Occupational Hygiene Relevance in Aviation Medicine

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Aviation Medicine (Aerospace Medicine)

- Concerns the determination and maintenance of the health, safety and performance of persons involved in air (military and civilian) and space travel.
- Multi-disciplinary: doctors, nurses, physiologists, bioenvironmental engineers, occupational hygienists, environmental health practitioners, human factors specialists, psychologist, and other professionals
Aviation Medicine in Hong Kong

- Civilian
- Medical assessments on applicants (Pilots / Air Traffic Controllers)
  - physically / mentally fit to perform necessary tasks
  - any risk of physical / mental incapacitation
  - whether environment adversely affect any existing conditions
- Approved Medical Examiner – conduct medical examinations, Cert AvMed
- Approved Medical Assessor – sign medical certificates, DAvMed / Master AvMed
# Aviation Medicine in Hong Kong

<table>
<thead>
<tr>
<th>Licence</th>
<th>Holder’s Age</th>
<th>Class of Medical Certificate</th>
<th>Validity period in months</th>
</tr>
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<tbody>
<tr>
<td>CPL/ MPL(A)/ ATPL</td>
<td>Under 40</td>
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<td>12</td>
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<tr>
<td></td>
<td>40-59</td>
<td>1</td>
<td>(i) Single-crew commercial air transport operations carrying passengers 6</td>
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<td></td>
<td>50 or over</td>
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<td>(ii) Commercial air transport operations other than (i) above 12</td>
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<td>PPL/ Student Pilot</td>
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<td>60</td>
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<td>40-49</td>
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<tr>
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<td>50 or over</td>
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<td>Air Traffic Controller’s Licence</td>
<td>Under 40</td>
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<td>48</td>
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<td>40-49</td>
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<td>24</td>
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<td>50 or over</td>
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Training in Diploma in Aviation Medicine

- 6-month course
  - 3 months in King’s College, London
  - 3 months in Royal Air Force (Henlow base)
Training in Diploma in Aviation Medicine

- Lectures
  - Physiology – cardiovascular system, respiratory system, altitude physiology, hypoxia, pressure, acceleration, vibration, thermal, vision, etc
  - Psychology – human performance, sleep & fatigue, decision making, crew resource management, etc
Training in Diploma in Aviation Medicine

- Clinical – cardiovascular system, respiratory system, ophthalmology, noise and ENT, neurology, renal, GI, haematology, psychiatry, dermatology, infectious diseases, etc

- Operational – motion sickness, spatial disorientation, environmental control and life-support systems, radiation, selection, training, emergency and disaster planning, accident investigation, etc

- Pilots, aircrew and passengers – fitness to fly

- Air traffic controllers
Training in Diploma in Aviation Medicine

- Visits
- Centrifuge (acceleration)
- Land and sea survival
- Air traffic control
- British Airway
- Martin Baker Aircraft Co.– ejection, escape system
- Aircraft Accident Investigation Branch
- Civil Aviation Authority
- Military base (RAF, Navy, Army)
Examination

- King’s College
  - Post-graduate Certificate in Aeromedical Science from 2012 (6-hour written in 1 day)

- Faculty of Occupational Medicine, Royal College of Physicians, London – Diploma in Aviation Medicine
  - 2 parts: physiology / psychology; and clinical
  - Written – 3 hours in am and 3 hours in pm
  - Oral
Aircraft Cabin Air Contamination

- For > 20 years, reports on
- Possible relationship between
  - Exposure to fumes from heated engine and hydraulic oils contaminating air drawn into air conditioning systems ("bleed air").
  - Post-exposure acute and chronic symptoms experienced by cabin occupants, mostly aircrew
- No air quality monitoring system on board
Aircraft Cabin Air Contamination

- In 2007, Civil Aviation Safety Authority (CASA), Australia established an Expert Panel on Aircraft Air Quality
- Panel members with expertise in aircraft engineering, occupational and environmental health, aviation medicine, toxicology and epidemiology
Aircraft Cabin Air Contamination

- Literature search completed in September 2009
- Review of governmental inquiries, expert opinions, incident reports, media reports, in vitro and animal studies and human epidemiology studies, as well as individual testimonies
- Report in October 2010
Aircraft Cabin Air Contamination

- Sources of contaminants
  - jet engines
  - auxiliary power units
  - air conditioning machines
  - de-icing fluid
  - condensation, smog, fog
  - from engine exhausts of aircraft
  - during takeoff, landing, significant change of altitude – oil seals vary in effectiveness
Aircraft Cabin Air Contamination

- Known contaminant of heated engine oils – tri-ortho-cresyl phosphate (TOCP), an organophosphate, neurotoxic
- Volatile organic compounds (VOCs)
- Carbon dioxide, carbon monoxide
- Fumes from oil leaks, hydraulic leaks, water leaks, inhibitor fumes
Aircraft Cabin Air Contamination

- Insufficient evidence to reach any conclusion on the normal range of air contaminants and their concentration in commercial aircraft during normal operation

- Likely contaminants: CO, organophosphate derivatives
Aircraft Cabin Air Contamination

- Symptoms
  - Irritant effects: eyes, throat, respiratory symptoms, skin
  - Central nervous system effects: loss of recent memory, poor concentration, lethargy, incoordination, confusion, headache
  - Could not link to any identifiable cause in cabin air or extent of exposure
Aircraft Cabin Air Contamination

- Biomarkers not sensitive: Butyrylcholinesterase inhibition, TCP metabolites in blood / urine
- Rare reports of aircrew incapacitation
- Chronic illness
  - Delayed effects, non-specific symptoms, neurobehavioural, neuropsychological
Aircraft Cabin Air Contamination

- Prevention
  - Maintenance of engines to minimize seal failure
  - In contamination events, immediate use of 100% oxygen, smoke goggles
  - Report events and investigate
Aviation Ergonomics

- Mainly military
- Anthropometry
  - Measurement of human body and its segments to survey aircrew population
  - Check against aircraft cockpit size limits
- Aircrew equipment integration
Aviation Ergonomics

■ Aircrew equipment integration
  ■ Life support – oxygen equipment, anti-G protection, CBRN, warfare protection, personal conditioning
  ■ Operation – communication facilities, vision enhancement, flying overalls
  ■ Escape & survival – restraints & parachute harnesses, head protection, flotation, immersion protection
Aviation Ergonomics

Applications

- Cockpit workspace design – minimize cockpit size to reduce aerodynamic drag, limited range of seat, wide range of clothing, display and control

- Aircrew selection – critical dimension: sitting height, arm length (functional reach), leg length (buttock heel), thigh length (buttock-knee)

- Weight restriction – small size \(\rightarrow\) injury potential
Noise

- Source of internal noise in aircraft
  - Power source, transmission system, propellers (rotary wing), jet efflux
  - Cabin-conditioning, pressurizing system, hydraulic system, communication equipment
  - Armament discharge
Noise

- Reduction of cabin noise level
  - Increase canopy thickness
  - Smoothing boundary layer
  - Redesign conditioning system, reduce airflow throw system
  - Damping walls of cockpit – but weight penalty
Noise

- Protection of aircrew
  - Helmet, headset – with earmuff, ear plug
  - ANR – Active noise reduction (production active noise reduction system fitted to the earshell of an RAF aircrew helmet)
  - Active ear plug – allows communication signal to be fed to the ear through noise cancelling transducer, as with conventional earshell ANR
  - Wireless connection between headset and earplug communication transducer
Thermal Stress

- Heat / cold
- High altitude, sea, land (normal operation, emergency landing, escape)
- Cockpit (Green house effect)
- Protective clothing
- Plan for operation
- Use of WBGT
Radiation

- Occupational exposure limit
  - 20 mSv/year effective dose, average over 5 years
  - 50 mSv in any one year
  - \( \geq 6 \text{ mSv/year} = \text{radiation worker} \)
  - Airlines - ensure aircrew’s exposure
    \(< 6\text{mSv/year}\)
Thank You