resistant, or nosocomial infections. Bronchoscopy yields a diagnosis in up to 41% of patients.[20] One study found it to be beneficial mainly in non-smoking patients aged less than 55 years with multilobar infiltrates.[21]

Where do we go from here? Further work using robust and reproducible definitions for treatment failure is required to confirm the findings of Menéndez and colleagues. The use of a different prediction rule to adjust for risk of mortality—for example, CURB-65 instead of PSI—may result in the identification of different risk factors for treatment failure. Most importantly, the optimal management of patients at risk of treatment failure and how it might differ from usual management needs to be determined, ideally through intervention studies with clinically relevant end points.

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Flying with respiratory disease

What happens to patients with respiratory disease when they fly?

R K Coker, M R Partridge

Updated guidelines now available but more research is needed into the safety of air travel for those with respiratory disease

Despite current concerns about terrorism, commercial air travel remains a common mode of travel for millions. It has been estimated that a single major UK airline carries over 30 million passengers each year. There are no data available to indicate how many passengers flying on commercial aircraft have respiratory disease, but as far back as 1974 it was estimated that around 5% of passengers were ambulatory patients. As the average age of western populations continues to rise, so does the propensity for passengers to have some form of medical condition. In addition, flights are getting longer and aircraft bigger. The new Airbus 380, for example, will carry around 600 passengers for up to and in some cases exceeding 20 hours.

Air travel is in general safe, even for those with medical conditions, and there are no established methods for determining morbidity associated with air travel. Nevertheless, available airline data consistently record around 10% of in-flight medical emergencies as being respiratory in nature, with approximately one third attributed to asthma. Medaire, a North American company offering radio link emergency medical assistance to commercial aircraft, has published figures for 2002 which show that respiratory problems are the third most common cause of in-flight medical emergency (A Hawkins, Medaire, personal communication). Respiratory problems are also the third most common cause of medical diversion after cardiac and neurological events (including syncope), accounting for 9% of diversions. In 2002 Medaire recorded 414 diversions, 206 advised by Medaire and 208 initiated by the pilot. In 2004 British Airways estimate the cost of a diversion at around £100 000 (€150 000, US$185 000) (M Popplestone, British Airways, personal communication). This includes hotel accommodation for passengers and staff, maintenance costs and landing fees. In addition, there is

knock-on disruption to the airline's schedule and there are safety concerns about an enforced landing at an unfamiliar airport.

Commercial aircraft routinely fly at around 38 000 ft and are pressurised to a relatively modest intermediate cabin altitude not exceeding 8000 ft (2438 m). The reduced partial pressure of oxygen at this altitude is equivalent to breathing 15% oxygen and will cause the arterial oxygen tension (Pa_{O_2}) of a healthy passenger to fall to between 7.0 and 8.5 kPa. The effects usually go unnoticed. However, exposure to this altitude may worsen hypoxaemia in patients with lung disease, especially if the subject is already hypoxaemic at sea level. Other factors to be taken into consideration include immobility predisposing to venous thromboembolism, an increase in gas volumes, reduced humidity, and increased potential for transmission of infection through promixity of seating arrangements.

In 2002 the British Thoracic Society (BTS) published recommendations for assessing passengers with respiratory disease planning air travel.[1] These were the first UK recommendations on air travel in the context of lung disease and, in contrast to existing disease-specific North American and European guidelines, considered a wide range of respiratory disorders. A patient information leaflet and summary for primary care physicians were published alongside the recommendations on the BTS and British Lung Foundation websites (www.brit-thoracic.org.uk and www.britishlungfoundation.org). It was recognised at the time that the BTS recommendations represented a consensus statement based on expert advice, with little solid evidence on which to base formal guidelines.

Two years on, the BTS flight recommendations have been updated with available evidence and published on the BTS website in September 2004. The data remain relatively sparse, but updated sections include reference to the demise of Concorde and the introduction of the Airbus 380, and a detailed explanation of the effect of Boyle's law on gas expansion in relation to humidified gas. Changes have also been made to the recommendations for pre-flight assessment in children based on new data from the Royal Brompton Hospital in London. There is some new advice for those travelling with oxygen. Some airlines now issue a Frequent Traveller's Medical Card to frequent flyers with special medical needs, and this may be of value to passengers in reducing the paperwork required before each trip.

With regard to patients with asthma and chronic obstructive pulmonary disease (COPD), from April 2004 a new law requires all aircraft on flights to and from the United States to carry bronchodilator inhalers as part of their medical kit. A new study of children with Down's syndrome has drawn attention to the fact that these patients probably merit careful evaluation before air travel, and there is reference to two studies of patients with diffuse parenchymal lung disease. An entire new section has been added on severe acute respiratory syndrome (SARS) with a hyperlink to the World Health Organisation site. Importantly, review of the available evidence has meant that the arbitrary ''six week rule'' has been discarded for patients with pneumothorax. A delay of just 1 week is recommended after the chest radiograph shows complete resolution, except in the case of a traumatic pneumothorax (or thoracic surgery) when a delay of 2 weeks is advised. There is further evidence strengthening the previous recommendations that low molecular weight heparin may be of benefit to travellers at high risk of venous thromboembolism.

Taken together, however, with the exception of the paediatric data there is little new evidence to suggest a need for radical change to the previous recommendations. Most previous investigations into the effects of air travel on lung disease have examined patients with COPD, and the available controlled studies involve relatively small numbers with stable disease and no co-morbidity. Simulated altitude did not generally exceed 1 hour and these studies have largely excluded additional stressors such as exercise, dehydration, and sleep. In 2002 the BTS Air Travel Working Party highlighted the need for further research and drew attention to those areas where data are particularly lacking. These included the predictive value (or otherwise) of spirometry, regression equations, hypoxic challenge, and walk tests in different disease groups, and the risk of air travel for patients with diffuse parenchymal lung disease.

In this setting, the paper by Seccombe *et al*[2] published in this issue of *Thorax* is especially welcome. The authors examined the effect of simulated cabin altitude—both at rest and during a 50 metre walk test—on 15 subjects with interstitial lung disease (ILD) and 10 subjects with COPD. All subjects were clinically stable, able to walk 100 metres, and had resting Pa_{O_2} equal to or above 9.3 kPa—well above the level at which most physicians would have concerns about potential complications from air travel. In both groups Pa_{O_2} fell significantly from that at rest on room air to that breathing 15% oxygen at rest, and again to completion of the walk test. Mean Pa_{O_2} fell to 5.5 kPa after exercise in the ILD group and to 5.3 kPa after exercise in the patients with COPD. Interestingly, 80% of subjects had flown in the previous 5 years and 64% were unaware that their oxygen levels might be lower when flying.

These results suggest that resting Pa_{O_2} is a poor predictor of hypoxaemia under simulated cabin altitude conditions. They also highlight the need for further research into predictors of hypoxaemia, better patient education, and improved methods for collecting data on passengers who do experience health problems while flying. The authors of this study suggest that prospective evaluation of a large number of patients with lung disease who plan to fly may be of value. The ongoing UK Flight Outcomes Study, funded by the BTS and British Lung Foundation, sets out to do this, and we hope it will help to answer some of the questions raised by this and other studies. Meanwhile, further high calibre laboratory research remains very welcome, together with more in-flight studies of those potentially at risk.

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