

Introduction to Extracorporeal Circulation in Theory and Practice

Among the greatest advances in healthcare that have led to an unprecedented increase in life expectancy in the 20th century is the development and mass production of the extracorporeal circulation machine. This complex device is capable of supporting end organ function for extended periods of time, permitting the surgeon to repair previously lethal heart and vascular defects. This accomplishment was a culmination of a series of events that enabled the development of the technology, as well as its manufacturing at a scale and cost that would permit application worldwide. While it is tempting to ascribe any one event as seminal in its development, such as Ludwig Rehn's successful suture of a right ventricular stab wound, McLean and Howell's discovery of heparin in 1916, and the use of protamine to neutralize heparin in vivo in 1939, it is John H. Gibbon in 1953 who is credited with the first successful use of this technology to repair a heart defect under direct visualization. As with many advances in the field of cardiac surgery, the initial efforts were fraught with difficulties and complications, which in Gibbon's case resulted in his abandonment of the technology. Fortunately, others, such as Richard de Wall, who refined the bubble oxygenator, and John Kirklin, who simplified the pump and circuit, took up the efforts and overcame the many hurdles they faced.

Since the early days of the roller pump and bubble oxygenator, a steady stream of technologic innovations has resulted in advances not only in extracorporeal circulation technologies and methods, but also in adjunct technologies such as medical devices and implants, including heart valves, blood vessel substitutes, and pacemakers, to name just a few. In parallel, research work to understand the effect of extracorporeal circulation on the body's end-organs, coagulation, and immune system has led to further refinements in the components of the circuit as well as the techniques for managing perfusion. Currently the science and practice of extracorporeal circulation spans the medical fields of anatomy, physiology, endocrinology, immunology and coagulation, as well as the function of individual organs including heart, lungs, brain, kidneys, liver, and pancreas. Extracorporeal circulation also spans the engineering fields of fluid mechanics, materials science, electronics, and an increasing role for computer science and data analysis. Indeed, to

completely cover all aspects of extracorporeal circulation, particularly the many applications in a wide variety of therapies, would require a multivolume text.

The current edition of *Extracorporeal Circulation in Theory and Practice*, edited by Tschaut, Rosenthal, Hodge, and Dreher, offers a masterful balance of the basic science and theory behind current technology and current methods of perfusion, its benefits and complications. The text begins with a review of the advances in extracorporeal circulation, followed by an introduction to the relevant anatomy and physiology of the cardiovascular system, and hematologic response to external perfusion.

A review of the more common surgical procedures on the heart and great vessels is followed by an introduction to trans-catheter techniques that are rapidly becoming an integral part of cardiovascular therapy.

The next four sections cover fundamental principles in the science of extracorporeal circulation as well as core engineering concepts that explain how mechanical perfusion is achieved and gas exchange controlled in current circuits. Practical aspects of perfusion are also covered such as cannulation techniques and devices and management of the circuit, along with myocardial protection methods.

The subsequent sections address specific aspects of extracorporeal circulation such as mechanical circulatory assistance, complications of bypass, special techniques for organ perfusion and methods for long-term support. The final sections cover the frontiers of the cardiovascular field.

To cover these diverse topics, the editors have gathered an impressive and long list of experts in the specific fields, representing institutions from Europe and North America. This text offers a comprehensive and up to date source of information for the student as well as the experienced professional in the fields of perfusion, cardiovascular surgery, transplantation, anesthesia, intensive care, and cardiac nursing.

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