



Pediatric Cotton-Tip Applicator-Related Ear Injury Treated in United States Emergency Departments, 1990-2010

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Objective To evaluate the characteristics of children with cotton-tip applicator (CTA)-related ear injuries.

Study design Data on CTA-related ear injuries among children presenting to US emergency departments (EDs) from 1990 through 2010 were obtained from the National Electronic Injury Surveillance System.

Results Between 1990 and 2010, an estimated 263 338 children aged <18 years were treated for CTA-related ear injuries in US hospital EDs. There was a nonsignificant increase in the annual number of injuries from 1990 through 2001 (78.2%) and a significant decrease from 2001 through 2010 (26.0%). Younger children sustained the highest rate of injury (32.2 per 100 000 for age 0-3 years). Ear cleaning was the most frequently documented circumstance at the time of injury (73.2%), and patients themselves were most commonly handling the CTA (76.9%). Foreign body sensation (39.2%) and bleeding (34.8%) were commonly documented reasons for visiting the ED. The presence of a foreign body (29.7%) and tympanic membrane perforation (25.3%) were common diagnoses.

Conclusion Most CTA-related injuries occurred with children themselves handling CTAs while cleaning their ears. Foreign body and tympanic membrane perforation were the most common associated diagnoses. Despite warnings against the use of CTAs in the ear canal and use of CTAs by children, these injuries continued to occur. Additional injury prevention strategies through further parent/caregiver and child education are warranted. (*J Pediatr* 2017;186:124-30).

In 1923, Leo Gerstenzang invented the cotton-tip applicator (CTA) after watching his wife use cotton on toothpicks to clean their baby's ears.¹ The first medical concerns regarding the risk associated with CTA use were published in 1972, citing reports of tympanic membrane perforation (TMP), otitis externa, and cerumen impaction.²⁻⁴ Despite manufacturers' warning labels and clinicians' advice to avoid using CTAs inside the ear canal, CTA use remains the most common cause of accidental penetrating ear injury in children.^{3,5-7}

Although CTAs have many uses, they are most commonly used for ear hygiene, principally to remove cerumen.^{3,5} Numerous studies have found an association between the use of CTAs for ear hygiene and the presence of cerumen impaction,⁸⁻¹¹ TMP,^{2,10,12} foreign body,¹³⁻¹⁵ and otitis externa.¹⁶ According to a UK study, the majority of mothers who use CTAs to care for their children also use the same CTAs for themselves.⁸ Common reasons cited for using CTAs were believing it was a good idea, saw them advertised, and saw others use them.^{3,8}

This study used the National Electronic Injury Surveillance System (NEISS), a nationally representative database, to describe the epidemiology and trends associated with pediatric ear trauma related to CTA use in the US. The findings from this study can be used to generate measures to help prevent future ear injury among the pediatric population.

Methods

Data on ear injuries in children aged <18 years treated in hospital emergency departments (EDs) in the US and its territories between 1990 and 2010 were obtained from the NEISS database. More recent data were not available because the NEISS stopped coding for CTA-related injuries after 2010. The NEISS is organized by the US Consumer Product Safety Commission to monitor consumer product-, sports-, and recreational activity-related injuries. The NEISS collects data from a sample of approximately 100 hospitals, which represents a stratified probability sample of more than 5300 hospitals located in the US and its territories with a 24-hour ED and at least 6 beds.¹⁷ The NEISS database includes information about patient demographics, body part injured, product(s) involved, injury diagnosis, and a brief case narrative.

CTA	Cotton tip applicator
ED	Emergency department
NEISS	National Electronic Injury Surveillance System
TMP	Tympanic membrane perforation

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Because there is no specific NEISS product code for CTAs, all pediatric ear injury cases were first queried from the NEISS using the NEISS body part injured code 94 for ear or if the case narrative contained the word “ear.” From these cases, a case was identified as CTA-related if the case narrative contained any of the following alternative terms for CTA: “Q-tip,” “cotton bud,” “cotton swab,” and “cotton-tipped swab.” Note that “Q-tip” is a trademarked name commonly used term to refer to CTAs of any brand (including Q-tips). The CTA-related ear injury cases thus identified were further reviewed to select only cases involving ear trauma or ear injury. Cases involving impaction or infection, such as otitis media and otitis externa, were excluded, given the difficulty in ascertaining whether they were present before CTA insertion or developed immediately after its use.

The NEISS variables for age, sex, location of incident, and ED disposition were recategorized for analyses. Patient ages was divided into 3 groups: 0-3 years, 4-7 years, and 8-17 years. These age groups were created based on children’s ability to provide overall self-care, which typically transitions from complete dependence to partial dependence to independence from parent/caregiver. Location of the incident was classified as home (including NEISS categories of home, apartment/condominium, and manufactured/mobile home) or other (including school, sports facility, and recreational area). ED disposition was classified as treated and released, admitted (included NEISS categories of treated and transferred to another hospital, treated and admitted for hospitalization, and held for observation), or left against medical advice.

The case narratives were used to code additional information regarding the person handling the CTA at the time of injury, circumstances of the injury, and reason for the ED visit. The person handling the CTA was classified as self, parent, sibling, or other (eg, other relative, friend). Circumstances surrounding the injury were classified as cleaning, playing, fell/tripped/slipped/ran into, bumped/pushed/hit by someone, or other (eg, laid down/rolled over, removing water, scratching/itching, imitating someone). The reason for the ED visit was coded as foreign body sensation, bleeding, ear pain, ear pain and bleeding, or other (eg, discharge, hearing loss, dizziness, ear pain and bleeding).

The NEISS diagnosis codes and case narratives were used to reclassify the diagnosis into the following ear-specific injuries: TMP (NEISS narrative containing TMP or NEISS diagnosis coded as puncture), foreign body, soft tissue injury (including NEISS categories of abrasion/contusion and hematoma), laceration, hemorrhage, and other (including NEISS categories of avulsion and other). Note that because TMP is considered one of the most severe ear injuries, the NEISS narratives were used to initially identify these cases.

Statistical Analyses

Statistical analysis was conducted using SPSS version 21 (IBM, Armonk, New York) and SAS version 9.3 (SAS Institute, Cary, North Carolina). PROC SURVEYFREQ and PROC SURVEYMEANS procedures in SAS 9.3, which accounted for the NEISS sampling design and sample weights, were used to

calculate national estimates for CTA-related ear injuries and the mean and median age of patients. Injury rates per 100 000 US residents aged <18 years were calculated using US Census Bureau population estimates.^{18,19} Trends were analyzed using weighted linear regression, with weights equal to the inverse of the variance of the estimated statistic. If the slope of the regression line was significantly different from 0, then the overall percentage of increase/decrease was reported as significant. If the slope was not significantly different from 0, then the overall percentage of increase/decrease was reported as not significant. Additional statistical analyses included Roa-Scott’s χ^2 analysis and relative risk calculation with 95% CIs. Statistical significance was established at $\alpha = 0.05$. National estimates reported in this article are stable estimates unless stated otherwise. As estimate is potentially unstable at a sample size <20 cases, an estimate <1200, or a coefficient of variation >30%. Unknown values for specific variables are given in the table but are excluded from the analysis. This study was approved by the Institutional Review Board of the Research Institute at Nationwide Children’s Hospital.

Results

Between 1990 and 2010, an estimated 263 338 (95% CI, 204 871-321 804) children aged <18 years were treated in US hospital EDs for CTA-related ear injuries, for an annual average of 12 540 injuries (95% CI, 9756-15 324), or 17.6 injuries (95% CI, 13.7-21.5) per 100 000 children. There was a nonsignificant 78.2% increase ($m = 322.6$; $P = .059$) in the annual number of CTA-related ear injuries, from 9794 injuries (95% CI, 6722-12 866) in 1990 to 17 449 injuries (95% CI, 9107-25 790) in 2001, followed by a decrease to 12 911 injuries (95% CI, 9621-16 202) in 2010, a significant decrease of 26.0% ($m = -442.5$; $P = .007$) (Figure, A). This corresponded to a nonsignificant 57.4% ($m = 0.29$; $P = .231$) increase in the annual injury rate per 100 000 children aged <18 years from 1990 (15.3; 95% CI, 10.5-20.0) through 2001 (24.0; 95% CI, 12.5-35.5) and then a significant decrease by 27.5% ($m = -0.64$; $P = .006$) from 2001 (24.0; 95% CI, 12.5-35.5) through 2010 (17.4; 95% CI, 13.0-21.8) (Figure, A).

Among the 61.7% of the injuries for which the location of the injury was documented, 99.4% occurred at home (Table I). The mean \pm SD age of patients treated for CTA-related ear injuries was 6.32 ± 0.13 years, and the median age was 4.09 years (IQR, 1.98-9.09 years). The number and rate of injuries peaked at age 2 years and then declined through adolescence (Figure, B). Patients aged 0-3 years accounted for 40.2% of the injuries, and patients aged <8 years accounted for 67.4%. Patients aged 0-3 years had the highest injury rate per 100 000 children (32.2; 95% CI, 25.5-38.9), followed by those aged 4-7 years (21.7; 95% CI, 16.8-26.5) and those aged 8-17 years (10.3; 95% CI, 7.6-12.9). Males accounted for 55.6% of the injuries (Table II). The majority of the CTA-related ear injuries among children aged 0-3 years (61.3%) and children aged 4-7 years (56.9%) occurred in males, whereas females account for the majority of the CTA-related ear injuries in children aged 8-17 years (52.5%).

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