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Everett Evans, nuclear war, and the birth of the civilian burn center

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Everett Evans, a civilian burn surgeon, conducted Cold War-era clinical and basic science research that predicted thermal burns as the major injury caused by the explosion of an atomic bomb. In 1947, in anticipation of the civilian casualties that would occur if an atomic bomb was dropped on an American city, he founded the first civilian burn center in the U.S. in Richmond, VA, to provide the necessary large-scale care. He called for training and standardized protocols in burn care, and the establishment of burn centers in strategically located cities throughout the country.

During Operation Ranger, a series of five open-air atomic bomb explosions at the Nevada Test Site in 1951, Evans studied the radiation and heat exposure from a nuclear blast. While acknowledging the undoubted significance of radiation exposure, lacerations, and fractures, Evans saw that nearly all victims exposed to the blast would suffer a flash burn, a new type of injury caused by the sudden exposure to the intense heat of a nuclear blast.

To treat the thousands of injured who would require specialty care of their burns, he envisioned a center to act as a hub for specialized burn care for an entire civilian community. Evans's creation, the modern burn center, was an early product of military-civilian partnership that introduced a new concept in health care delivery, system-based care.

Training and career

Everett Idris Evans (1910–1954) had a productive academic career as a general surgeon and burn specialist at the Medical College of Virginia (MCV) in Richmond from 1942 until his untimely death in 1954 (Figure 1).[1] After receiving MD and PhD degrees from the University of Chicago, he interned at the Pennsylvania Hospital in Philadelphia, began his residency in surgery at MCV in 1939, and spent a research year at the Massachusetts General Hospital. After completing his residency at MCV in 1942, he joined its faculty. He quickly rose in rank and was named professor of surgery and director of the surgical research laboratories at MCV in 1948.[2,3]

1

Evans founded the first civilian burn center in the U.S. in 1947 as a research center studying burn metabolism and the combined effects of thermal and radiation injury as would occur in an atomic bomb attack. As a member of the Committee on Atomic Casualties of the National Research Council and the National Academy of Sciences, he served on committees on blood and blood derivatives and surgery and chaired the subcommittee on burns.[1] He visited Hiroshima in 1947 as a surgical consultant to the Atomic Bomb Casualty Commission, the joint American-Japanese program to study the long term biological and medical effects among the victims of the atomic bomb detonations of 1945.[4] The Medical Research Board of the Department of the Army funded his work on the stress response in severely burned patients, fluid resuscitation, and the treatment of burn shock.[5-8]

Operation Ranger

Evans saw that primary morbidity from an atomic blast would be thermal injury (Figure 2).[9,10] He investigated the interaction of radiation and thermal burns on animals, human volunteers, and his patients at MCV. "[Dr Evans was] an excellent clinical surgeon and superb teacher," said Isaac Bigger, chair of the department of surgery at MCV during Evans's time on faculty, "but his greatest interest and forte was in research. ...[His] most important contributions were the result of his unusual ability to organize research projects and to stimulate others to achieve the best work of which they were capable."[1]

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He applied his talent for organized research during Operation Ranger, the series of five atmospheric nuclear blasts carried out in 1951 at the Nevada Proving Ground (Figure 3). With William Ham, a physicist at MCV, Evans and his research team studied the biological and medical effects of atomic blasts.[11] Film badges, fabrics, and other material and instruments measured radiation and temperature exposures at different distances from Ground Zero. He found that approximately 20 percent of the energy released by an atomic blast was the instantaneous exposure to intense heat such that "evasive action by exposed personnel would be difficult, if not impossible."[12]

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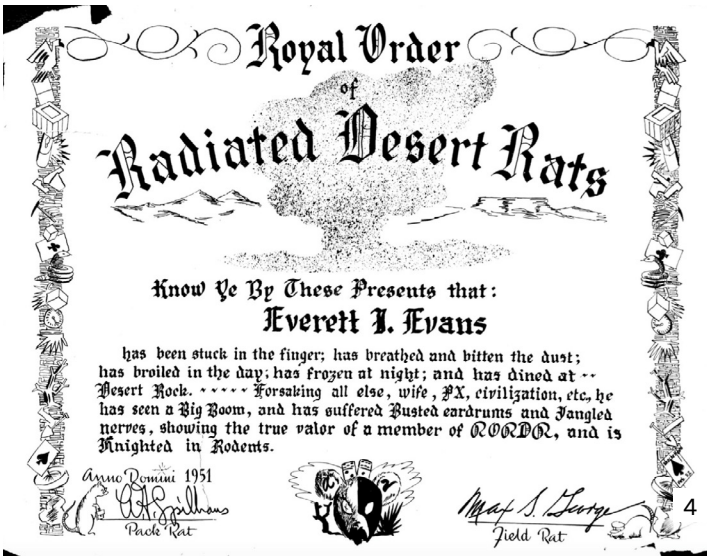
The phenomenon was given the apt term "flash burn." Evans found that the heat from a 24-inch Army searchlight approximated the injury caused by an atomic blast, a model that he later used on human volunteers.[8] Unprotected skin was more at risk from a flash burn than from clothing catching fire. Cotton and wool, especially worn as multiple layers, were protective, but the material used to make Army ponchos posed a special hazard. Their report stressed the protective effect of a simple foxhole from the combined effects of flash burn injury and radiation. Taking cover in a four-foot-deep foxhole reduced radiation energy exposures 25-fold.[12]

In addition to official recognition for his work from the Surgeon General, Evans also later received a tongue-in-cheek award from his colleagues at the test site: membership in the "Royal Order of Radiated Desert Rats" (Figure 4).


Royal Order
of
Radiated Desert Rats

Know Ye By These Presents that:
Everett I. Evans
has been stuck in the finger; has breathed and bitten the dust; has broiled in the day; has frozen at night; and has dined at -- Desert Rock. ----- Forsaking all else, wife, PX, civilization, etc., he has seen a Big Boom, and has suffered Busted eardrums and Jangled nerves, showing the true valor of a member of RORDR, and is Knighted in Rodents.

Anno Domini 1951
Pack Rat
Field Rat

4

The civilian burn center

The utter destruction of Hiroshima and Nagasaki in August 1945 sparked dozens of articles that appeared in professional journals and the lay press that speculated the consequences of similar blasts on American cities. In 1947 Herman Pearse and J. Thomas Payne of the University of Rochester predicted that thermal injury would be the "largest and most important category (numerically) of atomic-bomb injury [with] 90 percent of all persons requiring medical attention in the first week [following a blast] will have burns, and 60 to 85 percent of all patients will be burned."[13]

The tragic images from Japan became more horrifying and immediate when President Truman announced the successful detonation of a Soviet nuclear bomb in September 1949. Within months Evans published the first of two influential articles in the *Journal of the American Medical Association*.[9,10] While the hazard of gamma and neutron radiation was undeniable, he wrote, burn injury would be the predominant priority of the treatment after an atomic bomb explosion on a civilian population.

He summarized in a straight-forward manner the implications of his research. In a city of 250,000, at least several thousand would survive the blast with significant flash burn injury. Lacerations and fractures would certainly occur, as well as the feared early and late effects of radiation. But thermal injuries would be near-universal among those within a roughly 14-square-mile area from 1,500 to 4,000 yards from ground zero.

Few surgeons had expertise in the field, and the public had no knowledge of the simplest methods of burn treatment. He wrote

One can conclude that unless proper training…of large numbers of physicians and/or the public in burn therapy is instituted at once, the handling of large numbers of burn casualties after bomb attack on any of our cities must necessarily end in complete chaos and panic, with the accompanying inexcusable loss of many lives which might have otherwise been saved.[9]

However grim his predictions, Evans felt that those of Pearse and Payne were overly dire because they assumed an "unwarned population (9)." His solution was to prepare for an atomic blast in an American city. Thousands of rescue and first aid workers were needed to be trained in resuscitation, the application of burn dressings, and the initial management of concomitant traumatic injuries.[9]

Evans outlined five priorities of emergency management of the burn patient: (a) relief of pain; (b) emergency dressing; (c) prevention and treatment of burn shock; (d) salt and water requirements to insure adequate urinary output; and (e) the most feasible antibiotic therapy to aid in the prevention of infection. His guidelines reflected his belief that resources and expertise would be limited in a disaster situation. Many of his specific recommendations changed over time, such as the use of closed dressings, in which burn wounds were wrapped in compressive dressing of fine mesh gauze with outer layers of thicker cotton, and left in place for several days without change or debridement.

Resuscitation was another guideline that has undergone many modifications since Evans's articles. He recommended the use of whole blood and plasma transfusions in the early phases of burn shock. Knowing that blood products would not be readily available in the disaster situation, however, he wrote that with burns less than 20 percent body surface area (BSA), "if fluids are taken well by mouth, little or no plasma or blood is necessary."[9] He developed a simplified burn resuscitation formula, subsequently called the Evans formula, which was one of the first to take into account patient weight as well as percent BSA involved in burn injury.[2,3,7]

Evans then introduced the concept of the civilian burn center. "Finally, if bomb attacks are expected," he wrote, "we would be wise to give consideration to the setting up of special burn centers in strategically located cities in the several parts of this country." There surgeons and other trained medical personnel proficient in burn care and resuscitation would provide coordinated treatment of burn shock, and emergency surgery for lacerations, fractures, and blunt and penetrating injuries that would accompany a nuclear blast.[10]

Evans established the first civilian burn center in the U.S. at the Medical College of Virginia in Richmond in 1947, where he conducted his clinical research. Later the same year, the U.S. Army Wound Study Unit at the Halloran General Hospital in Staten Island, NY, was moved to the Brooke General Hospital at Fort Sam Houston in San Antonio, TX, under a new name, the Surgical Research Unit (SRU). While its initial focus was not specifically burn care, the threat of nuclear warfare led to the establishment of the second U.S. burn center at Brooke in 1949.[3] The center was later renamed the U.S. Army Institute for Surgical Research and would become the premier burn research center in the world.

The concept of organized burn care evolved over several decades. With urban growth and industrialization, the country had suffered significant burn disasters in the early 20th century, most notably the Rialto Theater Fire of 1921 in New Haven, CN; the Coconut Grove Fire of 1942 in Boston, MA; and the Texas City, TX, Fire in 1947. Sixty percent of the 500 casualties admitted to Pearl Harbor Naval Hospital after the December 7, 1941, attack involved burns.[3]

Each catastrophe demonstrated the advantages of a dedicated ward with professional staff for burn patients.[14,15] An inquiry into the care of the injured at Pearl Harbor revealed the lack of standardized burn care. In response the National Research Council established a subcommittee on burns in July 1942 with Allen Whipple of New York as its chair. In 1943, Whipple was the first to advocate for organized teams of surgeons, medical specialists, nurses, and orderlies that were "able and willing to stand the stress and strain of caring for severely burned patients."[3]

Evans, who succeeded Whipple as task force chair, expanded the team into a comprehensive system that coordinated the unique and complex needs of burn patients: the burn unit. From the first burn units in Richmond and San Antonio, more than 175 U.S. hospitals have developed specialized burn units. Today more than half of the nation's hospitalized burn patients receive treatment at burn centers.[16] Services provided at modern centers include the treatment of complicated facial and hand burns, the treatment of pediatric burns, and special attention to reintegrating burn patients into productive roles in society through physical and occupational therapy, nutrition, and psychological support. Contributions of burn research centers have added to the understanding of the metabolic response to injury, burn shock, resuscitation, the treatment of inhalation injury and invasive burn wound infection, and the advantages of early excision and grafting of deep burns. The validity of the burn center concept is shown by the decreasing mortality rates for increasingly large surface area burns.[16,17]

Controversy

Nearly a half-century later, Evans's research attracted criticism from Cliff Honicker, a writer specializing in environmental issues. Writing in the *Washington Post*, Honicker claimed that "secret and unethical Cold War experiments were performed," and that Evans failed to apprise people involved in his experiments of the non-therapeutic nature of his tests. Referring to the use of tagged red cell studies in shock and resuscitation, Honicker wrote that the use of radionuclides risked damaging untagged red cells, which he called, "the most chilling part of the experiments." "[Did] Evans knowingly put patients in harm's way?" the writer asked.[18]

The defense of Evans came swiftly from Eugene Trani, professor of history and president of Virginia Commonwealth University, the parent institution of MCV. He set the record straight on the use of radionuclides, at the time a new way of measuring blood volume and the accepted research method to assess fluid and blood replacement needs during burn shock. The patients under study, Traini wrote, were severely ill and if they died, it was almost certainly from the severe burns they had sustained, and not from the nuclide tests. They had verbally consented to the research project, which was the standard at the time. (Federal requirements for institutional review board oversight of human research were established in 1971.)

A separate study involved 44 white students from MCV and 22 black students at Virginia Union University who were subjected to dime-sized searchlight-induced flash burns of varying degrees. Evans and his research team also subjected themselves to the burns, and had undergone considerable personal risk with their field experiments at active nuclear test sites. Trani went on to summarize the scientific and clinical contributions that arose from Evans's research. Moreover, Evans wrote an article on ethics in surgical research in 1950. With regard to Honicker's criticism, Trani wrote that he "misreads the record, misrepresents the work of scientists, and moralizes about past research practices." The university president concluded, "The work of MCV's investigators ... and the former patients of MCV deserve better."[19]

Conclusion

In Bigger's words, Evans's premature death in 1954 at age 44 "brought to close a brief but brilliant career in surgery."[1] Dr Evans' research seeking to understand the impact of an atomic bomb blast led to a model of atomic thermal injury and one of the first formulas for resuscitation based on weight and body surface area burned. He predicted that burn victims would be the principal casualty of nuclear war, and recognized the need for coordinated burn care, which led to the establishment of the country's first civilian burn center in 1947. Never used for a nuclear attack in the U.S., burn centers that came from Evans' work remain integral to the modern system of trauma care.

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Legends

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