

process.

Difficulties of a more physical nature included difficulty sleeping more than a few hours a night although he feels worn out, difficulties with sex, which include variable difficulty in gaining an erection, also pain and lack of feeling during intercourse, and a reduced tolerance to alcohol.

He is learning to accept his intense frustration and anger, adapting to frustrations by avoiding them. T feels anti-depressants have been helpful, not just to improve the mood state, but they also permit him to tolerate his disability and its frustrations. However his wife thought they made him more aggressive.

This man has been left with the kind of cognitive impairments that frequently follow other forms of diffuse brain damage. The pattern of his neuro-psychological profile is strongly suggestive that he has organic dysfunction of the brain. This continues to have a profound impact on his family relationships and his ability to work.

Discussion

After some 3 years, and many conflicting reports, T is still awaiting final permanent disability settlement payments. He continues to have a poor attention span, impaired concentration, reduced short-term memory, depressed mood, labile emotions, language difficulties, impaired balance, weakness of his left shoulder muscles, occasional paraesthesiae in the right leg, episodic diarrhoea and urinary hesitancy.

Despite these crippling problems we have optimistic neurological reports in conflict with the neuro-psychological assessments which are more in keeping with our diving medical assessments. Others have noted that "The cerebral recovery from DCS and AGE is more refractory than previously thought".¹ T is not alone, he is one of 8 divers who were unable to return to their previous employment, because of persisting disorders of their higher intellectual function and mood state, after hyperbaric treatment at HMNZS PHILOMEL for a diving accident.² There were 30 patients in the series reported. These 8 patients were assessed as impaired using the criterion of return to usual employment. The patients were invited to make self-assessments. Assessment was also made by the spouse and by the family practitioner. In addition psychometric testing was performed at the Post-Concussion Clinic, Auckland Hospital.

All these assessments gave evidence of disturbed higher intellectual function and mood state, with considerable variability of the symptoms. Although the assessments have a large subjective component, and the report is brief, the conclusion is statistically significant (8/30) and the patients' disabilities are very real. The paper's conclusion

was "That the cerebral effects of sport diving accident cases are refractory when assessed by family observation, G.P. observation, and psychometric testing".

This case clearly demonstrates the difficulties in quantifying the late sequelae of decompression sickness and achieving appropriate compensation payments.

References

- 1 Curley MD, Schwartz HJC and Zwingelberg KM. Neuropsychologic assessment of cerebral decompression sickness and gas embolism. *Undersea Biomed Res* 1988; 15 (3): 223-236
- 2 Sutherland A. Diving accident cases treated at HMNZS PHILOMEL recompression chamber in 1988. *SPUMS J* 1990; 20 (1): 4-5

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FREMANTLE HOSPITAL HYPERBARIC MEDICINE UNIT THE FIRST YEAR

Harry Oxer and David Davies

Introduction

After 12 years planning, and annual submissions to the Government, the Hyperbaric Unit at Fremantle Hospital was opened for business on November 27th, 1989. Construction was directed by Hyox of Scotland but most of the work was subcontracted to local West Australian companies.

The Unit is located in a former laundry and has facilities for consultation and wound care in addition to the administrative and treatment areas. Its effectiveness was justified by achieving the planned operational goals within six weeks rather than the expected six months.

The treatment unit consists of two hyperbaric chambers connected to a separate entrance lock which has provision to lock-on a transfer under-pressure module (Figure 1).

"Mildred", as the main treatment chamber is known, is a vertical cylinder with an internal diameter of 3 m and is 3 m high. It has a large rectangular door through which patients can walk or be wheeled on trolleys. The door is large enough to allow a Drager Duocom transportable chamber to

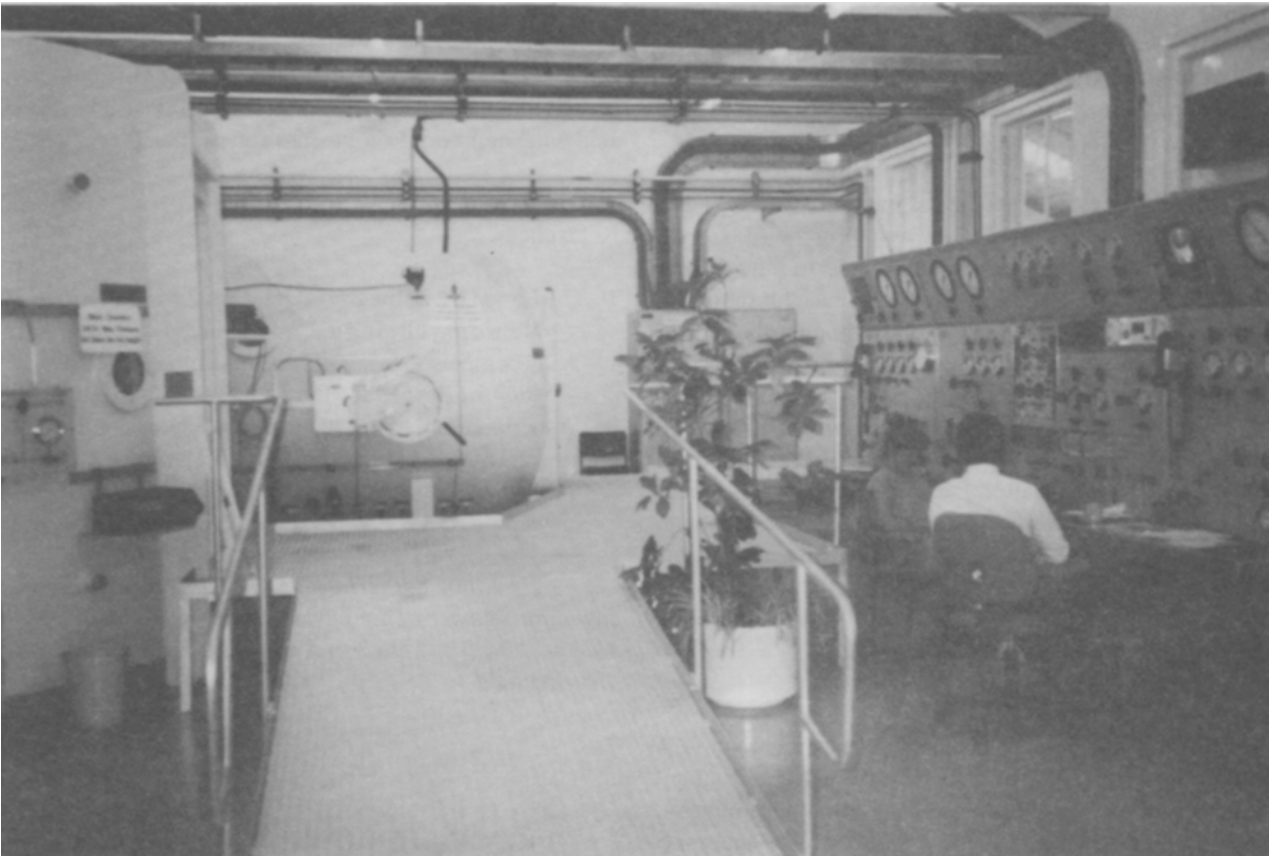


Figure 1. A general view of the Hyperbaric Facility. "Mildred" is shown in the left foreground with "George" behind. The control panel is on the right.

be carried in. The maximum operating pressure for this chamber is 3 ATA.

Normally patients are treated sitting in easy chairs with foot rests. Usually, four patients are treated morning and afternoon. Oxygen is usually administered by "Duke Hood" (Figure 2). Though Scott masks are available, they are more often used for treating divers. In an emergency, up to eight patients can be accommodated in this chamber. For comatose or intensive care patients, the chamber can take two trolleys with room for the attendants to move around it.

"George", the other chamber, has an operating depth of 7 ATA and has been tested to 13.4 ATA. It is a horizontal cylinder 2 m in diameter with two compartments. The treatment end has a walk in door and a fold down bunk on each side. With patients sitting on the bunks, a maximum of three plus attendant can be accommodated.

Access to both chambers can be made through a separate entry lock between them. This can be rapidly pressurised if required. A transportable chamber can be locked on to this entrance as it is fitted with a standard NATO mating flange.



Figure 2. The Duke hood on a patient.

Monitoring facilities are available in both chambers. This permits continuous monitoring of any modality in any patient transferred from the Intensive Care Unit. There are 72 channels available in each chamber.

Case Load

187 cases were treated from 31.11.89 to 31.12.90. There were 1,808 patient treatments in 806 chamber runs.

82 emergency cases have been treated to June 30th 1990. These have included divers, crush injuries, carbon monoxide poisonings, surgical flaps with poor circulation and head injuries. For these the average number of patient treatment was 3.7.

Non-emergency cases were made up of non-healing wounds, radiation necrosis and assorted ulcers. This group need many more treatments per patient, the average has been 29 and one patient required 71 treatments.

In Western Australia, the diving casualties fell into three main groups; pearl divers from Broome, professional divers and diving fishermen, and recreational divers and their instructors. 41 divers have now been treated since the chamber was opened.

Research

There are two research projects currently in progress. The first is to investigate the role of complement as a predictor of susceptibility to decompression sickness.

The second project is to study the effects of hyperbaric oxygen on cardiac ventricular wall movement in acute myocardial disease, such as infarction or cardiomyopathy. Other research projects planned include a study of stroke patients.

Staff

The Unit has a staff of Director, three nurses and two technicians (one part-time) who have had wide experience in commercial diving. Five other physicians with training in Diving and Hyperbaric Medicine, including the Directors of the Intensive Care Unit and the Emergency Department, assist in providing round the clock cover. The registrar medical staff of the Emergency Department also participate in the care of our patients. A pool of about 20 nurses trained in hyperbaric nursing, drawn from critical care areas of the hospital, provides extra staff for in-chamber patient care.

A close working relationship has developed with the Director of the Emergency Department, and all of his staff,

which provides early referral of acute cases, as well as, extra cover for the chamber operation.

Department case discussions are conducted so that all members are aware of what patients are being treated and their progress.

Discussion

Many years of research and discussion have resulted in a range of accepted indications for hyperbaric medicine being published by the Undersea and Hyperbaric Medical Society. As a result cases do not all have to be in double blind trials, as the effects of treatment have already been proven elsewhere.

As review of our clinical results is to be presented at the 1991 Annual Scientific Meeting by Dr Davies these will not be discussed in this paper. This paper will appear in a later issue of the SPUMS Journal.

Patients suffering from carbon monoxide poisoning who have a neurological deficit on presentation usually receive three treatments, often with rapid improvement in their mental state and resolution of other symptoms.

The close relations the Unit has with the Emergency Department in the hospital has ensured that acute crush injuries are transferred rapidly to the chamber.

One patient arrived from a remote area, 24 hours after a crush injury to the forearm. There was marked swelling, anaesthesia below the wrist with lack of movement of the fingers. Power and sensation returned during the first treatment and after three days of twice daily recompression he was discharged home symptom free, having avoided surgery completely.

Two other patients with crushed feet received great benefit, having previously been advised that amputation was probable, swelling was rapidly reduced and oxygenation increased.

Skin flap surgery, in which the vascularity of the flaps is compromised, can benefit from hyperbaric oxygen. This serves to reduce oedema and tissue tension, improve perfusion and may obviate the need for surgical revision. Short term treatment, twice daily, is usually effective for these patients.

Selected non-healing wounds benefit from multiple treatments but may require several weeks of therapy, six days a week. Often these patients have been unresponsive to prolonged normal therapeutic measures and are referred as a last resort. Peripheral ulcers are variable in their response but do best if there is a good, large vessel blood supply to the area.

Vasculitis as a result of radiotherapy delays healing and healing can be assisted by hyperbaric oxygen. Radiation osteonecrosis, especially of the mandible, has responded well to this form of treatment, after which effective surgical reconstruction is practical.

Our experience with pearl divers is that the incidence of decompression sickness is relatively low considering the repetitive nature of their diving and the long times they spend each day at depth. Dysbaric illness is usually associated with a lapse from their normally accepted diving practice.

Other developments in Western Australia

Other "professional" divers and diving fishermen perform frequent repetitive dives, often paying only lip service to accepted tables. Many give a history of "getting away with it" for some years. Detailed enquiry often reveals stories of paraesthesia, niggles and extreme fatigue especially early in the season.

In the recreational group of divers, the experienced divers have been those undergoing advance courses such as for dive Master qualification. They usually dived, technically within the accepted tables, but had exacerbating factors such as hard work, fatigue, hypothermia or strenuous activity after the dive. Student divers were more likely to be fatigued with dives near the limit of the tables.

Notable among the divers was the small number of pure type 1 decompression sickness. Careful examination usually elicited paraesthesia, numbness, problems with balance, alterations of concentration and short term memory loss. A number of patients reported that during recompression they felt as if a veil had been lifted. They were unaware of how much their concentrations and thought processes were impaired.

The Pearl Producers Association is installing a chamber at the Broome District Hospital and a training course for the staff has been conducted by our Unit. We will be able to provide further support when the chamber is commissioned. The Broome chamber will provide a significant improvement in diver support in the North West of the State and will reduce the need to transport injured divers over 1,200 km to chamber facilities in Perth.

Conclusion

The Hyperbaric Medicine Unit at the Fremantle Hospital is providing a valuable service to the West Australian community. Apart from treating divers and many other medical and surgical conditions the Unit has conducted courses for hyperbaric nurses, doctors, Commercial Diving

Supervisors, chamber attendants and for a group of pearl divers learning to operate their own chamber. There are frequent visits by diving clubs and other interested groups. SPUMS members visiting Western Australia are invited to contact the Unit and inspect the facilities.

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Dr David Davies presented a paper on the clinical cases treated in 1990 at the Fremantle Hospital Hyperbaric Unit at the 1991 Annual Scientific Meeting. This will appear in a later issue.

THE DIVING MEDICAL AND REASONS FOR FAILURE

John Parker

Introduction

This is one medical practitioner's review of two hundred consecutive sports diving medical failures in an attempt to detail why divers fail the medical assessment.

The divers

The majority of the divers were young international tourists travelling through North Queensland to dive on and experience the Great Barrier Reef. The average age was twenty five (Table 1). Twelve hundred (59%) of the divers were male and 851 (41%) were female.

TABLE 1

AGE DISTRIBUTION	
<20 years	9%
20-29	78%
30-39	10%
40+	3%

The medical

Every diver filled in a full questionnaire, as described