ORIGINAL ARTICLE

Comparative prospective study of foreign body removal from external auditory canals of cadavers with right angle hook or cyanoacrylate glue

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Objectives: Foreign bodies of the external auditory canal are a relatively common problem in emergency departments. Repeated attempts at removal with standard instrumentation can lead to significant ear injury. Recent case reports of using cyanoacrylate impregnated cotton buds suggest this is less traumatic and well tolerated by patients. No studies on this method have been performed. The objectives of this study were to identify whether there were significant differences in success rate, duration and injury caused by extracting beads from the external auditory canals of adult cadaveric ears using two different methods. This is the first study in a planned series of anatomical and clinical studies relating to foreign body extraction from the external auditory canal.

Methods: In this study the success rate, time taken and injury rate were assessed for removal of impacted spherical foreign bodies in the external auditory canals of cadavers using both a blunt right angle hook and cotton buds impregnated with cyanoacrylate glue. This process was performed by a specialist registrar in otolaryngology and repeated by a specialist registrar in emergency medicine.

Results: It was shown that both methods had a statistically similar success rate (two tailed binomial test $p=0.5$) and no injury was identified for either method. In addition the median extraction time for a right angle hook was 6 seconds and 42 seconds for cyanoacrylate. It was also noted that failed extraction was associated with a poor view of the foreign body in the external canal. This was caused by hair, a large tragus or tortuous external canal.

Conclusions: The authors feel that cyanoacrylate impregnated cotton buds are as effective at removing impacted foreign bodies as a right angle hook but the process takes longer. It is believed that patients could tolerate this longer time as the cyanoacrylate method is in theory less traumatic.

Foreign bodies (FBs) of the external auditory canal (EAC) are a relatively common presentation to the emergency department (ED). Reported incidence varies between 1 in 219 to 1 in 1792 attendances.¹ The majority of patients presenting to the ED with aural foreign bodies are under the age of 6.² There is no literature available that relates the actual size of the foreign body to patient age. There have been no comparative studies performed to guide the clinician as to which removal method best suits a particular clinical scenario.

The majority of FBs found in the EAC are spherical³ and cannot be retrieved with forceps as would an irregular shaped FB. Provided there is not complete occlusion of the ear canal it is common practice to attempt passage of a right angle hook^{4–5} past the FB and to then pull the FB laterally out of the EAC. This method can be painful and result in complications such as EAC laceration, tympanic membrane perforation and further impaction of the FB requiring removal under general anaesthetic and even endaural incision.⁶ In one series of 98 patients referred to an otolaryngology department for removal of EAC FB 61.5% of patients were noted to have EAC lacerations after a single failed attempt at removal by ED staff.¹

In the current literature there have been reports of clinicians using cyanoacrylate glue on the tip of a cotton bud, straightened paper clip or camel's hair paintbrush and adhering these to EAC FBs in an attempt at atraumatic removal. This literature while very scant mentions this method in two review articles,^{5–6} three case reports^{7–9} and two letters^{10–11} and this limited body of literature suggests a high success rate in adults and children with no complications reported.

The objectives of this study were to determine whether there was statistically significant difference in the success rate

and the time taken to remove a series of spherical EAC FBs from adult cadavers using a right angle hook or a cotton bud impregnated with cyanoacrylate glue.

Trauma to the external ear canal, by either method, was recorded.

METHODS

Fourteen embalmed adult cadavers were examined using an operating microscope and cleaned of all debris until the tympanic membrane could be clearly visualised and any pre-existing EAC or tympanic membrane abnormality identified. Identical spherical plastic beads 10 mm in diameter were impacted into the EACs of the cadavers occluding the EAC at the bony-cartilaginous junction. The bony-cartilaginous junction was chosen as it represented the more lateral of the two narrowings of the normal EAC and hence a probable area for FB impaction.¹²

Before attempting removal of the FBs it was agreed that less than 0.25 ml of cyanoacrylate glue would be placed directly onto the cotton of the cotton bud, which would in turn be placed onto the EAC FB in situ. The cyanoacrylate glue used was Super Glue Instant Adhesive as manufactured by the Loctite Corporation. The main component of this adhesive is ethyl cyanoacrylate. After a trial before the main study a drying time of 25 seconds was deemed to be the minimum time needed to provide sufficient traction to remove the FB.

Abbreviations: FB, foreign body; EAC, external auditory canal; ED, emergency department

Table 1 Results of success, extraction time, and trauma for removal of impacted EAC foreign bodies using right angle hook and cyanoacrylate impregnated cotton buds

	Hook	Cyanoacrylate
Successful attempts (n)	56 of 56	54 of 56
Median extraction time (sec.) (range in brackets)	6 (2–12)	42 (31–210)
EAC laceration (n)	0	0
Tympanic membrane perforation (n)	0	0

Removal with the right angle hook was attempted by passing the hook between the FB and the EAC, rotating it through 90° and applying lateral traction to draw the FB out. No manipulation of the EAC in excess of the normal clinical situation was allowed.

A specialist registrar in otorhinolaryngology using a cotton bud impregnated with cyanoacrylate glue performed removal. After this the bead was cleaned and replaced in the EAC for removal with a right angle hook and then discarded. Before any subsequent attempts the EAC and tympanic membrane were examined for any injury. A specialist registrar in emergency medicine then repeated this process. All attempts were performed under direct vision and not with the operating microscope. Each attempt at FB removal was timed in seconds by the non-participating specialist registrar. Timing started when the operator either picked up the right angle hook or commenced impregnating a cotton bud with cyanoacrylate. Timing stopped when a FB was removed completely from the EAC. Timing continued if the initial removal attempt failed and only stopped when the FB was successfully removed with further attempts. However, failure was defined as more than three attempts needed to remove a FB or if the non-participating registrar felt that there was excessive EAC manipulation. Every cadaver had this sequence of procedures performed using new identical beads and fresh cotton buds for each ear.

Data for the time taken and total attempts made were collated for both methods and both specialist registrars. Trauma to the EAC and tympanic membrane was also recorded. The data were then analysed.

RESULTS

No pre-existing abnormality was noted and all EAC FBs were removed eventually; however, using the definition of failure as more than three attempts there was a numerical difference in success rate between both methods. Altogether 56 of 56 attempts with the right angle hook were successful and 54 of 56 attempts with cyanoacrylate were successful (table 1). Two tailed binomial testing for statistical difference between these groups gave p value of 0.5. This shows that there is no statistically significant difference in success rate with either method.

Although not strictly part of the objectives of this study it was noted that certain anatomical features were associated with multiple or failed attempts using the cyanoacrylate impregnated cotton bud. These features included excessive hair, which interfered with the adhesion process and a large tragus or tortuous EAC, which obscured the view of the FB.

The median time for extraction with a right angle hook was 6 seconds (range 2–12) and median time using cyanoacrylate was 42 seconds (range 31–210). There was no evidence of tympanic membrane perforation with either attempt. No obvious EAC lacerations were detected with either attempt however it would be possible to overlook lacerations in cadavers because of the lack of bleeding (table 1).

DISCUSSION

It is clear from the data presented that the success rate for removing impacted EAC FBs is similar in both methods

although the time taken to perform extraction with a cyanoacrylate impregnated cotton bud was much greater. The main delaying factor was the drying time of the glue, which accounted for 25 seconds for each attempt. Although no injury was noted in this study, serious EAC and tympanic membrane injuries have occurred with standard instrumentation and are well documented as mentioned earlier.

The main limitation of this study was that the subjects were cadavers and as a result there was no measure of patient discomfort, cooperation or bleeding. Furthermore, as the cadavers used were adult it could be argued that access to the EAC is easier than in children. However, the authors feel that this would affect both extraction methods equally and not the comparison between them. There is definitely a need for a prospective randomised clinical trial in this area and also a need to identify anatomical features that predict difficult extraction.

On balance the authors feel that the cyanoacrylate impregnated cotton bud is a simple and effective method of removing impacted spherical EAC FBs. Obviously the authors would only recommend the use of a cyanoacrylate that is licensed for use in humans. In theory there should be less risk of EAC or tympanic membrane trauma than with a right angle hook and less patient discomfort that would facilitate the longer extraction time required. However, it was felt that cyanoacrylate impregnated cotton buds should be avoided in patients with excess EAC hair, a poor view of the FB or a non-impacted FB where there could be a danger of pushing it deeper into the EAC.

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