

TABLE 5

## INITIAL RECOMPRESSION THERAPY TABLES

Recompression	Type I DCS			Type II DCS	
	US Navy TT 5	US Navy TT 6	HBO Protocol	US Navy TT 6	US Navy, TT 6 with extentions
Ratio	31.6%	26.3%	42.1%	16.7%	83.3%

adjunctive medication. Rehabilitation was needed in 12 patients (32.4%). Residual symptoms such as weakness in some muscles and patches of numbness were left in 4 cases (10.8%). One case (2.7%) was resistant to the therapy and remained paraplegic.

### Discussion

Omitted decompression was the main reason of DCS in our cases. When their dive profiles were compared it was clear that recreational scuba divers paid more attention to the decompression rules than professionals. Inadequate decompression increased the risk of DCS, but cases did occur after no-decompression dives, confirming that DCS can be seen even after a dive within the no-decompression limits.

The frequency of the onset of DCS symptoms in the first 10 minutes after the dive shows the importance of both the dive profile and the ascent history in the differential diagnosis of DCS and arterial gas embolism due to pulmonary barotrauma.

Most of our cases presented late for recompression therapy since the importance of quick transport is usually not realised. For the majority of the cases the time intervals between the onset of the symptoms and recompression therapy was more than 12 hours. This occurred although most cases came from a distance which only takes 3-4 hours in an ambulance. Those cases delayed by geographical factors, position of the dive sites and difficulties encountered during the transport, indicate the necessity of recompression chambers in remote areas.

The percentage of the cases who had adequate first aid with adjunctive medical treatment was very low. The poor outcome of recompression therapy, the need for additional hyperbaric oxygen therapy and rehabilitation in delayed cases are evidence of the importance of immediate transport and adjunctive medications. Appropriate first aid and medical treatment can be provided by training medical staff near the diving sites about diving related disease and its treatment. Deterioration of the cases who applied in-water recompression on air shows the harmful effect of its improper application. Air transport was not used in these cases because of its high cost and the fact that there is no well established insurance system in Turkey.

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### DECOMPRESSION ILLNESS TREATED IN SOUTH THAILAND DURING 1998

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#### Key Words

Decompression illness, recreational diving, treatment.

#### Abstract

Decompression illness (DCI) occurred in 30 European recreational scuba divers, using compressed air, in South Thailand in 1998. This is the first report on such treatment. Of interest is the high proportion of patients who were employed in the recreational diving industry.

#### Introduction

Recreational diving in South Thailand is done on the west coast from live-aboard boats (predominantly near Surin, Similan and also in Burma) and from shore based dive shops. Day trips and shore diving are done off Phuket, Phan Nga Bay, the Phi Phi Islands, Hin Daeng and also in the Gulf of Thailand on the islands Ko Samui and Ko Tao. There are about 100 dive shops in the region with an estimated 1,000 dives per day are done during the high season (December-April).

The majority of recreational divers in South Thailand are foreigners visiting for a week or so.

Europeans form the majority of the dive guides and instructors. They dive regularly with longer periods between breaks than do the tourists. Inclusion criteria for the present study were decompression illness (DCI) in European recreational scuba divers breathing compressed air. Thirty such patients presented in 1998. Data about non-European nationals will be presented in a later report.

Hyperbaric Services Thailand (HST) is a private recompression facility. It has a multiplace, 1.5 m (5 ft) diameter, double-lock hyperbaric chamber in Phuket, Thailand. The nearest hyperbaric facility is in Bangkok, approximately 1,000 km away.

If one accepts the estimate of 1,000 dives a day in South Thailand in December to April there would be approximately 150,000 dives carried out in that time.

A total of 42 cases were recompressed in 1998 at HST. Of these, 41 cases were DCI and one case was peri-orbicular emphysema secondary to fracture of the floor of the orbit. Five were indigenous divers. The rest (36) were Europeans or from Canada (2), Israel (2), New Zealand (1) and the USA (1). The latter are not included in this report. All were recreational divers and are summarised in Table 1 by country and frequency. Because of the small numbers involved all percentages are given to the nearest appropriate whole number (so that the total is 100%) to avoid a spurious accuracy.

It is interesting that 12 of the 30 patients studied came from the Scandinavian countries. Britain and Germany with more than 10 times the population only provided 13 cases. There was no obvious reason for this.

**The divers**

Of the 29 treated divers who gave information about their experience 31% (9) had less than 6 months diving experience. Table 2 gives further details of the range of experience.

Twelve (40%) of the 30 treated European patients were locally based instructors/dive guides. Certification levels of the patients are shown in Table 3.

There were 21 males (70%) and 9 (30%) females. Age ranged from 21 to 46 years. One third of the cases (10) were between 25 and 29 years old.

Eleven of the 31 Europeans treated in the chamber (30 for DCI and one for peri-orbicular emphysema) had had previous illnesses. Table 4 gives the details. Four had had DCI on a previous occasion.

**TABLE 1**

**PATIENTS' COUNTRY OF ORIGIN**

Country	Cases	%
England	7	19%
Denmark	6	17%
Germany	6	17%
Sweden	5	13%
Canada	2	5%
Israel	2	5%
Austria	1	3%
Belgium	1	3%
France	1	3%
Italy	1	3%
New Zealand	1	3%
Norway	1	3%
Switzerland	1	3%
USA	1	3%
<b>Total</b>	<b>36</b>	<b>100%</b>

**TABLE 2**

**DIVER EXPERIENCE (TIME DIVING)**

Experience	Cases	%
Under instruction	2	7 %
Under 6 months	7	24 %
Between 6 months and 2 years	5	17 %
Between 2 and 6 years	9	31%
More than 6 years	6	21%
<b>Total</b>	<b>29</b>	<b>100%</b>

**TABLE 3**

**CERTIFICATION LEVELS**

Qualification	Cases	%
Student	2	7%
Open Water Diver	6	20%
CMAS 1 *	1	4%
CMAS 2 *	1	4%
Advanced Diver	6	20%
Rescue Diver	1	4%
Dive master	4	14%
Instructor	8	27%
<b>Total 29</b>	<b>100%</b>	

**TABLE 4**  
**PREVIOUS MAJOR ILLNESSES**

Illness	Cases	%
Previous DCI	4	13%
Musculo/skeletal	2	7%
Asthma	2	7%
Gout	1	3%
Neurologic	1	3%
Spine	1	3%
None	20	64%
<b>Total</b>	<b>31</b>	<b>100</b>

**TABLE 5**  
**CURRENT HEALTH PROBLEMS**

Problem	Cases	%
Fatigue	9	30%
Hangover	3	10%
Asthma	2	7%
Diarrhoea	2	7%
Neck pain	1	3%
Back pain	1	3%
None	12	40%
<b>Total</b>	<b>30</b>	<b>100%</b>

**TABLE 6**  
**DAYS DIVING DURING PRESENT TRIP**

Number of days	Number	%
1	4	15%
2	6	22%
3	2	7%
4	2	7%
5	1	4%
Working	12	45%
<b>Total</b>	<b>27</b>	<b>100%</b>

**TABLE 7**  
**CHARACTERISTICS OF 28 DIVERS WITH DCI**

Finding	Cases	%
Buoyancy problems	1	4%
Rapid ascent	5	18%
Single dive that day	7	25%
Within limits	27	96%
Symptoms prior to last dive	2	7%

Eighteen patients (60%) had a current health problem when they developed DCI (Table 5). Nine (30%) were suffering from fatigue.

#### Decompression Illness

Only 6 cases (20%) were diagnosed as DCS Type I (pain only). The majority, 24 cases (80%), had Type II DCS with neurological signs and symptoms. There were no cases of arterial gas embolism.

Only 27 divers provided information about how many days they had been diving before they developed DCI. Table 6 gives the numbers and the percentages of the 27 divers providing this information.

Nine out of 28 patients (32%) had consumed alcohol during the dive series that led to DCI.

Table 7 shows that the vast majority (96%) of the divers who provided the information were diving within the limits provided by their computers. Only one diver had buoyancy problems and 5 had made rapid ascents. Two divers had symptoms before they started the dive which led to them being treated.

Assuming that Europeans make up about the same percentage of the total as they do of those treated for DCI, the incidence of DCI in Europeans is about 0.02%. Most of the cases (27) came from Phuket, where the chamber is located, taking from 15 minutes to 3 hours to reach the chamber. The other two cases where the location was recorded came from a live-aboard based at Similan, taking 9 hours to reach the chamber, and from Kao Lak (3 hours).

There was a large variation in the time between the end of the dive and the onset of symptoms (Table 8). About a third of the patients developed symptoms within 30 minutes. Another quarter developed them in the next 3.5 hours, with a further quarter in the next 4 hours. However a tenth of the patients developed their symptoms between 16 and 24 hours after diving.

Divers delayed for long periods before reporting to the HST. Only three cases (10%) took less than two hours to reach the chamber. Only 5 patients (17%) reached the chamber within 6 hours of developing symptoms. Fifteen (50%) took two or more days to reach treatment. Table 9 gives the individual times for these delays.

#### Treatment

Few patients, only 9 out of 29 (31%), had had any first aid treatment during evacuation. Table 10 gives the depressing figures. There is obviously much room for

**TABLE 8**

**TIME TO SYMPTOM ONSET AFTER SURFACING**

Time	Cases	Accumulated percentage
10 min	2	8%
20 min	1	11%
First 30 min	9	35%
First 4 hours	16	61%
First 8 hours	23	89%
Between 16 and 24 hours	3	11%
<b>Total</b>	<b>26</b>	<b>100%</b>

**TABLE 9**

**TIME FROM ONSET OF SYMPTOMS TO RECOMPRESSION**

Minutes/cases	Hours/cases	Days/cases
30	1	2
	3	1
	4	1
	6	2
	7	1
	10	1
	12	4
	15	1
	18	1

**TABLE 10**

**FIRST AID BEFORE REACHING HST**

Oral fluids	3
Oxygen via free flow	3
Oxygen via demand valve	2
Aspirin	1
None	20
<b>Total</b>	<b>29</b>

improvement in the early management of DCI cases in the region.

All 30 patients had a US Navy (USN) Table 6 as initial treatment. For some cases the table was extended. For those who had not completely recovered USN Table 5 was used for follow up treatments. The average number of treatments was 3.83.

Seven patients had residual symptoms after recompression therapy was completed. Because these

patients moved away at the end of their holiday, follow up has not been possible.

**Discussion**

South Thailand has a booming recreational diving industry. In 1997 we treated 22 cases of DCI, in 1998 there were 42 and the total for 1999 will be higher. More specific data collection and analysis of the factors that resulted in DCI will be undertaken. The findings of the physical examination will also be described and follow up will be included in further reports.

In 1998 divers with less than 2 years experience accounted for 21 (50%) of our injured divers. The high percentage (40%) of locally based instructors or dive guides who suffered DCI deserves a detailed analysis. In the 1998 DAN report this group accounted for only 17% of the reported cases. It is likely that the reason lies in their pattern of diving and complete reliance on their dive computers.

The long delays in seeking treatment, with less than 20% of patients presenting in the first 6 hours after developing symptoms, can be attributed more to ignorance, or denial, rather than to distance to the recompression facility. Education of the local dive providers and medical personnel is needed in prevention, symptom recognition, on site management and evacuation procedures of DCI patients.

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**TEAR FILM BUBBLES AND DECOMPRESSION ILLNESS. FINALLY A DIAGNOSTIC TEST TO CRY FOR?**

Mike Bennett

**Key Words**

Bubbles, decompression illness, hyperbaric research.

**Introduction**

This presentation is intended to outline what may, in time, prove to be an important diagnostic tool for