

Cerumen: its fascination and clinical importance: a review

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The removal of ear wax and subsequent improvement of hearing can be one of the most satisfying clinical experiences for patient and doctor alike. Ear wax often blocks hearing aid-moulds, causing unnecessary difficulties to those whose hearing is already compromised. It has a role in local host defence; its composition varies in different racial groups, and there are changes in its production and constituents in certain systemic diseases. Yet with the exception of the occasional editorial^{1,2}, medical interest in this substance has not been great. In this review of the nature, function and pathophysiology of cerumen we hope to show that this sticky secretion is not only of considerable clinical importance but also a source of fascination.

What is ear wax?

Ear wax is a mixture of secretions from two different gland types (ceruminous and pilosebaceous glands²⁻⁵), together with squames of epithelium, dust and other foreign debris. The ceruminous glands are found deep within the skin of the outer two thirds of the external auditory meatus (EAM) and lined by cuboidal or columnar epithelial cells^{4,6}. Secretion of the cerumen into the lumen is by both eccrine and apocrine function - the latter process being similar to the axillary sweat glands, which accounts for the odour of the cerumen^{1,2,7-9}. An unknown stimulus, (possibly irritation of the overlying skin acting via adrenergic receptors) causes the surrounding myoepithelial cells to contract, expelling the liquid contents into the EAM or the lumen of associated hair follicles^{6,10}. Once secreted, evaporation occurs allowing the now sticky substance to entrap dust, bacteria, fungi and epithelial squames before being expelled by 'migration', a process which is aided by jaw movement^{2,3,11}.

Age, sex and genetic factors

Cerumen becomes drier with increasing age^{12,13}, possibly as a result of a reduction in both the number and the activity of ceruminous glands⁹. Although quality and quantity of cerumen is similar for both sexes, wax impaction is more common in males as the tragi, or hairs in the EAM, being larger and coarser, impair the natural dislodgement of cerumen¹⁴.

Genetic factors influence the consistency and composition of cerumen^{1,2,12,15-18}. Most caucasians and negroes have the so-called 'wet' phenotype, with moist, pale, honey-coloured cerumen that sticks to the auroscope. In contrast, mongoloid races tend to have grey, granular and brittle cerumen (the 'dry' phenotype). Cerumen type is determined by two

autosomal alleles, the wet allele being dominant¹⁷⁻¹⁸. This dimorphism reflects differences in the structure and function of the ceruminous gland⁷, as well as the biochemical nature of the cerumen¹. Wet wax has lower concentrations of immunoglobulins and lysosomes, but a higher lipid content than the dry variety^{1,2}. Cerumen, with its content of lysosomes, glycoproteins, immunoglobulins, lipids and trace elements has a bactericidal or bacteriostatic action and thus probably plays some role in maintaining local host defences^{1,5,12,14,15,19}. It has been postulated that there are selection pressures operating in different parts of the world, depending on the humidity and consequent infection of the EAM. However, infection rates are similar in people with wet or dry wax¹. It is unlikely that otitis externa would cause such selection pressure as the mortality from such infections is low¹⁷. A more probable explanation is that the cerumen phenotype is linked to other genes which promote resistance or susceptibility to infections or diseases.

Cerumen and systemic diseases

Ear wax may reflect local and systemic disease. Skin afflictions are associated with changes in the cerumen: for example, tinea vesicolor infection of the outer ear is more common in people with wet cerumen²⁰. Psoriasis can occasionally cause an increase in waxy material in the ear⁸.

In cystic fibrosis there are lower concentrations of most electrolytes and less water, which makes the cerumen scanty and very dry⁵. Many haemodialysis patients complain of dry skin and pruritus, possibly from decreased function of the sebaceous glands. It is therefore surprising that the cerumen does not become drier in the majority of haemodialysis patients²¹. Patients with alkaptonuria have dark brown or black cerumen from an early age, along with other pigmentary changes²². Parkinsonian patients, who often have greasy, seborrhoeic skin, may produce excess wax which blocks one or both ears²³. A correlation between the severity of the parkinsonism and the degree of wax impaction has been postulated but requires further investigations²³. It was thought that wet cerumen was a marker of genetic predisposition to breast cancer in females¹⁶, but this has since been refuted²⁴. In a small study of American Indians an association with different minor blood groups has been demonstrated²⁵ but the clinical relevance of this remains undetermined.

Symptoms of wax impaction

These include deafness, tinnitus, 'reflex' cough (through stimulation of the auricular branch of the vagus nerve), earache or fullness in the ear

and vertigo^{3,26-30}. The wax may obscure the tympanic membrane and hence the diagnosis also³¹⁻²⁴.

The role of impacted wax in causing or contributing to deafness is disputed. Some textbooks suggest that wax is an infrequent cause of hearing impairment¹¹ and only occurs with complete occlusion³ whereas others state the sensation of deafness may be marked and sudden²⁶. There is support for both statements. Nassar³⁵ reported gross hearing impairments (with marked subjective improvement following removal) in elderly patients with impacted wax. Warwick-Brown showed complete resolution of a 30-40 decibel (dB) hearing loss after wax removal³⁰. In contrast the two studies in which pure tone audiometry (PTA) was performed before and after syringing have only been able to demonstrate hearing losses of 5 dB (or at most 10 dB) which could be attributed to the impacted wax^{12,36}. Despite the minimal objective deficits, many patients felt a subjective improvement in hearing after syringing.

We believe that it is possible to reconcile these apparently opposing views, at least in older subjects. Hearing impairment is common in elderly people and increases with increasing age³⁷⁻³⁹. Any hearing loss caused by wax will be superimposed on this. For those whose hearing thresholds are already borderline for requiring a hearing aid, any additional impairment may significantly alter their ability to function socially. There may be a disparity between the objective impairment on testing with PTA and the social or communication handicap reported by the patient⁴⁰. PTA is only one measure of impairment, or disability, and does not measure handicap (ie the social consequences of disease or disability), which is influenced by other factors. Reliance on PTA alone can both under- and overestimate the handicap caused by hearing difficulties^{38,40}. A small worsening of hearing may cause a disproportionate increase in the handicap experienced. Also, hearing impairment due to wax may worsen suddenly: wax is hygroscopic and absorption of water during swimming or showering may completely occlude the outer ear^{26,27}. This sudden deterioration will be perceived as a greater hearing loss than that which occurred gradually. We therefore believe that impaction of wax may cause significant hearing handicap despite only minor changes in the PTA.

Why does wax accumulate?

Is there a group of individuals who secrete excessive quantities of cerumen, thus predisposing to accumulation and impaction^{11,41}? Mandour *et al.*⁴ examined the histology of the ceruminous glands in people with excess wax and a control group. They found evidence of increased glandular activity and secretion but concluded that this increased cerumen synthesis was secondary to an irritation rather than the primary event itself. Failure of the secreted wax to be expelled from the outer ear is a more likely explanation for wax accumulation. This tends to occur at the extremes of life^{32,35,42} but probably for different reasons. Wax retention will occur whenever there is obstruction and in older people this can be caused by anatomical abnormalities (eg tortuous canal, osteomata, surgically created mastoid cavity), hairs (particularly in males) and importantly by hearing aid moulds^{11,39,43}. In children the narrow canal is important, and in both age groups the inappropriate use of 'Q-tips' or 'cotton buds' for cleansing may cause impaction^{2,11,12,30,32}

although this belief has been challenged⁴⁴. Cleansing of the outer ear with cotton-buds is neither necessary nor appropriate as it may push the wax further in (which can cause rupture of the tympanic membrane) and interrupt the normal self cleansing process of the outer ear³⁰. Irritation of the skin by cotton-buds may predispose to otitis externa, which can lead to atrophy of the skin and the ceruminous glands^{6,12}. This in turn causes the ear to feel dry and itchy, thus perpetuating the desire to 'clean' the ear. This cycle can be interrupted by treating the otitis externa (with topical steroids and perhaps antibiotics) and most importantly by no longer using 'cotton-buds'. Of interest to doctors is the observation that stethoscope ear pieces may cause wax impaction⁴⁵.

The repeated insertion of a hearing aid mould may also cause wax impaction in the EAM. Additionally wax may occlude the mould of the hearing aid. This both reduces the effectiveness of the aid and may cause or exacerbate feedback⁴³. Nearly one-third of hearing aids are malfunctioning solely because of wax occluding the mould³⁹. The mould, and tubing if necessary, may be cleared easily (after disconnecting it from the amplifier) either by blowing down the tubing or by the gentle use of a pipecleaner.

However, some patients with recurrent wax impaction have no such apparent causes⁴⁶. These patients may have abnormalities of epithelial migration or separation, both of which are important in the self cleansing of the ear⁴⁷. Robinson *et al.*⁴⁶ found evidence of impaired separation in a group of patients with recurrent impaction. Several of the wax plugs consisted of long sheets of keratin (crinkled up, concertina-fashion) with some of these sheets still in continuity with the superficial layer of the epidermis of the EAM. They proposed that a lack of a substance, which destroys the binding between individual keratinocytes, could lead to lack of separation of the epithelial squames. Retention of these in EAM would ensue, with the formation of wax plugs. If these findings were confirmed then the development of topical agents, which mimic the action of this substance, might have therapeutic potential.

Removal of ear wax

Wax can be removed from the ear by ceruminolytics, syringing, suction or hooking it out under direct vision³.

Various softening agents and ceruminolytics (including oils and aqueous preparations) have been promoted as an adjunct or alternative to syringing^{8,11,48-57}. These have two main actions; (i) to soften wax prior to syringing or (ii) to disintegrate the wax thus avoiding syringing. Most probably do both. In vitro studies have suggested that preparations containing dioctyl are better at disintegrating wax than other proprietary brands, but may not be any better than distilled water^{52,53,57}, elderly patients with bilateral wax impaction were randomized to Cerumol, Xerumenex, olive oil, Dioctyl capsules or Waxsol in one ear only. Sodium bicarbonate ear drops BPC were instilled in the contralateral ear of all patients thus enabling them to act as their one control. Ears in which Cerumol, olive oil or Waxsol were used were significantly easier to syringe than the NaHCO₃ control ears. However, there were no significant differences between these three ceruminolytics. Olive oil is cheaper than Cerumol and Waxsol bicarbonate³⁶ and does not cause irritation nor

Table 1. Potential complications of ear syringing

Otitis externa
Perforation of the tympanic membrane
Trauma to the external auditory canal
Pain
Cough
Tinnitus
Vertigo
Otitis media

otitis externa that can occur with proprietary preparations^{48,56}. Thus if drops are required, then we would recommend olive oil for 2-3 days prior to syringing.

Syringing (with or without ceruminolytics) is the method most commonly used by general practitioners and nurses^{36,41}. It is a relatively safe procedure, which is easy to learn and can give gratifying results⁵⁵. The syringing fluid should be aimed on to the roof or posterior wall canal so that it passes around the wax plug forcing it outwards by pressure from behind. Hand held syringes are perfectly adequate. Motor-driven syringe pumps which can generate high pressures are potentially dangerous and should not be used⁵⁶. Sterile irrigation fluid is not required: tap water is satisfactory, providing it is heated to body temperature to avoid caloric stimulation and vertigo^{29,58}. The ear must be inspected afterwards to detect the uncommon (approximately 1 per 1000 ears syringed) but important potential complications (Table 1). Drying of the EAM afterwards may reduce otitis externa and is particularly important if the skin is traumatized or an unsuspected perforation is discovered^{11,29}.

When contraindications such as otitis externa, current or past history of a perforated tympanic membrane, previous ear surgery^{3,8,36,41} are present, then suction under direct vision is probably the safest method to employ³. Hooking the wax out, using a Jobson Horne probe, can also be used. Both of these methods require special care, experience and expertise and so are probably best left to the ENT specialist.

It has been said of syringing that 'with no other form of treatment is relief experienced so completely, in so short a space of time, with such gratitude'⁵⁵. Our patients perceive earwax as being very important. Perhaps we should look with renewed interest at this fascinating and clinically important sticky substance.

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