Air Travel and Passenger Health

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Disclosure Information

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I have no financial relationships to disclose.

The Trend . . . . .

- increasing number of passengers:
  - higher age
  - chronic diseases (medcation)
  - predisposing factoren
  - diseases during holiday
- travels non-stop over increasing distances

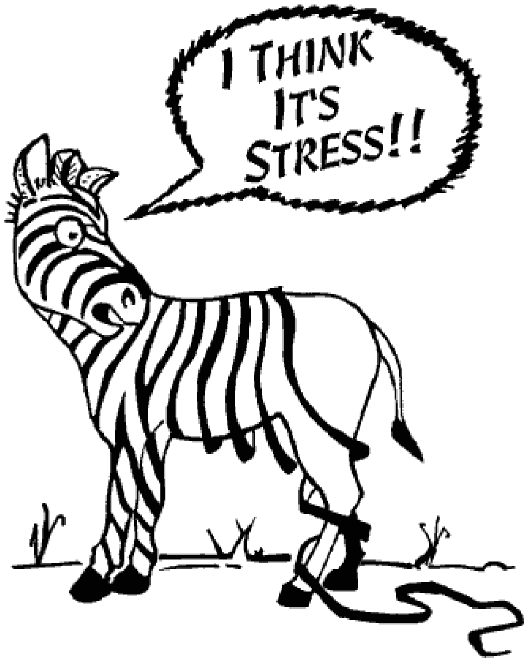
Travel conditions

- medication, sleep loss, stress
- lengthy immobilisation, alcohol
- jet lag

"AFTER THE SHOE BOMBER, THEY MADE US REMOVE OUR SHOES...
I FIGURE IT WAS ONLY A MATTER OF TIME..."

Stress before, during and after the flight

- Sleep debt
- Latent Fear of Flying (10-40%)
- Security
- Delays
- Physical exertion
- Fatigue



In-Flight environmental conditions

- Lowered atmospheric pressure
- Low relative humidity
- Immobility
- Turbulence, noise
- Temperature

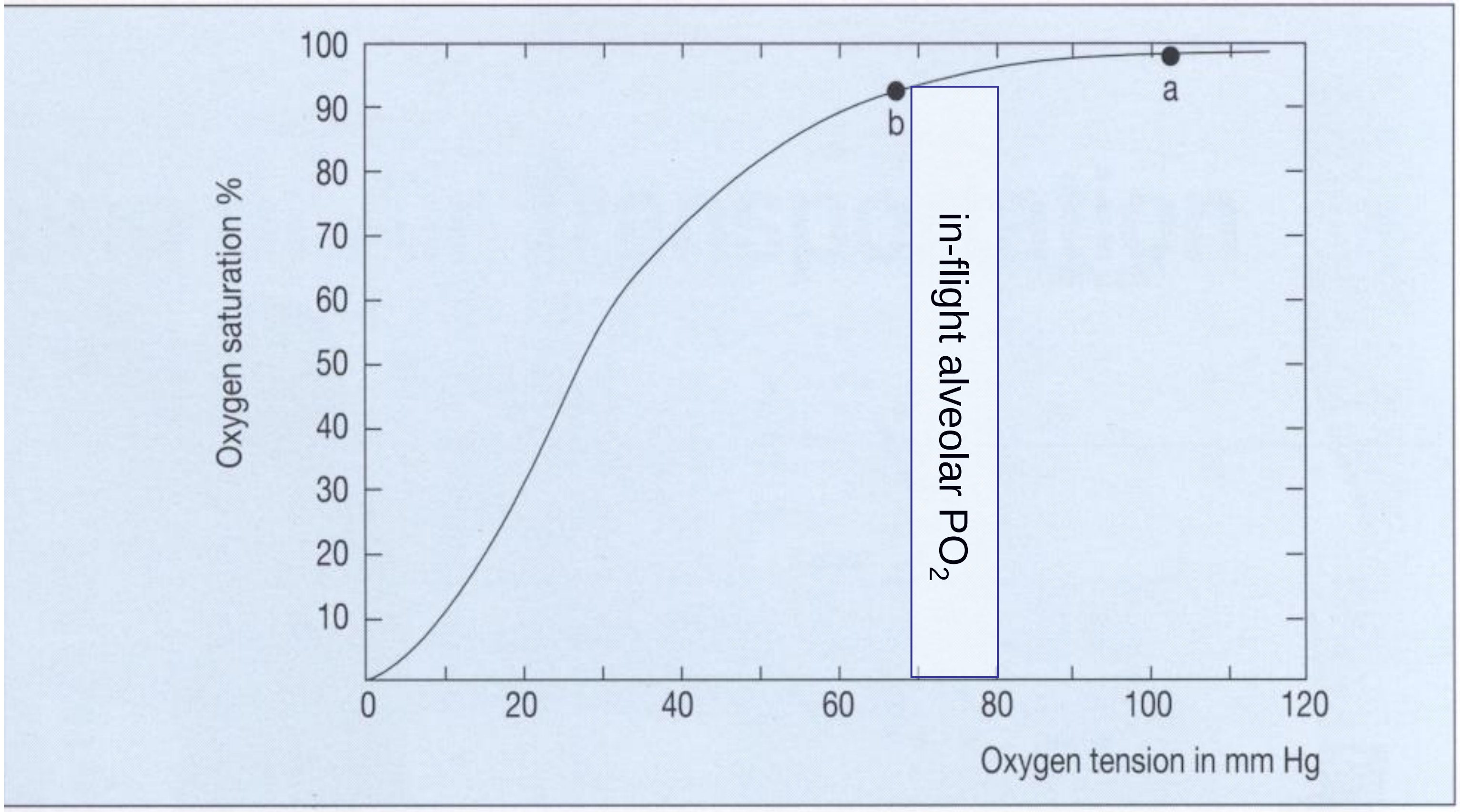
↓ atm. pressure

↓ part. Oxygen pressure

expansion gasses in

paranasal sinus, middle ear, GI tract

Hb - O_2 dissociation curve



Healthy Pax: $HbSaO_2$ 90-93%

During sleep + impaired ventilation: $HbSaO_2 < 90\%$

Expansion of gasses

BOYLE's Law:

P x V = Constant

$$\text{Rel. gass expansion} = \frac{(P_{\text{sea level}} - P_{\text{water vapour}})}{(P_{\text{cabin}} - P_{\text{water vapour}})}$$

at cabin pressure of 0.75 atm:

$$\text{Rel. gass expansion} = \frac{(760 - 47)}{(565 - 47)} = 1.4$$

Consequences Lowered Pressure in commercial aircraft

- Mild Hypovia
- Expansion stomach/intestines

↓

Bloated Belly

High Diaphragm

↓

Impaired Pulmonary ventilation

Managing passengers with stable respiratory disease planning air travel: British Thoracic Society recommendations

Thorax 2011;**66**:i1–i30. doi:10.1136/thoraxjnl-2011-200295

Fitness to fly for passengers with cardiovascular disease

David Smith,[1] William Toff,[2] Michael Joy,[3] Nigel Dowdall,[4] Raymond Johnston,[5] Liz Clark,[6] Simon Gibbs,[7] Nick Boon,[8] David Hackett,[9] Chris Aps,[10] Mark Anderson,[11] John Cleland[12]

Heart 2010;**96**:ii1–ii16. doi:10.1136/hrt.2010.203091

Consider the destination

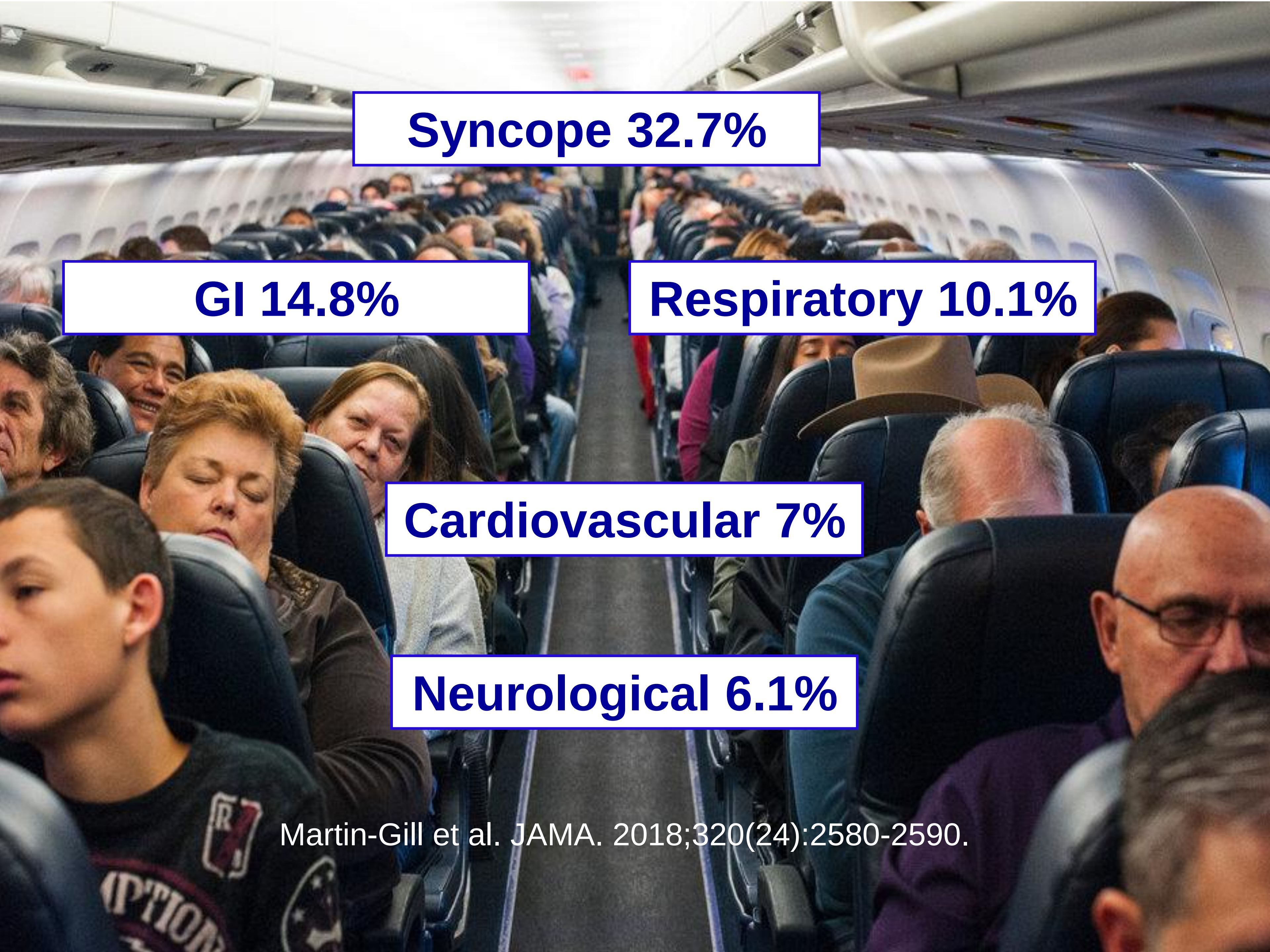
Airport	Altitude (ft)
Banga, Tibet	15 548
La Paz	13 310
Lhasa, Tibet	14 315
Quito, Ecuador	9 222

Is there a Doctor onboard?

In-FlightMedical Emergencies A Review

Martin-Gill C, Doyle TJ, Yealy DM. JAMA. 2018;320(24):2580-90

- 56,599 In-flight Medical Emergencies (IME)
- 1 per 604 flights,
- 75 IMEs per 1 million passengers (24 – 130)
- 2525 (4.4%) diversions


Syncope 32.7%
GI 14.8%
Respiratory 10.1%
Cardiovascular 7%
Neurological 6.1%
Martin-Gill et al. JAMA. 2018;320(24):2580-2590.

In-flight Syncope

- consternation in full cabin
- incorrect diagnosis → unnecessary actions
- such as diversions, ALS/ambulance at airport

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Useful ?

Alves et al., 2016

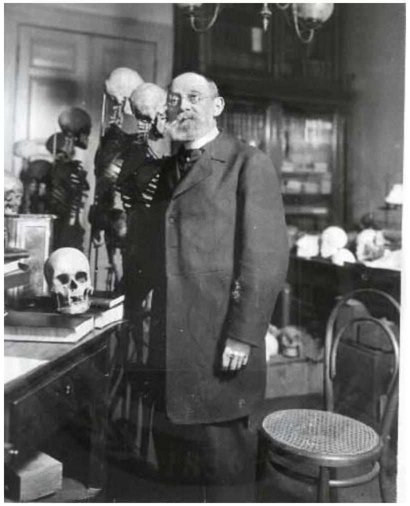
394 in-flight Cardiac Arrests

- 24.6% shockable: survival to hospital 22.7% of cases
- 75.4% non-shockable: survival to hospital 2.4%

Survival to hospital decreased with longer remaining flight duration: OR = 0.701 (0.535-0.920) per hour increase.

No correlation between diversions and survival for shockable cases

After Arrival . . . . Deep Venous Thrombosis



Deep Venous Trombosis

Virchow's Trias	Air Travel
- stasis →	long immobilisation
- vessel wall factors →	hypoxic pro-inflammation?
- activation of coagulation →	predisposing factors and hypoxia?

DVT / PE Risk long-haul travel

- Long-haul travel (all transport): 2-3 x increased risk
- Highest risk in first week after travel
- Higher Risk sub-groups

  (OAC, factor VL mutation, obesitas, predisp. diseases)
- DVT/PE risk 1 per 4500 flights
- Risk not increased for flights <3-4 hours

Prophylactic measures?

Yes or No ?

Prophylactic measures?

- Absolute DVT/PE risk 1/5000 pax
- Absolute DVT/PE risk too low to justify general prophylaxis

  (adverse effects: haemorrhage at 10 km altitude)
- Pax with higher risk: probably . . . .
- History of DVT/PE: Yes !
- insufficient knowledge of effect / risk balance

Low-molecular-weight heparines: 4 hrs before departure

All LMWHs: adapt dose in renal insufficiency

NOACs ? DOACs ? – not recommended yet

- Factor Xa inhibitors: Rivaroxaban

  Caveat! Renal insufficiency

- Direct thrombin inhibitor: Dabigatran

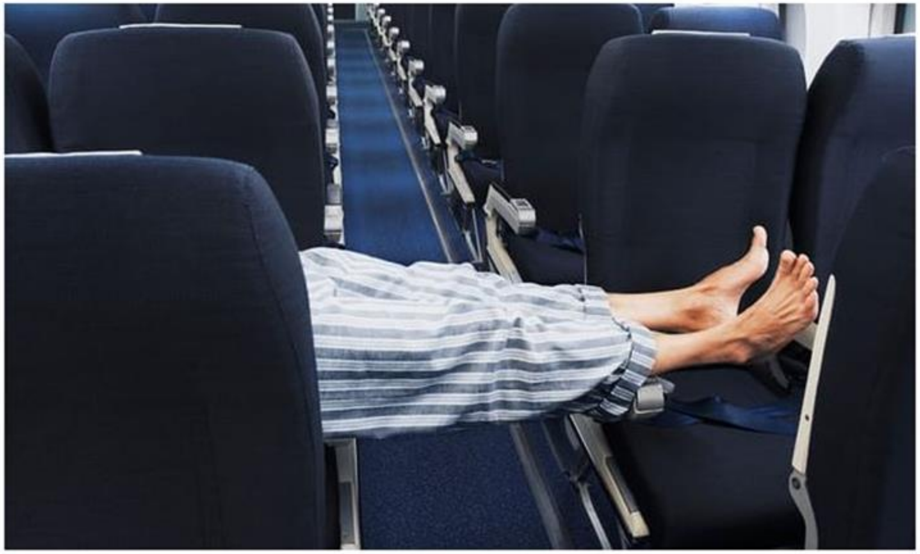
No evidence-based recommendation: off-label

Preventive Measures

- DVT/PE in history : LMWH
- Predisposing factors: doctors to weigh effect/risk balance
- Compression Stockings/ exercise calf muscles / exercises
- Ventilate your lungs (body position)
- No hypnotics
- Choose Aisle Seat

Aspirin:

insufficient protection!



▲ The first rule of flying: stretch whenever possible. Photograph: Henrik Sorensen/Getty Images

Sleeping during the flight ?

Avoid Hypnotics to reduce DVT risk

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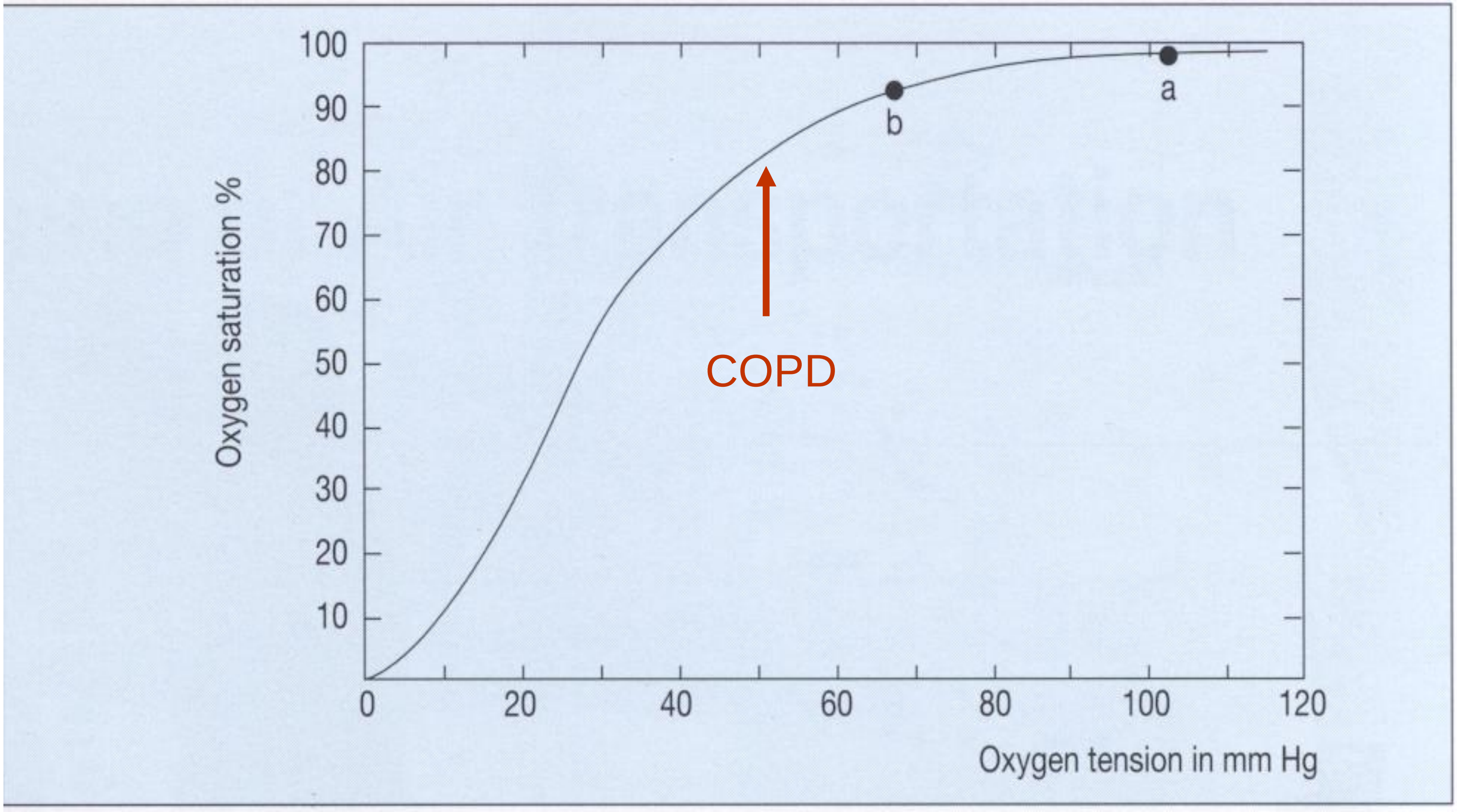
Commercial Air Travel After Intraocular Gas Injection

HOUSTON S, GRAF J, SHARKEY J. *Commercial air travel after intraocular gas injection.* Aviat Space Environ Med 2012; 83:809–10.

Passengers with intraocular gas are at risk of profound visual loss when exposed to reduced absolute pressure within the cabin of a typical commercial airliner. Information provided on the websites of the world's 10 largest airlines offer a considerable range of opinion as to when it might be safe to fly after gas injection. Physicians responsible for clearing passengers as 'fit to fly' should be aware modern retinal surgical techniques increasingly employ long-acting gases as vitreous substitutes. The kinetics of long-acting intraocular gases must be considered when deciding how long after surgery it is safe to travel. It is standard practice to advise passengers not to fly in aircraft until the gas is fully resorbed. To achieve this, it may be necessary to delay travel for approximately 2 wk after intraocular injection of sulfur hexafluoride (SF_6) and for 6 wk after injection of perfluoropropane (C_3F_8).

- do not fly within 12 hours after non-decompression dive
- do not fly within 24 uur after decompression dive
- do not fly within 24 uur after diving for several days

Hb - O_2 dissociation curve: COPD



British Thoracic Society- 2011

Sea Level SpO_2 >95% ⟶ no in-flight O_2 needed

Sea Level SpO_2 <92% ⟶ in-flight O_2 needed

O_2 use at home at sea level ⟶ double flow during flight

British Thoracic Society

Sea level SpO_2 92-95% without risk factor $\longrightarrow$ no O_2

Sea level SpO_2 92-95% with risk factor $\longrightarrow$

Hypoxia Challenge Test

Risk factors: hypercapnia, FEV_1 <50%, lung cancer, restrictive pulmonary diseases, cerebrovascular or heart disease, <6 weeks after exacerbation chronic pulmonary or heart disease

Hypoxic Challenge Tests for risk patients

- Hypoxia Challenge Test (HCT): 20 min 15 % O_2

- Hypobaric Chamber Exposure: 30 min at 8000 ft

Hypoxia: cardiovascular effects

- dilatation coronary and cerebral arteries
- increase cardiac frequency (bpm)
- increase cardiac output
- increase systolic blood pressure
- increase myocardial contractility
- increase pressure pulmonary artery

Significant > 4000-5000 m or SpO_2 <80%
or in-flight in patients with FEV_1 <30%

Who should not fly? - Rules of Thumb

- Uncomplicated Acute Coronary Syndrome <2 weeks
- After PCI ?
- Complicated ACS <6 weeks
- Unstable Angina Pectoris
- Severe or manifest heart failure
- Uncontrolled hypertension
- CABG <2 weeks
- CVA <2 weeks
- Uncontrolled arrhythmias
- Severe symptomatic valvular disease
- After Pacemaker insertion?

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Who should have extra in-flight O_2 ?

- Heart failure class III-IV (NYHA)
- AP class III-IV (NYHA)
- Cyanotic congenital defect (not always necessary)
- Rest $SpO_2 < 92\%$ of $PaO_2 < 70$ mmHg
- Hypoxic Challenge Test: $PaO_2 < 55$ mmHg

Pulmonary hypertension: always in-flight $O_2 \geq 2$ L/min

Elderly with early / mild dementia

- May function quite well in their familiar surroundings, but may become disoriented and agitated in a strange surrounding at night (night flights)
- Effects may be potentiated by hypoxia, dehydration, alcohol, hypnotics an jet lag
- People with cognitive and memory problems: higher risk of in-flight delirium

and what someone will be doing there . . .

Ries Simons