Diver training and education programs address the problem of ignorance and inexperience in divers. Diver education has indeed reduced fatalities over the years. Education has limits, however, and individual attitude is an important factor. Because people can do whatever they wish to do, responsible choice making and social peer acceptance variables have an important role and influence at the dive site.

The development of proper attitudes about training is the key to maximising the likelihood that the majority of divers will stick to proven safety guidelines. This process begins in the entry level diver course with the instructor. It is reinforced within the various training materials, texts and industry publications available to divers.

To be successful in reducing diving fatalities, responsible diving behaviour must be nurtured at a grass-roots level. Because diving is a social pursuit, divers do learn from other divers, buddies, friends and divemasters. All of these people collectively provide a community of example. In this way, divers go through a type of apprenticeship. Social forces and peer pressure shape diving practice either in a positive or negative way, depending on what the group tolerates. Good diving habits are developed in part by example and safety attitudes. Divers who rush into the water with leaking regulators or faulty equipment without solving the problem, need to stop and think about the fact that they are increasing the risk to themselves and their partners. Responsible group dynamics must accommodate corrective behaviour, before diving, in order to keep risk levels acceptable.

Ideally, safety is freedom from risk. Unfortunately, risk is unavoidable in any sport and diving is no exception. However, risk can be minimised. Good judgment and training will help ensure risks are judged as acceptable and diving will remain "safe." History has shown the benefits of detailed dive planning, performing a pre-dive safety check and following safe diving practices in reducing diving deaths. Diving death is not a random event. While we may never be able to reduce the fatalities to zero, we must never cease in our efforts to do so.

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A PROGRESS REPORT ON DIVING MEDICINE STUDIES IN THE ROYAL NEW ZEALAND NAVY

Des Gorman, Alison Drewry and Simon Mitchell

Abstract

Three prospective, randomised, controlled studies involving oxygen-helium and lignocaine in decompression illness and lignocaine in patients undergoing cardiopulmonary bypass are underway at the Royal New Zealand Navy's Auckland Naval Base. Two other studies are designed to elucidate whether there are objective markers of decompression illness, in either the coagulation cascade or bone imaging; and a survey of the health status of the Royal New Zealand Navy Diving branch has been conducted. No progress has been made in the study of the role of chest and abdominal splinting in the prevention of pulmonary barotrauma.

Introduction

A series of studies relevant to diving medicine have been initiated by researchers at the Auckland Naval Base. These include:

a) prospective, randomised, controlled trials of (i) oxygen-helium versus oxygen, (ii) lignocaine versus placebo in the treatment of decompression illness (DCI) arising from recreational air diving, and (iii) lignocaine versus placebo in the prevention of brain injury due to gas emboli during cardiotomy;

b) a study to determine whether there are any measurable changes in the coagulation system in DCI,

c) a study of bone changes in acute DCI using nuclear magnetic resonance imaging (NMRI);

d) a survey of the current health status of the Royal New Zealand Navy (RNZN) Diving Branch;

e) a study of the role of chest and abdominal splinting in the prevention of pulmonary barotrauma.

These studies are reviewed below:

Prospective randomised controlled trials

OXYGEN-HELIUM STUDY

The rationale for a comparison of oxygen and oxygen-helium as the ideal therapeutic gas mixture to be breathed during the recompression of divers with DCI has been described previously.[1] The study has been in progress for 2 years and 88 subjects have been treated, of whom 12 failed to meet the trial criteria (due to pregnancy, wrong diagnosis or failure to follow the study protocol).

One-year follow-up results are available for 56 subjects. The treatment groups are directly comparable with respect to age, sex and symptoms and a successful outcome was achieved in 80% for each group. However, fewer patients treated with the oxygen-helium required multiple recompressions (9 of 25 compared with 20 of 31 in the oxygen group) and this difference is statistically significant ($p= 0.03$). The cost-effectiveness of the treatment regimens will be compared to assess whether the use of oxygen-helium represents an important advantage. Meanwhile the study continues.

LIGNOCAINE STUDIES.

The need for a controlled trial of lignocaine versus placebo in the treatment of DCI has been demonstrated by a pilot study.[2] A prospective, randomised, controlled trial of lignocaine versus saline in refractory DCI has been initiated at RNZNH and acute cases will be studied after completion of the heliox trial. In the meantime, other centres are being recruited to commence the acute phase of the study, but no results are yet available.

The rationale for employing lignocaine in the treatment of DCI has also been applied to studying the use of lignocaine prophylactically in cardiothoracic surgery. Neuropsychological sequelae are reported with variable but significant frequency in patients following cardiotomy, largely due to the introduction of solid and gaseous emboli into the arterial circulation.[3-8] This has obvious parallels with the pathophysiology in DCI and cardiotomy patients are to be studied in a controlled trial of lignocaine versus placebo, in collaboration with the cardiothoracic surgical team at Green Lane Hospital. Efficacy will be assessed primarily by neuropsychological evaluation before and after operation, and test scores will be correlated with arterial emboli counts.

There is a need for an objective "measure" of DCI, which could be monitored and used to predict outcome and gauge response to treatment. These studies aim to determine whether measurable systemic changes occur in DCI and can be correlated with disease progress.

Coagulation change study.

It has been proposed that the formation of aggregates of blood constituents, and subsequent embolic phenomena, is both a primary and perpetuating event in DCI.[9] Coagulopathies have been demonstrated in animal models of DCI, but reports of abnormal haematological parameters in human subjects are rare, although this may be due to the use of insufficiently sensitive tests. In this study, all recreational divers with DCI presenting for therapy, will have sequential sampling of the coagulation cascade (APTT, INR, bleeding time, factor viii, von Willebrand's factor, fibrinogen and proteins c and s, antithrombin III) throughout the treatment period, and the results compared with clinical outcome.

Bone change study

The pathophysiology of dysbaric osteonecrosis is uncertain, but there is a significant relationship with DCI, although a common cause cannot necessarily be inferred.[10] NMRI is more sensitive in the early detection of avascular necrosis than other imaging modalities, and may detect acute ischaemic changes which subsequently resolve.[11] Patients with acute DCI will undergo initial NMRI within seven days of presentation for treatment and thereafter as the clinical course and imaging results dictate.

Health status of the RNZN Diving Branch

Concern over the long-term health effects of diving and significant changes to the diving practices in the RNZN (the introduction of helium, deep "bounce" diving and saturation diving) prompted a survey of the current health status of the RNZN diving branch. Health status has been evaluated by questionnaire, physical examination, neurocognitive assessment, long bone survey, audiometry and spirometry. Individual diving exposure was determined by recording the number and depth of dives, gas mixes used, decompression schedules followed and any diving incidents experienced. Few exposure-related abnormalities were found. This may reflect the "healthy-worker" effect, but the group now forms a cohort which will be matched with non-diving controls and subjected to sequential evaluation.

Pulmonary barotrauma

A study of the role of chest and abdominal splinting in the prevention of pulmonary barotrauma has not yet proceeded because of technical difficulties.

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ARTICLES OF INTEREST REPRINTED FROM OTHER JOURNALS

DEVELOPMENT OF SATURATION DIVING : THE HUMAN FACTORS

David Elliott

Abstract

The concept of remaining at depth beyond the time for equilibration with inert gas is attractive commercially because the ratio of working hours to hours spent in decompression is optimal. Saturation diving is a unique work practice with a mere 25 year history and is still developing. It is now a normal feature of offshore diving but, unlike most jobs, it requires the diver to live in his unphysiological workplace. This demands more attention from the occupational health physician than the application of conventional diving physiology and medicine. During compression, attention is usually focussed upon the amelioration of the high pressure nervous syndrome (HPNS), at depth upon the limits of safe excursions and during decompression, on the avoidance of bubbles. Though important, these are not the only issues. The ergonomic design of the chamber system includes details such as control of noise and lighting, and special provisions such as the need to adapt the facilities in response to possible medical emergencies. Bacteriological and environmental control extends to avoiding contamination. Bell design and, in particular, the setting of standards for breathing apparatus have received considerable attention but tool design, communication and thermal balance relatively neglected. For the saturation diver, the management of nutritional status requires careful attention. Work-cycles are carefully defined, but sleep can be disturbed by the noise of others in the chamber and by a sensitivity to small changes of temperature. Finally, on surfacing, reports of fatigue and intolerance are common. What are the medical priorities in the support of saturation diving, and what are the priorities for research?

Introduction

There is no doubt that the development of saturation diving over the last 30 to 40 years has been a simple consequence of man's need to work at depth for longer periods of time than are compatible with the maximum safe durations of surface-orientated bounce (there and back) diving. Indeed, after attaining equilibrium between the tensions of respiratory and dissolved gas any prolongation