Incidence of Facial Canal Dehiscent Noted Intraoperatively in Unsafe Chronic Suppurative Otitis Media: A Retrospective Study

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Abstract: Background: Dehiscence of the facial canal is a matter of great concern for an otologist as one of the most dreaded complications of mastoid surgery is injury to the facial nerve. In the present study, an attempt was made to determine the incidence of facial nerve dehiscence and its associated factors.

Methods: A retrospective study was carried out in the Department of Otorhinolaryngology in a tertiary referral hospital, Gujarat among 302 patients who suffered from chronic suppurative otitis media. The study’s inclusion criteria were primary and revision cholesteatoma surgery.

Results: The incidence of facial nerve dehiscence was found to be 21.22%. The factors associated with facial canal dehiscence were age, sex, duration of disease, and type of surgery.

Conclusions: The surgeon should keep in mind the importance of facial nerve protection during surgery. The rate of facial nerve dehiscence can be reduced by using operating microscope and drills.

Keywords: Dehiscence Facial canal, Cholesteatoma, Labyrinthine fistula, Dural plate dehiscence, Sinus plate dehiscence, Chronic suppurative otitis media.

INTRODUCTION

Cholesteatoma is a cyst or desquamating keratinized epithelium of pneumatized portion of temporal bone. It may expand in variable spaces of attic, mastoid, middle ear, with this there is expansion of cholesteatoma by destruction of bony structure. The major theories regarding the mechanism of bony destruction or absorption in chronic suppurative otitis media (CSOM) include the pressure theory and the inflammatory granulation tissue theory, which includes the enzyme destruction theory (Uno Y et al., 1995).

Surgery for chronic suppurative otitis media (CSOM) with cholesteatoma is most prevalent operation in the field of otology, particularly in developing countries. The incidence of intra cranial ad extra cranial complication of unsafe CSOM in developing countries is about 0.24-0.45%, respectively (Kangsanarak J et al., 1993). One of the common intra temporal complications is facial nerve paralysis (Lin YS et al., 2009), it was observed in 0.43% of patients suffering from COM. Some researchers believe that from supportive COM is a predisposing factor for Facial nerve canal dehiscence (FCD) (Oznek C et al., 2009). Any injury of the facial nerve represents the ENT surgeon’s greatest fear. Incidence of facial nerve injury reduced recently by using operating microscope and drills.

Anatomical variation of facial nerve is of significant concern to otologic surgeon. Facial nerve dehiscence most common variation usually present in tympanic part of facial nerve above the oval window. There may also be present in geniculate ganglion and mastoid segment of retro facial cells (Quaranta et al., 2007, Smith JA et al., 2006, Chu et al., 1988, Antoli-Candel F Jr et al., 1974). Histological study of normal human bones ranges from 25% to 57% (Moreano EH et al., 1995).
1994) that makes the risk of injury to facial nerve great when not covered by bony canal during surgery. On the other hand, the accuracy of the CT scan for detection of FCD was not constant and sometimes it may be impossible to find it in the thin bone of the facial canal precisely (Di Martino E et al., 2005, Alzoubi FQ et al., 2009, Rogha M et al., 2014).

METHODS

This retrospective study was carried out in tertiary referral hospital in Department of otolaryngology in GMERS medical college and hospital sola, in the Gujarat over two-year period from March 2019 to April 2021. This study included the patients undergoing primary and revision canal wall up (CWU) and canal wall down (CWD) tympano-mastoidectomy in patients who suffer from chronic supplicative otitis media (CSOM) with cholesteatoma, excluding all patient of tympanoplasty and patient with inadequate documentation. Included total 302 patients who underwent ear surgery for unsafe chronic otitis media by senior surgeon. Of these patients, 5 had revision ear surgery. Under the operative microscope with high magnification and also palpation with a blunt pick, facial nerve was assessed to find any possible dehiscence. The result of each surgery was used to define the presence of dehiscence of facial canal and its location and to identify the presence of labyrinthine fistula. Dural plate dehiscence, sinus plate dehiscence at same time (Moody MW et al., 2007).

The location of facial canal dehiscence recorded on whether it was located in: 1)1st genu (geniculate ganglion), 2) tympanic portion, 3) 2nd genu, 4) vertical/mastoid segment. Pre-operative and intra operative finding documentation done and preoperative clinical data in form of sign and symptoms of presentation of patient before surgery, that are such as: otalgia, vertigo, hearing loss, otorrhea, facial paralysis, external canal polyp, post auricular abscess/fistula.

RESULTS

In our study total 340 patient underwent tympano-mastoidectomy, out of them only 302 patients met inclusion criteria. Age of patients rage from 2 year to 65 year, in which 108 (35.76%) total male patients underwent ear surgery ad 194 (64.23%) female patients underwent ear surgery. Primary ear surgery was performed in 106 male patients and 191 female patients, where revision ear surgery performed in total 5 patient, 2 (40%) male patient and 3 (60%) female patients. In 22(20.75%) out of 106 male patient who undergoing primary ear surgery had facial canal dehiscence, in 40(20.94%) out of 191 female patient who undergoing primary ear surgery had facial canal dehiscence. In 1 male and 1 female patient have facial canal dehiscence in revision ear surgery (Table 1 Ear surgery performed in male and female patient).

All patient undergoing ear surgery, the most common complain they present were otorrhea (78.6%), hearing loss (88%), otalgia (7.1%), vertigo (4%), and facial nerve paralysis (2.1%). Preoperative present of external auditory canal polyp (8%), postauricular abscess (0.9%), and postauricular fistula was present (0.5%) (Table 2 site of facial canal dehiscence noted intraoperative).

Table 2 displays the distribution of facial canal dehiscence, the most common site for dehiscence was reported at tympanic segment 48.38% in primary ear surgery, second most common site for FCD was noted at vertical segment (mastoid part of facial nerve) 16.12%, third most common site for facial canal dehiscence at 2d genu and tympanic segment (9.68%). In revision ear surgery performed in 5 cases out of them 2 (100%) patient have facial canal dehiscence and common part involving was tympanic and vertical segment.

The study conducted in our tertiary institute and incidence of facial nerve dehiscence in otologic surgery in our study (21.22%). The most common location of facial nerve canal dehiscence by cholesteatoma in our study is tympanic portion is comparable with the most common areas of injury to the facial nerve, such as the tympanic portion. The surgeon should keep in mind during the procedures performed in the middle ear could potentially traumatize or damage the facial nerve at the site of dehiscence. A longer duration and more extensive cholesteatoma increase the chance of finding a dehiscent facial nerve. To this we can prevent facial nerve paralysis and other complication in post-operative period ad reduced morbidity.

| Table 1: Ear surgery performed in male and female patient |
|----------------|--------|--------|--------|
| PATIENT               | MALE  | FEMALE | TOTAL |
| Primary ear surgery without FCD | 84     | 151    | 235    |
| Revision ear surgery without FCD | 1      | 2      | 3      |
| Primary ear surgery with FCD | 22     | 40     | 62     |
| Revision ear surgery with FCD | 1      | 1      | 2      |
| Total                  | 108    | 194    | 302    |

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DISCUSSION

This is particularly true for cholesteatomas, which by their biological nature can induce reabsorption of the bony covering of the facial canal. The environment created by the cholesteatoma triggers numerous mechanisms that favour bone destruction (e.g. mechanical compressive factors due to keratin debris accumulation, endotoxin and enzyme released by bacteria colonizing the cholesteatoma, and subepithelial mesenchymal cells and their bone resorptive enzymes). Facial nerve dehiscence independent of cholesteatoma or chronic otitis media is a well-described anatomic variation. In 1971, Baxter showed that the dehiscence rate of the fallopian canal in anatomic study of 535 normal temporal bones is 55% (Baxter A, 1971). Baxter also mentioned that the inferior wall of tympanic segment adjacent to the oval window was most frequently involved with an 85% incidence rate (Baxter A, 1971). Moreano et al., reported that histopathologic study of 1000 temporal bones with neovascularization of the disease (Moreano EH et al., 1994) or inflammation revealed that 56% of the temporal bones had at least one facial nerve dehiscence (Jaswal A et al., 2008). A previous study identified the presence of neurotrophins in cholesteatoma (Kaneko et al., 1980, Moriyama H et al., 1987, Chole RA, 1993, Orisek BS et al., 1987). Radiologic studies have attempted to predict before operation the site and degree of bone reabsorption of the fallopian canal due to cholesteatoma (Artico M et al., 2008). In 1996, Fuse et al. confirmed that the facial nerves involved in 75% of their cases during operation, with 66% sensitivity and 84% specificity (Fuse T et al., 1996). These retrospective investigations provide valuable information on how, where, and in which patient’s facial nerve dehiscence occurs most frequently.

Our research with a relatively high population under study, revealed that the incidence of FCD in COM surgery was 21.19%. Various investigations have explored the subject, in a study of 67 cholesteatoma cases, Selesnick and Lynn-Macrae showed the incidence of 30% in the primary and 35% in the revision surgery. In the research by Lin et al., on 117 tympanoplasties (with or without mastoidectomy), they reported its incidence as 33% in the primary, and 37.5% in the revision procedures (Lin JC et al., 2004). Also, in a study by Ozbek et al., on 265 cases of mastoid surgery, the incidence of FCD was 1.26 times higher in the revision surgeries, and the difference was not statistically significant (Ozbek C et al., 2009). In this study, the dehiscence rate was a little higher in the revision procedures (21.2%) than the initial operations (17.3%). Recently in a retrospective study by Sun et al., on 212 patients, who underwent tympano-mastoidectomy, they reported the prevalence of FCD in was 27.7% in patients without cholesteatoma and 64.0% in patients with cholesteatoma (Choi SA et al., 2014). In another study by Genc et al., it was found that the rate of FCD was about 32% in COM with Cholesteatoma; also, about 88% of the patients with FCD who had undergone tympano-mastoidectomy suffered from chronic otitis with cholesteatoma. In a study on 202 patients who had undergone mastooidectomy, Bayazit et al., reported the incidence of 8.9 and 18.4% of FCD in patients without and with cholesteatoma, respectively (Bayazit YA et al., 2002). In another retrospective study by Kim et al., on 152 patients who underwent tympanoplasty with mastoidectomy for COM, they found that the rate of FCD was 8.6% (Kim CW et al., 2008).

The location of facial nerve dehiscence in patients operated on for cholesteatoma in our study were mostly in the tympanic segment (92.3%). This corroborates the current understanding of the growth patterns of cholesteatoma, in which cholesteatoma closely approximates the tympanic segment of the facial nerve. In addition to close proximity of cholesteatoma to the tympanic segment, the bony covering of the fallopian canal is particularly thin in this region.

We found a significant association between FCD and some intra-operative findings such as labyrinthine fistula, external auditory canal polyt, Dural plate dehiscence and sigmoid sinus exposure. A possible interpretation of these findings is that it will presumably take some time for development of such destructive complications; therefore, time is essential.

In our study, 48.38% of the FCD cases were located at the tympanic segment; the next most frequent site was the mastoid (vertical) segment (16.12%).

Table 2: Site of facial canal dehiscence noted intraoperative

<table>
<thead>
<tr>
<th>Part of facial nerve dehiscence</th>
<th>Primary ear surgery</th>
<th>Revision ear surgery</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Tympanic segment</td>
<td>30(48.38%)</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Vertical segment</td>
<td>10(16.12%)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>1st genu and tympanic segment</td>
<td>2(3.22%)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Tympanic and vertical segment</td>
<td>4(6.45%)</td>
<td>2(100%)</td>
<td>6</td>
</tr>
<tr>
<td>2nd genu</td>
<td>4(6.45%)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1st genu to vertical segment</td>
<td>2(3.22%)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2nd genu and tympanic segment</td>
<td>6(9.68%)</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>1st genu, tympanic segment, 2nd genu</td>
<td>4(6.45%)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>2</td>
<td>64</td>
</tr>
</tbody>
</table>
In our study, overall incidence of labyrinthine fistula was about 6%. This incidence rate is just like Moody and Lambert’s data in 416 ears with 6.5% fistula rate (Moody MW et al., 2007). In the literature, the overall incidence of labyrinthine fistulas ranges from 3 to 13% (Ozbeke C et al., 2009, Gacek RR, 1974, Mustafa A et al., 2008, Sheehy JL et al., 1977, Orisek BS et al., 1987, Palva et al., 1971). On the whole, our results are within this range. Some researchers have found an increase in the incidence of COM complications in revision surgery (Gacek RR, 1974; Gormley PK, 1986, Ritter FN, 1970). Nevertheless, we did not find as significant difference in the frequency of labyrinthine fistula in primary and revision COM surgeries. In a review article by Copeland and Buchman, they found that in extensive COM with cholesteatoma, 29% of cases with labyrinthine fistula also had FCD or preoperative facial weakness (Copeland BJ et al., 2003). In contrast, the presence of an SCC fistula increased the risk of facial nerve dehiscence by about 4.7 times. Preoperative identification of a fistula with imaging techniques should alert the surgeon to the possibility of a concomitant dehiscence. Similar to other studies, we found that the incidence of fistula was significantly higher in ears with FCD (Ozbeke C et al., 2009, Bayazit YA et al., 2002, Moody MW et al., 2007, Mustafa A et al., 2008, Lee JH et al., 2009). In the current study we found that all the cases of labyrinthine fistulas were limited to lateral semicircular canal (100%). Other Semicircular canals were never seen involved. These findings were similar to the studies of Faramarzi et al., and Grewal et al., who in their respective studies observed that lateral semicircular canal involvement was seen in 95.83% and 96% of cases compared to other sites (Faramarzi AH et al., 2011, Grewal DS et al., 2003).

We detected 11% cases with external auditory canal polyp. This study revealed a significant association between external auditory canal polyp and facial nerve canal dehiscence. Our result is in the same line with those of Jaswal et al., study; they detected 12% polyp in 146 patients who underwent radical and modified radical mastoidectomy (Jaswal A et al., 2008). In a study by Prasannaraj et al., on 42 cases with aural polyp, they found that in 19% of them, there are facing other complications (Prasannaraj T et al., 2003).

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DECLARATIONS

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