

# Aspiration Pneumonia in Pediatric Age Group: Etiology, Predisposing Factors and Clinical Outcome

Pages with reference to book, From 105 To 108

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## Abstract

**Introduction:** Aspiration pneumonia in children is an important disease in terms of the morbidity and mortality associated with it. The objective of this study is to characterize the cases of aspiration pneumonia on the basis of the predisposing factors, types of aspiration syndromes, materials aspirated and their clinical outcome.

**Methods:** A total of 107 patients diagnosed as having aspiration pneumonia, were included in this study. Cases were between 0-15 years of age, admitted to the Aga Khan University Hospital (AKUH) over five years. Results: The most common form of aspiration syndrome seen was chemical pneumonitis (52.1%). The three most common factors predisposing to pulmonary aspiration were accidental ingestion (37.4%), altered consciousness (34.6%) and neurologic disorders (29%). Children who aspirated oropharyngeal flora were at higher odds to require mechanical ventilation than those aspirating inert fluids and particulate matter (OR = 6.4, 95% CI: 1.5 -29.2, p = 0.003). Milk (31.8%), kerosene (21.5%) and oral secretions (19.6%) were the most common materials aspirated. Betel nuts were the most commonly aspirated foreign body. Patients aspirating oral secretions and milk were seen to have a relatively worse clinical outcome than those aspirating kerosene oil. Conclusion: Aspiration pneumonia is a relatively uncommon clinical entity at AKUH in children. However, it does cause significant morbidity and mortality (JPMA 49:105, 1999).

Aspiration pneumonia refers to pulmonary sequelae resulting from the abnormal entry of endogenous secretions or exogenous substances into the lower airways. For aspiration pneumonia to occur, there must be a breakdown of the usual defenses that normally protect the tracheobronchial tree as well as pulmonary complications that result from the aspiration event<sup>1</sup>.

Syndromes of pulmonary aspiration can be classified into three distinct categories based on the character of the inoculum that defines the pathogenesis of pulmonary complications. This includes chemical pneumonitis, oropharyngeal secretion aspiration and aspiration of inert fluids and particulate matter<sup>1,2</sup>.

Chemical pneumonitis is caused by fluids that are inherently toxic to the lower airways and which can initiate an inflammatory reaction independent of bacterial infection. Examples of such fluids include acid, kerosene, gasoline, milk, mineral oil and alcohol. Aspiration of oropharyngeal secretions results in bacterial infection of the lower airways by commensals of the oropharynx. The third category of pulmonary aspiration involves aspiration of inert fluids and particulate matter, which are not inherently toxic to the lung but can cause airway obstruction or reflex airway closure. Inert fluids include saline, water, barium and gastric contents with pH exceeding 2.5. Examples of particulate matter are peanuts, betel nuts and other vegetable and inorganic particles<sup>3</sup>.

Conditions predisposing to the development of pulmonary aspiration include altered consciousness<sup>3</sup>, anatomic disorders, physiologic disorders, neurologic disorders, mechanical disruption of the normal defense barriers and accidental ingestion of substances. Altered consciousness refers to children with

seizures<sup>3</sup>, cerebrovascular accidents, head trauma<sup>4</sup>, drug overdose, meningitis, encephalitis<sup>5</sup> or under general anesthesia<sup>6</sup>. Anatomic disorders include cleft palate, anomalies of face and skull, neoplasms, neoplasms, diverticulae, tracheo-esophageal fistula<sup>8</sup> and scleroderma<sup>9</sup>.

Physiologic disorders are incompetent cardiac sphincter, gastric outlet obstruction, gastro-esophageal reflux disease<sup>10</sup> and vomiting. Neurologic disorders include Downs syndrome, Werdnig-Hoffman disease, myasthenia gravis, birth asphyxia, cerebral palsy and preterm birth. Mechanical disruption of normal defense barriers refers to patients with instrumentation such as naso-gastric tube, endo-tracheal intubation or tracheostomy. Accidental aspiration includes drowning as well as the ingestion of materials like kerosene, peanuts and betel nuts<sup>1,11,12</sup>.

Complications of aspiration pneumonia include atelectasis, lung abscess, empyema, pneumothorax secondary to mechanical ventilation, septicemia, shock, prolonged hospitalization and in its extreme form, death<sup>2,16</sup>. Hence, aspiration pneumonia is an important disease entity in terms of the morbidity and mortality associated with it.

There is little data available in medical literature regarding the prevalence of aspiration pneumonia. It has been reported that 15% of adult patients with community-acquired pneumonia admitted to the Intensive Care Units have aspiration pneumonia<sup>13,15</sup>. Literature on pediatric patients is even more scant and mostly based on penoperative patients.

This study aims to characterize the cases of aspiration pneumonia in children admitted to AKUH on the basis of the predisposing factors, the type of aspiration syndromes and commonly aspirated materials with their clinical outcomes.

## **Material and Methods**

This is a hospital based retrospective case series conducted at the Aga Khan University Hospital (AKUH), a tertiary care teaching hospital in Karachi, Pakistan. Cases were defined as all patients admitted at the AKUH in the 0-15 year age group over a five year time period from January, 1993 to December, 1997 with a primary or secondary diagnosis of aspiration pneumonia. Data was retrieved from medical records of the cases using a standardized questionnaire.

Data analysis was done using Epi info version 6 software. Chi square test was used to analyze discrete variables while ANOVA and t-test were used to analyze continuous variables.

## **Results**

The total study population consisted of 107 children, of which 71 were males and 36 females. The mean age of the study population was 23.1±27.9 months. Twenty seven percent of the patients with aspiration pneumonia required of the three types of aspiration syndromes. Chemical pneumonitis was seen to be the most common form of aspiration syndrome (52.1%). The three most common factors predisposing to pulmonary aspiration were accidental ingestion, altered consciousness and neurologic disorders (Figure 1).

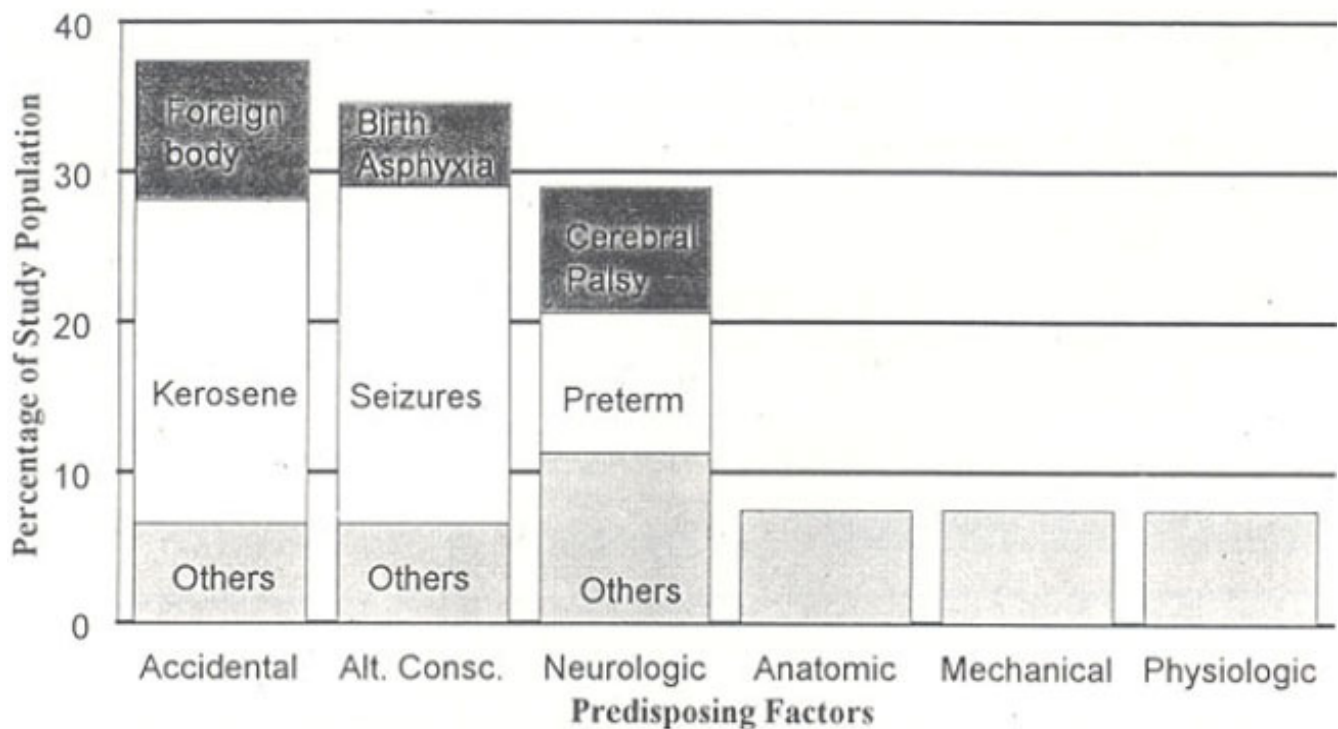


Figure 1. Predisposing factors for pulmonary aspiration.

Common substances ingested accidentally (37.4%) included kerosene oil (21.5%) and foreign body (9.3%). Of the 34.6% of patients with altered consciousness, 22.4% had a history of seizures and 5.6% suffered from birth asphyxia. Neurologic disorders were present in 29% of the study population, of whom 10% were delivered preterm and 9% had cerebral palsy. Anatomic disorders, mechanical disruption and physiologic disorders each occurred in 7.5% of the study population.

**Table 2. Length of hospital stay, need for mechanical ventilation and mortality of the three types of aspiration syndromes.**

Type of Aspiration Syndrome	Length of hospital stay		Need for ventilation		Mortality	
	Days±sd	p-value	n%	p-value	n%	p-value*
Chemical Pneumonitis	6±5		12(21.1)		7(1.3)	
Oropharyngeal flora	7±6	0.09	12(57)	0.002	7(33.3)	0.09
Inert fluid/particulate matter	4±4		5(17.2)		5(17.2)	

sd = standard deviation.

\*For the statistical significance of the differences in clinical outcome among the three types of aspiration syndromes using ANOVA.

Table 2 compares the three categories of aspiration syndromes with reference to their clinical outcomes, i.e., length of hospital stay, need for mechanical ventilation and mortality. Amongst these outcome variables, a statistically significant difference was found only in the need for mechanical ventilation.

**Table 3. Characterization of the three types of aspiration syndromes with respect to their need for mechanical ventilation.**

Type of Aspiration syndrome	OR (95% CI)	P-value
Chemical pneumonitis	1.28(0.36-4.77)	0.674
Oropharyngeal flora	6.4 (1.5-29.2)	0.003
Inert fluids/Particulate matter	Reference	

OR = Odds ratio

CI = Confidence interval.

Table 3 further compares the odds for need for mechanical ventilation in the three types of aspiration syndromes. Children who aspirated oropharyngeal flora were at higher odds (OR 6.4, 95% CI:

**Table 4. Length of hospital stay, need for mechanical ventilation and mortality of the three most commonly aspirated materials.**

Type of material aspirated	Length of hospital stay		Need for ventilation		Mortality	
	(days±sd)	p-value	n (%)	p-value	n (%)	p-value
Milk	8±6.1	*	12 (35.3)		7 (20.6)	
Oral secretions	7.2±6.1	0.01	12 (57.1)	0.0001	7 (33.3)	0.01
Kerosene oil	3.7±2.1		0 (0)		0 (0)	

sd=standard deviation.

\*For the statistical significance of the differences in clinical outcome among the three most commonly aspirated materials using ANOVA.

1.5-29.2, p = 0.003) of being mechanically ventilated than those aspirating inert fluids and particulate matter whereas no significant difference was found between the latter and children having chemical pneumonitis (OR = 1.28,95% CI: 0.36-4.77, p = 0.674).

As shown in Figure 2.

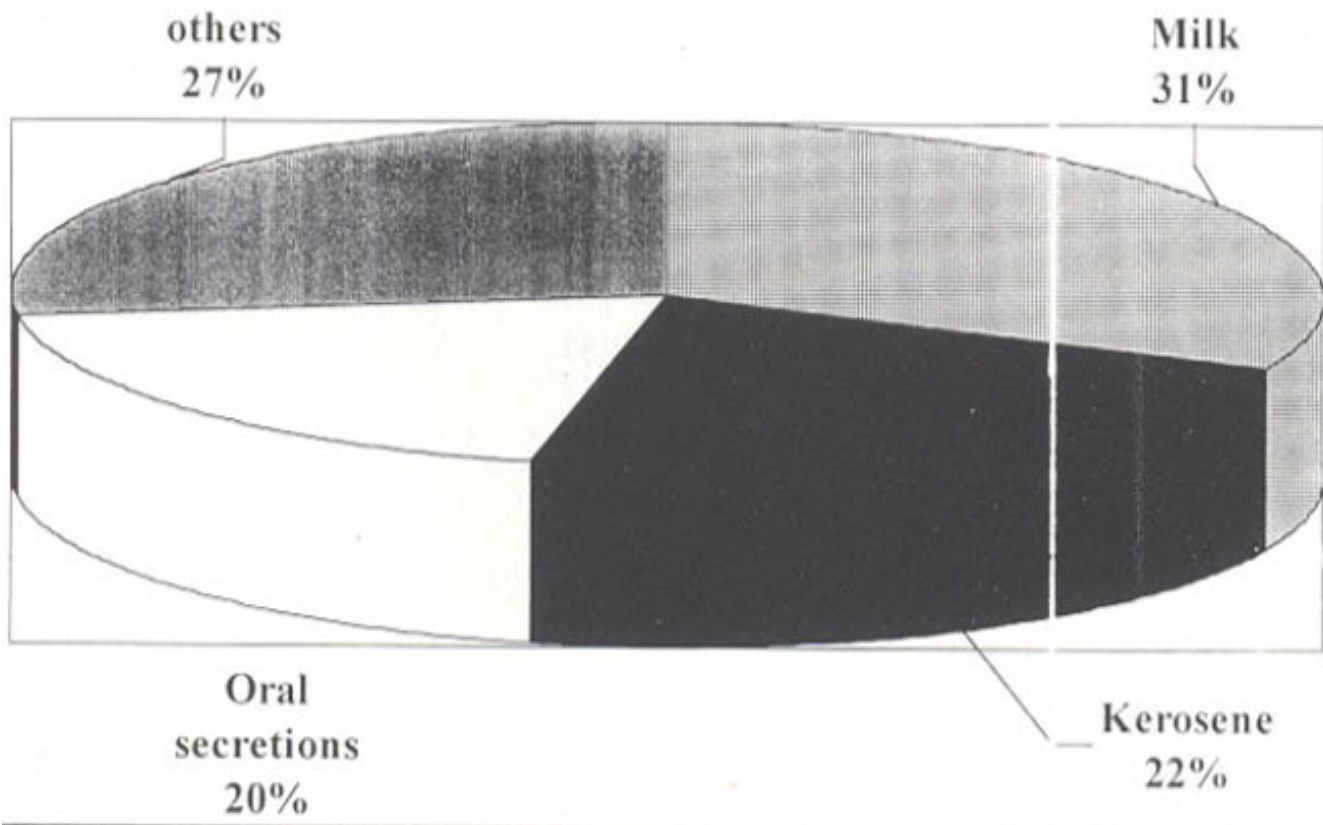


Figure 2. Frequency of individual types of aspirated materials.

the most commonly aspirated materials were milk (31.8%), oral secretions (19.6%) and kerosene oil (21.5%). Other aspirated materials (27.1%) included betel nut, which was also the most commonly aspirated foreign body, and vomitus (7.5% each).

Table 4 describes the clinical outcome of the three most commonly aspirated materials. Children aspirating milk and oral secretions required a longer hospital stay than those aspirating kerosene oil ( $p = 0.01$ ). Aspiration of kerosene oil was associated with less mortality and need for ventilation than that observed with aspiration of milk or oral secretions ( $p = 0.01$  and  $0.0001$  respectively).

## Discussion

The study characterizes the epidemiology, etiology and clinical outcome of aspiration pneumonia in the pediatric age group. Minimal data is available in international medical literature regarding these aspects of pediatric aspiration pneumonia. There is no data on Pakistani children. This study showed a mortality rate of 17.8% for patients with aspiration pneumonia. Previous studies have quoted different mortality rates, which range from 7.5%<sup>17</sup> to 62%<sup>18</sup> depending on the setting.

**Table 1. Frequency distribution and mean age of the three types of aspiration syndromes (n=107).**

Type of aspiration syndrome	n	%	Mean age (months) +sd
Chemical pneumonitis	57	52.8	15.5±18
Oropharyngeal flora	21	19.8	39.3±40.6
Inert fluids/Particulate matter	29	27.4	26.4±27.7

sd=standard deviation.

As shown in Table 1, chemical pneumonitis was the predominant aspiration syndrome (52.3%). However, Bartlett et al<sup>7</sup> report aspiration of oropharyngeal flora to be the most common type of aspiration syndrome.

Those patients who aspirated oropharyngeal flora were more likely to be ventilated than those who aspirated inert fluids or particulate matter ( $p = 0.003$ ). This observation may be accounted for by the occurrence of more severe pulmonary sequelae in patients aspirating oropharyngeal secretions such as pulmonary necrosis, lung abscess and empyema<sup>16</sup>.

MuL et al reported that 95% of foreign bodies aspirated were organic in nature<sup>19</sup>. This is consistent with our results, which showed all the aspirated foreign bodies to be organic in nature. Betel nuts were the most commonly aspirated foreign body in this study as opposed to peanuts reported by Mendez et al<sup>20</sup>. Cultural differences may account for this interesting observation.

Aspirates most commonly seen in this study were milk, kerosene oil and oral secretions. Kerosene oil is an important Med., household item in third world where it is used for lighting, cooking and heating<sup>21</sup>. Aspiration of kerosene is usually accidental and requires access of children to this material. It was observed that of the 23 patients who aspirated kerosene oil, none required ventilation nor did any of them die. This relatively benign clinical course of patients aspirating kerosene oil is consistent with previously reported literature. Dudin et al reported that following aspiration of kerosene oil in 78 patients, 2 required ventilation and later died<sup>13</sup>, while Gupta et al reported mortality rate of 4.5% in their series<sup>22</sup>. We observed comparatively more need for ventilation and mortality in patients aspirating milk or oral secretions than in those aspirating kerosene.

This is one of the few studies to characterize pediatric aspiration pneumonia patients according to the categories of aspiration syndromes, alongwith the factors predisposing the pulmonary aspiration. Clinical outcome associated with the different types of aspirated materials has been studied as well. The limitations of this study include the small sample size (n=107). Since this a hospital based study, its results cannot be generalized to the community at large. Moreover, the retrospective study design used has its own drawbacks regarding inadequate maintenance of records and lack of standardized diagnostic criteria.

This study has shown that patients aspirating milk and oral secretions have a relatively worse hospital course compared to kerosene. Therefore, a recommendation can be made for aggressive treatment and prompt antimicrobial therapy for these groups of patients. Other recommendations include discouraging the consumption of betelnuts in children and preventing their access to kerosene oil.

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