Pneumonia Associated with the Ingestion of Petroleum Products by Children

MORTON L. PODOLSKY, M.D., F.C.C.P.*
Chicago, Illinois

The ingestion of petroleum products by children is not infrequent. Some of the more common substances encountered are, benzene, kerosene, gasoline, and insect sprays. Kerosene is the most common poison taken by children. The ensuing irritant and toxic manifestations have been thoroughly described by previous authors. However, it is noteworthy that in the clinic, as well as in the literature, most of the emphasis is placed upon the gastrointestinal symptoms, and those associated with generalized intoxication, but it is only recently that our attention is being directed toward the pulmonary signs and symptoms. Whereas it was formerly believed that the pulmonary symptoms were due to the occasional aspiration of a toxic substance, more recent observers contend that this is not always the case, but that the chest findings may be produced by the effect of a toxic agent gaining entrance into the blood stream by way of the gastrointestinal tract. Closer observation of clinical material, as well as animal experimentation, indicates that the pulmonary manifestations are an integral part of the intoxication syndrome, and make their appearance in approximately 77 per cent of all cases.

There are numerous references in the literature to poisoning by products of petroleum. Barbour, 1926, reported four cases, one of which was fatal, and Higgins, 1933, recorded another fatal case, and suggested that the serious pulmonary sequelae were due to direct aspiration of the fluid into the lungs. Waring, 1933, working with dogs, and later Lesser, with rabbits, substantiated this conclusion. Nunn and Martin, 1934, and Farbaugh, two years later, showed that the prognosis was directly proportional to the amount of poison entering the lung, and that fatalities usually occurred within 18 hours after the accident. Lesser, Weens and McKey, 1943, produced lung changes in rabbits, only by means of a tracheal catheter leading paraffin directly into the lungs. Cassinelli, also in 1943, described the particular nervous system manifestations associated with broncho-pulmonary involvement. Delchman et al., 1944, concluded that pulmonary changes were produced by vascular damage, which resulted from

*Attending Clinician, Department of Pediatric Chest, Max Epstein Clinic, Provident Hospital, Chicago, Illinois.
Figure 1a: Chest film made 12 hours after the ingestion of one-half glass of fuel oil. Small, irregular opacities are evident in both lung fields.

Figure 1b: Chest film made 12 hours after Figure 1a. Unchanged.

Figure 2: The pneumonia is most prominent in the right lower lung field; hilar adenopathy is marked.
the absorption of toxic substances from the gastrointestinal tract. Scott, in the same year, reported a case of pneumonia, pneumothorax and subcutaneous emphysema, complicating paraffin poisoning; Lavenstein, 1945, recorded a similar case.

Steiner, 1947, in his excellent review of 35 cases, divides them into three categories, namely: Group I, acute toxicity and depression of the central nervous system with minimal pulmonary changes, and rapid uneventful recovery; Group II, severe pneumonia, hyperpyrexia and prolonged recovery; Group III, severe pneumonia with evidence of degenerative changes in the myocardium, liver, kidney, and gastrointestinal tract. Lastly, Heacock, 1949, analyzes 156 cases of poisoning in children due to the products of petroleum, and presents an excellent clinical and pathological study.

Case Reports

Case 1: P.H., female, age 18 months, was admitted to the hospital emergency room shortly after drinking about one half glass of fuel oil. The parents stated that the child did cough just after drinking the fluid, and vomiting occurred about 20 minutes later. The stomach was emptied and irrigated with normal saline; bright red blood and oil globules were noted in the emesis. The temperature was 101 degrees F. rectally, and returned to normal in five days. Physical examination revealed inspiratory crepitant rales bilaterally, which lasted four days, and an expiratory grunt and dyspnea, which lasted about 12 hours. There were no symptoms referable to the nervous system. The white cell count was 8,400, with 64 per cent lymphocytes, 29 neutrophils, and 6 monocytes. The urine showed an occasional leucocyte and erythrocyte. Later tests for met-hemoglobin were negative, as were tests for occult blood in the stools.

X-ray film inspection revealed vague mottled densities in both lung fields, with exaggeration and accentuation of root shadows, and bronchovascular markings (Figures 1a and 1b). The right side showed more changes than the left. The child received penicillin by aerosol and by injection, and made an uneventful recovery; however, an occasional cough was noted at the time of discharge, six days later.

Case 2: K.N., female, three years of age, was admitted to the hospital following the onset of hematemesis, after coughing and vomiting for about a day and a half. In this instance there was no clear cut evidence of time, or type of toxic substance ingested, but the child was known to have put coal, which had been coated with oil, in her mouth and ingest it. Subsequent tests for heavy metals, caustics, foreign body, and met-hemoglobinemia, were entirely negative, hence the impression that the symptoms were referable to the ingestion of fuel oil, was further substantiated.

Temperature on admission was 101.5 degrees F. rectally, respirations 30; pulse 60; systolic blood pressure 95, diastolic 75 mm.Hg. The child had a dry cough, but the only chest findings were a few crepitant rales heard only at the right base posteriorly, during inspiration. The blood count revealed 3,900,000 red cells per cmm., hemoglobin 11.5 grams,
6,900 white cells per cmm., 63 lymphocytes, 33 neutrophils, 2 monocytes, and 2 per cent Turk cells. The urine contained a few hyaline casts, and an occasional red cell. The tuberculin test was negative. There were no central nervous system symptoms, except for an early drowsiness and weakness, which may be attributed to the hematemesis.

X-ray film studies revealed small irregular opacities bilaterally, enlargement of the hilar gland shadows, with a fanning out appearance of the hilar densities. Inasmuch as there was kidney involvement, this case falls into Group III of Steiner's classification. The child received penicillin, and made an uneventful and full recovery in a week.

**Case 3:** L.S., female, age three and one half years. This child was seen at home after she had swallowed an undetermined amount of kerosene, the previous night. There were no immediate effects, hence the doctor was not called at that time. The next morning the mother noted coffee-ground streaks in the emesis, when the child coughed and vomited. Examination at that time revealed a rectal temperature of 104 degrees F., and a respiratory rate of 54. Moist crepitant rales were audible over both bases. The white count was 8,100 cells per cmm, 65 per cent neutrophils, 30 lymphocytes, 5 monocytes. No toxic cells were noted. Sputum examination was negative for pneumococci and acid fast organisms. The urine was normal, but the stool was positive for occult blood, on one occasion. The stomach was not irrigated. The child received aureomycin, and made an uneventful recovery, four days later.

X-ray films revealed a homogeneous density in the right lower lung field, and mottled densities in the corresponding areas of the left lung. The bronchovascular markings were accentuated, and the left hilar region was prominently enlarged. This case also belongs in Steiner's Group III, inasmuch as the blood in the stools and in the emesis indicated extensive gastrointestinal involvement.

**Discussion**

The foregoing cases illustrate the more common signs and symptoms of poisoning following the ingestion of petroleum products. Usually there is an immediate cough, and choking period, followed by epigastric pain and vomiting. However, in one case (L.S.), this did not occur. As a rule, the infant's immediate condition is not too serious; the more common signs are those of cerebral depression, i.e. drowsiness, collapse and disorientation. Physical findings within the chest are almost always noted upon the initial examination, and x-ray changes have been observed within 30 minutes after the accident.13

There is no pathognomonic x-ray picture; the findings will vary with the amount and type of fluid ingested, the duration of illness, and individual constitutional factors. Classically, however, "cotton-wool" opacities of small irregular size, are to be noted bilaterally.5 Heacock13 observes that most changes occur at the bases.

None of the cases reported at this time had any complications or sequelae. This is the rule, rather than the exception. The
complications which have been reported in the literature include pneumothorax, empyema, emphysema, pleural effusion, and several deaths.14-18

The treatment is generally agreed upon by most authors. Gastric lavage is instituted with utmost caution, inasmuch as aspiration during lavage may contribute to the hazards of complications and even death. If the child has vomited, lavage is best omitted. Therapy with the sulfa drugs, or with antibiotics is instrumental in preventing a secondary bacterial pneumonia from becoming superimposed upon a chemical pneumonia. The sagacity of the use of these drugs is evidenced by the absence of complications and mortality, and the rapid clinical improvement of the youngsters in this series.

There are several schools of thought pertaining to the pathogenesis of pulmonary inflammation as a result of intoxication by hydrocarbons, or products of petroleum. The earliest observers maintained that the pulmonary pathology was the direct result of aspiration of the toxic substance into the lung. This point of view has been adequately expounded by Waring, Lesser, et al., and in all probability is the mechanism exhibited in cases one and two. After sampling the intoxicating fluid, the children no doubt experienced a burning sensation, which in turn caused gasping and choking, and resulted in the aspiration of fluid into the lung. Because of the low volatility of these hydrocarbons, they were not expelled by the expiratory air currents, but remained in the alveoli to produce the pathology characteristic of aspiration pneumonia.

The third case exemplifies the thought of another school, which maintains that the toxic substances are absorbed through the gastrointestinal tract into the blood stream and are carried to the lung where they are eliminated. In this role as an excretory organ, the lungs probably suffered their pathological changes. In the aforementioned case, it will be noted that the child did not gag or choke, hence there is little possibility that any of the fluid was aspirated, so we must assume that most of the kerosene reached the lung by way of the blood stream. Finally, a third pathogenesis is offered by Casselli,15 who maintains that inhalation of the volatile vapors of certain products of petroleum, may result in pneumonic pathology.

SUMMARY

1) Cases of pneumonia associated with poisoning by products of petroleum are presented.
2) The several schools of thought pertaining to the pathogenesis
of pulmonary symptoms are discussed, and exemplified by the foregoing cases.

3) The value of chemotherapy and antibiotic therapy is stressed, and is responsible for the relatively low morbidity and the absence of mortality.

4) Attention is directed toward the pulmonary manifestations of cases of poisoning, and roentgenological changes are described.

RESUMEN

1) Se presentan casos de neumonías asociadas a envenenamiento con productos del petróleo.
2) A partir de los casos presentados, se discuten las diversas escuelas que explican la patogenia de los síntomas pulmonares.
3) Se hace énfasis sobre el valor de la quimioterapia y de los antibióticos y al uso de ellas se atribuye la escasa morbilidad y la ausencia de mortalidad.
4) Se llama la atención sobre las manifestaciones pulmonares en casos de intoxicación y se describen los cambios radiológicos.

RESUME

1) L'auteur rapporte des cas de pneumonie survenant chez des individus empoisonnés par des produits pétrolifères.
2) Il discute les différentes théories qui peuvent être émises au sujet de la pathogénie des symptômes pulmonaires en se basant sur les observations précédentes.
3) Il met l'accent sur la valeur de la chimiothérapie et des antibiotiques qu'il tient pour responsables de la morbidité relativement basse et de l'absence de mortalité.
4) Il attire l'attention sur les manifestations pulmonaire accompagnant les empoisonnements et il en décrit les manifestations radiologiques.

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