Fitness to Fly in Patients with Lung Disease

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I. The Aircraft Cabin Environment

Each year approximately 1 billion people travel by air.

It has been predicted that in the coming two decades, the number of passengers will double.

On most flights the cabin altitude will be between 5000 and 8000 ft. This results in reduced barometric pressure with a concomitant decrease in PaO_2.

While the barometric pressure is 760 mm Hg at sea level with a corresponding PaO_2 of 98 mm Hg, the barometric pressure at 8000 ft will be 565 mm Hg with PaO_2 of about 55 mm Hg. If these last data are plotted on the oxyhaemoglobin dissociation curve, we obtain a blood oxygen saturation of 90%.

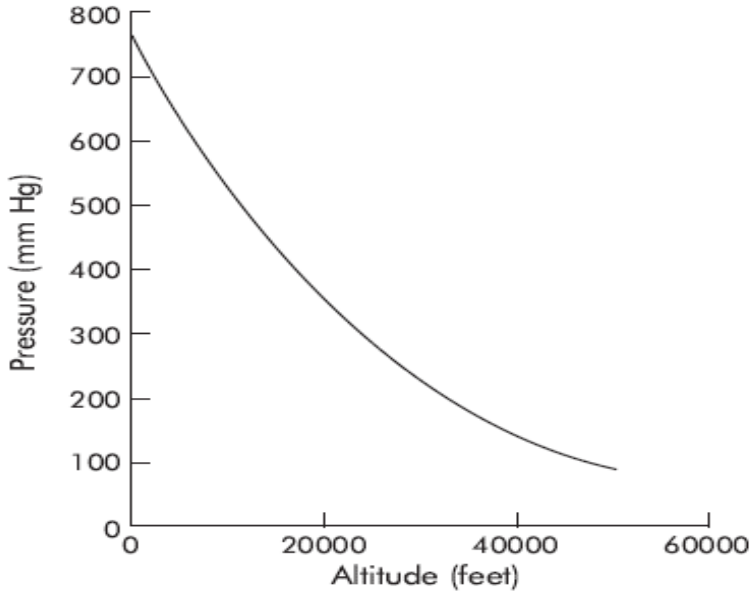
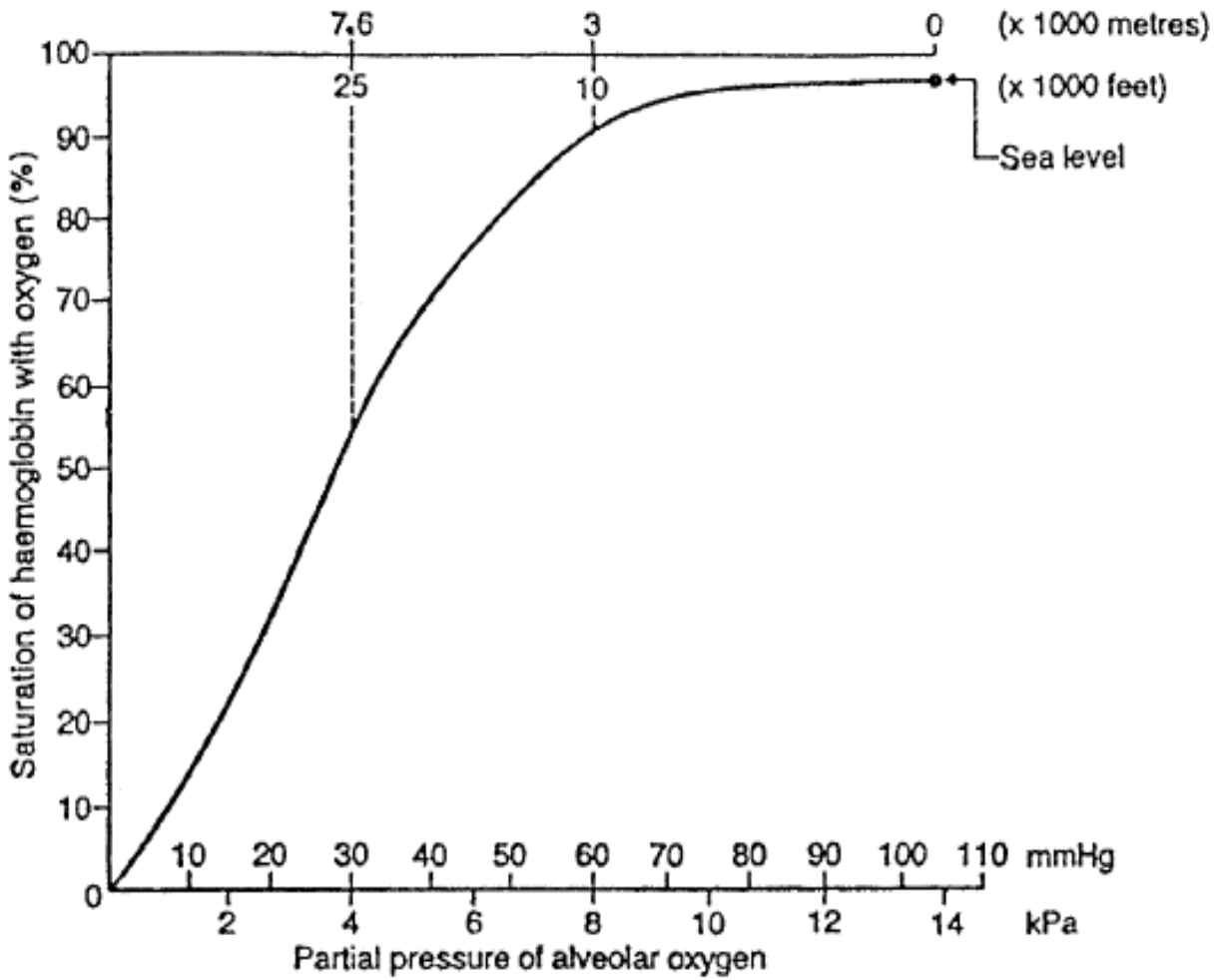


Figure 1 Relationship between atmospheric pressure (mm Hg) and altitude (feet).

MEDICAL GUIDELINES FOR AIRLINE TRAVEL



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- Reduced cabin pressure also can cause gas volume expansion (Boyle Law)

- Aircraft have very low cabin humidity, usually ranging from 10-20%. This is unavoidable because the air at high altitude is practically devoid of moisture. As a result, there can be a drying effect of airway passages, the cornea, and the skin.*

Aerospace Medical Association, Medical Guidelines Task Force, Alexandria, VA
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II. Respiratory Diseases with Potential Complications for Air Travelers

A healthy individual usually can tolerate cabin condition with no problems, but it may not be the same for someone with respiratory diseases.

These patients may already have a reduced PaO_2 on the ground, further reduction in aircraft cabin pressure will bring them to the steep part of the oxyhaemoglobin dissociation curve with a resultant very low saturation, which could cause distress and/or exacerbation of their illness.

Asthma

The flight environment experienced by commercial passengers should not pose a problem for most patients with asthma.

In a review of all consecutive in-flight medical incidents reported for QANTAS airlines in 1993 there were 454 significant medical incidents, 9% of which were reported as respiratory tract infection or asthma.*

A review of incidents on US commercial aircraft where an enhanced medical kit was used found that 10% of 362 episodes were due to asthma, lung disease or breathlessness.**

* Donaldson E, et.al. Aust NZ J Surg 1996;66:431–4.
** Cottrell JJ, et.al. JAMA 1989;262:1653–6.

COPD

Data on patients with COPD are limited, and existing guidelines contain largely empirical advice based on relatively small studies.

In addition to the risk of hypoxaemia, patients with severe COPD may be put at risk from high levels of COHb resulting from smoking. They may experience expansion of non-functioning emphysematous bullae and abdominal gases which could further compromise lung function.

BTS Standards of Care Committee. Thorax 2002;57:289–304

Infections

There is concern about the potential for transmission of infectious disease on board commercial aircraft. The most important is that of transmission of pulmonary TB, especially that of MDR TB.

Seven cases of possible transmission of M. tb. on aircraft have been reported to the CDC, Atlanta, Georgia, USA. The first concerned a flight attendant with documented tuberculin skin test (TST) conversion who did not receive prophylaxis and who developed pulmonary TB 3 years later.

Driver CR, et. al. JAMA 1994;272:1031–5

Previous Pneumothorax

A definitive surgical intervention makes the risk of recurrence of a pneumothorax negligible. Such patients may be able to fly 6 weeks after surgery and resolution of the pneumothorax, in the absence of other contraindications. Careful medical assessment is required beforehand. For others the risk of a further pneumothorax is considerable for at least a year after the first episode. This risk is greatest for those with underlying lung disease and for continuing smokers.

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Thoracic surgery

The volume of gas in air spaces will increase by 30% at a cabin altitude of 2438 m (8000 ft). Postoperative complications such as sepsis or volume depletion should have resolved before patients undergo air travel.

Severe headache precipitated by airline travel has been recorded 7 days after a spinal anaesthetic, presumed to be due to cabin pressure changes inducing a dural leak.*

* Vacanti JJ. Anaesthesiology 1972;37:358–9.

III. Pre-flight Assessment

In order to evaluate the risks related to air travel in patients with respiratory diseases, a clinical pre-flight assessment is required.

Three procedures used to assess whether patients are fit to fly

1. 50 Meters Walk Test

The first method has been put forward by the airline industry and consists of asking passengers whether they are capable of walking 50 metres on the flat. If the answer is “yes”, they are probably fit to fly.

Johnson AOC. Thorax 2003;58:729–732

2. Mathematical Equations

Formula from Dillard in COPD patient*

$$PaO2alt = 0.410(PaO2gr) + 17.652$$

Dillard also used spirometry values:

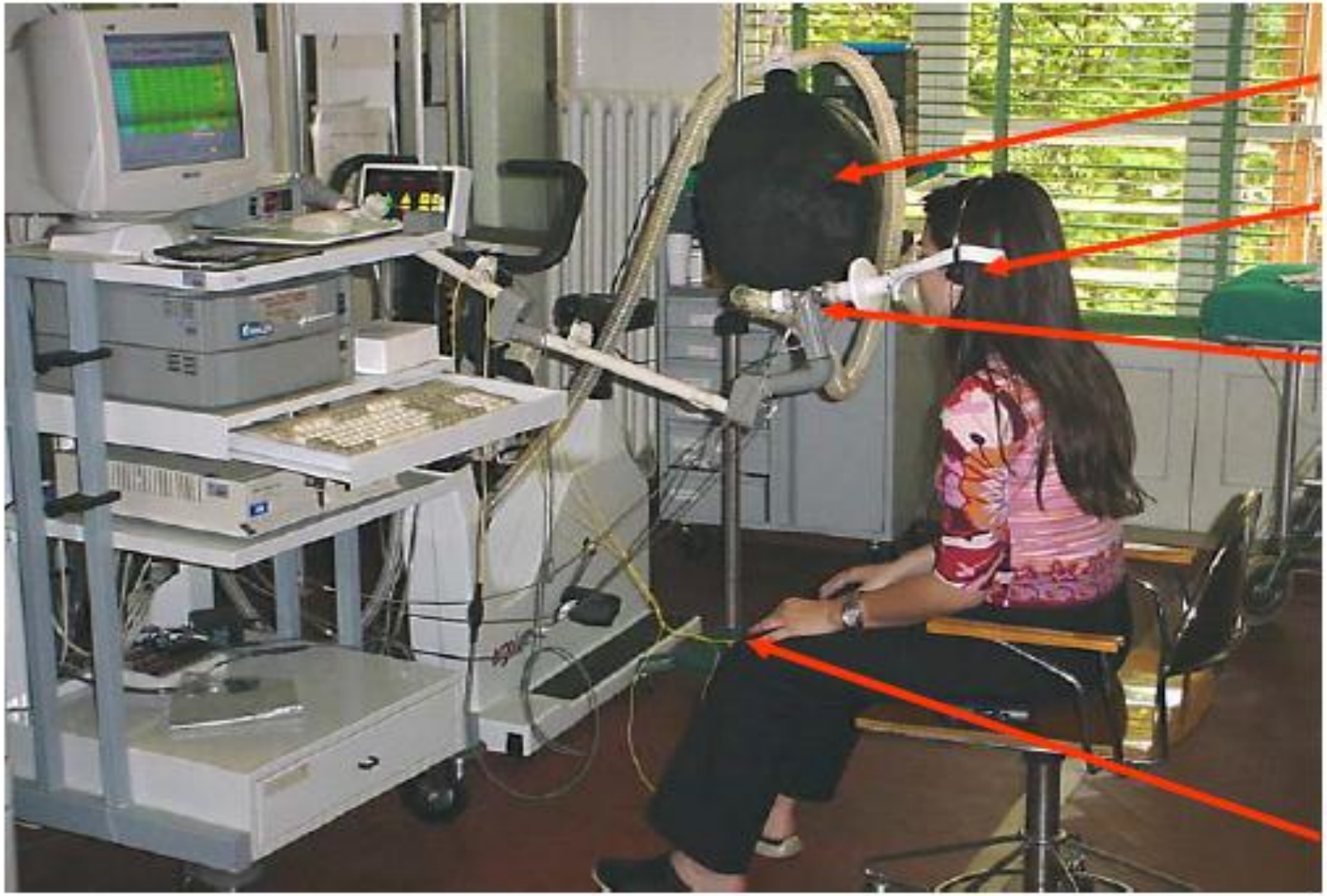
$$PaO2alt = 0.453\ (PaO2\ grnd) + 0.386\ (FEV1\ \%pred) + 2.440$$

* Dillard TA, et al. Ann Intern Med 1989. 1;111: 362–7

3. The Hypoxic Challenge Test (HCT)

- Involves breathing in a hypoxic gas mixture containing 15% oxygen in nitrogen.
- The person is usually asked to breathe the hypoxic gas mixture for 20 minutes or until in equilibrium. Saturation is monitored throughout and arterial blood gases or SpO2 measured beforehand and on completion.
- The HCT shown to reliably identify patients needing supplemental oxygen when flying.

Cramer D, et al. Thorax 1996;51:202–3.



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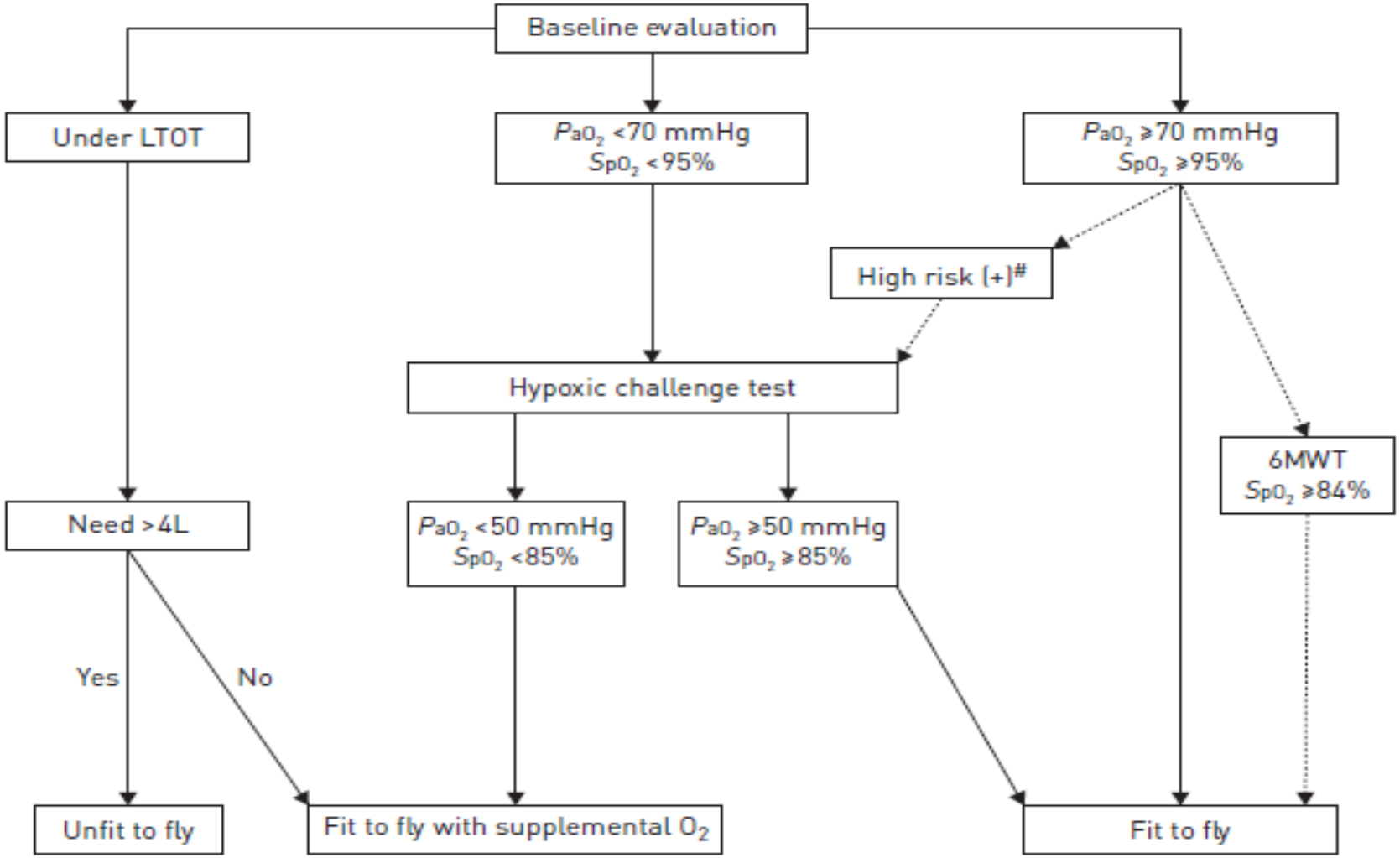
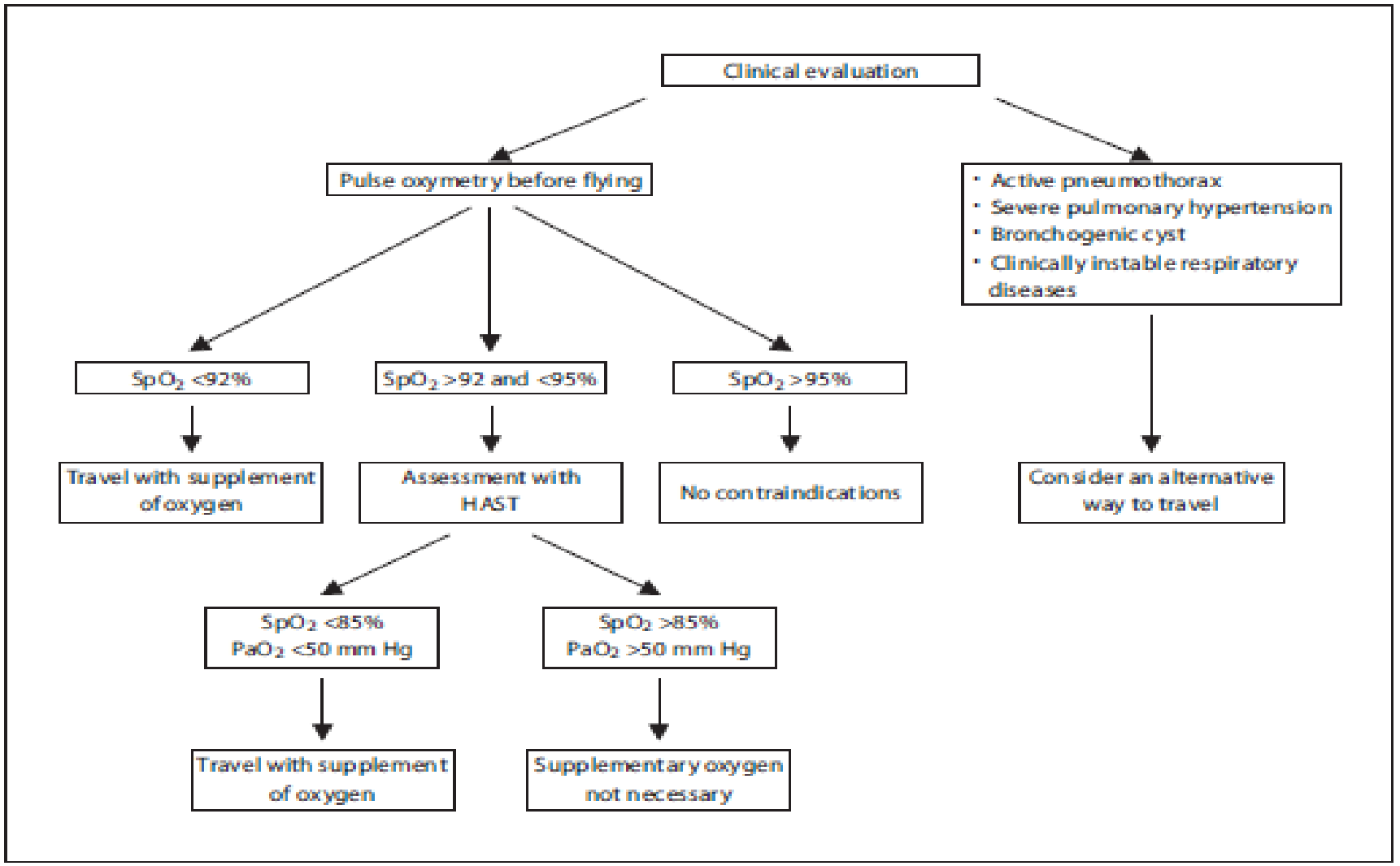
Algorithm of Pre-Flight Assessment



Ergan B, et al. https://doi.org/10.1183/16000617.0030-2018

Algorithm of Pre-Flight Assessment



Ergan B, et al. https://doi.org/10.1183/16000617.0030-2018

Pre-flight Assessment for Adults

The following groups should be assessed:

- **Severe COPD or asthma; [B]**
- **Severe restrictive disease (including chest wall and respiratory muscle disease), especially with hypoxaemia and/or hypercapnia; [C]**
- **Patients with cystic fibrosis; [C]**
- **History of air travel intolerance with respiratory symptoms (dyspnoea, chest pain, confusion or syncope); [C]**

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- Co-morbidity with other conditions worsened by hypoxaemia (cerebrovascular disease, coronary artery disease, heart failure); [C]
- Pulmonary TB; [C]
- Within 6 weeks of hospital discharge for acute respiratory illness; [C]
- Recent pneumothorax; [B]
- Risk of or previous venous thromboembolism; [B]
- Pre-existing requirement for oxygen or ventilator support. [C]

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The Following Assessment is Recommended:

- History and examination with particular reference to cardiorespiratory disease, dyspnoea, and previous flying experience; [C]
- Spirometric tests (in non-TB patients only); [C]
- Measurement of SpO2 by pulse oximetry. [C]

In those who are screened who have resting sea level oximetry between 92% and 95% with additional risk factors, hypoxic challenge testing is recommended. [C]

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Notes

(1) The following groups should not fly:

- **Patients with infectious TB must not travel by public air transportation until rendered non-infectious.**

Three smear negative sputum examinations on separate days in a person on effective antituberculous treatment indicates an extremely low potential or transmission, and a negative culture result virtually precludes potential for transmission; [B]

- **Those with a current closed pneumothorax should avoid commercial air travel. [C]**

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(2) Patients who have undergone major thoracic surgery should ideally delay flying for 6 weeks after an uncomplicated procedure.[C]

(3) Lung cancer per se is not a contraindication to flying. However, associated respiratory diseases should be considered in their own right. [C]

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(4) Additional Precautions for All Passengers:

- Excess alcohol should be avoided before and during the flight, particularly in those with OSA and those at risk of VTE; [C]
- Who not receiving O2 should remain mobile during the flight; [C]
- Exercise without supplemental O2 may worsen hypoxaemia; it may be prudent for the most compromised to use oxygen while walking on the plane and to let a flight attendant know how long they expect to be away from their seat; [C]
- The risk of VTE should initiate prophylactic measures; [B]
- Patients should carry preventative and relieving inhalers in their hand luggage; [C]
- Portable nebulisers may be used at the discretion of the cabin crew, but there is good evidence that spacers are as effective as nebulisers in treating asthma; [A]

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- Patients should check with their local or hospital pharmacists whether any medicine may be adversely affected by the extreme temperature in the hold baggage compartment; [C]

Key Point Recommendations

- Dry cell battery powered CPAP machines may be required by patients with OSA on long haul flights, but they must be switched off before landing; [C]
- Ventilator dependent patients should inform the airline of their requirements at the time of reservation, and a doctor's letter is required outlining the medical diagnosis, necessary equipment, recent blood gas results, and ventilator settings. A medical attendant is likely to be needed. Arrangements must be made for proceeding through air terminals before and after the flight. [C]

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(5) Logistics of air travel with oxygen:

Supplementary in-flight oxygen is usually prescribed at a rate of 2 l/min and should be given by nasal cannulae.

In-flight oxygen need not be switched on until the plane is at cruising altitude, and may be switched off at the start of descent. For patients on oxygen at sea level, the rate should only be increased while at cruising altitude. [B]

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(6) In complex circumstances patients can be referred for testing in a hypobaric chamber.

Even with in-flight oxygen, travel cannot be guaranteed to be safe. Air travel is almost always possible with appropriate medical support, but the logistics and economic costs may outweigh the benefits in individual cases.

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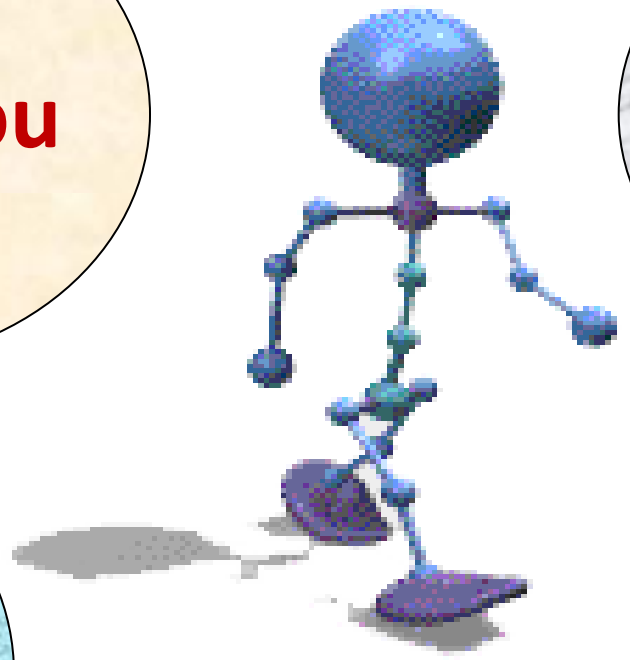
IV. Conclusion

1. Reduced oxygen in aircraft cabin could cause distress and/or exacerbation of respiratory disease.
2. Pre-flight assessment is essential to prevent exacerbation of respiratory disease

Thank You

Arigato Gozaimasu



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