of the Australian Underwater Federation. This diving safety project can achieve nothing without the interest and active involvement of many people.

PROJECT STICKYBEAK

The object of this investigation is to collect, store and, as appropriate, publish and make available for discussion, accurate information relating to all types and severities of problems encountered by divers.

CONFIDENTIALITY IS ALWAYS MAINTAINED CONCERNING THE IDENTITY OF THOSE INVOLVED IN EVENTS PUBLISHED.

The investigation is totally independent of any single diving or government organisation. Comments and reports to:

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THE INCIDENCE OF ACUTE OXYGEN TOXICITY IN A CLINICAL SETTING

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INTRODUCTION

The occurrence of oxygen toxicity is frequently described as one of the hazards of the use of hyperbaric oxygen in a clinical setting. Despite this, very few articles have been written on the incidence of acute oxygen toxicity in this setting.

A retrospective study of the occurrence of acute oxygen toxicity symptoms at the Maryland Institute for Emergency Services Systems, Hyperbaric Medicine Department (MIEMSS) from January 1978 to December 1983 was thus performed. During this period, 891 patients were treated with a total of 14,966 patient dives. All dives were performed in a multiplace chamber with the patients breathing 100% O_2 by face mask or hood and at various depths: 165 fsw, 66 fsw, 60 fsw, 48 fsw, 45 fsw and 33 fsw, depending on the condition treated.

METHODS

The patients and symptoms were identified by reviewing the chamber operators' dive logs for the time period involved and then reviewing the chamber nursing notes for the patients so identified. One problem with this method was that only patients with severe symptoms were identified, those with minor symptoms from oxygen toxicity are thus not included in this study.

A total of 137 incidents of acute oxygen toxicity symptoms in 90 patients and 11 categories of symptoms: nausea and vomiting, seizures, muscular twitching, anxiety, respiratory changes, vertigo (or dizziness), behaviour changes, visual changes, sweating, auditory changes, and altered consciousness were identified with this method.

RESULTS

The overall incidence of acute oxygen toxicity symptoms at MIEMSS during the 6 years studied is shown in Figure 1 and in Table 1.

TABLE 1
INCIDENCE OF ACUTE OXYGEN TOXICITY SYMPTOMS 1978-1983

Nausea & Vomiting	0.37%
Seizures	0.21%
Muscular Twitching	0.13%
Anxiety	0.09%
Respiratory Changes	0.05%
Vertigo	0.06%
Behaviour Changes	0.03%
Visual Changes	0.02%
Sweating	0.03%
Auditory Changes	0.02%
Altered Consciousness	0.05%

The incidence of acute oxygen toxicity symptoms was broken down further by calculating the incidence of symptoms in the treatment of the 10 categories of conditions shown in Table 2. The results are shown in Figures 1-7.

TABLE 2
CONDITIONS TREATED

Decompression Sickness
Gas Gangrene/Aerobic and Anaerobic infections
Air Embolism
Wound Healing Enhancement
Radiation Necrosis
Carbon Monoxide Poisoning/Smoke Inhalation
Osteomyelitis
Spinal Cord Injury
Head Injury
Multiple Sclerosis

We also attempted to determine whether or not there was a relationship between the duration of oxygen breathing before symptoms occurred and the number of dives (treatments) the patients have received, but there did not appear to be any significant trend other than that 73% of all incidents occurred between the first and tenth dives, with the incidence of symptoms decreasing as the number of dives increased (Table 3).

FIGURE 1

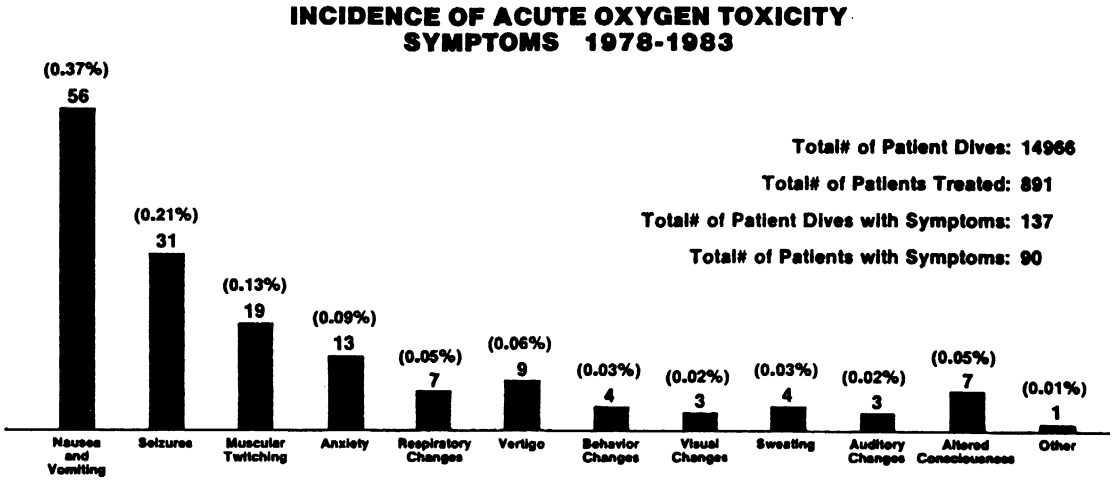


FIGURE 2

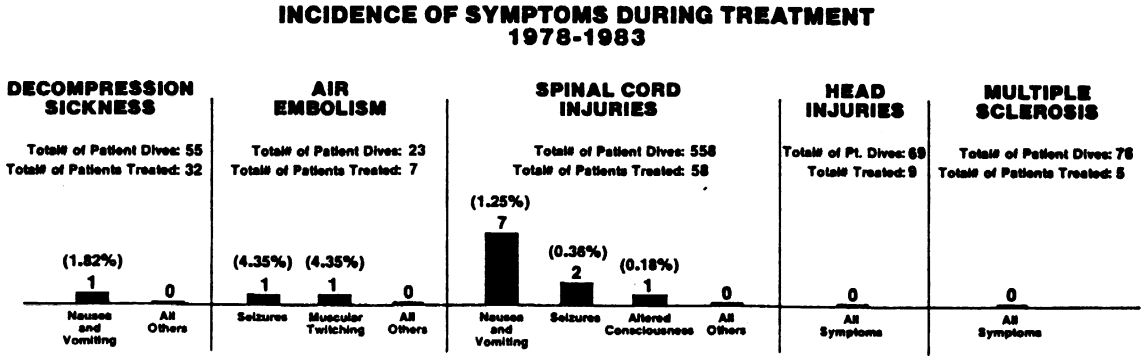


FIGURE 3

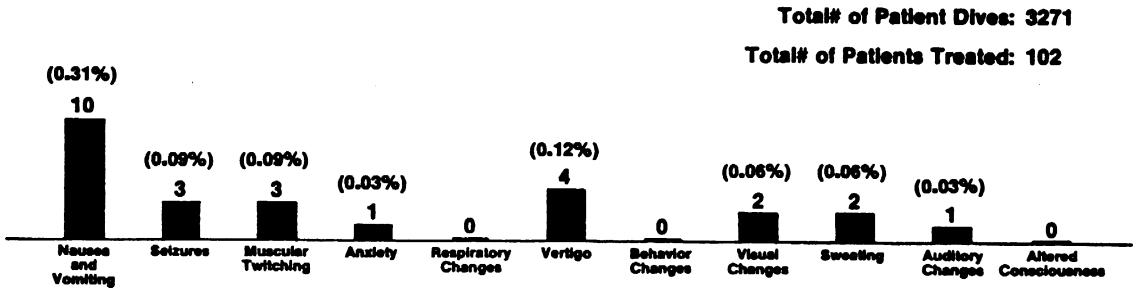


FIGURE 4

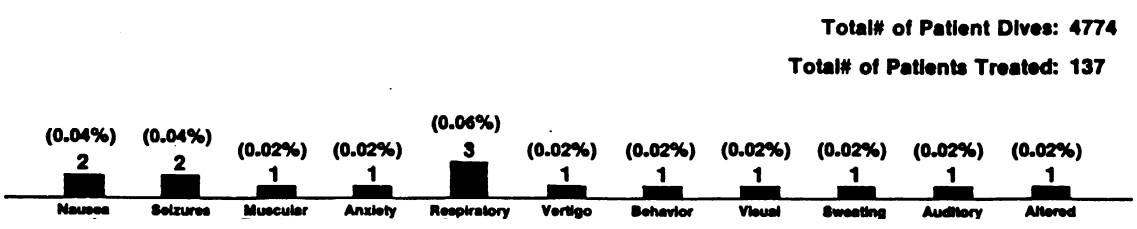
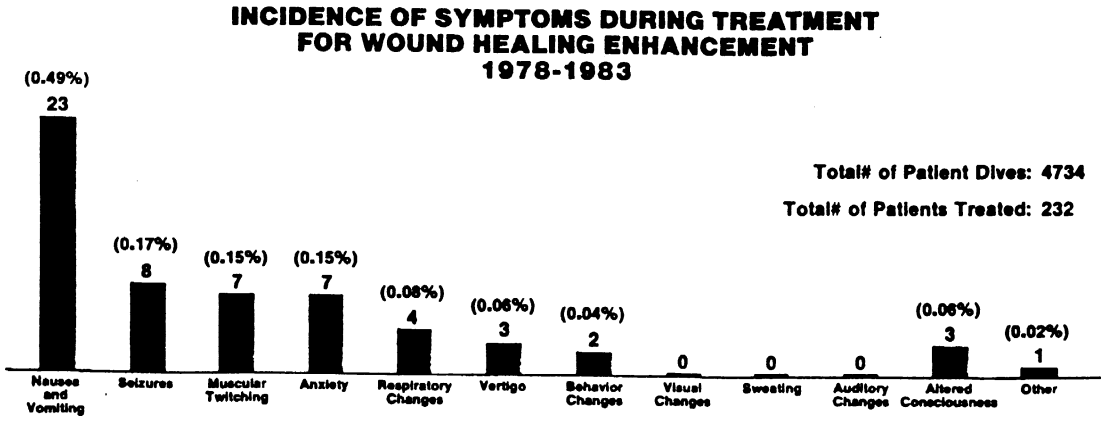


FIGURE 5



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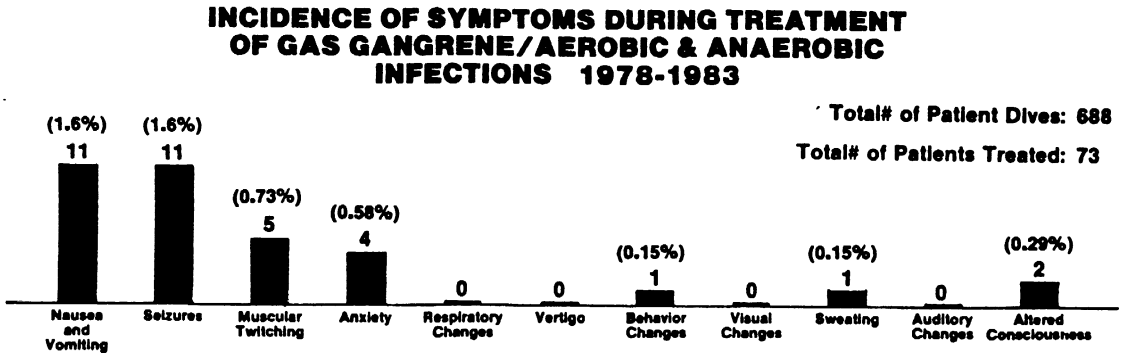


FIGURE 7

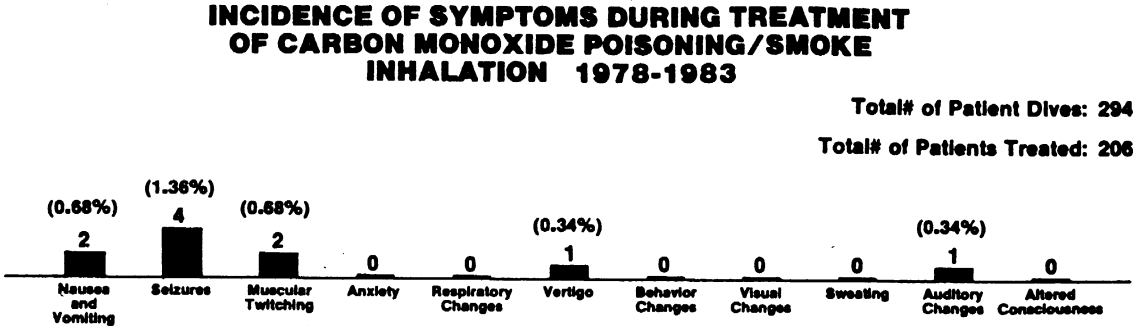
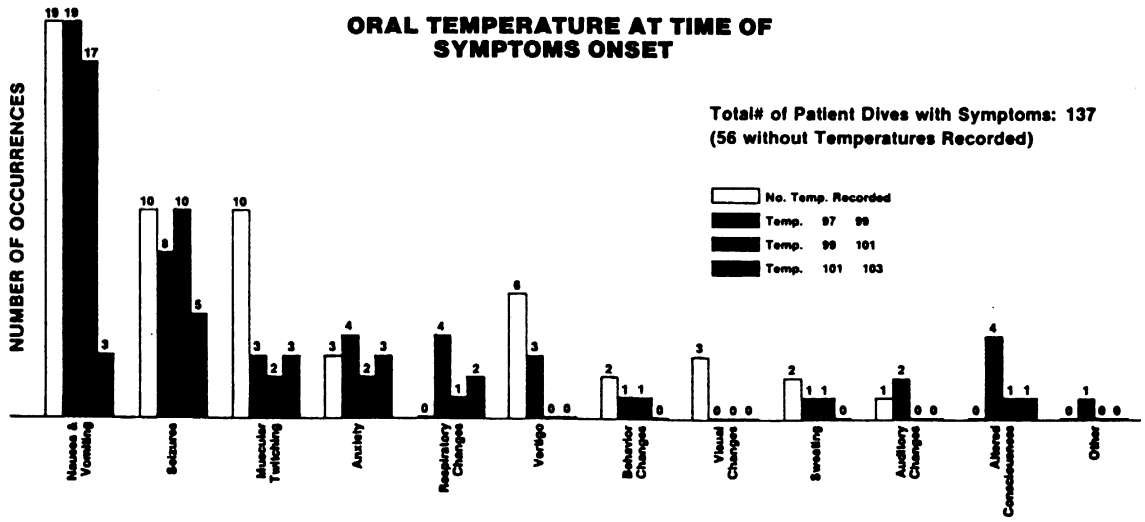


FIGURE 8



The oral temperature of the patients at the time of the onset of symptoms was looked at, but no pattern was identified (Figure 8).

TABLE 3
ONSET OF SYMPTOMS vs NUMBER OF DIVES

Number of dives	Number of incidents	Percentage
1 - 10	100	73%
11 - 20	17	12%
21 - 30	2	1.5%
31 - 40	7	5%
41 - 50	7	5%
51 & above	1	1%
No data	3	2%

DISCUSSION

Few authors have reported on the incidence of oxygen toxicity symptoms other than seizures. Ellis and Mandal (1983) in their review of 87 clinical patients, reported side effects in 18 patients: anxiety (43%), nausea/vomiting (13%), dyspnoea (12%), convulsions (5%), paraesthesiae (5%), and perspirations(30%). Donald (1947) found, in experiments with divers exposed to pressures of 3 ATA or greater, the following incidence of symptoms: convulsions (9.2%), twitching of lips (60.6%), vertigo (8.8%), nausea (8.3%), respiratory disturbances (3.8%), twitching of other parts other than lips (3.2%), sensations of abnormality (3.2%), visual disturbances (1%), acoustic hallucinations (0.6%) and paraesthesiae (0.4%). Both of these studies show far greater occurrence rates than here at MIEMSS. In the case of Ellis and Mandal, patients were treated in a monoplace chamber at 2 ATA and in Donald's study the subjects were divers breathing oxygen at depths 3 ATA or greater.

In our study all patients were treated in a multiplace chamber at depths of 6 ATA for decompression sickness (DCS) and Air Embolism, 2.8 - 3.0 ATA for Gas gangrene/Aerobic and Anaerobic infections and Carbon monoxide poisoning/ Smoke inhalation and 2.0 - 2.45 ATA for all other conditions. Thus comparisons of these studies are difficult due to the types of subjects and the different treatment protocols.

At MIEMSS the overall incidences of oxygen toxicity symptoms is much lower than in either of these studies. The highest incidence was that of seizures in patients with air embolisms (4.35%), a group that is prone to seizures just by the nature of their injury, followed by patients treated for gas gangrene or anaerobic and aerobic infections, our most septic patients, with an incidence of seizures being (1.6%) and an incidence of seizures in carbon monoxide poisoning/ smoke inhalation patients of (1.36%). In these 3 categories, patients were treated at depths ranging from 2.8 - 6.0 ATA, a range in which oxygen toxicity is a much greater problem. All other conditions were treated at lower pressures and as would be expected there was a much lower incidence of oxygen toxicity related problems (Figures 1-7 show the full details).

CONCLUSIONS

We have found that the incidence of oxygen toxicity related symptoms at MIEMSS is low, and is easily managed by removal from oxygen when symptoms occur, adjusting air break schedules and in some cases by pre-medication with Diazepam for subsequent dives.

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MAMMARY IMPLANTS AND DIVING

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The Divers' Alert Network has had several enquiries from sport divers concerning mammary implants and decompression safety. As little pertinent information could be found in the literature, an experimental study was conducted to determine if in vitro decompression of mammary implants would cause bubble formation and, if so, how extensive this bubble formation would be.

METHODS

Six mammary implants were tested in four simulated dives. Experiments were conducted with air at a temperature of 20° ± 2°C in a pressure chamber having an internal volume of about 10 cu ft. The implants were exposed to the desired pressure-time profile and then removed from the chamber for observation. The number of bubbles present and their sizes were estimated about once per hour for 5 to 8 hours and at 20 hours post decompression. The volume change of the implant was determined by submerging it in a water-filled container of known volume and measuring the change in container weight since the end of decompression. This method was accurate to a volume change of 1-2%. The maximum volume change occurred 4 t 5 hours after decompression.

RESULTS

Table 1 gives a summary of the results.

The first simulated dive was conducted at a depth of 120 feet of seawater (FSW) with a bottom time of 67 hours followed by immediate decompression to the surface. While this is an unrealistic exposure for divers, it was used because the extent to which bubbles would form was unknown.