6500 (Human Volunteers)

3900
Pers-A212-mh
8 SEP 1964

FIRST ENDORSEMENT on BUMED ltr BUMED-75:JHS:dms File:3900 R/S 51 Ser 510
of 31 Aug 1964

From: Chief of Naval Personnel
To: Secretary of the Navy

Subj: Permission to use naval personnel as subjects in developing a modified method of treating serious cases of decompression sickness; request for

1. Forwarded. Approval recommended.

Leon I. Smith Jr.

Copy to:
BUMED

LEON I. SMITH, JR.
BY DIRECTION

NAV1.941006.083

Approved 23 SEP 1964

PAUL B. FAY, Jr.
Acting Secretary of the Navy

Copy to Field BuPers,

RETURNED TO ORIGINATOR FOR
DISPOSITION THIS DATE 23 SEP 1964
A-P

9/16 ASN-G

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SECNAV

DEPARTMENT OF THE NAVY
BUREAU OF MEDICINE AND SURGERY
WASHINGTON 25, D.C.

IN REPLY REFER TO
BUMED-75:JHS:dms
File:3900 R/S 51
Ser: 510
31 August 1964

From: Chief, Bureau of Medicine and Surgery
To: The Secretary of the Navy
Via: Chief of Naval Personnel

Subj: Permission to use naval personnel as subjects in developing a modified method of treating serious cases of decompression sickness; request for

Encl: (1) Cy OinC ltr EDU:RDW:fw 3900 Ser:183 of 12 August 1964

1. Enclosure (1) outlines a modified form of treatment for serious cases of decompression sickness. This form of treatment has been used successfully at the University of Pennsylvania and with better results than is normally obtained with the currently recommended Navy treatment.

2. This Bureau requests permission to apply this form of treatment to a number of normal, healthy volunteers to obtain adequate information about its applicability for general use in the naval service.

3. Since this form of treatment is in reality a modification of the oxygen tolerance test and pressure test given to all applicants for deep sea diving, it is considered that volunteers would not be exposed to any undue health hazard in the course of the treatment.

R. B. BROWN
Acting

U. S. NAVY EXPERIMENTAL DIVING UNIT
U. S. NAVAL STATION
(WASHINGTON NAVY YARD ANNEX)
WASHINGTON, D. C. • 20390

EDU:RDN:fw
3900
Ser: 183
12 August 1964

From: Officer in Charge, U.S. Navy Experimental Diving Unit
To: Chief, Bureau of Medicine and Surgery (Attn: Code 7)

Subj: Low pressure recompression method using oxygen to treat serious cases of decompression sickness; request for authorization to use in selected cases

Ref: (a) U.S. Navy Experimental Diving Unit Research Report 1-63 "Decompression Sickness Among Divers: An Analysis of 935 Cases" by J.C. Rivera

Encl: (1) Low pressure recompression method using oxygen

1. Diving activities of the U.S. Navy have in recent years been faced with the responsibility to treat an increasing number of severe cases of decompression sickness occurring in civilian divers. These have resulted from grossly inadequate decompression which produced extensive damage to central nervous system tissues, and were further aggravated by delay in instituting treatment due to time required to transport these patients to a recompression facility.

2. It is obvious that functional impairment of central nervous system from mechanical trauma and tissue anoxia caused by gas bubbles which occlude circulation for some period of time will persist in spite of recompression treatment. Thus, an incidence of 47% residual effects following treatment of 57 cases of severe decompression sickness with U.S. Navy treatment table four described in reference (a) is understandable. Considerable improvement had occurred in many cases, but residual functional impairment persisted.

3. Of greater concern is the death of 4 patients treated with table four within the last two years. Two of these patients expired at full treatment depth of 165 feet without subsequent reduction of pressure. The remaining two patients expired at lesser depths with attempts to return them to the surface in accordance with the treatment table. In other cases which ultimately survived, recurrence or deterioration of the patient's condition required return to full pressure as many as four times before final surfacing was possible.

4. It is considered that in these severely injured patients inert gas exchange is grossly impaired in areas of tissue injury such that bubbles may be incompletely resolved during recompression, then increase in size again during pressure reduction. It is also possible that new bubbles

may form in areas of tissue injury which have inadequate inert gas elimination rates due to circulatory impairment.

5. With a growing awareness of the difficulties encountered in recompression treatment of such severely injured patients, this activity has undertaken evaluation of a treatment procedure with the following objectives:

a. Expose bubbles to maximum possible gradient for elimination of inert gas to resolve them rapidly.

b. Insure maximum oxygenation of tissues with circulation impaired due to bubbles by dissolved oxygen in blood and tissue fluids. Circulation will be improved to affected areas by overcoming vaso spasm induced by tissue anoxia resulting from bubble emboli, and thus tissue function improved.

c. Prevent inert gas saturation of tissues which serves to decrease bubble resolution rates. During subsequent decompression no further bubble growth or formation of new bubbles is possible in areas of tissue injury with decreased inert gas elimination rates due to circulatory and diffusion impairment.

6. The method used consists of recompression to 33 or 60 feet with oxygen breathing. This depth is then maintained for 30 minutes after all symptoms and signs have disappeared. Decompression then follows at a continuous rate of 1 foot per minute to the surface. If function has not completely returned after one hour at 60 feet, decompression can be carried out to 30 feet where oxygen is breathed for 1 or 2 hours, followed by ascent to the surface. All ascent rates are at 1 foot per minute. Should symptoms of oxygen toxicity occur, air breathing for 15 minutes is then followed by resumption of oxygen breathing.

7. If symptoms and signs are not completely resolved, the exposure may be repeated after 30 to 60 minutes air breathing at the surface, for little if any inert gas will have been taken up during the exposure to pressure to permit further bubble growth. Residual tissue damage induced by the initial injury can then be permitted to heal with time, uncomplicated by high inert gas tension in tissues which would result from air recompression, and permit bubble growth and new bubble formation in injured tissues during decrease of pressure.

8. We have now treated successfully by this method 15 cases of decompression sickness, including 7 with central nervous system manifestations. All but 2 cases have been relieved of symptoms quickly at a depth of only 33 feet. Two cases with CNS symptoms were recompressed a second time due

to return of mild symptoms after surfacing. Prompt relief of symptoms followed the second recompression and no further residual or recurrence followed. In Dr. Lambertsen's laboratory one case of altitude decompression collapse with CNS involvement, and one case of air embolism with mediastinal emphysema were treated successfully at 66 feet with oxygen. Both subjects made prompt and uneventful recoveries from the unconscious state which preceded treatment.

9. The prompt disappearance of symptoms and signs within 5 minutes of oxygen breathing at depth has impressed us that this method has considerable potential. If one can treat such cases successfully in from 2 to 4 hours, that would otherwise require 39 hours or more, then a distinct advantage has been gained in terms of obligation placed on personnel and facilities. There should be little reluctance to face the time obligation imposed by this treatment method compared to the conventional prolonged air treatment tables.

10. Enclosure (1) gives details of the oxygen recompression method described with short periods of air or helium-oxygen breathing between oxygen breathing periods. The use of short periods of air or helium-oxygen breathing will help to avoid onset of oxygen toxicity when prolonged exposures to oxygen breathing must be used. In this way sustained oxygenation of injured tissues is permitted to facilitate return of function. Since it is quite possible that no discrete indication of bubble resolution may be evident due to tissue injury present, it is highly desirable to sustain tissue oxygenation sufficiently long to insure complete bubble resolution. The prolonged periods of oxygen breathing at 60 and 30 feet will accomplish this.

11. It is requested that the proposed low pressure oxygen recompression method of treating serious cases of decompression sickness be approved for application in selected cases at the U.S. Naval Submarine Base, Pearl Harbor. That activity has faced a major responsibility in treatment of the most difficult cases of severe decompression sickness, and should have available for use a treatment procedure which is able to provide adequately for such cases. Two deaths at full treatment depth occurred on table four at that activity recently. Thus, it is considered that to meet this responsibility, the proposed method which has been very successful in use at this activity, should be available to them if they choose to use it. Further information gained through use of this treatment procedure would make possible a determination of adequacy for more widespread application at other U.S. Navy recompression facilities at some time in the future.

C.H. Hedgepeth

C.H. HEDGEPETH

Copy to:
BUSHIPS (Code 636)

Low Pressure Recompression Method Using Oxygen

	Depth (ft)	Time (min)	Breathing Mixture
1.	0–60	2	Oxygen
2.	60	28	Oxygen
3.	60	15	80 – 20% helium – oxygen or air
4.	60	30	Oxygen
5.	60–30	30	Oxygen
6.	30	15	80 – 20% helium – oxygen or air
7.	30	60	Oxygen
8.	30	15	80 – 20% helium – oxygen or air
9.	30	60	Oxygen
10.	30–0	30	Oxygen