

Criteria for Hospitalizing Children Who Have Ingested Products Containing Hydrocarbons

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• The clinical records of 950 children who ingested products containing hydrocarbons were reviewed. Eight hundred children were asymptomatic at the time of the initial evaluation and remained so during a six- to eight-hour period of observation. All had normal chest films, and all were treated as outpatients. One hundred fifty other children were admitted to the hospital; 79 were symptomatic at the time of initial medical evaluation and had abnormal chest roentgenograms. Seventy-one other children were asymptomatic but had roentgenographic evidence of pulmonary involvement (36) or had had pulmonary symptoms before arriving at the medical facility (35). Complications (seven) occurred only in symptomatic children who had roentgenographic evidence of pneumonia. These data suggest that the majority of children who are brought for medical evaluation after ingesting hydrocarbon-containing substances do not experience pulmonary complications and therefore do not require hospitalization. Only children who are symptomatic at the time of initial medical evaluation or who became symptomatic during a six- to eight-hour observation period require hospitalization.

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PRODUCTS containing hydrocarbons account for approximately 5% of all accidental poisonings in children younger than five years.¹ The ubiquity of these agents in the household and the unfortunate fact that many of these products, particularly furniture polishes, are pleasantly scented and colored make them attractive to young children. Furthermore, these substances are often placed by careless adults in containers such as soft drink bottles that may in themselves be enticing to the curious toddler.

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Recently, Eade and associates² reviewed the pathophysiology of hydrocarbon pneumonitis in children and discussed the various treatments that have been advocated for these patients. However, like previous authors, they provided few guidelines for the initial treatment of patients who have ingested a product containing hydrocarbons.

We conducted a retrospective study to determine which patients who have ingested hydrocarbon-containing products could be treated safely on an outpatient basis.

SUBJECTS

The clinical records of 950 children with suspected ingestion of hydrocarbon-containing products who were brought to the

outpatient clinic of Children's Medical Center or the emergency room of Parkland Memorial Hospital, Dallas, from 1969 through 1979 were reviewed.

Criteria for diagnosis of pneumonitis were history of recent (less than four hours) ingestion of a product containing petroleum distillates, with onset of symptoms within six hours after the ingestion and abnormalities on physical examination or abnormalities on the chest roentgenogram.

METHODS

Data were analyzed using Bartlett's test for equal variance.³ When significant differences between values were found, the two groups were compared using the Newman-Keuls *U* test.³ Differences in values were considered significant when $P \leq .05$.

RESULTS Clinical

Eight hundred children who were not hospitalized were asymptomatic after ingestion, at the time of the initial evaluation, and during a six- to eight-hour period of observation. All had normal chest films initially and again after a six- to eight-hour period of observation. A diagnosis of hydrocarbon pneumonitis was made in 150 children, and all were admitted to the hospital.

There were no substantial differences in the age and sex of the patients, or type of substances ingested between hospitalized and non-

hospitalized patients (Table 1). Eighty-four percent of patients were younger than 3 years, and two thirds were male. Only 24% of patients were younger than 1 year or older than 3 years. Furniture polishes, gasoline, and lighter fluid accounted for 69% of the substances ingested. In most instances it was impossible to quantitate the amount of petroleum distillate ingested. When known (138 patients), the amount of substance ingested, as estimated by the parents, was less than 30 mL in 67% of patients.

Of the patients who were hospitalized, 79 (53%) were symptomatic at the time of the initial physical examination (Figure). Abnormalities on physical examination were defined as mild (coughing, choking, tachypnea, irritability, or drowsiness) in 50% of patients and moderate (grunting respirations, lethargy, flaccidity) or severe (increased respiratory effort, with grunting respirations and retractions associated with cyanosis, seizures, or coma) in 40% and 10% of patients, respectively. All 71 patients who were asymptomatic at the initial medical evaluation were said to have had symptoms before coming to the clinic or emergency room; 36 were admitted to the hospital because they had roentgenographic evidence of pneumonia. The remaining 35 patients were hospitalized because of history of antecedent pulmonary symptoms. Spontaneous vomiting had occurred in 59 (39%) of 150 hospitalized patients. Vomiting was more frequent in children who ingested furniture polish than in those who ingested gasoline, paint thinner, kerosene, or lighter fluid; however, the differences between the groups were not statistically significant ($P=.43$).

Hospitalized children who ingested furniture polish ($P=.001$) and lighter fluid ($P=.001$) were significantly more likely to be symptomatic and have roentgenographic evidence of pneumonia than children who ingested other hydrocarbon-containing substances (Table 2).

Ninety-six patients (64%) had temperatures of 38 °C or greater at the time of admission to the hospital; 23 remained febrile (temperatures greater than 38 °C) for 24 hours or longer after admission.

There was a significant correlation

	Not Hospitalized	Hospitalized		
		Symptomatic	Asymptomatic	
			Pneumonia	No Pneumonia
No. of patients.	800	79	36	35
Age, yr, of patients				
<1	64(8)	5(6)	3(8)	1(3)
1-2	440(55)	50(63)	26(72)	21(63)
2-3	180(20)	11(14)	5(14)	10(29)
>3	136(17)	13(17)	2(6)	3(5)
Substances ingested				
Furniture polishes	312(39)	30(38)	12(34)	6(17)
Gasoline	128(16)	10(13)	7(19)	11(30)
Lighter fluid	112(14)	18(22)	3(8)	2(6)
Paint thinner	88(11)	8(10)	10(28)	5(14)
Kerosene	72(9)	7(9)	2(5)	3(9)
Cleaning fluids	24(3)	1(2)	1(3)	4(12)
Other	64(8)	5(6)	1(3)	4(12)
Amount ingested, mL				
Unknown	704(88)	56(71)	24(67)	28(80)
<30	72(9)	16(20)	1(3)	4(11)
>30	24(3)	7(9)	11(30)	3(9)
Time, hr, from ingestion to medical attention				
<1	328(41)	20(26)	8(22)	10(28)
1-2	184(23)	28(35)	12(33)	20(58)
≥2	288(36)	31(39)	31(39)	5(14)
Temperature >38 °C	18(2)	60(76)	25(70)	11(32)
Spontaneous vomiting	71(9)	34(43)	14(39)	11(31)
Induced vomiting	...	6(8)	4(11)	5(14)
Gastric lavage	...	10(13)	7(19)	10(29)
No vomiting or lavage	729(91)	29(36)	11(31)	9(26)
Mean duration of hospitalization, days	...	3.7	2.1	2.5

*Expressed as number of patients (percent of total).

between a temperature greater than 38 °C and the presence of roentgenographic abnormalities ($P=.001$). The degree of fever did not, however, correlate with clinical symptoms.

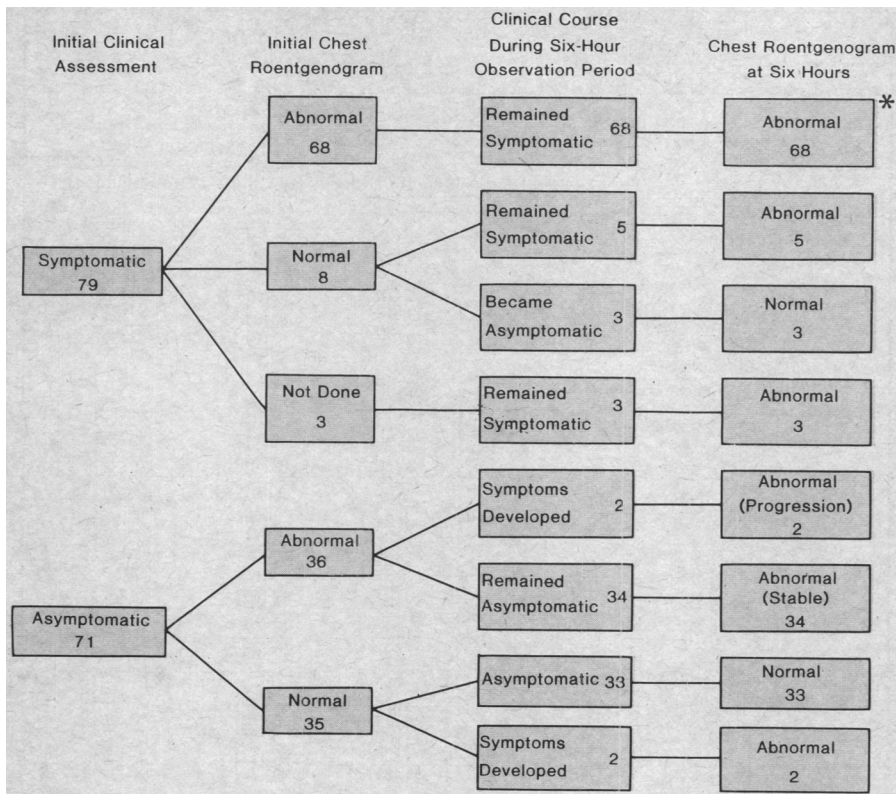
Laboratory Studies

The initial chest films were abnormal in 104 (71%) of 147 children who had a chest roentgenogram at the time of admission to the hospital. Findings ranged from fine perihilar densities that occasionally extended to the midline to basilar infiltrates or atelectasis. Lobar consolidation was rarely (4%) present. Pleural effusions, pneumatoceles, or pneumothoraces were not identified initially or in later examinations. The clinical symptoms and the findings on the initial chest roentgenograms are shown in the Figure. Thirty-six (35%) of the children whose chest roentgenograms were initially abnormal were asymptomatic. Two of this latter group experienced respiratory symptoms during the six- to eight-hour

observation period; both had progression of the abnormalities on their chest roentgenograms. Five of eight symptomatic children whose initial roentgenograms were normal remained symptomatic; both had abnormalities on their follow-up roentgenograms. The three children whose follow-up roentgenograms were normal had become asymptomatic by the time of their second roentgenogram. Only two of the 34 asymptomatic patients whose roentgenograms were initially normal experienced symptoms; both had abnormalities on their repeated chest roentgenograms. Overall, the chest roentgenogram remained normal or showed no progressive change in 135 (92%) of 147 patients.

Hospital Course

One hundred thirty-six (91%) of the patients had no progression of their pulmonary disease and had uncomplicated hospitalizations. Most were discharged within 72 hours after



Clinical course and roentgenographic findings in 150 hospitalized children who ingested petroleum distillates (asterisk indicates complications occurred in seven patients).

Table 2.—Relationship Between Clinical and Roentgenographic Findings and Type of Petroleum Distillate Ingested

Substance	No. (%) of Patients		
	Symptomatic, Pneumonia	Asymptomatic, Pneumonia	Asymptomatic, No Pneumonia
Furniture polish	30 (63)	12 (25)	6 (12)
Gasoline	10 (36)	7 (25)	11 (39)
Lighter fluid	18 (78)	3 (13)	2 (9)
Paint thinner	8 (35)	10 (43)	5 (22)
Kerosene	7 (59)	2 (17)	3 (24)
Cleaning fluid	1 (17)	1 (17)	4 (64)
Other	5 (50)	1 (10)	4 (40)

admission to the hospital. Fourteen patients had progressive respiratory symptoms after admission to the hospital, but in seven, the symptoms did not persist for more than 24 hours and all were discharged on their third hospital day. Seven patients experienced progressive pulmonary disease. Of these, two died of respiratory failure, one experienced a secondary pneumonia caused by *Staphylococcus aureus*, and four (who survived) required ventilatory support.

The mean duration of the hospitalization for all patients was three days (range, one to 21 days). Although patients who did not vomit tended to have a shorter duration of hospital-

ization then did those who vomited or who received gastric lavage, the differences between the groups were not statistically significant ($P=.6$). Additionally, there were no differences in complication rates between the two groups of patients.

COMMENT

The results of this retrospective study indicate that the majority of children who are brought to medical attention after ingestion of hydrocarbon-containing products do not experience pulmonary complications. Only 117 (12%) of the 950 patients who were seen during the ten-year period of this review developed clinical or

roentgenographic evidence of pulmonary involvement. This is substantially smaller than the 25% to 87% incidence of pulmonary involvement in previous reports.^{4,9} The smaller incidence of pneumonitis in this group of patients may be explained by the fact that many of the children may not have actually ingested petroleum distillates or, if so, swallowed only small volumes. Unfortunately, in the majority of patients it was not possible to quantitate the actual amount of substance ingested; however, when known, the amount ingested was generally estimated by the parents to be less than 30 mL. These findings are similar to those reported from the Cooperative Kerosene Poisoning study⁴ in which only 27% of patients were reported to have ingested more than 30 mL, and it was this group who tended to have a larger incidence of serious pulmonary complications.

Routine follow-up examinations were not done on patients who were discharged from the emergency room; therefore, it is possible that complications might have occurred in some of the children. However, a review of the medical records indicated that none of these patients later sought medical care or were hospitalized at either of our facilities. The possibility that they sought medical care at another emergency room in the area cannot be excluded but seems unlikely, since these facilities generally do not provide care for infants and children with medical problems. Additionally, the majority of practicing pediatricians in our community admit their patients to one of our facilities; therefore, it may be concluded that if any child did experience late complications, they were not severe enough to require hospitalization.

During the first five years of this study period, vomiting was induced in 15 patients and gastric lavage was performed in 27 others. Although the criteria for instituting either of these procedures were not stated, the decision to do so did not appear to be dictated by either the clinical condition of the patient or the type or quantity of substances ingested but rather by the bias of the attending physician. It was impossible to demonstrate any adverse effects of vomiting or gastric lavage in these patients;

however, it is clear that neither lessened the incidence of complications or shortened the duration of hospitalization. Children who did not vomit and did not have gastric lavage had a shorter duration of hospitalization than did those who vomited or who underwent gastric lavage (4.1 and 3.4 days, respectively). However, the differences between the groups were not statistically significant ($P=.27$). These findings tend to support previous observations⁴ that induced vomiting and gastric lavage do not have any beneficial effect on the course of patients who have ingested petroleum distillates.

Approximately half of the patients who were admitted to the hospital were asymptomatic at the time of the initial medical evaluation. Ninety-four percent of these patients remained asymptomatic regardless of the findings on their initial chest roentgenogram. Two of the four patients who experienced symptoms did so during the six- to eight-hour observation period; both had evidence of pneumonia on their initial roentgenograms. The other two patients

had normal roentgenograms initially but had roentgenographic evidence of pulmonary disease by six hours. All four of these latter patients were asymptomatic by their second hospital day. There were no complications in any of the 71 patients from this group.

Ninety percent of the children who were symptomatic at the time of the initial medical evaluation had abnormal chest roentgenograms. By six hours, all but three patients who had become asymptomatic had roentgenographic abnormalities. Two patients from this group died, and five others experienced progressive pulmonary disease.

Based on the findings of this review, we would make the following recommendations for the initial management of children who are suspected of ingesting petroleum distillates: Asymptomatic children with a history of ingesting hydrocarbon-containing products who have normal chest roentgenograms initially do not require hospitalization if they do not experience symptoms during a six-hour period of observation. Further-

more, repeated chest roentgenogram examinations are unnecessary if the children remain asymptomatic during the observation period. Asymptomatic children in whom the initial chest roentgenograms are abnormal do not require hospitalization if they remain well during a six-hour observation period. Repeated chest roentgenograms are optional in these patients. Children who are symptomatic and who have abnormal roentgenograms at the time of the initial evaluation should be admitted to the hospital. Prediction of their course is not possible. Symptomatic children whose initial roentgenograms are normal should be observed for six hours. If their symptoms persist or worsen, they should be admitted to the hospital. Emesis should be induced only if the patient has ingested more than 1 mL/kg of the substance or when the hydrocarbon contains a potentially toxic substance (insecticide, heavy metal, or camphor). Emesis should not be induced if CNS depression is present.

References

1. Tabulation of 1972 reports, bulletin. Rockville, Md, National Clearing House for Poison Control Center. May-June, 1973.
2. Eade NR, Taussig LM, Marks MI: Hydrocarbon pneumonitis. *Pediatrics* 1974;54:351-375.
3. Zar G (ed): *Biostatistical Analysis*. Englewood Cliffs, NJ, Prentice-Hall Inc, 1974.
4. Press E: Cooperative Kerosene Poisoning study: Evaluation of gastric lavage and other factors in the treatment of accidental ingestion of petroleum distillate products. *Pediatrics* 1962; 29:648-674.
5. Daeschner CW, Blattner RJ, Collins VP: Hydrocarbon pneumonitis. *Pediatr Clin North Am* 1957;4:243-253.
6. Ng RC, Darwish H, Stewart DA: Emergency treatment of petroleum distillate and turpentine ingestion. *Can Med Assoc J* 1974;3:537-538.
7. Baldachin BJ, Melmed RN: Clinical and therapeutic aspects of kerosene poisoning: A series of zoo cases. *Br Med J* 1964;2:28-30.
8. Brunner S, Rovsing H, Wulf H: Roentgenographic change in the lungs of children with kerosene poisoning. *Am Rev Respir Dis* 1964; 89:250-254.
9. Bonte FJ, Reynolds J: Hydrocarbon pneumonitis. *Radiology* 1958;71:391-397.