[¶27-201] The “Aerotoxic Syndrome” — real condition or flight of fancy?

Last reviewed: 18 May 2011

Introduction

Jonathan Burdon MBBS, MD, M Hlth & Med Law, FRACP, FCCP, FACLM, FAICD, Consultant Respiratory Physician, East Melbourne.

Address for correspondence: Dr Jonathan Burdon, Suite 68, 166 Gipps St, East Melbourne 3002.

Email: jburdon@bigpond.net.au.

J Burdon

Fumes produced by pyrolysed engine oil have been recognised to contaminate the incoming air in aircraft cockpits and cabins for more than fifty years.[1.] [2.] The toxic effect of these fumes on the health and wellbeing of aircrew has, however, only become recognised and the focus of public scrutiny over the last decade or so. This has been the result of the publication of the deleterious effects on the health of susceptible aircrew.[3.] [4.] [5.] [6.] [7.] [8.] [9.] Experience has shown that inhalation of these fumes may lead to a variety of different symptoms.[3.] – [5.] This constellation of symptoms has led to the condition that has now become known as the “Aerotoxic Syndrome”.[9.] The term “syndrome” is one that is loosely applied in clinical medicine to describe a range of symptoms and/or physical signs that often occur together. The existence of any of these factors alerts the clinician to the possible presence of others and specific enquiry can then be made. In any one case not all the described features will necessarily be present. For example, in the late 1970s, when the Acquired Immunodeficiency Syndrome was first recognised, astute clinicians in San Francisco noted that some of their patients presented with Kaposi’s sarcoma while others were suffering from unusual infections. Subsequently they were all found to be suffering from the same underlying condition.

Whether the Aerotoxic Syndrome is a real or an imagined entity has become the subject of widespread debate in recent years. Many august bodies have reviewed the evidence and have concluded that the broad range of reported symptoms fails to warrant a specific diagnosis. This opinion would seem to be based on the observation that not all the reported characteristics are seen in every individual. By extrapolation, these findings lead to the conclusion that these authorities believe that exposure to cabin fumes does not lead to ill health. This has led to the ongoing debate with the afflicted on the one hand and the air transport industry and its regulators on the other with the latter either apparently ignoring the problem or alternatively finding other more attractive explanations for the presenting symptom complex.[7.] For example, the hyperventilation syndrome has recently been mooted to provide the explanation for the observed complaints.

The paper by Judith Murawski and Steven Hecker in this issue of the Journal[10.] is a welcome update on this controversial subject. The authors have reviewed the subject with particular clarity and comment on the mechanical genesis of these contaminating events. They have also examined and commented on their likely frequency, the adverse effects on human health, and the attitude and response of the aircraft industry and its regulators. In many ways the paper tells a sad tale of neglect. The progressively accumulating evidence should be flagging the presence of an important occupational health and safety issue which should have been carefully investigated by those with appropriate clinical and investigational skills and funded by appropriate authorities. Such investigations should have been and, in the future, should be undertaken by experts without perceived conflicts of interest. The authors have called for a combination of engineering

and administrative controls to prevent exposure to fumes on aircraft as they believe it is clear that fume contamination events are causing ill health in, at least, some individuals. In this they are correct.

The frequency of occurrence of contaminating fume events in aircraft has naturally been the subject of some considerable interest. Without any standardised industry reporting system, it is almost impossible to be sure of how often smoke or fume events do occur in commercial aircraft. The authors in this issue of the Journal[10.] having analysed the available data and concluded that contaminating events occur with some degree of regularity but that aircrew report very few. They note that the data suggests that there is a daily average of 13 fume events in the US fleet. They opine that this figure may be an average of two events daily if frequency estimates from three Canadian airlines are applied to the US industry. A second question, and perhaps a more important one to ask, is "how often do these contaminating events affect the health and wellbeing of the aircrew?" This is similarly difficult to answer. It is clear that contaminating events are occurring, that some crew members are experiencing toxic effects from the fumes and that they are not all being reported. There are likely to be many reasons for this under reporting. These include the likelihood that there is a wide range of susceptibility to the ill effects of the fumes (ie some are affected while others are not), the stoics who ignore illness, the employer reaction to the sick report including demerit points and, for pilots, the fear of losing their license to fly.

As discussed previously, the question that needs to be examined is "are these fumes deleterious to health?". It is important to reach a scientifically robust conclusion to this question, for there are potentially disastrous consequences for all on board an aeroplane if those in control are incapacitated. While illness stemming from contaminating events was initially reported largely from BAe 146 crews,[6.] they are not restricted to this type of aircraft.[3.] –[4.] A wide range of symptoms have been reported by affected crew members.[3.] –[5.] Commonly these include nausea, headache, cognitive impairment, lethargy and fatigue, neurological problems (including peripheral neuropathy and visual abnormalities), dizziness, and gastrointestinal symptoms. Less common respiratory symptoms of breathlessness, sinusitis and skin rashes have also been reported.[3.] –[5.] ,[11.] The fact that not all those exposed develop symptoms is not surprising. There is clearly a differential sensitivity to the effects of the contaminating fumes. This may be related to a number of factors including the concentration of exposure, individual sensitivity and genetic predisposition just to name a few. There are parallels to be drawn between the aircraft situation and those affected by chemicals in the general community. For example, occupational asthma is clearly recognised, at least in some cases, to occur after exposure to chemical concentrations well below industry accepted standards. The latter are, of course, set to protect most persons — complete protection can only be made by exclusion.

There has been speculation that the Aerotoxic Syndrome is caused by, or at least associated with, exposure to tricresylphosphate and its ortho isomers.[12.] ,[13.] These are both recognised neurotoxins and while their effects usually follow ingestion, they may also occur following absorption through the respiratory tract mucosa and less commonly through the unprotected skin. Engine oils contain a large number of other hydrocarbon substances and it is most unlikely that any given chemical in the mix will be the sole cause of the observed health effects. It is much more likely that many of them will be toxic. Experience in clinical medicine related to the multiple chemical sensitivity syndrome, where a broad range of substances including volatile organic hydrocarbons has been implicated, would support this view.[14.]

More recently, the notion that hyperventilation is the cause of the symptoms reported by affected aircrew has been put forward and given credence, at least in some quarters. That hyperventilation may occur in stressful situations is unquestioned[15.] but, is it the cause of the symptoms reported following contaminating fume events? The hyperventilation syndrome is easily recognised by experienced clinicians and, while commonly of short duration, may cause chronic symptoms of dizziness, light headedness and breathlessness or a sensation of dissatisfied breathing. It does not, however, lead to long term neurocognitive disability or cardiac abnormalities as have been reported in the Aerotoxic Syndrome.[7.] To argue that fume-affected aircrew suffer from the hyperventilation syndrome because the symptoms exhibited by them are the same or similar is facile. It is no different to saying that the breathless patient suffers from lung disease when, in fact, there are many possible diagnoses including anaemia, cardiac and neuromuscular disease. In short, a diagnosis

cannot be made by forcing all the jigsaw puzzle pieces together to make a picture. A broader view taking into account the pattern of illness and the natural history is required.

In summary, the arguments that the data are inconclusive and that there is not enough evidence to reach a conclusion that the Aerotoxic Syndrome is not a real phenomenon is unacceptable with current knowledge. These reasons should be the prompt for further more detailed and broader data collection and reporting. Ignoring or providing poorly thought out alternative explanations for the facts are at best unhelpful and at worst put exposed individuals at risk of ill health which may not be temporary. Illness does not come easily to affected aircrew. These people are, on the whole, physically fit, highly trained and dedicated people who want to fly and are unable to do so.

Footnotes

1. Kitzes G. Cabin air contamination problems in jet aircraft. Aviation Medicine 1956;2:53–58.

2. Michaelis S. PhD Thesis: Health and flight safety implications from exposure to contaminated air in aircraft. ISBN 978-0-95-554377-7.

3. Cox L, Michaelis S. A survey of health symptoms in BAe 146 aircrew. J Occup Health Safety, Aust NZ 2002;18:305–312.

4. Harper A. A survey of health effects in aircrew exposed to airborne contaminants. J Occup Health Safety, Aust NZ 2005;21:433–439.

5. Somers M. Aircrew exposed to fumes on the BAe 146: an assessment of symptoms. J Occup Health Safety, Aust NZ 2005;21:440–449.

6. Inquiry into air safety — BAe 146 Cabin air quality. Senate enquiry, the parliament of the Commonwealth of Australia, March 1999.

7. Proceedings of the BALPA Air Safety and Cabin Air Quality International Aero Industry Conference. London, Britain, April 20–21 2005. C. Winder editor. Reports in safety and environmental science, School of Safety Science, The University of New South Wales, August 2005.

8. Mackenzie Ross S, Harper A, Burdon J. Ill health following exposure to contaminated aircraft air: psychosomatic disorder or neurological injury? J Occup Health Safety, Aust NZ 2006;22:521–528.

9. Balouet JC, Winder C. Aerotoxic syndrome in air crew as a result of exposure to airborne contaminants in aircraft. American Society of Testing and Materials (ASTM) Symposium on Air Quality and Comfort in Airliner Cabins. New Orleans, 27–28 October 1999.

10. Murawksi, J.and Hecker S. *Exposure to oil fumes on aircraft: necessary to regulate* J Health Saf Environ 2011, 27(2): 107–123.

11. Burdon J, Glanville A. Lung injury following hydrocarbon inhalation in BAe 146 aircrew. Aust NZ 2002;21; 450–454.

12. Schopfer LM, Furlong CE, Lockridge O. Development of diagnostics in the search for an explanation of Aerotoxic Syndrome. Anal Biochem 2010;404:64–74.

13.

Carletti E, Schopfer LM, Colletier J-P, Froment M-T, Nachon F, Weik M, Lockridge O, Masson P. Reaction of cresyl saligenin phosphate, the organophosphorus implicated in the Aerotoxic Syndrome, with human cholinesterases: Mechanistic studies employing kinetics, mass spectrometry and x-ray structure analysis. Chem Res Toxicol In Press. Sighted at http://pubs.acs.org/stoken/campaign/acs/full/10.1021/tx100447k 24 April 2011.

14. Report prepared by the National Industrial Chemicals Notification and Assessment Scheme and the Office of Chemical Safety and Environmental Health, Australian Government Department of Health and Ageing. A scientific review of multiple chemical sensitivity: identifying key research needs. November 2010.

15. Karavidas KM and Lehrer PM. In-flight hyperventilation among airline pilots. Aviation, Space and Environ Med 2009;80:495–496.