EMERGENCY MEDICAL CARE: IN THE TROPICS

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Diving research at tropical sites offers unique experiences for scientists as they travel more frequently to undiscovered remote reefs and oceans. The emergency medical support of diving research usually consists of a first aid kit. This would probably suffice if everything ran smoothly, but one could encounter a serious situation and not have the "cookbook nor utensils" for emergency use. The Hawaiian Islands have many areas that are remote, with regard to medical aid and transportation. Communicating with people that are experienced and adept at survival in these remote sites has proven beneficial to the UH Diving Safety Program.

INTRODUCTION

The University of Hawaii's Diving Safety Program has had the honor of gaining information from "survivors" in the Hawaiian Islands and Pacific Nations. Many of the treatments and remedies presented will, hopefully, excite and benefit fellow divers responsible for first aid in the field. These anecdotes and remedies were compiled from 1967 to 1988 and many were witnessed and experienced by the author. The author and the University of Hawaii does not guarantee the remedies that are presented.

BACKGROUND

New discoveries in the medical profession are occurring today with researchers seeking wonder drugs with new techniques and technology. Thus, the ultimate first aid kit would be an ambulance containing the latest germ fighting medications and support equipment available with a portable recompression chamber in tow. For practical and economic reasons, the basic first aid kit and knowledge of survival skills should effectively support emergency treatments in the field.

How many times were we told to apply mud or some substance to bee stings? Drinking warmed milk usually relieved stomach aches. Flat '7-Up' or ginger ale is still used as a remedy for an upset stomach and chicken soup is probably widely used as mother's cure- all. Many of these "home remedies" were passed on for generations and are still in use today with satisfying results.

The first emergency medical care incident of the tropics probably occurred hundreds of years ago. A polynesian diver, trying to impress his lady with his expertise in catching fish, dove into a patch of spiny sea urchins. After a painful and noisy exit from the ocean, the diver's lady proceeded to extract the protruding spines. The imbedded spines were then pulverized with a rock found on the beach. This action relieved his sufferings somewhat
and thus the diver could perform his manly duties. Removing sea urchin spines by this method is still used at remote locales.

**IN THE FIELD**

**Preparation at remote site:**

Research conducted in remote areas requires extensive preparation and one cannot anticipate all the problems that may arise. By being mentally aware of survival techniques, local fauna and flora, researchers may prevent minor problems from developing into major ones.

Upon arrival at the remote dive area, researchers should become familiar with the environment. Talk to the knowledgeable medical service providers and local natives for treatments, logistics and communications that are available. Recheck your medical kit. Locate a supply of oxygen to supplement yours if needed during diving emergencies by checking the local hospital, dispensary or a welding source. (Welding oxygen is usually of breathing quality). Make sure that the fittings are compatible with your oxygen rig. Prepare the research group for an emergency "fall-back" plan in the event of communications or logistic support failure.

**Auxiliary support in the field:**

The coconut tree is one of many useful plants used in survival. It provides shelter, fuel (the coconut shell makes good charcoal), nourishment, and a sterile fluid from the nut. These are some of the simple uses. This multipurpose plant can be used in many more ways by being creative and by observing the native uses.

The Kukui nut (Candle nut) tree is also used for many purposes. The sap of the young nut is rubbed in children's mouths as a remedy for thrush (an oral fungus infection, characterized by white eruptions in the mouth). Sap put on skin wounds hastens healing and the leaves are used as a poultice for swellings and infections. The kernels of the nuts are important because of the quality and quantity of oil, which can be used as fuel for lamps.

The breadfruit is a good source of starch and Vitamin B. This food is widely used in Polynesia. Other uses come from the milky sap that sets to become a latex. This is used for certain skin diseases and when gluing or caulking is needed.

**Examples of remote site remedies:**

**Coughing:** Equal parts of honey and whiskey with a few drops of lemon juice.

**Vomiting:** Stop intake for 2 hours. Later try drinking coconut water in increasing amounts. Start with 1 teaspoon and work up to normal intake at 10 minutes intervals. If vomiting persists, stop and start over. If failure occurs after 2 or 3 trials of increasing amounts, intravenous fluids will probably be necessary. Other fluids that may be used are flat 7-Up or ginger ale.

**Itching, generalized:** Sea water immersion gives some symptomatic relief.
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**Sore throat:** Gargle with hot sea water (boil sea water and let cool) or 1 teaspoon of salt in 1 pint of water.

**Anaesthetics, local or systemic:** A large dose of alcohol is most common and usually overused.

**Lacerations:** Tobacco on wound will slow and stop bleeding and usually prevents infection.

You could probably think of numerous other medical situations and ask why yours are not included. These are examples of brief practical approaches to most common complaints, and remind us that often not much can be done in the field.

**A few concerns to be aware of in the field:**

- Rashes; heat, etc.
- Sunburn and heat stroke.
- Ear infections.
- Bruises; *i.e.*: fights with natives. Fractures.
- Potable water.
- Coral Cuts.
- Fish poisoning.
- Dangerous marine life.
- Contaminated air.
- Decompression sickness.
- Food poisoning.
- Insects.
- Animals.

These maladies are not directed toward the tropics, but to list all the cures and cares for them would undoubtedly differ at different locales. Good hygiene with TLC (tender loving care) and common sense can provide the needed help in lots of situations.

**CASE HISTORIES OF FIELD SUPPORT**

**Case #1:**

A spearfisherman had speared a surgeonfish and was preparing to ice it down. In the process, the fish lacerated the diver's foot by flailing its tail and knifing through the top of the diver's fin. A blood vessel was severed and the blood kept spurting. The diver's partner quickly crushed a cigarette, placed it on the wound and wrapped his shirt on the injury. The bleeding stopped. Later, the diver replaced the dressing with a more acceptable one. The healing of the injury was accomplished without any infection or complications.

**Case #2:**

A diver was scouting for fish while being towed by a small boat. He would occasionally dip down to get a better look. During this process, he was towed through a plankton mass and was stung on his back. The diver got back on the boat and began complaining about the reaction to the stings. He asked his diving buddy to apply urine to his back. Once applied, the diver indicated relief and continued diving.
DIVING ACCIDENT MANAGEMENT

Diving research conducted in remote areas usually requires conservative depth-time profiles. Guidelines usually recommend staying well within the US Navy's "no-decompression" limits, or by using more conservative tables, and using "out-gassing" stops. Safety precautions are abundant and they might work, but bends symptoms have occurred following a single "safe" dive and/or after repetitive dives with "safe" surface intervals and bottom times. Scientific divers have a good safety record, but as in Murphy's Law, "If everything appears to be going well, something has been overlooked" and "Nature always sides with the hidden flaw". The unexpected diving injuries need immediate treatment.

The University of Hawaii's Diving Safety Program strongly emphasizes the use of surface and/or in-water air and oxygen breathing as an immediate treatment for decompression injuries. This recommendation developed after researching the practices of Hawaii's diving fishermen and reviewing the "Underwater Oxygen Treatment Of Decompression Sickness" developed by the Royal Australian Navy School of Underwater Medicine, as printed in "Diving And Subaquatic Medicine", by Edmonds, Lowry, and Pennefather.

Immediate, surface oxygen treatment has proven to be of great benefit to many stages of decompression sicknesses. This practice is cited in many texts and has also been experienced by the author. The ultimate goal is to deliver 100% oxygen to the victim. This can only be accomplished with a tight sealing oronasal mask.

Case Histories of surface oxygen treatments:

Case #1:
A diver with an unknown diving profile returned from peddling his catch. He was sitting in a garage of a dive shop sipping a beer when he noticed a type of "girdle effect" symptom developing, which began as a lower back pain, radiating towards the belly. After consuming a beer, he alerted his dive companions of his symptoms. He was placed on surface oxygen via an oronasal (SCOTT duo-seal) mask. Forty minutes of oxygen breathing and the victim stated that his symptoms had disappeared and continued with his social drinking. Some three hours later the diver had a return of symptoms. He proceeded to the local fire station and breathed their emergency oxygen for one hour and later went to sleep at the station symptom free.

Case #2:
A diving fisherman completed his normal four dives for the day. These dives were at a remote site with about a three hour travel time to home and the treatment center. Fifteen minutes from the dive site, the diver noticed that his left facial muscles were not functioning properly. This symptom was similar to "Bell's Palsy". The boat pilot realized that the diver had a problem and quickly assembled the surface oxygen system and started treatment. Thirty minutes later, the patient had complete facial functions and did not experience any residual symptoms.

Case #3:
A male diver made a dive to 110 feet and his bottom time was stated to be within 20 minutes. Upon surfacing, the diver started to lose lower limb coordination and began having muscular spasms. Realizing that he had symptoms of severe CNS bends, the diver donned the mask of his free-flow oxygen system. (This system is designed for non-diving support and does not have a tight fitting oronasal mask nor a sufficient oxygen supply). The diver gained some relief after about fifteen minutes of breathing, even with the limited
system. He felt he was improving and disregarded suggestions to seek further treatment. Four hours post dive, the diver could not move below the waist. He was treated in a recompression chamber and had some muscular function return, but is still considered a paraplegic.

Case Histories of In-Water Air and/or Oxygen Treatment:

Case #1:

A diving fisherman developed CNS bends symptoms while netting fish. His symptoms were geometric patterns in his vision, changing color patterns like a kaleidoscope, and some tunnel vision. He had experienced these symptoms before and knew that he was "hit" with the bends.

The diver first surfaced, got another SCUBA cylinder and descended to about 100 fsw. His symptoms started decreasing after about 5 to 7 minutes, thus he started a slow ascent to 60 fsw and decompressed until his air supply dropped to about 600 psi. He then started breathing from an in-water O₂ system and slowly ascended to 30 fsw and "outgassed" for about 50 minutes. After slowly ascending to the surface, the diver climbed into the boat, cold and tired, but symptom free. Breathing more oxygen on the surface as a prophylactic, he didn't experience any reoccurring or residual symptoms.

Case #2:

Four fishermen divers were working in pairs at a site about 165 to 180 feet deep. Each pair alternated diving and made two dives at the site. Both divers of the second pair rapidly developed signs and symptoms of severe CNS decompression sickness upon surfacing from their second dive. The boat pilot and other diver, decided to take both victims to the U.S. Navy recompression chamber and headed for the dock some 30 minutes away. During transport, one victim refused to go and elected to undergo in-water recompression, breathing air. He took two full scuba tanks, told the boat driver to come back and pick him up after transporting the other bends victim to the chamber, and rolled over the side of the boat down to a depth of 30 to 40 feet. The boat crew returned after 2 hours to pick him up. He was asymptomatic and apparently cured of the disease. The other diver died of severe decompression sickness in the Med-Evac helicopter enroute to the recompression chamber.

FLYING AFTER DIVING

There are many guidelines concerning flying after diving. This subject is becoming more apparent due to the incidences of aircraft losing pressure while at altitude. The University of Hawaii's Diving Safety Program recommends that following "no decompression" dives, there should be a 24-hour minimum surface interval before flying. In the event of completing a decompression dive or bends treatment, there should be a 48-hour minimum surface time before becoming airborne.

MEDICAL TRANSPORTATION

The decision to transport a patient, either to a distant hospital or dispensary where more help may be available, or to a far-away facility hundreds or thousands of miles and dollars away, is one of the hardest clinical choices you may ever face. It may be a serious illness or injury with deterioration, perhaps, and you are present as the decision maker. "Should we wait a little longer...the medication might work, or time may heal and all will be well," or should we choose an uncomfortable, tiring, possibly very dangerous journey
to questionably better facilities? What can really be gained by evacuation? How is the weather? What does the patient want to do? Medical, logistical, ethical and professional questions run through your mind and you will decide what to do. Share the decision if at all possible, with party members or anyone in authority. Guarantee nothing, but give of your best judgment. No one can do more.

CONCLUSION

Emergency medical care can and should be prepared for, by having a good foundation in first-aid, CPR and an understanding of the use of plants, lore and survival techniques. Common sense is used in many survival situations and heroic decisions must sometimes be made. The choice of treatment depends on the seriousness of the injury, the availability of supplies, transport, and time and distance relationships. THE INITIAL TREATMENT CARRIED OUT ON SITE WILL INFLUENCE SUBSEQUENT MANAGEMENT. Expeditions can be successful in treating medical problems. Have good communication and dive safely.

APPENDIX I

UH DIVING SAFETY PROGRAM SURFACE OXYGEN SYSTEM INSTRUCTIONS.

UNIVERSITY OF HAWAII
ENVIRONMENTAL HEALTH AND SAFETY OFFICE
DIVING SAFETY PROGRAM

DIVER'S EMERGENCY OXYGEN

TO USE:

1. Unscrew case cap.
2. Uncoil hose.
3. Attach mask.
4. Turn On oxygen slowly with attached handle.
5. Apply mask to patient and check for good seal.
6. Record time (important).
7. Keep constant attention on patient's mask seal.
8. Be aware of patient's symptoms....record.

NOTE: KEEP PATIENT ON OXYGEN EVEN IF THEIR SYMPTOMS GO AWAY (at least 40 minutes after relief of symptoms, if possible).

9. Contact the UH Hyperbaric Treatment Center (HTC).
   PHONE: (808) 523-9155 or nearest medical facility.
10. Follow instructions from medical personnel.

TO SECURE:

1. Turn Off oxygen with attached handle.
2. Detach mask and clean with a mild detergent.
3. Rinse well with water.
4. Restore in case.
5. Attach a tape with date of usage.

APPENDIX II

UH DIVING SAFETY PROGRAM IN-WATER OXYGEN SYSTEM INSTRUCTIONS

UNIVERSITY OF HAWAI'I
DIVING SAFETY PROGRAM

DIVER'S EMERGENCY IN-WATER OXYGEN SYSTEM

Use of Diver's Emergency Oxygen System

NOTE:

The use of in-water oxygen breathing is designed for the emergency treatment of acute decompression sickness and/or air embolism and is not to be used in place of definitive therapy as provided by qualified BENDS Treatment Facilities.

It should be appreciated that this in-water treatment may require a period of time remaining underwater for the patient and tenders, of three hours or more, so that protection against cold (wet suits) and a weighted staging line should be provided for the comfort of the Patient.

PROCEDURE:

1. The Patient breathes 100% oxygen while the in-water oxygen rig is being deployed.

2. Immediately after initiation of emergency oxygen treatment, if possible, establish contact with a responsible diving officer for advice and guidance, i.e. The University of Hawaii's Hyperbaric Treatment Center. Phone: (808) 523-9155. UH Diving Safety Officer: Edwin M. Hayashi Phone: (808) 948-8660 during normal working hours and (808) 737-4809 after hours.

3. The Patient is lowered from the boat on a line to a depth of 30 fsw while breathing 100% oxygen.

4. The Patient breathes oxygen at the 30 fsw depth until relief of signs and symptoms occurs and for an additional 30 minutes, if possible.

5. The Patient is then decompressed to the surface at a rate, not to exceed 2 feet per minute (very slow).

6. Upon reaching the surface, the Patient continues to breathe 100% oxygen while an assessment of his/her condition is performed and for, at least, an additional 30 minutes after signs and symptoms of decompression and/or air embolism have disappeared.

7. A safety diver breathing air should be in attendance with the Patient for the first period of treatment, at least until symptoms are relieved and continuously until the
patient surfaces if no communication to the Patient is available. If surface-to-Patient communication is available and understandable, then the tending diver may keep in contact visually from the surface with frequent dives to the Patient to assure that progress and comfort are satisfactory.

8. Divers and team leaders should be aware of the fact that 100% oxygen breathing may cause convulsions at 33 fsw and deeper with certain time durations. Although breathing oxygen at 30 fsw is accepted as a safe practice, consideration should be given to the possibility that the Patient may experience toxicity symptoms at which time this treatment depth should be decreased to 20 fsw. If symptoms persist at 20 fsw, then in-water oxygen treatment should be discontinued and resumed on the surface.