

# Historical Perspectives in Critical Care Medicine: Blood Transfusion, Intravenous Fluids, Inotropes/Vasopressors, and Antibiotics

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## KEYWORDS

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- Anti-bacterial agents • Vasoconstrictor agents
- Infusions • Intravenous

The field of Critical Care Medicine is now recognized as a distinct and essential medical specialty, providing care to those who are most severely ill and who need intensive monitoring. Key therapeutic advances in medicine, such as mechanical ventilation and invasive hemodynamic monitoring, have geographically defined the specialty within a hospital setting, but the needs of critically ill patients go beyond the walls of the intensive care unit (ICU). Though the need to care for seriously ill patients has been constant throughout time, the ability to fully appreciate the needs of the most critically ill and the capacity to provide meaningful care are recent advances in the history of medicine.

Significant progress in critical care medicine has been the result of tireless observation, dedicated research, and well-timed serendipity. This article provides a historical perspective for four meaningful therapies in critical care medicine: blood transfusion, fluid resuscitation, vasopressor/inotropic support, and antibiotics. For each therapy,

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key discoveries and events that have shaped medical history and helped define current practice are discussed. Prominent medical and social pressures that have catalyzed research and innovation in each domain are also addressed, as well as current and future challenges.

### HISTORY OF BLOOD TRANSFUSION IN CRITICAL ILLNESS

The transfusion of blood and blood components is a relatively recent practice in the history of medicine, but man's fascination with blood dates back to before the common era. Blood was revered by the Greeks as one of four essential humors, and was thought to contain a person's vital essence according to Romans.<sup>1</sup> Believed to have mercurial powers, blood was drained to expunge evil and transfused to soothe mental illness. Rooted in our understanding of physiology and perfected by war, blood transfusions are now routine practice among the critically ill and are administered to 42% to 50% of patients during the course of an ICU admission.<sup>2,3</sup> Expensive and not without risk, blood transfusions are nonetheless an indispensable therapy administered to millions of patients per year.

Venesection, or blood letting, was widely practiced from the time of Hippocrates into the nineteenth century; however, transfusion only gained acceptance as a necessary medical therapy in the last 100 years.<sup>1</sup> The transfusion of blood first required a working knowledge of anatomy and circulation, credited to the British physician William Harvey in 1628.<sup>4</sup> Direct transfusion between two animals was reported by Richard Lower (Oxford) in 1665 and, ironically, though Lower successfully resuscitated hypovolemic dogs, blood transfusions would not be used to treat hemorrhage for more than 150 years. In 1667, Jean-Baptiste Denis (France), published his experience with transfusion of lamb's blood to a human being (**Fig. 1**).<sup>4</sup> The indication in this case was mental illness, with the idea that the blood of a docile animal would impart calm when administered to the deranged.<sup>1</sup>

Blood transfusion in the sixteenth century was controversial and poor outcomes prompted bans on the practice. Bans were imposed by the British Royal Society (1668), the French Government, and the Vatican in 1669.<sup>5</sup> Significant progress did not occur until 1795, when Philip Syng Physick suggested human-to-human transfusion.<sup>5</sup> It was not until 1818 that James Blundell, a London obstetrician, reported the first human-to-human transfusion to treat postpartum hemorrhage. At the time, Blundell knew nothing of human blood groups or aseptic technique; successes were frequent enough to encourage the operation's continued use, while failures were attributed to clotted blood or to the hopeless state of the patient.<sup>6</sup>

Karl Landsteiner (Vienna) transformed the practice of transfusion with his discovery of the ABO blood antigen system in 1901—a discovery for which he would later receive the Nobel Prize for Medicine and Physiology. Landsteiner carefully observed that serum from some individuals would cause clumping of reds cells isolated from other patients. The next defining event in the evolution of transfusion occurred in 1915, when Richard Lewinsohn (Mt. Sinai Hospital, NY) showed that a 0.2% solution of sodium citrate could safely anticoagulate collected blood.<sup>1</sup> The following year, the addition of dextrose was shown to reduce hemolysis of blood that was stored for 2 weeks.<sup>7</sup> These advances meant that the physical presence of a live donor was no longer a requirement. Red cell viability and storage would be later optimized and prolonged with cold storage and the addition of phosphate. As the world prepared for World War I, the practice of blood transfusion gained in popularity throughout America. British physicians, however, were more interested in the merits of saline as a blood alternative.

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