ABSTRACT. Introduction. Chronic constipation is a common symptom in pediatrics, and physicians often use mineral oil to treat chronic constipation in children. Mineral oil, a hydrocarbon, may not elicit a normal protective cough reflex and may impair mucociliary transport. These effects can increase the likelihood of its aspiration and subsequent impaired clearance from the respiratory tract. We report a case of a child with neurodevelopmental delay with chronic constipation and a history of chronic mineral oil ingestion presenting as asymptomatic exogenous lipoid pneumonia (ELP).

Case History. A 6-year-old white boy with a history of developmental delay was found to have an infiltrate in his right upper lobe on a chest radiograph obtained during evaluation for thoracic scoliosis. The patient had a long history of constipation with daily use of mineral oil. He was fed by mouth and had occasional episodes of coughing and choking during feeding. He was asymptomatic at presentation and physical examination was unremarkable. The patient was advised to stop administration of the mineral oil and was treated empirically with antibiotics during a 3-month period. At follow-up examination the patient continued to be asymptomatic, with the radiologic persistence of the infiltrate. Diagnosis of lipoid pneumonia was made by diagnostic bronchoscopy with bronchoalveolar lavage (BAL). The exogenous origin of the lipid in the BAL fluid was confirmed by gas chromatography/mass spectrometry.

Discussion. The clinical presentation of ELP is nonspecific and ranges from the totally asymptomatic patient with incidental radiologic finding, like our patient, to the patient with acute or chronic symptoms attributable to pneumonia, pulmonary fibrosis, or cor pulmonale. Bronchoscopy with BAL can be successful in establishing the diagnosis of ELP by demonstration of a high lipid-laden macrophage index. Treatment of ELP in children is generally supportive, with the symptoms and roentgenographic abnormalities resolving within months after stopping the use of mineral oil.

Conclusion. Lipoid pneumonia as a result of mineral oil aspiration still occurs in the pediatric population. It can mimic other diseases because of its nonspecific clinical presentation and radiographic signs. In patients with swallowing dysfunction and pneumonia, a history of mineral oil use should be obtained and a diagnosis of ELP should be considered in the differential diagnoses if mineral oil use has occurred. Our case points to the need for increased awareness by the general pediatricians of the potential hazards of mineral oil use for chronic constipation.

ABBREVIATIONS. RUL, right upper lobe; CXR, chest x-ray; BAL, bronchoalveolar lavage; ELP, exogenous lipoid pneumonia.

Chronic constipation, a common symptom in pediatrics, accounts for 3% of referrals to teaching hospital clinics and 10% to 25% of referrals to pediatric gastroenterology practices. Liquid paraffin, or mineral oil, is a hydrocarbon that physicians often use to treat chronic constipation in children and adults. It is a tasteless, indigestible liquid that is poorly absorbed from the gastrointestinal tract and acts as a stool softener by decreasing the reabsorption of water from the intestinal lumen. However, other properties such as its low volatility and high viscosity may contribute to undesirable side effects. Mineral oil may not elicit a normal protective cough reflex and may impair normal mucociliary transport. These effects can increase the likelihood of its aspiration and subsequent impaired clearance from the respiratory tract. We report a case of a child with neurodevelopmental delay, chronic constipation, and a history of chronic mineral oil ingestion who presented with an infiltrate in the right upper lobe (RUL) as an incidental finding on a chest radiograph (CXR).

CASE REPORT

A 6-year-old white boy with a history of developmental delay and a seizure disorder was found to have an infiltrate in his RUL on a CXR obtained during an orthopedic evaluation for thoracic scoliosis. He had no signs or symptoms of respiratory disease at that time. He was treated with one 10-day course each of amoxicillin with clavulanic acid and cefazolin during a 2-month period. The patient continued to be asymptomatic, but a follow-up CXR showed persistence of the infiltrate and the patient was referred to our center for further evaluation. The patient had a long history of constipation with daily use of mineral oil. He was fed by mouth and had occasional episodes of coughing and choking during feeding.

Physical examination was unremarkable except for findings related to his chronic neurologic and orthopedic problems. The CXR (Fig 1) showed a dense alveolar infiltrate in the anterior and posterior segments of his RUL. These findings were unchanged from those noted on the initial CXR taken 3 months earlier. The patient was started on an empiric treatment with clarithromycin and advised to stop administration of the mineral oil. Laboratory evaluation included a normal complete blood count and differential, a stool specimen negative for ova and parasites, a negative IgG titer for Mycoplasma pneumoniae, and a normal total IgE. A purified protein derivative skin test was negative. At follow-up evaluation, 1 month after discontinuation of mineral oil use, he continued to be asymptomatic, and a repeat CXR at that time...
revealed no change in the infiltrate. A computed tomographic scan of the chest done at this time showed a dense infiltrate in the anterior and posterior segments of the RUL without any hilar lymphadenopathy, volume loss, mass, or airway compression (Fig 2). A 24-hour esophageal pH probe was negative for gastroesophageal reflux. A modified barium swallow showed a disordered oral phase of swallowing with poor labial seal, drooling, anterior loss of the bolus, difficulty in manipulating the bolus, and difficulty in propelling the bolus posteriorly.

In view of the persistent radiologic opacity, a diagnostic bronchoscopy with bronchoalveolar lavage (BAL) was performed. Bronchoscopic findings included normal airway anatomy except for mild erythema around the posterior segmental bronchus of the RUL. BAL was done in this segment and the recovered fluid was milky white in appearance, with fat globules floating on the surface. Oil red O staining of BAL fluid demonstrated high numbers of lipid-laden macrophages (Fig 3) with an index of 280° and free droplets of extracellular oil. Viral, bacterial, fungal, and mycobacterial studies on the BAL specimen were negative.

To confirm the exogenous origin of the lipid, BAL fluid and a sample of the patient’s mineral oil were analyzed by gas chromatography/mass spectrometry. The analysis demonstrated identical retention time and the same mass spectrum between the BAL fluid and the patient’s mineral oil sample (Fig 4). The mass spectrum of the BAL was matched to a library of lipid standards including the mass spectrum of the patient’s mineral oil using commercial spectrum identification software. This computer analysis indicated a 99.99% likelihood that the BAL sample matched that of the patient’s mineral oil.

Three months after the bronchoscopic examination, the patient was in his usual state of health without any respiratory symptoms and the infiltrate persisted on CXR. Because the patient was asymptomatic and the pathology was focal, no further specific therapeutic interventions were done. Periodic follow-up at 6-month intervals was recommended.

**DISCUSSION**

Mineral oil is commonly prescribed for the treatment of constipation in children and adults. Annually, 2 million to 3 million people are prescribed cathartics and laxatives by physicians in the United States. These estimates do not include self-medication, because mineral oil can be purchased without prescription. Consequently, mineral oil can be a common household product and children are at additional risk from accidental ingestion. Because of its high viscosity, mineral oil depresses the cough reflex facilitating aspiration even in normal persons, and patients with swallowing dysfunction are at an additional increased risk. In adults, 25% of cases of exogenous lipid pneumonia (ELP) have been reported in normal individuals without any predispos-
Once deposited in the alveoli, mineral oil can lead to chronic alveolar and interstitial inflammation leading to ELP.

In a majority of cases, ELP is a result of mineral oil given orally for medicinal purposes. Aspiration is the common mechanism, although it has been reported after rectal administration as a result of mineral oil embolization and from excessive use of lip balm. Because mineral oil is a tasteless substance, infants and small children often object vigorously to its oral administration, resulting in gagging that precipitates aspiration. Patients with neurologic impairment and an associated swallowing dysfunction are particularly vulnerable to aspiration, as was the case with our patient. The clinical presentation of ELP is nonspecific and probably depends on the age of the patient, the volume of the aspirate, and the chronicity of aspiration. Accordingly, the presentation ranges from the totally asymptomatic patient with incidental radiologic finding, like our patient, to the patient with acute or chronic symptoms as a result of pneumonia, pulmonary fibrosis, or cor pulmonale.

Laboratory tests may show peripheral blood polymorphonuclear leukocytosis with an elevated erythrocyte sedimentation rate. Roentgenographic findings are nonspecific with alveolar consolidation and ground glass opacities being the most frequent pattern. The distribution of radiologic changes can vary from bilateral abnormalities to focal changes.

Computed tomographic scans can measure the density of the parenchymal lesions and can be diagnostic. A negative density between −150 and −30 Hounsfield Units is highly suggestive of intrapulmonary fat. The computed tomography scan performed on our patient was done at another hospital and density measurements were not done. Open-lung biopsy has been used as a diagnostic method, but carries the disadvantage of being a much more invasive procedure.

Bronchoscopy with BAL has been reported to be successful in establishing the diagnosis of ELP. The macroscopic appearance of BAL with fat globules on the fluid surface and the cytologic demonstration of lipid-laden macrophages is consistent with the diagnosis of ELP. Kameswaran et al reported a series of 24 cases of lipoid pneumonia in children, 22 of which were diagnosed by rigid bronchoscopy with BAL. Bronchoscopy has the additional advantage of assessment of airway anatomy to rule out other causes of chronic nonresolving pneumonia. Although the demonstration of a high lipid-laden macrophage index is diagnostic of lipoid pneumonia, additional diagnostic tests like the chemical analysis of BAL fluid may be necessary to confirm the exogenous nature of lipid.

Infants and children account for a minority of reported cases of lipoid pneumonia. Consequently, the natural history of ELP in children cannot be accu-
rately derived from case reports. Elston\textsuperscript{16} reported a fatal case of ELP in a 9-month-old girl as a result of mineral oil aspiration. De la Rocha et al\textsuperscript{17} reported a 13-month-old infant with accidental aspiration of mineral oil who had a severe protracted clinical course with chronic lung disease requiring supplemental oxygen for a 5-month period. Fan and Graham\textsuperscript{13} reported a 4-month-old infant with respiratory distress and hypoxemia with a history of mineral oil administration at age 2 weeks who improved slowly. Mild residual abnormalities on CXR were present even at age 5 years. In a retrospective multicenter study of 44 cases of ELP in adults, Gondouin et al\textsuperscript{18} observed that 21\% of the patients developed complications of fibrosis, repeated infections in the territory of lipoid pneumonia, and aspergillus infections with cavitation. These patients are at risk for nontuberculous mycobacterial infections because of the fact that the lipids enhance the growth of the organisms and impede phagocytosis by the host’s macrophages.\textsuperscript{18}

Treatment of ELP in children is generally supportive, with the symptoms and radiographic abnormalities resolving within months after stopping the use of mineral oil. In patients with diffuse pulmonary damage, aggressive therapies with prednisone\textsuperscript{19} and therapeutic whole-lung lavage\textsuperscript{20} have been reported.

**CONCLUSION**

In summary, lipoid pneumonia as a result of mineral oil aspiration still occurs in the pediatric population. It can mimic other diseases because of its nonspecific clinical presentation and radiographic signs. In patients with swallowing dysfunction and pneumonia, a history of mineral oil use should be obtained and a diagnosis of ELP should be considered in the differential diagnoses if mineral oil use has occurred. When ELP is suspected, fiber optic bronchoscopy with BAL can confirm the diagnosis and should be considered early in the evaluation. Our case points to the need for increased awareness by the general pediatricians of the potential hazards of mineral oil use. It reinforces the recommendation by a previous author\textsuperscript{13} that the administration of mineral oil for chronic constipation should be administered with caution and should be avoided in infants and young children who frequently resist the administration, and in developmentally delayed children with or without swallowing dysfunction.

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