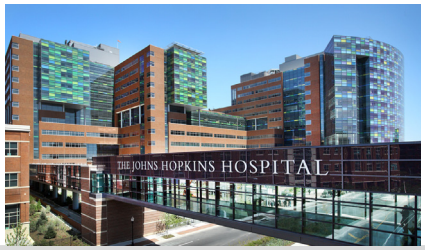
The History of Heart Surgery at The Johns Hopkins Hospital

Nishant D. Patel, MD, Diane E. Alejo, BA, and Duke E. Cameron, MD

Johns Hopkins has made many lasting contributions to cardiac surgery, including the discovery of heparin and the Blalock-Taussig Shunt, which represents the dawn of modern cardiac surgery. Equally important, Johns Hopkins has trained some of the world's leaders in academic cardiac surgery, and is committed to training the future leaders in our specialty.

Semin Thoracic Surg 27:341–352 © 2015 Published by Elsevier Inc.

Keywords: Cardiac surgery, training, research, clinical care



Johns Hopkins Hospital

Central Message

Johns Hopkins has a storied past and continues its steadfast dedication to research and innovation, providing excellent clinical care, and training the next generation of leaders in academic cardiac surgery.

HISTORY OF JOHNS HOPKINS

Johns Hopkins (Fig. 1) was born on May 19, 1795 in Anne Arundel County, MD, as the 2nd of 11 children of a tobacco farmer. At an early age, young Johns (his great-grandmother's maiden name) moved to Baltimore to help his uncle run a wholesale grocery store. He eventually started his own business, Hopkins Brothers, where he sold tobacco, corn, and whiskey. As his business grew more successful, Johns Hopkins shifted his interest toward lending money and banking. He served as president of the Merchants National Bank of Baltimore, and director of the First National, Mechanics' Central, National Union, Citizens', and the Farmers and Planters' banks. He also served as director of the Baltimore and Ohio Railroad, which he saved from financial ruin on 2 separate occasions. In his later years, he began to look for ways to bequeath his enormous wealth. By 1867, Johns Hopkins had arranged for a $7 million gift (a value of $11 billion in today's dollars) to create a hospital linked to a medical school, and both part of a university. This radical idea became the model for all academic institutions in the United States and is stated explicitly in his letter[1] to the newly formed board:

> It is my wish that the plan … shall provide for a hospital, which shall, in construction and arrangement, compare favorably with any institution of like character in this country or in Europe … In all your arrangements in relation to the hospital, you will bear constantly in mind that it is my wish and purpose that the institution should ultimately form a part of the medical school of that university for which I have made ample provision by my will…

The Johns Hopkins Hospital opened in 1889 (Fig. 2), and the School of Medicine followed 4 years later. Before the opening of the School of Medicine, most medical students in the United States were taught in "trade schools." Johns Hopkins radically transformed medical education by establishing rigid entrance requirements, formalizing a curriculum based on the scientific method, incorporating bedside teaching and research, and creating standardized postgraduate training models. It was also among the first medical schools to admit women.

Johns Hopkins Hospital opened its doors under the auspices of the "Big Four": William Welch, pathologist and dean of the school of medicine; William Stewart Halsted, surgeon-in-chief; William Osler, physician-in-chief and chair of medicine; and Howard Kelly, gynecologist and obstetrician (Fig. 3). All 4 contributed substantially to the innovation and prowess of the newly formed institution. Halsted's legacy was marked by meticulous attention to surgical technique, use of gloves, and contributions to general surgery, gastrointestinal surgery, endocrine surgery, and residency training that arguably make him the most influential surgeon in American history.[2] It was within the scope of Johns Hopkins' original vision and on the shoulders of the Big Four that Johns Hopkins Cardiac Surgery was born and flourished.

JOHNS HOPKINS CONTRIBUTIONS TO CARDIAC SURGERY

The Discovery of Heparin

Heparin was discovered in 1916 by a Johns Hopkins medical student, Jay McLean.[3] At the time, McLean was working in the physiology laboratory of William Henry Howell. Howell's interest was in substances that could promote coagulation, as bleeding was

Division of Cardiac Surgery, Department of Surgery, The Johns Hopkins Medical Institutions, Baltimore, Maryland

Address reprint requests to Duke Cameron, MD, Division of Cardiac Surgery, Zayed 7107, The Johns Hopkins Hospital, 1800 Orleans St, Baltimore, Maryland 21287. E-mail: dcameron@jhmi.edu

Figure 1. Johns Hopkins by Thomas C. Corner, 1896, Oil on canvas. Courtesy of The Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions. Photograph by Aaron Levin.

the dominant issue in surgical practice at the time. He believed that cephalin from platelets and leukocytes neutralized antithrombin, which permitted activation of prothrombin by calcium.

McLean joined Howell's laboratory and was tasked to purify cephalin preparations to prove that cephalin, and not a contaminant, was responsible for procoagulant activity. In the course of that work, McLean began extracting fat-soluble compounds (phosphatides) from canine liver and heart to test their procoagulant activity. Surprisingly, McLean found that these substances harbored anticoagulant properties. In the summer of 1916, he injected one of the isolated phosphatides into a dog and observed excessive bleeding from an incision made in the animal. In 1922, Howell introduced the aqueous extraction protocol for isolating heparin, which led to commercial production of heparin by a local pharmaceutical company in Baltimore. Before the 1940s, many credited Howell for the discovery of heparin. McLean, upset that his contribution was not adequately recognized, began a campaign claiming he had discovered heparin, and was ultimately successful.

Cardiopulmonary Resuscitation and the Cardiac Defibrillator

Life in the United States changed dramatically in the 1920s as electricity provided many conveniences to homes. Electric companies scrambled to install power lines but many utility workers suffered sudden death from electrocution. Edison Electric provided research funding to William Kowenhoven, a professor of electrical engineering at Johns Hopkins, to study the nature of ventricular fibrillation and its possible treatment. He conducted experiments in rats that showed that high voltage currents led to cardiac arrest, and later in dog experiments, that currents applied to the heart externally could restore the heartbeat. By 1957, he developed an external defibrillator, which consisted of a small box and 2 insulated cables with copper electrodes, which was used in the hospital for clinical cardiac arrest (Fig. 4).

Guy Knickerbocker, a graduate student in electrical engineering working in Kouwenhoven's laboratory, noticed that an animal's blood pressure rose every time he pressed down on the electrodes on the chest. This observation was critical to the development of closed chest compressions in cardiopulmonary resuscitation, and was described in their 1960 landmark article in the Journal of the American Medical Association:

> With the patient in the supine position, preferably on a rigid support, the heel of one hand with the other on top of it is placed on

Figure 2. Billings Administration Building— Johns Hopkins Hospital, ca 1889. Photographer unknown.