



Pathology Biology Section – 2003

G43 Determining the Cause of Death and Contributing Factors in Fatal Recreational SCUBA Diving Accidents

James L. Caruso, MD, Office of the Armed Forces Medical Examiner, The Armed Forces Institute of Pathology, Washington, DC*

The goals of this presentation are to provide the forensic community with epidemiological data on diving fatalities and offer guidance and resources for investigating such deaths.

Diving with SCUBA (self-contained underwater breathing apparatus) equipment while breathing compressed air is a popular pastime in the U.S. An average of 90 to 100 recreational diving deaths occur in the U.S. or involve U.S. citizens diving abroad each year. Few medical examiner offices have enough experience with diving related deaths to adequately investigate such cases and errors in reporting the cause of death and contributing factors frequently occur. The goal of this presentation is to provide background data on the epidemiology of fatalities involving recreational divers and to arm the forensic community with some tools and guidance in properly determining the cause of death in such cases.

The Divers Alert Network (DAN) is a diving safety organization affiliated with Duke University Medical Center and located in Durham, North Carolina. DAN collects data on all recreational diving accidents and fatalities that occur in the U.S. or that involve U.S. citizens diving abroad. The information collected includes autopsy reports, investigational reports from law enforcement agencies and the U.S. Coast Guard, witness accounts, newspaper articles, and any other information from contributors involved in the case (e.g., medical treatment personnel, other divers, rescue personnel). Each case is reviewed by DAN staff, which includes individuals with technical diving expertise as well as a physician trained in both diving medicine and pathology. The Divers Alert Network publishes the data, including case reports, in an Annual Review of Diving Accidents and Fatalities. DAN also provides formal consultative services, free of charge, to any medical examiner office or government agency.

The Divers Alert Network fatality database was queried to obtain information on recreational diving deaths that occurred during the period 1989-1998. During that time there were 911 total diving deaths, over 70% involving male divers. Nearly half of all diving related fatalities involved divers age 30 to 49. Autopsies were performed in most, but not all, of the fatalities and in some cases a body was never recovered.

Not surprisingly, the most common cause of death was drowning (59%), though this should be considered a final common pathway in recreational water sports and the circumstances resulting in drowning are far more meaningful from a public health aspect. Other significant causes of death included cardiac events (11%) and arterial gas embolism (9%). Significant contributing factors that resulted in death while diving included running out of air at depth (17.2%), entrapment in a cave or other structure (10.7%), and having a medical problem during the dive (e.g., cardiac event (19%), asthma attack, etc.).

Diving experience varied but many were novices. Nearly half of the deaths involved divers who had made 20 or fewer lifetime dives, though a small, but significant, percentage occurred when the diver was under instruction in a formal training class. A large number of deaths involved divers who were involved in more challenging types of diving, such as cave exploration, wreck penetration, and deep diving. Of the divers who died while involved in these specialty types of dives, only a third had any documented formal training in that type of diving. Many divers in the fatality database were infrequent divers, making only a few dives each year. Diving dogma dictates that one always dives with another diver (the dive buddy). For the fatalities in the database, 40% became separated from their dive buddy during the dive; 14% chose to dive alone and had no assistance available when a problem occurred in the water.

Deaths that involve recreational divers are infrequent but can occur in almost any jurisdiction. For the ten-year period of data used in this report, nearly a third of the fatalities occurred in the southeastern part of the U.S. The states with the greatest number of diving related deaths were Florida, California, and Hawaii. However, a significant number of diving fatalities occurred in New England, the states bordering the Great Lakes, and the Pacific Northwest.

The medical examiner or forensic investigator involved in the investigation of a diving related fatality should either have a solid foundation in diving techniques and underwater physiology or seek expert consultation. To correctly assign a cause and manner of the death, these cases require a thorough investigation of the scene, knowledge of the circumstances surrounding the death (including a detailed history of the dive, if available), professional evaluation of the diving equipment used, and a complete autopsy with proper toxicological studies. Some modification in the autopsy protocol to look for pneumothorax and air embolism are necessary and a carboxyhemoglobin should be part of the standard toxicology for these cases.

Despite being uncommon events, recreational diving fatalities often involve young people with a large number of years of productive life lost and the cases nearly always go to litigation. The importance of a thorough investigation and arriving at accurate conclusions cannot be overstated.

SCUBA Diving, Drowning, Air Embolism