CASE REPORT

Diffuse alveolar haemorrhage associated with aerosol propellant use

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mark.huntington@usd.edu**SUMMARY**

Diffuse alveolar haemorrhage (DAH) is a clinical syndrome resulting from injury to the alveolar microcirculation, most commonly associated with not only autoimmune disorders or connective tissue disease, but also a variety of infections, neoplasms and toxins. We report here a case of an otherwise healthy young man with DAH attributable to an inhalation injury resulting from use of aerosol spray paint.

BACKGROUND

Diffuse alveolar haemorrhage (DAH) results from injury to the alveolar microcirculation and can potentially lead to respiratory failure. Most commonly caused by autoimmune disorders, it is also associated with a variety of infections, neoplasms and toxins.¹

CASE PRESENTATION

A 20-year-old man presented with a 1-day history of haemoptysis, dyspnoea and pleuritic chest pain. Symptoms began immediately after painting a car using '99-cent spray paint, the cheapest stuff you could find' inside of an enclosed garage without use of any personal protective equipment. He was on no medication and had no recent respiratory or other illness. He denies fevers, chills, weight loss, epistaxis, weakness, history of abnormal-looking urine or rashes. He was a current one pack/day smoker and has smoked for 1 year. He denied any illicit drug or alcohol use. Physical examination revealed diffuse coarseness throughout the lung fields with good air movement and without wheezes. No blood was seen on head and neck examination, and the remainder of the physical examination was unremarkable.

INVESTIGATIONS

Chest X-ray and high-resolution contrasted CT showed diffuse bilateral infiltrates (figure 1). The results of laboratory investigations are shown in table 1. A urine drug screen was positive only for cannabinoids, despite his initial denial of marijuana use. When confronted with the results of the drug screen he admitted to smoking one serving of marijuana from a glass pipe one time 3–4 weeks prior to admission.

Bronchoalveolar lavage revealed cloudy pink fluid with predominantly neutrophilic inflammation. Subsequent thorascopic wedge biopsies of the right upper, middle and lower lungs were performed and showed identical findings of DAH with

associated acute lung injury, negative for vasculitic changes, granulomas or viral inclusions (figure 2).

DIFFERENTIAL DIAGNOSIS

The initial differential diagnosis included infectious, autoimmune, as well as chemical pneumonitis.

TREATMENT

He was initially placed on azithromycin 500 mg daily and ceftriaxone as empiric therapy for pneumonia, and the azithromycin was continued throughout the hospitalisation. Clinical improvement was very slow.

Steroids are indicated for many of the causes of DAH. While inhalation-related DAH may be a

Figure 1 (A) Chest X-ray demonstrating diffuse alveolar airspace opacities. (The unusual appearance of the cardiac silhouette apex is due to a coincidental benign pericardial cyst, identified on CT.) (B) CT demonstrating reticular-nodular and ground glass appearances.

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Table 1 Laboratory investigation for causes of DAH in our patient

Study	Result
Haematology	
Leucocytes	12.4×10 ³ /μL
Haemoglobin	13.8 g/dL
Erythrocyte sedimentation rate	37 mm/h
C reactive protein	32.7 mg/L
Platelet count	363×10 ³ /μL
Urine studies	
Urinalysis	Within normal limits
Comprehensive drug screen	Positive for cannabinoids
Autoimmune serologies	
Lupus anticoagulant	Within normal limits
ANA screen	
Antimyeloperoxidase	
Anti-Smith antibody	
RNP antibody	
DsDNA antibody	
Anti-DNAse-B antibody	
Glomerular basement membrane IgG and IgA	
Serine protease 3 antibody	
Anticardiolipin IgG and IgM	
Infectious disease serologies	
Hantavirus IgG and IgM	Within normal limits
Histoplasma IgG and IgM	
HIV Ag and Ab	
Legionella via BAL, IgM and DFA	
Mycoplasma pneumonia IgM	
Q fever IgG	
ASO	
Chlamydia psittaci IgG and IgM	
Chlamydia trachomatis IgG and IgM	
Chlamydia pneumoniae IgM	
Viral respiratory DFA antigen panel (adenovirus, influenza A and B, RSV, parainfluenza 1, 2, 3)	
Sputum and bronchoalveolar lavage cultures	
Bacterial	No growth
Fungal	
Viral	

ANA, antinuclear antibody; ASO, antistreptolysin O; BAL, bronchoalveolar lavage; DFA, direct fluorescent antibody; RNP, antiribonucleoprotein; RSV, respiratory syncytial virus.

self-limiting process, this patient's poor initial clinical progress prompted a trial of steroid. Methylprednisolone intravenous 60 mg every 8 h was initiated after the lung biopsy showed diffuse alveolar haemorrhage. This was tapered to 80 mg daily as his clinical condition improved, and then switched to oral prednisone 60 mg daily prior to discharge.

OUTCOME AND FOLLOW-UP

He was discharged to home on a prednisone taper starting at 40 mg orally daily, decreasing 10 mg daily every week.

DISCUSSION

DAH has been associated with a wide variety of connective tissue disorders and infections. There is an association with cancers and their treatments.² DAH has been described in organ transplantation and immunosuppressive therapy. Medications

Figure 2 Pathological section confirming alveolar haemorrhage, demonstrating hemosiderin-laden macrophages within the alveolar spaces, oedematous spindle fibroblast infiltration, mixed acute and chronic inflammation and the absence of vasculitis, granulomas, viral inclusions or malignancy. (photo courtesy of Dr Jacquelyn D Choate).

that modulate coagulation and platelet activity have also been implicated, as have been an assortment of other medications.

In addition to systemic conditions and agents, localised inhalational injuries have been associated with DAH.^{1–3} Respiratory exposure to pesticides has led to this condition, though this does not appear to be a common pathology in these exposures.⁴ Inhalational injury resulting in DAH is perhaps most commonly associated with illicit drug use, specifically cocaine,^{5–6} though there are reports following the use of cannabinoids, specifically via plastic water pipes.^{7–8} Inhalational injury via the use of consumer products employing aerosol spray cans has been implicated in DAH.^{9–10}

We believe the aetiology of our patient's condition was the latter source of inhalational injury. The temporal relationship to the exposure to paint and onset of symptoms suggest causality. Extensive investigation failed to identify connective tissue or other autoimmune conditions, infections, neoplasms or pharmaceutical interventions to which a systemic cause of DAH could be attributed. Although our patient had a history of cannabinoid use, we do not believe it to be the cause of his condition: he used glass rather than plastic water pipes—the production of the acid anhydrides via incomplete combustion in plastic smoking vessels is attributed to be the cause of DAH in cannabinoid-associated cases.⁸ Other acute toxic exposures such as cocaine are less likely given their absence from the toxicology tests.

Aerosol spray cans used for household consumer products are uniquely capable of causing diffuse alveolar injury. Though droplets are relatively large during spraying (median diameter of 22 μm), they rapidly reduce in size to nanoparticles with a diameter of 75 nm—capable of entering the alveoli—due to evaporation of the propellant.¹¹ For spray ingredients capable of causing injury, this is a potentially dangerous exposure due to direct contact with the alveoli.

The use of consumer products employing aerosol spray cans has been implicated in development of DAH. Previous reports include those used for detergents⁹ and waterproofing.¹⁰ The current report adds spray paint as a third category of aerosol sprays implicated, and to our knowledge is the first report of aerosol spray-paint associated DAH in the literature.

Learning points

- ▶ There are many potential causes of diffuse alveolar haemorrhage (DAH), including some seemingly unlikely sources.
- ▶ DAH may still be underlying pathology despite non-diagnostic bronchoalveolar lavage.
- ▶ A careful exposure history is warranted in patients with DAH that demonstrated negative autoimmune, infectious or connective tissue disease work-up.
- ▶ Temporal relationship between exposure and symptom onset may help discriminate between different possible culprits.
- ▶ Common household spray products may be associated with serious respiratory illness.

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Contributors FJ and PK were directly involved in the patient's care. MKH and PK contributed to the literature review and drafting the manuscript. PK, FJ and MKH were involved in crafting the final version of the manuscript.

Competing interests None.

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