Original Article:

Predictors of development of chemical pneumonitis among children admitted in pediatric emergency ward of Burdwan medical College with ingestion of liquid hydrocarbon

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Abstract:

Background & Objectives: Informations regarding predictors for development of chemical pneumonitis among children who ingested hydrocarbon are scarce in Indian context. Hence this study was undertaken to find out the factors responsible for development of chemical pneumonitis among children admitted with ingestion of liquid hydrocarbon in pediatric emergency ward of Burdwan Medical College, Bengal.

Mehodology: A hospital-based study was conducted among 173 children selected by complete enumeration method with a mean age of 4.81±2.48 years. Chi-square test and binary logistic regression method was used to find significance of association between different variables and chemical pneumonitis.

Result: 38.15 of the study population developed chemical pneumonitis. Majority of them were from to rural area (68.2%),ingested more than 30 ml of hydrocarbon (80.3%), hospitalized more than 2 hours after ingestion (69.7%), not treated with hydrocortisone (75.8% & 71.2%, respectively) and developed fever within 1st 2days after ingestion(84.8%).Our model predicted 96% of dependent variable correctly.

Conclusion: Proper treatment protocol should be developed for treatment of hydrocarbon ingestion. Appropriate preventive measures should be taken to prevent ingestion of hydrocarbon.

Keywords:Kerosine poisoning, chemical pneumonitis

Introduction:

Liquid Hydrocarbon ingestion is the most common mode of poisoning in children of low & middle-income countries like India.1 One study in Africa estimated that cost of hospitalization due to ingestion of hydrocarbon is approximately 1.4 million US $ per year.2 Ingestion of liquid hydrocarbon may lead to development of a distinct type of chemical pneumonitis, also known as Fire-eater's pneumonia.3,4 Almost half of the children may develop this complication following ingestion of hydrocarbon.5 Different studies had identified use of corticosteroid(either intravenous or inhalational or both) & nebulisation with salbutamol/ levosalbutamol as important treatment which protect from development of chemical pneumonitis following ingestion of hydrocarbon.6 But these type of studies are scarce in Indian scenario. Hence this study was undertaken to find out the efficacy of different modes of treatment in preventing development of chemical pneumonitis in patients who ingested liquid hydrocarbon.

Methodology: This hospital-based study was conducted in the pediatric emergency ward of Burdwan Medical College, Burdwan from May 2016 to October 2016. All children who were admitted for liquid hydrocarbon ingestion were

included, following complete enumeration method. Total 179 children were admitted for hydrocarbon ingestion, but six were excluded from the study (3 for not giving consent, 2 were discharged on risk bond and 1 patient had congenital heart disease from which he died). Hence, a total of 173 children were studied. Data were collected by reviewing hospital record as well as clinical examination of admitted patients. Single stethoscope is used throughout the study for quality control. X-ray plates of each patient who developed chemical pneumonitis was reviewed twice by two different radiologists.

Operational Definition: Chemical pneumonitis cases were defined as who developed tachypnea, fever or have distinct radiological abnormality in form of unilateral or bilateral consolidation and/or pneumatocele formation.7

Statistical Analysis: Collected data were put in Microsoft excel worksheet. Mean values are used for continuous data, whereas categorical data are expressed in proportion. Chi-square ($\chi2$) test was used to assess significance of association between two attributes in contingency tables. Degree and direction of relationship between two variables was computed by Pearson's product moment correlation co-efficient (r). Scores were assigned for categorical variables (Rural-0, urban-1; hydrocortisone not used-0, used-1; Nebulisation not used-0, used-1; amount of ingestion: <10ml-1, 10ml-30 ml-2,>30ml-3; time between ingestion & hospitalization: <1 hour-1, 1-2 hour-2, >2 hour-3; presence of fever in 1st 2days: absent-0, present-1)) A logistic regression model (forward conditional method) was also generated using development of chemical pneumonitis [not developed (0) / developed (1)], as the outcome / dependent variable. Amount of ingestion, time between ingestion & hospitalisation, presence of fever in 1st 2 days after ingestion & use of nebulisation were entered in step 1, 2, 3 & 4, respectively. P< 0.05 was considered statistically significant. All the statistical analysis was done in SPSS software, version 19.0 (Statistical Package for the Social Sciences Inc, Chicago, IL, USA).

Result: Mean age of the study population (n=173) was 4.81±2.48 yrs. Females are 52.6%, rest are male (43.4%). 58.9% of them are from rural population & maximum (54.9%) of them belong to middle class according to modified BG Prasad Scale8.Kerosene was the most frequently (89.0%) ingested substance, followed by terpene and others(diesel, petrol, glycerol etc).38.1% of study population developed chemical pneumonitis subsequently. Most commonly affected lobes are both lower lobes (38.1%), followed by left upper lobe (22.6%).

Chemical pneumonitis more commonly develops among rural patients (68.2%), who ingested more than 30 ml of hydrocarbon (80.3%), who are hospitalized more than 2 hours after ingestion (69.7%), in whom hydrocortisone & nebulisation were not used (75.8% & 71.2%, respectively) and who developed fever within 1st 2days after ingestion(84.8%).On the other hand it is less commonly developed among urban patients(53.7%), who ingested less than 10 ml of hydrocarbon(81.3%), who are hospitalized within 1 hour after ingestion(79.4%), in whom hydrocortisone & nebulisation were used (88.8% & 84.1%, respectively) and who did not develop fever within 1st 2days after ingestion (81.3%). All these associations are found to be statistically significant. (Table 1) On the other hand, there is no statistically significant association between development of chemical pneumonitis with age, sex, socio-economic status, type of ingested hydrocarbon & use of antibiotic.

There is statistically significant positive correlation of chemical pneumonitis with amount of hydrocarbon ingestion (0.780), time between ingestion and hospitalization (0.686) and presence of fever (0.646). Whereas, correlation of chemical pneumonitis with use of nebulization and hydrocortisone (-0.557 & -0.654) respectively is statistically significant but negative, i.e. they are protective. Though urban residence seems to be protective in development of chemical pneumonitis, correlation is insignificant statistically (Table 2). Chemical pneumonitis is

31.8 times more likely to develop in children who ingested higher amount of hydrocarbon. It also more likely develops among children who were hospitalized in late (Adjusted odds ratio: 9.4) & who developed fever in 1st two days after ingestion (Adjusted odds ratio: 15.5). On the other hand, nebulisation with salbutamol/levosalbutamol found to be protective , having an adjusted odds ratio of 0.07. Use of hydrocortisone, though significantly correlated with development of chemical pneumonitis among the patients, become insignifacnt in the binary logistic regression model. (Table 3) Amount of ingestion, time between ingestion & hospitalization, use of nebulisation & presence of fever in 1st 2days- these four variable can explain 66.7% to 90.7% variance of development of chemical pneumonitis among the study subjects. Overall, our model can correctly predict 96% of the outcome variable.

Discussion:

Lifshitz M5et al found that 43% of children who ingested kerosesne developed chemical pneumonitis, which is slightly larger than our finding (38.1%). Karim RM9et al found that 52% victims of accidental ingestion of kerosene develops chemical pneumonitis later on. Similar to the finding of Basu M10et al, we also found that kerosene is the most common culprit (in 89% cases). Konca C11et al found inhalational or intravenous hydrocortisone is protective and prevents chemical pneumonitis. Similarly we also found that used of hydrocortisone protects the patients from development of chemical pneumonitis. Balme KH12et al in a randomized control trial showed that antibiotic has no role in treatment of chemical pneumonitis. We also noted similar finding. But use of antibiotic may be justified, because chemical pneumonitis also has similar signs and symptoms of bacterial pneumonia, and in the early days they are very difficult to differentiate. Moreover, Singh H13et al also found that antibiotic like Carbencillin may decrease morbidity. Ahmed B14et al found that lower socio economic status as a risk factor, but we do not find any significant relationship with it.

Conclusion:

The main limitation of this study is small sample size. But it may help to develop appropriate treatment protocol for liquid hydrocarbon ingestion.

Preventive measures should be taken in form of child-resistant packaging15, legal measures16 and proper education17,18 of the parents for prevention of ingestion of liquid hydrocarbon, so that this grave problem is eliminated at the root.

Contribution of Authors:

KI: collection of data, writing manuscript, statistical analysis, AKD: Concept of Study, Revising manuscript, gurrantor, AR: Revising manuscript, RD: Revising manuscript, SS: Collection of data

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Table 1: Distribution of study population according to development of chemical pneumonitis & different variables.   (n=173)

Variables	Chemical Pneumonitis Developed No (%)	Chemical Pneumonitis Not Developed No (%)	P value
Place of residence			
Rural	45 (68.2)	57 (53.3)	P<0.05
Urban	21 (31.8)	50 (46.7)	
Amount of Ingestion			
<10 ml	6(9.1)	87(81.3)	
11-30 ml	7 (10.6)	13(12.2)	P<0.001
>30 ml	53 (80.3)	7(6.50)	
Time between ingestion and hospitalization			
Within 1 hour	9 (13.6)	85 (79.4)	
1-2 hour	11 (16.7)	13 (12.2)	P<0.001
>2 hour	46 (69.7)	9 (8.4)	
Use of Hydrocortisone			
Not used	50(75.8)	12(11.2)	P<0.001
Used	16(24.2)	95(88.8)	
Use of nebulisation			
Not used	47(71.2)	17(15.9)	P<0.001
Used	19(28.8)	90(84.1)	
Presence of fever in 1st 2 days			
Absent	10(15.2)	87(81.3)	P<0.001
Present	56(84.8)	20(18.7)	

Table 2: 6 variable correlation matrix showing the relationship between dependent & independent variables.   (n=173)

Variables	Resi.	Amount	Time	Use of Hydro--cortisone	Use of Nebulisation	Presence of Fever	Dev. of Chem. Pneumonitis
Residence	1.000	-0.044	-0.130	0.109	0.104	-0.083	-0.147
Amount		1.000	0.513*	-0.561*	-0.393*	0.478*	0.770*
Time			1.000	-0.468*	-0.458*	0.497*	0.686*
Use of Hydroccortisone				1.000	0.476*	-0.484*	-0.654*
Use of Nebulisation					1.000	-0.436*	-0.557*
Presence of Fever						1.000	0.646*
Dev. of Chem. Pneumonitis							1.000

*Correlation coeficient is significant at 0.01 level

Table 3: Binary logistic regression model for development of chemical pneumonitis following hydrocarbon ingestion (n=173)

Variable Interval	B	S.E.	Significane	Exp (B)	95% Confidence
Step 1					
Amount of ingestion	2.356	0.293	<0.001	10.551	5.938-18.748
Step 2					
Amount of ingestion	2.652	0.476	<0.001	14.179	5.579-36.033
Time between Hospitalization & ingestion	2.259	0.474	<0.001	9.572	3.782-24.229
Step 3					
Amount of Ingestion	3.087	0.683	<0.001	21.917	5.749-83.554
Time between Hospitalisation & ingestion	2.262	0.585	<0.001	9.601	3.051-30.218
Prsence of fever	3.014	0.788	<0.001	20.362	4.345-95.417
Step 4					
Amount of Ingestion	3.460	0.811	<0.001	31.822	6.489-156.050
Time between Hospitalisation & ingestion	2.238	0.648	0.001	9.371	2.629-33.400
Use of Nebulisation	-2.652	0.959	0.006	0.071	0.011-0.462
Presence of fever	2.739	0.859	0.001	15.476	2.873-83.357