Kerosene poisoning in children

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Summary

The epidemiological and clinical aspects of 100 cases of kerosene poisoning have been studied.

The use of gastric lavage is discussed, and it is considered that this measure is probably valuable in treatment.

The importance of preventive measures is stressed.

Introduction

Kerosene is a petroleum distillate used as fuel or as an insecticide or for other purposes, and is kept in many homes. Kerosene poisoning is, therefore, a common cause of admission to children's hospitals in many parts of the world, for example the United States, Canada (Report of Subcommittee on Accidental Poisoning, 1962), Australia (Southby, 1965), Malta (Cachia & Fenech, 1964), and Turkey (Coruh & Inal, 1966). It is estimated that in the United States 28,000 children under the age of 5 years ingest petroleum distillate products annually. Among these children the number of deaths each year ranged from sixty-six to 110 in the period 1951-58 (Report of the American Academy of Paediatrics, 1962).

The main risks are due to the pulmonary and neurological complications. Cough, cyanosis and rapid shallow breathing are associated with a chemical pneumonitis of bronchopneumonic distribution. A secondary bacterial infection may supervene.

The central nervous system disorder manifests itself by drowsiness, irritability, stupor or coma and occasionally convulsions.

Gastro-intestinal disturbances consist of nausea, vomiting, constipation or diarrhoea.

The purpose of this study was to gather epidemiological and clinical information on accidental ingestion of kerosene and to evaluate gastric lavage in its treatment.

Materials and methods

We have studied prospectively 100 children in the Children's Welfare Hospital, Baghdad, in the period from 1 January 1966 to 4 July 1967. This number constitutes the majority of cases of kerosene poisoning brought to the hospital.

The children were seen within minutes of arrival at the hospital. The histories were taken from the parents or the near relatives present in the home at the time of the accident.

Chest radiographs were taken within 24 hr of admission, and on the 3rd, 7th and sometimes the 15th day. Most of the children were admitted to the waiting ward under observation for 1 day or more.

Gastric lavage was done on alternate days using the usual gastric tube (not cuffed).

Children with cyanosis or obvious respiratory distress were nursed on an oxygen tent for periods of $\frac{1}{2}$ hr to several hours, as necessary. Intramuscular procaine penicillin was given prophylactically to 78% of the children.

Results

Epidemiological aspects

Age. The age of the children ranged from 10 months to 5 years. 94% were in the age group 1-3 years. Children at this age are active and very curious (Table 1). This agrees with the results of Olstad & Lord (1952).

Sex. Sixty-eight boys and thirty-three girls. This male preponderance is a feature of most of the accidents in the paediatric age-group.

Race. All the three major racial groups, Arabs, Kurds and Turkman, are represented.

Season. The monthly distribution for the year 1966 is shown in Table 2. A peak in May corresponds to the early heat-wave of summer. This agrees with the experience of Cachia & Fenech in Malta (1964). It is logical to think that the children became thirsty

TABLE 1. Age distribution

under 1 year	1-2 years	2-3 years	3-4 years	4-5 years	5-6 years
2	50	33	12	2	1

TABLE 2. Monthly incidence during 1966

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2	2	4	6	15	2	1	4	—	—	20	4

TABLE 3. Time of accident

Time of accident	No. of cases
Early morning, 06.00–10.00 hours	15
Late morning, 10.00–12.00 hours	37
Afternoon, 12.00–16.00 hours	14
Early evening, 16.00–18.00 hours	11
Late evening, 18.00–20.00 hours	11

and wanted to help themselves to a drink. Another peak was observed in November, the month when kerosene heaters come into active use. No cases were admitted in August and September 1966 because of an outbreak of cholera during which the hospital was temporarily converted into an emergency hospital for diarrhoeal illnesses.

Time of accident. Most accidents occurred around midday, when atmospheric temperature is at or near its maximum (Table 3).

Social aspects

From recording fathers' occupations we found that the majority (85%) were in the lower socio-economic classes. This is similar to the findings of Cachia & Fenech (1964) in Malta.

Ninety-three mothers were full-time housewives: eighty-three were illiterate, nine had at least primary school education. It is evident that poverty is an important factor in kerosene poisoning. Individual children receive less attention among poorer families as these tend to be larger than those of the well-to-do, and these families tend to use kerosene stoves more often than more expensive heaters.

Sixty-two mothers did not know that kerosene was toxic; thirty did. Three mothers thought it was useful as a medicine for the treatment of worms. This may explain why some mothers did not take active steps to keep kerosene out of reach of the children.

Home conditions and the circumstances of accidents. The houses in which the accidents happened were usually single or double room brick houses. Eight occurred in mud huts. The doors of the rooms in which kerosene was kept were open, allowing easier accessibility. Two accidents happened in the garden around the house.

The container of kerosene was the standard gasoline tin in 45% of instances. In the rest it was a barrel with a tap but no lock, small cans, milk or soft-drink bottles, kettles, tea-cups, salad-bowls or drinking glasses.

The kerosene container was placed on the floor in 74% of the cases. In fifteen cases it was at a height between 50–100 cm but this did not prevent the toddler from reaching it with the aid of chairs, tables or drawers.

The presence of an adult in the house did not appear to guarantee against such accidents. In 85% of the cases an adult, usually the mother, was present but apparently occupied with another child or with cleaning, cooking or other housework.

It was difficult to estimate the quantity of kerosene ingested. The parents' estimates as measured in domestic containers and converted into millilitres ranged between 5 and 240 ml. In 86% of the accidents it was 60 ml or less. We could find no constant correlation between these estimates and vomiting, bowel movement, state of consciousness or pulmonary complications.

Clinical features

Respiratory complications. Cough was present in seventy-nine children but only described as severe in six. It was found in all Olstad's cases, 56% of Reed's and 19% of Steiner (1947). Cyanosis was noticed by us in twenty-nine cases though 61% of the parents had remarked on its presence. Laboured breathing was noticed by sixty-three parents. We noticed rapid shallow breathing in forty-eight with a respiratory rate of 40–80/min. No physical signs in the chest were found in seventy-four; crepitations were present in seventeen and rhonchi in twelve.

Central nervous system complications. In thirty-six cases the parents noticed drowsiness. Three children were stuporous. From parents' descriptions thirteen appeared to be comatose, but only two were still in coma at the time of admission. Six children had convulsions before admission and two after arrival at the hospital.

Gastro-intestinal symptoms. Fifty-six children were vomiting, from once in twenty-eight cases to six times in one case. Vomitus was blood-stained in five. The incidence agrees with Olstad & Lord's (1952)

experience. Cachia & Fenech (1964) reported vomiting in one-third of their cases.

Abdominal distension was noticed in seven. There was no complaint of abdominal pain.

Fever and other features

Fifty-six per cent of the children were considered febrile by their parents. Temperature records revealed that twenty-seven cases had a rectal temperature of 38–40°C. Fever was present in 73% of the cases of Cachia & Fenech (1964) and in 29% of the Report of Subcommittee on Accidental Poisoning (1962).

The duration of fever was not studied because very often the mother took the child home after staying overnight in the waiting ward because of home commitments.

A history of previous kerosene poisoning was mentioned only in four cases. Nine of the children had had other accidents in the past.

None of the children had any past illness considered to lead to mental retardation. One child had meningitis, one paralytic poliomyelitis and one whooping cough. Only one had perinatal anoxia.

Milestones of development were considered normal in eighty-two, grossly delayed in eight and doubtful in ten.

Nine of the children had siblings with previous kerosene poisoning.

Investigations

The haemoglobin was estimated in sixty-two cases. Fifty (81%) had a level less than 70%.

Leucocyte counts were done in forty-two cases. Five of these (12%) had counts more than 15,000/mm³ and twenty-one had counts of 10,000–15,000/mm³. Urinalysis was performed in forty cases. Albumin was positive in one and sugar in another. Olstad & Lord (1952) found albuminuria in twenty-nine of their seventy-one cases, glycosuria in fifteen and both in seven.

Chest radiographs were taken in sixty-nine cases. In thirty-two (43%) no lesion was detectable. In the

remaining thirty-seven (53%) pulmonary opacities were seen. Olstad & Lord (1952) found a positive X-ray in 59.1% while Cachia & Fenech (1964) reported positive X-ray findings in 78%.

In fifteen of our cases (41%) the lesions were bilateral; right sided in eighteen (49%) and left-sided in four (12%). All were bronchopneumonic in appearance, except one which looked like lobar pneumonic consolidation.

Reed *et al.* (1950) stated: 'The pulmonary changes were seen oftenest bilaterally and were usually most pronounced in the base of the right lung.' Of the cases with radiographically evident pneumonitis, fifty-nine (85%) had no abnormal auscultatory findings in the chest. Other investigators were also struck by the absence of physical signs in the chest in the presence of positive radiological evidence of pneumonitis (Lesser, Weens & McKay, 1943; Olstad & Lord, 1952; Cachia & Fenech, 1964).

Seven cases with auscultatory findings in the chest (five with rhonchi and two with crepitations) had no demonstrable lesion in the chest X-ray.

Therapeutic measures

First-aid measures were given at home to forty-one cases in the form of milk or other dairy products or insertion of a finger in the mouth. Of these twenty-two (54%) vomited. Of the fifty-nine children who did not have first-aid thirty-four (58%) vomited. One may conclude that the first-aid measures were no more effective in inducing vomiting (Table 4). Capel & Gardner (1960) suggested vegetable oil or ice-cream given to dilute kerosene and diminish its absorption. This view was questioned by George (1960) on the possibility that a diminished rate of absorption might well mean a greater degree of absorption.

Gastric lavage was performed on thirty-six cases of the sixty-nine with available chest radiographs. The results are shown in Table 5. It will be seen that 47% of those who had gastric lavage developed pneumonitis whereas this occurred in 61% of the cases who did not, suggesting that pulmonary com-

TABLE 4. Relation of vomiting to first aid administered at home

Cases	Vomiting	No vomiting	Total
First aid given at home	22 (54%)	19	41
No first aid at home	34 (58%)	25	69

TABLE 5. Relation of gastric lavage to the radiologically diagnosed pneumonitis

Gastric lavage	Radiographic evidence of pneumonitis present	No radiographic evidence of pneumonitis	Total
Performed	17 (47%)	19 (53%)	36
Not performed	20 (61%)	13 (39%)	33

TABLE 6. Relation of CNS complications to gastric lavage

	CNS complications	No CNS complications	Total
Performed	14 (27%)	37	51
Not performed	13 (26.7%)	36	49

TABLE 7. Relation of vomiting to the subsequent development of radiologically proved pneumonitis

Cases	Pneumonitis	No pneumonitis	Total
Vomiting present	23 (58%)	17	40
No vomiting	13 (45%)	16	29

TABLE 8. Relation of vomiting to CNS complications

Cases	CNS complications	No CNS complications	Total
Vomiting present	11 (20%)	44	55
No vomiting	15 (33%)	30	45

plications were less common when gastric lavage was done.

On correlating gastric lavage with CNS complications (as manifested by drowsiness, coma or convulsions) little difference was found (Table 6). Radiologically proved pneumonitis was found to be more common in the children who had vomited than in those who had not (Table 7).

There appeared to be no correlation between the incidence of vomiting and that of CNS complications (Table 8).

None of our children died and the same was Olstad & Lord's (1952) experience. Other workers quote mortality rates between 0.2 and 16% (Blattner, 1951; Gershon-Cohen, Bringham & Byrne, 1953; Cachia & Fenech, 1964).

Discussion

Kerosene is a hydrocarbon complex derived from petroleum. It is made up of varying mixed proportions of paraffins and naphthenes. The toxicity of kerosene depends upon its contents of naphthenic and aromatic hydrocarbons. These would vary in type and proportion with the place or origin of the parent crude oil (George, 1960).

The degree of toxicity of ingested kerosene has been investigated by many workers in animals. Diechmann *et al.* (1944) and Ashkenazi & Berman (1961) established that pneumonitis may follow gastro-intestinal absorption and considered it of greater importance than aspiration into the lungs, but Lesser *et al.* (1943) and Gerard (1959) emphasized the greater role of the latter in causing pneumonitis.

Richardson & Pratt-Thomas (1951) concluded from animal experiments that a 23-kg child would have to ingest more than 600 ml of kerosene to develop pneumonitis. Smith *et al.* (1950) believed that pneumonia is the result of both aspiration and

absorption from the gastro-intestinal track and, therefore, recommended immediate gastric lavage. Olstad & Lord (1952) advocated gastric lavage in all cases of kerosene poisoning.

Other workers felt that it is not advisable to do gastric lavage because of the danger of gagging and aspiration of kerosene into the lungs (Waring, 1933; Reed *et al.*, 1950; Foley *et al.*, 1954; Capel & Gardner, 1960).

Another group of workers thought that gastric lavage should be reserved for children who had ingested a large quantity of kerosene (Lesser *et al.*, 1943; Cachia & Fenech, 1964; Coruh & Inal, 1966; Anderson, 1964).

In the Report of Subcommittee on Accidental Poisoning (1962), it was found that gastric lavage was not harmful but there was no conclusive evidence that it was useful. It was also shown that a higher percentage of those who vomited developed pulmonary complications regardless of whether or not gastric lavage was performed.

Our prospective study has shown that gastric lavage cases had fewer pulmonary complications and no significant difference in CNS complications. Our findings also agree with the American co-operative study in that pulmonary complications are closely associated with vomiting. Since more than half of the children (one-third in the co-operative study) will have vomiting anyway and since it is often difficult if not impossible to estimate the quantity ingested we felt it is more beneficial to do gastric lavage on kerosene poisoning cases, taking good care to avoid aspiration.

We believe that active measures should be taken for prevention. These are the responsibilities of paediatricians, educators and public health workers. The following measures are recommended:

(1) Informing the public by means of radio, tele-

vision and the daily press, and by pamphlets and posters in hospitals, child-welfare centres, public places, filling stations and on distribution tanks, that kerosene is dangerous to young children.

(2) Explaining to parents that kerosene should be kept out of reach of children not by placing it high up but by the use of barrels with lockable taps or by placing the containers in spaces with lockable doors, the keys of which are kept with the mother. At no time should the kerosene be put in containers normally used for water or other drinks, e.g. cups, soft drink bottles, etc.

(3) The public should learn that no attempt be made to induce a child who has ingested kerosene to vomit. It may be ineffective and potentially harmful.

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