

# DIVING AND CORONARY ARTERY DISEASE

---

by Dr Simon Mitchell & Dr Lynn Taylor

## Current at time of writing (2005)

Here, we consider coronary artery disease, a topic we frequently get asked to comment on, with typical questions being:

- Before starting my dive training course, I completed the medical questionnaire and I indicated that I have high cholesterol – Will this be a problem when I have my diving medical?
- Last year I had an episode of chest pain which was diagnosed as angina and now I get short of breath when I walk up stairs – Can I still dive?
- My husband is about to have heart surgery and is worried that he may not be able to dive ever again – Is that true?

This article aims to provide educational information about Coronary Artery Disease (CAD) and how it may affect the decision to dive, as well as raise the awareness that this is a condition which definitely needs to be discussed with a doctor who has additional training in diving medicine.

### What is coronary artery disease?

The coronary arteries are the blood vessels that supply the heart muscle with blood (and oxygen). They arise from the aorta (the main artery through which all blood leaves the left heart) almost immediately after it arises from the left ventricle, and spread out over the surface of the heart. Small branches penetrate down into the heart muscle and divide repetitively to form the capillaries from which the heart muscle extracts oxygen.

Because of its constant activity and high oxygen demand, the heart is critically dependent on blood flow through the coronary arteries. If this flow is interrupted for any reason, the heart muscle becomes hypoxic. At a “subcritical” level, this may be manifest as shortness of breath or central chest pain which sometimes radiates to the neck and left arm. Such pain is commonly referred to as “angina”. If the lack of oxygen becomes critical then some of the heart muscle may actually die, causing what is commonly referred to as a “heart attack” or in medical parlance, a “myocardial infarction”. If enough of the heart muscle is affected, or if the electrical conducting tissue of the heart is compromised, then this might result in a cardiac arrest and the patient will die unless resuscitated.

Coronary artery disease (CAD) refers a progressive narrowing of the coronary arteries as a result of a complex pathological process in their walls. These processes result in the formation of so-called “plaques” which consist mainly of fatty material in the coronary artery wall. The exact cause of plaque formation is still being established, but genetic influences are important, as is the level of cholesterol in the blood over the long term. Other important risk factors include obesity, hypertension, smoking and diabetes. The risk of CAD increases with age, and clinically significant levels of change are uncommon in people less than 40. Having said this, patients with multiple risk factors can suffer CAD at a very young age. A strong family history, smoking and high blood cholesterol is a very ominous combination, and such patients have suffered heart attacks in their 30s or even 20s.

For obvious reasons, as the size of plaques (and the narrowness of coronary arteries) increases, the more interruption of coronary blood flow will occur and the more likely it will be for angina pain to occur. At first, this may be apparent only during exercise, because the heart's demand for oxygen increases. As CAD progresses, it is possible to suffer angina even at rest. In addition to this progressive narrowing, it is also possible for sudden blockages of the artery to occur. This may arise because the plaque tissue is both fragile and abnormal, and if the surface of the plaque is disturbed it can provoke blood clotting. This sequence of events is thought responsible for many heart attacks. Unfortunately, it is possible for this to occur on even relatively small plaques that have not previously caused any angina. Thus, heart attacks can occur unexpectedly in patients who have never been diagnosed as having CAD.

Patients with symptomatic CAD frequently use a nitrate based spray medication (sprayed under the tongue) to relieve angina. This works by relaxing the muscle in the wall of the coronary arteries, and thereby dilating them. Over the longer term, diet, cessation of smoking, control of hypertension, weight loss, and adequate control of cholesterol and diabetes are also important. Where more interventional treatment is considered appropriate, patients may undergo a procedure known as coronary angiography. This uses a special dye to image the coronary arteries and accurately define any narrowing. Sometimes narrowing can be treated by inserting a catheter via an artery in a leg and threading it back up the aorta and into the affected coronary artery. A balloon on the end of the catheter is then inflated, which squashes the plaque. Using a similar technique, a "stent" may be placed in the vessel to hold it open, much like the supports in the wall of a mine shaft. Ultimately, open heart surgery may be required to "bypass" the affected segments of diseased coronary artery using veins harvested from the leg. This procedure is referred to as coronary artery bypass grafting (CABG).

### **Coronary artery disease and diving**

It does not require a lot of thought to appreciate the potential problems with CAD and diving. In general, diving is not a strenuous activity, but it can become so in certain situations familiar to all divers, such as swimming in a current. In a diver with CAD this might precipitate angina or a heart attack. Any medical condition that might limit the ability to cope with the realistic physical demands of recreational diving must be considered a barrier to diving. Similarly, it must also be remembered that if a diver were to suffer a heart attack in the water, then the likelihood of survival would be much lower than if the event occurred on land because of the obvious danger of drowning. Finally, there is good cause to suspect that CAD might predispose the diver to a rare condition known as immersion pulmonary oedema. In part, this condition occurs when the heart struggles to cope with the extra effort of pumping against the increased resistance of constricted peripheral blood vessels, as a result of the cold water.

### **Assessment of fitness for diving**

From the point of view of diving fitness, we can split CAD patients into 3 groups.

First, there are those patients who have CAD but no symptoms. This is the most troublesome group because in most cases neither they nor the examining doctor know who they are!! The point of singling out this group here is to highlight the need for a high index of suspicion on the part of examining diving doctors, and the need to (where appropriate) conduct investigations that will identify patients with a significant problem. Thus, for example, if a 45-year-old person presented for a diving medical and reported no medical problems except high cholesterol and a family history of CAD, it would be appropriate to investigate them further. This might take the form of an exercise electrocardiogram (ECG) which exercises the subject whilst monitoring them for the tell tale ECG signs that the heart muscle might be becoming hypoxic.

If the test showed no problems, it would be appropriate to let them dive whilst ensuring optimal management of their high cholesterol (and any other risk factors, such as smoking!). Such a diver would probably be advised to undergo periodic review (perhaps a repeat exercise ECG every two years) in recognition of the potentially progressive nature of the problem. If the test did indicate some heart muscle hypoxia, then diving would not be appropriate and the patient would fit into the next category.

Second, there are those patients with known CAD, many of who will suffer from angina or shortness of breath on exertion. Decisions regarding these patients are relatively easy: diving is simply not appropriate. Such patients should be referred to a cardiologist for management.

Finally, there are those patients who have had some form of definitive intervention for their CAD such as angioplasty, stenting, or bypass grafts, and who now want to dive. It is difficult to make blanket generalisations about this group, and each case would need to be considered on its own merits. However, as a general principle, in this more permissive age of diving fitness assessments (and assuming there are no other potential medical problems) there is no reason why a candidate with definitively managed CAD (ie: the problem has been “fixed”) should not dive, provided steps are taken to ensure that their exercise tolerance is adequate. At the very least, this would involve an exercise ECG as described above. There are other investigations that a diving doctor might require, but these are beyond the scope of this review. In addition, such patients would have to accept that their history of CAD does imply some extra risk in diving, no matter how definitively it has been managed. Adequate performance in tests of exercise tolerance should ensure that this risk is within acceptable (albeit poorly defined) limits.

In summary, the potential impact of coronary artery disease on a person’s ‘fitness’ to dive and the degree of increased risk that may be associated with the condition is very individual and depends largely on the severity of the disease.

For those of us who have now passed the great age of 40 years, the likelihood of us having some form of underlying CAD is starting to become a reality, even if we don’t want to admit to ourselves! As we approach our 50’s and 60’s, it would be unusual for us not to have some underlying CAD, whether we are aware of it or not. The key is to keep fit and healthy and reduce all other risk factors if we want to keep on diving into our retirement years. Part of the role that we can play as individuals is to accept the responsibility for having regular medical check-ups, with a doctor who has additional training in diving medicine, to ensure that any conditions are diagnosed early and are managed in the best possible way. In many cases, we will be able to continue diving and if the risk is deemed to be too high, at least you will be informed and not left to wonder.