



Case report

Buried under gypsum powder – A rare respiratory complication

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ABSTRACT

Gypsum is a mineral dust consisting of calcium sulfate and is commonly used in building construction. We here report the first case of an acute calcium sulfate aspiration.

An accidental avalanche of fine gypsum powder covered entirely a silo worker. He aspirated a large amount of gypsum powder without losing consciousness. At admission to the emergency department the patient was breathing spontaneously and directly underwent emergency bronchoscopy. Acute tracheobronchitis was diagnosed. Remaining calcium sulfate was removed by aspiration without rinsing with additional water in order to avoid further exothermic damage to the bronchial mucosa from chemical reactions. He received steroid treatment and antibiotics, as well as bronchodilative therapy in an attempt to increase mucociliary clearance. Within a month the patient was symptomfree without any residual radiological or functional impairment.

This unusual aspiration accident is to our knowledge the first case report of an accidental calcium sulfate aspiration. Our treatment choice left the patient without residual pulmonary impairment.

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1. Introduction

Gypsum is commonly used in building constructions, but also for medical orthopedic braces. It consists of calcium sulfate dehydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). If dry calcium sulfate powder (plaster) is mixed with water, gypsum is formed. Intoxications or accidental exposures with gypsum or plaster powder are mainly due to its exothermic reaction upon mixture with water. Exposure to calcium sulfate dust can cause temporary irritation to eyes, skin, nose and upper respiratory tract. Eye burns have been described.¹ In the human upper airways, short-term repeated calcium carbonate inhalation (at a maximum concentration of 5000 g/m^3) provokes irritation.² Although ingestions in a suicidal attempt have been reported,³ acute inhalations or aspiration incidents of gypsum powder are not described in the literature so far.

We here report on the first case of acute accidental gypsum powder aspiration, its treatment and short-term outcome.

2. Case summary

A 34 year-old Caucasian worker of a gypsum factory was admitted to the emergency department after being involved in

a spillage accident with gypsum powder. The accident happened in a closed gypsum silo, where several tons of stored gypsum were mobilized accidentally. The patient was pushed against the silo wall by a gypsum avalanche and entirely buried with fine gypsum powder. He initially aspirated a large amount (at least several spoons) of gypsum, but he was able to rapidly free his airways himself. His body remained buried in gypsum powder for a total of about 15 min. At the gypsum factory the gypsum was removed by showering. Initially the patient presented respiratory symptoms with dyspnea and stridor. He was coughing gypsum particles. Oxygen saturation without supplemental oxygen was diminished (90% measured by pulseoxymetry) and oxygen was administered. The patient was transported to the emergency department by helicopter. At hospital admission the patient was breathing with an increased frequency of 27/min. Lung auscultation revealed wheezing during inspiration and expiration. Arterial blood gas analysis performed in the emergency department was in the normal range (pO_2 89 mmHg, pCO_2 44 mmHg). The chest radiography at admission showed bronchial opacities involving the right upper lung lobe, corresponding to gypsum accumulation (Fig. 1A). Ophthalmological exam revealed superficial keratitis. Laboratory investigations showed no acute inflammatory signs with normal C-reactive protein (CRP), but a slight elevation of leucocyte count (12.3 G/l). Emergency bronchoscopy was performed and revealed gypsum deposits (in form of chunks) in the entire bronchial system (Fig. 2A and B) proving bronchial aspiration of a large amount of gypsum powder. The tracheal and bronchial mucosa was irritated

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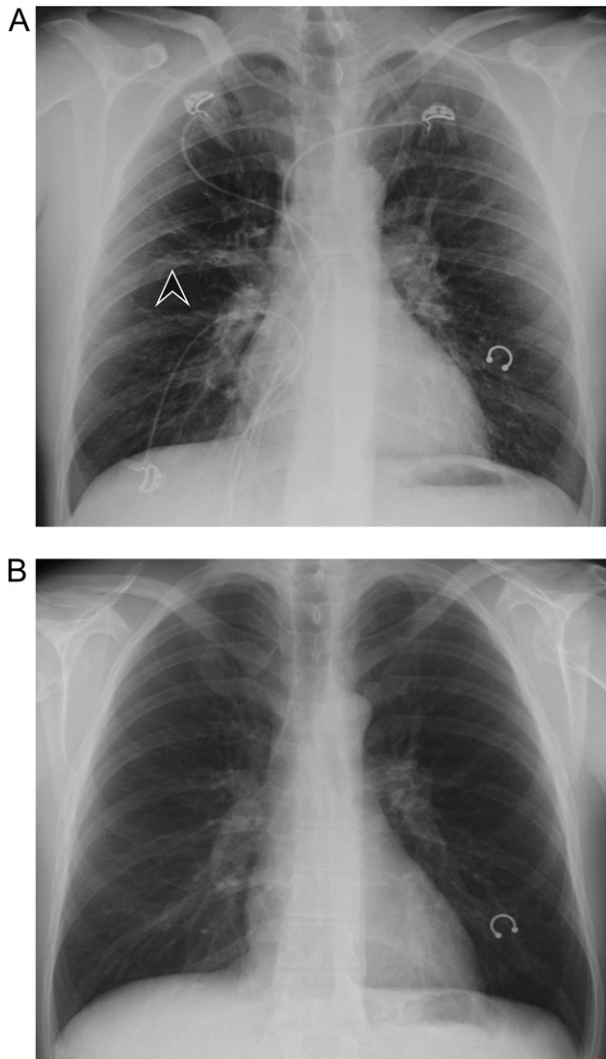


Fig. 1. Chest X-ray at admission (A) and 1 month later (B).

in areas with gypsum deposits and acute tracheobronchitis was diagnosed. We removed gypsum deposits by bronchoscopy from the main airways by aspiration without rinsing to avoid further exothermic chemical reactions (Fig. 2C). In addition, the patient received systemic corticosteroid therapy and antibiotic treatment with amoxicillin–clavulanate. In an attempt to stimulate mucociliary clearance,⁴ bronchodilative inhalation therapy was initiated. Lung function before discharge showed normal lung volumes without obstruction. Diffusion capacity was normal. One and three months after the accident we examined the patient in our ambulatory clinic. He then reported no respiratory symptoms. His diffusion capacity and lung volumes remained normal with an additional increase in his forced vital capacity (FVC) of nearly 1 L (111% of predicted FVC). Control chest radiography showed clearance of the bronchial opacities without signs of residual gypsum depositions or infiltrates (Fig. 1B). Due to the favorable follow-up, no further bronchoscopy was performed.

3. Discussion

To our knowledge, this is the first case report describing aspiration of large amounts of gypsum powder into the lung and its management and outcome.

Current treatment recommendations for gypsum inhalation or aspiration advocate supportive treatment without any published evidence.⁵ Our main treatment goal was to remove endotracheal and endobronchial gypsum chunks and powder without inducing additional mucosal burns by exothermic reaction upon contact with water. The entire tracheobronchial tree is covered by an airway surface lining fluid consists of two phases with an aqueous based inner and viscous mucous gel outer layer.⁶ Some of the gypsum powder probably caused already exothermic reaction in this patient and lead to tracheobronchitis. Because of the large amount of gypsum aspirated with remaining gypsum powder chunks in the tracheobronchial system, we expected further exothermic reaction of remaining unresolved powder upon rinsing with water. We thus carefully removed residual gypsum from the tracheobronchial tree by aspiration.

Similar to our case report, one recent accidental aspiration of portland cement has been described previously.⁷ This construction material may contain gypsum in addition to other ingredients (different calcium salts). Like gypsum it also hardens mixed with water and can cause burns. The patient described in this case report received antibiotic therapy for bilateral pneumonia and supportive non-invasive ventilation after cement aspiration. Cement deposits were removed spontaneously.

Respiratory effects of gypsum or calcium sulfate have been studied in a few animal experiments after inhalation or intratracheal administration. Major amounts of gypsum were found in dust samples along with other components after the World Trade Center Collapse.⁸ Mice, which were exposed to high concentrations of this dust, developed mild to moderate lung inflammation and airway hyperresponsiveness.⁹ Chronic inflammatory changes were also observed after intratracheal calcium sulfate administration in syrian hamsters.¹⁰

Today, there is no literature available about pulmonary effects in humans after aspiration or inhalation of calcium sulfate, while respiratory manifestations of acute inhalation and aspiration accidents of other mineral dusts like talcum and silica are extensively reported. We will present the clinical observations of other mineral dust aspiration accidents briefly below.

Talcum powder consists of finely ground magnesium silicate. Talcum is therapeutically used for pleurodesis in malignant effusions.¹¹ Commonly used for baby care before, it has lead to acute mineral dust inhalation and aspiration accidents especially in children. The described cases often occur during diaper changes, when talcum powder is accidentally spilled over the baby's face. The children can present delayed hours after accidental inhalation or aspiration with severe respiratory difficulties.¹² Treatment is supportive and includes steroid administration and antibiotic treatment.^{12,13} Bronchoalveolar lavage has been advocated but remains controversial.¹² Outcome can be fatal.

Crystalline silica is another mineral dust leading to pulmonary diseases.¹⁴ Although silica is the most copious mineral on earth, acute silicosis is rare. In acute silicosis symptoms develop within weeks to years after exposure to crystalline silica.¹⁴ Patients can develop respiratory failure in a short time as described in previous reviews.¹⁵ Symptoms are often present before radiographic changes occur. The later include diffuse nodular opacities, which can confluence.¹⁴

Treatment of acute silicosis is mainly supportive, but steroid medication can be beneficial.¹⁶ Ultimately, pulmonary transplantation has been described in one single case for a patient with aspiration-induced silicosis.¹⁷ In general, the prognosis of patients with acute silicosis remains poor.¹⁵

In analogy to these treatment strategies, and the animal studies described before, we decided to treat our patient with steroids and antibiotic treatment after emergency bronchoscopy.

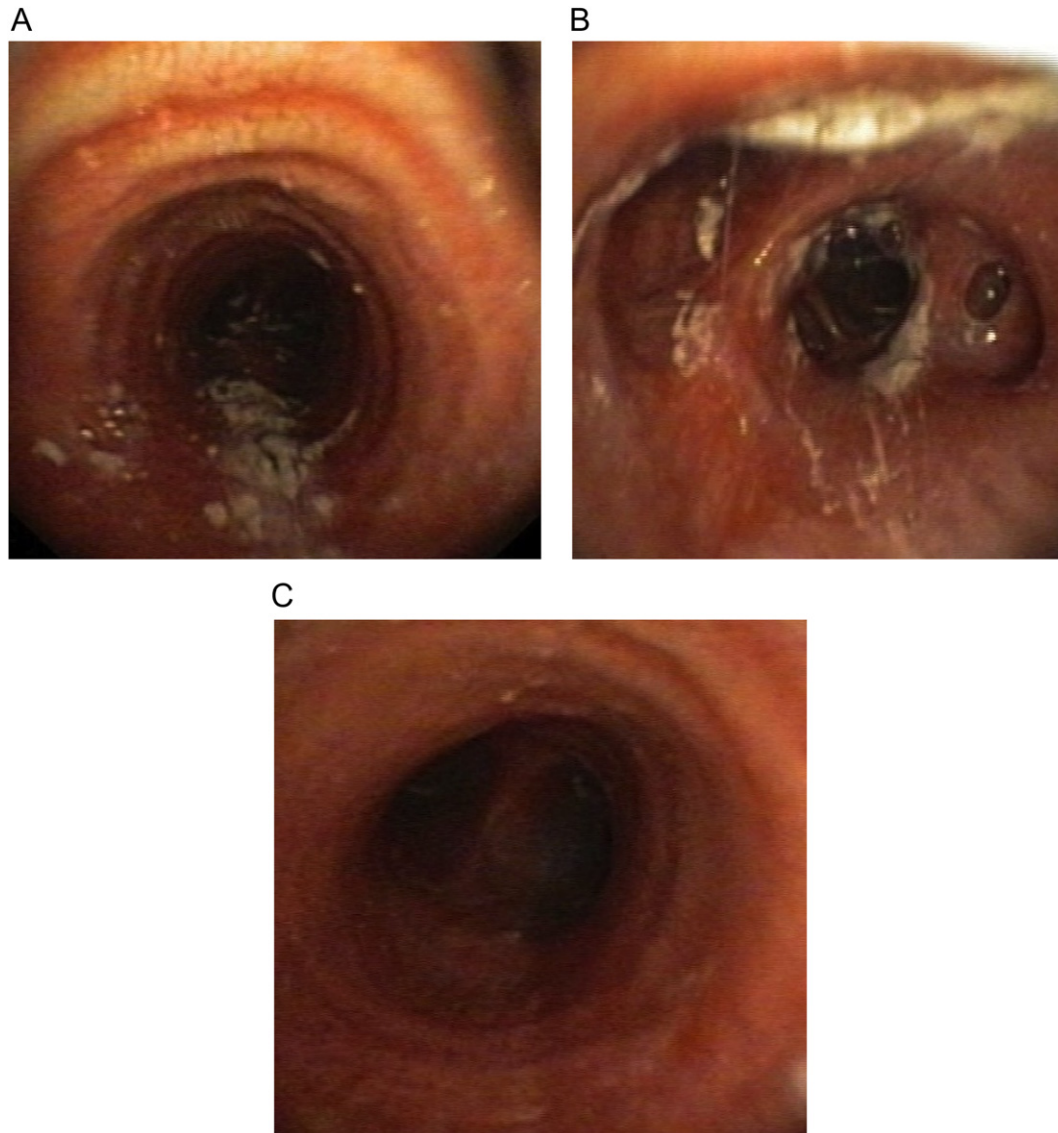


Fig. 2. Flexible bronchoscopy showing gypsum deposits in the trachea (A) and distal bronchi (B: view in the lower right lobe). After aspiration the trachea was free of gypsum particles (C).

Because of the risk of exothermic burns from the chemical reaction upon water of the remaining almost dry gypsum powder chunks in the tracheobronchial tree we did not perform bronchoalveolar lavage. The outcome of our patient was favorable after 3 months with no respiratory symptoms indicating bronchial hyperresponsiveness, no lung functional limitations and no radiological anomalies.

4. Conclusion

This report shows the first case of accidental aspiration of a large amount of gypsum powder. The patient was treated by bronchoscopy with aspiration of remaining endobronchial gypsum deposits. To avoid a further exothermic reaction and to prevent further distribution of gypsum into the lung parenchyma, we minimized local anesthesia and did not apply any additional saline during this procedure. The outcome was favorable with no residual clinical symptoms, no lung function impairment or radiological manifestations after 3 months.

Conflict of interest statement

None declared.

References

1. Daly M, Tuft SJ, Munro PM. Acute corneal calcification following chemical injury. *Cornea* 2005;**24**(6):761–5.
2. Riechelmann H, Rettinger G, Weschta M, Keck T, Deutsche T. Effects of low-toxicity particulate matter on human nasal function. *Journal of Occupational and Environmental Medicine/American College of Occupational and Environmental Medicine* 2003;**45**(1):54–60.
3. Yegane RA, Bashashati M, Bashtar R, Ahmadi M. Gastrointestinal obstruction due to plaster ingestion: a case-report. *BMC Surgery* 2006;**6**:4.
4. Lafortuna CL, Fazio F. Acute effect of inhaled salbutamol on mucociliary clearance in health and chronic bronchitis. *Respiration; International Review of Thoracic Diseases* 1984;**45**(2):111–23.
5. RK K. *Poisindex®System*. Greenwood Village CO: Thomson Reuters; 2011.
6. Widdicombe JH, Bastacky SJ, Wu DX, Lee CY. Regulation of depth and composition of airway surface liquid. *The European Respiratory Journal: Official Journal of the European Society for Clinical Respiratory Physiology* 1997;**10**(12):2892–7.

7. Gilomen SBT. Zementunfall mit harten Folgen. *Swiss Medical Forum* 2012;**26**(12):539–41.
8. McGee JK, Chen LC, Cohen MD, Chee GR, Prophete CM, Haykal-Coates N, et al. Chemical analysis of World Trade Center fine particulate matter for use in toxicologic assessment. *Environmental Health Perspectives* 2003;**111**(7): 972–80.
9. Gavett SH, Haykal-Coates N, Highfill JW, Ledbetter AD, Chen LC, Cohen MD, et al. World Trade Center fine particulate matter causes respiratory tract hyperresponsiveness in mice. *Environmental Health Perspectives* 2003;**111**(7): 981–91.
10. Adachi S, Takemoto K, Kimura K. Tumorigenicity of fine man-made fibers after intratracheal administrations to hamsters. *Environmental Research* 1991;**54**(1): 52–73.
11. Shaw P, Agarwal R. Pleurodesis for malignant pleural effusions. *Cochrane Database of Systematic Reviews* 2004;**1**. CD002916.
12. Piraudeau PW, Wilson RG, Hall MA, Milne M. Inhalation of baby powder: an unappreciated hazard. *BMJ* 1991;**302**(6786):1200–1.
13. Patarino F, Norbedo S, Barbi E, Poli F, Furlan S, Savron F. Acute respiratory failure in a child after talc inhalation. *Respiration; International Review of Thoracic Diseases* 2010;**79**(4):340.
14. Adverse effects of crystalline silica exposure. American Thoracic Society Committee of the Scientific Assembly on Environmental and Occupational Health. *American Journal of Respiratory and Critical Care Medicine* 1997;**155**(2): 761–8.
15. Leung CC, Yu IT, Chen W. Silicosis. *Lancet* 2012;**379**(9830):2008–18.
16. Goodman GB, Kaplan PD, Stachura I, Castranova V, Pailles WH, Lapp NL. Acute silicosis responding to corticosteroid therapy. *Chest* 1992;**101**(2):366–70.
17. Chida M, Fukuda H, Araki O, Tamura M, Umezu H, Miyoshi S. Lung transplantation for aspiration-induced silicosis of the lung. *General Thoracic and Cardiovascular Surgery* 2010;**58**(3):141–3.