Regulatory and occupational considerations in cardiology

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Abstract

For any occupation, the level of acceptable medical incapacitation risk needs to be defined (e.g airline pilots ≤1% per annum, HGV drivers <2% per annum). Guidelines from Civil Aviation Authority (CAA), Driver Vehicle Licensing Agency (DVLA) and consensus statements for athletes are the most useful reference points when making occupational decisions in patients with cardiological disease particularly those in higher-risk occupations. Common findings on screening ECGs and regulatory decisions in arrhythmias, coronary artery and structural heart disease are discussed.

Keywords Athletes; aviation; DVLA; ECG; fitness to drive; regulation; screening

What's new?

- Seattle criteria for defining boundaries of ECG normality in athletes
- Recertification in pilots with mechanical aortic prostheses
- Composite risk assessment of stroke and bleeding risk in individuals taking oral anticoagulants for AF
- Recertification following AF ablation

Introduction

For individuals proposing to work in high-risk occupations, it is usual to undertake pre-employment cardiac screening to exclude serious underlying cardiac disease. This may apply to military recruits, deep-sea divers, professional sportsmen, train drivers, heavy goods (HGV) and public service vehicle (PSV) drivers, and commercial airline pilots.

Many of these occupations will have statutory legal requirements covering medical aspects of fitness for work. In addition to these legal requirements, industry regulators often produce more detailed regulations, which provide a practical interpretation of the law.[1] However, the level of regulatory detail available varies widely between occupations. For larger industries, it is common for a panel of specialists to advise on the development of these regulations. This often relies predominantly on expert opinion, as the data from randomized clinical trials based on older populations with comorbidities may not always be directly applicable to young otherwise healthy individuals in the workforce. For other occupations, such as train driving in the UK, such detailed regulations may not be available, and fitness decisions in such individuals are made on a case-by-case basis by occupational physicians with advice from specialists.

In some high-risk occupations involving very high levels of exertion or exposure to other hazards, such as extremes of altitude or depth, the risk is predominantly personal. While these individuals, particularly athletes, may be prepared to accept additional risk in order to compete/work, this may not be acceptable to their employer on health and safety grounds. In other situations, particularly involving public transport, the rights of an individual to work need to be balanced against the potential dangers to the travelling public should a train driver or airline pilot or other transport worker suffer incapacitation due to an already diagnosed illness.

The concept of acceptable incapacitation risk was defined in the aviation industry where a rate of <1% per annum is accepted in a multicrew environment.[2] This risk is based on a two-pilot model in which each flight lasted 1 hour and only the first 3 minutes of take off and the last 3 minutes landing were judged absolutely critical.[3] The model estimated that a fatal accident due to pilot medical incapacitation would occur in 1 in 10^9 flying hours. For commercial pilots who fly solo operations the acceptable risk is lower at <0.15% per annum (Table 1). The concept of acceptable incapacitation risk was extended by the United Kingdom Driver and Vehicle Licensing Agency (DVLA), which uses a 2% per annum incapacitation risk for individuals who hold a Class 2 (HGV and PSV) vocational licence.[3] Based on this work, well-developed guidelines are available from the DVLA for occupational drivers and from the United Kingdom Civil Aviation Authority (CAA) for commercial and other vocational pilots.[4,5] Guidance focused on professional sportsmen may also be relevant to individuals in the aviation industry and other high-risk occupations.

Other industries may look to these standards when drawing up their own specific regulations. For example, Canadian railway regulators considered the acceptable level of risk for a train driver to be closer to that of a DVLA Class 2 driver than an airline pilot, and therefore developed regulations based on a 2% per annum risk model.[6] Following a rail accident due to the death of the driver from myocardial infarction, Australian rail regulators also produced detailed regulations that included a proactive approach to coronary risk factor management.[7] Using standard coronary risk factor tables, train drivers with <5% 5-year risk are passed unconditionally as fit. Those with a higher risk score are referred for risk-factor management and further investigation with stress testing, while those with >25% 5-year risk are judged unfit to work pending investigations.

All recruits to a high-risk occupation should have a clinical and family history, a physical examination, and an electrocardiogram (ECG). Additional investigations such as echocardiography, Holter monitoring and exercise testing may be indicated, depending on the clinical scenario.

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Maximum acceptable incapacitation risk for different activities

Class licence	Activity	Acceptable risk per annum
CAA Class 1 — unrestricted	Fly solo commercially Air ambulance, police helicopter Commercial airline work	<0.15%
CAA Class 1 — restricted	Commercial airline work with co-pilot only	<1%
CAA Class 2 — unrestricted	Flying instructional work Fly non-commercially larger, heavier aircraft >3 passengers	<1%
Class 2 — restricted	As Class 2 above with co-pilot only	<5%
Light aircraft pilots licence (LAPL) — unrestricted	Light aircraft. Carry up to 3 passengers	<2%
LAPL — restricted	Fly light aircraft with co-pilot or with no passengers	<20%
DVLA Class 2	Drive HGV, public service transport	<2%
DVLA Class 1	Drive personal car	<20%

Table 1

Electrocardiography and arrhythmias[8]

The ECG may reveal abnormalities, such as a delta wave indicative of an accessory pathway, which allow a definitive diagnosis. Other abnormalities, such as Q waves suggestive of previous myocardial infarction or hypertrophic cardiomyopathy, require further investigation but may be normal variants. Major repolarization abnormalities in healthy individuals, in whom further investigation reveals no discernible underlying cardiac abnormality, present a particular challenge. It may be difficult to distinguish between ECG changes caused by physical endeavour and those due to cardiac pathology; up to 14% of high-level athletes, particularly those in endurance sports, were formerly classified as having distinctly abnormal ECGs using standard criteria.[9] New European guidelines and the Seattle conference have lead to a re-evaluation of the ECG in the highly trained athlete population.[10,11]

Atrioventricular (AV) block

First-degree AV block is common in healthy fit individuals and, provided the PR interval is ≤240 ms, further investigation is not usually required.

Second-degree AV block of Wenckebach type (Mobitz type 1) is common in younger fit individuals, particularly nocturnally. Provided there is no additional bundle-branch disease, the condition is generally benign, even when there are periods of daytime Wenckebach or several consecutive non-conducted P waves during a nocturnal episode. The finding of asymptomatic Wenckebach in younger individuals should not impose any occupational restrictions.

Wenckebach conduction in the older population may not be such a benign condition and may require permanent pacing, though controversy still exists as reflected by differences between European and US guidelines.[12,13]

Second-degree AV block of Mobitz type 2 is most commonly associated with additional bundle-branch disease, and is a clear indication for implantation of a permanent pacemaker, as is third-degree AV block.

Bundle-branch block

Right bundle-branch block (RBBB) is generally thought to be a benign condition, which can be found in up to 1% of otherwise healthy individuals. However, over the longer term it does carry a small but definite increased cardiovascular risk, particularly in women. Further investigation should be undertaken to exclude underlying conditions, such as coronary artery disease or sarcoidosis, but serious underlying disease is relatively uncommon. Commercial pilots can continue to fly in a multicrew environment only while these investigations are completed. If the investigations are satisfactory, unrestricted certification is allowed after 1-year follow up. For other occupations no restrictions are usually required.

Left bundle-branch block (LBBB) is a more serious finding and is associated with a higher incidence of detectable cardiac disease. Isolated LBBB usually carries a good prognosis, but in the presence of structural heart disease LBBB may indicate an adverse prognosis. In the aviation environment, flying is suspended when LBBB is detected until investigations have been completed, which will include functional testing for ischaemia (myocardial perfusion scanning, stress echocardiography or stress MRI) or coronary CT angiography in those over 40 years of age. For DVLA Class 2 license holders, LBBB, in common with other AV conducting disease, is acceptable provided it has not caused or is likely to cause incapacity and there is no other disqualifying condition. A satisfactory functional test with myocardial perfusion scanning or stress echocardiography is also required.

Left anterior (or posterior) hemiblock is a common finding in middle-aged individuals. Statistically, it is associated with a slightly increased risk of cardiovascular events but in the large majority of individuals no serious cardiac pathology is found following investigation. New-onset hemiblock in an aviation setting requires investigation with exercise stress testing as a minimum.

Short PR interval and ventricular pre-excitation

In an asymptomatic individual the isolated finding of a short PR interval with a normal QRS on an ECG is not a cause for concern, but the associated presence of palpitations raises the possibility of

