Brief Reports

Predictors of Outcome in Children with Hydrocarbon Poisoning Receiving Intensive Care

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The retrospective study included 48 children between 8.5 months - 10 years, admitted to the PICU of an urban, tertiary care, teaching hospital in northern India from January 1995 to December 2001. Eighteen (38%) patients were hypoxemic on arrival, of which 8 (45%) required mechanical ventilation. Compared to the non-hypoxemic children, the hypoxemic patients were more likely to have received gastric lavage before arrival to our center (Odds Ratio 23.2, 95% CI 2.4 - 560.7) and had higher frequency of severe respiratory distress and leucocytosis (Odds Ratio 8.0, 95% CI 1.79 -38.6). On multiple regression analysis, we could not identify any particular variable that could predict hypoxemia. Secondary pneumonia developed in 16 (33.3%), with the duration of PICU stay being longer in these patients as against those who did not (144 hours vs 72 hours, p <0.05). Two (4.2%) children died and one suffered hypoxic sequelae. Prior lavage, hypoxemia at admission, need for ventilation, secondary sepsis and ventilator related complications were associated with poor outcome.

Key words: *Hydrocarbon, Hypoxemia, Intensive care, Lavage.*

THE morbidity and mortality associated with hydrocarbon ingestion in children are primarily related to the pulmonary aspiration and its subsequent complications(1). There have been few studies from the developing countries focusing on the predictors of outcome(2) but none on the impact of intensive care in these patients. In this retrospective review we aim to highlight the predictors of outcome in children with hydrocarbon poisoning receiving intensive care. This can serve as a tool in early identification of the severity of illness and allow prioritization of intensive care especially in developing countries with limited resources.

Subjects and Methods

Forty-eight consecutive children with hydrocarbon poisoning admitted to the PICU of a multi-specialty tertiary care, urban teaching hospital with 1200 beds between January 1995 to December 2001 (7 years) were studied retrospectively. Patients were identified from the PICU admission register and data was retrieved from their case-records with respect to age, seasonal distribution, clinical features and occurrence of hypoxemia at presentation ($PaO_2 < 60$ mmHg at room air), treatment, need for mechanical ventilation, complications and outcome. Outcome was defined as length of PICU stay, survival, death or survival with sequelae.

All patients presenting with hydrocarbon poisoning to our Emergency were admitted and treated with a standard protocol consisting of skin decontamination, maintenance of oxygenation, fluid and electrolyte balance and ventilation, if required. Monitoring was carried out as per standard guidelines. Hypoxemia was defined as PaO_2 <60 mmHg in room air, on arrival. Before December 1997, all symptomatic patients were given antibiotics. After 1997, only patients with secondary pneumonia received parenteral antibiotics (cloxacillin and gentamicin) in usual doses.

Descriptive statistics, frequencies and mean ± SD were used for data presentation. Measures of central value were compared by Student's 't' test for parametric data and by Mann-Whitney U test for nonparametric data. Categorical data were compared using the Chi-square test. Hypoxemic and non-hypoxemic children were also compared using a univariate and multiple logistic regression analysis to determine the significant predictors of hypoxemia. SPSS version 10.0 and Epi-Info 2000 were the statistical packages used in data analysis.

Results

During the study period, 143 patients with poisoning were admitted to our PICU; 48 (34%) of these had ingested hydrocarbons. Of the hydrocarbon ingested, kerosene was the commonest 41 (85%), followed by petrol 3 (6%), turpentine oil 2 (4%) and diesel and sewing machine lubricant in one patient each. The demographic and clinical characteristics of these patients are as shown in *Table I.* Almost all patients had onset of symptoms within 4 hours; only 2 had symptoms after 48 hours.

TABLE I– *Clinical features of 48 children with hydrocarbon poisoning admitted to PICU*

Demographic features	
Age (years), median [Range]	2 [0.7 - 10]
< 5 years, n (%),	45 (94)
Sex, M: F	3.4: 1
Presenting features, n (%)	
Respiratory distress	48 (100)
Altered sensorium	22 (46)
Seizures	2 (4)
Vomiting	6 (13)
Fever	4 (8)
Onset of symptoms (hours) median [1 Q Range]	0.21 [0.16-1.6]
Chest radiograph abnormality n (%)	
Bilateral lower lobe infiltrates	34 (71)
Right lower lobe infiltrates	6 (12.5)
Left lower lobe infiltrates	3 (6.3)
Pleural Effusion	2 (4.1)
Pneumatocele	2 (2)
Pneumothorax	1 (2)
Leucocytosis, n (%)	18 (38)
Intensive care needs and outcome, n (%)	
Hypoxemia	18 (38)
Hypercarbia	2 (4.1)
Metabolic acidosis	2 (4.1)
Mechanical ventilation	8 (16.6)
Secondary pneumonia	16 (33.3)
Died	2 (4.2)
Hypoxic sequelae	1 (2.1)

Of the 18 patients who were hypoxemic on arrival; 10 (55%) improved on supplemental oxygen (6 L/min) and 8 (45%) needed mechanical ventilation. Results of univariate analysis on comparison of hypoxemic vs. non-hypoxemic children are provided in *Table II.* On multiple regression analysis, we could not identify any particular variable that could predict hypoxemia.

Six of the ventilated children developed complications: pneumothorax (n = 3), ARDS

TABLE II–*Comparison of Hypoxemic vs Non- hypoxemic Children with Hydrocarbon Poisoning.*

	Hypoxemic (n = 18)	Nonhypoxemic (n = 30)	Odds ratio	95%CI for OR
Age (years) Mean ± SD	2.32 ± 2.12	2.02 ± 1.50**		
Sex, M: F	2.6: 1	4.2: 1		
Lavage given, n(%)	8(44.4)	1 (3.3) *	23.2	2.43- 560.7
Signs of Respiratory distress, n (%)				
Tachypnea	18(100)	30(100)	Undefined	
Retractions	18(100)	14 (46.6) *	Undefined	
Nasal flare	14(77.8)	3 (10) *	31.5	5.05- 244.1
Head bob	8(44.4)	1 (3.3) *	23.2	2.35- 560.7
Leucocytosis, n (%)	12(66.7)	6 (20) *	8.0	1.79- 38.6
Secondary Pneumonia, n (%)	12(66.7)	4(13.3)*	13.0	2.58-73.65

* P < 0.05 by Chi Square test; ** Students 't' test.

with pneumothorax (n = 2) and ventilator associated pneumonia (n = 1). In 6 of 8 patients who were ventilated and survived, the median duration of PICU stay was 360 hours (range 192-2040 hours), in contrast to the non-ventilated group (40/48), where it was 72 hrs (range 24-216 hours) (p <0.05 by Mann-Whitney U test).

Nine patients had received gastric lavage prior to reaching our center. These children were compared with thirty-nine others who had not received lavage (*Table III*). Patients in the lavage group presented significantly more often with severe respiratory distress (tachypnea, chest wall retractions and use of accessory muscles of respiration), were hypoxemic on arrival and needed mechanical ventilation. No difference was found in the incidence of neurological symptoms, secondary pneumonia and hospital stay between the two groups, but both the deaths in the study population occurred in patients in the lavage group.

TABLE III–*Comparison of Children who Received Gastric Lavage vs no Lavage Before Admission.*

	Lavage group (n = 9)	No lavage (n = 39)
Age (years)		
Mean ± SD	1.61 ± 0.60	2.12 ± 1.8
Sex (M : F)	1 .25: 1	5.1: 1
Signs of respiratory distress, n(%)		
Tachypnea	9(100)	39(100)
Nasal Flare	5(55.5)	12(30.7)
Retractions	8(88.9)	24(61.5)
Head bob	2(22.2)	7(17.9)
Hypoxemia, n(%)	8(88.9)	11*(28.2)
Leucocytosis, n(%)	5(55.5)	13*(33.3)
Need for mechanical ventilation, n(%)	5(55.5)	3*(7.6)

* P < 0.05 by Chi Square test.

Sixteen patients developed secondary pneumonia and received intravenous antibiotics. Twelve patients had received prophylactic antibiotics. The remaining twenty patients had no evidence of secondary pneumonia and hence did not receive any antibiotics.

Out of 48 patients, 46 survived, 2 died and one had hypoxic sequelae. Hypoxemia on arrival, prior lavage, higher need for ventilation and higher frequency of secondary pneumonia and ventilator-associated complications were associated with poor outcome.

Discussion

In our series, hydrocarbon ingestion constituted 35% of all poisonings admitted to PICU, kerosene being the commonest. Marked seasonal predilection for summer months could be attributed to kerosene being mistaken for water(3-6). Most patients were symptomatic by 4 hours, which is similar to the previous observations(1,7). Delayed presentation at 48 hours in 2 patients could be explained by superimposed bacterial infection. All symptomatic patients had chest radiographic abnormalities, the commonest being bilateral lower lobe infiltrates(2,4,6,8).

Hypoxemia at admission was evident in nearly one third of our patients and was associated with poor outcome. These patients had signs of severe respiratory disease, higher frequency of lavage and leucocytosis and increased need for mechanical ventilation. Mechanical ventilation as a modality of therapy to overcome hypoxemia and respiratory failure in hydrocarbon ingestion has been well described(3,4,9). Nearly one sixth of our patients needed mechanical ventilation and three fourths of these went on to develop ventilator related complications over and above the primary disease. This tended to prolong the length of hospital stay as compared to the non-ventilated group. Need for mechanical ventilation by itself becomes a poor prognostic factor as it is associated with higher incidence of ventilator related complications and longer ICU stay. Development of secondary pneumonia similarly contributed to the increase in length of hospital stay, as compared to those who did not. We, however, did not find any significant difference in the median duration of hospital stay between the group that received prophylactic antibiotics and the one that did not. Our findings do not support the use of prophylactic antibiotics in patients with hydrocarbon ingestion.

In our series, the severity of aspiration pneumonia was higher in the lavage group, substantiating the earlier hypothesis that induced vomiting and lavage; by re-exposing the patient's glottic opening may increase the severity of pulmonary symptoms(1,10-12). Similarly, the higher morbidity and mortality in this group, reaffirms the fact that lavage should be avoided in hydrocarbon ingestion and if indicated should be performed only after proper airway protection. In a developing country like ours, with limited resources it may not be possible to shift all patients with hydrocarbon ingestion to an intensive care set up. Our findings may help in recognizing children with hydrocarbon poisoning who are at high risk for development of hypoxemia and therefore should get priority over others for intensive care management so as to improve the outcome.

Conclusions

Hydrocarbon poisoning continues to be an important cause of poisoning related morbidity and mortality in developing countries. Most poisonings were accidental and occurred in the under five-age group. Hypoxemia on arrival, prior lavage, higher need for ventilation and higher frequency

Key Message

- In hydrocarbon poisoning prior lavage, hypoxemia at admission, need for ventilation, secondary pneumonia and ventilator related complications were associated with poor outcome.

of secondary pneumonia and ventilator-associated complications were associated with poor outcome. In a developing country with scarce resources, patients at high risk for development of hypoxemia should hence be selected for intensive care, as the mortality and morbidity in these patients tends to be higher. This group should include patients with history of lavage, signs of severe respiratory disease and leucocytosis at admission. This approach can help in using the limited intensive care resources effectively.

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