Clinical records

Physiological tympanostomy

A new technique of middle ear ventilation

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Summary

Physiological tympanostomy is advanced as a 'substitute' eustachian tube because it opens regularly only on swallowing, as does the 'natural' eustachian tube. The efficacy of the physiological tympanostomy operation was first proved in experimental animals (two dogs). Subsequently, six patients with eustachian insufficiency were successfully managed by this new surgical technique within period of one year, with no post-operative complications. The hearing improved and the middle ears remained air-filled.

The method seems to have the following merits: permanent ventilation of the tympanum with preservation of an intact drum (from the functional point of view); no tympanophonia or autophonia; simple technique, short operative period (five minutes); no risk of postoperative complications; and no danger of ascending infection of the middle ear from the ear canal. The demerits appear to be: drainage not ensured; no facility to increase the middle ear pressure by the Valsalva manoeuvre or, Politzerization.

Review of Literature

Undoubtedly adequate eustachian tube function is essential for maintaining the health and integrity of the tympanic-cleft. Tubal insufficiency usually initiates diseases of the tympanic cleft (Miller, 1965). Armstrong (1954) obtained ventilation as well as drainage of the middle ear by inserting a plastic tube through a myringotomy opening in cases of tubal dysfunction. But it is of temporary value, as sooner or later the plastic tube will be extruded and the drum will heal. Silverstein (1966) recommended the use of a small steel wire clip around the handle of the malleus for fixing the tubes; however, the risk of permanent perforation persists. Sometimes, in cases of adhesive otitis media, it is not possible to introduce a plastic tube through the drum. However, in cases where the complete restoration of eustachian tube function is hoped for, the Armstrong method is of immense value in preventing permanent changes in the middle ear.

In recent days attempts have been made to create an alternative air conduit to the middle ear without exposing the middle ear mucosa directly to the atmosphere. Siirala (1964) introduced a polythene tube under the skin of the meatus from the outside and into the mastoid antrum after mastoidectomy. Lapidot and Kapila (1967) connected the anterior part of the middle ear to the

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oropharynx by a no. 240 polythene tube, with a mucosal onlay graft sewn over it. Drettner and Ekvall (1969) established a substitute air conduit from the middle ear to the maxillary antrum by constructing a 'tympanomaxillary shunt'. House and Miles (1969) described a middle cranial fossa approach for recanalization of the eustachian tube in cases of total osseous stenosis. These forementioned methods do not seem to have acquired general acceptance. Recently, Misurya (1975) constructed a 'tympano-nasopharyngeal shunt' by connecting the anterior part of the middle ear to the nasopharynx by a silicone tube introduced through the semi-canal of the tensor tympani muscle, with encouraging results.

However, the Armstrong method being a simpler technique, is used in spite of the disadvantages inherent in it.

A cursory search of the literature revealed that a wholly satisfactory method for permanent ventilation of the middle ear is yet awaited, hence this paper.

Material and method

This new surgical technique is based on the fact that on swallowing there is always synchronous and sustained contraction of the tensor tympani muscle associated with opening of the eustachian tube by contraction of the tensor palati muscle (Bezold, 1894). In other words, every act of swallowing is associated with the active inward displacement of the malleus, due to the pull of the tensor tympani tendon inserted in the neck of the malleus. This phenomenon is due to the fact that the tensor tympani and tensor palati muscles are continuous parts of the same muscle-group, as demonstrated by Lupin (1969).

The aforementioned fact has prompted the author to evolve a new operation—physiological tympanostomy—for permanent ventilation of the middle ear in cases of eustachian insufficiency. The efficacy of the physiological tympanostomy operation was first evaluated in artificially stenosed eustachian tubes in two dogs. Subsequently within one year, six cases of eustachian insufficiency were submitted to this surgical procedure.

Method

Under adequate general or infiltration anaesthesia, a horizontal myringotomy puncture is done on both the sides of the root of the handle of malleus. Then the tips of a specially designed malleus nipper* are introduced through the myringotomy punctures and the root of the handle of malleus is cut *Obliquely* from above (laterally) downwards (medially). Thereby, the oblique cut surface of the upper cut end of the handle of malleus faces infero-laterally; whereas the oblique cut surface of the lower cut end of the handle of malleus faces supero-medially. This step of the operation is the vital one. If the handle of malleus is cut horizontally, then the purpose of the operation is forfeited. The tympanostomy is opened by inward displacement of the upper segment of the handle of malleus, caused by contraction of the tensor tympani muscle during swallowing, whereas tympanostomy is closed by the outward pull of the upper segment of the handle of malleus by the elasticity of the malleolar ligaments. The lower segment of the handle of malleus remains stationary during the whole process.

*The cutting arms of the malleus nipper are angled 1100 sidewards. The right and left-angled forceps are meant for the right and left ears respectively.

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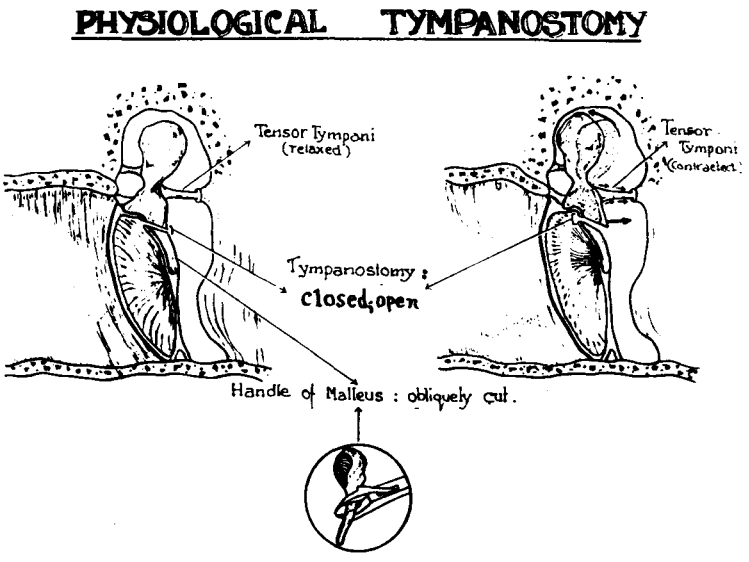


FIG. 1

Diagram illustrating the mechanism of opening of a 'Physiological tympanostomy'. Inset: handle of malleus obliquely cut from above (laterally) downwards (medially) by special malleus nippers.

Animal Investigation

Mongrel dogs were the animals for the experiment, as the eustachian tube in dogs corresponds closely with those in Man (Rich, 1920). Experimentally, eustachian insufficiency was obtained by stitching together the lips of the torus tubarius on both sides. This was performed under direct vision by a transpalatal route in the anaesthetized dog. Then the physiological tympanostomy was performed in one ear (right); whereas the other ear (left) was taken as a control. The animals were kept under observation for six months.

These dogs tolerated the surgical procedure well and revealed no untoward effect. The middle ear with the physiological tympanostomy facility (right) was air-filled: but the ear without physiological tympanostomy facility (left) started discharging within three days.

Selection of cases

There are the cases of eustachian insufficiency in whom adeno-tonsillectomy, decongestants, eustachian catheter inflation and repeated myringotomies are of temporary value. The eustachian tube is impervious to the Valsalva manoeuvre or Politzerization, but not to catheter inflation in such cases. The Armstrong tube is useful only for a shorter duration on account of its propensity for spontaneous extrusion. These individuals may be suitable for the physiological tympanostomy operation.

Case reports

Case 1. Twenty-year-old female.

History: Recurrent deafness and discharge right ear for four years.

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Examination: Tympanic membrane retracted and partially mobile with healed perforation.
Eustachian tube was impermeable to Politzerization and Valsalva manoeuvre, but not to catheter inflation.

Treatment: Adeno-tonsillectomy, decongestants and repeated myringotomies gave temporary relief; Armstrong tube was inserted but was extruded after one month, with recurrence of disease. Lastly the physiological tympanostomy was performed after explaining the experimental nature of the operation.

Post-operative course: Patient is asymptomatic so far; middle ear has remained air-filled (one-year follow-up).

Case 2. Eighteen-year-old male.

History: Recurrent deafness and watery discharge left ear for six years.

Examination: Drum retracted but partially mobile, with healed perforation. Eustachian tube was impervious to Valsalva manoeuvre and Politzerization, but not to catheter inflation.

Treatment: Adenoidectomy, decongestants, eustachian catheter inflation, myringotomy and Armstrong tube gave short-termed relief. Finally physiological tympanostomy was performed after narrating the experimental nature of the surgical technique.

Post-operative course: Post operatively there was improvement in hearing; patient is symptom-free so far (post-operatively ten-months have elapsed).

Similarly four more cases of eustachian insufficiency have been managed successfully and all are asymptomatic so far (follow-up periods have ranged from six-to-twelve-months).

Comment

The efficacy of the physiological tympanostomy operation as a 'substitute' eustachian tube has been proved in experimental animals (dogs). It is too early to judge the true value of the reported method until and unless a long period of observation has elapsed post-operatively in several patients. However, the following comments may be made:

This surgical technique is more of value for its permanent ventilatory capacity rather than for drainage of the tympanum. Physiological tympanostomy is quite efficient in taking over the function of the eustachian tube, as proved experimentally and clinically in the patients of the present series (one-year follow-up). This tympanostomy-like eustachian tube also opens during swallowing, on average once per minute when awake and once every five minutes when asleep (Graves and Edwards. 1944).

The physiological tympanostomy shunt remains closed except during swallowing. Therefore, there is no risk of ascending infection of the middle ear from the external ear canal, a danger common to all types of shunt operations. Secondly, the patient is quite comfortable as there is neither tympanophonia nor autophonia which are annoying experiences with other shunt operations.

From a functional point of view the drum remains intact and the cut ends of the handle of malleus (being oblique) vibrates as one mass in response to sound waves. Thereby the transmission of sound through the drum and malleus to the incus is not hampered.

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The operative procedure is simple, short (five minutes) and can be accomplished even under local anaesthesia. The postoperative morbidity is nil.

The demerits seem to be: drainage of middle ear is not ensured; no facility to increase middle ear pressure by Valsalva manoeuvre or Politzerization.

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