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27 Physiological limitations of human performance In hyperbaric environments

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Man has evolved to be able to live and work satisfactorily at one atmosphere absolute pressure and between narrow thermal constraints. The effects on human physiology of exposure to either hyperbaric or hypobaric pressures provide significant limitations to function and to life itself. Indeed It has been inferred that there is no practical working environment with a more severe and complex composite of physiological stresses than that encountered by the modern deep diver in the alien and hostile hyperbaric environment. Every phase of a man's compression, at pressure and decompression has numerous hazards which occur in three main areas: the basic life support systems, the physiological stresses of the special gases and pressure and the special medical factors to individuals who may be living in small confined pressure chambers for as much as 30 days or more and who will require much more time to decompress to surface pressure than it takes an astronaut to return from the surface of the moon.

Life support factors necessary for maintenance of the body within safe physiological limits may include effective communications, correct humidity and temperature, monitoring and control of correct percentages of breathing gases, fire hazards due to high oxygen partial pressures, adequate nutrition and sleep, relaxation activities. showers and toilets. Medical stresses may involve procedures for diver selection with physicals and psychological screening. Infections and common medical and surgical illness can be extremely serious since there IS little information on how drugs behave at increased pressure and surgical procedures are extremely difficult to undertake in such an isolated environment.

However, over and above all these difficulties are the physiological stresses. Most of the life support factors can be controlled by good engineering equipment and knowledge of the limitations imposed by pressure exposure. However, the physiological stresses of very deep diving are less amenable to solution and require careful and continual attention to compression profiles. gas mixtures, and decompression technology - mostly based on empirical data. This is because in spite of much research a clear understanding of the mechanisms and the means for prevention of these stresses remains elusive.

The stresses include oxygen toxicity. nitrogen or inert gas narcosis, respiratory embarrassment, temperature, decompression and post decompression sequalae. Any individual exposed to Pressure is likely to experience more than one and possiblv all in a given exposure.

Yet by understanding the limitations on human performance by these stresses, various means have been developed to elude many of the problems. Thus using a trimix breathing gas (N2/He/02) and slow exponential compression rates over 7 days with stages for pressure adaptation, man has attained a pressure of 68 atmospheres or the equivalent of 2250 ft under the sea and been able to function appropriately and made a safe, if long at 31 days, decompression back to surface pressure.

However, much basic research is still required to understand the mechanisms of these problems so that more effective solutions may be achieved to these physiological limitations to man's exposure to high pressures and thus also to his conquest of the depths of the oceans.