

area which was an area of avascular necrosis. From the ordinary scan one could not say what the etiology of the condition was but from the SPECT one could be very certain that it was avascular necrosis.

Coming to aseptic necrosis in commercial divers I must say I could find very little in the literature about the application of bone scans to commercial divers. A paper, in the Lancet, from the Decompression Sickness Central Registry looked at a large number of divers, almost 5,000 over a period of 5 years from 1976 to 1980, with many divers having multiple films. The overall prevalence of osteonecrosis from an X-ray diagnosis was 4.8%. The majority of these were head, neck and shaft lesions which are felt not to be of major significance in terms of producing disability. In fact they are often asymptomatic. Juxta-articular lesions were present in 1.2% and these are the ones that are potentially going to give the divers problems in the long run. Hip avascular necrosis, which is probably the most important site, has a very low prevalence in this group. Shoulders were slightly more commonly affected and these can also produce disabling features if there is articular collapse.

Should one screen divers routinely? I am going to be making suggestions based perhaps on inadequate information. The points against screening are firstly that the prevalence really is very low. Juxta-articular lesions are comparatively rare. It is, as far as I understand, totally unknown whether the presence of head, neck and shaft lesions predicts the future occurrence of juxta-articular lesions. Secondly, it is obviously going to be a fairly costly exercise to screen people. A standard bone scan costs around \$300. That would put it in the same ball park as the CT and skeletal survey. The main argument for screening divers is the terrible morbidity of a young person having to have a joint replacement. People who have had decompression sickness are more likely to develop osteonecrosis. The incidence of dysbaric osteonecrosis was 10.7% with definite evidence of decompression sickness and this included the large majority of people with joint damage. Without decompression sickness the prevalence was only 1.7%. It was also apparent that multiple episodes of decompression sickness puts one at greater risk of developing osteonecrosis. They also found the depth of diving was an important predictive factor in developing osteonecrosis. For those diving less than 30 metres there was no osteonecrosis, going up to 15.8% in those diving to more than 200 metres.

I think a reasonable screening plan, if one accepts that it is a worthwhile thing to do and was effective in divers, is to take baseline X-rays of the humeri, the femora and the tibias. I think any screening plan has to include bone scan because of its sensitivity in the early phase of the disease. So a base line bone scan is also indicated. One should repeat the scan if the person develops skeletal pain after an episode of decompression sickness. Perhaps repeat the scan yearly if they are diving to more than 50 metres. As the specificity of bone scanning is not high the correlation is warranted. I

think the primary method for following people, if one is going to do it, should be the bone scan. I should emphasise that I am not saying this from any published studies on the subject that I know of, it is just my general feeling about the sensitivity of bone scanning in diagnosing skeletal disorders.

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MEDICOLEGAL ASPECTS OF AVASCULAR NECROSIS IN DIVERS

Audrey Mills

Introduction

I propose to talk briefly about the diving industry in Tasmania particularly abalone divers. I will use this as a background to the question of what legal remedies are available to divers who suffer avascular necrosis. I will then examine the legal problems involved in diagnosing the condition as that affects medical practitioners.

I would like to acknowledge the assistance of Mr D. Wolfe of The Department of Sea Fisheries for the information on the Abalone Industry in Tasmania.

Professional Divers in Tasmania

Abalone divers would represent the largest group of divers in Tasmania. The abalone industry in Tasmania is one of the biggest abalone industries in the world and is responsible for 22% of the world market. At present, there are 125 abalone licenced divers.

Commercial divers are employed by the Marine Board, CSIRO and Police Department and a few private companies working in salvage and construction areas. The total working in these areas would be approximately 15.

The abalone industry has very few regulations concerning work practices. Whilst diving tables are available and are recommended, it is doubtful that they are strictly

adhered to by divers in the abalone industry, where most are self-employed. I base this purely on reports of people in the industry. There are no governmental regulations incorporating the Australian Standard No. 2299 of 1979, Underwater Air Breathing Operations, so as to make this applicable to the abalone industry.

History

Abalone have been commercially harvested around Tasmania since late 1963. Special licences were required from 1965. During the first years the fishery rapidly expanded until during 1967 more than 250 divers were participating. The Government began to regulate the industry during 1968 and restricted the number of licences in 1969 to those already holding licences in the industry. The number of licences has remained at 125 since 1973.

In 1973 annual medical examinations were introduced for abalone divers and licence holders were required to be full-time abalone divers rather than just full-time fishermen. In 1969 to 1973 production was relatively stable but prices increased by 400%. During this time, diving related illnesses began to cause some concern and it was becoming evident that a number of licence holders were not fully utilising their licences fully with the result that fishing effort and production fell. Recommendations were made to provide a turnover of divers and to allow veteran and/or unfit divers to leave the fishery by allowing those holding licences for more than three years to transfer that is sell that entitlement, to another diver.

In August 1974 the Government agreed to allow divers to transfer their licences. Production then increased until quotas were set in the mid 1980s. The current quota is 24 tonnes. By the end of 1981 the annual catch was almost double the production in the years immediately before 1975; and the value of the fishery had increased by a factor of three in real terms. Fishing returns are submitted annually to the Department of Sea Fisheries by divers and Mr A.J. Harrison has collated figures showing that divers' hours for 1972 to 1973 total 26,773. These hours gradually increased so that in the year 1980/81 the figure was 53,048. The total catch had increased from 2074 tonnes in 1972 to 1973 to 3747 tonnes in 1980 to 1981.

In 1973 when licences were allowed to be transferred, the transfer price was approximately \$5,000-\$10,000. This steadily increased but has now steadied at \$800,000-\$850,000. This has caused a lot of speculation with licences. There is a requirement that one diver may hold only one licence at any one time, although it is well known that some divers do control more than one licence. This is done by employing another diver and under a written agreement, transferring the licence to that diver who works for a percentage of the catch. The capital involved in getting into the abalone industry is now so great that there are more financial

pressures on divers to meet commitments. In recent years this has been relieved to some extent by the imposition of quotas and the current quota of 24 tonnes is likely to be reduced by 30% next year.

The abalone industry has very few regulations. It is not covered by the Department of Labour and Industry and there is no government body responsible for work practises within the industry. Most divers are self-employed and therefore responsible for their own work practices. The Australian Standard including diving tables is just a guide.

The Department of Labour and Industry does cover divers employed by companies which operate in the construction and salvage areas in inland and estuary waters (includes 3 miles off shore). Australian Standard 2299 of 1979 is applicable to these divers. This sets out tables for diving and recompression and also makes provision for medical examinations and x-rays.

At present, to obtain an abalone licence once you have raised the capital to buy a licence, all you need to obtain the transfer approval from the Sea Fisheries Department is a medical examination by your own general practitioner. There is no compulsory training or experience necessary nor is there any regulation on the work practices. The only regulation which applies is that pressure equipment must be certified and divers must have annual medical examination. There are no requirements for x-rays.

Legal Remedies

When a diver contracts avascular necrosis he has remedies of compensation open to him depending on his work situation. If a diver is an employee, the Workers' Compensation Act will apply. The current Workers' Compensation Act, which is shortly to be amended, specifically recognises avascular necrosis as a "disease". This was an amendment to the Act introduced in 1980. Employees suffering avascular necrosis prior to 1980 would have had difficulty making a claim for workers' compensation because it was not recognised as a Scheduled Disease covered by the Act.

The new Workers' Compensation Act which is to commence operation before the end of the month (November 1988), adopts a wider definition and states (Section 26) that where a worker suffers a disease listed in Schedule 4, it shall be presumed in absence of evidence to the contrary, that the disease arose out of and in the course of his employment and that his employment contributed to a substantial degree to that disease. The disease is described in Schedule 4 as "Compressed air illness including avascular necrosis caused by any work involving exposure to increased or reduced atmospheric pressure from working underground or underwater or from working at high altitudes". By virtue of S26 of the Act an employee suffering from avascular necrosis is

able to claim workers' compensation from his employer and the link between his diving work and the disease will be presumed unless evidence to the contrary is proved.

Another avenue of compensation is to claim damages for negligence or breach of contract against the employer for unsafe work practices, insufficient training and unsafe equipment. Because there is an Australian Standard governing work practices of divers, a successful claim could be made against any employer who did not enforce that standard.

Because avascular necrosis is a long-term problem and may not become evident for many months or even years after it is first contracted, problems can arise with time limits with respect to making such claims. There is a three year time limit in which to bring a claim for negligence and if six years elapse from the date when the condition first became symptomatic no claim for damages can be made at all. Because a condition may take a long time to develop it will be well advanced by the time it is obvious on x-ray and there may be difficulties for some people to come within this time limit.

As most abalone divers are self-employed, the remedies under the Workers' Compensation Act and for damages for negligence will usually be unavailable to them. However most would have income insurance for disability and sickness. The definitions of sickness under these policies vary and some of the more common ones are:

"Sickness or disease contracted and commencing while this policy is in force".

"Illness of the insured which declares itself during the period of this insurance and occasions the total disablement of the insured within twelve calendar months after declaring itself".

The nature of the progress of avascular necrosis would mean in some cases that even if diagnosed early, if it did not cause total disablement within twelve months of a person first feeling the symptoms, they would not have a claim, even though at a later stage they may be permanently disabled through having to have a hip replacement operation. In addition because of the difficulty in diagnosis it may not be diagnosed until a late stage which while producing disability may cause problems in working out which insurance company the claim is to be made against if the person is covered at varying times by different companies. Proof of insurance may also be a problem if the claim arises seven years after the policy was terminated (changed to another company) as sometimes insurance records are not kept beyond this period.

The claim for compensation has to be proved on the balance of probabilities, that is, that it is more probable than not that diving has caused the condition of avascular necrosis. Insurance companies, by their nature will look to seek

whether there are any other causes which could be responsible and whether the diagnosis is certain. This has in the past lead to claims being questioned and it is therefore important for full history of a diver to be taken so that other causes can be excluded. If the diagnosis is made perhaps supported only with a suggestion of damage on the bone scan, then other factors such as history of diving and symptoms are very important.

Difficulty in Diagnosis

At present medical examinations are required annually in the abalone industry. X-rays are optional. Given that the condition is well advanced by the time it is obvious on x-rays, there is some argument that bone scans should be performed for divers in risk categories.

At present medical examinations can be performed by any doctor. I would suggest that a panel of doctors experienced in this area would be more qualified to do those examinations and would be better able to judge those divers at risk who should have further diagnostic procedures and also to recognise early symptoms. It may be that there are many divers within the industry who go undiagnosed until the condition is too far gone and major surgery is the only answer.

The problems of not being able to make an early diagnosis may produce major health costs for the community when this problem becomes more apparent as divers grow older.

There are at present 125 divers holding licences and there have been since 1965 another 247 divers involved in the industry. Of the current divers there is one diver who has been in the industry for 20 years, one diver for 19 years, one diver for 18 years, 5 for 17 years, 1 for 15 years, 1 for 13 years. The vast majority of divers are still within the first ten years of diving. The abalone industry in Tasmania is still relatively young and long-term problems in divers' health is likely to become more frequent from now on. No specific records as to divers medical history whilst in the industry are kept. There are no provisions for reporting of major accidents.

This could be analogous to the asbestos industry where major claims are now being made by workers employed with companies over 20 years ago. If avascular necrosis is a major health risk to divers, then because of the resulting cost in health care terms to the community, which in Tasmania would be significant, it is important that more information is known and kept about divers' health. The abalone industry is worth so much in export income to this State, it is surprising that there is so little regulation and relatively little information regarding divers' health.

An interesting argument which I put forward, and it

is no more than that at this stage, would be that the State may be liable to pay compensation to abalone divers suffering avascular necrosis because:-

- (a) The Government is aware of the risk to professional divers because of its regulation of the salvage and construction divers and making those divers comply with the Australian standards.
- (b) The State Government assumes some responsibility for regulating the industry and providing licences. So it could be argued it is therefore under a duty of care to advise divers of the risks and to insist on proper instruction and training and safe working methods. It could be argued that the Government's failure to do so is negligence, assuming that avascular necrosis is caused by unsafe working methods.

This is similar to the arguments used against the Tobacco Industry by smokers who have contracted cancer.

Problems for Medical Advisers

Lastly, I wish to make some comment on the difficulties for the medical adviser in making the diagnosis of avascular necrosis from the legal point of view.

At the stage of obvious x-ray damage, the option for treatment and prognosis are fairly straight forward.

However, if the diagnosis is uncertain and the evidence can only be seen on, say, bone scans, what are the duties of the medical adviser in advising her or his patient?

If he says "You may have avascular necrosis so do not dive again" then the consequences for the patient may be disastrous. The diver may have to give up a very lucrative profession and suffer financial hardship when in fact his condition may not proceed to serious avascular necrosis.

However, on the other hand, if the medical adviser says "There is a risk that this shadow we can see on the bone scan could be bone necrosis but we can not really say and given there are no other signs you can continue diving" (and there could be a lot of pressure from the patient to continue to dive because of the financial rewards). Then if the patient goes on to develop serious bone necrosis, what is the medical adviser's position?

The test at law is, (though it is under some pressure over the last few years to be changed), "a doctor is not guilty of negligence if he has acted in accordance with a practice accepted as proper by a responsible body of medical men".

So if the medical adviser discloses the uncertainties of the diagnosis and the risks of future damage then he should not be at risk to any claim of negligence.

As medical science advances the problem of diagnosis should become easier for medical advisers.

This paper was presented at the Hyperbaric and Diving Medicine Meeting held at the Royal Hobart Hospital on November 4th, 5th and 6th 1988. The conference was co-sponsored by SPUMS and the Royal Hobart Hospital.

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DIVER RETRIEVAL IN TASMANIA

Mike Martyn

Introduction

Tasmania, being an island state, has a large per capita diving population. Diving occurs both commercially and for sport. A hyperbaric facility exists in Hobart and over the years has developed a system for early notification and retrieval of diving medical emergencies. This paper discusses the diving population, the initial contact and notification guide, retrieval options and finally some of the problems.

There are two main groups, commercial divers and sports divers. (See Table 1) Commercial divers can be subdivided into three sub groups. There are some 20 standard work divers. The actual number varies depending on what jobs are around at the time. They have certainly caused some problems with three cases of decompression sickness from the Bowen Bridge building site and more recently the death of a diver from air embolism whilst working on a pipeline at Burnie. There are 125 abalone divers licensed by the Department of Sea Fisheries in Tasmania. One can presume that the majority of these are active although some do sell a part of their licence. The Fisheries also has given out some 300 other commercial diving fish licences, which are specifically for sea urchins and periwinkles. A lot of these are being bought on speculation. There are probably only about 30 to 50 that are actually actively worked. There are also people diving for the aquaculture industry, farming salmon, but most of these are in fact sports divers earning some additional money.