CASE BASED DISCUSSION

Lesson of the month: extrinsic allergic (bronchiolo) alveolitis and metal working fluids

Paul Cullinan,1 Eva D’Souza,2 Rachel Tennant,3 Chris Barber4

INTRODUCTION

One of us was asked to consider a diagnosis of occupational asthma for a man who had worked for 20 years as a metal turner in a large, modern factory producing specialised machine parts. He described a 2 year history of severe breathlessness that improved when he was not at work. His spirometry was restrictive with a FEV$_1$ of 1.35 L (40% predicted) and FVC of 1.8 L (45% predicted), a ratio of 75%. Other lung function measurements indicated gas trapping; his TLC was 5.01 L (79% predicted) and RV/TLC 170% predicted. A high resolution CT scan of his lungs revealed a widespread ‘mosaic’ pattern of attenuation indicative of small airflow obstruction. We made a diagnosis of occupational extrinsic allergic bronchioloalveolitis and recommended that he change his work. After 12 months working elsewhere in the same company, away from the machine shop, his dyspnoea was greatly improved but had not disappeared; his FVC had increased to 2.41 L, his FEV$_1$ to 1.45 L and his TLC to 5.36 L.

Four months later we were referred a man who was also a metal turner in the same factory. For 2 years he had been a patient in a specialist interstitial lung disease clinic with a diagnosis of chronic hypersensitivity pneumonitis. A marked lymphocytosis in his bronchoalveolar lavage suggested ongoing exposure to an external cause. The nature of this had not been established although the positive findings of an autoimmune screen had led to conjecture of an ‘autoimmune’ aetiology, and of a high level of serum-specific IgG antibodies to *Aspergillus* species, that exposure to ‘mould at home or work’ might be relevant; an occupational history noted only that he worked for a machine parts manufacturer. While continuing to work he had been treated with pulsed methylprednisolone, cyclophosphamide, prednisolone, mycophenolate and N-acetyl cysteine with little evidence of success. His referral was occasioned by a (new) physician noting that his symptoms improved when he was not at work. On being informed that his illness was in all probability caused by his occupation, he chose not to return to work. Six months later, without any specific treatment, his lung function measurements had started to improve.

Following the first diagnosis, discussion with the factory’s occupational health service led to a systematic survey of 250 employees who worked in the same area. Through this we established that another metal turner was a patient at a third hospital with a diagnosis of hypersensitivity pneumonitis made 2 years previously; to his bemusement, since he had never kept them, a probable attribution to ‘birds’ had been made. He had been treated, intermittently, with high doses of prednisolone with no evidence of lasting benefit. The survey of other employees and subsequent specialist investigation established a further two cases of occupational bronchioloalveolitis with probable onset in 2010–2011.

DISCUSSION

These five men had a diagnosis and an occupation in common; all were metal machinists in a single factory, a job that entails exposure to mists of metal working fluids (MWFs). Inhalation of MWF is well recognised as a cause of extrinsic allergic bronchioloalveolitis (in this context a more accurate term than hypersensitivity pneumonitis),1–2 but it appears, from this experience, that the association is not widely appreciated by respiratory physicians.

Machining or ‘turning’ metal parts on a lathe is a skilled occupation used in the manufacture of a very wide variety of components; this is often done using cutting tools controlled by a computer and metalworking machinists in the UK and elsewhere may describe themselves as ‘computer numerical control’ operators. Other terms include computer numerical control grinder, turner, tool setter, cutter and machinist. Metal shaping and grinding commonly involves the use of MWF (in the UK also known as ‘coolant’, ‘cutting fluid’ or ‘suds’) to lubricate the process, to control its temperature and to carry away the waste metal (‘swarf’). The machines are generally enclosed and may be exhaust-ventilated to reduce—but rarely eliminate—the escape of MWF mist into the atmosphere. MWF is collected and recirculated, often with several machines sharing a common ‘sump’ or reservoir. Systems of MWF management are required to replenish and maintain its effectiveness and to monitor levels of microbial contamination. In the factory above, new lathes had been installed in 2010; in contrast with those they replaced, the new machines were capable of being operated continuously for 24 h and used a far higher volume of MWF. These changes probably led to far higher concentrations of MWF mist in the air of the shop floor.

Most modern MWFs are complex emulsions of water and a mineral, synthetic or semisynthetic oil; they also contain a wide range of chemical additives designed to enhance their performance and limit microbial growth. Allergic respiratory conditions due to water-containing MWFs date back to the late 1980s, with challenge studies confirming cases...
of occupational asthma caused by chemicals such as ethanola-
mine and pine oil deodorants. More recently, a number of large
outbreaks of respiratory disease have been reported in US
and European MWF-exposed workers, with cases of extrinsic
allergic (bronchiolo)alveolitis (EAA), occupational asthma, bron-
chitis and humidifier fever. Although difficult to prove, the
aetiology of the outbreaks is thought to be due to poor control
of MWF mists, linked with microbial contamination occurring
during their recirculation and prolonged use. Evidence to
support this comes from the unpredictable nature of the out-
breaks and the demonstration of IgG antibodies to a range of
bacteria, fungi and environmental mycobacteria in the serum of
exposed workers (with and without disease).

A high index of suspicion is required in EAA due to MWF
exposure as the symptoms are often non-specific and may be pro-
gressive, rather than clearly work-related. In some cases the pre-
senting symptoms have been predominantly constitutional, with
general malaise and unexplained weight loss. Long delays in
reaching the correct diagnosis are not uncommon because symp-
toms are often attributed to asthma, COPD or to recurrent chest
infections; or, as here, the diagnosis has been otherwise
explained. A HRCT with inspiratory and expiratory views in a
period when the patient is symptomatic is probably the most
useful diagnostic tool. This may show typical features of bronch-
chioloalveolitis, with one or more of ground glass opacities, small
centrilobular nodules and lobular areas of gas trapping although
this last finding is not specific. In other cases however, the HRCT
may appear normal (particularly during periods of relatively low
exposure), or show a pattern of disease more suggestive of non-
specific or usual interstitial pneumonitis. As with any other cause
of EAA, early recognition and the prevention of further expos-
ures offer the best outcome; as with all occupational diseases,
every effort should be made to maintain employment and
relocate affected workers to a safe, non-exposed work role.

An additional consideration is that the patient who has EAA
from MWF may have a number (sometimes several hundred) of
colleagues with similar exposures. The diagnosis of a single
case should prompt the workplace to review their risk
assessment and exposure controls, and to survey the remaining
workforce to identify other affected workers. Investigating large
outbreaks is logistically challenging, and where possible should
involve a multidisciplinary team including occupational lung
disease specialists, occupational health providers and occupa-
tional hygienists. In the outbreak above, careful scrutiny of all
exposed employees indicated that the problem was confined to
a small area of the shop floor; following extensive remedial
works to control MWF mists there have been no further cases.

Over the last decade, MWF exposure has become the most
commonly reported cause of occupational EAA in the UK,
responsible for approximately half of all cases. We recommend
that all patients with suspected EAA (and other patterns of inter-
stitial lung disease) are routinely asked about MWF exposures,
and that all potential cases are discussed as soon as possible with
an occupational lung disease centre.

Contributors PC and RT identified the cases and wrote the manuscript with the
assistance of ED and CB.

Competing interests None.

Provenance and peer review Not commissioned; internally peer reviewed.

Open Access This is an Open Access article distributed in accordance with the
Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which
permits others to distribute, remix, adapt, build upon this work non-commercially,
and license their derivative works on different terms, provided the original work is
properly cited and the use is non-commercial. See: http://creativecommons.org/
licenses/by-nc/4.0/

REFERENCES
1 Rosenman KD. Asthma, hypersensitivity pneumonitis and other respiratory diseases
associated with exposure to water-based metalworking fluids. Ann Occup Hyg
3 Barber CM, Burton CM, Robinson E, et al. Hypersensitivity pneumonitis due to
inspiratory CT scan: a finding of oblitative bronchiolitis and other causes of
bronchial obstruction. Multidiscip Respir Med 20013;8:1–86.
5 Robertson W, Robertson AS, Burge CB, et al. Clinical investigation of an outbreak of
Lesson of the month: extrinsic allergic (bronchiolo)alveolitis and metal working fluids

Paul Cullinan, Eva D'Souza, Rachel Tennant and Chris Barber

Thorax published online July 8, 2014

Updated information and services can be found at:
http://thorax.bmj.com/content/early/2014/07/08/thoraxjnl-2014-205251

These include:

References
This article cites 5 articles, 2 of which you can access for free at:
http://thorax.bmj.com/content/early/2014/07/08/thoraxjnl-2014-205251#BIBL

Open Access
This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

Open access (245)
Interstitial lung disease (559)
Pneumonia (infectious disease) (579)
Pneumonia (respiratory medicine) (562)
TB and other respiratory infections (1273)
Occupational and environmental medicine (128)
Asthma (1782)
Chemotherapy (183)
Radiology (diagnostics) (812)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/