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Original Article

Not typical pneumonia: acute exogenous lipoid pneumonia in 19 children

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Abstract: Aim: The aim of this study was to investigate clinical characteristics, radiological findings and therapies of ELP in healthy children. Methods: 19 children hospitalized in our hospital were retrospectively reviewed, with a mean age of 30 months (range: 14-60 months). The medical records including clinic manifestations, radiologic findings and treatments were analyzed. Results: There were 19 patients with diagnosed acute ELP caused by aspiration of mineral oil (machine oil in 12 cases, gasoline 3 cases, kerosene 3 cases and diesel 1 case). Diagnoses were based on clinical and x-ray or computed tomography (CT) findings (n=15) and bronchoalveolar lavage (n=4). All patients developed choking and cough immediately after ingestion of oil and 10 patients had vomited. 15 cases developed progressive fever, wheezing, shortness of breath, cyanosis, dyspnea, moaning uneasy, chest pain and so on. Chest CT scan showed abnormal in 18 children, except the rest one only received chest X-ray scan. Corticosteroid and antibiotic treatments were given to every child. 3 children received albumin transfusion, and 7 children received intravenous immunoglobulin. 15 patients recovered completely from oil aspiration pneumonia 8 days to 5.5 months later. Conclusion: ELP in children occurs in almost all cases after mistaking mineral oil. Pulmonary opacities can be found by chest CT in most patients within 24 hours after aspirating mineral oil. Clinical history and CT examination are very helpful for making a diagnosis of lipid pneumonia. Corticosteroids therapy was effective for patients with ELP which limited inflammatory response and ongoing pulmonary fibrosis.

Keywords: Mineral oil, aspiration pneumonia, children

Introduction

Exogenous lipoid pneumonia (ELP) is an uncommon condition resulting from aspiration or inhalation of fatty substances like mineral oils and petroleum jelly. In initial reports, most patients with lipoid pneumonia were debilitated adults or children who often had local anatomic defects such as cleft palate. But, reports have indicated that this condition could also occur in healthy people [1]. More recently, one or two cases were reported in the literatures annually [2-4]. Acute exogenous lipoid pneumonia occurs sporadically and typically results from exposure to large amounts of mineral oils [5, 6]. Acute form is usually associated with accidental poisoning in children. In an adult population, ELP typically occurs in fire-eaters, who use oily substances in their shows [7]. In this study, 19 cases of lipoid pneumonia in healthy children caused by mineral oil aspiration were reported. These cases illustrated new clinical characteristics in patients with ELP, who developed choking and cough immediately following ingestion of oil and vomiting in 10 patients. These cases highlighted the need for warning labels to be placed over the counter of mineral oil and the need to educate primary care physicians about possible adverse reactions to this type of mistaking, especially in patients with choking and cough or vomiting immediately following ingestion of oil.

Methods

The medical records of 19 children (a mean age of 30 months; 11 boys and 8 girls) including the clinic manifestations, radiologic findings and treatments were retrospectively reviewed. They were diagnosed with ELP caused by aspiration

Table 1. Summary of clinical findings of patients with ELP

Patient no.	Age (months)	Gender	First visit time (hours)	Symptoms	Hospital stay (days)	Mineral oil
1	36	M	23	Cough and vomit	5	Kerosene
2	17	M	24	Cough, vomit, fever, dyspnea	11	Machine oil
3	24	F	144	Cough, fever, shortness of breath	12	Machine oil
4	24	F	72	Cough and fever	8	Machine oil
5	28	F	12	Cough and fever	6	Machine oil
6	18	F	22	Cough and vomit	4	Machine oil
7	36	F	20	Cough and vomit	5	Kerosene
8	48	M	24	Cough and fever	10	Gasoline
9	36	M	18	Cough, vomit, fever, dyspnea, chest pain	14	Machine oil
10	24	M	140	Cough	4	Gasoline
11	60	F	19	Cough and fever, dyspnea, chest pain	4	Machine oil
12	18	F	7	Vomit and cough	2	Diesel
13	26	M	4	Cough, fever	5	Machine oil
14	60	M	168	Cough, fever, cyanosis, shortness of breath	12	Machine oil
15	14	M	120	Cough, fever, moaning uneasy	18	Engine oil
16	15	F	6	Cough, vomit, dyspnea	23	Engine oil
17	24	M	2	Cough, vomit, fever	11	Kerosene
18	27	M	2	Cough, vomit, fever, cyanosis	18	Engine oil
19	38	M	0.5	Cough, vomit, fever	14	Gasoline

of mineral oil. Diagnosis was made on the basis of 1) history of exposure to oil substances, including ingestion and aspiration; 2) characteristic findings in CT examination; 3) clinical manifestations of fever, cough, shortness of breath, cyanosis, etc.; 4) exclude pulmonary tuberculosis, lung cancers and other basic diseases; 5) presence of lipid-laden macrophages in bronchoalveolar lavage fluid or sputum. Having the conditions of 1), 2), 4), or 1), 3), 4) was for the clinical diagnosis of cases and having 5) was for laboratory confirmation [7, 8].

Statistical analysis

Data were analyzed with SPSS version 17.0 (IBM Co.). X^2 test was adopted to compare theclinical manifestation before and after one-week treatment in 19 children, while paired t test was used to compare laboratory results before and after one-week treatment in 19 children.

Results

Basic information

These children had an average age of 30.16± 13.76 years old. Among them, 58% were boys, while 42% were girls. The meanclinic time was 43.55±55.58 hours, while they stayed in hospital for 9.79±5.8 days on average.

Clinical manifestations

13 cases presented fever, 10 out of 13 patients had fever in 4-8 hours after inhaling mineral oil, and the temperature recorded was 38.3-40°C. There were wheezing in seven cases, shortness of breath in eight cases, cyanosis in two cases , dyspnea in three cases, uneasy moaning in two cases, and chest pain in onecase (**Table 1**). Crackle and/or rhonchus were heard during auscultation of chest in six patients. Peripheral white blood cells increased in 11 cases, and C-reactive protein elevated in 8 patients.

Imaging examination

ELP in children occurred in almost every case who had developed choking, cough and/or vomiting immediately after ingestion of oil. Pulmonary opacities can be found by chest CT in most patients within 24 hours after aspirating mineral oil. Clinical histories and CT examination are very helpful for making a diagnosis of lipid pneumonia. CT finding swere abnormal

Table 2. Clinical manifestation comparison before and after one-week treatment in 19 children

	Case number		x^2	*P* value
	Before treatment	After treatment		
Fever	13	2	13.33	<0.05
Wheeze	7	1	5.7	<0.05
Shortness of breath	8	1	7.13	<0.05

Table 3. Laboratory results comparison before and after one-week treatment in 19 children

	Before treatment	After treatment	τ	*P* value
White cell count (10^9/L)	15.39±7.59	10.5±3.2	3.268	<0.05
CRP (mg/L)	27.29±46.65	11.58±13.92	2.143	<0.05
PO_2 (mmHg)	87.31±16.96	100.26±10.40	4.874	<0.05

Note: CRP: C reactive protein, PO_2: partial pressure of oxygen.

in 18 children, and the earliest CT was done in 2 hours after accidents. The other child got chest X-ray. The earliest X-ray was done in 3 hours after an accident. And one case did not show any significant change in the first chest X-ray 2-3 hours after an accident until 3 days.

Treatment

An early corticosteroids therapy was effective in patients with ELP, which limited inflammatory responses and ongoing pulmonary fibrosis. All patients received corticosteroid and antibiotic treatments, four cases underwent bronchoalveolar lavage (BAL), three patients were administered with albumin, and seven cases received intravenous immunoglobulin. There were three cases delayed in treatment with corticosteroid due to misdiagnosis, and three cases of them had clear secondary infections. 15 patients recovered completely after eight days to 5.5 months. Clinical manifestation and laboratory result comparison after one-week treatment among 19 children was shown in **Tables 2** and **3**.

Discussion

Mineral oil is an inert substance that is not metabolized by pulmonary enzymes when aspirated. Instead, it is emulsified and phagocytosed by alveolar macrophages, and returned to alveolar space after cell deaths. The release of inflammatory cytokines by activated macrophages probably leads to fever and presence of infection markers, which causes misdiagnosis of lipoid pneumonia as bacterial pneumonia [9]. ELP consists of a chronic inflammatory reaction of lung parenchyma with interstitial involvement due to the accumulation of lipid material in alveoli [10]. In 1925, Laughlen [11] first described ELP when he reported discovering oil droplets in lungs during autopsies of three children and one adult who had received mineral oil nose drops ororal laxatives during lifetime. And aspiration was also related to high-fat diet such as ketogenicdiet [12] and fire-eater [13]. ELP is rarely reported in children caused by mistaking mineral oil aspiration. The degrees and types of tissue reactions to aspirated mineral oil are variable, related to quantity of aspirated mineral oil and cough or vomit after ingestion, the chemical characteristics of oil, and complicating effects of other substances which may be aspirated at the same time. All cases were acute aspiration.

J.S. Lee [8] reported high-resolution computed tomography findings of ELP. But high-resolution computed tomography wasn't the first choice for children because of a large amount of radiation. So chest X-ray and CT were used in this study. 13 out of 18 cases had chest CT scan within 24 hours after ingestion and results were abnormal in all cases. The earliest finding was 2 hours after ingestion. Results of chest X-ray more than three hours after ingestion were also abnormal in 9 cases. Chest X-ray revealed a normal result in 1 case 2 hours after ingestion, but an abnormal result 24 hours after ingestion. Combined with late imaging examination, 18 out of 19 cases had chest CT examination. CT findings were abnormal in one side of the lung in four cases; both lungs in 14 cases, mainly located in middle and lower lobes. Chest CT scans showed lobar or segmentalconsolidation (13/18), a geographic lobular distribution of ground-glass opacities at both lungs (3/18) (**Figure 1A**), miliary change (2/18) (**Figure 1B**), thickening of interstitium and pa-

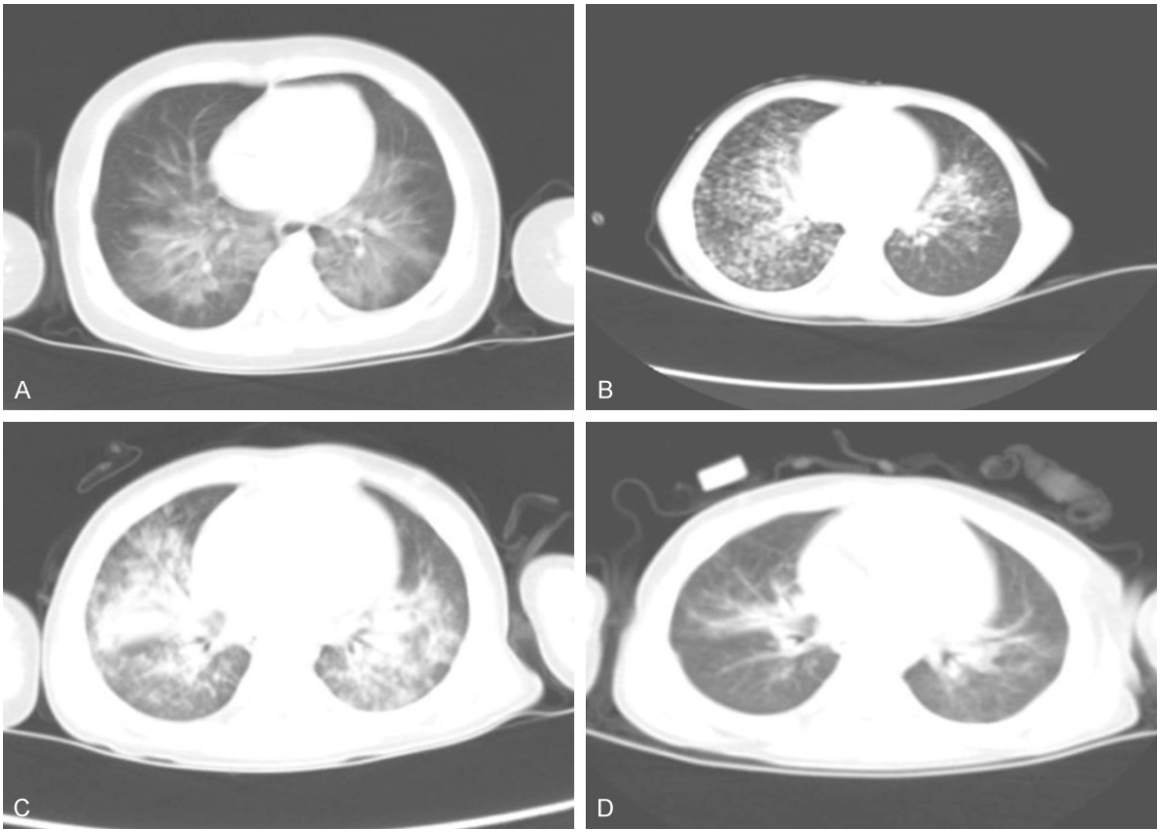

Figure 1. A: A 17-month-old boy with proved acute ELP caused by aspiration of machine oil for 24 hours. CT shows a geographic lobular distribution of ground-glass opacities at both lungs; B: A 14-month-old boy aspiration of machine oil for 5 days with clinical findings of fever, cough, chest pain, shortness of breath who once misdiagnosed as acute upper respiratory tract infection and septicemia. CT showing military change in bilateral lungs; C: A 24-month-old girl aspiration of machine oil for 6 days with clinical findings of fever, cough, dyspnea who once misdiagnosed as typical pneumonia. CT showing bilateral opacities in the mid and lower lung zones; D: CT shows apparently absorption of pulmonary imaging in third case after one month.

renchymal distortion (2/18) and cavity (1/18), mediastinal pneumatosis (1/18).

Treatment of this disorder is not well defined. Besides avoiding ongoing exposure, supportive care should be provided and complications should be treated [14]. A majority of children with lipoid pneumonia recovered. However, in a few instances, oil can lead to a severe inflammatory response, chronic alveolar and interstitial inflammation, fibrosis, corpulmonale and chronic respiratory failure [10]. Several modalities of treatment have been tried to prevent or halt progress of damage in lipoid pneumonia, but there is no consensus on a right treatment. Steroid therapy is one of the modalities that have been used by several clinicians [15]. Therapies of 19 patients receiving effective treatment were retrospectively reviewed in this study. Glucocorticoidused in oil aspiration pneumonia, regardless of severity of diseases, can be traced back to 1960s. It was a conventional treatment of Prednisolone 2 mg/kg/day by oral, gradually tapered until pulmonary imaging absorption. Annobil [16] and Indumathi [14] reported ELP cases by reviewing chest X-ray showed pulmonary imaging fundamental absorption in 1-5 months. Individualized treatment programs according to conditions were adopted in this study. Intravenous methylprednisolone was started with 2 mg/kg/day for 3 days followed by oral methylprednisolone for next 2 weeks in mild ELP. The moderate cases with wheezing, shortness of breath, fever, pulmonary lesions <40%, moderate white blood cells increases, were treated with intravenous methylprednisolone (2 mg/kg/q12 h) for 3-5 days followed by prednisolone and its dose was gradually tapered and stopped over next 4 weeks. Intravenous methylprednisolone (5-10

mg/kg/day or 2 mg/kg/q8 h) for 3 days can be withheld unless lung injuries were severe (**Figure 1C**) followed by moderate cases treatment and prednisolone was gradually tapered and stopped over next 8 weeks. In this study, cases showed clinical improvements after therapies and showed almost complete radiological clearance within from 8 days to 5.5 months (**Figure 1D**). Multiple BAL, either alone or in combination with steroids, have been tried in resistant cases [17, 18]. Sequelae included reduced lung functions, both restrictive and obstructive. Abnormal lungs function tests may take severalmonths to resolve and all affected patients should undergo lung function tests periodically. However, result of lung function test was normal in one child only. The others could not receive these tests in children of this study as they were too young to cooperate. In theory, combined treatment of BAL can shorten treatment time and reduce adverse reactions caused by long-term usage of glucocorticoid. Not all patient's parents accepted BAL. In fact, BAL was only done in four severe cases, showing significant changes in pulmonary imaging. This study has achieved basic or completely absorption of pulmonary imaging in 15 cases, and there was no recurrence during this period. Follow up was interrupted in four cases.

The most common cause of lipoid pneumonia is aspiration of mineral oil, which is often used in treatment of intestinal constipation [19]. In adults, hemoptysis and chest pain have also been reported [20]. Hochart [21] reported recurrent chest pain in a child with lipoid pneumonia.

The clinical presentations of patients wereunusual in four aspects in this study. First, in this study, there were 19 children with proved acute ELP caused by aspiration of a variety of mineral oil who were at young ages of 1-5 years old without local anatomic defects. Second, all patients had developed choking and cough immediately after ingestion of oil and 10 patients had vomited. Clinical aspects of ELP include fever, cough, progressive dyspnea, chest pain and unresolved radiological features of pneumonia. Third, this study highlighted successful usage of glucocorticoid which limited inflammatory response and ongoing fibrosis in treatment of ELP, with combination with BAL in severe cases. Fourth, pulmonary infiltrates showed diffuse ground-glass opacity, lobar or segmental consolidation, interstitial abnormalities, miliary change, cavity and mediastinal pneumatosis on CT.

Conclusion

ELP in children occurs in almost all cases after mistaking mineral oil. Pulmonary opacities can be found by chest CT in most patients within 24 hours after aspirating mineral oil. Clinical history and CT examination are very helpful for making a diagnosis of lipid pneumonia. Corticosteroids therapy was effective for patients with ELP which limited inflammatory responses and ongoing pulmonary fibrosis. Depending on presentations of this disease, these lesions should be differentiated from other forms of pneumonia, interstitial lung diseases, tuberculosis and lung tumors.

Disclosure of conflict of interest

None.

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