Fuel Siphoner's lung: a case of inhalational pneumonia

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ABSTRACT

Background: Practices of manual siphoning of fuel around the globe has exponentially increased the incidence of chemical pneumonitis. As evident by studies, chemical pneumonitis constitutes quite significant proportion of community-acquired pneumonia. In this case report, we follow up on the case of hydrocarbon pneumonitis along with its diagnostic uncertainty and treatment challenges.

Case Presentation: A 66-year-old male presented with shortness of breath, fever, and hemoptysis after accidentally aspirating diesel while siphoning it from a generator. computed tomography pulmonary angiogram revealed bilateral pneumonitis and ruled out pulmonary embolism. He required high-flow oxygen initially due to extensive nature of pneumonia and was managed conservatively with broad-spectrum antibiotics and steroids. He recovered to discharge after 21 days. This represents a case of chemical, hydrocarbon (exogenous lipoid) pneumonitis, complicated by transudative pleural effusion and likely bacterial superinfection.

Conclusion: Chemical pneumonitis is associated with varied symptoms and radiological presentation. Its treatment is essentially same as pneumonia caused by other pathogens. Timely diagnosis, escalation, and treatment can reduce the morbidity and mortality caused by these harmful insults.

Keywords: Siphonage, inhalation, hydrocarbon pneumonitis, aspiration.

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Background

Pneumonia or pneumonitis arises due to an interaction between lung exposures and the host inflammatory response that causes a cellular inflammatory response filling alveolar airspace. The great majority of pneumonia has a simple infective etiology. In contrast, inappropriate activation of immune and inflammatory responses to factors that is normally relatively innocuous or remains unidentified, cause inflammatory interstitial lung diseases. Non-infective agents, for example, inhaled chemicals, can also directly cause pneumonitis that is independent of infection but may coincide with it. Due to the introduction of electronic cigarettes, the prevalence of inhalation pneumonitis is increasing exponentially in all age groups.

Prevalence of chemical pneumonitis in patients with community-acquired pneumonia ranges from 5% to 24% [1]. Autopsy series indicate an incidence of 1%-2.5% [2]. Manual siphoning of diesel inherently risks inhalation and pneumonitis. Worldwide it is a widespread technique, particularly in south Asian countries among vehicle mechanics, drivers, and farmers [3]. The Medline search strategy "chemical pneumonitis" on 15th of June, 2022 identified eight case reports from Asian countries describing hydrocarbon pneumonitis in mechanics and farmers In North Carolina, a case series described five cases of previously healthy people who developed acute respiratory failure after exposure to hydrocarbon aerosols [4]. There is a lack of evidence supporting any specific management approach and no consensus guidelines exist [5].

Case Presentation

A 66-year-old man presented to hospital complaining of shortness of breath, intermittent fever, and hemoptysis following accidental ingestion of diesel whilst siphoning it from a generator tank. He was an ex-smoker with a 20 packyear history and no other relevant co morbidities. On admission, he was hypoxemic on room air and hemodynamically unstable. He was transferred initially to the Respiratory High Dependency Unit (HDU) on high-flow nasal oxygen delivery with an FiO_2 of 0.7 and was transferred to the intensive care unit during the first day of admission due to the trajectory of his increasing respiratory support requirements. His ABG at presentation (pH 7.46, pCO_2 8.20, pO2 7.86, and HCO3 27.8), showed

type 1 respiratory failure, and his infection markers were elevated.

He was started on intravenous co amoxiclav, oral doxycycline, and oral steroid treatment. His chest radiograph at presentation showed bilateral consolidation, greater on the right side (Figure 2). Covid polymerase chain reaction came back negative. Computed tomography pulmonary angiogram (CTPA) (Figure 1) excluded pulmonary embolism and confirmed extensive consolidation in both upper lobes and right middle lobe along with areas of air trapping, in keeping with underlying emphysema were also noted.

He did not require intubation or vasopressor support and his FiO_2 requirement was reduced to 40%, prompting transfer back to HDU. A day later he became tachypneic, tachycardic, and pyrexial, and his repeat chest X-ray demonstrated worsening infiltrates (Figure 3). He remained in type 1 respiratory failure, though his FiO_2 requirement improved to 35%. His antibiotics were changed to tazocin to cover hospital-acquired infection. Pyrexial episodes subsided after 2 days. There was a clinical suspicion of heart failure and so oral furosemide was started. Inpatient transthoracic echocardiography indicated trivial mitral regurgitation, and mild left ventricular systolic dysfunction with and ejection fraction estimated at 45%-50%. Whilst pyrexias persisted, an ultrasound chest was undertaken to assess for possible empyema. A fluid pocket was visualized that was 8 cm deep and appeared echoic. A chest drain was inserted and 2 l drained (Figure 4).

Following clinical improvement (admission day 16) he was transferred to Level 1 ward care under the pleural specialist team. His clinical state, FiO_2 requirements, and inflammatory markers showed further improvements to the point he was discharged (admission day 21) having been off oxygen for 24 hours (Figure 5).

Investigations

The following Table 1 compares the results of white blood cells and C-reactive protein (CRP) levels during patient's stay at the hospital.

Microscopic analysis of a blood film was undertaken following initial presentation with associated lymphopenia and neutropenia. This showed anisocytosis, left shift

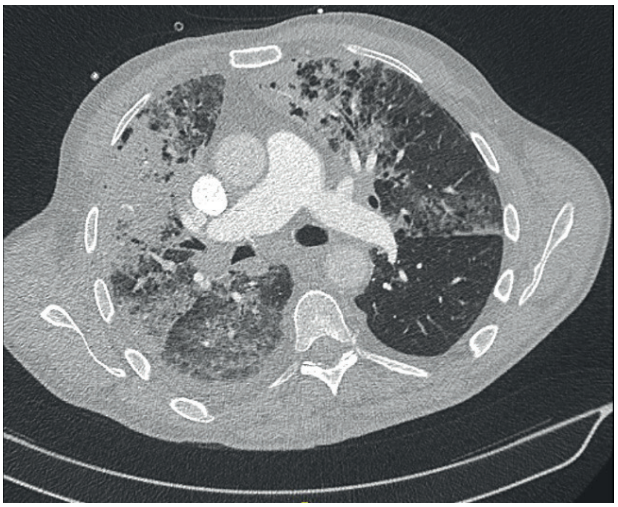

Figure 1. *CTPA on admission.*

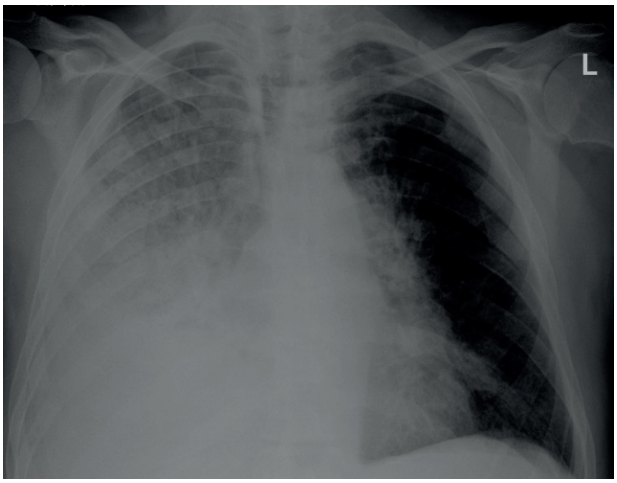

Figure 3. *X-ray done at temperature spikes.*

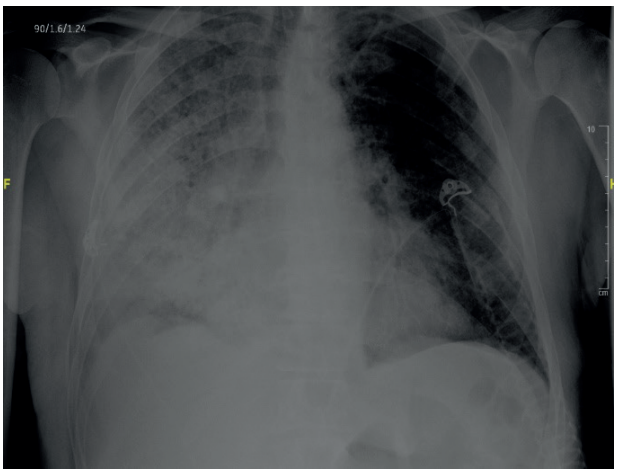

Figure 2. *X-ray on admission.*

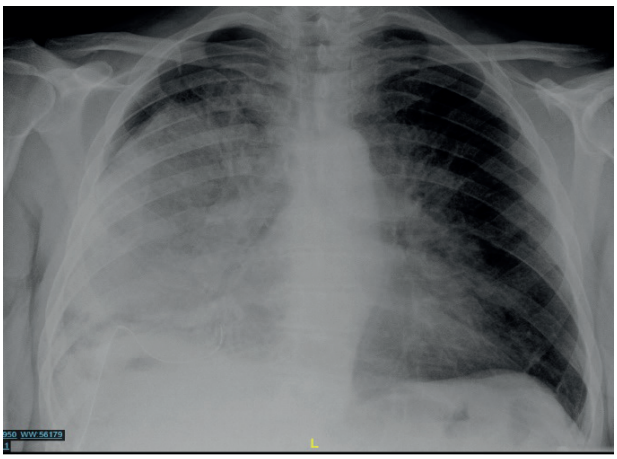

Figure 4. *X-ray post drain insertion.*

of neutrophils, and moderate neutropenia. There have not been many studies or case reports published to show lymphopenia and neutropenia in chemical pneumonitis. The transience of this response might reflect a rapid influx of leukocytes from the circulation to the lungs in response to a large-scale insult, or possibly brief bone marrow depression secondary to infection.

Procalcitonin on admission was 10.20 (normal range <0.1 ng/ml).

Three sets of blood cultures at different timepoints did not grow any microorganisms.

Figure 5. *X-ray pre discharge.*

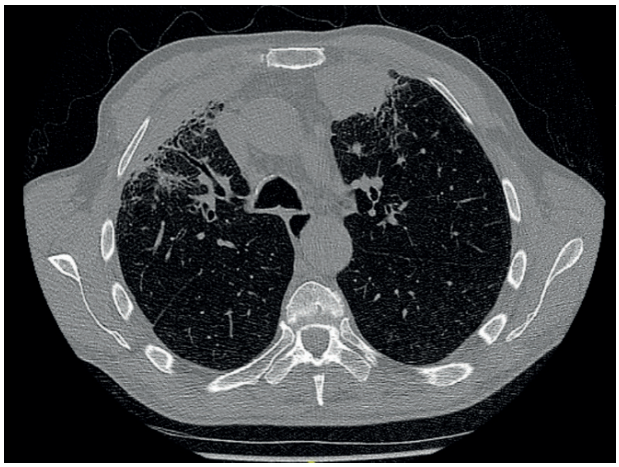

Figure 6. *Follow up scan in January 2022.*

Pleural fluid biochemistry: LDH 238, Fluid protein <20.

The transudative nature of the pleural effusion may be considered surprising in view of relatively mild cardiac dysfunction indicated by echocardiogram and a major inflammatory process within the lungs. We speculate it could relate to transient myocardial suppression, due to increased oxygen consumption and/or sepsis, that was resolving by the time of echocardiography.

Pleural fluid cytology showed reactive changes and no malignant cells.

Treatment

Multidisciplinary team was involved in the treatment of patient [6]. At pharmacological end of spectrum, steroids and antibiotics were the mainstay of treatment. Initially, on presentation, IV co-amoxiclav and doxycycline were given as per CURB-65 score along with oral Prednisolone. Microbiology advice was sought at every step, who advised to switch to I/V Tazocin upon deterioration. Patient was managed on high-flow nasal cannula initially in intensive care which was later tapered to 35% venturi mask on 10th admission day. Even upon successful de-escalation of oxygen requirement, patient infection markers peaked on 10th post-admission day along with clinical presentation of persistent pyrexia and raised jugular venous pressure. Lung ultrasound and echocardiography were conducted to look for alternative sources of infection and clinical worsening. Later investigation ruled out acute heart failure, but lung ultrasound raised suspicion

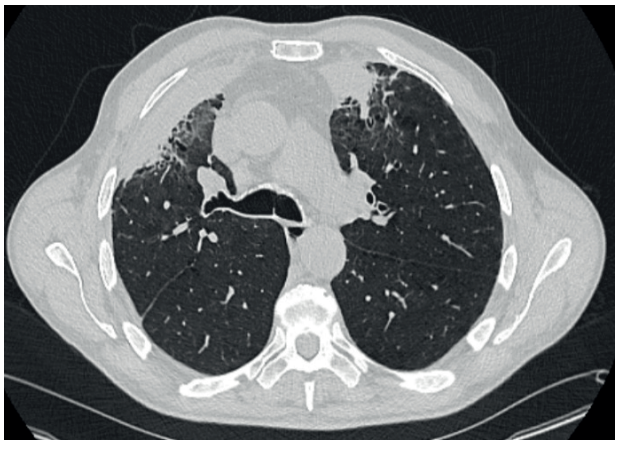

Figure 7. *Follow up scan in March 2022.*

Table 1. Biochemical markers during patient's hospital stay.

BLOOD TESTS	ON ADMISSION	2ND DAY	6TH DAY	10TH DAY	14TH DAY	19TH DAY	PRE-DISCHARGE
WCC (7-11 × 10^9/l)	1.4	8.4	11.6	Normal	normal	Normal	normal
NEUTROPHILS (1.5-8.0 × 10^9/l)	0.76	7.83	11.02	Normal	normal	Normal	normal
CRP (<5 mg/l)	7	273	217	315	245	119	67

of empyema. Chest drain was inserted eventually, and patient showed clinical improvement within 48-72 hours. Ultimately on guidelines of empyema, antibiotics were continued to cover full course of 4-6 weeks. Non-pharmacological treatment aimed at physiotherapy who assisted in breathing exercises, sputum expectoration, and mobilization.

Discussion

Chemical pneumonitis also known as lipoid pneumonia can be divided into endogenous and exogenous types. Exogenous can be further divided into acute and chronic depending on duration. Our case report is primarily focused on exogenous type [7].

The pathophysiology of chemical pneumonitis is not clearly understood as there have not been many studies into it. Hydrocarbons and oil-based products can enter the airways through, inhalational, aspiration, or regurgitation. Though paraffins and highly purified lamp oil, which are mostly used by fire eaters and can cause similar features of chemical pneumonitis are characterized as more volatile, less viscous, low surface tension, and can diffuse easily into the bronchial tree [8]. Contrarily, as diesel is a mixture of saturated and aromatic hydrocarbons, so there is no definite data available on their absorption, distribution, metabolism, and excretion in animals and humans. Due to their non-irritating and bland nature, they can easily reach lower respiratory tract and inhibit mucociliary clearance even in the absence of risk factor. Deposited lipids are emulsified and swallowed by alveolar macrophages due to absence of enzymes in humans. Lipid macrophages are discharged into the alveoli in a timely manner once they have been disrupted. The result is fibrosis and bronchus disruption, as well as a giant cell reaction [9].

Chemical pneumonitis is asymptomatic in around 50% of patients though symptomatic patients can present with variety of symptoms characterized by acute shortness of breath, cough, chest pain, and hemoptysis in some cases.

There is no standard diagnostic test to diagnose chemical pneumonitis. However, certain tests can help us determine the severity of injury to the lungs. These include blood gases, computed tomography (CT) scan of the chest, chest X-rays, pulmonary function tests, and bronchoalveolar lavage. Our case was distinctive in a way that no bronchoalveolar lavage/transbronchial biopsy was undertaken and conservative approach was applied [10].

Treatment is purely focused on reducing symptoms and reversing the inflammation. Most of the treatment is supportive which follows the fundamental resuscitation method of airway protection, breathing support, and circulation maintenance. Though given the inflammatory nature of disease, anti-inflammatory medications play a crucial role in mitigating initial cytokine storm reaction.

We discovered that diverse diagnostic and therapeutic procedures were used depending on clinical assessment, physician preference, and prognostic variables in a review of the literature on lipoid pneumonia.

The prognosis depends solely on age and the patient's medical condition. However, studies have suggested that following appropriate care and accurate diagnosis prognosis for such patients has been excellent with full recovery [11].

Outcome and follow-up

The patient was followed up within 4 weeks initially and then 8 weeks of discharge with repeat CT thorax. On his subsequent follow-up, patient reported to be back on his baseline and his exercise tolerance also improved significantly. His follow-up CT scan after 4 weeks (Figure 6) showed improvement in bilateral upper lobe mass-like consolidation. His subsequent 8 weeks post-discharge CT scan showed residual anterior lung necrotic ranges with high risk of reinfection. After discussion with radiologist, it was planned to repeat chest X-ray after 3 months to see resolution of those changes, which the patient is still awaiting [12].

Learning points

I. Chemical pneumonitis can present with wide range of symptoms, initial presentation if quite severe needs timely management, and urgent review by critical care.
II. Treatment of chemical pneumonitis is essentially same as that of pneumonia caused by other pathogens.
III. Exogenous lipoid pneumonia has wide range of presentation on chest X-ray and diagnosis in mostly based on clinical history on many occasions.
IV. Corticosteroids are the mainstay of treatment in chemical pneumonitis as it helps to reduce inflammation of airways. Antibiotics are used second line if there is suspected bacterial infection (proven by clinical and biological markers).
V. Chemical pneumonitis can present after acute or chronic exposure. Our case report demonstrates case of chemical pneumonitis after acute exposure. Symptoms of chronic chemical pneumonitis may or may not be present and can take months or years to develop to the point of noticeability.

What is new?

Fuel Siphoning is a widespread technique, particularly in south Asian countries among vehicle mechanics, drivers, and farmers. The Medline search strategy "chemical pneumonitis" on the 15th of June 2022 identified eight case reports from Asian countries describing hydrocarbon pneumonitis in mechanics and farmers. In North Carolina, a case series described five cases of previously healthy people who developed acute respiratory failure after exposure to hydrocarbon aerosols. The authors describe a case of chemical, hydrocarbon (exogenous lipoid) pneumonitis, complicated by transudative pleural effusion and likely bacterial superinfection. We review the literature on the incidence of this and related categories of disease, and management approaches.

Conflict of interest
Authors declare that there is no conflict of interest regarding the publication of this article.

Funding
None.

Consent for publication
No consent was taken from patient due to the maintenance of anonymity.

Ethical approval
Ethical approval is not required from our institution for publishing a case report.

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Summary of the case

1	**Patient (gender, age)**	66 years old male
2	**Diagnosis**	Chemical pneumonitis (Lipoid Exogenous pneumonia)
3	**Symptoms**	Shortness of breath, fever, and hemoptysis.
4	**Medications**	Broad spectrum antibiotics and steroids.
5	**Background**	Fuel siphoning practices has increased the prevalence of chemical pneumonitis around the globe. Hydrocarbons exposure can stimulate host inflammatory responses in similar manner as other insults causing pneumonia.
6	**Conclusion**	Due to similar presentation of chemical pneumonitis as other causes of pneumonia, it is a clinical diagnosis in most cases. Initial presentation if severe, warrants urgent review by intensive care team and timely management plan.