

# The Combined Use of Inhaled and Intravenous Steroids for Children With Chemical Pneumonitis After Ingestion of Paint Thinner

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Received 2014 October 11; Revised 2015 April 21; Accepted 2015 May 08.

## Abstract

**Background:** Some studies in the literature support the use of either inhaled or systemic steroids for the treatment of chemical pneumonitis; however, no data have been published on the combined use of inhaled and intravenous (IV) steroids.

**Objectives:** This brief report describes the effective use of inhaled plus systemic steroids in managing six critical pediatric patients.

**Patients and Methods:** Medical records of patients were analyzed retrospectively.

**Results:** Of the six patients, 83.3% (n = 5) were male and 16.7% (n = 1) were female, with a mean age of  $2.1 \pm 0.49$  years. The most common clinical signs were dyspnea (83.3%), fever (66.6%), and vomiting (66.6%). Owing to supportive treatments and the combined steroid treatment, respiratory distress diminished and there was no need for oxygen in any of the patients after 5 days. All patients were discharged without any sequelae.

**Conclusions:** The use of steroids in treating hydrocarbon pneumonias is still controversial. However, we suggest that the combined use of inhaled and intravenous steroids had positive effects on the clinical and radiological recovery of our patients.

**Keywords:** Combined, Steroid Treatment, Chemical Pneumonia, Children, Hydrocarbon Pneumonias

## 1. Background

Chemical pneumonia is caused by aspiration of substances that are harmful for lung tissue, such as volatile hydrocarbons and chemical oils (1). Pneumonitis after hydrocarbon ingestion is relatively rare and occurs in 2% of cases (2). The main purpose of treatment is for the lungs to recover and the patient to have a good outcome (3), and management is mainly supportive. However, the use of antibiotics and steroids in treating pneumonias related to hydrocarbon poisoning is still controversial. Some studies in the literature support the use of either inhaled or systemic steroids for the treatment of chemical pneumonitis; however, no data have been published on the combined use of inhaled and intravenous (IV) steroids.

## 2. Objectives

This brief report describes the effective use of inhaled plus systemic steroids in managing six critical pediatric patients who developed chemical pneumonia after ingesting paint thinners.

## 3. Patients and Methods

In this study, the medical records of six patients admitted to the pediatric intensive care unit (PICU) of Adiyaman University teaching and research hospital (tertiary center) due to ingesting paint thinners between January 1, 2013 and September 1, 2014 were retrospectively evaluated. The clinical features, laboratory findings, and treatment outcomes of cases diagnosed with chemical pneumonia due to ingesting paint thinners were analyzed retrospectively. Critical pediatric patients who had developed chemical pneumonia after ingesting paint thinners and who had been admitted to the PICU were included in the study; other paint thinner poisoning cases were excluded. Chemical pneumonia was diagnosed based on the history and the radiological and laboratory findings. A sudden onset of dyspnea or coughing and infiltrations on chest X-ray, along with information about the patients' medical history, supported the diagnosis.

Supportive treatments, including the administration of IV fluids, parenteral nutrition, and oxygen inhalation therapy, were started immediately for all patients and administered in the PICU. In spite of the supportive treatments, nebulized budesonide (200  $\mu$ g, twice daily) was administered to patients because of ongoing respiratory

distress and a worsening in their chest radiographic findings after 6 - 12 hours. As a result of delays in the onset of clinical response, parenteral methylprednisolone (0.5 mg/kg/dose, IV) was added to the treatment on the second day. Ampicillin sulbactam (two patients) and ceftriaxone (one patient) were the initiated antibiotics.

Because of its retrospective design, this study does not conflict with the Declaration of Helsinki. As a result, ethics committee approval was not required.

The data were analysed using IBM SPSS 15 software (SPSS Inc., Chicago, IL), and the descriptive statistical characteristics of the patients were determined. No comparative analysis was performed.

#### 4. Results

Of the six patients, 83.3% (n = 5) were male and 16.7% (n = 1) were female, with a mean age of  $2.1 \pm 0.49$  years (range 18 months - 3 years). The most common clinical signs were dyspnea (83.3%), fever (66.6%), weakness (66.6%), and vomiting (66.6%). Although the initial chest X-rays were normal for four of the patients (66.6%, [Figure 1A](#)), pneumonic infiltrates developed on their chest radiographies after 6 - 12 hours. In addition, pleural effusions occurred in two patients during follow-up ([Figure 1B](#) and [1C](#)). The biochemical investigations were normal in all except two patients, who had elevated C-reactive protein (CRP) levels. Hypoxemia was detected in the blood gas analysis at admission for all patients, and elevated white blood cell (WBC) counts were found in three patients. The clinical and demographic features of the patients are given in [Table 1](#).

A significant clinical improvement was observed for all patients after they received the combined steroid treatment. In the majority of patients (83.3%), respiratory distress diminished and there was no need for oxygen on the third day of the combination treatment. In one patient, respiratory distress and the need for oxygen persisted for five days after the combination treatment was administered. The mean duration of oxygen inhalation was  $3.8 \pm 1.1$  days. Owing to supportive treatments and the combined steroid treatment, respiratory distress diminished and there was no need for oxygen in any of the patients after 5 days. Antibiotics were started on the fifth day for three patients who had fever and elevated CRP and WBC levels. The mean hospitalization time was  $8.1 \pm 4.1$  days. All patients were discharged without any sequelae ([Table 1](#)).

#### 5. Discussion

The main purpose of treatment in chemical pneumonia following exposure to hydrocarbon compounds, such

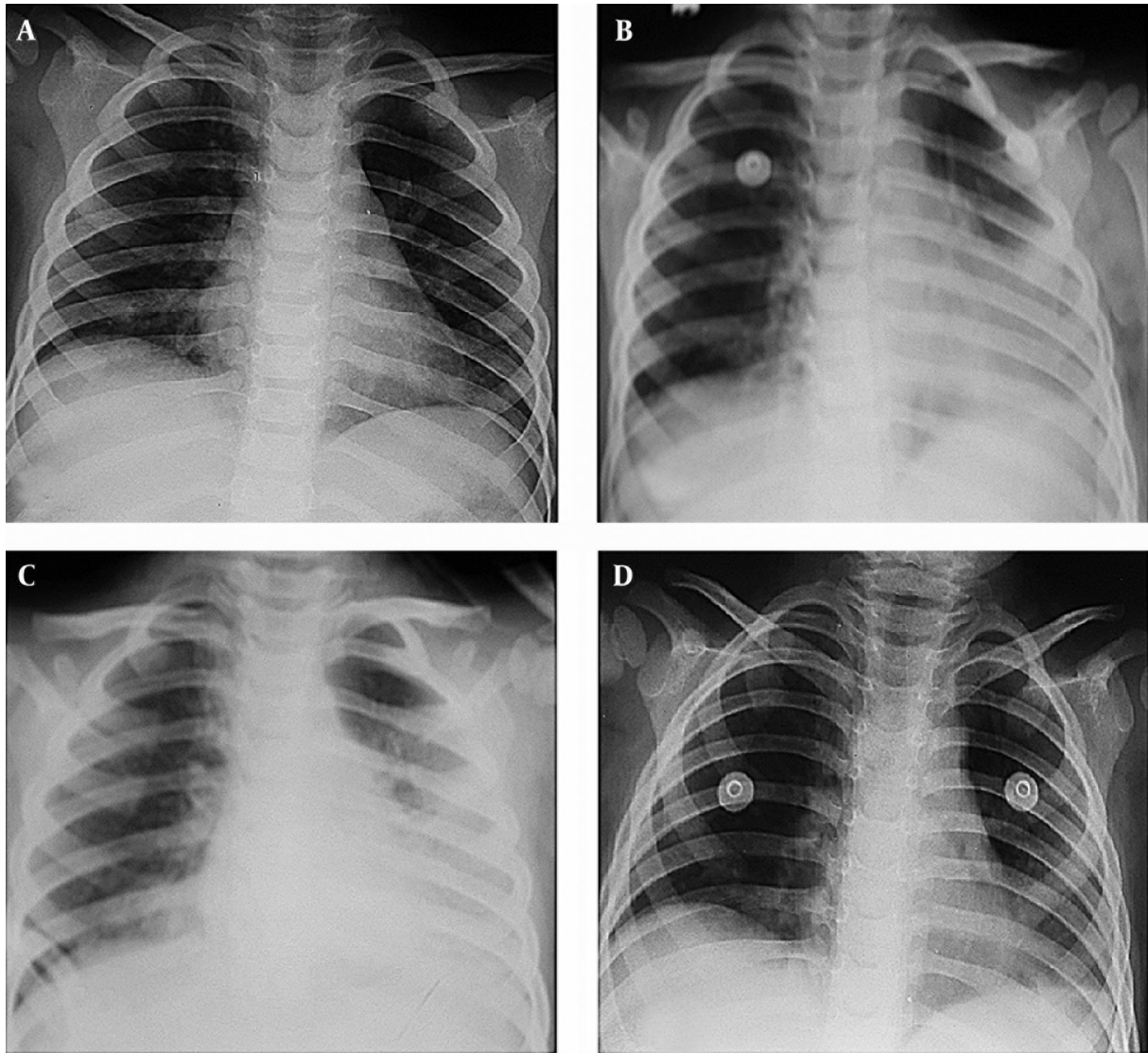
as paint thinners, is for the lungs to recover and the patient to have a good outcome (3). Administering antibiotics and steroids in the treatment of pneumonias related to hydrocarbon poisoning is still controversial.

Many studies have supported the use of steroids to treat chemical pneumonia. Inhaled budesonide was effective in treating two children who developed chemical pneumonia after ingesting petroleum naphtha, and parenteral pulse steroid treatment was effective in treating an adult patient who developed adult respiratory distress syndrome (ARDS) after ingesting petroleum naphtha (4, 5). A study that analyzed four patients who developed chemical pneumonia following hydrocarbon poisoning reported that parenteral use of methylprednisolone was an effective treatment and resulted in no secondary infections (6). Lipoid pneumonia is a necrotizing type of pneumonia that can be observed in hydrocarbon poisoning and can be characterized by pulmonary abscess, pneumatocele, pneumothorax, and pleurisy (7). Oral prednisolone was reported to be very effective in treating a patient who developed lipoid pneumonia following aspiration of machine oil (8). Annobil et al. reported a series of five children with lipoid pneumonia following nasal instillation of olive oil, where prednisolone was used for varying periods of 2-5 months, resulting in complete clinical and radiological recovery without adverse events (9). Similar to previous studies, respiratory symptoms and roentgenographic findings in our study resolved rapidly within 5 days in all patients after combined corticosteroid therapy and without adverse events.

In contrast to studies that have advocated the use of steroids, there are several that recommend they not be used. One multicenter study that evaluated the effectiveness of steroid treatment for hydrocarbon pneumonia in children recommended avoiding steroids (10). Another study reported that three-quarters (74.3%) of the patients had radiological abnormalities and were successfully discharged without the use of steroids (11). However, a major limitation of both these studies is that the number of severe cases was very low (4.2% and 6.5%, respectively). An earlier animal study in which 10 dogs who had been intratracheally injected with kerosene and treated with dexamethasone and ampicillin sodium were compared to 10 controls showed no benefits of using corticosteroids and antibiotics (12).

Some studies have reported the use of steroids in a limited number of cases. Franzen et al. reported that corticosteroids were administered in 4.9% of acute chemical toxic pneumonitis (13), while Sen et al. reported that 18 patients (33.3%) who were admitted to the PICU were treated with steroids (1).

Our study has several limitations. First, it included



**Figure 1.** Chest Radiograph Findings for the Patients

only a few patients. In addition, the independent effect of the steroids on recovery could not be evaluated because this was not a randomized controlled trial.

In conclusion, the use of steroids for treating hydrocarbon pneumonias is still controversial. However, we suggest that the combined use of inhaled and intravenous steroids had positive effects on the clinical and radiological recovery of our patients. Comprehensive randomized controlled trials are needed to elucidate the independent effects of steroids on treating hydrocarbon pneumonias.

#### Footnote

**Authors' Contribution:** Study concept and design: Capan Konca; acquisition of data: Capan Konca, MT; analysis and interpretation of data: Mehmet Tekin and Mehmet Turgut; drafting of the manuscript: Capan Konca; critical revision of the manuscript for important intellectual content: Mehmet Tekin and Mehmet Turgut; statistical analysis: no statistical analysis was performed; administrative, technical, and material support: no such support was required; study supervision: Capan Konca, MT.

**Table 1.** Clinical and Demographic Features of the Patients

Patients	U.D.	E.P.	Y.S.	ER.C.	AY.D.	AM.K.
<b>Gender</b>	M	M	M	F	M	M
<b>Age, y</b>	2	2	2	1.5	3	2
<b>Clinical signs</b>						
Fever	Yes	No	Yes	Yes	No	Yes
Dyspnea	Yes	Yes	No	Yes	Yes	Yes
Coughing	Yes	No	Yes	No	No	No
Vomiting	Yes	Yes	No	Yes	Yes	No
Nasal flaring	Yes	Yes	No	Yes	No	Yes
Weakness	Yes	Yes	Yes	Yes	No	No
<b>Radiological findings</b>						
Pneumonic infiltration	Yes	Yes	Yes	Yes	Yes	Yes
Pleural effusion	Yes	No	No	Yes	No	No
<b>Laboratory results</b>						
Elevated WBC	Yes	No	No	Yes	No	Yes
Elevated CRP	Yes	No	No	Yes	No	No
Hypoxemia	Yes	Yes	Yes	Yes	Yes	Yes
<b>Hospitalization time, d</b>	9	6	5	16	5	8
<b>Use of antibiotics</b>	Yes	No	No	Yes	No	Yes
<b>Duration of oxygen supplementation, d</b>	4	3	3	6	3	4
<b>Duration of steroid treatment, d</b>	6	4	4	12	4	6

Abbreviations: CRP, C-reactive protein; d, day; F, female; M: male; WBC, white blood cell; y, year.

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