cases. Lenticular process in 51.4% and long process 50.6% were most commonly involved part of incus. Malleus was eroded in 40 (28.6%) cases and malleus head was most commonly eroded (17.9%) part of malleus. Similarly. Stapes was intact in 95 (67.9%) cases, stapes supra structure absent in 41 (29.3%), footplate absent in one (0.7%) cases, and in three cases stapes could not be properly assessed because of granulation tissue.

Table 2: Various difficulties/problems encountered during mastoid surgery (n=152).

Characteristics	Number	Percentage
Breach of dural plate		
Exposed (iatrogenic)	16	10.52
Dehiscence	3	1.97
Breach of sinus plate		
Exposed (iatrogenic)	11	7.24
Dehiscence	0	
Presence of Korner septum		
Present	5	3.29
Absent	147	96.71
Facial canal dehiscence		
Yes	25	16.45
No	127	83.55
Lateral SCC fistula		
Present	2	1.31
Absent	150	98.68
Disease present in sinus tympani		
Present	95	62.5
Absent	57	37.5
Damage to chorda tympani nerve		
Present	9	5.92
Stretched	4	2.63
Not handled	139	91.45

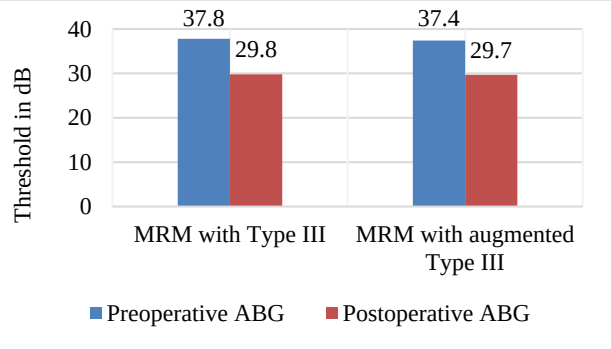

Figure 1: Age group distribution.

Ossicular reconstruction was done in a single stage. In 77 cases, type III tympanoplasty and its modification were done (38 cases; CWD mastoidectomy with type III tympanoplasty and 34 cases; CWD mastoidectomy with augmented type III tympanoplasty). Hearing assessment done after 10 weeks of surgery showed an average preoperative air-bone gap of 37.8 dB and average postoperative air-bone gap of 29.8 dB with a net average gain of 9dB (in 0.5 kHz, 1 kHz, 2 kHz, 4 kHz) in CWD with type III tympanoplasty group. Similarly, an average preoperative air-bone gap of 37.4 dB and an average postoperative air-bone gap of 29.7 dB with a net average gain of 7.7 dB (in 0.5 kHz, 1 kHz, 2 kHz, 4 kHz) was seen in CWD with augmented type III tympanoplasty group. But there was no statistical difference in air-bone gap closure between these two groups (Figure 1).

Some major and minor complications were noted in this study, which is summarized in Table 3.

Table 3: Early post-operative complication noted till 10th POD in cases with mastoidectomy (n=152).

Characteristics	Number	Percentage
Major complication		
Labyrinthitis	5	3.29
Facial nerve palsy	4	2.63
Local surgical site complication		
Incision site infection	7	4.61
Wound gape	5	3.29
Periorbital swelling	3	1.98
EAC bleeding	2	1.32
Perichondritis	2	1.32
Taste disturbance on 10th POD		
Present	13	8.56

DISCUSSION

COM has an estimated incidence of 31 million new cases year, out of which 22.6% occurs in children less than five years.[7] Majority of the patients requires the surgery, especially in the squamous type (unsafe type). There are various techniques to treat mastoid disease in COM-based on the preservation or removal of the posterior bony canal wall. Canal wall up restores the normal anatomy and includes cortical mastoidectomy, combined approach tympanoplasty, and mastoidectomy with canal wall reconstruction. The entire posterior bony wall is removed in the Canal wall down mastoidectomy (modified radical mastoidectomy and its various types, radical mastoidectomy) exposing middle ear and epitympanum.[8] The choice of choosing canal wall up (CWU) or CWD mastoidectomy in patients with chronic otitis media is determined by several factors, such as the extent of the disease, status of middle ear ventilation, the hearing in the ipsilateral ear, state of the contralateral ear, associated complications, possibility of regular follow-up, and the surgeon's choice. Regardless of the surgical type, the principal aims of mastoidectomy in COM squamous type are a disease-free and dry ear, the prevention of recurrent disease, and the maintenance of hearing or the possibility to reconstruct an affected hearing mechanism.[9]

Most of the complications encountered in the mastoid surgery are not only because of the surgeons' incompetence but because of the unusual and distorted anatomy that causes surgical challenges. Temporal bone anatomical variations are relatively comm on and there is always a risk of dreaded postoperative complication even with the experienced surgeon.[4,5]

There are studies quoting various difficulties in the mastoid surgery mentioning roles of various factors such as contracted antrum, low-lying dura, unusual tegmen shape, the severity of middle ear and mastoid disease, and expertise of the surgeon.

Injury to dura may cause a subdural hematoma, cerebrospinal fluid leak, and brain abscess with fatal consequences. In our study, dural plate breach was recognised in 19 cases (12.5%) among which iatrogenic exposure was high. It was exposed (iatrogenic) in 14 cases in the middle cranial fossa and two cases in posterior cranial fossa during surgery. But in three cases breach was seen in MCF due to disease pathology. In all the cases, breaches were less than 7 mm and breach more than 5 mm were repaired using temporalis fascia. Wang et al noted dural exposure of the mastoid tegmen in 26 (16.8%) of 155 ears.[3] The study by Yorgancilar et al noted 50 cases (5.52%) with tegmen mastoid erosion out of 905 cases with chronic otitis media.[10] This variation is mainly because of the variation in the disease severity and type of diseases (cholesteatoma or granulation). Granulation tissue as major pathology had an unfavourable outcome with a high percentage of exposure of the dura.[11] In our study, the granulation tissue was present in most of the cases and isolated cholesteatoma cases were few. Such complication can be prevented if anticipated preoperatively using imaging modalities such as HRCT, which has a high sensitivity of 91.93-100%, a specificity of 95.45%.[12]

Sinus plate breach is another common difficulty responsible for troublesome bleeding hindering the surgical field. In our study, we found sinus plates breach with exposure of sinus in 11 cases (7.24%). All cases were iatrogenic, which inadvertently occurred during drilling. There was only minor bleeding during surgery, which was controlled with adrenaline-soaked cottonoids and bipolar cautery. The rates are similar to study by Yorgancilar et al 56 (6.19%) out of 905 with chronic otitis media had sigmoid sinus plate erosion.[10] Sigmoid sinus plate erosion on HRCT temporal bone when correlated with preoperative finding had high sensitivity, specificity which could be valuable to surgeons during surgery.[12] Sinus plate erosion is more common in forward lying sinus and contracted antrum. In a study by Chrisanthus et al contracted antrum was noted in 15.3% cases, forward lying sigmoid sinus in 13.9% cases and sinus plate erosion in 2.9 % cases among 149 mastoidectomies.[8]

Korner's septum is challenging anatomical difficulty, especially for young surgeons. During mastoid surgery, it could be taken as a false medial wall of the antrum so that the deeper cells might not be explored, which could compromise surgery and its results. The chances of the complication are also high in cases with Korner's septum. In our study, Korner's septum was noted in five cases (3.29%). Approximately 6.5% to 45% of temporal bones without a history of aural pathology may have Korner's septum.[13]

In our study, facial canal dehiscence (FCD) was seen in 25 cases (16.4%), 84% in the horizontal segment and in 16% cases it was noted in the vertical segment, but the sheath was intact in all cases. The finding is similar to Chrisanthus et al in which FCD was observed in 17.52%, out of which 87.5% was noted in the tympanic segment (second genu) and in 12.5% it was noted in the vertical segment.[8] The incidence of facial canal dehiscence varies from 0.5% to 74%, the tympanic segment near the oval window is the commonest site followed by segment at the level of the geniculate ganglion.[14] Moreano et al reported facial canal micro-dehiscence in one-third of the temporal bones among 1000 cases.[15] FCD was found in 28/79 (35.44%) patients who underwent mastoidectomy compared to 18/76 (23.68%) patients who underwent the only tympanoplasty.[3] Facial nerve palsy can occur as a complication of the disease as well as surgery for chronic otitis media. Pre-existing FCD increases the incidence of injury to the nerve during surgery. So, HRCT temporal bone helps to warn the surgeon to potential intraoperative complication associated with the particular surgery. However, the bony covering over the tympanic part is so thin that it may not be seen in all computed tomography images. Intraoperative microscopic observation remains the best way to recognize the dehiscence of the facial canal to reduce the chances of iatrogenic facial nerve injury.

In our study, fistula in lateral semi-circular canal (LSCC) was noted in two cases (1.32%) both were less than 3 mm which were repaired using temporalis fascia. These findings were lesser compared to 12.4% by Chrisanthus et al, 5.16% by Wang et al and 2.23% by Yorgancilar et al.[3,8,10] The sensitivity of HRCT in predicting lateral semicircular canal fistulas ranges from 25% to 100%, which could be used by surgeons in suspected cases to prevent complications.[12]

Identification of the ossicular lesions during surgery is important for reconstruction of the sound conductive mechanisms to restore hearing. In our study, incus was most susceptible to bony erosion with the lenticular process and long process were the most commonly involved parts of incus. Malleus was the most resistant, with malleus head being commonly eroded part of malleus. This is similar to the published literatures showing similar results.[16-18] Ossiculoplasty re-establishes the sound conduction between the graft and remnant ossicles, however, hearing improvement is unpredictable. Commonly, type III tympanoplasty and its modifications are the options available as there is the destruction of incus and stapes suprastructure. In most of our cases, we performed single-stage ossicular reconstruction, as most of the patients do not come for second staged surgery due to financial issues. Hearing assessment done after ten weeks of surgery showed similar results in CWD with type III tympanoplasty group and augmented type III tympanoplasty group with no statistical difference in air-bone gap closure between these two groups. The postoperative air-bone gap of 0-20 dB as a result of type III and augmented type III tympanoplasty in canal wall

down mastoidectomies ranges between 30-69% in the different series.[19-21]

In this study, taste disturbance was noted in 13 cases (8.55%), when inquired on 10th postoperative day. Among these cases with taste disturbances, chorda tympani nerve (CTN) was not identified in four cases and was injured during surgery in the remaining nine cases. Most common taste disturbances were metallic taste, bitter, salty or sore sensation, tongue numbness or dry mouth. A similar study by Gurung et al showed taste disturbance in 4.2% cases in middle ear surgery.[22] Saito et al showed the results with electrogustometry that there was a better long-term recovery of clinical (subjective) taste perception than of objective taste function with less than 2.7% subjective taste impairment after two years.[23] In our study, taste disturbance was not voluntarily complained but rather admitted when asked specifically. Taste disturbance may not be noticed despite CTN injury because of gradual hypofunction due to long-standing middle ear disease and patient is not aware of further post-operative taste disturbances following surgery.[24] Though a small percentage of the patient will have long term taste disturbance, this could be significant for professional like chefs and wine-tasters. So, the risk of taste disturbance should be addressed in the consent procedure.

Some local site complications were also noted in the study. These complications were managed conservatively, but the hospital stay was prolonged for a few days. These complications could have been prevented by antibiotic prophylaxis, taking proper aseptic precaution and regular dressing.

Majority of the complications can be prevented by meticulous surgery and preoperative anticipation of the difficulties. HRCT temporal bone can guide us with the high sensitivity and high specificity rate. Though Computed Tomography helps in preoperative identification of some variation in anatomy, it occasionally gives the false impression of lateral semicircular canal fistula, tegmen tympani erosion, and facial canal dehiscence.[6] The positive aspect of the study is that the surgeries performed by the experienced surgeon only were included. Department of ENT has separate customized operative proforma for ear surgery where all major and minor operative details have to be mentioned by the surgeon himself immediately after the surgery, which minimizes the missing of minor details, the operative finding and chance of recall bias. However, the retrospective nature of the study is the potential limitation of the study. Multiple surgeons with different techniques might have affected the study results.

CONCLUSION

Anatomic variations of the temporal bone and surgical difficulty are common in mastoid surgery. The major complication rate is around 2-3% despite numerous anatomic variations and difficulties. Majority of variations can be identified during meticulous surgery and complications can be prevented by preoperative anticipation of the difficulties. This allows the surgeon to customize the procedure appropriate for each patient and to improve the outcome of surgery with less complication.

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