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Review Article

A review of retraction pockets: past, present and future management

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Abstract

Retraction pockets can lead to hearing loss and cholesteatoma. Distinguishing stable from progressive disease is challenging to any otologist. The management of retraction pockets is a contentious issue with present treatment options often plagued with recurrence. The purpose of this article is to summarize recent developments in the aetiology of retraction pockets of the pars tensa, its diagnostic and management problems and to define possible future therapeutic options.

Key words: Tympanic Membrane; Retraction Pockets, Eustachian Tube; Laser Surgery; Otologic Surgical Procedures

Introduction

Retraction pockets of the pars tensa are not uncommon, especially in children, and can progress rapidly from relatively limited disease to cause ossicular erosion and cholesteatoma. It presents an otological dilemma as there is no consensus about which treatment is ideal despite increased understanding of the pathophysiology behind the disease.

There are several classification systems to grade the severity of retraction pockets of the pars tensa. Sade's clinical grading is the best known and most commonly used; grade I representing simple retraction, grade II is retraction onto the incudostapedial joint with or without erosion, grade III is retraction onto the promontory without adhesion (Figures 1 and 2) and, lastly, grade IV is adhesion to the promontory.[1]

Pathophysiology

Over recent years greater insight has been gained into the pathophysiology of retraction pockets. This has identified eustachian tube dysfunction[2,3] and weakening of the tympanic membrane from otitis media with effusion[4,5] to be the two major contributors to retraction pockets.

The normal eustachian tube serves to equilibrate the pressure in the middle ear and prevent nasopharyngeal reflux into the middle ear. Anatomically, the medial two thirds is cartilaginous and the lateral third is bony. At rest, the eustachian tube is closed due to apposition of the anterior and posterior mucosal surfaces of the cartilaginous portion of the tube. Contraction of the tensor veli palati attached to the anterior portion of the tube, for example during yawning or chewing, causes the eustachian tube to open.

Eustachian tube dysfunction can be due to a number of factors ranging from mucosal oedema of whatever origin, cartilaginous pathology such as with a patulous eustachian tube, abnormalities of the tensor veli palati or postnasal space masses such as enlarged adenoids or nasopharyngeal tumours. This is supported by the observation that children with cleft palate have increased middle-ear abnormalities secondary to eustachian tube dysfunction due to deficiency or absence of the palatal muscles that open the eustachian tube.[6,7] In addition, recent computed tomography (CT) scanning studies have identified a loss of soft tissue in the cartilaginous portion of the patulous eustachian tube.[8] Since the eustachian tube is continuous with the nasopharynx, it can also be easily blocked by mucosal oedema resulting from respiratory tract infection, allergy and reflux. This problem is exacerbated in children who possess a narrower, shorter eustachian tube than adults. As the child matures, the eustachian tube undergoes a number of important anatomical and physiological changes, making it less prone to otitis media. These include the development of muscle and the stiffening of the cartilage that maintain patency of the tube, and increases in both the length and angle of the eustachian tube to reduce reflux into the middle ear. In addition, the adenoids tend to regress improving ventilation of the middle ear.

Eustachian tube dysfunction can also be due to an abnormally patent tube, known as the patulous

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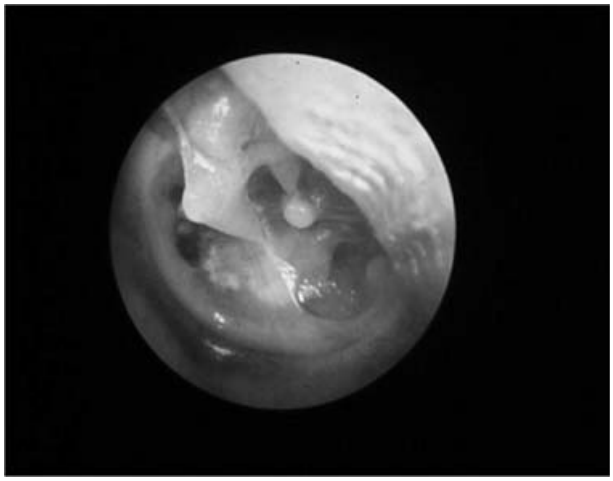

FIG. 1
Grade III retraction pocket (seen intra-operatively with 0° scope).

eustachian tube. This phenomenon, though rare, may account for a minority of cases of otitis media and retraction pockets in adolescence and adults. The incidence of patulous eustachian tube is variously reported between 0.3 and 6.6 per cent of cases. It is rarely found in children and is more common in females. Habitual sniffers are believed to be most affected by this condition.[9] Repetitive evacuation of the middle ear though a patent tube leads to prolonged negative pressure in the middle ear. This repetitive barotrauma is believed to cause secondary effects such as otitis media and retraction. Recent CT imaging has identified loss of soft tissue in the cartilaginous patulous eustachian tube, making this an ideal target for treatment.

Retraction pockets are commonly observed in previously diseased ears, and usually there will be a history in children with previous episodes of otitis media. Otitis media results in histological degeneration or atrophy of the lamina propria of the tympanic membrane.[1] This weakens the tympanic membrane resulting in the formation of retraction pockets, in the setting of negative middle-ear pressure. There is increasing evidence to suggest that otitis media with effusion is secondary to tubal mucosal inflammation, which may be allergic or reflux in origin. Gastric enzymes like pepsin/pepsinogen and *Helicobacter pylori* have been found in middle-ear fluid of children with chronic otitis media, implying gastroesophageal reflux in its pathogenesis.[10,11] With respect to atopy, common inflammatory mediators are found in the middle ear, eustachian tube and adenoid tissue.[12] There is an increased expression of interleukin-4 (a Th2 cytokine) and eosinophilic infiltration in these three regions in atopic compared to normal patients. This supports the association between allergy and otitis media with effusion, and also that the middle ear may be an integral part of the united airway concept i.e. contiguous with the upper respiratory tract.

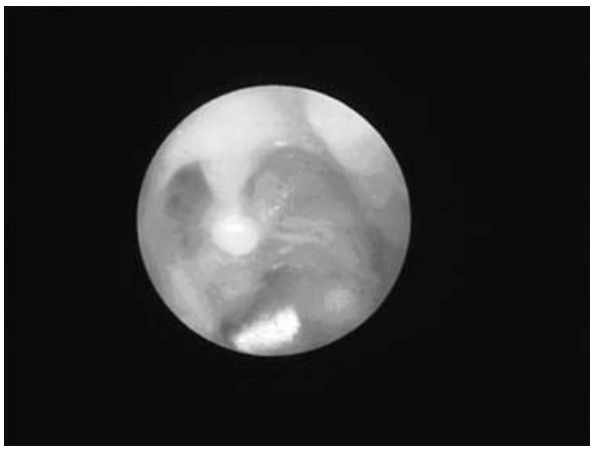

FIG. 2
Grade III retraction pocket (intra-operatively with 30° scope).

The dynamics of retraction pockets has been studied extensively. Charachon *et al.* demonstrated a deterioration in the grade of the retraction pocket in 16 per cent of grade I and II cases over a five-year period.[13] Conversely, in children, once eustachian tube function is restored, retraction pockets can resolve spontaneously. Normally the pressure in the middle ear is the same as that externally. However, when the eustachian tube is blocked, passive resorption of gases in the middle ear results in negative pressures in this region. With a weakened tympanic membrane from previous inflammation, retraction pockets tend to form. This link between negative ear pressure and retraction pockets is supported by tympanometry findings.[14] In addition, Bluestone showed that patients with retraction pockets had functional obstruction of their eustachian tubes as proven by eustachian tube ventilation tests.[15]

The site of retraction pockets, is usually, but not always, in the posterosuperior portion of the pars tensa as confirmed by Mills[16] and Poe.[17] Ars showed that 60 per cent of retraction pockets are situated in the pars tensa (36 per cent posterosuperior quadrant; 16 per cent in the inferior half) whilst the remaining 40 per cent are in the pars flaccida.[18] The reason why the posterosuperior pars tensa is most at risk can be explained by a histopathological study of temporal bones of children of less than three and a half years.[19] It was shown that there was persistence of mesenchyme (normally resorbed at two months) in this portion of the tympanic membrane for up to three years in those patients with inflammatory ear disease. As a consequence, there is poor maturation of elastin in this region, leaving a weaker tympanic membrane once this mesenchyme is finally resorbed. With respect to the pars flaccida, this region is inherently weaker, compared to the rest of the tympanic membrane, as it lacks a fibrous layer, putting it at risk of retraction and attic cholesteatoma.

Presentation and management

The finding of retraction pockets may be purely incidental and from the patient's perspective entirely

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asymptomatic. Symptomatic patients tend to present with recurrent ear infections, hearing loss and occasionally otalgia. The exact incidence is not known, but both children and adults may present with retraction pockets. Both groups tend to have a history of previous childhood ear infections. On presentation to an otologist, pure tone audiometry and tympanometry are carried out. Pure tone audiometry may be entirely normal in the early stages progressing to a conductive hearing loss. Tympanometry can show negative middle-ear pressure due to eustachian tube dysfunction or with flat traces due to concurrent glue ear. The central problem at diagnosis is distinguishing stable from progressive disease. With children, the disease tends to pursue a more aggressive course compared to adults, requiring frequent follow up to allow identification of progression.

The management options include observation, medical treatment and surgery. In the first instance treatment should be conservative generally. Chronic serous otitis media leads to a high incidence of atelectasis and retraction.[20] Hence prevention using oral antibiotics, decongestants and forced middle-ear insufflation techniques has been advocated, although with equivocal results. The majority of grade I and II retraction pockets tend to resolve spontaneously with time, hence a watch and wait policy or medical treatment (decongestants, antiallergy medication or autoinflation with an otovent balloon to dilate the middle-ear cleft) is normally adopted. In selected cases, progression of grade I and II towards grade III and IV occurs. Surgery has a very defined role in these grade III and IV retractions where the lamina propria of tympanic membrane has undergone irreversible degeneration. This is usually indicated if there is a deterioration in hearing or if a non-cleansing pocket is formed, predisposing to a higher risk of cholesteatoma and erosion of the ossicles, especially the long process of incus.

There is a diversity of opinion as to which surgery is the best option (Figures 3 and 4). The options include insertion of a ventilation tube alone,[21] excision of the retraction pocket combined with ventilation tube insertion, tympanoplasty, reinforcement tympanoplasty (with cartilage) and insertion of ventilation tube with or without cortical mastoidectomy.[22] A grommet can offer temporary benefit but its insertion through a thin membrane may convert it to a sizeable perforation, which may need to be repaired later. Excision and insertion of a ventilation tube has several advantages compared to tympanoplasty in that it is quicker, less invasive and can be performed as a day-case procedure. Sharp and Robinson had a successful result in 65 per cent of their mixed group of adults and children.[23] This result compared favourably with a further study by Blaney *et al*.[24] Following initial surgery, there was minimal or no recurrence in 67 per cent cases. This increased to 75 per cent following further surgery for recurrence. To date the recurrence of retraction post-operatively has proved unpredictable. Srinivasan *et al*. showed that neither age, retraction severity nor previous grommet insertion appear to affect final post-operative outcome.[25]

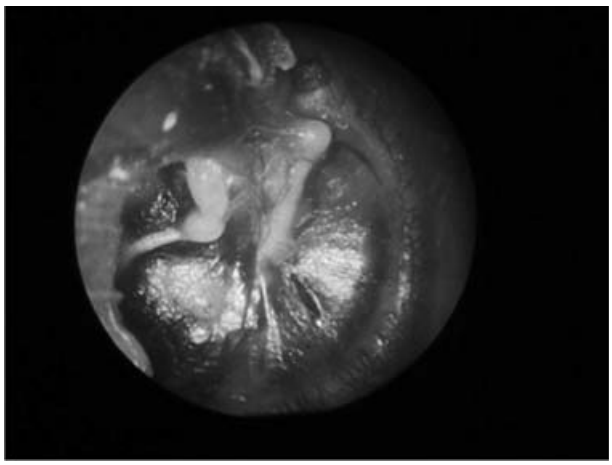

FIG. 3
Grade III/IV retraction pocket treated with myringotomy.

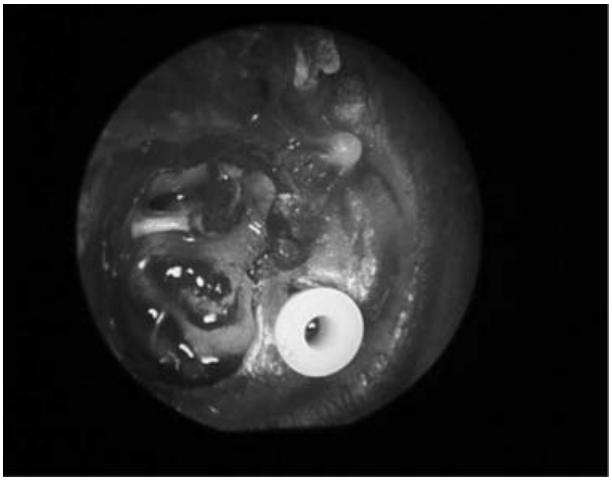

FIG. 4
Retraction pocket post-excision and grommet insertion.

Reinforcement tympanoplasty has a place in the treatment of retraction pockets but is best reserved for adults with chronic eustachian tube dysfunction.[26,27] It is not generally performed in children as eustachian tube dysfunction tends to improve with time. Moreover, a tympanoplasty can still be performed in future should excision fail. A further disadvantage is that it obscures keratin pearls behind the graft. Like all other procedures, post-operative recurrent retraction occurs due to persistent eustachian tube dysfunction being deflected to the unsupported regions of the tympanic membrane especially anteroinferiorly. Fortunately, this region does not present the same risks of ossicular erosion and cholesteatoma formation.

The future

Current treatments are plagued with the problem of recurrent retraction and cholesteatoma formation. The reason for this is that the underlying cause, i.e. eustachian tube dysfunction, is not addressed.

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The causes of eustachian tube dysfunction therefore offer potential therapeutic pathways in the future. It is known that eustachian tube dysfunction is due to mucosal, cartilage and tensor veli palate abnormalities. Stenting of eustachian tubes have so far produced disappointing results. Surgery on the eustachian tube has previously been targeted at the bony isthmus (via middle-ear, preauricular and middle fossa craniotomy) but failed to produce permanent results. Recent dynamic video analysis has suggested that the tubal cartilage, rather than the bony isthmus to be the primary problem.

As a result, studies of the technique of laser tuboplasty has been shown to improve eustachian tube function and middle-ear disease in patients with refractory otitis media with effusion and retraction (especially type C).[28] In this procedure, a portion of soft tissue (mucosa and cartilage) in the posterior wall of the eustachian tube cushion was ablated, hence widening the diameter of the tube resulting in better ventilation of the middle ear. With postoperative slow-motion dynamic videoendoscopy, it was shown that normal eustachian tube appearance and motility was achieved in 69 per cent and 65 per cent at year one and three respectively using this procedure. This paralleled the improvement in ear disease. In the above laser tuboplasty study, only six out of 56 patients were under 13 years and the mean age was 36. With promising results already in the adult group, further trials need to be undertaken in the paediatric age group to evaluate the efficacy of this new technique. Long-term results of this procedure are still not available, with longest follow up being two and a half years. As such, this technique should be used judiciously until further information is available.

For those with a patulous eustachian tube, endoscopic closure of the lumen of the eustachian tube may offer some benefit. The tubal valve incompetence in patulous eustachian tube has been traced to a longitudinal scaphoid defect in the anterolateral wall of the cartilaginous tube lumen that prevents closure of the valve.[8] Conversion of the concave defect into a normal convex bulge by submucosal implantation of graft material endoscopically has been effective in sealing the lumen and relieving patulous symptoms, yet preserving tubal dilation function.[29]

Another source of eustachian tube dysfunction is tubal inflammation, of either allergic or reflux origin, making these conditions potential targets for treatment. Patients should be investigated for allergic rhinitis and gastroesophageal reflux, and if necessary, the appropriate medical treatment in the form of proton pump inhibitors and anti-allergy medication may be commenced. Indeed, prior to laser tuboplasty, proton pump inhibitors were used intensively in patients suspected of having laryngopharyngeal reflux with good results. Despite these encouraging findings, proton pump inhibitors should be used judiciously as a recent review of the literature by Krakos *et al*. did not support routine use of antireflux treatment in children with refractory otitis media.[30] In the laser tuboplasty study, antireflux treatment was only commenced after confirmation by endoscopy or pH probe.

Obstruction of the eustachian tube by persistently enlarged adenoids may make adenoidectomy another possible option. This has been shown by Nguyen *et al.* to reduce the incidence of otitis media in conjunction with insertion of ventilation tubes, especially if the adenoids abut the torus tubaris.[31] However, in children under four years of age adenoidectomy may not significantly reduce otitis media compared to insertion of ventilation tube alone.[32] For those not keen on surgery, topical nasal steroids can also significantly reduce adenoid hypertrophy, at least in the short term.[33]

Development of a clinically useful test of eustachian tube function would also be a major step in the future management of middle-ear disease. Currently, there are many tests that look at the patency rather than function of the eustachian tube. This includes the Valsava manoeuvre (increase in middle-ear pressure by blowing out against closed lips and nose) and the Toynbee manoeuvre (development of negative middle-ear pressure on closed swallowing). The tests that do measure function, for example forced response, pressure equilibration and nine-step inflation-deflation tests, do so under non-physiological circumstances. Recently, advances in sonotubometry have shown it to be as good as other tests in measuring ventilatory function of the eustachian tube.[34] This method uses sound to measure function of the eustachian tube and offers several advantages over current techniques in that it is physiological, non-invasive and easy to perform in both adults and children.

Another technique using dynamic video imaging allows visualization of the anatomy and function of the nasopharyngeal end of the eustachian tube as well as motility of the eustachian tube. By establishing the function of the eustachian tube, those with chronic eustachian tube dysfunction can be identified. As this group is at high risk of developing refractory middle-ear disease, they may benefit from some early intervention on the eustachian tube.

The procedures outlined above address the cause of retraction pockets i.e. eustachian tube dysfunction, and predictably one would expect improved outcomes in the management of retraction pockets. However, in some cases, the tympanic membrane has undergone irreversible degeneration due to previous otitis media. Therefore any management of retraction pockets should focus not only on the underlying cause, but also treat the retraction pocket itself either by excision or reinforcement tympanoplasty. Combining treating the underlying cause, i.e. eustachian tube dysfunction, with existing techniques may represent a major leap in the future management of retraction pockets.

Conclusion

The management of retraction pockets is challenging to any otologist. Much of the pathophysiology has been elucidated over recent years, aided by recent video imaging studies, although the full extent of

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the pathophysiology remains obscure. This has identified eustachian tube dysfunction as a major player in this disease. Previous attempts at treatment did not focus on this underlying cause, resulting in a high rate of recurrence and cholesteatoma. The preliminary encouraging results using LETP (Laser Eustachian Tuboplasty) make the treatment of eustachian tube dysfunction a possible target for the future.

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