

BONE SCINTIGRAPHY

Peter Valk

Bone scintigraphy is actually better known as bone scanning. It occurred to me that it might be an interesting topic to discuss at a SPUMS meeting. I discovered, with quite some surprise, last year that Australian professional divers are required by regulation to have annual X-rays of their long bones. Annual seems a bit frequent. If you are going to look for bone necrosis X-rays are not ideal. Those of us who have been working with general medical and surgical patients in hospital know that when looking for bone necrosis in other conditions scintigraphy is much more sensitive and picks up lesions much earlier than X-rays.

Bone scintigraphy is basically the injection of a radioactive substance, a radiopharmaceutical, intravenously and then, at various times after the injection, a gamma camera is used to collect data which gives a two dimensional display of radioactivity. In the case of bone scintigraphy this is a picture of the skeleton. The radiopharmaceutical now used for bone imaging is one form or another of a Technetium 99 m phosphate complex and various phosphates have been used. When these compounds are circulating through bone they are absorbed through the bone surface, particularly if it is recently mineralised or mineralising bone, and to a lesser extent there is actual binding of the phosphate to calcium in hydroxyapatite. That is the mechanism by which the radiopharmaceuticals stick to the bone. What determines how much is going to end up in a particular area of bone is the functional status of that bone.

That is one thing that makes scintigraphy significantly different from radiography. Radiography looks at shadows cast by different amounts of calcium that happen to be present. What can be seen with scintigraphy is two things. One is the blood flow to the bone, because obviously a piece of bone cannot take any up unless the radiopharmaceutical gets there via the blood stream. Secondly, the level of osteoblastic activity. This will determine what fraction of the radioactivity that goes through the bone will be fixed and what fraction will move on. Obviously a decrease in either of these factors can lead to decreased and finally absent up-take. As far as any increase is concerned, the most important factor is bone blood flow because this can be increased up to 20 or 30 times, whereas with normal bone extraction efficiency is about 50%. So there will only be a 2 to 1 increase in uptake by an increase in osteoblastic activity.

Having discussed how this tracer binds to bone, let us look at what happens in a case of avascular necrosis. First the blood supply to the marrow in the bone is cut off, and instantly there is an absence of up-take of tracer in that part of the bone. Within 24 hours the marrow dies and then gradually over a couple of weeks the osteoblasts of the bone die. At any time during this period bone scintigraphy shows a cold area where the infarct is located. Subsequently, to varying degrees, there is revascularisation of the marrow from adjacent areas, there is reabsorption of dead bone and there is a laying down of new bone. At this stage as the perfusion increases and osteoblastic activity increases the

uptake within the pathological area becomes greater than in normal bone. It becomes a hot spot. Then subsequently as the acute bone formation reduces, one may end up with bone that scintigraphically looks perfectly normal. In the end there is an area of dead bone and marrow surrounded by a fibrous capsule and outside this capsule there will also be calcification of the dead marrow. It is this calcification that produces the appearance seen on X-rays. However it takes months for the X-ray changes to develop.

What do these changes mean? In the shafts of the long bones, the osteonecrotic lesions probably mean very little because they seem to have no functional importance. It is very different with the juxta-articular lesions, which are mainly in the heads of the humerus and femur as these lead to joint damage. Gradually patches of dead bone develop under the joint surface. Dead bone is not as strong as living bone so the joint surface is inadequately supported leading to break up of the joint surface and eventually loss of joint function. Juxta-articular lesions have some importance, clinically speaking.

There are two ways of looking at the uptake of radio isotopes. Studies soon after injection reflect the rate of bone blood flow, or one can do late pictures, two or three hours after the injection which is what I usually deal with clinically.

At this point Dr Valk showed numerous slides of bone scans in patients with various forms of osteonecrosis. Common causes include fractured neck of femur, steroid therapy, chronic renal failure. A rare case he presented was the bone scan of a black patient after an acute crisis of sickle cell disease. These patients, after an acute crisis, have extensive revascularisation throughout the skeleton.

The most sensitive way of picking up bone necrosis is by bone scintigraphy. Why one wants to pick up bone necrosis is another question, but if one wants to spot osteonecrosis then this is the test one ought to be doing.

A CASE OF CEREBRAL GAS EMBOLISM

Chris Acott

This is the story of a 31 year old diver who had been diving for six months. He was NAUI qualified, holding a C card. He had had no medical examination before learning to dive, however when I examined him there was nothing of note in his past medical history.

He and his buddy went diving on a Sunday. Their first dive was to 30 feet for about 40 minutes. This depth was verified by his buddy, but he was equally uncertain about the time. However I know the area involved and the maximum depth could only have been 30 feet. The surface interval was not accurately timed, but it was probably about 40 minutes. They then went diving again. The patient only had about 700 psi in his tank. So it is not surprising that he ran out of air about 20 minutes later. He made a free ascent from 25-30 feet, breaking the surface about 5 seconds after lift off. The patient admits that everything that occurred after that is uncertain. His buddy

told me that there was enough air in his tank to inflate his ABLJ (adjustable buoyancy life jacket or buoyancy compensator). They then swam back to the boat. When they were on shore they had a few beers. His buddy remarked that there did not appear to be anything wrong with the patient at that time.

The patient, although confused, could remember a right sided headache occurring later that night which slowly got worse over the next few days. As this happened he began to get more confused, according to his wife, until finally on the Wednesday he was totally confused. He was unable to maintain his balance effectively, had slurred speech and had been engaging in repetitive behaviour. He was taken to the Yeppoon Hospital, where he was kept in overnight and given 100% oxygen to breathe. They rang me next day about him, and he was transferred to the Rockhampton Base Hospital that day.

When I saw him he was conscious, slightly confused and very unsteady on his feet. Examination revealed some slight barotrauma of both tympanic membranes. He admitted to some difficulty with clearing his ears on descent on the first dive. He was totally unco-ordinated, unable to perform the finger to nose test, as well as the knee to toe test. When asked to perform the Romberg test, he fell over immediately. I thought that there was some decreased power in his left arm. His fundi were normal. His visual fields, to my crude testing, appeared normal. Nothing else was noted in his clinical examination.

I telephoned the Townsville General Hospital to alert the Australian Institute of Marine Science (AIMS) chamber and I also spoke to Dr Des Gorman at HMAS PENGUIN. The patient was sent to Townsville in our pressurized twin engine Queensland Air Ambulance aeroplane. He was given IV frusemide, IV dexamethazone, IV methyl prednisolone, and of course oxygen.

When he reached the chamber he was recompressed on Table 62. It was noted that the patient suddenly became lucid and admitted that for the first time since the dive he could think clearly and remember events clearly. He deteriorated later that day and had two further treatments in the chamber with only minor improvement.

POST SCRIPT

The patient intends setting up a diving business on Great Keppel Island taking tourists for a quick dive!

PRESS RELEASE

CMAS RECOGNITION OF SCHOOLS

(Printed as received)

There has recently been the most important development in the history of sport diving.

The World Underwater Federation (CMAS) has established a procedure which allows diving centres (schools) to teach its international standards directly. In the past, this has not

been possible as schools have first been required to teach their national standard and then equate it internationally.

The importance of this direct link between schools and the World Underwater Federation cannot be overstressed. Diving is an international activity enjoyed by people from all countries and all walks of life.

In order to participate and experience the wide variety of different and exciting environments which are available, divers must travel between countries and mix with divers of other nationalities. Misunderstanding of qualifications which might lead to an inexperienced diver being exposed to water conditions which exceeded the limits of his competence, are a perpetual hazard.

Equally, while fascinating and enjoyable, diving nevertheless takes place in an unusual environment and adequate safety standards are vital as with any similar activity. The alignment of procedures, which this new scheme, will therefore contribute effectively and unobtrusively to the ease with which divers may pursue their activities.

In order to obtain the World Federation's authority to teach the international standards, schools must undertake to teach only the CMAS standards, and to provide adequate instructional staff and facilities, and of course pay an appropriate levy.

Customers-divers can therefore be certain of obtaining reliable and safe training as well as having a good deal of fun in an international centre. They will also be able to walk away from their holiday-course as they qualify with a certificate which is recognised all over the world.

Schools have an opportunity to feed their knowledge back into the appropriate committee of the World Federation (OCC commission) and the benefit of their huge experience will therefore not be lost but used to update and improve standards of safety and enjoyment.

KAI ESTRUP
President
OCC COMMISSION.

EDITOR

Publication of this CMAS Press Release does not in any way imply support for the proposal to by-pass the development and developing organisations involved in training and assisting Sport Divers.

There is difficulty at the present time in enforcing standards and it would be naive to believe that CMAS could exert effective control of the day to day actions of a multitude of independent dive shops.

SPUMS ANNUAL SCIENTIFIC MEETING 1985

This will be held on Bandos Island in the Maldives from Thursday April 18th to Wednesday April 24th 1985.