OBESITY IN AVIATION MEDICINE

A Growing Concern?

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ABSTRACT

This paper will examine the impacts of obesity in aviation medicine. The World Health Organisation (WHO) has described the problems of obesity and being overweight as one of the greatest public health challenges of the 21st century (1) and this will certainly lead to increasing numbers of obese aviators (or potential aviators) presenting for medical certification. These people may not realise the impact their increased weight could have on their flying career and is often going to be an incidental finding in their examination rather than the specific problem they present with. This leads to the question for the medical examiner, does being overweight/obese matter in aviation and how might it increase a person's risk of incapacitation in the cockpit?

OBESITY

The WHO defines overweight and obesity as abnormal or excessive fat accumulation that may impair health (1). Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters, which can be used to screen for weight categories. The WHO defines obesity as a BMI of greater than or equal to 30 and being overweight is defined as a BMI of greater than or equal to 25 (1). Recent WHO estimates suggest that in 2016 39% of adults were defined as overweight and 13% were obese and this is rising, with prevalence tripling in some countries since the 1980's.

The exact prevalence of obesity amongst all pilots is not clear and there is likely to be significant variation between differing types of aviators. Military members flying physically demanding jets are much less likely to be obese by virtue of the job they do and their organisational fitness requirements and anthropometric requirements. Private or long haul commercial pilots may lead a more sedentary working life. A recent Brazilian study (2) found a prevalence of 53.7% of pilots being defined as overweight and 14.6% being obese. This is similar to other study results (3,4).

Being overweight or obese is a major risk factor for developing many other conditions including cardiovascular disease, venous thromboembolic disease (VTE), hypertension, type 2 diabetes, obstructive sleep apnoea (OSA), musculoskeletal conditions (including osteoarthritis), mental health issues and some cancers. The risk increases with increased BMI (1,5). Clearly all of these disease processes, their complications, as well as the actual physical size of the person have significant ramifications for current or potential aircrew medical certification and will be discussed further below.

TREATMENTS AVAILABLE FOR OBESITY

Obesity is a complex chronic multifactorial disease. Genetic, nutritional, medical, pharmacological, socio-economic and lifestyle factors all play a part and therefore it makes sense that multifaceted interventions will be more effective than a single treatment. The National Health and Medical Research Council have developed Obesity Guidelines (6) to assist primary health care providers in initially managing this complex condition, ensuring that an accurate assessment is done, with referral for appropriate therapies if required. These guidelines provide a stepwise framework called the **5A's** approach. Some patients will need very little input escalating up to those who require multiple management strategies.

Ask and Assess, Advise, Assist and Arrange

This encompasses asking patients, who are, in our case aviators, specifically about their weight and if they perceive it to be a problem and if they have the desire and motivation to lose weight? A thorough history can help to establish if being overweight has been a chronic life long pattern which will likely need much more intensive and long term strategies to manage, or, if it is an acute new issue. Recent new weight gain can be associated with a number of factors such as recent smoking cessation, some

pharmacological agents (for example the oral contraceptive pill) or acute life stressors (marital or employment issues) and in this case strategies should be directed at dealing with the underlying issues as well as weight loss.

An accurate BMI and also waist circumference should be undertaken to stratify the extent of the problem and guide referral and treatment choices. Waist circumference predicts total body fat and may help refine the risk of cardiovascular disease and diabetes (6). The greater the circumference the greater the risk.

Advising patients that there is clear evidence that even losing a small amount of weight can bring significant health improvements (7) can provide motivation for weight loss, particularly to aviators who may not realise the impact their weight might have on their flying career. It is then the role of the primary health care provider to assist and arrange (if required) referral on to specialist providers for further evaluation and treatment. This may involve drug treatments, surgery, multi disciplinary allied health input or a combination of those strategies.

Pharmacotherapy for Obesity

It is suggested that drug therapy may be considered for patients with a BMI > 30 (5,8,9). The Therapeutic Goods Administration (TGA) currently approves Phentermine, Orlistat and Liraglutide in Australia for the treatment of obesity. Topiramate is also used although its use in the treatment of obesity is off label. Unfortunately all these drugs come with the potential of significant side effects making them unsuitable for use in pilots currently flying due to the risks of incapacitation. These are discussed further below.

Phentermine is a sympathomimetic agent, which suppresses appetite. It has the potential to cause arrhythmias, gastrointestinal (GI) upset, insomnia and hypertension (10) This could lead to sudden acute incapacitation from loss of consciousness and cardiovascular collapse due to a malignant arrhythmia. Palpitations or an acute gastrointestinal upset may lead to distraction and insomnia can lead to fatigue and subtle decreases in cognition and ability. It is prohibited for use whilst flying by the Civil Aviation Safety Authority (CASA) of Australia (15)

Orlistat is a GI lipase inhibitor essentially preventing fat absorption in the gut. Up to 27% of people taking this will suffer from significant GI side effects including an oily rectal leakage, flatulence with discharge and abdominal pain (10), clearly making the risk of incapacitation very significant and thus unsuitable for use. It also associated with headaches and other side effects.

Liraglutide is a glucagon like peptide used to treat type 2 diabetes (10,11). It was found to cause a decreased appetite in some patients so subsequently has been used in the treatment of weight loss. Unfortunately it comes with the risk of significant GI side effects, the potential to cause hypoglycaemia (particularly in those taking a sulphonylurea) and electrocardiographic (ECG) changes (11) rendering it unsuitable for use in aviators.

Topiramate is an anticonvulsant that has been used to treat obesity off label (10,11). As with most anti epileptic drugs, topiramate comes with a myriad of side effects that could cause potential incapacitation in the cockpit. Psychiatric issues causing overt delusions or suicidal behaviours, acute angle glaucoma leading to intense eye pain or blindness are amongst the problems.

Bariatric Surgery for Obesity

A 2014 Cochrane review (12) found that surgery for obesity resulted in greater weight loss than other treatments in the short term and also reduced some co morbidities. It suggests that bariatric surgery may be considered for people with a BMI of >40 or less than 40 with obesity related diseases (eg diabetes) where other methods have failed. Unfortunately, most of the studies involved only measured outcomes up to 2 years so the true long-term outcomes are not known. The most common procedures in Australia are the adjustable gastric band, the sleeve gastrectomy and the roux-en-Y bypass (13) all of which have similar complications which may impact on the ability to fly safely afterwards. These include acute surgical complications such as bowel perforation or anastomotic leaks and post operative infections. These issues should be addressed and treated during the postoperative recovery period and if successfully managed pose no long term risk to medical certification in the future. Obviously if a pilot was to embark on weight loss surgery they would require a period of grounding until they demonstrated a full recovery.

Unfortunately longer-term complications may arise from all of these procedures that could cause potential issues for medical certification. Dumping syndrome can occur in up to 50% of people post gastric bypass when high levels of simple

carbohydrates are ingested leading to a rapid fluid shift from the plasma to the bowel and causing hypotension, tachycardia with possible diarrhoea and nausea. Hyperinsulinaemic hypoglycaemia is another complication that could cause acute incapacitation. Other conditions associated long term post bariatric surgery are iron deficiency anaemia, vitamin B12 deficiency and thiamine deficiency.

In the case of gastric band surgery over restriction of the band may be a problem causing discomfort and the inability to keep food down (13).

Multidisciplinary Allied Health Input

It has been shown that behavioural based programs improve weight loss results (14) and referral may be needed to dietitians, psychologists or exercise physiologists to aid initial weight loss and maintain the loss.

EFFECTS OF THE AVIATION ENVIRONMENT ON PEOPLE WHOM ARE OBESE OR WHO ARE BEING TREATED FOR OBESITY AND ITS RELATED COMPLICATIONS

The aviation environment can be considered as hostile. Pilots operate in a cockpit which is restrictive in space, there are barometric pressure differences, relative hypoxia, and vibration all of which can impact on the obese pilot more so than the none obese pilot. These will obviously vary between airframes. The single seat unpressurised helicopter will be very different to a large pressurised climate controlled A380.

The small cockpit space may limit movement during flight leading to a further increased risk of thromboembolic events (15,16). This, along with vibration may exacerbate chronic pain issues such as lower back pain and worsen conditions such as venous ulcers causing distracting pain.

Those with a gastric band run the risk of over restriction leading to discomfort and the inability to eat and drink normally, this is due to expansion of the band (or small air bubbles with in the band) at altitude due to decreased barometric pressure. Several gastric band information sites suggest removal of some of the liquid prior to a long haul flight to prevent this (17) but it is unclear what this would mean for a pilot flying often.

Hypoxia at altitude may be of concern due to obesity hypoventilation syndrome giving rise to subtle cognitive defects especially in small unpressurised airframes.

If the pilot is working in the long haul sector with stopovers and transiting multiple time zones then timing of medications and availability of regular food required for associated conditions (such as type 2 diabetes or post gastric surgery) may become a problem, as would be the logistics of managing a continued positive airway pressure (CPAP) machine if required for OSA.

EFFECTS OF PERSON'S PHYSICAL SIZE AND WEIGHT

The obese pilot may be unable to egress the aircraft safely in an emergency, be unable to fit through emergency exits or manoeuvre themselves quickly out of the cockpit. They may also have difficulty utilising life saving equipment such as life jackets. Seats may be too small to fit into comfortably and the safety harnesses may not fit, all of which are incompatible for safe operations.

They may also be physically unable to do external pre-flight checks if these are required, and potentially have difficulty operating the controls.

If the pilot is very big and the plane is very small there could be a dramatic effect on the weight and balance of the plane leading to safety issues. CASA recommends a morbidly obese pilot provide a completed calculated weight and balance sheet to be provided during the certification process (15) if a small plane is to be flown to prevent safety issues occurring.

Risk of Incapacitation Due to Obesity Related Conditions or Their Treatments

The range of medical conditions associated with being obese is nearly endless which makes evaluation very complex. This is also true for the extensive treatments that could be involved. Below is a review of some of the more common conditions occurring, but these are by no means exhaustive. Many of these conditions alone require grounding periods for pilots and potential restrictions on certification.

Cardiovascular disease may cause overt sudden incapacitation due to an acute myocardial infarction or cerebrovascular event. Distraction from pain or dyspnoea caused by angina or cardiac failure. Confusion or transient neurological issues due to transient ischaemic attacks is a risk.

Respiratory issues include OSA and is a particular strongly associated with obesity (5). It can cause

sudden incapacitation due to hypersomnolence and also some more subtle decreases in cognition and difficulty concentrating which may go unnoticed. It also independently increases the risk for many other conditions. Obesity hypoventilation syndrome may lead to hypoxia and impaired cognition at altitude. Pulmonary embolus can lead to sudden incapacitation and treatment of VTE disease with anticoagulants have their own risks of bleeding and incapacitation.

Being overweight or obese has been shown to be associated with depressive illness (and vice versa) (18). This, along with the stigma that may be felt by the person due to excess weight, leads to a potential risk of overt suicidality or self-harming behaviour that makes certification difficult. Depression alone can cause fatigue and cognitive dysfunction that may lead to errors in the cockpit.

Type 2 diabetics are at risk of hypo or hyperglycaemic episodes (depending on treatments) leading to incapacitation and also long-term complications such as visual and neurological problems, which may lead to subtle decrease in performance.

Other complications include but are not limited to are: gall bladder disease, osteoarthritis, lower back pain, venous ulcers and stress incontinence, these may not cause immediate catastrophic issues however have the potential to distract the pilot leading to errors and decreased performance.

Many people will have several issues to address.

Risk of Incapacitation Due to Obesity Treatments

Surgical treatment has been discussed above, as has the disqualifying nature of appetite suppressants. Toxicological analysis post mortem found that the drugs found in obese pilots involved in a fatal accident were similar to that for the general pilot population (19) which would indicate that obese pilots are not generally flying whilst using weight loss treatments covertly, which is reassuring.

GUIDANCE AVAILABLE FROM AUTHORITIES

The International Civil Aviation Authority (ICAO), Federal Aviation Administration (FAA) and the Civil Aviation Authority of New Zealand (CAA NZ) do not provide any specific guidelines on the approach to certifying an obese pilot, only advice on how to manage associated conditions. However it has been shown that obese aviators in the US are more likely to require a special issuance medical clearance than their non-obese counterparts (5) presumably due to increased prevalence of complex problems.

The Civil Aviation Authority of the United Kingdom have guidance when a person presents with a BMI > 35 (20) but nothing for those with <35.

CASA, however, has comprehensive guidelines regarding the approach to medical certification (15). They suggest assessment be broken down into operational constraints, complications of obesity, treatment issues and then demonstrated stability (of treatment and of weight). They have a risk assessment protocol based on BMI and age which would guide further information and testing required. This includes but is not limited to:

- Fasting glucose tolerance test
- Sleep Study
- CASA cardiovascular risk profile and if required evaluation by a cardiologist/physician
- Operational check conducted by an approved officer (CASA Flight Operations Inspector/CASA Safety Approved Test Officer/local Chief Flying Instructor)

There is no mention specifically of air traffic controllers in the CASA guideline.

SUMMARY

Obesity is a complex and multifactorial issue with multiple interconnections and feed back loops between the original condition, treatments and complications. Developing one complication can often lead to the risk of developing another. For example, developing type 2 diabetes increases your risk of cardiovascular disease. Developing OSA (in addition to leading to hypertension and thus cardiovascular disease) can make you fatigued, more sedentary and thus more obese. Treatments for conditions associated with obesity may be incompatible with medical certification or at the very least mean the person needs to fly with a multicrew restriction.

In general, the more obese the individual the more comprehensive the evaluation will need to be. Mildly overweight pilots may respond well to counselling regarding diet and lifestyle and be very motivated especially if they realise that further weight gain could jeopardize their flying career. Uncomplicated bariatric surgery and a period of grounding with no

complications also has a favourable outcome for certification.

The use of appetite suppressants and uncontrolled complications of obesity have an unfavourable outcome with regards to certification (15)

As with most things in aviation medicine there is no clear answer in regards to the obese individuals fitness to fly. They will have to be assessed on a case-by-case basis and take into account the type of certification they require, the aircraft they are intending to fly, and what duties they intend to perform.

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