

Prevention of skin problems in saturation diving

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saturation diving
skin problems

prevention
ear problems

Since 1978 the National Undersea Research Center on St. Croix has conducted 100 scientific saturation missions of 7- to 14-days duration in which 515 aquanaut scientists accumulated about 66,500 saturation man-hours. On average, guest scientists spend about 7 h of each day in the water conducting their research. In previous in-water saturation operations, prolonged exposure to open sea water has commonly caused serious dermatologic problems, mostly infections, and some have been severe enough to require abortion of the mission. In our own 11 yr of experience, we have seen remarkably few skin infections, and we attribute this to an aggressive program of preventive medicine. Although we do not dive in grossly contaminated water, it may be possible to apply some of the measures found to be successful in preventing skin infections after prolonged immersions in open sea water to shorter exposures in water contaminated with microbes. Most of the measures are not new or revolutionary.

We use a combined engineering-operations-medical approach, and emphasize the importance of proper skin care to aquanauts during their training. We try to encourage compliance by making proper skin care as simple, convenient, and noninterfering as possible.

[The skin is remarkably well designed to perform its assigned tasks: to keep those things that should be outside the body out, and to keep those things that should be inside the body in. To perform these tasks properly, the skin should be kept clean, dry, and free from breaks.] Our habitat permits maintenance of temperatures within the comfort range for most people; normally it is held between 78° and 82°F and relative humidity is normally held between 65 and 75%. Clean, dry towels and ample hot, fresh water for showers are available.

[The external auditory canal has been the bane of diving medical officers, and has been mentioned as a major medical concern in the after-action reports of most saturation dives. To address this problem, the external auditory canal is cleared of all accumulated cerumen and debris before saturation. Macerated epithelium remain-

ing in the canal serves as a mulch which retains moisture and provides a protein-rich, alkaline culture medium ideal for bacterial growth. Excess cerumen acts as a physical barrier to egress of water from the external auditory canal, and because of cerumen's hydrophobic properties, it forms a meniscus with water, which further impairs proper drainage. We believe that a clean, dry patent external auditory canal is essential before saturation.

After every excursion our aquanauts are advised to lavage the canal with fresh water. Even if all salt water in the canal is drained, a small amount may remain coating the canal. As the water evaporates, salt crystals will remain. Salt is hygroscopic, and therefore will imbibe moisture from air and keep the walls of the canal moist. In circumstances where the water is microbially or chemically contaminated, lavage with clean, fresh water is particularly important. It is important to dry the external ear parts as thoroughly as possible with a clean, dry towel, and the interior of the external auditory canal should be further dried with a flow of heated, dry air; a hair drier works very nicely.

At the end of every diving day the canals are lavaged with specially prepared ear drops, a mixture of alcohol and acetic acid. The alcohol is miscible with any remaining water, which is then drained away with the alcohol and the acetic acid leaves behind a pH of about 5.5, the normal pH of healthy skin. The aquanauts are carefully instructed in the proper technique of instillation, and since the procedure takes only a few seconds, we have achieved good compliance.

Using these procedures, we rarely have to delay an excursion for ear problems and have never had ear problems interfere with scientific productivity. My ear, nose, and throat colleagues warn of the potential hazards of alcohol depleting the cerumen and its protective properties, but in our hands the alcohol-acetic acid solution has almost always prevented acute otitis externa.

Intertriginous areas are affected by infection from bacteria, yeasts, and fungi, and by contact dermatitis due to primary irritants. At the end of every excursion the aquanauts are asked to bathe well with soap and fresh water, dry their skin thoroughly with a clean, dry towel, and don clean, dry, warm clothing. We normally use no other protective measures to prevent infection, and, of course, powders and talcs are not permitted in the habitat.

When a diver spends 3 to 6 h in the water, it is nearly impossible to avoid urinating into the wet suit. If urine and its breakdown products are permitted to remain in the suit, a typical "diaper rash" is common. We recommend frequent and thorough washing of the wet suit bottoms, at least once every other day, using a good detergent, followed by a thorough rinse with fresh water. In addition to reducing the likelihood of a primary irritant dermatitis, this washing reduces the odor of urine in the habitat.

Chafe occurs most commonly on the dorsal surfaces of the toes, behind the knees, in the axillae, along the seams of wet suits, and at the wrists and around the collar line of the wet suit. To prevent chafe, we recommend wearing a full-body leotard. We have seen three benefits: The leotard provides an additional sliding surface, greatly reducing chafe; it makes donning the wet suit much easier, particularly when the suit is wet; and it increases warmth by reducing water movement under the wet suit. We prophylactically put tape on skin areas that have a high probability for chafe, such as the dorsal surface of toes. It is not unusual for our aquanauts to swim 300 m to and from a work site so the skin of the toes takes a terrible beating.

We occasionally see traumatic incisions and lacerations of the skin due to interactions between the scientist and residents of the reef or to careless use of tools or

knives. To manage these injuries so that the scientists can continue their excursion schedules, we clean, debride, and suture the wound as soon as possible after the injury occurs, usually within an hour, and we try for perfect approximation, especially of the stratum germinativum. The wound is left covered, but not occluded, during habitat time. During excursions, the wound is occluded with a petrolatum-base antibiotic ointment. At the end of the excursion, the wound is washed with soap and fresh water and the ointment removed. In most instances, no prophylactic systemic antibiotics are used.

[In conclusion, skin problems can be controlled in saturation diving by cooperation between habitat engineers, operations personnel, the scientist aquanauts, and the medical staff.]