

Profiles in Cardiology

Peter Safar: Father of Modern Cardiopulmonary Resuscitation

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Countless numbers of people owe their lives to the quick application of cardiopulmonary resuscitation (CPR). The technique of coupling positive pressure ventilation and external cardiac compression was the result of the work of Peter Safar, who is also credited with the creation of one of the first intensive care units in the United States as well as one of the first paramedic emergency services.¹

Safar was born in Vienna, Austria on April 12, 1924, in a family of physicians (Fig. 1). His father, Karl, was an ophthalmologist and his mother, Vinca, was a pediatrician.² His grandfather was also a medical publisher whose company eventually became the Vienna branch of Springer-Verlag known as Minerva.³ He was destined to become a physician. As the political climate of Europe deteriorated during the 1930s and Vienna was eventually occupied by Nazi Germany in 1938, Safar's parents lost their jobs in medicine, due primarily to his mother's heritage not being "Aryan". Peter was sent off to a Bavarian labor camp, and would have been drafted into the German army had it not been for his tenacity and ingenuity. He had no intention of being drafted and found that if he rubbed tuberculin cream into his eczema sores

they would become inflamed and would immediately be noticed by the examining army physicians.² He was able to thwart being drafted in this way. After avoiding being drafted, he was eventually able to begin medical school in Vienna at the young age of 19, in 1943. His medical education, included caring for patients who had suffered the indignities of war. In 1949, Safar was awarded a surgical fellowship at Yale University and he moved to the United States to accept the opportunity. In 1950, he briefly returned to Vienna to marry Eva, a woman he had met there in 1947.² They returned to the United States where Safar instead completed an Anesthesiology residency at the University of Pennsylvania, a change that resulted from his realization that "surgery would not advance without better life support and you learn life support in anesthesiology."¹ His thorough understanding of anesthesiology led to the idea that the anesthesia techniques used in the operating room could be applied outside that environment. His interest in resuscitation inside and outside the operating room began to grow.¹

Safar and his wife moved to Lima, Peru in 1952 because of visa requirements where he established one of the first academic anesthesiology departments in that country at the National Cancer Hospital. Two years later he returned to the United States where he joined the staff of Johns Hopkins Hospital in Baltimore, Maryland. He encountered resistance there in his efforts to establish a separate department of anesthesia, so he transferred to the Johns Hopkins affiliated Baltimore City Hospital. His efforts to establish his second academic department of anesthesiology was successful there.¹

The next 6 years here as chief of the department were some of Safar's happiest, and most professionally rewarding of his career. He began a number of research projects here that led to his meeting James Elam at the American Society of Anesthesiologists meeting in Kansas City in October of 1956. Safar learned that Elam's research had determined that expired air ventilation via mask or endotracheal tube was capable of maintaining normal blood gases in patients.³ This triggered a series of studies that eventually led to Safar's

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FIG. 1 Peter Safar (1924-2003). Photograph courtesy of the Safar Center for Resuscitation Research, University of Pittsburgh.

now famous paper on mouth to mouth ventilation published in the *Journal of the American Medical Association* in 1958. The paper was the result of his research on anesthetized human volunteers, many of whom were physicians, nurses, and medical students who were ventilated by mouth to mouth technique, and by manual technique (Holger–Nielsen method) using a bell spirometer attached to a mask. Manual ventilation was carried out by rescuers from the Baltimore City Fire Department, and mouth to mouth ventilation was performed by laypersons from the community. The experiment determined that ventilation provided by the mouth-to-mouth method was superior to that of the manual method of Holger and Nielsen. Many feel that the experiment would never have received ethical approval today and that if Safar had come on the scene 40 years later, our approach to providing ventilation during resuscitation would be quite different.³ Safar presented his work at the Scandinavian Society of Anaesthetists meeting in Norway that same year, and one of the anesthesiologists present was Bjorn Lind. Lind happened to know Asmund Laerdal who was a toy maker from Norway. Lind told Laerdal about this new resuscitation technique, and he immediately became interested in meeting Safar. A collaborative effort involving Safar, Lind and Laerdal resulted in the eventual development and production of the now famous resuscitation training manikin known as “Resusci Anne”

in 1960. During this same time period, an electrical engineering professor at Johns Hopkins, William Kouwenhoven and his colleague Guy Knickerbocker had been conducting research on defibrillation in animal models. In the course of this research, they also happened upon the discovery that external compression of the chest was capable of producing a blood pressure pulse in animals. James Jude shortly thereafter conducted human clinical trials that supported the concept of external cardiac compression for maintaining blood flow during cardiac arrest.^{4,5} Safar then combined the techniques of establishing the airway, applying mouth-to-mouth ventilation and external cardiac compression.³ This led to his development of the “ABC’s of Cardiopulmonary Resuscitation” (airway, breathing, and circulation).

In 1961, Safar’s desire to create a department of anesthesiology at a major university was realized when he was offered the opportunity to become chair of the department at the University of Pittsburgh. Here he established one of the world’s first critical care medicine programs and one of the first multidisciplinary intensive care units. His interest in providing CPR outside the hospital environment grew even stronger after the tragic death of his daughter from a severe asthma attack at the age 12. His continued work eventually led to the development of one of the first paramedic teams when he established the Freedom House Enterprise Ambulance Service, employing residents of Pittsburgh’s inner city community.² He was commissioned to write a CPR instructor manual by the World Federation of Societies of Anaesthesiologists in 1968. This later evolved into the well known textbook *Cardiopulmonary Cerebral Resuscitation*, which he published with Nicholas Bircher in 1988.⁶ After years of tireless work as chair of the department, Safar decided to relinquish the position in 1978, and concentrate on his research. In recognition of his service and contributions to the institution, the University of Pittsburgh appointed him as Distinguished Professor of Resuscitation Medicine.⁶ One year later, he established the International Resuscitation Research Center (IRRC) in Pittsburgh where he continued his research focusing on brain resuscitation, using various animal models including monkeys and dogs. His work there resulted in a strong foundation of scientific knowledge in areas such as cardiopulmonary bypass, hypertensive fluid infusion, and the effects of induced hypothermia to improve cerebral outcome after cardiac arrest.⁶ He retired as head of the IRRC in 1994, and soon after the institute was renamed the Safar Centre for Resuscitation Research in his honor. He was also honored by the University of Pittsburgh when the chairmanship of the department of anesthesiology was renamed by Leonard Firestone in 1996 as the “Peter and Eva Safar Chairman of Anesthesiology and Critical Care Medicine”.⁶

Safar’s later years were spent speaking at conferences, writing manuscripts, and working at the Safar Centre for Resuscitation Research until his death from cancer on

August 3, 2003, at the age of 79. He was survived by his wife, his sons, and five grandchildren. His life was one of tremendous accomplishment and personal fulfillment, and he made the most of each day until its end. His legacy included 384 peer reviewed articles, more than 30 books and manuals, and over 600 abstracts: a truly impressive body of work.⁷

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