CRITICAL CARE

The care of patients who are experiencing severe health crises-short-lived or prolonged, accidental or anticipated-that require continuous monitoring.

Science and Profession

Critical care is the branch of medicine that provides immediate services, usually on an emergency basis. It also encompasses some forms of ongoing care provided in a hospital setting for patients who are so sick that they are medically unstable and must be monitored constantly. Such patients are at an ongoing high risk for disastrous complications.

Critical care personnel must be specially trained, and standards for training and evaluation in this field have been prepared for physicians, nurses, and other hospital personnel. Approximately 90 percent of hospitals in the United States with fewer than two hundred beds have a single critical care unit, usually called an intensive care unit (ICU). Only 9 percent of these hospitals have a second intensive care facility, typically dedicated solely to the care of heart attack victims. In total, 7 to 8 percent of all hospital beds in the United States are used for intensive care. Because ICU facilities are at a premium and are expensive to operate, patients are transferred to a regular hospital bed as quickly as possible, given the severity of their specific

medical condition. Of the physicians who are certified in critical care, most are anesthesiologists, followed by internists.

Critical care facilities are available in several varieties, providing specialized care to particular patients. The most common type of ICU is for individuals who require care for medical crises. These patients frequently have a short-term condition or disease that can be treated successfully. Others are admitted to a medical ICU for multiple organ system failure. These people are often very sick with conditions that overwhelm even the best available care and equipment. Heart attack victims are often admitted to a coronary ICU, which has specialized equipment for support and resuscitation if needed. Once medically stable, coronary ICU patients are transferred to a regular hospital bed.

Larger hospitals may have an ICU for surgical patients. Typically, these individuals are admitted to the surgical ICU from the operating room after a procedure. In the ICU, they are stabilized while the effects of anesthesia wear off. They, too, are transferred to a normal hospital room as soon as is medically safe. Neonatal ICUs exist in some larger hospitals to provide care for premature and very sick infants. Such infants may stay in neonatal ICUs for extended periods of time (weeks to months) depending on their specific condition. There may also be a pediatric ICU specially designed for very sick children.

Diagnostic and Treatment Techniques

Critical care is synonymous with immediate care: Swift action is required on an emergency basis to sustain or save a life. The most immediate of critical care needs are to establish and maintain a patent airway for ventilation and to maintain sufficient cardiac functioning to provide minimal perfusion or blood supply to critical organs of the body.

Resuscitation is the support of life by external means when the body is unable to maintain itself. Basic life support is for emergency situations and consists of delivering oxygen to the lungs, maintaining an airway, inflating the lungs if necessary, and assisting with circulation. These methods are collectively known as cardiopulmonary resuscitation (CPR). Oxygen can be transferred from one mouth to another by forceful breathing or by the means of pumps and pure oxygen from a container. The airway is commonly maintained by positioning the head and neck so as to extend the chin and open the trachea. It is also possible to make an incision in the trachea, insert a tube, and provide oxygen through the tube. The lungs may be inflated by using the force of exhaled air from one person breathing into another's mouth or by utilizing a machine that inflates the lungs to a precise level and delivers oxygen in accurate, predetermined amounts. When a victim's heart is not working, the circulation of blood is provided by external compression of the chest. This action squeezes the heart between the sternum and the spine, forcing blood into the circulatory system.

Advanced life support includes attempts to restart a nonfunctioning heart. This goal is commonly accomplished by electrical means (defibrillation). The heart is given a

brief shock that is sufficient to start it beating on its own. Drugs can also be used to restore spontaneous circulation in cardiac arrest. Epinephrine (adrenaline) is the most commonly used drug, although sodium bicarbonate is used for some conditions. A heart can be restarted by manual compression. This technique requires direct access to the heart and is limited to situations in which the heart stops beating during a surgical procedure involving the thorax, when the heart is directly accessible.

Prolonged life support is administered after the heart has been restarted and is concerned chiefly with the brain and other organs such as the kidneys that are sensitive to oxygen levels in the blood. Drugs and mechanical ventilation are used to supply oxygen to the lungs. Prolonged life support uses sophisticated technology to deliver oxygenated blood to the organs continuously. The body can be maintained in this manner for long periods of time. Once begun, prolonged life support is continued until the patient regains consciousness or until brain death has been certified by a physician. A patient's state of underlying disease may be determined to be so severe that continuing prolonged life support becomes senseless. The factors entering into a decision to terminate life support are complex and involve a patient's family, the physician, and other professionals.

Individuals who are critically ill must be closely monitored. Many of the advancements in the care of these patients have been attributable to improvements in monitoring. While physiologic measurements cannot replace the clinical impressions of trained professionals, monitoring data often provide objective information that reinforces clinical opinions. More people die from the failure of vital organs than from the direct effects of injury or disease. The most commonly monitored events are vital signs: heart rate, blood pressure, breathing rate, and temperature. These are frequently augmented by electrocardiograms (ECGs or EKGs). Other, more sophisticated electronic methods are available for individuals in intensive care units.

Vital signs are still frequently assessed manually, although machinery is available to accomplish the task. Modern intensive care units are able to store large amounts of data that can be analyzed by computer programs. Data can be transmitted to distant consoles, thus enabling a small number of individuals to monitor several patients simultaneously. Monitoring data can also be displayed on computer screens, allowing more rapid evaluation. Automatic alarms can be used to indicate when bodily functions fall outside predetermined parameters, thus rapidly alerting staff to critical or emergency situations.

Breathing-or, more correctly, ventilation-can be monitored extensively. The volume of inspired air can be adjusted to accommodate different conditions. The amount of oxygen can be changed to compensate for emphysema or other loss of oxygen exchange capacity. The rate of breathing can also be regulated to work in concert with the heart in order to provide maximum benefit to the patient. The effectiveness of pulmonary monitoring is itself monitored by measuring the amount of oxygen in arterial blood. This, too, can be accomplished automatically, with adjustments made by instruments.

Common situations that require critical care are choking, drowning, poisoning, physical trauma, psychological trauma, and environmental disasters.

Choking. Difficulty in either breathing or swallowing is termed choking. The source of the obstruction may be either internal or external. Internal obstructions can result from a foreign body becoming stuck in the mouth (pharynx), throat (esophagus or trachea), or lungs (bronchi). The blockage may be partial or total. A foreign body that is caught in the esophagus will create difficulty in swallowing; one that is caught in the trachea will obstruct breathing. Any foreign body may become lodged and create a blockage. Objects that commonly cause obstructions include teeth (both natural and false), food (especially meat and fish bones), and liquids such as water and blood.

Obstructions can occur externally. Examples of external causes of choking include compression of the larynx or trachea as a result of blunt trauma (a physical blow or other injury sustained in an accident), a penetrating projectile such as a bullet or stick, and toys or small items of food that are swallowed accidentally. An object that becomes stuck in the lungs frequently does not cause an acute shortage of breath, but this situation can lead to aspiration pneumonia, which is extremely difficult to treat.

The symptoms of choking are well known: gagging, coughing, and difficulty in breathing. Pain may or may not be present. Frequently, there is a short episode of difficulty in breathing followed by a period when no symptoms are experienced. The foreign body may be moved aside or pushed deeper into
he body by the victim's initial frantic movements. A foreign body lodged in the esophagus will not interfere with breathing but may cause food or liquids to spill into the trachea and become aspirated; as with an object in the lungs, this usually leads to pneumonia or other serious respiratory conditions.

Drowning. Drowning is defined as the outcome (usually death) of unanticipated immersion into a liquid (usually water). Consciousness is an important determinant of how an individual reacts to immersion in water. A person who is conscious will attempt to escape from the fluid environment, which involves attempts to regain orientation and not to aspirate additional liquids. An unconscious person has none of these defenses and usually dies when the lungs fill rapidly with water. Normal persons can hold their breath for thirty seconds or more. Frequently, this is sufficient time for a victim to escape from immersion in a fluid environment. When a victim exhales just prior to entering water, this time period is not available; indeed, panic frequently develops, and the victim aspirates water.

Most but not all victims of drowning die from aspirating water. Approximately 10 percent of drowning victims die from asphyxia while underwater, possibly because they hold their breath or because the larynx goes into spasms. The brain of the average person can survive without oxygen for about four minutes. After that time, irreversible damage starts to occur; death follows in a matter of minutes. After four minutes, survival is possible but unlikely to be without the permanent impairment of mental functions.

The physical condition of the victim exerts a profound influence on the outcome of a drowning situation. Physically fit persons have a far greater chance of escaping from a drowning environment. Individuals who are in poor condition, who are very weak, or who have disabilities must overcome these conditions when attempting to escape from

a drowning situation; frequently, they are unable to remove themselves and die in the process.

Another physical condition such as exhaustion or a heart attack may also be present. An exhausted person is weak and may not have the physical strength or endurance to escape. A person who experiences a heart attack at the moment of immersion is at a severe disadvantage. If the heart is unable to deliver blood and nutrients to muscles, even a physically fit person is weakened and may be less likely to escape a drowning situation.

The temperature of the water is critical. Immersing the face in cold water (below 20 degrees Celsius or 56 degrees Fahrenheit) initiates a reflex that slows the person's heart rate and shunts blood to the heart and brain, thus delaying irreversible cerebral damage. Immersion in water even colder leads to hypothermia (subnormal body temperature). In the short term, hypothermia reduces the body's consumption of oxygen and allows submersion in water for slightly longer periods of time. There have been reports of survival after immersion of ten minutes in warm water and forty minutes in extremely cold water. Age is also a factor: Younger persons are more likely to tolerate such conditions than older persons.

Poisoning. Whether intentional or accidental, poisoning demands immediate medical care. Intoxication can also initiate a crisis that requires critical care. Alcohol is the most common intoxicant, but a wide range of other substances are accidentally ingested. When an individual is poisoned, the toxic substance must be removed from the body. This removal may be accomplished in a variety of ways and is usually done in a hospital. Supportive care may be needed during the period of acute crisis. The brain, liver, and kidneys are usually at great risk during a toxic crisis; steps must be taken to protect these organs.

Physical trauma. Trauma is the leading cause of death in persons under the age of forty. Motor vehicle accidents alone account for nearly 2 percent of all deaths worldwide. Globally, nearly six million people die each year from accidental or violence-related injury, accounting for nearly 9 percent of total global mortality. The three leading causes of trauma-related deaths are motor vehicle accidents, suicide, and homicide. Trauma is commonly characterized as either blunt or penetrating.

Blunt trauma occurs when an external force is applied to tissue, causing compression or crushing injuries as well as fractures. This force can be applied directly from being hit with an object or indirectly through the forces generated by sudden deceleration. In the latter event, relatively mobile organs or structures continue moving until stopped by adjacent, relatively fixed organs or structures. Any of these injuries can result in extensive internal bleeding. Damage may also cause fluids to be lost from tissues and lead to shock, circulatory collapse, and ultimately death.

The most frequent sources for penetrating wounds are knives and firearms. A knife blade produces a smaller wound; fewer organs are likely to be involved, and adjacent structures are less likely to sustain damage. In contrast, gunshot wounds are more likely to involve multiple tissues and to damage adjacent structures. More energy is

released by a bullet than by a knife. This energy is sufficient to fracture a bone and usually leads to a greater amount of tissue damage.

The wound must be repaired, typically through surgical exploration and suturing. Extensively damaged tissue is removed in a process called debridement. Any visible sources of secondary contamination must also be removed. With both knife and firearm wounds often comes contamination by dirt, clothing, and other debris; this contamination presents a serious threat of infection to the victim and is also a problem for critical care workers. The wound is then covered appropriately, and the victim is given antibiotics to counteract bacteria that may have been introduced with the primary injury.

Psychological trauma. Critical care is often required in situations that lead to psychological stress. Individuals taking drug overdoses require critical supportive care until the drug has been metabolized by or removed from the body. Respiratory support is needed when the drug depresses the portion of the brain that controls breathing. Some drugs cause extreme agitation, which must be controlled by sedation.

Severe trauma to a loved one can initiate a psychological crisis. Psychological support must be provided to the victim; frequently, this is done in a hospital setting. An entire family may require critical care support for brief periods of time in the aftermath of a catastrophe. Severe trauma, disease, or the death of a child may require support by outsiders. Most hospitals have professionals who are trained to provide such support. In addition, people with psychiatric problems sometimes fail to take the medications that control mental illness. Critical care support in a hospital is often needed until these people are restabilized on their medications.

Environmental disasters. The need for psychological support, as well as urgent medical care, is magnified with natural or environmental disasters such as earthquakes, hurricanes, floods, or tornadoes. Environmental disasters seriously disrupt lives and normal services; they can arise with little or no warning. The key to providing critical care in a disaster situation is adequate prior planning.

Responses to disasters occur at three levels: institutional (hospital), local (police, fire, and rescue), and regional (county and state). The plan must be simple and evolve from normal operations; individuals respond best when they are asked to perform tasks with which they are familiar and for which they are trained. The response must integrate all existing sources of emergency medical and supportive services. Those who assume responsibilities for overall management must be well trained and able to adapt to different and rapidly changing conditions that may be encountered. Because no two disasters are ever alike, such flexibility is essential. Summaries of individual duties and responsibilities should be available for all involved individuals. Finally, the disaster plan should be practiced and rehearsed using specific scenarios. Experience is the single best method to ensure competency when a disaster strikes.

Environmental disasters such as earthquakes, hurricanes, floods, or tornadoes cause loss of life and extensive property damage. Essential services such as water, gas, electricity, and telephone communication are often lost. Victims must be provided

food, shelter, and medical care on an immediate basis. Critical care is usually required at the time of the disaster, and the need for support may continue long after the immediate effects of the disaster have been resolved.

Fast Fact

Your heart is about the size of your two hands clasped together. The earth's largest mammal—the blue whale—has a heart that weighs more than 1,500 pounds.

Source: Clevelandclinic.com

Perspective and Prospects

One of the most important issues with regard to critical care is sometimes controversial: when to discontinue life support. Life-support equipment is usually withdrawn as soon as patients are able to function independent of the machinery. These patients continue to recover, are discharged from the hospital, and complete their recovery at home. For some, however, the outcome is not as positive. Machines may be used to assist breathing. For a patient who does not improve, or who deteriorates, there comes a point in time when a decision to stop life support must be made. This is not an easy decision, nor should it be made by a single individual.

The patient's own wishes must be paramount. These wishes, however, must have been clearly communicated while the individual was in good health and had unimpaired thought processes. A patient's family is entitled to provide input in the decision to terminate care, but others are also entitled to provide input: the patient's physician, representatives of the hospital or institution, a representative of the patient's religious faith, and the state.

Medical science has developed criteria for death. The application of these criteria, however, is not uniform. The final decision to terminate life support is frequently a consensus of all the parties mentioned above. When there is a dispute, the courts are often asked to intervene. Extensive disagreements exist concerning the ethics of terminating critical care. It is beyond the scope of this discussion to provide definitive guidelines. This logical extension of critical care may not have a uniform resolution; the values and beliefs of each individual determine the outcome of each situation.

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