nitrogen, which is not much of a problem if you have access to nitrogen.

All you need in terms of gas supply and gas analysis, is a simple oxygen analyser, which is pretty cheap, a supply of sodalime, a sheet of masonite, a few pairs of pantihose and of course, oxygen. You also need some sort of cover over the chamber because if it is out in the hot sun the people inside will get very hot and become dehydrated very, very quickly. Once you have a cover over the chamber you do not need a sophisticated cooling system to cool it. If you have adequate evaporation then wet blankets on the chamber will remove heat from the chamber. If you are in a humid, hot climate then cooling is somewhat more difficult, but it can be done if you play a spray of water on the chamber. Saturation treatment can be done in most small chambers, but it is uncomfortable and messy. It is not something to be embarked upon lightly. Because of these problems and the staffing and logistical problem of handling this sort of operation for the necessary length of time the patients are likely to be sent to a major centre rather than treated with nitrox saturation in the chambers around the Caribbean. Generally speaking, the major centres they go to are ourselves or the chamber at Brooks Air Force Base at San Antonio, Texas.

Chairman (Dr Tony Slark)
I would like to tell you a story about a patient of mine which was similar to the story you opened with. She was diving under a ledge when she saw jaws looking at her, so she said. She darted straight to the surface. When she reached us she was, as you said, “a bit slow in mentation”. Her only comment was “Aw shit”. After being on the long oxygen Table for about half an hour she brightened up a great deal. Her symptoms all disappeared and she would not stop talking.

Dr John Miller
Our Swiss girl had a remarkable increase in her level of mentation during her treatment. She went from speaking only German to becoming multi-lingual during the course of 24 hours. We also have had one of these strange birds that people did not like. That was the lady who was on the instructor’s course. She arrived in a gold lame bikini. She was young but very well used. She was on her third husband at the age of 24. She had scars from various riding and motor cycle accidents. She and her husband ran a travel business among other things. They were both learning to fly with the idea that they would get groups of people together, fly them, in their own tax deductable aeroplane, to the Caribbean and then teach them how to dive. She was a fine young lady whose libido was to say the least, extraordinary.

Dr Jimmy How
In the treatment of decompression sickness you really have to deal with each individual patient. It is not just the application of a table or the application of a particular flow chart. I think we have to determine the response. I fully agree with John Miller that one should hang on at 60 feet and then wait and determine the type of table according to these patient’s response. I am frightened to have tables and flow charts in case we begin not to think at all and just flow into it in one way or the other. Most of us here, I think, are not doing treatment at all. But you may see patients who turn up at your clinic or at your hospital. I would like to tell you about a case to emphasize how important it is that doctors do not fall into the trap of applying tables in our minds and forgetting that the patient has to be examined clinically to determine what really is wrong with him.

This happened last week while I was anxiously waiting for you all to turn up. We had a case that was three weeks delayed. This chap had a dive to 100 feet for 90 minutes. When he surfaced he had swelling on his face and swelling around his neck. That was all he had. He was not dyspnoeic. He went to a general practitioner. He was examined and treated for nephritis for about a week. He was not getting any better. Then he went down to the Government outpatients. He was again examined and asked to go home. Finally a registrar saw him and when they took the history they found that he had got a diving history so they thought it could be bends. They quickly sent him over to us to think about maybe pulmonary barotrauma or some form of decompression sickness. Now all of these doctors probably did not do enough clinical examination of the patient. My doctor saw him, examined him and gave me the history. I said “Have you examined him?” and he said “Yes. The chest was clear, everything was clear”. But I was not happy. With the swelling of the face many things could have happened. There could be lymphoedema from decompression sickness or there could be a ruptured lung with air tracking up both sides of the neck. So I said “You cannot put him the chamber until we have a chest X-ray and have a look at it”. We took a chest X-ray and the right apical lobe was completely opaque. We examined the case again and we found dullness and diminished air entry on the right side. Watching carefully while he breathed we could see that the chest was not moving equally. Now I stress all this because we really look at our cases. Sometimes the moment you think of the bends you refer the patient to a chamber just because he has been diving. People forget that he is a patient any more and people forget about clinical examination. This patient had a complete opacity of the right upper lobe. Had we put him into the chamber, we would have been in a bit of a problem.

At the moment he is still in hospital being bronchoscoped. Your guess is as good as mine as to what the diagnosis is. It could be a carcinoma, it could be something from the mediastinum, or it could be an effusion into that part of the lung. Clinical examination is really important before putting the patient in the chamber. I say this because we sometimes get misdiagnoses sent to our hospital. It is common in Singapore where decompression sickness is really not well known at all. We have no lectures in the University on such illnesses. It is important that knowledge of decompression sickness be propagated. I find that proper clinical examination will usually reveal the

correct diagnosis. Many cases have been misdiagnosed as transverse myelitis and things like that. Once we have the proper diagnosis and have examined the case, we can go into the chamber. Then we can go into our flow chart and determine specifically which table we are going to apply.

Chairman (Dr Tony Slark)
I think that was a most valuable comment. I have been trying to impress this sort of knowledge to all medical groups for a long time. The diving accident patient deserves the very best of medical management whether there is a recompression chamber immediately available or not. I have also noticed that doctors tend to switch off if they think it may be a diving accident and tend to not treat the case as a patient who really requires the full gamut of their normal medical skills including those of full investigation. We certainly try to make sure that everybody is given the benefit of X-rays, ECG's and blood screening tests, at least initiated, before they actually go into the chamber.

I think that is very important and something that is often forgotten by our colleagues. When they know that somebody is in fact a diving accident, they tend to feel that their ignorance of diving means that they cannot deal with the patient in a proper medical fashion at all. This is not true and we should try to educate our colleagues. Thank you very much for making that point, Jimmy.

Dr Jimmy How
I would just like to add a word of caution here. When one is dealing with delayed cases we can play around a little with time. The caution is that acute cases come in. Then one should not try to run through a battery of tests and delay another 4 to 6 hours. Time becomes precious. One should determine by a clear clinical examination where you think tests are indicated. You should proceed with them. But be very careful not to waste time as time is as important as compression in the treatment of acute cases. Do not delay to a point that jeopardizes the prognosis of the patient. The misdiagnosed cases that I have been talking about I see at least 4 days after the incident. Then you really have to have a good clinical examination. You need a good clinical examination in either case, but we need a bit of speed in acute cases.

Question
Why did the young lady in the instructor's course, who obviously had an air embolism, need treatment for decompression sickness?

Dr John Miller
She was at first not a case of decompression sickness, she was clearly a cerebral air embolism. They treated her by recompression to 165 feet. Then they stayed longer than 30 minutes at 165 feet. If you stay less than 30 minutes at 165 feet you are allowed to follow a very shortened course of recompression therapy whereby you come back to 60 feet at 25 feet a minute and then plug into the longer of the two short oxygen decompression sickness tables, which is called table 6A. If you stay longer than 30 minutes then you are automatically committed to a significantly longer decompression. The standard treatment formats in that situation are the US Navy Table 4 and the RN Table 71. That gets you into something like a 36 or 38 hour decompression. They felt it was going to be too long, so they switched the whole treatment then into an experimental type of decompression by using the exceptional exposure tables of the US Navy Diving Manual. They calculated the "appropriate" decompression from these and that was what caused her decompression sickness. By the time she developed decompression sickness she was in fact long since over the cerebral air embolism episode.

I might also echo what Jimmy has said of the need to quickly and thoroughly perform a physical examination. For over 2 years we have been looking very closely at people who reputedly had a pain only bend. On a detailed neurological examination we kept on finding relatively minor, but nevertheless present, neurological dysfunction. So a high proportion of the people who claim they feel the pain in a joint also have a patchy numbness or a little weakness and not infrequently it is around the sacral distribution so you have to look at the sacral outflow.

Dr Chris Lourey
It is a total body disorder that you are dealing with. We had a case, an abalone diver, who presented at one of the major teaching hospitals in Melbourne with a pain in his knee. The senior resident on duty was mildly aware of decompression sickness. He knew it was due to bubbles so he applied an above the knee tourniquet. The pain did not resolve. Some twelve hours later he presented at Prince Henry's Hospital, which has a chamber, not with a Type 1 bend, but with a severe Type II vestibular lesion.

One of the problems is that there is not only a level of ignorance in the community but that there is a fair level of ignorance in the profession. Not all of us have the experience or the skills of treating decompression sickness but we should be able to make the medical community aware of the salient features of decompression sickness.

Dr Jimmy How
Also a point about air embolism and decompression sickness. We should not separate air embolism and look at it simply as air embolism nor decompression sickness as decompression sickness requiring two different sets of Tables to treat. A clear history, a good history is very, very necessary as in all medicine. How long has he been underwater? If you have been underwater long enough, whether you are going to get symptoms or not, you are going to bubble. It is just if you do not get decompression sickness nobody will ever know that they bubbled.

If the diver shoots up there are lots and lots of intravascular bubbles. He is going to bubble a great deal in addition to his air

embolism. Sometimes air embolism is not cleared because we are looking at two things. Usually one takes him to 165 feet and then comes back to 60 feet after a short while. Some treatments fail because that ascent from 165 feet to 60 feet was too rapid. In many cases it would be a better idea to move on the US Navy Table 4 or RN Table 71. I would certainly keep him at 165 feet and bring him up slowly with intermittent oxygen at a partial pressure close to or over 2 atmospheres at that depth. We can now bring him up, taking care of both the intravascular bubbles all over the body and the ruptured lung which gave rise to the air embolism. You must look at the history, if he has been diving long enough, deep enough and then he ruptured his lung.

Dr John Miller
Table 6A was designed exclusively for submarine escape training accidents where there is absolutely no tissue nitrogen loading. There the situation is relatively clear cut. Cerebral air embolism associated with diving is not at all clear cut. In a number of the cases that we have had, if you go very carefully into the history, you can find something that may or may not be related to a cerebral air embolism occurring or certainly one can put a pointer to a mixed type of lesion.

Dr Mike Davis
I would like to add another case to the two that we have heard already to reinforce how important an adequate history and examination is. This was a man of 32 who presented with a pain only bend in the right shoulder. When he was examined he had nystagmus and one would immediately assume that he had a cerebral problem as well. His nystagmus was due no severe vital meningitis that had occurred 15 years earlier and had always been with him ever since and had not got any worse on this occasion. We do not believe he had a bend at all, but that this was purely a physical strain to the shoulder doing some heavy lifting work that was related to the dive. It is a good example of how vital it is to take a good history.

Dr John Miller
A further example is a problem that I had about 12 years ago in Turkey. This was a man in his thirties who was grossly overweight. I subsequently discovered that he had a history of chronic duodenal ulcer. He and some friends went spear fishing on a Sunday afternoon after a Saturday night wedding. He had been 90 minutes at 115 feet when the elastic broke as he was loading his speargun. The butt of the gun drove into his belly. He came straight to the surface and was comatose when he reached the surface.

You can imagine the effect of all that gas that was in his stomach, expanding and blasting out through the hole in the duodenum. The other people with him did not know any of this. He arrived at the little chamber we had on the expedition in a comatose state, having apparently been seen to be loading his speargun, the elastic broke, and go straight to the surface. You will appreciate that my Turkish was pretty rudimentary. We got him into the chamber. There was improvement at 60 feet. So then we went to 165 feet and he improved tremendously. He woke up and was able to talk to me. I then discovered that his abdomen was board-like and elicited the history of the ulcer. Unfortunately, the wretched man died in the chamber before anything could be done for him. Again it is an example of the fact that you may be dealing with decompression sickness but the decompression sickness may be masking something else. It may be a duodenal ulcer or it could be a bleed or it could be a myocardial infarction.

Dr Jimmy How
I would like to make two other points. One is, do not look at the tables and then decide that he does not need any recompression because his dive was within the limits, so it cannot be decompression sickness. Divers do get decompression sickness, even though their dive was within the tables. I do not know why, but they do. I have seen such cases. Two chaps doing exactly the same dive, one chap got sick, the other did not.

The second point is that it is easy to malinger in decompression sickness. I have a special way of watching them. They have to walk a great distance to my office. I get my medics to take a look at him, how he comes in. When he walks in he smiles and then he changes into a very sad man. You have got to know that he is really not very sick. But when he reaches my door he has here a pain, there a pain. They are great guys because they know that the moment you diagnose them as something residual they get about 2 weeks off the rig. They do not need to get back to the rig. They get time off. Some of them would try to malinger over here to get off the rig to see their wives for a fortnight. So that is the second point.

I had a very unusual case where the diagnosis was made on a full history. He was flown from Diego Garcia to Singapore for treatment. A Taiwanese diver was employed to build the harbour at Diego Garcia for the Americans. He came up from a 45 feet dive and the history was that he became totally blind and he collapsed. He was diagnosed as a case of decompression sickness. They radioed to the Philippines as the nearest place with an American chamber. The people in the Philippines said that it would take too long to reach the Philippines and that he had better go to Singapore. While the arrangements were being made, the patient regained his sight.

Being a Taiwanese diver we could speak Mandarin with him, which his employers could not do, and get a clear history. What had happened was that he came up from a dive to 45 feet for about 45 minutes. The water was cold. After surfacing he grabbed hold of the rail on the side of the boat and he could not feel anything. He had a friend who had been totally paralysed who had told him that in paralysis you first lose all your feeling and then you become paralysed. And this poor chap was so cold, that he could not feel the rail. When he caught hold of the railing the thing that

came to mind was his friend who was paralysed, and he thought he was going to be paralysed. He was so hysterical that he went totally blind. He just could not see any more and he just fell on the deck. This sort of blindness is unusual in decompression sickness. Most commonly it is a patchy fog, they see a black fog all over and rarely do you get a complete blindness of this nature. After talking to him we asked him to stand up and walk. The chap just stood up and he was walking around and he was quite happy. We really could not call him a case of decompression sickness so we discharged him. That night we went out to dinner together and that was all the treatment he got. The next day we telephoned the American Embassy and said that the patient was quite well and that we had discharged him. So you can see that all this takes us back again to basics. Watch out for the symptomatology again the clinical examination and the symptomatology. You have to match them up.

Question

Should a patient with air embolism be put in the Trendelenberg position?

Dr John Miller

I do not think it is a tremendously rationalor useful thing to do. Even if there were a lot of gas trapped around the valves it would be the mitral valve that would have bubbles of gas trapped under it and not the tricuspid valve. Elevating the legs might be useful if you are dealing with a venous air embolism. Also it is often very inconvenient to do when you are transporting a patient. However, it is taught fervently to most paramedical personnel and it certainly does no harm. It certainly allows a little bit of extra venous return for somebody who for various reasons has had some impairment of cardiac output. If the people transporting the patient really fervently desire to do this why not let them do it?

But the Trendelenberg position increases the central venous pressure and therefore increases the intracranial pressure. That is going to tend to increase the back pressure which would tend to develop into cerebral oedema. So it may even be a bad thing to do.

Dr Jimmy How

I see it in another way. The moment you have bubbles reaching the brain you can get into a shock situation. If you compare decompression sickness in aviators with decompression sickness in divers you find cerebral effects are commoner in aviators, while strangely enough in divers it is the spinal cord that is more commonly affected with decompression sickness. You can get a shock syndrome when the blood pressure falls rapidly. I suppose that it is due to the micro-damage in the vessels and the effects of anoxia. By and large when you record the blood pressure it is low. I think it would help if we use that position. It would push the blood back to the vital organs. When you have bubble formation it is mainly venous. Venous return is increased when one is in the Trendelenberg position. I think it should be the left lateral as well. This would tend to allow the blood to rush through and the lungs to filter out the bubbles. Someone has said that there is always a small intra-auricular defect even in the adult. This would allow bubbles to reach the arterial blood. So if you allow the bubbles to go freely through the heart the chance of this is reduced. I still teach the medics to put the patient into that position, because it will help in at least these two situations.

Dr Chris Acott

If bubbles reach the right side of the heart the blood flow to the right ventricle will be decreased. So the amount of blood that is going into the left side of the heart will drop. Therefore the cardiac output will drop. That is why you get a drop in blood pressure. Because of the air bubbles trapped in the lung you get an increase in pulmonary vascular resistance. The pulmonary artery pressure is increased. So you get pressure rise in the right ventricle. As 33% of adults have got a patent intraventricular septum you can get air going into the left side of the heart. And it may reach your brain. I think the decrease in blood pressure is due to the decrease in cardiac output. Secondly it may be due to the decreased blood flow to the vasomotor centre of the brain.

Dr John Knight

As a change from the people who have got good chambers I am going to talk about treating decompression sickness without a chamber.

TABLE I

PRESENTING SYMPTOMS OF DECOMPRESSION SICKNESS. US NAVY

From Rivera (1963). US Navy. 900 cases

Cerebral (including inner ear)	6.4%
Spinal	0.2%
Cardiorespiratory	0.4%
Pain only	82.7%
Other	10.3%

If you follow the tables closely, serious decompression sickness has a pretty low incidence, adding up to somewhere about 7% (Table 1). However, if you treat sports divers, who have deep water to dive in, you get a different picture. Edmonds worked in Sydney and Erde in Hawaii. They treated 100 people and somewhere above 50% had serious decompression sickness (Table 2). Depending on where you are situated you are going to get a very different group of people to treat. We are lucky here, we are not likely to get serious decompression sickness because we have not been in any water deeper than about 60 feet so far. So even if we are going to have trouble, we would be very unlikely to get anyone seriously ill with decompression sickness.