ORIGINAL ARTICLE

Foreign bodies in the ear: a simple technique for removal analysed in vitro

S Kumar, M Kumar, T Lesser, G Banhegyi

Emerg Med J 2005;22:266–268. doi: 10.1136/emj.2004.015016

See end of article for authors' affiliations

Correspondence to:
Mrs S Kumar, Department
of Otolaryngology,
Whiston Hospital,
Warrington Road, Prescot,
Merseyside, L35 5DR, UK;
mmkumar@btinternet.com

Accepted for publication
25 March 2004

Objective: Foreign bodies in the ear are mainly encountered in children. This can often pose a problem especially in an accident and emergency department where a microscope or expert help is not routinely available. This paper presents a simple, safe, and effective way of ear syringing. The ease and simplicity of the procedure along with the equipment are described.

Method and result: The equipment consists of a "disposable" sterile kit, consisting of a 20 ml syringe, saline at body temperature and 14 or 16 gauge cannula (without the needle). An in vitro experiment was conducted to calculate the pressure generated by the water jet on the eardrum. The pressure was well below the pressure required to burst a tympanic membrane, and hence this technique is safe to use.

Conclusions: Ear syringing is an effective and easy way of removing most foreign bodies. A detailed history and an otoscopic examination must precede the procedure. The novel method of syringing described in this paper with the usual safeguards could be a useful adjunct in the management of this common condition.

Foreign bodies in the ear are encountered mainly in children, who can push items of jewellery, food, or any small object that comes to hand into the ear.¹ Such children need careful management so that they are not frightened or hurt. Most children can be convinced to have their ear cleaned with syringing.

The traditional methods of ears syringing use the metal syringe and the electric pulsed water syringe. Both methods have disadvantages, such as availability of syringes and the proved risk of ear damage during manual syringing.² The metal syringe is filled with water from a receiver and the water stream is directed into the ear canal manually. The electric syringe has an internal pump which sends pulsed jets of water from an attached reservoir through a nozzle into the ear canal.

Here we describe a simple assembly for safe syringing. The advantages of the equipment include easy assembly and availability of sterilised equipment, and safe operability.

NOVEL SYRINGING TECHNIQUE

Equipment

The disposable kit consists of a 20 ml Luer lock syringe and a 14/16 gauge cannula (without the needle) secured to its tip (box 1). The patient is informed about the procedure and protected by a waterproof cape over their shoulder. The tip of the cannula is introduced into the ear canal at an angle of 45° in a posterior and superior direction away from the ear drum to direct the saline stream towards the roof of the canal. A receptacle is placed under the affected ear.

In vitro analysis

Our main concern about this novel technique was whether the pressure would damage the ear drum. To measure the pressure exerted by a jet of saline on the tympanic membrane, and to determine its safety, an experiment was conducted to determine the maximum pressure exerted by the jet of saline on the diaphragm based on simple principles of physics.

$$P = F/A$$

where P = pressure, F = force, and A = area. Thus pressure in a syringe is equal to the ratio of force to area. Thumb pressure on a 20 ml syringe can produce a force of 25 newtons (N). The area of a plunger in a 20 ml syringe is $2.5 \times 10^{-4} \text{ m}^2$, so pressure of 100 kPa (~ 1 atmospheric pressure or 750 mm Hg) can be produced.³

A diaphragm (fig 1) made of Biogel surgical glove, the "in vitro tympanic membrane", was attached to the barrel of a 3 ml syringe the piston of which had been removed. (We used a 3 ml syringe because its internal diameter corresponds to the diameter of the tympanic membrane.) This was attached to a saline filled pressure transducer set (Edward lifesaving type) which was further connected to an Ohmeda Module cardiovascular monitoring anaesthetic system. The whole system was zeroed to a table top with the 3 ml Luer lock syringe attached. A jet of saline was delivered in 10 ml boluses onto the diaphragm from a distance of 2.5 cm. The maximum pressure generated after six runs with each cannula was as follows:

- 14 gauge cannula – 8 kPa (60 mm Hg)
- 16 gauge cannula – 6.6 kPa (50 mm Hg)
- 18 gauge cannula – 4 kPa (30 mm Hg)

Box 1: Ear syringing kit

- 20 ml disposable syringe
- 14 or 16 gauge cannula
- Receptacle $\times 2$
- Waterproof cape or "incontinence" sheet
- Normal saline at body temperature

Figure 1 Diagrammatic representation of the in vitro set-up to test the pressures generated in the novel ear syringing technique.

Application of the technique

We have successfully used this method of ear syringing to remove foreign bodies in 23 children presenting to our Accident and Emergency (A&E) department. Patients who refused to undergo the procedure and those with impacted or hygroscopic (for example beans) foreign bodies were referred to ENT.

Precautions and contraindications

It is always a good idea to let the child or the parent/guardian know that if the foreign body is not removed in A&E they will be referred to a specialist. Syringing should be avoided in the following situations:

- obvious signs of infection and ear discharge
- recurrent otitis externa, which may be exacerbated by syringing
- previous/present tympanic membrane perforation or grommet
- previous ear surgery
- uncooperative patient
- impacted hygroscopic (for example beans) foreign bodies.

DISCUSSION

Syringing of the ear for removal of foreign bodies is a well described technique. Rupture of the tympanic membrane during syringing is a rare but unpleasant event. The use of a pulsed electric syringe for the removal of a foreign body in the ear has been described,⁴ but it is not always available in an ENT or an A&E set-up. An oral jet irrigator with a special “ear irrigating tip” attachment for syringing the ear has also been used to provide better pressure control and to direct the water jet more precisely.⁵

The pressure exerted on the ear drum by a metal syringe can be much greater than 100 kPa.⁶ Although the normal tympanic membrane has a median rupture pressure of 121.6 kPa (range 50.6–202.6), in atrophic membranes a median rupture pressure of 60.8 kPa has been reported.⁷ Blake *et al*,⁸ in their report of litigation claims stated that the metal syringe will not perforate a healthy eardrum if used properly. Bapat *et al*⁹ provided further evidence of complications arising due to faulty technique. They described a case of audiovestibular damage due to the nozzle being inserted too far down the external auditory canal. Oral jet irrigators can generate enough force to rupture the tympanic membrane even at a submaximal power setting. Three cases have been reported where, in addition to tympanic membrane rupture, oral jet irrigators caused ossicular disruption, round and oval window fistulas, and subluxation of the stapedial footplate.¹⁰ Parameters for safe use of these irrigators need to be better established. A comparison of the standard systems with our method is presented in table 1.

There is no evidence that the metal syringe is better or worse than the electric ear syringe, both being commonly used safely. In a randomised trial looking at the effectiveness of ear syringing for wax in general practice both electric and the metal syringes were used and no detrimental effects were noted with either.¹¹

The literature suggests that syringing may precipitate an infection and that the ear should be dried after syringing to remove the residual water.¹² The manufacturers of Propulse also suggest that at the end of the day any residual water should be discarded, as bacteria, including *Pseudomonas*, can build-up—a common reason for patients needing treatment for otitis externa.¹³

CONCLUSION

Syringing of the ear for removal of foreign bodies is far from a new technique. We have presented a novel syringing method including an in vitro analysis of its safety. We would like to draw attention to the easy assembly, operability, and availability of sterilised equipment for this method. The pressure generated by a 20 ml syringe connected to a

Table 1 Methods of syringing: advantages and disadvantages		
Method	Advantages	Disadvantages
Handheld syringe	Can be used in any setting Cheap Easy to obtain Quiet during operation	Difficult to manipulate Hard to control pressure of water jet Can damage ear due to too much pressure Nozzle can go adrift if not secured properly
Disposable assembly (our method)	All advantages of the handheld syringe Sterile Always available Safe to use	No other disadvantages except for the routine precautions for syringing of the ear
Electric syringe	Water pressure is controlled Jet can be directed precisely Foot switch gives instant start/stop control Pulsed jet assists removal of foreign body	Requires electrical supply Needs flat surface close to the patient Noisier than manual syringe method Bacteria (<i>Pseudomonas</i>) can build-up if water is left in the apparatus

14 gauge cannula is far less than the minimum pressure required to perforate an ear drum, and yet it has proved sufficient to remove most foreign bodies seen in our A&E department. A timely referral to a specialist must be considered for uncooperative patients and for those with impacted or hygroscopic foreign bodies.

Authors' affiliations

S Kumar, T Lesser, G Banhegyi, Department of Otolaryngology Head and Neck Surgery, University Hospital Aintree, Liverpool, UK

M Kumar, Department of Anaesthesia, Royal Liverpool University Hospital, Liverpool, UK

Competing interests: none declared

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