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Assessing the risk of hypoxia in flight: the need for more rational guidelines

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ABSTRACT: This study aimed to test the hypothesis that advice currently given by respiratory physicians to potentially hypoxic patients planning air travel varies and is not evidence-based.

A prospective observational study was performed, surveying respiratory physicians in England and Wales.

Sixty-two per cent responded. Nearly two-thirds worked in district general hospitals, a quarter in university hospitals, and the rest in tertiary referral (specialist) centres or a combination thereof. Most provide advice routinely; most of the remainder do on request or if concerned. Assessments comprise spirometry, blood gas level measurement, oximetry, predictive equations and hypoxic challenge tests. Twenty-five per cent of physicians measuring blood gas levels recommend in-flight oxygen when arterial oxygen tension (P_{a,O_2}) <7.3 kPa, 50% when P_{a,O_2} is 7.3–8.0 kPa. Over two-thirds using spirometry recommend oxygen when the forced expiratory volume in one second <40% of the predicted value. Half recommend oxygen when arterial oxygen saturation (S_{a,O_2}) <90%, 33% when S_{a,O_2} is 90–94%. Fewer than 10% of district hospital physicians (and none in other hospitals) use predictive equations. More than half of specialists but fewer than 10% of district hospital physicians perform hypoxic challenge tests.

The risk of hypoxia at altitude is recognized by most respiratory physicians in England and Wales, but assessment methods and criteria for recommending oxygen vary widely. This suggests that most current advice is not evidence-based. Evidence-based guidelines are required.

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The number of passengers on scheduled commercial flights was recorded at 1,285 million world-wide in 1995 and is predicted to exceed 2,000 million by the year 2005 [1]. Given the high prevalence of respiratory disease, especially chronic obstructive pulmonary disease (COPD), the rising age of Western populations and the increasing numbers of adults with cystic fibrosis, significant and increasing numbers of air passengers are likely to have respiratory disease. This study aimed to determine whether evidence-based advice is currently given by respiratory physicians in England and Wales to potentially hypoxic patients planning air travel.

Methods

A prospective observational study was performed in 1997. All consultant respiratory physicians in England and Wales [2] were circulated a letter explaining the study and a short anonymous questionnaire. This requested information on hospital workplace (district general hospital, university or tertiary referral) and on whether advice was routinely given to hypoxic patients planning air travel, or only following a request by the patient. Those respondents who gave advice were asked to provide information about which assessments they perform before recommending in-flight oxygen. Options included spirometry, oximetry, blood gas level measurement, predictive formulae [3, 4] or hypoxic challenge testing [5]. The criteria for recommending oxygen were requested. Those performing spirometry were asked to select one of the following: forced expiratory volume in one second (FEV1) <40% of the predicted value, 40–60% pred and or 61–75% pred. Respondents using blood gas analysis were asked to select from arterial oxygen tension (P_{a,O_2}) on air <7.3 kPa (indicating severe hypoxaemia), 73–8.0 kPa (moderate hypoxaemia) and 8.1–10.0 kPa (mild hypoxaemia). Options for physicians using oximetry were: arterial oxygen saturation (S_{a,O_2}) <90%, 90–94% and 95–97%. All were asked whether symptoms and/or flight duration influence their decision, and brief additional comments were invited.

Results

Four hundred and thirty-eight letters were sent out by August 18, 1997, and 268 replies from current respiratory physicians received within three months, representing a 61% response rate. One hundred and sixty-five (62%) respondents were based in district general hospitals, 67 (25%) in university hospitals, 16 (6%) in specialist centres and 18 (7%) in two or more of these.

Pattern of advice

Two-thirds (109) of district hospital physicians provide advice routinely, as do 51 (76%) university hospital practitioners, 14 tertiary referral specialists and 15 of those working in more than one setting. Forty-four (27%) district hospital physicians, six university hospital physicians, one tertiary referral physician and two working in more than one hospital give advice on request. Fewer than 8% of respondents give no advice.

Pattern of assessment

Figure 1 shows assessments according to kind of hospital. The most frequently used are blood gas analysis, spirometry and oximetry. One hundred and twenty (78%) district hospital physicians measure blood gas levels, as do all university and tertiary referral hospital physicians who responded. In district general hospitals, capillary blood gas measurement comprises 20% of these analyses; in tertiary referral centres it comprises 60%. One hundred and two (67%) district hospital physicians use spirometry, as do 42 (74%) university hospital practitioners and 10 (67%) of those in specialist centres. Eighty-four (55%) district hospital, 34 (60%) university hospital and five (33%) tertiary referral physicians perform oximetry. Ten (6%) district hospital physicians, but no other respondents, use predictive formulae. Hypoxic challenge testing is performed by 15 (8%) district hospital, 11 (19%) university hospital and eight (53%) tertiary referral physicians.

Criteria for recommending in-flight oxygen

Approximately half of those measuring blood gas levels recommend in-flight oxygen when P_{a,O_2} is 7.3–8.0 kPa. Most of the remainder (>50%) do not recommend in-flight oxygen unless the P_{a,O_2} is <7.3 kPa. Eighty per cent of physicians performing spirometry consider an FEV1 of <40% pred to be an indication for oxygen. Half of those performing oximetry consider an S_{a,O_2} of <90% to be an indication for oxygen, whereas 30% recommend oxygen when S_{a,O_2} ranges 90–94%.

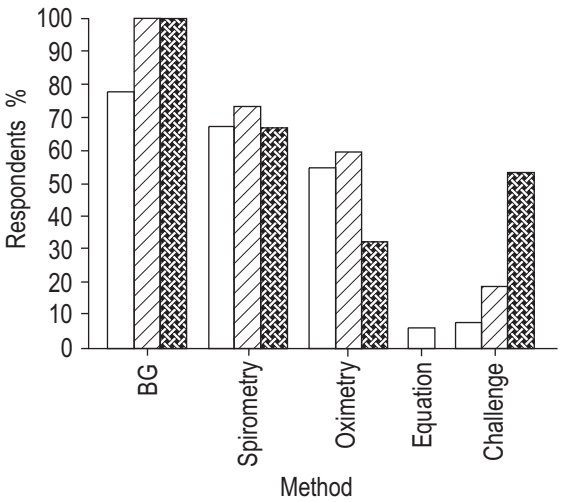

Fig. 1. – Assessments performed by respiratory physicians for potentially hypoxic patients planning air travel. □: district general hospital; ▨: university hospital; ▩: specialist or tertiary referral centre. BG: blood gas level measurement; Equation: use of published formulae [3, 4]; Challenge: hypoxic challenge testing.

On average, 36% of respondents, and more than half of tertiary referral hospital physicians consider flight duration important when advising patients. Thirteen per cent of respondents overall, and nearly one-third of district hospital physicians, consider symptoms or exercise tolerance important factors.

Respondents were not asked about the basis for their advice, but a few physicians enclosed justification. Several quoted CRAMER *et al.* [5], others a review by HARDING and MILLS [6]. Several respondents at one hospital enclosed local chest clinic advice based on European Respiratory Society (ERS) guidelines [7].

Discussion

The good response rate suggests a high level of interest, and the profile of respondents probably reflects the university/district hospital distribution of respiratory physicians in England and Wales, with the results likely to be fairly representative of current respiratory medical practice. The fact that the majority of respiratory physicians give advice routinely suggests that the problem is well recognized, but the variety of assessment methods used indicates the absence of a national consensus regarding the best method. The techniques chosen varied considerably, particularly in the case of predictive equations, used exclusively by district hospital physicians, and capillary blood gas analysis. The latter is three times more frequently performed in tertiary referral hospitals than in district hospitals. The minimal use of oximetry in specialist centres presumably reflects the greater availability of capillary blood gas testing.

Wide variations in the criteria for recommending in-flight oxygen or for advising on fitness to fly were reported. Respondents were almost evenly divided as to whether oxygen is required when the patient's P_{a,O_2}, lies on the range 7.3–8.0 kPa or only when P_{a,O_2} <7.3 kPa. There was similar division in opinion regarding oximetry, with approximately half recommending oxygen if the S_{a,O_2} <90%, but 30% advising oxygen if the S_{a,O_2} is 90–94%. Regarding factors such as flight duration, symptoms or exercise tolerance, opinion varied considerably, for reasons which are unclear. Although it may appear self-evident that longer flights entail more problems, the authors are not aware of published evidence supporting this. Cabin pressurization varies between aircraft but appears unrelated to flight duration [8], and symptoms and exercise tolerance may not correlate closely with blood gas disturbances. A further consideration is that different types of hypoxic patients probably tolerate hypoxia to differing degrees, possibly reflecting coexistent disease states.

Further comments from respondents indicated they would welcome national guidelines. British Airways flew 33.4 million passengers between 1996 and 1997 (M. Bagshaw, British Airways, personal communication). During this period, there were 3,026 medical incidents. Seventy-six unscheduled diversions resulted, of which four were the result of respiratory incidents. This number has risen since

1996, with the cost of each estimated at US$ 60,000. Ten per cent of incidents on nine US airlines In 1996 reflected respiratory illness [9]. Some probably involved passengers with asthma, but it is likely that COPD patients were also implicated. Although many airlines and aeromedical assistance companies have their own guidelines, they differ with regard to oxygen provision and its cost to the passenger.

In conclusion, the problem of flight-induced hypoxia appears well recognized by respiratory physicians in England and Wales, but no consensus exists regarding assessment methods or criteria for recommending oxygen, suggesting that current advice is not evidence-based. Guidelines for managing COM produced by the ERS and the American Thoracic Society (ATS) contain advice [7, 10], but neither reach a conclusion as to the optimal approach. Both societies recommend predicting hypoxaemia and describe challenge testing and predictive equations. The ERS provides no information on how to perform either test. The ATS describes both methods, but states that challenge testing "is not performed in many clinical laboratories in the United States and is not recommended for routine clinical use". The ERS lists relative contraindications to air travel, and the ATS suggests an increase of 1–2 $L \cdot min^{-1}$ for patients on continuous domicilary oxygen. Although the present findings may not reflect European practice, the disparity between ERS and ATS guidelines, uncertainty about assessment methods and lack of consideration of other causes of hypoxia, such as pulmonary fibrosis, lead to the conclusion that new guidelines are needed in Europe including the UK.

The British Thoracic Society Standards of Care Committee has now established a committee to examine the feasibility of producing guidelines on this subject. The authors recognize that more research is needed in order to develop satisfactory evidence-based guidelines, but nevertheless consider that interim guidelines based on the available evidence should be developed in anticipation that this will stimulate further studies. The committee would welcome input from interested parties.

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References

1. Johnson AOC. Asthma Journal June 1997, 52–54.
2. Directory of Training Posts and Services in Respiratory Medicine, Hawker Publications Ltd, London, 1996.
3. Gong H, Tashkin DP, Lee EY, Simmons MS. Hypoxia-altitude simulation test. *Am Rev Respir Dis* 1984; 130: 980–988.
4. Dillard TA, Rosenberg AP, Berg BW. Hypoxaemia during altitude exposure. A meta-analysts of chronic obstructive pulmonary disease. *Chest* 1993; 103: 422–425.
5. Cramer D, Ward S, Geddes D. Assessment of oxygen supplementation during air travel. *Thorax* 1996; 51: 202–203.
6. Harding R , Mills JF. Aviation Medicine, London, 1993.
7. Siafkas NM, Vermeire P, Pride NB, *et al*. Optimal assessment and management of chronic obstructive pulmonary disease (COPD). *Eur Respir J* 1995; 8: 1398–1420.
8. Cottrell JJ. Altitude exposures during aircraft flight. *Chest* 1988; 92: 81–84.
9. Kahn F. Way forward on air emergencies. *Hospital Doctor* 1999; 18 March, pp. 25–30.
10. Standards for the Diagnosis and Care of Patients with Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med* 1995; 152: S77–S120.