Flying after heart surgery

The discovery of significant cardiac disease in a pilot (or air traffic controller) results in the licensing authority temporarily removing his or her medical certificate, which automatically invalidates his or her pilot's licence. (In the United Kingdom the “authority” is the Civil Aviation Authority (CAA) medical department, which is now using European-wide medical standards (Joint Aviation Requirements).) The return of this medical certificate may be very important—the professional pilot wishes to regain his livelihood, and the private pilot wishes to return to a much loved hobby. Pilots may see cardiac surgery as their only hope; therefore, it is important for all those involved in the decision whether to perform an operation, in particular the surgeon, to have some knowledge of the criteria that the CAA will use when considering recertification. (The criteria set out in this brief article reflect those set out in the workshops in aviation cardiology published as supplements to the *European Heart Journal* 1984, 1988, and 1992 rather than the personal opinions of the authors.)

1% rule
For over 20 years the CAA medical department has been advised on individual cases by its Medical Advisory Panel (MAP), a group of cardiologists and cardiac surgeons aware of aviation requirements. During this time a concept called the 1% rule has evolved. This starts with the recognition that any aeroplane system, including the pilot, has a failure rate that could lead to an accident. Statistically, a pilot incapacitation rate of one in one thousand million flying hours (1:1 000 000 000) maintains an “acceptable” overall aircraft failure/accident rate for commercial flying. This rate may seem small, but the aviation industry is highly safety conscious, and wishes to maintain its status as the safest way to travel (per distance covered).

A combination of MAP experience, aircraft simulator studies, and more statistics have defined this acceptable risk in an individual pilot. The vast majority of commercial flights have two pilots in the cockpit. The incapacitation of one becomes a relatively minor problem. Only a small proportion of the flight time is critical (takeoff and landing), and even if the incapacitation occurs during that critical time, simulator studies have shown that in more than 99% of incidents the other pilot can successfully take control and land the aircraft. Statistics show that this overall level of safety is maintained if neither pilot has more than a 1% risk of incapacity per year. It has been the job of the MAP to define what cardiac anatomy or pathology meets this 1% per year risk criterion. If a commercial pilot, after a cardiac event, is deemed to be within the 1% per year risk, then he can return to flying in a two crew cockpit. Private flying tends to be a solo activity, but the absence of paying passengers allows a lower overall risk target, and if he falls within the 1% per year risk, then that pilot can return to solo private flying.

Coronary artery disease
The criteria for recertification following cardiac surgery have not changed substantially since the first UK workshop in aviation cardiology and have been substantiated by a CASS (coronary artery surgery study) data analysis looking at pilot equivalent cases and a US follow up of pilots. They are essentially the same following a myocardial infarct or coronary angioplasty. The first evaluation should be no sooner than nine months after surgery “in view of the quite high incidence of usually transient neuropsychiatric sequelae following cardiopulmonary bypass procedures” and to allow perioperative morbidity to resolve.

The initial requirement is an assessment by a CAA medical department cardiologist using a Bruce protocol exercise test to stage 4 without ECG changes or symptoms. Subsequent investigations must include a MUGA scan with an ejection fraction of greater than 40% and satisfactory coronary angiography. This must show patent grafts and no stenosis greater than 30% in any ungrafted vessel.

Surgeons should note these requirements. Three excellent grafts, but a fourth ungrafted vessel with a 40% stenosis would mean that the pilot remains grounded. Those who balk at these regulations should remember that the CAA is concerned only that the risk of incapacity remains less than 1% per annum while the pilot remains flying. Long term survival is not relevant in the medical certification of pilots. Repeat angiography will be required at five years and every two to three years thereafter.

Congenital heart disease
Criteria for flying with corrected or uncorrected congenital heart disease are set out in the first European workshop in aviation cardiology. An unrestricted certificate is possible in the presence of a small fossa ovalis atrial septal defect with pulmonary to systemic flow ratio (Qp:Qs) less than 1.5. Those with primum defects would not be able to fly under any circumstances. Other defects that may be certificated without correction are a small ventricular septal defect (Qp:Qs < 2:1), mild pulmonary stenosis (gradient < 30 mm Hg), and a small persistent ductus arteriosus (PDA).

Operated congenital conditions include fossa ovalis defects operated on before the age of 17 years and surgical correction of PDA, pulmonary stenosis, and coarctation before the age of 14. Although meeting the 1% per annum risk criterion for two crew commercial flying, at present the Licensing Division of the CAA will not issue initial professional pilot licences without an unrestricted medical certificate. These patients are therefore barred from commercial flying but would be able to fly privately. It may be possible for a professional pilot who develops problems from unsuspected congenital heart disease to continue flying in a two crew capacity. Recently, a pilot had a single transient ischaemic attack during exercise and was found to have a patent foramen ovale (PFO). It has been accepted in principle by the MAP that proved closure of a PFO, either by surgery or by a device, may allow recertification.

Valve disorders
Asymptomatic and haemodynamically unimportant bicuspid aortic valve disease is compatible with certification. However, if the disease progresses to the point of surgery then a conflict between continued flying and what is “best” for the patient may arise. This is because anticoagulants prevent any sort of certification to fly other than privately with another pilot (a safety pilot) in the cockpit. Best care of a 40 to 50 year old with aortic valve disease is likely to be a mechanical valve replacement, but if he is a pilot who wishes
to continue flying, alternatives will have to be considered. Restricted certification may be possible 12 months after an unmounted homograft in the aortic position. The valve must be functioning normally, there must be normal or near normal LV function, a normal or near normal ECG and echocardiogram, and good exercise tolerance.6 8 The 1988 workshop suggested that two named tissue valves (Carpentier-Edwards and Ionescu Shiley) might be acceptable in the very best cases,9 but the failure rate beyond five years was noted11 and this advice was not repeated at the European Workshop in 1992. In the case of the Ionescu Shiley valve the guidelines are clearly out of date and other European Workshop in 1992. In the case of the Ionescu Shiley valve the guidelines are clearly out of date and other European Workshop in 1992. In the case of the Ionescu Shiley valve the guidelines are clearly out of date and other

Therefore, it remains to be seen whether the free hand porcine valves or pulmonary autograft (Ross operation), which is enjoying a resurgence of interest, will be compatible with flying.

Relief of mitral stenosis with obliteration of the left atrial appendage will allow two crew professional flying.9 Mitral valve prolapse was discussed in the 1992 workshop12; a repaired valve with no regurgitation was thought to allow restricted certification,9 but recent analysis of the problem suggests not.13

Summary
Cardiovascular events causing incapacitation in aircrew are very rare. In a study by Bennett of 36 000 pilots at risk over 10 years there were 26 episodes of complete incapacitation in the air. Ten were caused by myocardial ischaemia, seven by epileptic fits, six by syncope, and three by cerebral haemorrhage.14 In the UK there were no multicrew scheduled aircraft accidents attributable to cardiovascular disease in the 20 years (250 million flying hours) leading up to the first European aviation cardiology workshop1; however, almost a third of pilots have had to ask another crew member to take over their duties. In the vast majority of cases this was because of an acute gastrointestinal disorder, and safety was an issue in only 3% of cases.15 Cardiovascular disease remains the most common reason for premature loss of a pilot’s medical certificate and licence. Most of these pilots will have been investigated by the CAA medical division, and discussed by the MAP. The MAP believes that the lack of cardiovascular related aircraft accidents is because of applied medical standards, rather than in spite of them.

The miniature sheet from Uganda was issued in 1978 for the World Health Day campaign of that year “Down with high blood pressure”. The four stamps in the set, each issued separately in full sheets, are reproduced together in the form of a miniature sheet showing various aspects of hypertension and its complications.

M K DAVIES
A HOLLMAN