

THE SINGAPORE APPROACH

Dr Jimmy How

I do not intend to say very much on the Singapore experience because most of you heard about it last year. So I will carry on from where I left off last year and present a few cases. Just to stress again what I said last year, although diving illnesses are emergencies to be rushed to the chamber, do not forget the examination and a proper history. It is so absolutely important that we take a clear-cut history and find out exactly what is wrong with the patient and then do a proper, thorough physical examination. That man is already late, by quite a number of hours, and an extra fifteen minutes really will not cost him that much. So I try to get a diagnosis before he goes into the chamber.

The first case I want to present concerns an Eurasian aged 30 who was a professional diver. His story starts in 1976 when I examined him for his annual physical. On the X-ray there were some apical scars and the radiologist reported that they were old tubercular scars. They are very common in Singapore. We are very much exposed to tuberculosis, even children get primary tuberculosis, most of us are exposed. Some scarring somewhere is a common finding. So I watched him, but I was not particularly happy because the lung function was dropping. His FEV1/VC% came down to somewhere around 80, then 79. Then instead of a yearly physical, I put him on a six monthly physical. This is one of the things we should do. When you are not happy, bring him back sooner than the annual physical examination. Then his percentage was only 75 and I got onto the radiologist. Now besides the old scars there was also minimal infiltration in the left first intercostal space. He had active tuberculosis. He gave a history of tiredness, loss of weight, etc. there comes a point when diving is contraindicated. I stopped him diving. After eighteen months of treatment, he came back and said that he wanted to dive again. What do you do? You do a lung function test. There was no change and I could not consider him fit for diving.

In Singapore, where we take X-rays in full inspiration and full expiration, we do occasionally see cysts which also contraindicate diving. However, I have sent two cases to the thoracic surgeons. What they do is abrade the pleura and remove the cysts. I have sent one man back to professional diving.

The second case was an American belonging to Solus Ocean Systems. He made a very interesting dive on 26th January 1981. I finally saw him on 9th February. The working conditions were very strenuous and cold. He dived to 256 feet, the decompression stops were inadequate and he had to do a surface decompression. Thirty minutes after he was out of the chamber he got pain in the small of his back and difficulty in breathing. He was rushed to the chamber and while descending to 60 feet his condition became worse. He had pins and needles in his right leg and arm. The right arm was totally paralysed, while only the toes could be moved in the right leg. He could not

micturate. They contacted Dr Lambertsen in the USA. Due to his severe condition he was taken to 165 feet. Then he started on a 6A table. That did not work and Dr Lambertsen decided to change to 7A. Back at 165 feet he had chest pain with other symptoms, there was relief for a short while and then they came back. But the back pain was gone. After completing the 7A table he got back touch sensation in his right arm and right leg. He had regained some motor power, but he was still very, very weak. After this he was treated five times with table 5 until he started to get spasms. They decided that they could not treat him any further and flew him to Singapore, where he came to my Diving Medical Centre.

After I examined him I decided that I could not help him any further. Not because it was already thirteen days since the incident. Thirteen days is not long by our standards. We have seen people who are twenty or twenty-five days delayed who are totally paralysed and we put them in the chamber. If he had come direct to me I would have put him in the chamber. But his lungs were so damaged by oxygen that we could not help him, not even with an air table. With 100% oxygen on the surface he got severe spasms and was coughing, had chest pain and tracheitis. One has to be very careful to avoid oxygen toxicity. There is a way of calculating oxygen dosage academically. I find it a great help to do Vitalograph test before you put a patient into the chamber. Slow down, and do some preliminary tests before you shoot the patient into the chamber. It is too late later on, you do not have a base line. We could not help this man so we sent him to the rehabilitation centre, where they work on the patients' bowel and bladder problems. He was put on physiotherapy and by March had recovered pretty well.

The third case demonstrates that we really have to examine patients. A fisherman diver had as his presenting symptom a swelling on the right side of the face. A huge swelling going right down into the neck. He had been diving with a surface supply. He went to 50 feet for an hour, then he repeated the same dive three or four times and came up with this problem. One of my medical officers saw him and was just about to put him into the chamber, when I said "Slow down and let us examine him". We examined him, percussed him and found that one side of the chest was dull, and the upper chest entry was poor. So we took an X-ray and there was a huge opacity on the right side. There were jagged edges which made us suspect it could be carcinoma. When he went diving he could have ruptured some part of the right lung and the air went up to his face. We gave him surface oxygen and packed him off to hospital where the diagnosis was confirmed. It would not have been a wise thing to have rushed that particular case into the chamber for a simple emphysema. Again, you do not really want to rush patients in too quickly.

My last case is a man who came to me with grade 4 paresis on both sides and loss of sensation from T10 downwards. The loss was patchy and this made me wonder. When you have loss of sensation from decompression sickness either it is diminished all the way down or there is total loss of

sensation. With the latter there is usually loss of bladder function and bowel action. But this chap was patchy. He also said that when he came up he coughed up blood which made me very suspicious. You normally get this sort of patchy loss of sensation as a residual effect. I said to him "Have you been here before?" and he refused to say very much. Finally, after about half an hour my secretary managed to discover that he was admitted to our place in 1977 on the 27th May and when he left after physiotherapy he did have these areas of patchy numbness. We had managed to convert him from complete paralysis back to grade 4 or 5. He went back to work as a fisherman diver because the money was good. Each time they come back with a boatload of fish it is worth \$60,000 which is good money. Obviously there was something happening to his lungs, so we sent him for an X-ray which showed tuberculosis with haemorrhage. Yet another case where by slowing down we find great returns. I have learnt to slow down and apply a mental discipline to every case because of the time factor, the delay in reaching us.

THE PRINCIPLES OF TREATMENT

Dr David Elliott

It was kind of the Chairman to introduce me as the Medical Advisor for Shell, but one of the things that I am really quite proud of is that I was employed as diving adviser to Shell, not as the medical adviser, advising on their commercial contracts all around the world. Not that I think that makes any difference to this lecture.

The principles of the treatment of decompression sickness, pulmonary barotrauma and arterial gas embolism you all know inside out. You have got three things to play with, pressure, oxygen and drugs.

Pressure

Pressure is obviously good at squashing down bubbles. But to be a bit iconoclastic, an awful lot of bubbles are cylindrical in shape and all you do is shorten them. Nevertheless experience has shown that pressure is good news for somebody who has got bends. In fact some limb bends are extremely pressure sensitive, so much so that it is very, very difficult to believe that they can be so sensitive. I am talking of bends at as deep as 1,000 feet or more, where 3 to 5 feet of difference in pressure can actually make all the difference between pain and relief. Pressure is definitely the important treatment.

I will say a little more on the type of pressure. Do you go to the depth of relief, or do you go to some arbitrary depth?

The depth of relief is obviously the best thing to do. If you can cure the pain with pressure, you have no more problems. The problem is getting them back from that particular depth. However, the depth of relief is not an easy end point and there are some conditions where there is residual bruising. If you are running an ENG (electronystagmogram) on somebody with vertigo the ENG will not necessarily revert to normal for 48 hours after you have in fact cured his lesion. So depth of relief even in skilled hands is not a good depth necessarily to go to. Certainly in unskilled hands it is asking for problems. The depth of the dive is a very useful treatment depth and indeed for blowup we find that the depth of the dive is the depth of relief. A blowup can be from a depth deeper than your chamber goes to and this can be embarrassing.

With 150 foot diving, a 165 feet chamber will be adequate. But people who go down to 250 feet on air, could be in real trouble, because 165 feet would not necessarily be enough pressure to cure them.

Oxygen

50 m or 165 feet of air has a surface equivalent of 120% oxygen. The French Navy uses a 40% oxygen, 60% nitrogen table. At 30 m, which is 100 feet the PO₂ of that is 1.6 atmospheres, which is equivalent to 160% oxygen at the surface. You can see that by pushing the oxygen partial pressure up while applying the pressure you can deliver a very good dose of oxygen to the patient. Comex, the French Diving Company, use a 50/50 mixture. They can even use that at 50 metres, which will give a partial pressure of 3 atmospheres or 300% oxygen at the surface. The 18 m oxygen Goodman and Workman tables give you very nearly 3 ATA of oxygen. Oxygen is easy to deliver. Before we leave pressure and oxygen, let us not forget that the balance is an inert gas, usually nitrogen. You may well hear in coming months some discussions as to whether or not nitrogen is the best treatment gas for air bends. As far as I am concerned, the hypothesis that helium may be a good inert gas for treatment of air bends remains an hypothesis until it has been further investigated. There is one particular centre that is pushing helium treatment for treatment of air bends. As yet the case is unproven.

Recompression is the treatment of choice. It should be given to any person who suffers virtually any condition within 36 hours of a dive. There are people who have had coronaries, acute appendicitis, cerebral vascular accidents, all of whom have been slung in the chamber because they might be slightly bent. Surprisingly, it did not do that correct diagnosis too much damage. They got through OK. The alternative, diagnosing bends incorrectly as a stroke or a heart attack or appendicitis, could leave the diver with permanent damage. So, when in doubt recompress.

To re-emphasize the point which I made yesterday about immediate recompression and no examination until you get to depth.