

## REVIEW

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# Death as a Consequence of Foreign Body Aspiration in Children

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## ABSTRACT

**Aim:** To analyze the rate of mortality in children with foreign body aspiration (FBA). **Methods:** We outlined a retrospective review of hospital data of patients between 1971 and 2013. FBA occurring in children 0 year to 14 years was considered for inclusion (patient ages ranged from 0.6 to 15 years, with a median age of 2.2 years). The gender structure within the investigated cases was 75.8% males and 24.2% females. During the study period, 772 patients undergoing rigid bronchoscopy with the diagnosis of FBA were included. Deaths on arrival were excluded. **Results:** Total rate of mortality (for whole investigated period) was 0.785. For last fifteen years of the investigated period the rate of mortality was zero. **Conclusion:** For prevention of foreign body aspiration in children and its mortality should be taken two strategies: non-medical (alterations in product design and public education campaigns) and medical (education of medical staff and improvement of equipment).

**Keywords:** foreign body aspiration, children, the rate of mortality, death.

## 1. INTRODUCTION

Foreign body aspiration (FBA) continues to be a common problem in paediatrics that may have severe consequences, as it can result in both acute and chronic health problems (1). FBA is a serious condition during childhood that requires immediate management to keep away complications and irreversible lung injuries (2). Tracheobronchial foreign body aspiration is life-threatening emergency for children (3) and comprise the majority of accidental deaths in childhood (4). After tracheobronchial foreign body aspirations, cardio-pulmonary arrest and sudden death may be seen in patients, especially in children (5). Foreign body aspiration is the most likely cause of accidental fatalities in children under 1-year-of-age (6). In the group of children up to 3 years, presence of foreign body in the respiratory tract accounts for 7% of sudden deaths (7). The prevalence in young children could be because of their lack of molar teeth; poor swallowing of food; their tendency to put objects in the mouth; playing with objects in the mouth; talking, crying, or moving while eating; having weak protective laryngeal reflexes; and having the desire to explore the world (8). FBA is one of the most common cause of accidental death at home in age <5 years (9). Statistics show that, in United States, 5% of all accident-re-

lated deaths in children under the age of 4 is caused by FBA, which is also the leading cause of accidental deaths in the home among children under the age of six (10). Foreign body aspiration (FBA) continues to be a concerning pediatric problem, accounting for thousands of emergency room visits and more than 100 deaths each year in the United States (11). Delay in diagnosis, and hence in treatment, may have serious consequences (12) and especially if treatment (bronchoscopy) done by experts in this field, this condition (FBA) can cause a death of children (13). The aim of this study is analysis of the rate of mortality in children with foreign body aspiration and compare with results of other authors.

## 2. MATERIAL AND METHODS

This is a retrospective study of foreign body aspiration in children in ENT clinic, University clinical center Tuzla, Bosnia and Herzegovina. We reviewed medical records of 772 children (patients ranged from 0 year to 14 years, with median age of 2.2 years), with definite and even without definite history of FBA. The gender structure within the investigated cases was 75.8% males and 24.2% females. All of them underwent rigid bronchoscopy under general anesthesia. The main analysis is focused on the rate of mortality in children with FBA.

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### 3. RESULTS

Seven hundred and seventy-two children who an ENT clinic Tuzla underwent rigid bronchoscopy for removal of foreign body in the airways were evaluated (Table 1). Due to some technical reasons (relocation of clinics to another building, loss of medical documentation and other), this structure was divided into 4 periods: 1971-1985, 1987-1998, 1999-2004 and 2004-2013. Neither in one of these 4 periods, mortality was not greater than 1%, and for whole period (1971-2013) the rate of mortality was 0.785. It is also interesting that last fifteen years there was not a death of children.

Comparison of data about number of performed bronchoscopies of different authors, average number of performed bronchoscopies per year, the rate of mortality, duration of investigated period (in years) is displayed on Table 2. There are group of authors that reported zero mortality, mortality below 1%, mortality between 1-2%, and mortality higher than 2%. There were not statistically significant correlation between the number of per-

Period	Total (no.)	Per year (No.)	Mortality (%)
1971-1985	204	14.57	0.7
1987-1998	230	19.01	0.87
1999-2004	172	28.60	0
2004-2013	166	18.44	0
TOTAL	772	18.38	0.785

Table 1. A comparison number of performed bronchoscopies at ENT clinic Tuzla

formed bronchoscopies (total number or average number) and the rate of mortality.

### 4. DISCUSSION

Tracheobronchial foreign-body aspiration is a relatively frequent pediatric emergency and a cause of substantial morbidity and mortality especially in preschool children (14). Children present a higher risk of foreign body aspiration because they are in the habit of putting objects into their mouth, absence of molars the chew some

Continent	Author	Country	No. of performed bronchoscopies	Av. No. of performed bronchoscopies per year	Mortality (%)	Duration (years)
Europe	Lain A	Spain	65	5.4	0	12
	Fernandez J	Spain	210	-	0.9	22
	Schmidt	Germany	98	12.25	0	8
	Bartnik	Poland	33	4	0	7
	Pinto A	Italy	31	6	0	5
	Mantel	Germany	224	-	0	-
	Steen KH	Germany	94	13.4	1.06	-
	Bless	Germany	103	12.86	0	8
	<b>Brkic</b>	<b>Bosnia&amp;Herz.</b>	<b>772</b>	<b>18.38</b>	<b>0.785</b>	<b>42</b>
Asia	Li Y	China	749	44.05	0	17
	Zhu F	China	1276	-	0.24	-
	Xu M	China	4217	248.05	0	17
	Zhijun	China	1428	64.90	0.42	22
	Wang G	China	163	-	0	-
	Zhang J	China	7260	476	0	16
	Feng C	China	172	17.2	0	10
	Pan H	China	316	63.2	1.58	4
	Shubha AM	India	102	10.2	0	10
	Shafi	India	50	50	6	1
	Yeh LC	Taiwan	81	4	0	20
	Chik KK	Hong Kong	27	1.5	0	13
	Watanabe	Japan	33	-	0	8
	Eroglu	Turkey	357	35.7	0.56	10
	Eren	Turkey	1160	-	0.8	-
	Erikci	Turkey	189	47.25	0	4
	Aytac	Turkey	500	-	1.8	-
	Kiyan G	Turkey	102	51	0	2
	Pasaoglu	Turkey	822	137	0.6	6
	Oguzkaya	Turkey	548	54.8	0.7	10
Hasdiraz	Turkey	1035	60.88	0.77	18	
Martin A	New Zealand	227	21.8	0	12	
Africa	Albirmavy	Egypt	3600	180	0	20
	Falase	Nigeria	24	6	<b>8.3</b>	5
America	Menendez	Puerto Rico	58	11.6	<b>7.7</b>	5
	Fidkowski	USA	12797	-	0.42	-
	Vane	USA	131	-	0	-
	Black RE	USA	262	-	0	0
	Fraga	Brazil	69	11	0	5
	Sjogrenn PP	USA	450	-	1.1	10

Table 2. A comparison between number of performed bronchoscopies and the rate of mortality

types of food, crying or running with objects inside their mouth and lack of coordinating mechanisms of swallowing (15). Despite the fact that Chevalier Jackson removed tracheobronchial foreign body in early part of twentieth century (16), aspiration of foreign body into tracheobronchial tree still attract attention of the investigators. Namely, a computer-aided search of MEDLINE database (December 19, 2017) for key words: “foreign body” AND “aspiration” AND “children” showed more than 615 abstracts of articles (and articles). 67 articles published in core clinical journals, and 443 articles published in English language. Here are large series of patients (total number more than 1000 performed bronchoscopies and more than 400 performed bronchoscopies per year).

Bronchoscopy is essential if FBA suspected, first to confirm the diagnosis and also because it can be used for therapeutic treatment in the same stage (17). The children can die before, during and after bronchoscopy (18). Melaku et al. stated strictly that six children died before, two during and one after bronchoscopy. Goren et al. (19) reported that 36.4% patients were dead on arrival in hospital, 50% on intervention and 13.6% after complications. In one big revision of more than 12,000 cases of foreign body aspiration, Fidkowski (20) noted that mortality at the time of tracheobronchoscopy was 0.42%.

Data about death of children with FBA before admittance in the hospital (or before bronchoscopy) can get from the different sources (21-23). Sahin et co-workers (24) in their study are excluded deaths of children on arrival in hospital. In their study, Ciftci at co-workers (25) stated that two patients died immediately after FBA, although foreign bodies were removed as quickly as possible (cardiac arrest was irreversible). Karatzanis et al. (26) stated that the decline in the total number of bronchoscopies during recent years has been a result of a campaign for proper education of the public and especially parents, caretakers and families. In this way, other authors also emphasised significance of parents attention on their children during activities (27,28) or medical staff education (29-31).

Although asphyxia at presentation or initial emergency bronchoscopy causes some deaths, hypoxic cardiac arrest during retrieval of the object, bronchial rupture, and unspecified intraoperative complications in previously stable patients constitute the majority of in-hospital fatalities (20). Cardiac arrest was a cause a death of three children during bronchoscopy (0.5%) in study of Senkaya et al (32). Kitcher (12) reported one death during bronchoscopy (0.5%). Some authors strictly stated that death of children occurred after bronchoscopy (4, 25, 33-38).

Literature data about the rate of mortality according to FBA can be divided into next categories: zero mortality, mortality less than 1%, mortality 1-2% and mortality higher than 2%. The highest rate of mortality is recorded in the next countries: Ethiopia-11% (18), India-6% (39), Puerto Rico-7.5% (40), Nigeria-8.3% (41). Here is also important to say, that there is also study from India with zero mortality (42). Except study of Pan H (43), in which stated that the rate of mortality was 1.58%, other studies from China showed zero mortality (44-47), or very low

mortality- below 0.25% (48-51). The results of our study indicate that mortality in the last 15 years has been 0%, which is in contrast to the results of Zhang X (50), which states that adverse postoperative events have been on the rise in the past 5 years. The reasons for this disagreement can be explained by possible differences in nutrition and other sociopedimeiological characteristics.

The incidence of major complications was related not only to the size of the foreign body and its location but also the duration since aspiration (16). Late diagnoses of foreign body aspiration were defined as occurring beyond 3 days between the aspiration of the foreign body, or onset of symptoms, and correct diagnosis. The causes creating late diagnosis of foreign body aspiration in children were as follows: parental negligence, misdiagnosis by the fellow professionals and pediatricians, the normal chest roentgenographic findings, lack of typical symptoms and signs, mismanagement and a negative bronchoscopic finding (52).

From the data in Table 2. it is evident that it is so, because there is no other special rules that could be taken in the distribution of results. Somewhere, as seen, for a number of procedures performed less mortality, and sometime more. The same is the case with a small number of procedures performed. This means that it is not RULE: “higher repetition rate- less mortality”. It is agreed with statement that surgeon and hospital volume did not significantly correlate with higher complication rates (53).

The total number of procedures performed bronchoscopy, in the multi-year, and the one-year level, is not statistically associated with the rate of mortality, which is determined by calculating the Spearman correlation coefficient (the level of statistical significance of  $p < 0.05$ ). This means that, in our opinion, as a key reason for this result imposes the level of training- the expertise of staff who carried out bronchoscopy procedure, not the frequency of procedures performed. Good trained staff adequately implemented bronchoscopy procedure which probably causes lower mortality. In our view, if sufficiently trained personnel, and procedures may not perform the same (modern) equipment, then this may affect the mortality and better equipment (assets) facilities, working conditions, etc., and even a growing number of doctors in one facility involved in carrying out the procedure (which in turn somehow implies a different level of expertise). It is agrees with a position paper of the American Academy of Pediatrics published on prevention of FB aspiration. The association calls for more proactive preventative measures to protect children from FB aspiration and to prevent mortality and morbidity. These include: a) Raising awareness of parents and caregivers to supervise children and create a safe environment for them; b) Promoting legislation and enforcing regulations that will prevent dangerous products being sold for children; c) Changing the design of products, especially food products and toys, that will reduce the risks of choking (54).

## 5. CONCLUSION

Foreign body aspiration (FBA) is a major cause of co-incident death in children less than one year old and is

the cause of death in 7% of children less than four. In this respect, minimal two various strategies should be taken to decrease risks of foreign body aspiration and prevent adverse outcomes. These strategies include: non-medical (alterations in product design and public education campaigns; parental education about the causes and hazards of this condition, especially mothers with children younger than 12 months old and mothers with a first child; consider the population lifestyle and cultural habits to be more effective) and medical - improvement of knowledges and skills (improved training of primary care physicians will enhance diagnostic accuracy and reduce treatment delays, that can play a critical role in increasing education efforts during each well child office visit through anticipatory guidance of choking risks, and education of otorhinolaryngologists, pulmonologist, anesthesiologists and thoracic surgeons; and improvement of equipment - the renewal of technical ultrastructure with technological advance).

- Conflict of interest: none declared.

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