Rehabilitation of The Tympanomastoid Cavity In Canal Wall Down Procedures

A. Mahadevaiah • Bhavin Parikh • R. Govindaraj

Abstract

During 1980 to 2004, 1602 Canal Wall Down (CWD) procedures was performed of which 978 had primary surgery and 624 were revision cases. We have highlighted various methods for total clearance of disease process from the tympanomastoid area, making of a smooth cavity, augmentation of middle ear space for better functional results, inlay temporalis fascia grafting, ossiculoplasty with live tissue grafts, natural obliteration of the cavity and meatoplasty.

Healing of cavity and tympanic membrane (TM) graft was achieved in 1548 (94.2%) of cases. Revision surgery was performed in 32 cases for recurrence or residual cholesteatoma, mostly in the attic and middle ear. Persisting discharge was present in 12 cases. Serviceable hearing (air-bone (A-B) gap closure up to 20 dB) was achieved in 1017 (63.5%) cases. Hearing was worse than pre-operative level in 154 (9.6%) cases. There was no improvement in hearing in 397 (24.8%) cases. Serviceable hearing was obtained after second stage ossiculoplasty in 34 (2%) cases.

Keywords Canal wall down Tympano Mastoidectomy • Tympanomastoid Cavity • Cholesteatoma.

Introduction

The surgical management of cholesteatoma has undergone tremendous advances during the past four decades. Now we are in a position to achieve dry ear and improvement of functional hearing in majority of patients. This is all due to untiring efforts of outstanding otologists throughout the world, and the use of advanced surgical equipments, operative microscope and micro drill. In addition, development of many broad-spectrum antibiotics has helped to control resistant infection. Rehabilitation of the tympanomastoid cavity is important to achieve a long-standing trouble free cavity and good functional hearing level. Long term experiences in otologic surgery with proper postoperative follow up and critical analysis of failures, and appropriate modifications have standardized the procedure to get dry (or healed) ear and serviceable hearing.

Recently more emphasis is on refinement of steps in the ossicular reconstruction for optimization of functional hearing level. Tympanoplasty with closed (canal up) or open cavity (canal down) Mastoidectomy is performed for cholesteatoma. The type of technique whether the closed or open cavity is decided during surgery depending on the site and extent of cholesteatoma. Canal wall down procedure is performed in invasive cholesteatoma, discharging mastoid cavity after a previous surgery, recurrent cholesteatoma after a closed cavity mastoidectomy procedure, extensive keratosis obliterans with destruction of the posterior and attic walls and sclerosed mastoid with forward lying lateral sinus and low lying mid fossa dura.

Materials and Methods

A retrospective analysis of 1602 patients who underwent CWD mastoidectomy with tympanoplasty for cholesteatoma during January 1980 to December 2004 was carried out. All the patients had pre-operative and post-operative pure tone audiometry at 3 months and one year. Details of disease extent during surgery, ossiculoplasty and post-operative complications were noted. Post-operative follow-up visits were also recorded.

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Fig. 1 Showing circumferential saucerization leading to obliteration from surrounding soft tissue.

Fig. 2 Showing preservation of medial part of anterior buttress for middle ear space augmentation.

Fig. 3 Showing myringostapediopexy in cases with stapes suprastructure present.

Fig. 4 Showing myringoplastinopexy in cases with absent stapes suprastructure.

Fig. 5 Showing obliteration of tip and posterior part of cavity with pedicled musculoperiosteal flaps.

Fig. 6 Showing meatoplasty.

Healing was considered successful if the patient had dry cavity with complete epithelialization without any TM graft failure, persisting granulations or recurrent cholesteatoma. Hearing results were analyzed based on the pre-operative and one year post-operative audiograms. The air conduction thresholds and A-B gap closure were compared for pre-operative and post-operative audiograms with respect to the speech frequencies i.e. average of 500 Hz, 1 kHz and 2 kHz. The hearing results were divided into three categories depending on the extent of A-B gap closure of <20 dB, no improvement and worse than pre-operative level. Presence of post-operative severe to profound sensorineural hearing loss was noted. Serviceable hearing was considered as A-B gap closure within 20 dB.

Surgical steps:

Cholesteatoma surgery involves a series of meticulously performed steps where each step can individually affect the

final result with regard to hearing and healing. The secret of success in cholesteatoma surgery is dependent on many factors. While an extensive experience is extremely valuable, the major factor is the skill of the surgeon in

gaining good exposure, meticulous removal of entire disease process, careful attention to all minute tympanoplasty steps and returns the ear to normal anatomical and functional state. The steps, which are particularly important for functional results and dry small cavity, are highlighted.

Tympanomeatal skin flaps

Temporalis fascia graft harvest and cortical mastoidectomy

Through the external auditory meatus initial canal incisions at about 6 o'clock and 12 o'clock positions starting just lateral to the fibrous annulus are made to develop a posterior meatal skin flap and semicircular tympanomeatal skin flap. With a post auricular incision after taking a required amount of temporalis fascia, the mastoid cortex and external

canal are exposed. A simple mastoidectomy is done by removal of cholesteatoma and diseased air cells. At this stage superior and inferior tympanomeatal flaps, which contains 5mm of canal skin and remnant tympanic membrane is elevated and pushed into anterior sulcus to be used later.

Circumferential Saucerization

Circumferential saucerization (Fig.1) by removal of mastoid cortical bone superiorly to the level of dural plate, posteriorly to the level of lateral sinus and inferiorly to the tip and if necessary removal of lateral wall of the tip up to the digastric ridge. It facilitates the surrounding soft tissue collapse and reduces the size of the cavity in a natural way.

Total Disease Clearance

It is mandatory to have a total clearance of the disease tissue from the tympanomastoid region before we think of rehabilitation process. The bony walls are removed to expose the attic, sinus tympani, posterior tympanum and hypotympanic area. Posterior bony wall and the posterior buttress are lowered up to the facial ridge. Entire cholesteatoma matrix, granulation tissue from the attic and middle ear space including the oval window area and sinus tympani along with diseased incus and malleus is removed. Complete exenteration of perilyabyrinthine, sinodural and tip cells is must. After clearing the entire diseases tissue from the tympanomastoid area, the cavity is thoroughly washed with diluted hydrogen peroxide and normal saline to clear the squamous debris, bone dust and bacteria.

Smooth Mastoid Cavity

The Mastoid cavity is made smooth to enhance the self-cleaning activity and for prevention of postoperative accumulation of squamous debris and cerumen.

Middle Ear Space Augmentation

If the mastoid is sclerosed and the tip cells are not developed, as seen in some cases, the posterior buttress is left a bit higher to preserve a mesotympanic space which provides a better opportunity for middle ear reconstruction. The medial part of anterior buttress is preserved (Fig. 2) which helps to retain the mesotympanic space anteriorly for better middle ear reconstruction. It also makes a shelf like superior surface in continuity with anterior canal wall facilitating the tympanic membrane grafting over it. The attic and supralabyrinthine areas are filled with fibrofatty tissue taken from the subcutaneous tissue over the cortex (Fig.1a and 1b). If there is any deep pocket at the retrolabyrinthine area, it is also filled with the same tissue to level with lateral semicircular canal. The facial ridge is left a little high in cases of sclerosed mastoid where tip cells are not developed. These steps help to increment middle ear space and the area of vibrating tympanic membrane.

Tympanoplasty

Underlay temporalis fascia grafting is done by securing it over the bony walls and under the already elevated superior and inferior tympanomeatal flaps. Gelfoam pieces soaked in antibiotic steroid eardrops are placed over the fascia graft and tympanomeatal flaps. Temporalis fascia is gently lifted until exposure of the oval window area, to place the ossicle graft. Ossicular reconstruction depends on the existing situation in each case. We prefer short columella (with autograft/allograft incus body or malleus head.) for myringostapediopexy if stapes arch is present (Fig. 3) and long columella (with autograft/allograft remodeled malleus or septal spur cartilage) for myringoplastinopexy if stapes arch is absent (Fig. 4). A piece of skin removed either from the posterior meatal skin flap or post auricular region is placed as a free graft over upper part of the temporalis fascia and tegmen plate and it acts as a nidus for new epithelium growth and faster epithelialisation. When the middle ear diseased mucosa is completely removed, a thick silastic piece is placed and fascia grafting is done. Second stage ossiculoplasty is planned after 6 months.

Cavity Obliteration

If there is any deep cavity at the tip area, it should be filled up by an inferiorly based fibrofattyperiosteal flap to raise or to make a level with the meatal floor (Fig. 5). Divide the soft tissue over the cortex into superficial and deep flaps. The superficial flap with pedicle at the mastoid tip is rotated and filled at the tip pocket and the deep flap falls in to the cavity. Similar posteriorly based superior and inferior flaps may be used to obliterate sinodural angle and posterior part of cavity. Superior parts of cavity need not be obliterated as it has gravity dependant drainage.

Meatoplasty

A T shaped incision is utilized (Fig. 6) to elevate superior and inferior meatal and conchal skin flap and adjusted as per the size of the cavity. A wide meatoplasty is essential for self-cleaning action, ventilation and postoperative inspection.

Post-Operative Care and Medications

Broad-spectrum antibiotic is started pre-operatively; it's level maintained per-operatively and is continued post-operatively for a week. Post-operative skin sutures and packing are removed after two weeks. Gelfoam in the cavity is undisturbed and patient is advised to put Neosporin H ear drops for ten days followed by instillation of white cooking vinegar equally diluted with normal saline until healing of the cavity. It is essential to demonstrate different head positions in which to put the drops in order to circulate solution in the entire cavity. A cotton ball soaked in spirit is to be placed in the meatus to prevent secondary cavity infection or perichondritis and use of ordinary cotton is strictly condemned.

Results

1602 patients underwent CWD mastoidectomy during January 1980 to December 2004 with 978 of them having primary surgery and 624 having revision surgery for mastoid cavity problems (operated by other surgeons). Complete epithelialization of cavity with TM graft healing was seen in 1518 (94.7%) cases. Dry healed cavity after repeated removal of granulation tissue over six months was noticed in 40 (2.5%) cases. Recurrence or residual cholesteatoma was found in 32 (2%) cases. Revision surgery was performed in 12 (0.8%) cases. Serviceable hearing (A-B gap up to 20 dB level) was achieved in 1017 (63.5%) cases while there was no improvement in 397 (24.8%) cases. 154 (9.6%) patients had hearing that was worse than pre-op level. Second stage ossiculoplasty was carried out in 34 (2.1 %) with all of them having serviceable hearing. Complications during these procedures included three cases of facial palsy that required grafting, one case of profound sensorineural hearing loss and ten cases of perichondritis within three weeks of surgery.

Conclusions

In canal down technique, a circumferential saucerization of the cortical bone, making cavity smooth without any projections and pocket, filling the deep cavity at the

perilabyrinthine and mastoid tip, temporalis fascia grafting to cover the middle ear and eustachian tube orifice and a wide meatoplasty are important steps to achieve a smooth, dry and trouble free cavity. Disease recurrence and revision surgery were observed earlier (before 1990). Later with experience and modifications the dry cavity is obtained in all most all cases except occasional granulation and accumulation of cerumen. To get serviceable hearing in majority of case, use of live graft material with proper size and shape and its stabilization is very important. Normal or near normal middle ear mucosa is essential for better functional results. If the middle ear mucosa is very much damaged, the procedure should be staged for better results.

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