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Deaths Due to Foreign Body Aspiration in Children: The Continuing Hazard of Toy Balloons

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ABSTRACT: Asphyxia due to aspiration of a foreign body is a common cause of accidental death in children. Foreign body aspiration is the most likely cause of accidental fatalities in children under 1-year-of-age. Children may die due to airway obstruction by food objects such as hot dogs, nuts, candies, grapes, seeds, and egg shells. Non-food objects such as balloons, coins, pop tops of beverage cans, pills, safety pins, ball bearings, marbles, and baby powder also may be fatally aspirated. To better understand and help prevent this well recognized health risk to children, we reviewed 10 years of cases at the Cook County Medical Examiner's Office in which deaths in children 14-years-of-age and younger were due to aspiration of foreign objects. The most common item that caused fatal aspiration in our series was a toy balloon.

KEYWORDS: forensic science, pathology and biology, children, asphyxia, aspiration, choking, foreign objects, balloons, accidental death, death

Aspiration of foreign bodies is a well recognized health hazard especially in very young and elderly individuals (1–5). Children aspirate a wide variety of food and non-food objects (6–16). The percentage of children dying after aspirating foreign bodies has decreased to about 1% in recent years due to improved bronchoscopic techniques, safer anesthesia, and more effective first aid methods (17–19). Yet fatal aspiration of food and non-food objects remains a common cause of fatalities in young children. In fact, it is the most likely cause of accidental death in infants 1-year-of-age or less (18–23). This article reviews deaths in the pediatric age group 14 years and younger due to aspiration of foreign objects that occurred in Chicago and surrounding Cook County, Illinois during the decade 1984–1993. Our objective is to examine childhood deaths due to airway obstruction in a large urban community. Hopefully a better understanding of these fatalities will aid in the prevention of future deaths of this type.

Methods and Cases

We reviewed the records of the Cook County Medical Examiner's Office over the ten years of 1984 through 1993. This office investigates all sudden and unexpected or possibly violent deaths in Cook County, Illinois which has a population of approximately 5.1 million people. Over this period our office investigated approximately 180,000 deaths, 23 of which were deaths in children 14-years-of-age and younger due to the aspiration of both non-food and food foreign objects. In each of these cases there was an examination of the body, an investigation of the circumstances surrounding the death, and a review of all available medical history. Table 1 summarizes the cases where deaths were due to non-food items, and Table 2 summarizes the cases where deaths were due to food items.

Findings

- There were 11 (48%) male and 12 (52%) female foreign body aspiration fatalities in children age 14 years and younger.
- African Americans accounted for 12 (52%) of the cases, Hispanics for 6 (26%), whites for 5 (22%), and there were no Asian American or Native American deaths.
- Predominantly very young children died. In 8 (35%) of the cases the child was 1 year or less, in 4 (17%) cases 2 years, in 4 (17%) cases 3 years, and there was 1 (4%) case each at 4 years, 6 years, 7 years, 10 years, 13 years, and 14 years (Fig. 1).
- The average number of cases per year was 2.3 with an unexplained cluster of 6 cases in 1985.

TABLE 1—*Deaths in children 14-years-old and younger due to aspiration of* non-food *objects in Cook County 1984–1993.*

Case #	Age/ Sex	Object	Adult	Circumstances
1	1yr/M	cap	nearby	found choking on cap of inhaler
2	3yrs/M	tablet	present	took prescribed calcium tablets
3	1yr/M	screw	present	swallowed screw at home
4	10yrs/M	marble	absent	playing and put marble in mouth
5	3yrs/M	ball	nearby	playing jacks at home
6	3yrs/F	balloon	present	playing with balloon at home
7	2yrs/F	balloon	nearby	found deceased in bed at home
8	4yrs/F	barrette	nearby	watching television at home
9	7yrs/F	balloon	present	shopping with grandmother
10	6yrs/M	balloon	present	playing with balloon at home
11	1yr/M	balloon	nearby	playing with balloon at home
12	3yrs/M	screw	present	at laundromat with aunt
13	7yrs/M	ball	present	playing with ball at school
14	1yr/F	marble	nearby	found choking in bed at home
15	1yr/F	screw	nearby	found choking in bed at home

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TABLE 2—*Deaths in children 14-years-old and younger due to aspiration of* food *in Cook County 1984–1993.*

Case #	Age/ Sex	Food	Adult	Circumstances
1	2yrs/F	Gum	Present	With mother riding in auto
2	13yrs/F	Bread	Absent	Found bread in garbage can
3	1yr/M	Seed	Present	Family fed pumpkin seed at home
4	2yrs/M	Gum	Present	With mother in auto accident
5	2yrs/F	Hot dog	Nearby	Family fed hot dog at home
6	1yr/F	Hot dog	Nearby	Family fed hot dog at home
7	1yr/M	Grape	Present	Baby sitter fed grape at home
8	14yrs/F	Rice and bread	Present	Eating dinner with parents

• A latex toy balloon was aspirated in 5 (22%) cases, and was the most common item involved (Fig. 2). In 3 (13%) cases children aspirated a screw, in 2 (9%) cases a marble, in 2 (9%) cases a small ball, in 2 (9%) cases chewing gum, and in 2 (9%) cases a portion of hot dog. There was 1 (4%) case each involving a barrette, a pumpkin seed, a grape, a piece of bread, and a combination of rice and bread.

• By far, the most common location for fatal foreign body aspiration was the home where 18 (78%) cases occurred. There were 2 (9%) cases that occurred in moving automobiles and 1 (4%) case each in a laundromat, a shoe store, and at school.

• In 18 (78%) of the cases the child had apparently been given the item which they aspirated by an adult either to play with or to eat.

• In 12 (52%) an adult was present when the incident occurred, in 9 (39%) an adult was very nearby, and in only 2 (9%) cases was an adult absent.

• There was a history of mental retardation in 4 (17%) cases and these tended to be older victims of foreign body aspiration: a 6-year-old, a 7-year-old, a 13-year-old, and a 14-year-old.

Discussion

Cook County's racial makeup is about 25% African Americans, 14% Hispanics, 57% whites, 4% Asian Americans, and 0.2% Native Americans. Therefore, African Americans and Hispanics

FIG. 1—*Distribution by age of the 23 deaths in children 14-years-of-age and younger due to aspiration of foreign bodies in Cook County, Illinois, 1984–1993.*

FIG. 2—*Autopsy photograph of balloon at bifurcation of trachea that caused fatal choking in a 2-year-old girl. (Photograph courtesy of Mary I. Jumbelic, M.D.)*

were over-represented in our series of children dying from foreign body aspiration. At this time we have no clear explanation for these differences. The findings raise a significant public health issue that requires further investigation.

The cluster of cases we found in 1985 was worrisome. But no common factor could be identified. Of these six children, three were white, two African American and one Hispanic. Five were male and one female. They ranged in age from 1 year to 13 years. Three aspirated food and three aspirated non-food objects. All aspirated different types of foreign bodies. And the locations of the incidents were widely geographically dispersed throughout the county. Therefore the peak of 6 cases in 1985 appears to be a random variation.

In our series of 23 cases we found 8 children who fatally aspirated food and 15 who fatally aspirated non-food objects—thus non-food items predominated. This distribution differs significantly from two previously reported series of pediatric choking deaths. In one review of 20 pediatric fatalities due to the aspiration of foreign objects from the Maryland Medical Examiner's Office by Susan P. Baker and Russel S. Fisher over the 9 year period of 1970 through 1978, 12 children died from airway obstruction due to food and 8 due to non-food objects (17). Roger E. Mittleman, in a review of 23 cases of fatal foreign body aspiration in children over the 28 years from 1956 through 1983 from the Dade County, Florida Medical Examiner's Office, reported 17 children who aspirated food and 6 who aspirated non-food objects (22). In contrast to our findings, in both of these studies food objects predominated. A possible explanation for this difference may be that the Dade County and Maryland studies covered earlier time periods than ours. Our series begins nearly a decade after the publication of the Heimlich maneuver which was originally described as a life-saving technique especially to prevent food-choking (18). Also of interest is that the most commonly involved foreign object in the two previous studies was a hot dog (17,22), while in our series we found the most common item to cause fatal airway obstruction was a balloon (Fig. 3).

Though the types of objects involved may differ, most deaths due to foreign body aspiration follow a similar pattern. Carole Stallings Harris and her coauthors describe a three phase injury control model that can be applied to fatal aspirations of all types. According to their model, the three phases of fatal airway obstruc-

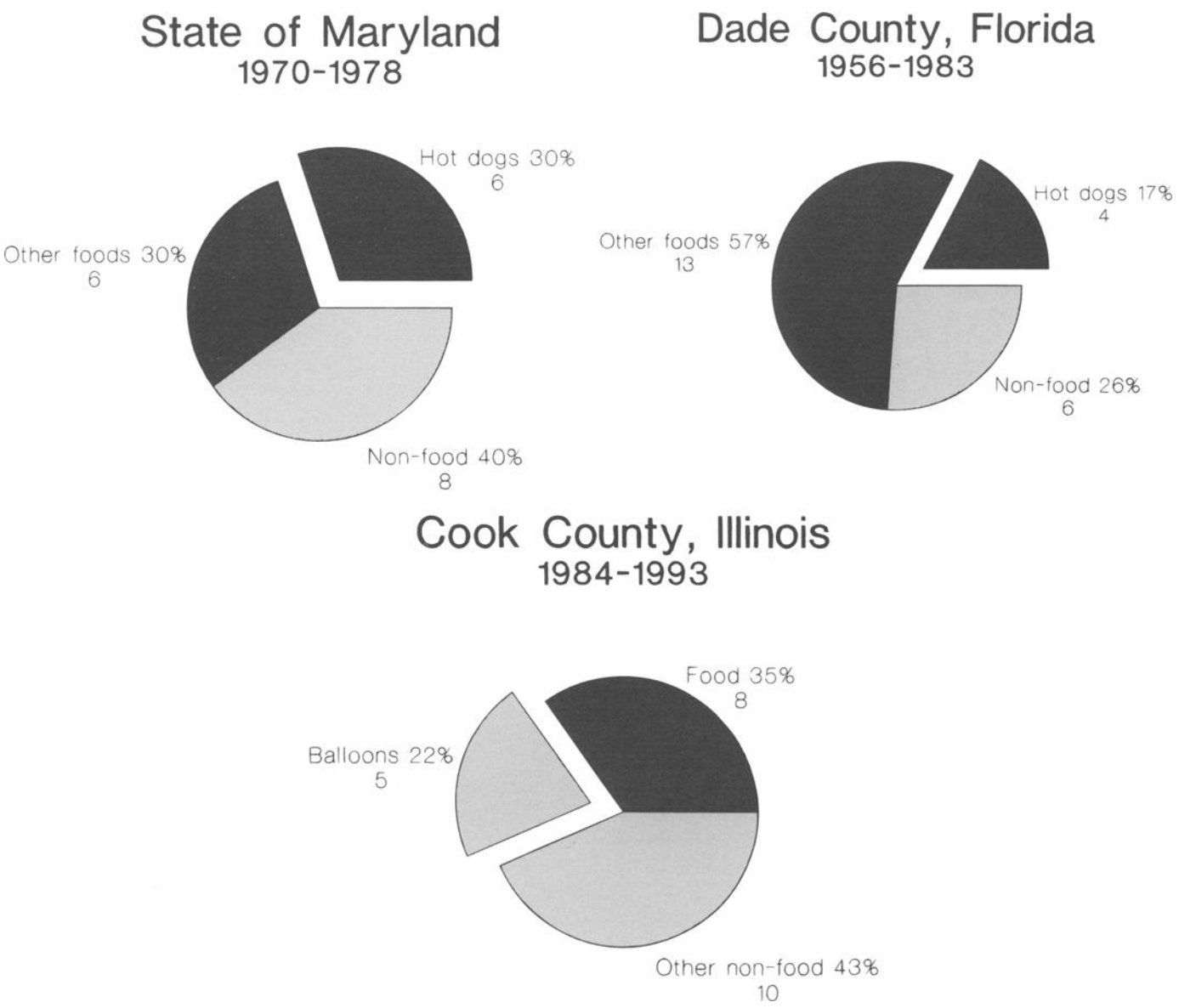

FIG. 3—*Distribution by type of object choked on for fatal aspirations in children:* (a) *in 20 cases from the Maryland Medical Examiner's Office* (30); (b) *in 23 cases from the Dade County, Florida Medical Examiner's Office* (49); *and* (c) *in 23 cases from the Cook County, Illinois Medical Examiner's Office.*

tion are: 1) *penetration* of the object into the airway; 2) *obstruction* of the airway; and 3) failure of the victim to *expel* the object once obstruction has occurred (21). Fatal aspirations due to balloons, the most common type of case in our series, follows this model closely.

A balloon is smooth and slippery allowing easy *penetration* into the airway. And because of its pliability, a balloon easily conforms to the size of the airway causing *obstruction* and making it difficult to *expel.* Expulsion may be further hindered because the membranous balloon can act as a valve and allow air to be expelled from, but not to enter the airway. Under such circumstances natural defense mechanisms like coughing and first aid measures like abdominal thrusts (which depend on forcefully exhaled air to dislodge an obstruction) are much less effective (7,8,18).

The dangers of balloons have been well recognized and, according to the Consumer Product Safety Commission, they are the most common cause of pediatric aspiration deaths due to toys (9,23). Our findings give further evidence of the hazards of toy balloons. We found them to be the most common of *all types* of foreign bodies in our series to cause fatal aspiration.

What else about balloons makes them so dangerous? A number of additional factors may account for the hazard balloons pose. One problem may be that balloons apparently seem safe to parents, in contrast to toys which fire projectiles or have sharp points or edges. Also, because of their association with festive occasions, balloons are often distributed to children at celebrations like birthday parties. And because of their pleasing color and texture, young children have a tendency to put balloons into their mouths (23).

Various strategies have been tried in an attempt to reduce the number of aspiration deaths, especially those due to children's toys like balloons. Though well recognized as dangerous, standardized tests are difficult to apply to balloons. The Consumer Products Safety Commission's Small Parts Standard of January 1980 states that objects given to young children must not fit into a truncated cylinder of 1.25 inches in diameter with a depth ranging from 1.00

FIG. 4—*Plexiglass test truncated cylinder showing:* (a) *balloon fitting into cylinder indicating it is* **unsafe** *to give to young children, and* (b) *balloon sitting on top of cylinder wrongly indicating it might be* **safe** *to give to young children.*

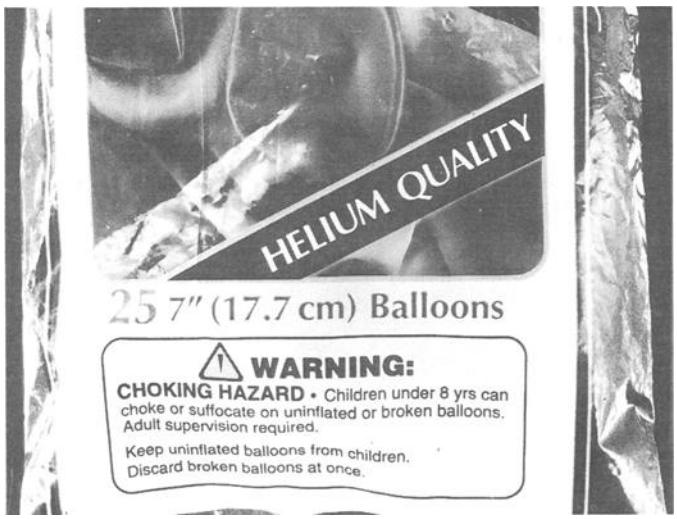

FIG. 5—*Label on package of balloons warning they should not be given to young children.*

to 2.25 inches (23). When folded and compressed pliable objects like balloons may be small enough to fit into a such a cylinder and fail the safety test. But when not folded, or when inflated, balloons may appear large enough to seemingly pass the test (Fig. 4).

To prevent deaths due to airway obstruction by balloons, several safety modifications have been explored. For example, rings or discs have been placed in balloons to make them more difficult to swallow. This change, however, does not prevent the aspiration of fragments from broken balloons. A more successful modification has been making balloons from foil or polyester film—materials less likely than latex to burst into fragments or to mold and cling to the linings of the airways (23).

Efforts have also been made to spread information about the dangers of toy balloons by informing health professionals, the press, and the public. And because warning labels may help alert consumers to possible risks, most packages of balloons now have labels indicating that they should not be given to young children (13,19,23) (Fig. 5). Still, the relatively large number of childhood deaths due to aspirations of toy balloons we found in our study is evidence that even more needs to be done to control this significant pediatric health risk. Ultimately, abandoning the traditional latex balloon may be the only solution.

Conclusion

In our series more children died due to airway obstruction by non-food objects than food. African Americans and Hispanics were over-represented for reasons we cannot yet explain. The most common cause of fatal aspiration was a latex toy balloon. Predominantly very young children choked on foreign bodies—over one third of the deaths were children 1-year-old or less. Over three quarters of fatal aspirations occurred at home. In most cases the child had been given the item they fatally aspirated by an adult, and in the great majority of cases an adult was present or very nearby when the fatal aspiration occurred.

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