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BRIEF COMMUNICATION

A pilot study of skin disinfection in the hyperbaric environment

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Nichols G, Goad RF, Page B, Lightfoot N. A pilot study of skin disinfection in the hyperbaric environment. Undersea Biomed Res 1981; 8(4):239–243.—An opportunity was taken to carry out a pilot study on human skin disinfection during a recent long-term saturation dive at extremely high pressure. Despite a number of difficulties, results were sufficiently encouraging to suggest that, given ideal conditions, sterilization of the skin in preparation for surgical or anesthetic procedures, or both, in a hyperbaric environment is possible.

sterilization of skin
hyperbaric skin disinfection

General anesthesia using inhalation techniques is fraught with a myriad of difficulties in the high pressure environment (1). Intravenous analgesia may offer an attractive alternative for certain surgical procedures, and this is an area that has attracted recent attention (2). Likewise, local analgesia (particularly peripheral nerve blocks and spinal and epidural analgesia) might logically be considered to have a place in bypassing many of the problems posed by inhalation techniques. Recent animal work suggests that spinal anesthesia could be safely used for surgical procedures that are usually performed under spinal block at surface conditions (3). There is, however, a fear that risk of infection as a result of an altered bacterial flora on the skin of chamber inhabitants during a saturation dive (a possible shift from Gram-positive cocci to Gram-negative bacilli) would mitigate against the use of local techniques (4).

With the foregoing in mind, an opportunity was taken during a recent long-term saturation dive in the high pressure chamber at the Admiralty Marine Technology Establishment, Physiological Laboratory to carry out a pilot study on the feasibility of skin disinfection of subjects under extreme hyperbaric conditions.

TABLE 1

RESULTS OF BACTERIOLOGICAL COLONY COUNTS FROM SUBJECTS A AND B DURING DECOMPRESSION FROM A 660-MSW SATURATION DIVE ON TRIMIX

Day	Colony Count*				Colony Types				Colony Count*		Colony Types	
	Pre-cleansing		Post-cleansing		Pre-cleansing		Post-cleansing		Control Pad 1	Control Pad 2	Control Pad 1	Control Pad 2
	A	B	A	B	A	B	A	B				
1	60	>700	1	1	5	4	1	1	2	1	2	1
2	21	320	2	1	4	4	2	1	1	2	1	2
3	50	240	1	11	4	3	1	3	3	6	1	3
4	28	51	1	21	4	4	1	4	2	0	1	0
5	36	230	1	61	4	4	1	4	0	1	0	1
6	18	95	2	14	4	5	2	2	1	2	1	2

*Final check on all stamp cultures made after incubation for 48 h.

TABLE 2
RESULTS OF BACTERIOLOGICAL COLONY COUNTS FROM THREE SUBJECTS ACTING AS SURFACE CONTROLS

	Colony Count*		Colony Types		Colony Counts*	
Subject	Precleansing	Postcleansing	Precleansing	Postcleansing	Control Pad 1	Control Pad 2
C(L)**	40	1	4	1	0	0
C(R)**	>200 (confluent)	13	5	2		
D(L)	1	0	1	0	0	0
D(R)	8	0	4	0		
E(L)	9	0	3	0	0	0
E(R)	15	0	3	0		

*Final check on all stamp cultures made after incubation for 48 h. **(L) and (R) refer to samples taken to left or right of control subject's lumbosacral spine area.

During October-November 1980 two young male subjects participated in a 660-msw dry chamber pressure exposure on an oxygen-nitrogen-helium gas mixture (trimix). Sampling of the skin flora at pressure was achieved by means of specially constructed wooden "stamps" covered with furnishing velour. These are similar to the stamps used by microbiologists in the "replica plate" technique to demonstrate bacteriostatic and bactericidal action of antibiotics (5). Each man in turn, using sterile techniques, took daily for 6 days a precleansing sample from an area just lateral to the lumbosacral spine; cleansed the area three times with standard circular center-to-periphery wipes; soaked the area for 5 min with gauze sponges saturated with povidone-iodine antiseptic; wiped off the excess liquid with one circular center-to-periphery movement; and finally took a postcleansing sample. Sample pads (stamps) were carefully repacked in a container, the lid was closed, and the container was removed from the main chamber via a small hand lock. Culture plates were inoculated in the laboratory, incubated at 37°C, and examined after 24 and 48 h for evidence of bacterial growth. The 6-day study took place during the mid-decompression phase of the dive, ensuring that the subjects had been confined in the humid, high pressure environment sufficiently long for skin flora patterns to be established. A 3-day surface control trial, using the same pads on different subjects, was carried out for comparative analysis.

Results of bacteriological colony counts from the two subjects and from the surface controls are shown in Tables 1 and 2. Although the present investigation failed to achieve complete sterility of the postcleansing samples, the reduction in colony counts was sufficiently encouraging to suggest that full sterility in the hyperbaric environment must be a possibility. As shown in Table 1, of the 12 control pads taken into the chamber environment, none of which were handled by the subjects, only two were recovered sterile, the remainder having been contaminated during the compression-decompression cycle. It can therefore be argued that some, if not all, of the postcleansing colonies were in fact contaminants derived from the hand lock maneuvers and were not residual on the cleansed skin. In the subsequent surface control trial all control pads were sterile, as demonstrated in Table 2, perhaps reflecting the absence of hand lock maneuvers.

As a result of this pilot study, further investigation to confirm or refute the findings is planned. A number of changes in technique are under consideration, the most important probably being the use of custom-made containers for sterilization and transfer of the samples. While skin disinfection is only one part of an overall plan for handling a patient should a surgical procedure have to be carried out in the hyperbaric situation, it is nonetheless an important consideration that until now has received little attention.

Nichols G, Goad RF, Page B, Lightfoot N. Une étude pilote de désinfection de la peau en environnement hyperbare. Undersea Biomed Res 1981; 8(4): 239–243.—On a récemment eu l'occasion d'effectuer chez l'homme une étude pilote de désinfection de la peau au cours d'une plongée a saturation de longue durée et sous une pression extrêmement élevée. Malgré de nombreuses difficultés, les résultats on été suffisamment encourageants pour suggérer que soit possible, dans des conditions idéales, la stérilisation de la peau pour la mise en oeuvre de techniques chirurgicales ou anesthésiologiques en environnement hyperbare.

stérilisation de la peau
désinfection de la peau en hyperbarie

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