Deep sea diving

from M. J. Halsey

A new record was recently set at Duke University when three men successfully underwent conditions simulating a dive to a depth of 650m of sea water. This achievement set the background for a recent workshop* on the problems of very deep dives, in the range 460-760m (1500-2500ft).

Fifty years ago men dived using only compressed air but nitrogen narcosis, which increases with increasing partial pressure of the gas, effectively prevented this technique from being used at depth. The subsequent development of helium/oxygen mixtures allowed safe diving to depths beyond 50m, but problems develop when the 450-550m range is reached. At these depths the high pressure neurological syndrome (HPNS), characterised by muscular tremor, disorientation, and short sleep-like periods of loss of attention develops; in animal experiments even higher pressures have been shown to cause convulsions. However, a breakthrough has now been achieved by the discovery that HPNS can be overcome by the use of low partial pressures of anaesthetics. It is this that has lead to new techniques and to new records in deep diving. In experiments with animals, gases with anaesthetic action such as nitrogen or nitrous oxide and low doses of intravenous anaesthetics such as ketamine or althesin have been found effective. Nitrogen deliberately introduced in small quantities into the helium/oxygen breathing mixture was the basis of the trimix which was used in the record chamber dive. This has also been used in the successful open sea dive to 460 m by Comex, S.A. Marseille, which has set a new standard for deep water work.

Current work on a wider pharmacological approach to the problem suggests that selective drugs for HPNS may exist. Structural isomers of some steroid anaesthetics, such as althesin, have been found in animals to continue their action against HPNS even though they no longer have anaesthetic effect.

Additional problems in deep diving include those of temperature control, respiration and decompression. Temperature control is of great concern in working dives because high pressure seems to affect the body's thermoregulatory capacity. Not only is there a narrowing of the limits within which the body can make corrections to mantain a stable temperature but also the subjective experience of heat and cold may become divorced from actual conditions.

Respiration in chamber dives is not a general problem but dyspnoea, exacerbated by exercise, is present. This could become a limitation in future deep dives. The phenomenon appears to be unrelated to gas density but is an aspect of HPNS that is not alleviated by nitrogen. Decompression from deep depths is proving possible although recompression or a change of gas breathing mixture may prove difficult.

Although diving beyond 460 m has now certainly been made possible, and both naval and commercial interests agree there will be a definite need for such dives, it must be remembered that the principles underlying the effects described above are not at all understood. The number of men who have been beyond 300m remains very small; only an understanding of the basic mechanisms involved can ensure that such deep dives can continue in safety. □

*The meeting was held at the Institute of Marine Biomedical Research, Wilmington, N. Carolina and the proceedings will be published as *Techniques for diving deeper than 1500ft* by the Undersea Medical Society, Bethesda, Maryland.

M.J. Halsey is in the HPNS group at the Clinical Research Centre, Harrow, U.K.

(University of Chicago). Over a brief period there were 8 cases of HSV encephalitis at Massachusetts General Hospital, and since this is an extremely rare disease it was inevitably thought that the epidemic was caused by a particularly neurovirulent strain of virus. However, restriction enzyme analyses were made on the genome DNA of viruses isolated from all 8 patients and as the patterns were distinct from each other it was proven that the cases were caused by different virus strains.

The viruses may be particularly dangerous in two situations; infections of the newborn and of the immunosuppressed. CMV may cross the placenta and infect the fetus sometimes causing severe brain damage. HSV may be contracted from the infected genital tract of the mother leaving the fetus with only a 50/50 chance of survival (A.J. Nahmias, Emory University, Atlanta). HSV, CMV and VZV are all common infections of immunosuppressed patients such as those under-going cancer therapy or organ transplantation. The diseases in these patients are often very severe and they are a significant cause of death. There were also suggestions that such diverse conditions as hardening of the arteries and psychotic depression (S. Sprecher, Institut Pasteur du Brabant) and even gastric ulcers (B.F. Vestergaard, Institute of Medical Microbiology, Copenhagen) might be initiated by recurrent HSV infections.

It has long been debated whether herpes viruses are involved in the induction of human cancers. Certainly the association between EBV and Burkitt's Lymphoma is extremely strong, but much less certain is the connection between HSV type 2 and cervical cancer. R.P. Eglin and his colleagues (Institute of Virology, Glasgow) reported some very careful *in situ* hybridization experiments which showed low level expression of HSV-specific RNA sequences in pre-invasive and invasive carcinoma tissues, while two groups reported the induction of cervical carcinomas in animal model systems, W.B. Wentz and colleagues (Case Western Reserve University, Cleveland) using inactivated HSV type 2, and C. Minhui and associates (Hupei Medical College, Wuhan, China) using live virus. A very large prospective study to determine the risks associated with HSV type 2 infections in women is currently underway in Czechoslovakia (V. Vonka and colleagues, Institute of Sera and Vaccines, Prague) involving colposcopy, cytological smears and blood tests on 10,000 women selected at random.

One of the tantalizing questions about herpes viruses is how latent infections are maintained for long periods. What factors are important in the suppression of the infection? This is an area in which very little real progress has been made although it is generally accepted that specific antibodies are important in maintaining HSV latency. However some elegant experiments described by H. Openshaw (University of California, Sacramento) using a mouse model throw considerable doubt on this idea. Latent infections were established in mice which were protected during the primary infection by administration of immune antibody so that their own immune systems were not primed. It was shown in the majority of animals that as the passive antibodies faded the latent infections were maintained.

From the clinical point of view there are two areas which require urgent attention. The clinician would like to be in a position to offer some protection to a patient (e.g. a prospective organ recipient) who he knows will be at risk from these viruses in the immediate future. Such protection could be generated by a suitable vaccine. Secondly he needs effective drugs to control the more serious diseases associated with these viruses. There appear to be encouraging developments in both areas.

The problems associated with assessing the safety of attenuated herpesvirus vaccines are considerable since we have to take into account not only the primary infection but also recurrent disease and the oncogenic potential of these viruses. Attenuated VZV vaccine strains have been developed and are in use in some countries although the prevailing view, expressed by P.A. Brunnel (University of Texas), was that these vaccines should be used only in cases where patients are exposed to serious risk. An attenuated CMV vaccine has also

Graham Darby is in the Department of Pathology, University of Cambridge.

0028-0836/80/19014-01$01.00