Inflation-deflation test as a predictor of aditus patency in patients with chronic suppurative otitis media

Regi Kurien · Shipra Chrisolyte · V. Rupa

Abstract

Aims To assess eustachian tubal function (ETF) preoperatively in patients with chronic suppurative otitis media (CSOM) with central perforation by performing the inflation-deflation test. To correlate the results of the inflation-deflation test with the finding of aditus patency or block in patients with CSOM

Study design Prospective, cohort

Setting Tertiary care hospital

Subjects Eighty adult patients with chronic suppurative otitis media and central perforation were recruited into the study. There were 45 males and 35 females.

Methods All patients underwent preoperative inflation-deflation test followed by cortical mastoidectomy and tympanoplasty. The patency of the aditus was assessed intraoperatively.

Main outcome measure Equalization of pressure on inflation-deflation test and intraoperative assessment of aditus patency

Results Of a total of 80 patients, 49 patients were found to have discharging ears and 31 had dry ears at the time of surgery. In dry ears the inflation-deflation test had a sensitivity of 93% in predicting aditus patency although the specificity was lower at 67%. In discharging ears the sensitivity in

predicting aditus patency was 72% and the specificity was 67%.

Conclusion The eustachian tube inflation-deflation test is a sensitive test for predicting aditus patency in patients with dry ears but less so in patients with discharging ears. Hence, it could be used in the former to avoid unnecessary exploration of the mastoid.

Keywords Chronic suppurative otitis media (CSOM) · Eustachian tube inflation-deflation test · Aditus patency

Introduction

The ET forms a vital bridge connecting the middle ear and the nasopharynx performing the functions of protection, pressure regulation and clearance of the middle ear cleft. The middle ear is ventilated by the ET. Abnormal function of the ET is one of the important factors in the pathogenesis of chronic suppurative otitis media (CSOM) [1]. Some authors believe it to be one of the main causes of failure following tympanoplasty [2]. While a number of factors have been shown to influence graft take rate in tympanoplasty, good preoperative tubal function has been noted to be associated with a high rate of success [2].

Various tests have been devised to test ET patency over the years. These include manometry [3, 4], tympanometry [5], eustachian tube endoscopy [6, 7], dye studies with fluorescein [7, 8] and saccharin [9] and sonotubometry [10]. The inflation-deflation test was first reported by Flisberg et al. [11]. It has been adapted for routine clinical use by Bluestone et al. [5]. The test enables one to assess both the active and passive opening function of the ET. It can be performed in all patients with perforated eardrums such as those with chronic suppurative otitis media and those who have undergone myringotomy and grommet insertion for otitis media with effusion. It is easy to perform, non-invasive and reproducible.

R. Kurien · S. Chrisolyte · V. Rupa
Department of ENT,
Speech & Hearing, Christian Medical College Hospital,
Vellore, India

V. Rupa (✉)
E-mail: rupavedantam@cmcvellore.ac.in

Another factor which can affect graft take in tympanoplasty is the presence of granulations or thickened mucosa within the mastoid. The presence of an obstructed aditus can adversely affect graft take or produce retraction of the repaired eardrum following tympanoplasty if the mastoid has not been cleared of disease simultaneously. The granulations or thickened mucosa may block the aditus and impede ventilation of the mastoid. To preoperatively determine which patient requires mastoid clearance may not be possible based on X-ray findings of lack of aeration alone. Preoperative high resolution CT scanning could demonstrate the presence of soft tissue thickening in the mastoid and aditus. However, this is not performed routinely in most centres of the world.

We hypothesised that preoperative assessment of ETF by the inflation-deflation test could help predict whether the aditus was patent or blocked by tissue. If this prediction was possible with some degree of accuracy, the decision to explore the mastoid in a particular patient with CSOM could be made preoperatively. A prospective study with this aim in mind was designed to test this hypothesis.

Materials and methods

Patients aged 12 years and above diagnosed with CSOM who had undergone cortical mastoidectomy and tympanoplasty between April 2006 and July 2007 were included in the study. Patients with other comorbidities such as sinusitis, congenital defects of the upper airway or immunodeficiencies were excluded from the study.

Calculation of sample size was based on the results of a pilot study in which 7 of 10 patients who demonstrated a patent eustachian tube on testing ETF preoperatively were found to have a patent mastoid aditus also. In order for the study to have 80% power to detect a difference between the prevalence of aditus patency in those in whom tests of ETF showed a patent ET and those in whom it did not at 5% significance level, a sample size of 80 patients was required.

Preoperative assessment

All patients underwent pure tone audiometry and X-rays of the mastoid preoperatively. On the day before surgery, all patients underwent inflation-deflation five swallow tympanometry test to assess the function of the eustachian tube. The patient was seated comfortably and explained regarding the procedure. The external auditory canal was fitted with a rubber ear tip of corresponding size so as to maintain an airtight seal. The otoadmittance probe was connected to a standard otoadmittance meter (GSI Ltd.).

The middle ear was first inflated with a constant flow of air until the eustachian tube opened passively. This was denoted by a sudden fall in pressure (opening pressure)

– forced response test. The middle ear pressure was then equilibrated by performing five consecutive swallows with an interval of ten seconds in between to prevent strain on the pharyngeal muscles (active tubal function). The residual pressure after five swallows, if any, was recorded (Fig. 1a and 1b). The deflation phase of the test was then performed. A pressure of -200 mmHg was applied to the middle ear and the patient was again instructed to swallow. The pressure remaining in the middle ear after five consecutive swallows was noted and recorded (Fig. 2a and 2b). The eustachian tube was considered to be patent if there was no residual pressure during both inflation and deflation.

Intraoperative assessment

At surgery, cortical mastoidectomy was performed in a standard fashion using an electric drill and operating microscope. The presence of mucosal thickening or granulations in the mastoid or aditus was noted. The tympanomeatal

Fig. 1 Tympanogram showing no residual pressure (A) and residual pressure (B) during inflation phase of inflation-deflation test

Fig. 2 Tympanogram showing no residual pressure (A) and residual pressure (B) during deflation phase of inflation-deflation test

flap was elevated and aditus patency checked by irrigating it with saline and visually checking for its flow into the mesotympanum. The results of aditus patency testing were recorded as “patent” if there was free flow of saline from the aditus into the mesotympanum and “blocked” if this did not occur. The data was stored in a computerized database for future statistical analysis.

Results

A total of 80 consecutive patients were enrolled in this study. There were 45 males and 35 females (Table 1). All patients were found to have sclerotic mastoids on X-ray.

Patients with dry and discharging ears were considered separately. Of a total of 80 patients, 49 (61.3%) patients were found to have discharging ears and 31 had dry ears. Both aditus and ET patency was present in 18 discharging and 26 dry ears. While the overall prevalence of ET and aditus patency was 55%, the phenomenon was more commonly seen in patients with dry ears (83.9%) than discharging ears (36.7%) ($p < 0.001$).

Statistical analysis

In dry ears the inflation-deflation test had a sensitivity of 93% in predicting aditus patency although the specificity was lower at 67%. In discharging ears the sensitivity in predicting aditus patency was 72% and the specificity was 67%. In patients with either dry or discharging ears, the test predicted a blocked aditus in 67%.

Discussion

Our study has shown that a patent ET diagnosed by the inflation-deflation test could be predictive of a patent aditus in most (93%) patients with CSOM with dry perforations. Accordingly, performing tympanoplasty alone without mastoid exploration would probably be sufficient in the majority of cases with these results. The procedure of a cortical mastoidectomy, although commonly performed for patients with CSOM and central perforation, may be associated with complications such as injury to the tegmen, sinus plate, lateral semicircular canal and facial nerve palsy. These complications, although rare, can be quite devastating to the patient and surgeon. Moreover, the addition of this procedure to tympanoplasty adds to the operating time, with additional financial burden to the patient.

To the best of our knowledge, there has been no similar study described till date in the English language literature. Miller [4], studying ET function in normal ears and ears with CSOM and central perforation, found that the condition of

Table 1 Results of inflation-deflation test and aditus patency status in ears ($n = 80$)

Discharging ears ($n = 49$)		
	Aditus patent	Aditus blocked
ET patent	18	8
ET blocked	7	16
Dry ears ($n = 31$)		
	Aditus patent	Aditus blocked
ET patent	26	1
ET blocked	2	2

the middle ear mucous membrane was the most important determinant of ET function in patients with CSOM. To some extent, this inference reflects the findings of our study in that aditus block by diseased or edematous mucous membrane (which is necessarily in continuity with middle ear mucous membrane) was most often associated with eustachian tubal block in both dry (50%) and discharging (69.6%) ears. If eustachian tubal function is significantly better in a dry ear, it is probably more likely that an operating on a dry ear will result in a successful outcome. Thus, converting a discharging ear to a dry one preoperatively with a course of topical and systemic antibiotics may be one way of improving outcomes following surgery. Further, performing tympanoplasty or myringoplasty alone without mastoid exploration in such ears could be recommended based on the finding of ET patency on the inflation-deflation test.

The association between ET patency and mastoid pneumatization has been reported by some authors, however. Holmquist [2] studying ET function in patients with CSOM and dry central perforations, found that ET block was present in 78% of patients. Mastoid pneumatization correlated positively with good ET function. Shimada et al. [12] investigated the relationship between the eustachian tube's ventilatory function and pneumatization of mastoid air cells. Their research showed that poor mastoid pneumatization was associated with poor ET function. In the present study, despite the fact that all the studied patients had sclerotic mastoids, the percentage of those with ET patency (66.3%) was much higher than in other series. Evidently, there is no relationship between mastoid pneumatization and ET function in our series.

A few studies have reported on the use of tests of ET function preoperatively to predict outcome following middle ear surgery. MacKinnon [13] measured tubal function in 80 patients prior to tympanoplasty. In this test, the ability of the eustachian tube to equalize, by deglutition, pressure applied to the middle ear was measured. Residual pressure after deglutition was stratified into good function (residual pressure 0–100 mm H₂O), moderate function (100–200 mm H₂O), and poor function (>200 mm H₂O). Eighty percent of the patients with good or moderate function had success, whereas only 29% of those with poor function had successful ear drum closure.

Similarly, Sato et al. [13] in 1990 evaluated ET function preoperatively with the inflation-deflation test for patients undergoing tympanoplasty. They found that the outcome following surgery correlated better with the results of negative pressure equalization than with the results of positive pressure equalization. They recommended the use of the latter test in the prediction and prognosis of successful tympanoplasty.

Conclusion

ET patency is one of the determinants of outcome following middle ear surgery for CSOM. The association

between a well aerated mastoid, patent aditus and a patent eustachian tube is well-known. The inflation-deflation test to assess ETF was used in this study to predict the patency of the aditus preoperatively in patients undergoing cortical mastoidectomy and tympanoplasty for CSOM. Our results show that a patent eustachian tube as detected by the inflation-deflation test is a good predictor of aditus patency in patients with CSOM and dry central perforations. With the use of this test unnecessary exploration of the mastoid may be avoided in these patients.

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