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POSTERS

Bulletin of the Surgical History Group

Papers from the 2016 Poster Competition

SURGICAL
HISTORY GROUP

AMERICAN COLLEGE OF SURGEONS
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Clinical Congress 2016. Washington, DC

J. Patrick O'Leary, MD, FACS,
POSTER COMPETITION CHAIR

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Acknowledgements

The activities of the Surgical History Group (SHG) are possible only because of the work of several key persons on staff at the American College of Surgeons (ACS). Connie Bura, Associate Director, Member Services, administers the SHG. She was responsible for making sure that article and files from the poster competition were collected and that this volume was produced. Patricia Turner, MD, FACS, Director, Member Services, gives overall leadership and guidance to the SHG. Dolores Barber, Assistant Archivist at the ACS, gives loyal support to the SHG activities and the maintenance of the ACS Archives. The ACS Division of Integrated Communications produced the present volume.

J. Patrick O'Leary, MD, FACS, Miami, FL, chaired the Poster Competition Committee and shaped its present success. He has been helped by his able assistant, Mariselly Rivero, in his present position as senior associate dean at the Florida International University. Dr O'Leary will step down as Chair of the committee and will be succeeded this year by Patrick Greiffenstein, MD, FACS, New Orleans, LA. Special thanks goes to the members of the Poster Competition Committee and those who spent time as judges at Clinical Congress 2016. The session's success was the result of their dedication to the program and interest in promoting surgical history.

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Preface

This is a collection of papers from the annual poster competition of the Surgical History Group (SHG) of the American College of Surgeons (ACS), one of the group's most successful projects. Held at the annual Clinical Congress of the ACS, the session features the scholarly work of students and residents on a wide range of historical topics. More than 40 submitted abstracts for presentation at the Clinical Congress in Washington, DC, in October 2016. A panel of judges led by J. Patrick O'Leary, MD, FACS, Miami, FL, and Patrick Greiffenstein, MD, FACS, Chair and Co-Chair of the Poster Competition Committee, selected 21 for the program. The judges singled out two posters for top prizes, a task made difficult by the quality of the presentations.

The SHG agreed that the students' and residents' scholarship deserved wider distribution in a more permanent format than posters on bulletin boards. All participants therefore were invited to submit their work in written form for a collection of articles available for the study and enjoyment of the Fellows of the ACS and the public interested in the history of surgery.

A glance at the poster titles reveals the range of topics and interests certain to appeal to anyone with a passing interest in medical history. Topics include the use of primary sources (for example, payments to support the grave robbing activities of a slave owned by the faculty of the Medical College of Georgia in the antebellum South) and a review of how surgeons' garb in the operating room evolved from blood-spattered frock coats to clean scrubs (first white, then green, then blue). Short biographies of figures familiar to surgeons serve as reminders of the contributions of Billroth, Liston, Halsted, and Kelly.

There are profiles of Letterman and Kountz, surgeons largely overlooked today but who had a lasting impact on military surgery and transplantation. Finally, there is Sidney Ringer, now completely unknown but whose name is on resuscitation orders in trauma bays across the nation.

The SHG was organized and spearheaded by former ACS president LaMar McGinnis, MD, FACS. He envisioned a group of surgeons dedicated to advancing the appreciation and study of American surgical history. Basil Pruitt, MD, FACS, has chaired the program committee since its first meeting in 2015. Dr. O'Leary organized the original poster competition that year and assured its continued excellence as shown by this collection. Their dedication and leadership embodies the purpose of the SHG. It is appropriate that the present collection is dedicated to Drs. McGinnis, Pruitt, and O'Leary.

LaMar McGinnis
MD, FACS

Basil Pruitt
MD, FACS

J. Patrick O'Leary
MD, FACS

The collection will be distributed as a bulletin of the SHG through the ACS Communities on the ACS website, facs.org. In addition to the history of surgery community, the general surgery and pediatric surgery communities will be included in the distribution of the collection. The articles will be housed in the Archives website of the ACS, the forum for SHG communications.

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1

From formalwear and frocks to scrubs and gowns: A brief history of the evolution of operating room attire

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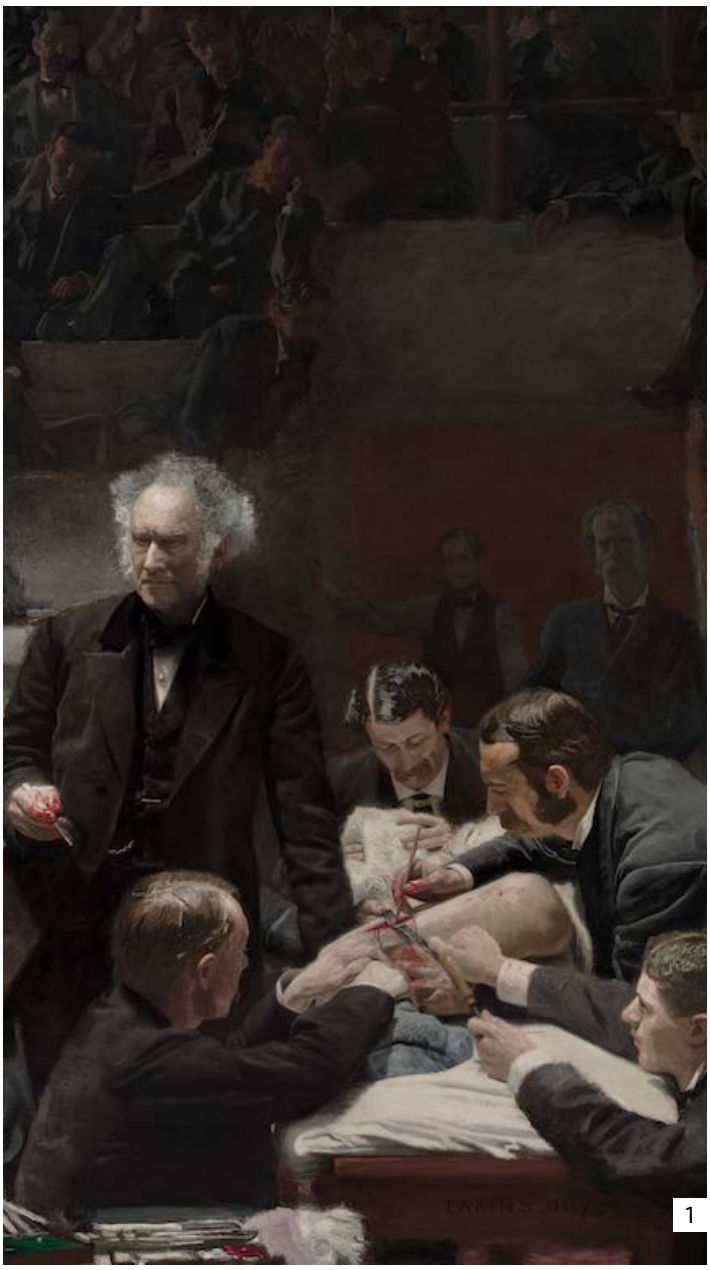
Most of the knowledge of the history of surgical attire is derived from drawings, paintings and anecdotal reports. Although conventional today, "scrubs" were not routinely worn until the mid-20th century. In the 19th century, it would be commonplace for a surgeon to shrug off his suit jacket, roll up his sleeves, throw on a frock or apron, and begin operating. Over the years, surgical garb continues to evolve to make procedures safer for both the patient and the surgeon. This paper will serve to outline the interesting evolution of operating room attire.



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Introduction

Stroll into any operating room and you will find surgeons adorned in various shades of blues and greens along with their masks, scrub hats, and surgical gowns. The surgical attire that has become commonplace throughout operating rooms around the world, has only been around for less than a century.

A brief surgical timeline

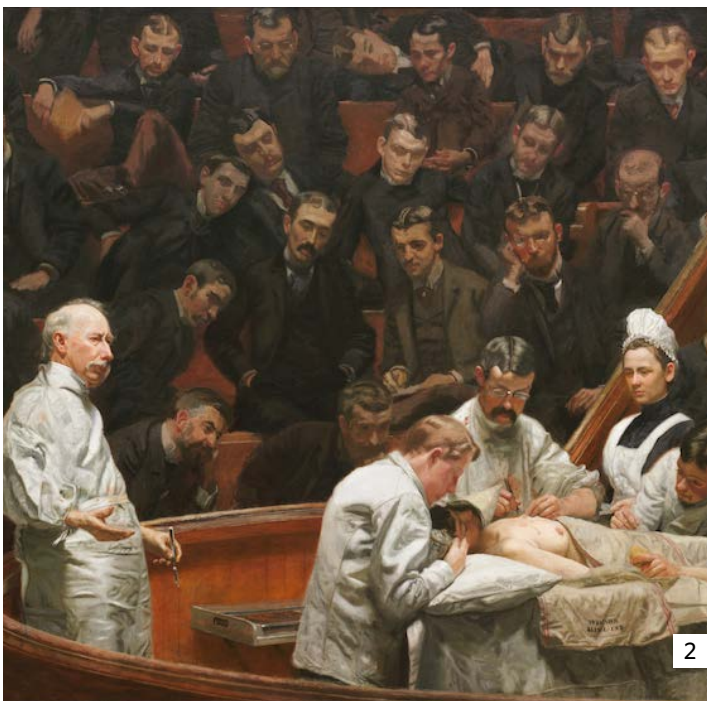
Prior to 19th century - Surgeons performed operations in their street clothes with the only concessions being the removal of coats and rolling-up of shirt-sleeves during bloody procedures.

Early 19th century - Surgeons often wore black "frock coats" to reflect respectability and the "somber nature of their work,"[1] leading to the perennial surgical story of the frock coat "stiff with caked blood"[2] (Figure 1).

Late 1870s - Lister covered his waistcoat and trousers with an "ordinary unsterilized huckaback towel for his own protection not that of the patient."[3]

1883 - German Surgeon, Gustav Neuber of Kiel, was the first to use a sterilized surgical gown.[4]

1885 - Lucy Osburn, Lady Superintendent of Sydney Hospital, wrote to Florence Nightingale about the outfits worn by surgeons in the operating theatre: "The doctor and all his assistants take off their coats and have tied round them garments of white makintosh which cover them from chin to toes, and over this a shift- a kind of white cotton surplice with loose sleeves coming to the elbows, this latter changed after each case" (Figure 2).[5]



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1893 - Halsted's senior resident, Dr. Joseph Bloodgood (Figure 3), noted that the practice of gloving the surgical team dramatically decreased infection rate but surgeons reluctant because gloves led to an "impaired sense of touch".[4]

Early 1900s - The Spanish flu" pandemic and growing interest in Lister's germ theory led to some surgeons wearing cotton masks in surgery to protect themselves from diseases.[6]

1916 - The technique of "donning gloves" during surgery first appears referenced in texts.[6]

1920s - The use of masks becomes routine practice in the operating room.[2]

1939 - Devenish and Miles showed that when the wrists of a cotton gown became wet during an operation, skin microorganisms which may infect the patient pass readily through the material. By equipping the surgeon with waterproof over-sleeves Devenish and Miles prevented wetting of the sleeves.[6]

1940s- Advances antisepsis and wound infection led to antiseptic drapes and gowns become adopted.

2016- American College of Surgeons announces new guidelines for surgical attire.

The evolution of scrubs

Originally known as "surgical greens" because of their color, this form of attire has now colloquially been termed "scrubs" because of the simple notion that they are worn in a "scrubbed" environment. The first mention of scrubs was in 1894 when Dr. Hunter Robber stated, "It is safer and better that all should put on a complete change of costume rather than simply don a sterilized coat and pair of trousers over the ordinary clothing." He also suggested this attire be made white so that it can easily be washed.[7]

When electricity took hold and more lights were used operating rooms rather than relying on windows and skylights, the combination of bright lights and white attire led to significant glare and "there was a green ghosting effect when shifting gaze from bloody red innards to white backgrounds.[2]

In 1914, San Francisco surgeon Harry Sherman, believed that a color scheme might evolve from the red of blood and tissues. He recommended green, a color "less wearisome to the eyes and [one that] minimized reflection." He further suggested that green "keeps the surgeon's eye acute to red and pink."[8] "Ciel" (sky) blue became popular as a color for surgical apparel in the 1950s, when color television began to be used for videotaping and closed-circuit teaching.[9]

Where we are today

Attire has been a new significant focus of the American College of Surgeons (ACS). In 2016, the ACS announced specific guidelines for appropriate surgical attire reasoning that these guidelines are based on decorum, professionalism, common sense, and available evidence.[10]

The statement in its entirety can be viewed on the ACS website.[10] Some highlights include the notion that operating room scrubs should not be worn outside the hospital perimeter and should be changed at least daily. Scrubs worn outside of the operating room suite should be covered up with a white coat or other appropriate cover. Masks should never be worn dangling at any time. In addition to promoting patient safety, the ACS guidelines uphold a culture of professionalism.[10]

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Legend

1 Thomas Eakins, *The Gross Clinic* (1875). Samuel Gross (1805-1884) wears a frock coat during surgery, as do all of his attendants. Gross expressed skepticism regarding Lister's use of carbolic acid and the latter's antiseptic system. Image courtesy of the Philadelphia Museum of Art.

2 Thomas Eakins, *The Agnew Clinic* (1889). D. Hayes Agnew (1818-1892) was among the first in the U.S. to adopt Listerism. All members of his team wear clean white gowns. None wear gloves. Image courtesy of the University of Pennsylvania Art Collection, Philadelphia, PA.

3 Surgeon Joseph Bloodgood (third from left) wearing gloves during an operation, 1893. One of the first operations where the surgeon wears rubber gloves. Image courtesy Alan Mason Chesney Medical Archives, Johns Hopkins Medical Institutions.

2

The first steps in the management of esophageal atresia

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Called to see an infant who could not swallow, Thomas Gibson in 1696 saw the first described case of esophageal atresia (EA) with tracheoesophageal fistula (TEF), the most common of congenital defects of the foregut. Surgeons struggled with the condition from the first attempt by Charles Steele in 1888. Their persistence, epitomized by Thomas Lanman's 1940 review of 32 cases of EA that all ended in death, reached a climax when Cameron Haight in 1941 reported the first patient to survive primary anastomosis for EA. In the 75 years that have followed advances in intraoperative care, neonatology, and surgical technique have produced survival rates that approach 100 percent among babies with EA uncomplicated by prematurity and associated conditions such as cardiac malformations.

Discovery

In 1670 William Durston made the first English description of esophageal atresia (EA) in a pair of conjoined twins. One of the twins, who did not survive, had an esophagus "[that] from the mouth of the right head descended no lower than a little above half an inch off the mid-riff, and there it ended."[1] In 1697 Thomas Gibson made the first description of the most frequently encountered combination of tracheoesophageal anomalies, a proximal EA with a distal tracheoesophageal fistula (TEF).[2] His careful description clearly describes the symptoms and anatomy.

About November 1696 I was sent for to an infant that would not swallow. The child seem'd very desirous of food, and took what was offer'd it in a spoon with greediness; but when it went to swallow it, it was like to be choked, and what should have gone down returned by the mouth and nose, and it fell into a struggling convulsive sort of fit upon it. It was fleshy and large, and was two days old when I came to it but the next day died. The parents being willing to have it opened, I took two physicians and a surgeon with me... We blew a pipe down the gullet (esophagus), but found no passage for the wind into the stomach. Then we made a slit in the stomach, and put a pipe into its upper orifice, and blowing, we found the wind had a vent, but not by the top of the gullet. Then we carefully slit open the back side of the gullet from the stomach upwards, and when we were gone a little above half way towards the pharynx, we found it hollow no further. Then we began to slit it open from the pharynx downward, and it was hollow till within an inch of the other slit... the imperforated part ... did not seem ever to have been hollow ... the parts were here smooth as the bottom of an acorn-cup. Then searching what way the wind had passed when we blow from the stomach upwards, we found an oval hole on the fore-side of the gullet opening into the aspera arteria [trachea].[2]

In 1840 Thomas Hill described a case in that was associated with rectal agenesis,[3] the first observation of one of the spectrum of associated anomalies known familiarly by the acronym VACTERL (**V**ertebral, **A**tresia – duodenal and anorectal – **C**ardiac, **T**racheoesphageal, **R**enal, **L**imb).

Failure

In the latter half of the 19th century anesthesia and aseptic surgery allowed bolder operations, including the repair of EA. Timothy Holmes proposed in 1869 a primary anastomosis for EA. While never performing the operation, he described how he would set about finding the two ends of the esophagus.

[The} object would be to cut down upon the point of a catheter passed down the pharynx, and then attempt to trace the obliterated oesphagus down the front of the spine until the lower dilated portion is found.[4]

Charles Steele made the first attempt in 1888 in an infant with EA under chloroform anesthesia. Approaching the defect

through an upper midline abdominal incision he found the gap between the upper pouch and the distal esophagus was an inch-and-a-half, too wide for a primary repair. He abandoned the attempt, and his patient died within 24 hours.[5]

The hazard of the communication between the distal esophageal segment and the trachea was demonstrated by Joseph Brennemann in 1913. He attempted to feed one patient through a gastrostomy, and in a second a jejunostomy. The procedures did not address the communication between the gastrointestinal and respiratory tracts and both died from pulmonary aspiration.[6]

Harry Richter directly addressed the TEF through a thoracic approach in two patients that he reported in 1913. He entered the right sixth interspace, extended the posterior aspect of the incision superiorly, and divided "three or four" ribs. While an assistant's finger held exposure by depressing the ipsilateral lung, Richter tried to assure adequate inflation of the lung (and presumably the contralateral lung) by maintaining positive pressure within the trachea using a homemade pump. He still was confronted by the unusual anatomy.

Lack of familiarity with the surgical anatomy of the parts will obviously be a source of embarrassment to most general surgeons. It was to the author. The smallness of the parts in a new-born infant and the peculiarly difficult site of the operation made the hazard apparently.[7]

He closed the fistula and performed an anastomosis between the ends of the esophagus. Without the benefit of intravenous infusion, positive pressure ventilation, and having only auscultation to verify complete inflation of the lung after operation, he was able to complete both procedures only to have both infants die after operation.[7] His approach, without the superior extension and division of the ribs above the thoracotomy, would become standard 50 years later.

Thomas Lanman's (Figure 1) 1940 review of the experience of the Children's Hospital in Boston with EA is a landmark in its thorough and candid appraisal of the management of these desperately ill infants.[9] All 32 patients died, including 30 who had undergone a variety of operative procedures. Among the hard-won lessons learned involved care of the infant before surgery. Early diagnosis and treatment was a priority. Aspiration was an ever-present threat, and delays only assured that the baby would be malnourished, dehydrated, and subject to an increasing risk of pneumonia. The diagnosis could be made without giving the child oral barium, a tube defining the limit of the proximal EA and air in the gastrointestinal tract below the diaphragm confirming the presence of a TEF. Children died of pulmonary infection even after technically successful operations. Babies could not tolerate injudicious fluid administration, as one infant who had undergone a successful primary anastomosis appeared to die in pulmonary edema.[8]

The immediate surgical priority was to prevent aspiration by exteriorization of the proximal EA and division of the TEF. The former was a comparatively simple task compared with the latter. Brenneman had showed already that gastrostomy alone was not going to work. The Boston surgeons tried Gage and Ochsner's operation, dividing the cardia at the level of the esophagogastric junction. It proved to be a failure because still attached to the trachea was a long diverticulum that once filled would spill into the lungs.[8]

A thoracotomy would be necessary to divide the fistula. Surgeons in Boston had adopted a posterior approach to the mediastinum with the baby prone, using a longitudinal incision to the right of the erector spinae, resecting the fourth rib, and dividing the posterior aspects of the ribs above and below. In the pre-antibiotic era they recognized the hazard of an esophageal leak and sought to contain it in the posterior mediastinum. Thus they kept the dissection out of the free

1

pleural cavity, another principle followed by many surgeons today. They tried to exteriorize the distal esophagus through the incision, but learned a hard lesson about the segmental blood supply of the distal esophagus when it became ischemic and retracted into the chest.[8]

When the two ends of the esophagus appeared sufficiently close and the child's condition would permit, they attempted primary anastomosis. Between 1936 and 1939 they made the attempt in five patients. One patient died during the operation and two within hours after surgery. However, two survived nine days after repair, proving that survival after primary anastomosis was possible. Lanman said, "[Every] reasonable risk should be taken to secure a primary anastomosis."[8] Despite 32 deaths he said,

That this method will eventually be successful I have no doubt.... Given a suitable case in which the patient is seen early, I feel that, with greater experience, improved technic and good luck, the successful outcome of a direct anastomosis can and will be reported in the near future.[8]

Success

In 1935 a report in the literature appeared of a child with EA without TEF who survived with a gastrostomy and cutaneous esophagostomy for 16 years.[9] In 1939 William Ladd in Boston and Logan Leven in Minneapolis had babies with EA and TEF born under their care on consecutive days. Both divided the TEF and performed an esophagostomy and gastrostomy. Once survival was assured, each surgeon began to painstakingly construct in stages skin tubes from bipedicle skin grafts from the anterior thorax. Situated on the surface of the chest, the tube received swallowed material from the esophagus above and drained by gravity into the stomach below. The children were the first long-term survivors of EA with TEF.[10,11]

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Finally, in 1941, Cameron Haight of Ann Arbor (Figure 2) fulfilled Lanman's prediction and had a baby survive a primary anastomosis of an EA.[12] Hiram Langston gives an entertaining account of the operation.[13] The infant, a girl, was in remarkably good shape, surviving 12 days without significant pulmonary contamination, and avoiding dehydration by means of intravenous fluids administered by her pediatrician. She had also evaded the hazard from a barium swallow, despite aspirating some of the material.

Under local anesthesia Haight entered the posterior mediastinum through a vertical incision in the left chest by resecting the posterior portions of the 2nd through 5th ribs, keeping the parietal pleura intact. The aorta and left subclavian artery were clearly in the field, the latter requiring retraction during the rest of the case. Haight's illustration shows the entire field but clearly exposure was a problem, as he notes that the operative field had to be shifted during the case.[12] He ligated and divided the TEF. The blind end of the upper esophageal segment was nearby. Its mobilization required a deeper plane of anesthesia so open drop ether was administered. Using a single layer of silk sutures, Haight sewed the proximal end to the open distal segment that he had just freed from the trachea. He closed the thoracotomy over a rubber drain that he left near the anastomosis. The child received rectal sulfathiazole by rectum in an effort to address the possibility of perioperative infection.

Saliva appeared in the drain a few days after surgery, the leak at the anastomosis verified by giving the child radio-opaque lipiodol. One of Haight's associates placed a gastrostomy, through which feedings were cautiously begun. They tried to probe the anastomosis with a catheter placed through the baby's mouth. Imagine the alarm when the catheter emerged out of the thoracotomy incision! They reduced the volume of gastrostomy feedings in the hope of avoiding any of it refluxing into the esophagus and out the repair.

On the 21st day after operation the baby happened to burp some evaporated milk from her mouth. Correctly taking it as a sign that the anastomosis was patent, they repeated the lipiodol study. The leak had sealed, the first example of a lesson well known to pediatric surgeons, that esophageal leaks often seal after EA repairs. The child eagerly accepted oral feedings, the only problem being a stricture that required dilation when the child was 17 months old.[13] The baby was discharged to her family 18 months after her birth. Haight proudly showed a photo of his patient, aged 16, at his presidential address to the American Association for Thoracic Surgery in 1957.[14].

She was the last patient Haight saw before his death in 1970. As of a review published in 2005 she was still alive.[13] Her survival was a signal achievement, being sole survivor and number 10 of a series of 15 patients in his series. The remaining 14 all died within two weeks of their operation.[12]

Epilogue

Still, Haight proved that survival after EA repair was possible. Other reports of successful EA repairs appeared after Haight's signal achievement. Improvements in positive pressure ventilation in newborn infants, intraoperative care, antibiotic therapy, and neonatal intensive care produced a survival

rate of nearly 100 percent among infants that were free from extreme prematurity, other malformations, and heart defects. Advances in surgical technique produced solutions to long-gap EA and obviated the unwieldy skin tubes of Leven and Ladd. Right, not left, thoractotomy exposures are used. No longer do surgeons resect ribs to expose the posterior mediastinum. They routinely enter the pleural cavity to perform thoracoscopic repairs, avoiding a thoracotomy altogether. The 75-year story of surgery for EA demonstrates why one writer described it as the "epitome of modern surgery."[15]

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Legend

1 Thomas Lanman, standing fourth from left. The famous 1939 portrait of the surgical staff, The Children's Hospital, Boston. William Ladd, chief, is to the right of Lanman, Robert Gross is standing at the far right, Orvar Swenson and seventh from the left, seated.

2 Cameron Haight. Courtesy University of Michigan Millennium Project.

3

Grave robbing in the North and South in antebellum America

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The transition in medical education from the apprenticeship model to formal medical courses in eighteenth and nineteenth century America required a supply of cadavers for anatomic dissection. By the 1850s, all American medical schools required anatomy courses as a prerequisite for a medical degree, all of them facing the difficulty of acquiring the needed cadavers. Early colonial laws forbade dissection, although later the use of cadavers of convicted criminals was permitted. Still, the demand for cadavers greatly exceeded the supply.

Grave robbing thus became a commonplace but highly illegal activity. Victims were often poor, criminals, or black. Outcries against the practice came especially after corpses from families outside the indigent poor group were taken. The most notable events were the "resurrection" riots of 1788 in New York City, and of 1824 in New Haven, the term referring to the ghoulish task of exhuming corpses from graves.

This article reviews the changing laws regarding cadaver procurement and grave robbing in antebellum American history, notable episodes of public outcry, and investigate the men who were responsible for supporting this burgeoning illegal trade and the social makeup of grave robbing victims in antebellum America.

Grave robbing and anatomy legislation in antebellum America

Colonial American medical education in the eighteenth century, based on an apprenticeship model, still considered practical anatomy essential to complete medical education. Formal courses in anatomy began to form, and by the 1850s, all American medical schools required anatomy courses as a prerequisite for a medical degree. The schools needed a steady supply of instructional material—frankly, cadavers.[1]

In the colonial era, the procurement of cadavers and the practice of dissection were regulated by British law. Dissection was viewed as the ultimate punitive action. A 1752 British Parliamentary Act required posthumous dissection of murderers' bodies, so that "further Terror and peculiar Mark of Infamy might be added to the Punishment of Death."[2] After Independence several states passed laws that allowed judges to sentence criminals—and in Massachusetts, those who participated in duels—to execution and dissection. However, no national laws regulating dissection were enacted.[2]

As new medical schools formed in the early nineteenth century, state legislatures began to pass acts outlawing the disinterment of bodies, beginning in New Hampshire with the chartering of Dartmouth Medical School. In 1815, Massachusetts outlawed even the unauthorized possession of a dead body, which was quickly followed by the rest of New England by 1818.[5] These laws did not change the required bodies to supply anatomy courses. Legal barriers did not deter professional grave robbers, students, and the faculty and employees of medical schools from stealing bodies.

Grave robbing flourished as new medical schools formed during the early years of the Republic. The public generally turned a blind eye to the goings-on because, as noted by historian Warner, bodies filched were mostly from "groups whose aggrievement was least likely to incite wide public protest: Criminals, African Americans, [and] paupers."[3] The victims were the most powerless in society, in unmarked graves in potter's fields next to almshouses, with family and friends too poor to spare the time or money to provide for and protect their remains. Upper classes, devoted to the scientific and medical progress, were deaf to the concerns of those whose family members' graves were being desecrated, so long as their bodies were not among the dissected ones. The rare occasions when grave robbers happened to snatch a corpse from an upper class family often created a public outcry.

At least twenty "anatomy riots" occurred from 1788 to 1857 in the United States. Most were sparked by stealing "the wrong kind of body."[3]

These incidents underscored the need for a legal and morally acceptable means of procuring bodies for dissection. By the

late 1850s, several states passed anatomy acts allowing the dissection of the bodies of the indigent poor. Still the growth of new medical schools and the popularity of anatomy courses outpaced the new legal supply of cadavers. Thus the body trade remained active, especially in states that had no legal means of acquiring bodies for dissection.

New York City

Samuel Clossy, an Irishman, offered New York's first formal anatomy course in the mid-1760s. He performed dissections on two young females, one black and one white; however, he was unable to obtain a body for his third scheduled dissection. Because of his growing notoriety, "we could not venture to meddle with a white subject, and a black or Mulatto I could not procure,"[4] he wrote. While unable to complete his curriculum, Clossy still was later appointed as the first professor of anatomy at King's College.

Anatomy instruction resumed at the school, newly renamed Columbia College, with the end of the Revolutionary War. In the 1780s, an estimated fifteen percent of the New York City population were blacks, but bodies of blacks from the city's Negroes Burying Ground were the major supply of corpses for dissection. Free blacks and slaves petitioned the New York City Council against the violation of black graves in 1787:

[It] hath lately been the constant practice of a number of the young gentlemen in this city who call themselves students of physick, to repair to the burying ground assigned for the use of your petitioners, under cover of night, ... to dig up the bodies of the deceased friends and relatives, carry them away and ... mangle their flesh out of a wanton curiosity ... your petitioners are well aware of the necessity of physicians and surgeons consulting dead subjects for the benefit of mankind, ... your petitioners humbly pray your Honors ... adopt such measures as may seem meet to prevent similar abuses in the future.[1]

But no action was taken in response to the petition. Though the black community continued to protest, the Negroes Burying Ground continued to be the primary supply for Columbia's anatomy classes. (The lower Manhattan site is now the African Burial Ground National Monument.)

Students and suppliers also pilfered churchyards. One such incident sparked the most infamous incident, the April 1788 Doctor's Mob. Accounts differ, but begin with the story of medical students taunting boys playing outside their dissecting rooms by waving a dissected arm, claiming it was their recently deceased mother's. The families checked, and one mother's grave was indeed empty. Whatever sparked the incident, all accounts then concur that, as reported in the New Haven *Gazette*, "a number assembled and broke into the hospital where tis said some mangled bodies of the dead were fonnd [sic], in consequence of which a considerable dust was kicked up and sundry doctors and others were considerably mauled."[5]

After sacking the school, the mob captured four medical students. The mayor and sheriff arrested the students, in effect rescuing them by placing them in protective custody in jail. Undeterred a mob of five thousand marched on the jail the next day. Governor Clinton ordered the state militia to action. The *Gazette* reported that "the militia fired on the populace, and killed four men and wounded several others."[5]

The Doctor's Mob showed that the public would no longer tolerate grave robbing. Recognizing the need for anatomy material for legitimate medical education, the New York legislature passed a 1789 anatomy act that made grave robbing illegal but allowed judges to add dissection after execution to the sentence of murderers, arsonists, and burglars.[6] Despite the new law, there still were not enough "legal" bodies to dissect, so the practice continued. There were so many violations that the state legislature in 1819 classified grave robbing as a felony with a sentence of five years in prison. However, going without punishment were the anatomists who purchased bodies from the growing ranks of professional grave robbers.

Grave robbers were willing to risk arrest due the large payoff—from $5 to $25 per body in an era when skilled workers earned $20-25 per week. The correspondence of Harvard anatomy professor, John Collins Warren, confirmed the shady relationship between anatomy professors and grave robbers. Harvard faced shortage of bodies in the 1820s, so Warren wrote to acquaintances in nearby cities. He was referred to New Yorker James Henderson, "a trusty old friend and servant" who could "obtain the articles you desire" and "take upon himself all charge of procuring, packing and forwarding to any designated address."[2]

After unsuccessful attempts by the ruling Whig party to control the practice in 1851-1853, they finally met success when New York legislature finally passed the "Bone Bill" in 1854. The Whigs, supported by the growing middle class, introduced the "Act to Promote Medical Science and Protect Burial Grounds" that had the support of county medical societies and the medical colleges, both of which lobbied for its passage. Proponents argued that medical knowledge gained by dissection would lower mortality and morbidity rates and thus benefit all of society, including the urban poor. There would be a direct financial benefit as well. Better supplied, medical schools would attract more students, thus strengthening the state economy.[2]

The ethical justification advanced by supporters of the act reasoned that being a body for dissection was an opportunity for criminals and the poor to pay for their misdeeds, ignoring that being poor was not a crime nor an affront to society. One advocate wrote

[Having] either afflicted the community by their misdeeds, and burdened the State by their punishment; or having been supported by public alms—by offering up their bodies, to the advancement of a humane science they will make some returns to those whom they have burdened by their wants or injured by their crimes.[2]

Democrats, most from New York City and largely immigrants, opposed the bill. Most vocal were Irish and German newspapers and societies, as their countrymen were frequent victims of illegal grave robbing. They argued the lower class was already condemned and victimized by society. The act would further exploit them by turning their bodies into a commodity to be traded.

After heated debate the act passed by a single vote and became law on April 3, 1854. Unclaimed bodies and the dead too poor to pay for funeral costs were given to medical schools, their bodies treated as those of criminals. Though the law was not perfectly enforced, New York's medical schools finally got the bodies they needed. Grave robbing declined, but the city was still a source schools in other states that had not passed similar legislation.

Augusta, Georgia

When the Medical College of Georgia (MCG) opened in 1829, there was no legal supply of cadavers and the practice of dissection was illegal. At its third meeting in 1834 the faculty charged the dean and anatomy professor with the task of finding a "resurrection man" to supply bodies for dissection. In 1839 the school paid $100 for cadavers from New York. The anatomy professor had to go to Baltimore to procure cadavers in 1842. MCG accounts from 1848 to 1852 show purchases of 64 bodies from a number of "resurrectionists."

They were able to find most bodies from local sources, but others came from neighboring towns. Records allude to controversies surrounding the practice. For example, records from 1851 note additional expenses of reinterring of bodies already purchased. Some might have been the "wrong kind of body," outraged surviving family members demanding their reburial.[7,8]

In 1852, MCG contrived a solution that was unique even in the antebellum South. As recorded in their minutes the "faculty… purchased a slave named Grandison for seven hundred dollars" at the slave auctions of Charleston.[9] Officially Grandison Harris was a "porter" but his real duty was grimmer: He was to obtain bodies. Living in Augusta's black community and its cemetery, he would have ready access to the main source of MCG's cadavers. Probably unaware, he would also be a convenient scapegoat for the illegal collaboration.[10]

1

Harris's situation was privileged for a slave. He was paid for his work and he had leave to travel about town and to visit his family in Charleston. Moreover, the grateful faculty gave him blankets, a mattress, clothes, whiskey, board, and "sundries," all duly noted on its account ledgers.[8] The frequent to trips to Charleston got to be costly, so the faculty decided to reunite him with his family, a luxury rarely afforded to slaves. The 1858 faculty minutes recorded one more eyebrow raising decision: "[It] was noticed that the Dean be authorised to purchase Grandison's wife and child on account of the faculty."[11] The Grandison family was together.

Not only providing bodies from local cemeteries, Harris also acted as MCG's agent in purchasing them. His responsibilities expanded to all facets of dissection at MCG, including preserving the bodies in whiskey (an expense noted in faculty accounts), laying out bodies for dissection, and finally disposing of them. The last task was especially delicate, as dissection was illegal in Georgia until 1887. As his expertise grew, he acted as a teaching assistant in the anatomy lab (Figure). He learned to read and write (illegal for slaves at the time), and communicated through written letters to the faculty. Though still a slave he was *de facto* a free man under contract to MCG. His duties interrupted when MCG closed during the Civil War, Harris was promptly rehired when the school reopened after Appomattox. Later a judge in South Carolina, he never gave up his franchise at MCG.

Harris discarded many cadavers in the basement of the old Medical College, covered with saltpeter to conceal the odor of rotting flesh. Excavations for building renovations a century later in 1991 uncovered the bodies. Study of the remains revealed the racial and societal make-up of the victims of the grave robbing activities of Harris and the MCG faculty. Robert F. Blakely, a forensic anthropologist specializing in urban archeology, mobilized his anthropology class to study the remains. They found that 79 percent of the bones were black, with black men the most common group, followed in order by black women, white men, and white women. The distribution was a statistically significant overrepresentation of blacks among the MCG remains in comparison with the concurrent Augusta census at the time, when blacks represented 42 percent of the Augusta population.[12] Blakely concluded that the disproportionate number of blacks was the "result of accessibility, selectivity, or both."[12]

Southern slaves, being the most marginalized group, were the most vulnerable for exploitation. Slave owners sold and donated the bodies of their slaves to medical schools.[13] Free blacks buried in rural cemeteries were also at risk, especially if they were interred outside community churchyards and graveyards that were more visited and watched.[14]

Dissection and society in antebellum America

Several factors led to the use of bodies of the black and poor for dissection. First, their bodies were easier to obtain. Slaves and the poor could not afford time or money to ensure that graves of friends and relatives were secure during the first crucial days when bodies were relatively fresh and grave robbers were known to strike. Furthermore, their gravesites generally were remote and outside the fenced protection of a churchyard.[14] Megan Highet, anthropologist at the University of Alberta, says, "The theft of bodies was essentially segregating in death those who had been marginalized in life,"[14] death offering no escape from institutionalized racism.

The white society chose to overlook the practice so long as their graveyards went unspoiled. The desecration of the graves to the blacks and the poor was "less noticeable and less objectionable among middle and upper class society,"[14] according to Highet. In 1838, the English travel writer, early feminist, and perceptive social observer Harriet Martineau said, "In Baltimore the bodies of coloured people exclusively are taken for dissection because the whites do not like it, and the coloured people cannot resist."[15]

Blacks and the poor had little power to block the practice. "Objections to the grave robbers' activities, when they did arise, were often the result of extreme provocation."[1] Free blacks did object to the desecration of the Negroes Burying Ground, but their 1787 petition to the New York City Council had no effect. Similarly representatives of the Irish and German poor failed in their opposition to the Bone Bill of 1854.

Finally, white medical schools used the bodies of blacks and the urban immigrant poor because they could. Edward Halperin at the University of Louisville said, "Anatomical dissection served as a means for a ruling class to exert social control over the weak, the marginalized, and criminals."[6] Dissection after death was a hideous act that served as a deterrent against both crime and poverty. The debates surrounding the Bone Bill revealed some of the prevailing attitudes toward poverty: If dissection did not drive the poor to support themselves during life, then their bodies could be used for dissection to further medical progress and repay their debt to society. Thus dissection became a form of punishment, criminalizing poverty and institutionalizing racism.

In the antebellum South, some slaveholders used the threat of dissection to maintain control of over slaves. Black slaves grossly outnumbered whites and slave uprising was constantly feared. Black folklore is replete with stories of the "night doctors," who kidnapped and murdered blacks for dissection.[6] As in the North, southern medical schools had the same requirements for cadavers. The faculty at MCG was unique in owning a slave as its agent, Grandison Harris, in conducting the grim task. Truly a curiosity, Harris was a man set apart and entirely unique in the medical history.

Blacks were exploited for dissection in both the North and South. There was a shift to poor immigrants in large Northern cities in the later antebellum period. As northern states passed anatomy acts in the 1840s, the urban poor became a legal supply of cadavers. In the South, slaves and free blacks were illegally dissected and even lauded as anatomical supply by medical schools of that time. The use of the poor and blacks as an unobjectionable source of dissection material reinforces the deep racism and rigid classicism of antebellum America, both North and South.

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Legend

Faculty and students of the Medical College of Georgia, 1877. Grandison Harris stands at the far rear.

4

Major Jonathan Letterman: Unsung war hero and father of modern battlefield medicine

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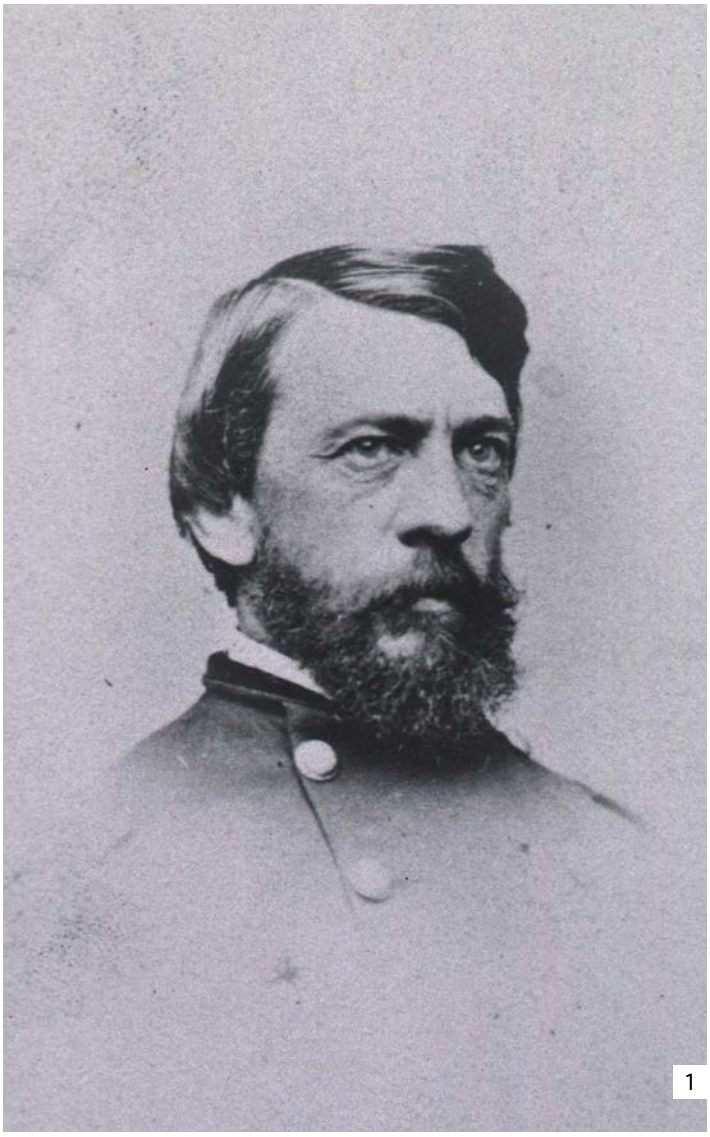
Hippocrates said, "War is the only proper school for surgeons." Dr. Jonathan Letterman (1824-1872), as the medical director of the Army of the Potomac, originated the Ambulance Corps that trained men to quickly transfer the wounded to field dressing stations. He later organized a system to triage and transfer to evacuate patients to three levels of care, an innovation that saved thousands of lives in future conflicts. His accomplishments remain an integral part of U.S. military medical operations that affect the lives of countless wounded warriors today. Letterman deserves the title of "the father of modern battlefield medicine."



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Education and early career

Major Jonathan Letterman (1824–1872) grew up in Canonsburg, PA, the son of a prominent western Pennsylvania surgeon (Figure 1). He graduated from Jefferson College (now Washington and Jefferson College) in 1845, and then attended Jefferson Medical College in Philadelphia. On graduation in 1849, he applied for and received an army commission. For the next 13 years, he was assigned throughout North America where he cared for sick and injured soldiers, challenged by terrain, exposure, malnutrition, and infectious disease in remote locations. In California when the Civil War began, he returned east at the end of 1861.[1]

Care of the wounded at the onset of the Civil War

Technological advances in Civil War weaponry had far outpaced battlefield tactics. The newly developed 0.58 caliber Springfield musket was accurate to more than 500 yards, but armies still lined up across fields in traditional formations and charged each other head-on. More than a third of a unit could die in such assaults. Overcrowding and abysmal hygiene in camps caused thousands more to suffer dysentery, scurvy, typhoid fever, pneumonia, smallpox, tuberculosis, measles, and malaria. About 60 percent of the Union soldier deaths during the Civil War were from noninjury diseases.[1,2]

The first salvo of the war revealed a startling lack of organization, planning, and effectiveness in the care of so many sick and injured. At the Battle of Bull Run (or Manassas), clearing the wounded from the battlefield took a week. The wounded had to make their way to Washington to seek medical care, including one man shot in both thighs and the scrotum. One civilian organization assisting the military after Bull Run reported, "[It] was unable to learn of a single wounded man having reached the capital in an ambulance." Ambulances devoted to the transport of the wounded were rare. Wagons from the quartermaster corps were devoted for hauling munitions, then appropriated for transporting patients only on the rare occasions when they were free. Injured soldiers had to be carried off the battlefield by friends and other soldiers. Not surprisingly, many chose not to return.[2]

The army failed to bring medical care to the wounded in any location. Army brass scrimped its appropriations for medical care, a budgetary decision based on limited resources, political challenges and lack of insight. Line officers prioritized troop movements and the delivery of weapons and ammunition at the expense of medical supplies and support.[2]

There were few military surgeons with adequate training and expertise. In 1860, the US Army had only 100 doctors for 16,000 soldiers, a ratio that became only worse when the

Union Army reached its peak strength of 2 million, at which point it had 10,000 surgeons. Most were civilian physicians with a limited contract with the government. Their training was at best a two-year stint at an unregulated, proprietary medical school. Few had formal training in surgery, and fewer had ever treated a gunshot wound. Without a separate command structure for the medical department, there was no oversight or evaluation of qualifications. Promotions were often based on seniority and political connections instead of clinical performance. Surgeons from one regiment often refused to care for soldiers of another.[1,2]

Wounded soldiers removed from the battlefield found themselves in a hodgepodge of locations, few that could generously be called a medical facility. Often they were places of opportunity such as homes and barns Resources were few and of poor quality, without established supply lines, command, and hierarchy of supervision. An established civilian hospital in a city that happened to be close to an action was overwhelmed by massive numbers of casualties. Resources were quickly exhausted making necessary secondary dispersal of the wounded to more distant cities and towns. Without stabilization and initial treatment, patients often succumbed during the long journeys to community facilities or died shortly after their arrival.[2]

Letterman's solutions

In May 1862 Letterman was appointed first as medical director of the Department of West Virginia where he established a solid reputation and won the admiration of political influential figures in the Army and government. The dismal state of care of wounded became quickly evident, so he was named medical director for the Army of the Potomac, the largest army in the Union.[1] In less than two years he developed many of the ideas and plans that continue to serve as the foundation for battlefield medicine today. Recognizing his leadership and medical skill, General George B. McClellan, commanding general of the Army of the Potomac, gave Letterman authority to make any changes necessary to improve and maintain the health of his fighting force. The latter faced a myriad of challenges with ingenuity, dedication and foresight.[2]

From his years of service prior to the Civil War he knew his first task was the health and nutrition of the soldiers. If more were fit, there would be more for battle. Camp hygiene practices were improved, especially handling of waste. Soldiers were given bigger and more nutritious rations, prepared with better cooking methods and more hygienic handling of food. Breakfast was ensured. Improved shelter allowed better sleeping conditions. Breaks for rest were mandated. Improved supplies included clean uniforms. Morale improved. After less than a month under Letterman as its chief medical officer, the disease rate in Army of the Potomac decreased by one-third.[1,2]

Letterman's next undertaking was improved casualty evacuation. At Letterman's request McClellan issued an order that created an ambulance corps with an established structure for its management, regulation, and evaluation. Each ambulance was staffed by a driver and two men, each trained for specific tasks and with no combat duties. Letterman and three others designed the original ambulances, in service for most of the war. Called the "Wheeling Wagons," each was pulled by two horses, carried two to six patients, and had compartments for water, stretchers, and medical supplies. The use of ambulances to shuttle line officers about was expressly prohibited.[2]

Two major battles in the span of just a few weeks in the summer of 1862 illustrated the consequences of Letterman's ambulance corps. On August 28, 1862, the Battle of Second Manassas left 14,000 northern troops were killed or wounded. The wounded lay on the battlefield, desperate for help, for a full week before all of them could be removed from amongst the dead.[2] Less than a month later on September 17, 1862, the Battle of Antietam had more than 12,000 Union casualties. In stark contrast to the battle less than a month earlier at Manassas, every injured Union soldier was evacuated from the battlefield in just 24 hours. Letterman wrote, "[It] affords me much gratification to state that so few instances of apparently unnecessary suffering were found to exist after that action and that the wounded were removed from that sanguinary field in so careful and expeditious a manner."[2]

The month following Antietam a hiatus afforded Letterman the opportunity for other improvements. Next on his agenda was an overhaul of the medical supply system. He created a tiered supply chain that decentralized supplies from the brigade headquarters in the rear to forward units on the battlefield. Each brigade was assured one hospital wagon, one medical supply wagon, and one medical chest and knapsack for each medical officer. The system met the needs of a more mobile army. Letterman's reorganization was timely, for within weeks the Army of the Potomac was in pursuit of General Lee.[2]

Despite being on the move Letterman continued his work. His experience in major battles revealed that field care required integration with definitive treatment in general hospitals in cities distant from the fighting. Another requirement was to assure that the injured needed the best surgeons, chosen on the basis of "known prudence, judgment, and skill." He made sure that regimental surgeons cared for all soldiers, not just the members of their own regiment. He established standards for the number of surgeons and assistant surgeons assigned to each unit, and made sure each division had its own hospital.[2]

Letterman established a new system of triage and graduated echelons of care. Surgeons at aid stations near the front made the initial assessment and treatment, including tourniquets, morphine, and water or whiskey. They decided which patients could be saved, and which had fatal injuries. Ambulances at collection points transported the wounded to field hospitals in nearby buildings, and those with more severe injuries to general hospitals. His system provided consistent and better medical care to the wounded. It also kept soldiers with mild injuries closer to the battlefield where they could return to battle once they recovered.[2]

The Battle of Fredericksburg in December 11-15, 1862, tested Letterman's newly restructured medical corps, just months after his appointment in May (Figure 2). The corps was ready with 1,000 ambulances and 550 medical officers, one in fifteen of whom performed operations. The Union Army suffered nearly 13,000 casualties. Surgeon George Stevens of the Sixth Corps wrote of the experience, "The medical department has become so thoroughly systematized, that wounded and sick men were cared for better than they had ever been in any army before…[This] was perfected…by the efficient and earnest medical director of the army, Dr. Letterman; to whom belongs the honor of bringing about this most desirable change."[2]

Legacy

Letterman's innovative changes in the delivery of battlefield medical care were widely adopted and established through an Act of Congress in 1864. The foundation of U.S. military medical operations, they remain the framework of the care of soldiers injured in battle. His statements can be heard in a modern statement of his ideas: "A basic characteristic of organizing modern health services support is the distribution of medical resources and capabilities to facilities at various levels of command, diverse locations, and progressive capabilities."[5]

Since the Civil War, almost four million Americans have served their country during times of war; more than 600,000 have died and more than 1.3 million have been injured. Letterman's contributions to the organization and management of battlefield medicine have affected nearly all of them, without which surely more would have lost their lives. Letterman is deserving of the title, "Father of Modern Battlefield Medicine."[2,5]

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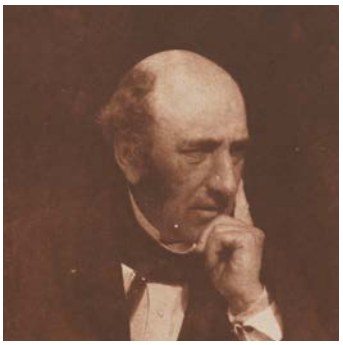
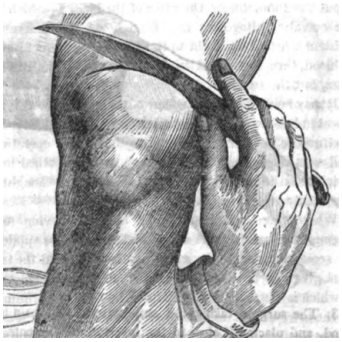
Legend

1 Joseph Letterman.

2 Letterman (seated at left) and his medical staff. Image from National Library of Medicine.





5

Time me, gentlemen! The bravado and bravery of Robert Liston

American College of Surgeons
Inspiring Quality:
Highest Standards, Better Outcomes
100+years

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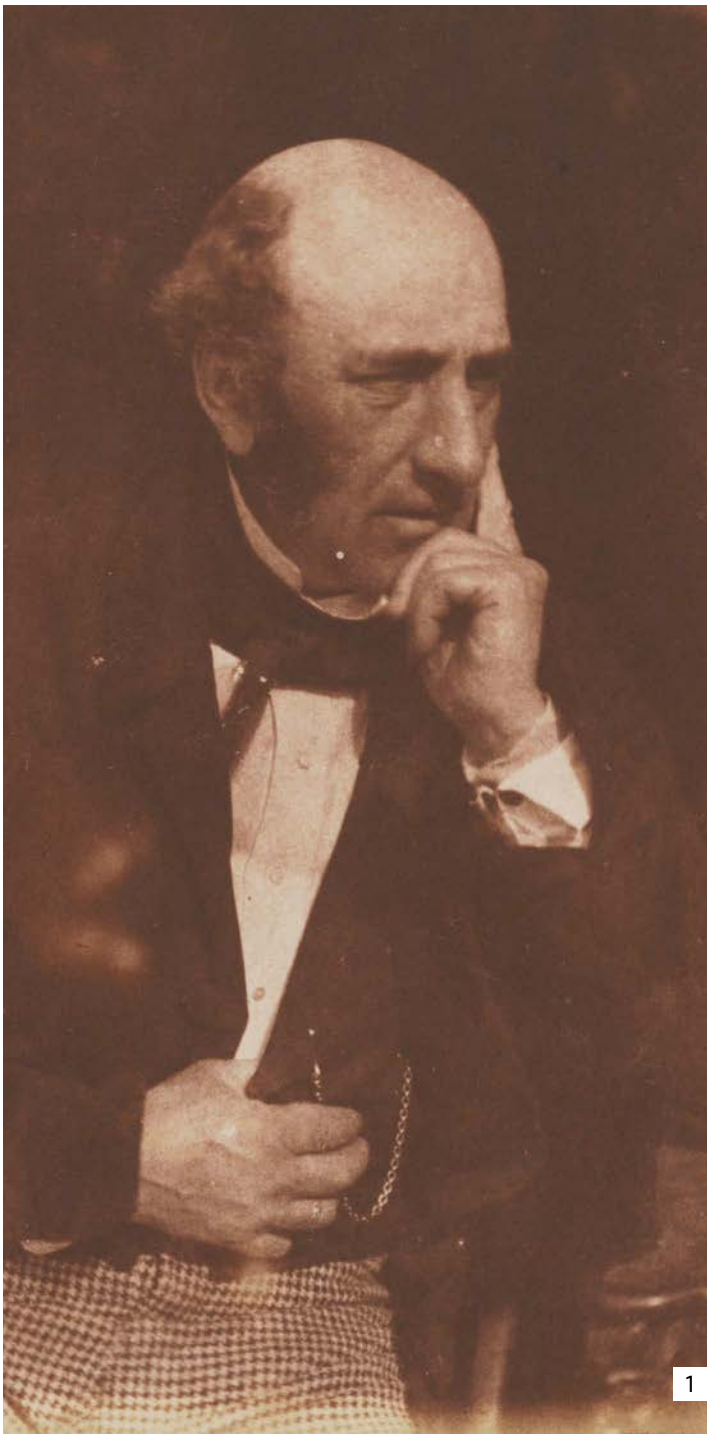
Standing six feet two inches and powerfully built, Robert Liston (Figure 1) embodied the bold surgeon of Victorian England. Famous for his ability to complete an amputation in less than a minute and his intimidating and argumentative nature, he was a scholarly and principled practitioner deserving of his reputation as the leading surgeon of his age.



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Education and early career

Robert Liston was born on October 28, 1794 in a small village in West Lothian, Scotland, the firstborn of Reverend Henry Liston, the village minister and a pipe organ inventor. His mother died when he was six, so he was raised and taught by his father. He entered the University of Edinburgh at 14.[1] Only two years later, in 1810, Liston began his medical training under the famed anatomist John Barclay (1758–1826). He was appointed house surgeon at the Royal Infirmary in Edinburgh in 1814, and was admitted to the Royal College of Surgeons in London two years later at age 22.[2,3]

Even then, Liston had a reputation as an argumentative and intimidating man, especially when he stood to his full height of 6 feet 2 inches. A disagreement with Barclay led him in 1818 to open his own anatomy class, which attracted 60 students that winter.[3] Liston was known as a fearless surgeon who would operate on patients sent away from the Edinburgh Infirmary by other surgeons who thought that their conditions were too severe.[3,4] Without apology he expressed his disapproval of surgeons he did not respect and whose practices he found inferior.[1] Some patients had been rejected by surgeons at the Infirmary, leading to a charge that he was inducing patients away from the facility to his own practice. The accusation led to a brief banishment from the Infirmary, but he was soon reinstated.[1,4] The stormy episode probably contributed to his decision to accept an appointment as professor of surgery at the newly-opened University College Hospital in London. He was only 34. He would remain there for the rest of his life.[1,2]

Master surgeon

In an era where surgical skill meant boldness, precision, and especially speed, Liston became known widely for his surgical excellence. His nickname, "The Fastest Knife in the West End,"[4] endures today. His above-the-knee amputations from incision to final suture were completed in less than thirty seconds.[5] Visiting surgeons packed Liston's surgical theatre to witness his unparalleled technique. With a showman's presence, he would nod to the medical students, pocket watches in hand, and say, "Time me, gentlemen, time me!"[1,5] Patient survival in Liston's era, before anesthesia, asepsis, and blood transfusion, often depended on how quickly the surgeon could complete the operation and control bleeding.[4,5]

However, Liston was much more than a lightning-quick hatchet-man. Believing that surgery was often a patient's last resort, he firmly believed that a surgeon must know when not to operate.[1,5] In the preface to his text, *Elements of Surgery*, he noted that the study of anatomy and pathology had led to a better understanding which conditions were best addressed by surgery. He wrote:

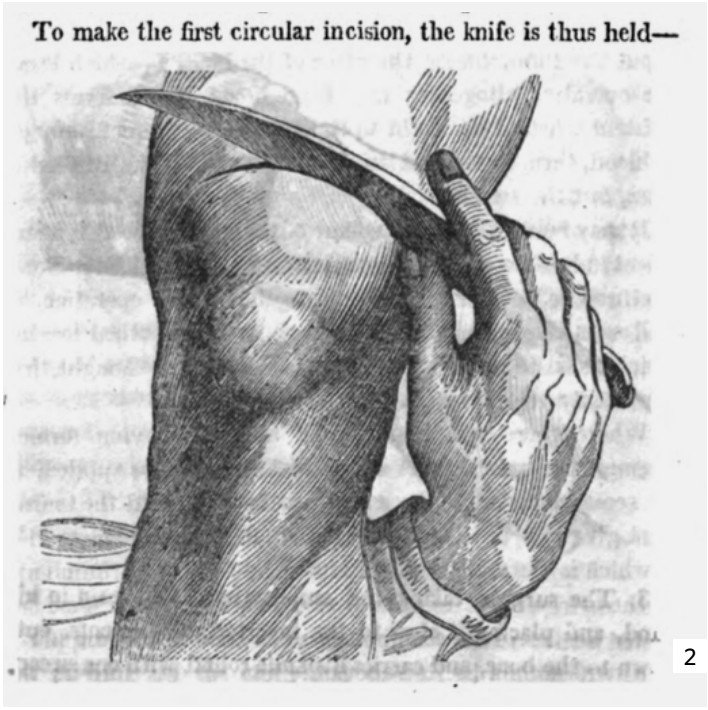
The functions and structure of parts are more frequently preserved uninjured—mutilation is more rarely required—and operations are dispensed with. The wider the extension of Pathology, the fewer the operations will be—thus affording the best criterion of professional attainment. Who will question, that there is more merit in saving one limb by superior skill, than lopping off a thousand with the utmost dexterity?[6]

Liston made several contributions to the progression of aseptic practice, even though he practiced a half-century before Pasteur and was known to clench his knife in his teeth when his hands were otherwise occupied. Before the discovery of microorganisms and formulation of the germ theory, his routines in surgical hygiene probably came from an inherent sense of cleanliness and order. He was one of the few surgeons known to wash his hands prior to an operation, long before Simmelweis introduced hand washing at the Allgemeines Krankenhaus in 1847. He always wore a clean apron for each operation, counter to the common practice of wearing the same apron caked with blood, pus, and filth as evidence of ability and experience.[5] He shaved surgical sites prior to incision, a practice recognized only within the past decades to increase the risk of surgical site infections. Surgical sponges had to be clean. His dressings were soaked with cold water only, not the salves and other nostrums that often harbored infection.[1]

Innovator and educator

Liston performed Europe's first operation under anesthesia on December 21, 1846.[3] At the conclusion of the operation, he said, "This Yankee dodge beats mesmerism hollow,"[5] referring first to the first use of ether in the United States, and to "mesmerism," the discredited attempt at using hypnotism for pain control during surgery.[1] Liston was one of among the few to reject the notion that the excruciating pain of a surgical procedure without anesthesia enhanced the healing process.[4,5]

He revolutionized the way amputations were performed, the operation for which he was most noted. A standard method was a circular incision, starting with the surgeon's arm wrapped behind the extremity, poised to sweep around its circumference as the surgeon pulled his scalpel around the limb (Figure 2).[7] This however left a cylinder of skin, subcutaneous tissue and muscle that was difficult to pull over the cut end of the bone. Liston's solution was to leave a U-shaped flap that could be turned over as a pad over the cut end of the bone. His technique was to insert a long knife into the midsection of the limb, parallel to the bone, then sweep it outward to slice the soft tissues outward (Figures 3 and 4).[8] It required a long straight knife that had both edges sharpened at Liston's request. The famous Liston knife became a standard amputation knife ever since. He also invented forceps with a built-in snap that kept the tips pressed together to control arterial bleeding.[8]



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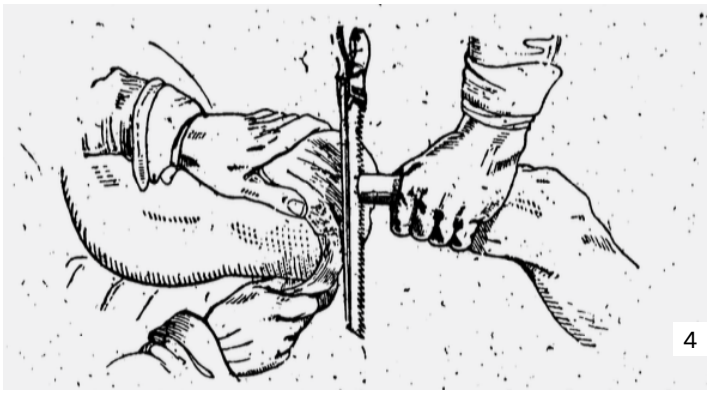
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To guide the expert surgeon Liston had three principles, outlined in the introductions to his two multi-volume surgical texts, *Elements of Surgery* and *Practical Surgery.* First, and to Liston the most important, was a mastery of anatomy. He wrote:

The foundation of the art of operating must be laid in the dissecting room, and it is only when we have acquired dexterity on the dead subject, that we can be justified in the operating room.[8]

Liston believed that the emotions of the patient were next in importance.[2] He knew that his patients felt that surgery was something to be feared.

It is of utmost importance to attend to the state of the patient's mind and feelings. He ought not to be kept in suspense, but encouraged and assured; and his apprehensions must be allayed.[6]

If the patient expressed dread, the operation was postponed or cancelled. Once the operation was completed, Liston considered the task only to have started.

Attention to after treatment is of much greater importance [than the operation itself]. The Practitioner is not to rely on success however well the manual part has proceeded. He must consider his labour only begun, when the operation is finished; the patient is yet to be conducted, by kindness and judgment, through the process of cure.[6]

Third, Liston felt that a surgeon must be willing to take courageous action, confidence that came from study and experience. He spoke of timid surgeons who left patients to die on the operating table for fear of making the wrong decision.[2] This was unacceptable. Age did not guarantee experience and ability. Being a surgeon who started his career at a young age, Liston argued that volume of cases dictated experience. He said:

The greatest number of well-assorted facts on a particular subject constitutes experience, whether these facts have been culled in five years or fifty…It is only from experience, directed and aided by previous study, that accuracy and celerity of decision can be acquired. Besides knowing in what manner to proceed, the Surgeon must know well wherefore he acts, and also the precise time at which he should interfere. With knowledge and confidence derived from experience, he will perform such operations as are indispensable for the removal of pain and deformity, or the preservation of life, with calmness and facility – with safety to his patient, and satisfaction to those who assist in, or witness, his proceedings.[6]

Ethics

Liston was tough and demanding. He was especially harsh to trainees, who served as his dressers.[1] They received severe admonitions in the operating suite when their performance did not meet the professor's standards. He was generous outside the hospital, however, and appeared to compensate for rough treatment during surgery with an invitation to his home for a plentiful dinner.[1]

Liston would not stand for practices that he considered unethical.[9] One of his most famous confrontations was with Robert Knox (1793–1862), surgeon and unindicted collaborator in the notorious Burke-Hare serial murders of 1827-1828. William Burke and William Hare were grave robbers who supplied anatomists and students in the lucrative trade in bodies for dissection. Liston grew suspicious of Knox, suspecting that the corpses the latter used for his anatomy demonstrations were victims of the infamous duo. Bursting into Knox's laboratory with his students, Liston found one of the corpses, a young woman named Mary Paterson, in a lascivious pose. Outraged, the powerfully built Liston threw Knox to the floor and retrieved the body for a proper burial.[9]

Liston denounced practices that he considered objectionable and unscientific. He publicly disparaged James Yearsley (1805–1869) for removing the tonsils and uvula for stammering.[10] Often correct in his assertions, he was not infallible. His hubris had fatal consequences in a child that had a neck mass. Convinced unequivocally that it was an abscess, Liston took a knife from his apron and plunged it into the mass. Unfortunately, the mass was indeed an aneurysm and the boy exsanguinated.[11]

Impact

Liston died in 1847 at age 53 of a ruptured aortic aneurysm.[1,2] His funeral was attended by 500 students, friends, and pupils.[1] For nearly 100 years following his death, the Liston Medal for Surgery was awarded for surgical excellence at University College Hospital.

Popularly known today for his bravura 30-second amputations and operations and its apocryphal 300 percent mortality (the patient, the assistant who lost a finger, and a bystander who died from shock from nearly being sliced by his errant scalpel), Liston had a substantive impact on surgical technique in his use of flaps in amputations and in such commonplace instruments as his amputation knife and locking vascular forceps. His practices had features that anticipated aseptic surgery.

His stature and imperious behavior influenced surgical education. His operating theatre and wards were austere locations for learning. His trainees were challenged by his high standards, but he had still treated them fairly. This fostered an environment for the continual pursuit of excellence. He was unabashed and candid when it came to criticism of his peers.

Less known today is his devotion to his patients. His era was one where patients entered hospitals fearing certain death, with a justified terror of surgery. Liston understood that he had a responsibility to his patients' feelings. His duty as a surgeon was to have a thorough knowledge of anatomy and pathology and be experienced and accurate in diagnosis. Surgery inflicted horrible pain and agony, so the surgeon needed the resolve to proceed without hesitation with confidence and deftness, important features of Liston's surgical technique. While the embodiment of the domineering surgeon, a complete picture of Liston includes a compassionate doctor, devoted to his patients, convinced that they are best served by his command of the field and technical skill.

Acknowledgements

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Legend

1 Liston circa 1843-1847. On calotype by Hill & Adamson, © National Portrait Gallery, London, England.

2 Technique of thigh amputation, making the incision from the skin to the femur. From Bell (ref. 7).

3 Thigh amputation using Liston's amputation knife to create a flap from the femur outward. From Liston (ref. 8).

4 Transecting the femur. From Liston (ref. 8).

6

Mary Edwards Walker: Trailblazing feminist, surgeon, and war veteran

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Dr. Mary Edwards Walker, the first American female surgeon, served in the military for the Union in the Civil War but treated soldiers from both sides of the conflict. She was interned as a prisoner of war. In recognition of her service she was awarded the Congressional Medal of Honor, today the only woman so honored. Disabled by her wartime experience, she became recognized after the war for her progressive feminism and her outspoken advocacy for women's rights.

1

Childhood and education

Walker was born on a farm in Oswego Town, NY on November 26, 1832, the youngest of seven children. Her parents, Alvah and Vesta Whitcomb Walker, were very progressive and her upbringing was unconventional. Her parents supported equality for all. They vigorously opposed slavery and believed that both genders should be granted the same rights and opportunities. They modeled non-traditional roles. Her mother often did heavy fieldwork and her father shared the housework. Her father held traditional female garb in disdain and believed that corsets impeded circulation and long trailing skirts were unsanitary. So young Mary grew up wearing "comfortable, practical clothing, instead of the corsets and dresses common in her era."[1]

Her parents were determined that their daughters would be educated in the same manner as their brother. They founded the first free school house in Oswego on their farm in the late 1830s.[2] Thereafter, she attended Falley Seminary in Fulton, a school that fit her parents' expectations regarding progressive reform and gender equity in education. Her education strengthened her rebellion against stereotypical gender roles.

After graduation she became a teacher at a school in Minetto. She aspired for a career in medicine, so she saved her salary for medical school tuition. Her inspiration may have come from her father, who may have been a self-taught physician and kept medical texts in the home.

Medical training

Walker was the only woman in her class at Syracuse Medical College (now the State University of New York Upstate Medical University), the nation's first medical school to grant a full medical degree to a woman. She graduated with honors in 1855 after completing three 13-week semesters, each at a tuition of $55.[3]

After graduation she married Arthur Miller, a classmate. With an inherent feminist mindset, she wore a suit and top hat, omitted the word "obey" from her vows, and kept her own last name.[1] They moved to Rome, NY, and opened a private practice that was unsuccessful. Many patients were uncomfortable with a female physician. Some were openly derisive. Alleging infidelity, Walker separated from Miller around the start of the Civil War.[4] Their divorce became final after the war in 1868.

Civil War years

Because of her gender Walker failed in her attempt to join the Union Army at the outbreak of the American Civil War in 1861. Unable to secure an active duty commission, she volunteered to serve as a surgeon but be counted as a "nurse" on military records. Her first post was at a temporary army hospital in the patent office in Washington, D.C. An advocate for patient rights,

she felt that it was her duty to counsel soldiers about their right to refuse amputation despite the risk of her own dismissal. She examined the soldiers herself. "In almost every instance," she said, "I saw amputation was not only unnecessary, but to me it seemed wickedly cruel."[5] During this time, she helped to establish an organization to aid women traveling to Washington to visit wounded relatives.[6]

She served throughout the duration of the war, including the First Battle of Bull Run (1862), and the Battles of Chickamauga (1863) and Atlanta (1864). In the field she wore bloomers or trousers. Eventually she created her own modified Union officer's uniform consisting of a calf length skirt over trousers that allowed her to follow troop movements and tend to the wounded (Figure). She purposely left her hair long and curled "so anyone could know that she was a woman."[6]

She never stopped petitioning for a commission as an Army surgeon. In 1863, she wrote to the Secretary of War, Edwin M. Stanton. When he refused, she wrote directly to President Lincoln the following year. She asserted that a commission was denied "solely on the ground of sex."[5] Lincoln replied that he could not interfere in military matters. After more than two years of battlefield service, she was promoted to "Contract Acting Assistant Surgeon (civilian)" in the Army of Cumberland by General George Henry Thomas,[1] then an assignment with the 52nd Ohio Regiment when their assistant surgeon died.

She was captured by a Confederate sentry in April 1864 while crossing alone on horseback across lines to provide care to wounded civilians left behind as the Union Army withdrew. She was arrested as a spy largely because she was garbed in men's clothing. She spent four months in the Castle Thunder prison near Richmond, VA.

Her appearance as a female military prisoner caused a commotion that was recorded in many diaries of the time. One Confederate captain wrote

[The crowd was] both amused and disgusted... at the sight of a thing that nothing but the debased and depraved Yankee nation could produce....[She] was dressed in the full uniform of a Federal surgeon...not good-looking and of course had tongue enough for a regiment of men.[5]

She was eventually freed as part of a prisoner exchange that returned at least fourteen physicians to their respective armies. A later biography noted that she later said she was delighted to have been part of a "man for man" swap.[1]

After her release she was assigned at her request to be the surgeon for female prisoners of war in Louisville, KY, with the title Acting Assistant Surgeon. She thus became the first female surgeon commissioned in the Army at a salary of $100 per month plus $434.66 in back pay. After only four months, however, frustrated with both prison officials and prisoners that questioned her care, she transferred to the Refugee Home in Clarksville, Tenn., where she returned to treating wounded soldiers. At war's end she returned home to upstate New York.

In November 1865 Walker was awarded the Congressional Medal of Honor by President Andrew Johnson. The citation said

[Dr Walker] has devoted herself with much patriotic zeal to the sick and wounded soldiers, both in the field and hospitals, to the detriment of her own health, and has also endured hardships as a prisoner of war.[7]

Her award was among 910 others that were rescinded in 1917 when the criteria for the honor were restricted to only those who had engaged in "actual combat with the enemy." She refused to surrender the medal and proudly affixed it to her clothes daily for the rest of her life. After extensive lobbying by her relatives and supporters long after her death, the honor was restored by President Jimmy Carter in 1977. Once more her heroism was recognized for her "distinguished gallantry, self-sacrifice, patriotism, dedication and unflinching loyalty to her country, despite the apparent discrimination because of her sex."[7] Walker remains the only woman recipient of the Medal of Honor.

Social activism

Walker's wartime experience, especially the time spent in a Confederate prison, physically diminished her and her eyesight started to fail. She took up the causes of equal rights for women's and abstinence from alcohol and tobacco in lectures throughout the United States and Europe. She published two books that advocated for women's rights that drew on her own experiences: *Hit: Essays on Women's Rights (1871),* and *Unmasked, or the Science of Immorality: To Gentlemen by a Women Physician and Surgeon (1878)*. Women should not be subservient to men, she argued. She had positions that were forerunners of the modern women's movement: Compensation for domestic labor, equal rights in divorce, and retention of maiden names after marriage.

She was a member of the National Dress Reform Association and often wore the dress and trouser combination ("bloomers") popularized by her friend and fellow activist Amelia Jenks Bloomer. Walker said

I am the original new woman. Why, before Lucy Stone, Mrs. Bloomer, Elizabeth Cady Stanton and Susan B. Anthony were—before they were, I am. In the early '40's, when they began their work in dress reform, I was already wearing pants...I have made it possible for the bicycle girl to wear the abbreviated skirt, and I have prepared the way for the girl in knickerbockers.[8]

Walker was often criticized, ridiculed and even arrested for wearing men's clothes, but in keeping with her unique point of view, she proclaimed, "I don't wear men's clothes, I wear my

own clothes."[5] At one trial for impersonating a man, she said that she had the right "to dress as I please in free America on whose tented fields I have served for four years in the cause of human freedom."[6] The judge dismissed the case and freed Walker, admonishing the police to never arrest her again.

Not surprisingly she was active in the women's suffrage movement. In 1868, she sued the Election Board in Washington and asserted that as an American she was entitled to the right to vote. She served the cause throughout her life, testifying before Congress in 1912.[9] She unsuccessfully ran for Congress in 1890 and for the Senate in 1892.

She died in 1919 at the age of 86 just one year before the 19th Amendment was ratified giving women the right to vote. She was buried in her black suit and tie.

Legacy

In World War II, the Liberty ship *SS Mary Walker* was commissioned. The U.S. Postal Service issued a twenty-cent stamp to commemorate the anniversary of her birth in 1982. She is honored in the Women in Military Service for America Memorial Dedicated in 1997. A number of medical facilities are named in her honor, including the Whitman-Walker Clinic in Washington, DC, and the Mary Walker Health Center at SUNY Oswego. AUS Army Reserve Center in Walker, Mich., bears her name. The American College of Surgeons, Women in Surgery Committee created the Mary Edwards Walker Inspiring Women in Surgery Award in 2016 to be given to a surgeon in recognition of an individual's significant contributions to the advancement of women in the field of surgery.

One of her descendants provided a succinct and insightful into Walker's life. While appealing to get Walker's Congressional Medal of Honor restored she said, "Dr. Mary lost the medal simply because she was a hundred years ahead of her time and no one could stomach it."[10]

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Legend

Mary Edwards Walker wearing her Congressional Medal of Honor. Image from the National Library of Medicine.

7

Hirschsprung's Disease: Stimulating surgical investigation for over a century

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Since Harald Hirschsprung's classical description of congenital megacolon in 1886, Hirschsprung's disease has challenged pediatric surgeons to the present day, spurring a century of pathological and surgical investigations. Initially the focus was on the megacolon, which could reach spectacular dimensions. It was not until 1949 when Boston surgeon Ovar Swenson demonstrated the absence of peristalsis in the rectosigmoid that the pathogenesis was established and rational surgical strategies could be devised.

1

First description

Frederick Ruysch first described Hirschsprung's disease in 1691 as the phenomena of an extremely dilated colon.[1,2] However, this disease was eponymously named after Harald Hirschsprung (Figure 1) who presented the first comprehensive description of the clinical histories of two infants with fatal constipation at the Society of Pediatrics in Berlin in 1886. In his original description Hirschsprung describes the pathologic appearance of the colon from an 11 month old child as "not only dilated, but the wall is also greatly hypertrophied, especially the muscle layer."[3,4] Although there were a handful of prior reports on congenital megacolon, Hirschsprung's classical descriptions officially recognized this disease entity in the medical community. Few diseases in pediatric surgery has stirred as much disagreement and misunderstanding as the pathophysiology and optimal treatment of Hirschsprung's disease.

Pathogenesis debated

Following Hirschsprung's publication many prominent surgeon-scientists offered their opinions. There were three major theories regarding the etiology of Hirschsprung's disease. Hirschsprung and his associate Mya, who first coined the term "congenital megacolon," put forth the malformation hypothesis. They believed congenital dilatation and hypertrophy of the colon was the root cause of this disease.

Marfan and Treves were among those who thought that the colon became obstructed by some kind of mechanical obstruction. The redundant and dilated colon, particularly the sigmoid, caused enlargement of the rest of the colon present in their patients. In 1905 Perthes offered evidence that the colon formed valves that led to a functional obstruction.[5]

In 1900 Lennander began to venture close to the current view when he proposed that a deficiency in the innervation of the bowel as the cause of colonic obstruction.[6] Given the knowledge of the time he saw two possible neurogenic causes: Parasymphathetic inhibition and sympathetic hyperfunction. Evidence for parasympathetic inhibition was experimental evidence of megacolon developing following resection of parasympathetic nerves distal to the colon in animals in 1926.[7] Clinical observations in the 1930s reported colonic dilatation developing in patients treated with atropine, at the time interpreted as evidence of autonomic dysfunction as contributing to Hirschsprung's disease.[8]

Theories in practice

The debate on pathogenesis had a practical basis – it would dictate a rational surgical solution. Based on Hirschsprung's view the 19th century solution was surgical resection of the

dilated colon. However, the distal segment still presented a functional obstruction. It is no surprise that nearly all patients so treated failed to improve and many died. Still, those ascribing to Hirschsprung's malformation theory continued to resect the dilated colon into the early 20th century. Other operations included removal of rectal valves or folds that would be created by crimped loops of bowel[5] and bypass operations to exclude problematic segments of the colon.[4]

Those who held a neurogenic basis for the disease tried to improve colonic peristalsis. Lennander[6] observed an enterprising attempt to pass electrical current through an enema in a 4-year-old boy. The boy passed stool, perhaps out of a desire not to have the procedure repeated as the faradization itself can be extremely painful.

Addressing the supposed parasympathetic deficiency, others proposed parasympathomimetic drugs. Law and colleagues in 1940 administered acetyl-beta-methylcholine bromide to treat Hirschsprung's disease. Despite the toxicity of his treatment, he believed his treatment was a success.[9]

On the other end of the autonomic nervous system, lumbar sympathectomy received attention during the 20s and 30s. Telford and Haxton reported improvement in constipation following treatment with spinal anesthesia and lumbar sympathectomy in patients with spastic paraplegia.[10] The latter operation was advocated by Ladd and Gross in their landmark text in 1941.[11] Despite some successes, failure was more common.

Intestinal peristalsis and innervation

In 1901 Tittel focused on the intrinsic nervous system in the first histologic study of Hirschsprung's disease.[12] He found that the colon lacked nerve plexuses, although the innervation to the ileum appeared normal. Given the current understanding of the disease, it comes as no surprise that his findings were refuted at that time. Other investigators found ganglion cells in the colons in their specimens, in retrospect clearly coming from patients with short segment disease or with functional constipation.

The debate resurfaced in 1940 when Tiffin and co-workers called attention to the absence of ganglion cells in the myenteric plexus of a patient with congenital megacolon.[13] Despite these findings, opinions regarding the significance of the absence of ganglion cells were slow to change. As late as 1970 Ehrenpreis argued that the lack of ganglion cells was as a result of colonic dilation instead of the cause.[4]

Orvar Swenson

Educated at Harvard Medical School and with residency training from the Peter Bent Brigham hospital, Orvar Swenson (Figure 2) was recruited in 1945 to set up a surgical research

2

laboratory at The Children's Hospital by its chief of surgery, William E. Ladd. Swenson became particularly interested in children who were slowly dying with megacolon without an effective treatment.

In a 2003 interview he remembered a young child with abdominal distention who was believed to have inflammatory bowel disease. Ladd performed a colostomy and the patient's distention resolved.[14] Swenson knew that Sidney Farber, pathologist and famed cancer researcher, had equipment to measure intestinal peristalsis. He used it to study intestinal peristalsis through the child's colostomy. Surprisingly, his tracings demonstrated active contractions, where tracings in the colon distal to the stoma demonstrated no peristalsis. Swenson thus made the crucial discovery that patients with Hirschsprung's disease, rather than a mechanical obstruction, had a functional one.[14]

He reviewed the contrast studies of megacolon patients with Edward Neuhauser, radiologist at The Children's Hospital. Most of the colon were hugely dilated, but they couldn't make out the rectum and sigmoid in the studies. Swenson proposed placing contrast into the rectum as an enema.[14] They found that the rectum and sigmoid in many of the patients were patent but normal in caliber, compared with the much larger distended proximal to that level. This finding would become the standard imaging study for the diagnosis of Hirschsprung's disease.[15]

Knowing that children with megacolon improved after colostomy, surgeons at The Children's Hospital began to do the procedure only to find that obstruction recurred when the stoma was later closed. Swenson decided for his next patient

with megacolon he would bring the stoma down to a level as close to the anus as possible, in effect performing a colo-anal anastomosis above the dentate line, the procedure that would later be known as the Swenson procedure.[16]

Swenson faced extensive criticism when he explained what he planned to do. He recalls being told, "You're going to ruin these patients; they'll have urinary incontinence; they're going to have sexual problems."[14] Robert Gross, who had assumed the position of chief of surgery upon Ladd's retirement, tried to take over care of Swenson' patient. The mother refused and Swenson went on with the operation. The child did well, and Swenson went on to do the procedure on six other megacolon patients languishing on the hospital wards.[14]

Five of the six did well. One did not. Repeating the barium enema, there was an area of constriction that had been left behind. Swenson had the crucial idea of doing an intraoperative biopsy to confirm the presence of ganglion cells at the level of the bowel being connected to the anorectum. In yet another innovation that would define the management of the disease was to perform a rectal biopsy to confirm the diagnosis. "Well hell, the thing to do is to do a rectal biopsy!" he remembered thinking.[14] The test would become standard in the diagnosis of Hirschsprung's disease and a necessary part of its intraoperative management.[16]

Discussing the idea with Gross, however, was a mistake. The chief became angry. "Swenson," he said, "I forbid you to do this either on your own patients or on a ward patient in this hospital. You'll end up with a lot of infection and trouble that I don't want."[13] Swenson went on to do the biopsies. And within months he was out of a job, his office taken away from him by Gross.[14] He moved across town to the Floating Hospital for Children at Tufts University School of Medicine and continued to treat generations of children with megacolon.[17]

Other operations

Once Swenson demonstrated the pathophysiology of Hirschsprung's disease and devised an effective surgical approach, other surgeons devised successful operations that addressed some of the difficulties posed by his procedure. Despite its success the Swenson procedure was an extensive and difficult operation that had a high mortality when performed in infants. Surgeons were concerned that the deep pelvic dissection around the anorectum risked anastomotic leak, incontinence, and sexual dysfunction.

In 1956 Duhamel proposed excluding the rectum, bypassing it by bringing the ganglionated segment to the posterior aspect of the anorectum through the retrorectal space. The retained anorectum and the pulled through segment was connected side-to-side by crushing the two using a pair of clamps left in place, handles emerging from the child's anus until the walls annealed weeks later.[16] Modifications to the Duhamel procedure included placing the anastomosis above the internal sphincter to address postoperative soiling[18] and the use of stapling devices to connect the native anorectum with the pulled through segment, saving the infant the hassle of having clamps dangling from his or her anus.[19]

In 1962 Soave described the technique of separating the mucosal layer of the anorectum from the seromuscular layer and bringing the ganglionated segment through the sleeve of muscularis that remained.[20] The technique had been devised by Sabiston and Ravtich in 1947[21] and had been applied to an adult patient with Hirschsprung's disease by Yancey 10 years previously in 1952.[22] Soave left the pulled through colon hanging out the infant's anus for 10 days to facilitate adherence of the pulled through colon to the mucosa of the anorectum before it was trimmed away. Boley did away with that step by everting the mucosal remnant and bringing the pulled through segment out with it, allowing a direct anastomosis outside the perineum.[23] Another technique for resecting the rectosigmoid was proposed by Rehbein in 1958, in effect doing a low anterior resection less extensive than Swenson's original operation.[24]

With improvements in the anesthetic and critical care of newborn infants, surgeons began to perform pull through procedures earlier in infancy and finally in the newborn period. Cilley and Coran began to do one-stage pull through procedures routinely in the first weeks of life in 1994.[25] In 1998, De la Torre-Mondragon and Ortega-Salgado described a single stage transanal pull-through procedure by starting a submucosal dissection just above the dentate line, in effect doing a Soave procedure from below. A muscular sleeve thus is created to allow mobilization of the rectum and sigmoid colon down and out of the anus, full thickness biopsies obtained to identify the transition zone. Once ganglion cells are identified, the ganglionated segment is sutured to the rim of anal mucosa. One patient was under one month of age, another was a month-and-a-half, demonstrating that the procedure was appropriate in infants.[26]

Conclusion

The 130-year history of Hirschsprung's disease exemplifies the perseverance and dedication of surgeon-scientists to investigate its pathology and to pursue a rational basis for appropriate surgical management. Swenson's fresh interpretations of what he was observing in his patients, the originality of his use of diagnostic biopsy and imaging, and his bold surgical solution combine to form one of the landmark achievements of a single individual in pediatric surgery. Research into the molecular genetics of Hirschsprung's disease has brought the understanding of the pathology of the condition into the modern era.[27]

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Legend

1 Harald Hirschsprung.

2 Orvar Swenson. Digital Collections and Archives, Tufts University.

8

Sydney Ringer: The pipe water of New River Water Company and the discovery of the elixir of life.

American College of Surgeons
Inspiring Quality:
Highest Standards, Better Outcomes
100+years

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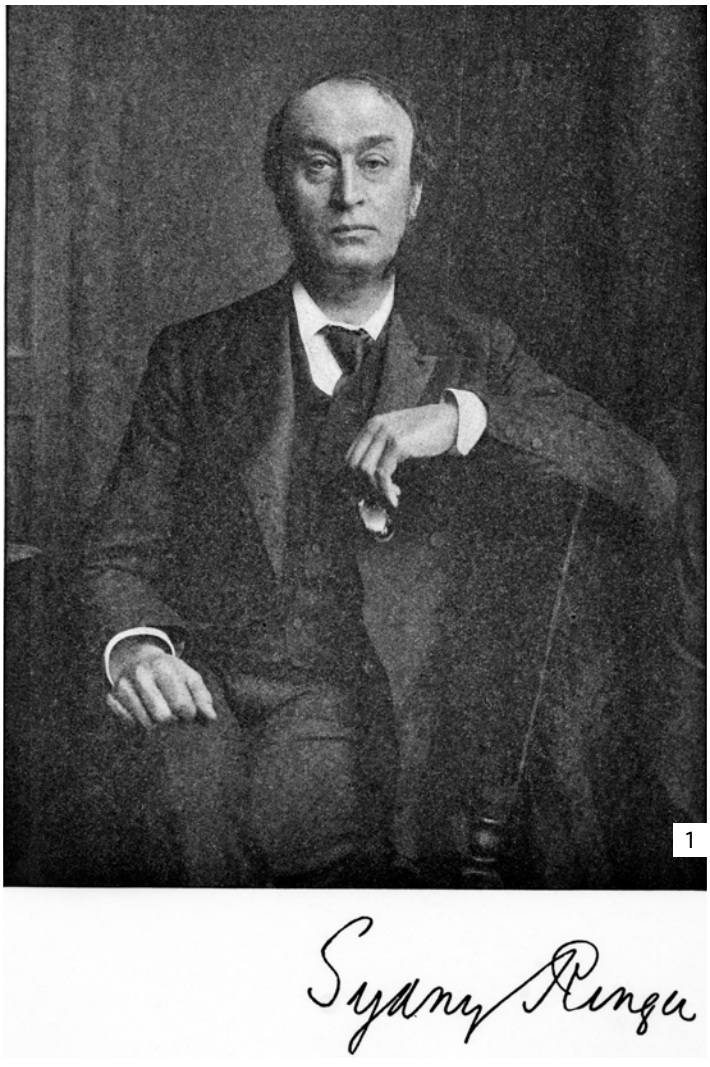
Sydney Ringer published 4 papers between 1880 and 1883 that demonstrated the role of calcium in the contraction of the heart. His research led to the discovery of the role of sodium, potassium and calcium ions in myocyte action potential, cardiac myocyte contraction, and their essential presence in all physiologic solutions. The importance of inorganic ions came about when one of his technicians used ordinary tap water instead of distilled water. Isolation of key inorganic constituents in pipe water led to the creation of the first physiologic saline solution. Modifications in Ringer's original formulations would be used in physiological research on resuscitation from hemorrhagic shock and pathophysiologic states that are basic to modern surgical practice.



1

Early life and education

Sydney Ringer (Figure) was born in 1835 in Norwich, England to a family of non-Anglican Protestants, known at the time as nonconformists or dissenters.[1-4] In 1853, he spent a year under surgeon Mr. Benjamin Henry Norgate at Norfolk & Norwich Hospital before entering medical school at University College London (UCL) the following year, the normal sequence in medical education at the time.[4] He chose UCL was because it was one of the few medical colleges that admitted nonconformists, unlike Oxford or Cambridge, where admission was offered only to practicing Anglicans.[4] With a faculty that boasted T. Wharton Jones, William Jenner, Edmund A. Parkes, and J. Russel Reynolds, UCL maintained a tradition of original research and rigorous scientific education.[5-8]

Ringer graduated M.B. in 1860, and served as resident medical officer at the University Medical Hospital from 1861 to 1862.[4] After he earned his medical degree in 1863 he was appointed as assistant physician to the hospital, becoming a full physician in 1866.[9] For four years (1865-1869) he also served as assistant physician at the Children's Hospital, Great Ormond Street.[4]

Professional career

In 1859 Ringer published his first paper while still a medical student, the first of three on the urinary excretion of urea, sugar, and electrolytes.[10] His mentor was E.A. Parkes, who was appointed during that time as the professor of clinical medicine at UCL. Under Parkes Ringer learned to balance the commitments to the practice of medicine, teaching, and original research.[11] Ringer developed into an excellent bedside teacher who maintained the twin standards of clinical instruction and scientific investigation. For most of his career he maintained a small laboratory in the department of physiology.

His text, *Ringer's Handbook of Therapeutics*, was a classic of its day and underwent thirteen editions from 1869 to 1897. The book was originally commissioned as a revision of Jonathan Pereira's (1804-1853) massive *Elements of Materia Medica* (first edition, 1839). Ringer improved the work by offering a concise summary of the actions and indications of drugs that made the book practical for clinical use. Ringer held the chair of *materia medica*, pharmacology, and therapeutics, and the principles and practice of medicine at UCL. In 1887, he was named Holme Professor of Clinical Medicine, a chair he held until his retirement. He was a fellow of the Royal College of Physicians (1870) and Fellow of the Royal Society (1885), and held honorary memberships with the New York Medical Society and the Paris Academy of Medicine.

Ringer's solution

Ringer is most remembered for his invention of Ringer's solution. In four sentinel papers between 1880 and 1883 in the *Journal of Physiology* he described the mixture, the predecessor for future physiological saline solutions.[12-15] His work played a key role in the understanding of the role of calcium in muscle contraction, particularly the contraction of the heart.

Ringer studied isolated heart tissues from the common frog (*Rana temporaria*) to find a substitute solution for blood that was could sustain normal heart function.[14-16] The frog suited his experiments because it had no coronary vascular supply, the extracellular myocytic space communicating with the contents of the ventricular lumen.[16] He examined the effects of various levels of electrolytes, hoping to replicate cardiac function in blood. At first his focus was on potassium and sodium.[13]

One day, Ringer's technician revealed that he had inadvertently used regular tap water from the New River Water Company to prepare the saline solution for the day's experiments rather than the distilled water that Ringer requested.[16] Informed of the error Ringer tried to repeat his results using the distilled water for which he had planned.[12] Something in the New River Water Company water sustained a normal heart beat.[12] Ringer eventually arrived at a mixture of 0.75% sodium bicarbonate, 0.1% calcium chloride, and 1% potassium chloride. Using the concoction, Ringer reported, "the heart will continue beating perfectly."[14] And thus Ringer's solution was born.

Appropriate levels of potassium were also necessary. With progressively lower potassium concentrations the beats would "broaden," in his words, until "fusion of the beats would occur and the ventricle would be thrown into a state of tetanus."[17] The effect, unknown to Ringer, was the effect of low potassium on shortening the refractory period. Despite also being a cation like potassium and "two elements apparently so nearly akin,"[14] sodium had no effect. Ringer also researched fish, finding that they would die in distilled water and depended on sodium and calcium salts for survival.[18]

Ringer's achievements are remarkable given that he did his experiments without a pH meter, digital balance, modern pipette, or ready access to reagents. With his colleagues, including E. G. A. Morshead, William Murrell, Harrington Sainsbury, and Dudley Buxton, he published more than thirty papers from 1875 to 1895 on the actions of inorganic salts on living tissues.

His papers may seem odd to a reader familiar with the modern structure of methods, results, and discussion. He presents his findings in the form of an experimental diary with commentaries of his observations. He seldom presented his data in tables. Publishing in an era before modern statistics, Ringer did not use any form of statistical analysis.[16] The word "frog" surprisingly is not found in the primary calcium papers at all, although the species is clearly mentioned in his first paper.[16] The scientific name *Rana temporaria* first appears in a later paper by Ringer and Salisbury.[17]

Clinical use

Alexis Hartmann, a pediatrician and biochemist, worked with M.J.C. Senn in 1932 to treat acidosis with sodium lactate in his patients.[19] Worried by a too-rapid correction and development of alkalosis, Hartmann combined sodium lactate and Ringer's solution. He felt that "the conversion of sodium lactate into sodium bicarbonate would be sufficiently slow to lessen the danger of alkalosis."[3] The mixture is known today as lactated Ringer's or Hartmann's solution.

Conclusion

Ringer was a natural polymath, drawn to other fields and curiosities. He was an early enthusiast of acupuncture in England. He had family contacts in the Far East, and may have heard of the practice "needling" from a stay in Paris, where it was already known.

Ringer was a brilliant clinician, an avid teacher and a pioneer scientist in biomedical research, an early model of clinician-scientist that would become the model was for medical faculty in UK and the US.

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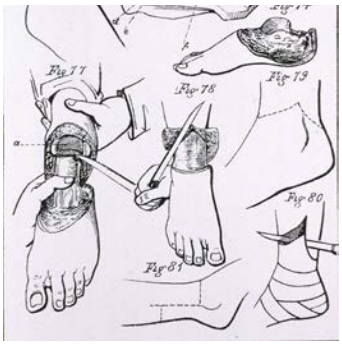
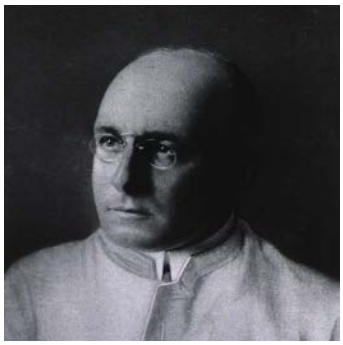
Legend

Figure. Sydney Ringer's only known portrait (Courtesy Wellcome Library, London).





9

Acute arterial injury in U.S. military surgery

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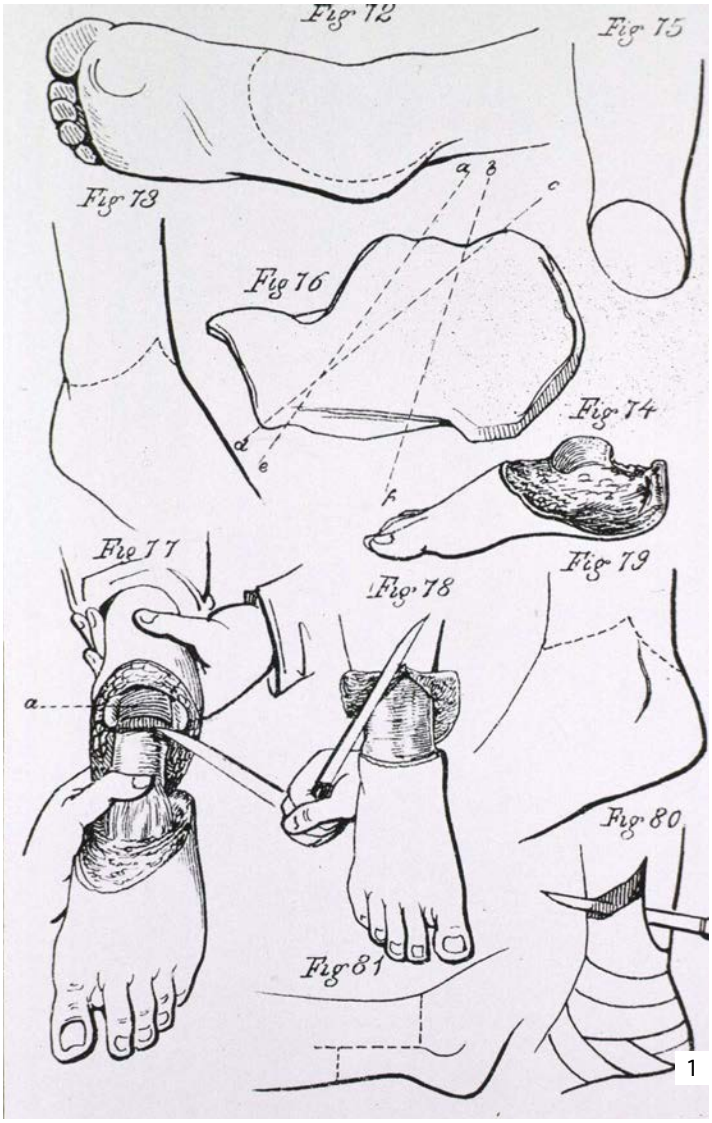
Hippokrates of Kos said, "He who wishes to be a surgeon must first go to war." New surgical techniques are discovered and old ones are perfected close to the battlefield.[1] Surgery for arterial injury is a perfect example of how a century of American military conflicts established modern principles of vascular repair.



1

Civil War

I noticed a heap of amputated feet, legs, arms, hands, etc. – about a full load for a one-horse cart.
—Walt Whitman

In the Civil War amputation was the sole lifesaving option for acute arterial injury (Figure 1). From 1861-1865 an estimated 60,000 amputations were performed, accounting for about three-fourths of all operations performed during the four years of the conflict, most of which were for gunshot injuries to the limbs.[2] Technical manuals describe arterial ligation and primary amputation by a circular incision under tourniquet for hemostatic control in cases of arterial injury.[3]

Because prompt surgical control of bleeding dictated survival, the majority of soldiers with arterial trauma died. In the First Battle of Bull Run (Battle of First Manassas, July 21 1861) wounded soldiers had to make their own way from the battlefield to the only hospital in Washington, DC, a distance of 27 miles, to receive medical care.[4] General George McClelland, commanding general of the Army of the Potomac, gave Major Jonathan Letterman, MD, authority to reorganize the medical care of his troops. By war's end Letterman had been given Presidential authority to organize hospitals in cities and on trains and ships to create a national network of an estimated 400,000 beds to transport, receive, and care for the Union wounded.[4]

Letterman's efforts had an immediate impact on survival from gunshot wounds and arterial injuries. More soldiers survived transport to field hospitals where they underwent amputations sooner after initial injury and at more distal levels. Mortality rates decreased as the war progressed as a result of the reorganization of field care,[5] the primary reason for the reduction in mortality in previous major conflicts such as the Crimean war.[6]

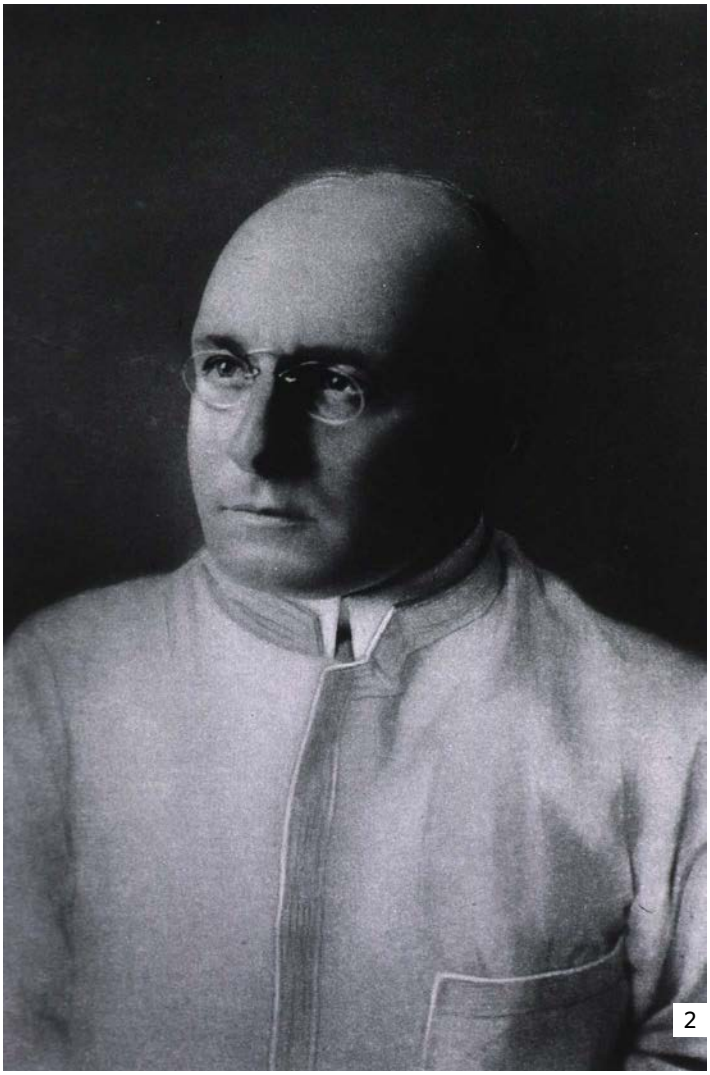
World War I

Your blood coagulates beautifully.
—Ernest Hemingway, A Farewell to Arms

World War I brought the myriad advancements in medicine and technology in the last half of the 19th century and the beginning of the 20th to military medicine. Systems of field surgery were well-established by the time the U.S. entered the war in 1917. American physicians and surgeons attached with the American Expeditionary Force saw the operation of British Casualty Clearing Stations (CCS) staffed by surgeons, anesthetists, and nurses just 6 to 9 miles behind the front lines.[6] U.S. military surgeons adopted the French system of triage of the wounded developed by Antoine De Page (1862-1925).[7]

Karl Landsteiner's work delineating the major ABO blood types and the experience of the surgeons in the British Second Army

with transfusion led American surgeon Oswald Robertson (1886-1966) to deduce in 1917 that stored universal donor whole blood could be given quickly and safely in forward medical units.[8] English chemist Henry Dakin (1880-1952), joined French-American surgeon-scientist Alexis Carrel (1873–1944; Figure 2) to develop the Carrel-Dakin method of wound decontamination, irrigating battle injuries with his namesake solution prior to closure.[9,10]



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Carrel's technical achievement of vascular anastomosis, for which he received the Nobel Prize in medicine in 1912, and the improvements in wound care that he put forth with Dakin encouraged American surgeon Bertram Bernheim to attempt primary repair of vascular injuries. While he had some success, he was discouraged due to the high rate of infection. "(It) would have been a foolhardy man," he said, "who would have essayed sutures of arterial or venous trunks in the presence of such infections as were the rule in practically all of the battle wounded."[11] Repair of arterial wounds in battle would need advances in infection control, resuscitation, and continued logistical improvements to reduce the time between injury and definitive care.

World War II

It doesn't make a damned bit of difference who wins the war to someone who's dead.
—Joseph Heller, Catch-22

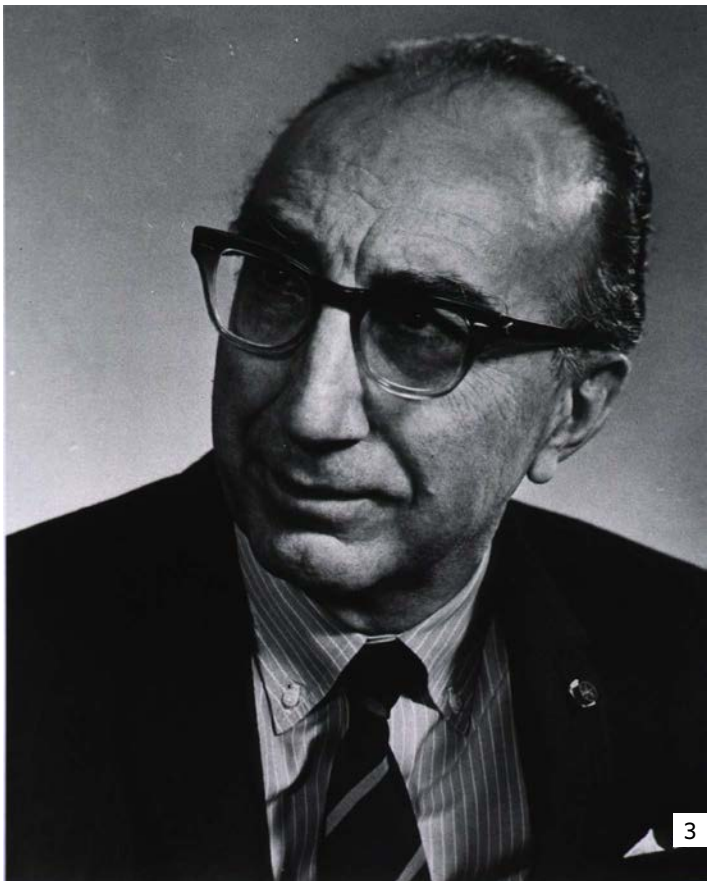
During World War II (WWII) American forces had 535,000 medics, 57,000 nurses, 47,000 physicians, and 2000 veterinarians under the leadership of Surgeon General Norman Kirk (1888–1960). Each battalion had two combat medics to make an initial determination whether if an injured soldier required evacuation to a battalion aid station. If an injury needed additional treatment, the patient was send to a divisional clearing stations were urgent surgical took place. Definitive care was provided at 700 overseas hospitals and military facilities stateside. Kirk's guidelines, developed before his appointment as Surgeon General, were adopted as standard procedures: Leaving skin and soft tissues longer than the bone in amputations, double ligation of blood vessels, and delayed closure of contaminated wounds.[12]

Improvements in record keeping allowed Michael DeBakey (1908–2008; Figure 3), Colonel and Chief of the Surgical Consultants Division, and Colonel Fiorindo Simeone to track outcomes of 2471 cases of acute arterial injury during WWII.[13] Primary repair was attempted only 81 times, with only a slightly improved subsequent amputation rate (36%) compared with arterial ligation (50%). They recognized significant obstacles to successful arterial repair, including delays in treatment and the hazard of contamination of the wound and subsequent infection, often precluding vascular anastomosis.[13] Overcoming these problems would allow primary repair of arterial injuries in subsequent American military conflicts.

Korean and Vietnam Wars

Major Taylor: A British artery in an American leg, eh?
Capt. Benjamin Franklin "Hawkeye" Pierce: Right.
Taylor: Probably develop an irresistible urge to drive on the left side of the road.
Pierce: Quite.
M*A*S*H *Season 3, Episode 17: The Consultant*

DeBakey's WWII experience led to the development of Mobile Army Surgical Hospital (MASH) units in the Korean War. Thus operations to save life and limb were performed within 10 miles of combat. Helicopter evacuation became the modern equivalent of Dominique Larrey's *ambulance volante* (flying ambulance) during the Napoleonic Wars. Research at the Walter Reed Army Hospital before the war focused on homograft replacement of injured arteries and prolonged ischemia on muscle cell death.[14] Army surgeons therefore were ready to attempt primary vascular repair in field hospitals. Pioneering vascular surgeons Carl W. Hughes, Edward J. Jahnke,



3

John M. Howard, and Curtis P. Artz visited MASH units in Korea and employed up-to-date techniques and vascular instruments. With the advantages of antibiotics and blood products, the first 130 cases had an 89% limb salvage rate using either direct anastomosis or vein grafts.[15] Army surgeons ultimately finished the conflict with a 13% amputation rate over 304 cases, compared to an overall amputation rate of 49% in World War I.[15] Non-vascular specialist surgeons performed vascular repair in the Vietnam War, still achieving a limb salvage rate of 87% despite their varying levels of skills and training.[16]

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Legends

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10

Howard Atwood Kelly: Man of science, man of God

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Howard Atwood Kelly (Figure 1) was the youngest of the "Big Four"—William Stewart Halsted, William Osler, and William Welch—the founding chairs at Johns Hopkins School of Medicine and creators of the Hopkins legacy. To Halsted he was an "enigma;" to Osler he was the "Kensington Colt" because of his surgical dexterity; and to his students and residents he was simply "The Chief." He was a clinical innovator, performing the first successful Cesarean section (C-section) in Philadelphia in 1888, and pioneered the use of radium in the treatment of gynecological cancer. The consummate clinician, his name is behind the Kelly clamp and he is the one identified with the test to find the ureter by stimulating its peristalsis by touching it with a forcep. His lasting legacy was the residency program in obstetrics and gynecology at Hopkins and the generation of leaders he trained. His devotion to surgery and his patients were inspired by his faith.

1

Upbringing and education

"Accordingly as we remember others, so those yet to come will remember us. If we live only for the present and for our own age and reject the past because of imperfections, so in turn will we ourselves as surely be forgotten and despised as the centuries roll over our dusts."[1]
—Howard A. Kelly, 1912 Presidential Address, American Gynecological Society

Kelly was born in Camden, New Jersey on February 20, 1858, of Irish-German ancestry and was the second of nine children (Figure). The family moved to Philadelphia where his father, Henry Kuhl Kelly, served in the Civil War as a lieutenant in 118th Pennsylvania Volunteers and was in the sugar industry business. His mother, Louisa Warner Hard, held fast her own religious upbringing by her father, Anson Bois Hard, the first graduate of the Theological Seminary of Alexandria, Virginia. Years later Kelly dedicated an altar in the seminary chapel to his grandfather's memory.[2]

Kelly's mother made sure her children used the Bible as the Word of God and their daily guide. His father's background was no less religious. Kelly's great-great-grandfather, Thomas Kelly, who established the family in America, was a recent Methodist convert seeking freedom from persecution. As a boy Kelly frequently took nature walks in the countryside with his mother, an experience that sparked a lifelong interest in nature and the environment.[3] In 1875, the 17-year-old became a member of the Academy of Natural Sciences where he learned the names and classifications of the numerous fossils and specimens that he would continue to collect for a lifetime. His ancestors had a proud tradition of achievement in politics, business, real estate and civic service. Another great-great-grandfather was Michael Hillegas, the first Treasurer of the United States. None of his forebears were in medicine.

At 10 Kelly entered the Classical Institute in Philadelphia, a respected school founded by Reverend John W. Faires. In 1873, at age 15 he entered the University of Pennsylvania where he excelled, honored in Latin and mastered Greek and Spanish.[4] In evenings, he attended lectures of the Franklin Scientific Society and became its president two years later. At Penn he fulfilled Faires' prediction that "Kelly would be outstanding in leadership and first honor man because of the boy's well established trait of sticking to his work and carrying it through completion."[2 p. 17]

Kelly entered the University of Pennsylvania School of Medicine in 1873. He took his father's advice to pursue a field which offered a better livelihood and "fair financial return,"[2 p. 20] turning away from his dream of becoming a naturalist. Of 136 students in his class he was one of only 19 who held a baccalaureate. In typical fashion he became class president. In addition to his medical studies, he made sure he continued his Bible study with his mother. He also maintained his collection of reptile

2

and mammal specimens (Figure 2). Overwork and insomnia drove him to a needed sabbatical year from medical school in Colorado Springs as a ranch doctor and cowhand. During the break he had an experience that reinforced his religious conviction.

There came as I sat up in bed an overwhelming sense of a great light in the room, and of the certainty of the near presence of God, lasting perhaps a few minutes and fading away. I was left with a realization and a conviction never afterward to be questioned in all the vicissitudes of life whatever they might be, a certainty above and beyond the processes of human reasoning.[5]

Upon graduation from medical school in 1882 he wrote in his diary

I dedicate myself, my time, my capabilities, my ambition, everything to Him. Blessed Lord, sanctify me to Thy uses. Give me no worldly success which may not lead me nearer to my Savior."[2 p. 37]

Kelly interned at the Episcopal Hospital in Kensington, Philadelphia, where he continued to receive inspiration.

Hospital experiences drew me into intimate touch with the problems of suffering humanity and revealed the priceless gratitude of the poor when treated with affectionate consideration; this was the final touch necessary to convert all my interests to my profession, no longer merely a means of livelihood, but a shining path of service replete with spiritual rewards.[3 p. 27]

Professional career

Direct contact with the needy led the groundwork for an eventual career in gynecology and the organization of a clinic devoted to the health care of women. In an era before laboratory diagnosis and radiological imaging, diagnosis was a challenge. Kelly recalled a woman admitted to the surgical ward with what was presumed to be a "large fibroid tumor." Uncertainty led to delay, but the woman was eventually scheduled for surgery. However, on the day of her operation the surgeon received a message. "Professor, there won't be any operation today," it said. "The tumor was born last night."[2 p. 38]

After his 16-month residency Kelly began in general surgery but soon began to concentrate on gynecological conditions, unique in an era where such specialization was rare. A clinical innovator, he described the Kelly stitch in 1883 to lift the retroflexed uterus to the anterior abdominal wall. In 1888, he performed the first successful C-section in Philadelphia. After visiting Prague and Berlin, where he met Virchow, he developed an air cystoscope and a technique of cannulating the ureter.[6]

He earned the reputation for surgical dexterity, equally skilled using either hand with a thorough knowledge of anatomy. Suspecting that one of his patients had died of nephritis and fearing that he could not obtain permission for an autopsy, he removed, postmortem, both kidneys through the vaginal vault, a harbinger of modern natural orifice surgery.[2 p. 39] From a two-room facility where he started practice, he built the Kensington Hospital for Women. Osler admiringly nicknamed him the "Kensington Colt."

Osler recommended Kelly's appointment to the faculty at Penn as an associate professor in 1888. One year later the don recruited the colt to the newly established Johns Hopkins School of Medicine. At 31, he became the youngest of Hopkins's Big Four, along with William Stewart Halsted, William Osler, and William Welch, the founding chairs responsible for the Hopkins legacy. Despite his junior status, the relationship among the four was "notable for a lack of jealousy." As was his custom, the relationship reminded Kelly of a Bible passage. He said:

We unconsciously afforded another illustration of the value of the maxim, 'In honor preferring one another,' for where love is, their happiness and progress are sure to find their congenial dwelling place.[3 p. 28]

At Hopkins he continued a career in surgical innovation. He was among the first to use nitrous oxide for anesthesia, incorporate absorbable suture in his operations, and use electrical lights in

the operating theatre. He advocated the use of radium in the treatment of gynecological malignancy despite the opposition of many in his field. William and Charles Mayo were among the few that offered support and encouragement. When he developed gall bladder disease he was operated at the Mayo Clinic. He dedicated his book, *Diseases of the Kidney, Ureters, and Bladder*, to the Mayo brothers.[7,8]

Like Osler and Halsted, Kelly was an educator. He established a leading training program in gynecology, the residency and the men he trained being his greatest legacy. He worked with famed medical artist Max Brödel to revolutionize the use of technical drawings to illustrate key steps in his surgical operations. He took stereoscopic photographs during surgery, and published them as "Stereo Clinics" to enhance the visualization of the procedures to benefit students and surgeons in practice.[9]

Kelly became the first professor of gynecology in the U.S. He retired in 1919 at the age of 60, having served as chief for 30 years, but continued to operate until he was 80. At the end of his career his 550 articles and books covered a wide range of clinical subjects, including urogynecology, caesarean delivery, pulmonary resuscitation, appendectomy, use of radium in malignancy, electrosurgery, and ureteral catheterization. His publications also included non-clinical topics that reflected topics important to him, such as medical history, religion, herpetology and botany.[7,10]

Kelly was a member of major professional organizations, including American College of Surgeons, and had honorary memberships in societies in Ireland and London. The American Gynecological Society named him its president in 1912. One of his honorary doctorates was from his alma mater, the University of Pennsylvania. Of the Four Founding Doctors, only Kelly and Osler received an honorary LL.D. degree from Hopkins. His name is familiar today as one of the standard hemostats used by all surgeons. Less familiar is the Kelly test used to identify the ureter by inducing its peristalsis by gently prodding or grasping it with a pair of forceps. After his death in 1943 a US Liberty ship was christened the "SS Howard Kelly" in his honor.

Religious life

Religion guided Kelly's professional and personal life. He said

Like most boys, I owe my real start in life to my mother, who began to teach me the Bible, standing at her knee, as soon as I could dimly grasp the simple words and before I could read.[2 p. 9]

A Christian Fundamentalist from his teens, he carried a New Testament in his pocket or a portion of Scripture that he would pass to his friends. He read the original Greek and Hebrew texts of the Bible. When the minister was unavailable for Sunday prayer, Kelly would take the pulpit, give the sermon, lead the congregation in prayer. He said a prayer before every operation.

In his book, *A Scientific Man and the Bible,* he promoted his faith. He said, "Fellow Christians, you who have families, hold family prayers daily and read and discuss some Scripture in the family at least twice a day, for the reward is a rich one."[3 p. 38] On his lapel he wore a pink rose in a small vial of water and a blue button that featured a question mark as devices to open a discussion on faith. When asked he turned his lapel to reveal the stem in water and said, "This is a Christian rose with hidden sources of grace and life, [and the question mark signifies the questions] 'what think ye of Christ? Whose son is He?'"[2 pp. 173-174]

Not everyone shared his zeal. To Halsted, Kelly was a mystery; to H.L. Mencken, the acerbic columnist and editor of the *Baltimore Morning Herald*, Kelly was "Dr Evangelicus Extremus."[5, 11] In a review of Kelly's book Mencken said,

Hours on end I have discussed his theological ideas with him, and heard his reasons for cherishing them. They seem to me now, as they seemed when I first heard them, to be completely insane – yet Kelly himself is surely not insane.[12]

Mencken remembered traveling with Kelly on a train from Washington to Baltimore where they discussed Christianity. "Three separate times I was on the point of jumping out of the train window," the journalist said.[13] Even Mencken, however, would agree that Kelly was an honest and caring soul who truly loved mankind.

Family life and legacy

Kelly married Olga Elizabeth Laetitia Bredow in Danzig, Germany in 1889. After a Paris honeymoon they settled in Baltimore and raised nine children in the same religious tradition that Kelly was raised. Only his youngest son, Edmund Kelly, followed his footsteps into medicine. Their home at 1406 Eutaw Place today is a registered landmark in the historic Bolton Hill neighborhood (Figure 2) and so is "Liriodendron," the family's summer retreat in Bel Air, Maryland.[5]

The love of nature and animals that his mother instilled into him as a boy continued into adulthood. Fascinated with reptiles, he allowed snakes to slither freely in his house. The Division of Reptiles and Amphibians at the University of Michigan named him honorary curator, a title that no doubt pleased him. Among his many publications were articles and books on snakes. As an environmentalist, he purchased and eventually donated 200 acres of land in Florida that became Kelly Park near Apopka.[14]

Among the worthy causes he supported was service to the poor and women in medicine, and as an admirer of Florence Nightingale, nursing as a profession.[10] He opposed child labor and prostitution. He provided housing with a housekeeper to former prostitutes needing temporary lodging.[7]

Kelly died of uremia at the Union Memorial Hospital on January 12, 1943, a few weeks short of his 85th birthday.[15] His wife

of 54 years died just hours later in an adjacent room, giving poignancy to the words "till death do us part." A joint funeral was held at the Memorial Episcopal Church, followed by a burial at Woodlawn Cemetery in Baltimore (Figure 3).

Kelly was a unique blend of surgeon and humanitarian deserving of his stature among the prominent figures in the history of medicine. His clinical achievements and humanity represent the best in the profession, a life that was well lived, guided by faith, and continues to be an inspiration.

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Legend

A Howard A. Kelly as a young man (ca. 1912).

B Kelly with his collections of artifacts (ca. 1930). Images reprinted with permission from The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.

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The evolution of the treatment of pyloric stenosis

American College of Surgeons
Inspiring Quality:
Highest Standards, Better Outcomes
100+years

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Once associated with a high mortality when first described in the early 18th century, surgery for infantile hypertrophic pyloric stenosis today is commonplace and all infants are expected to make an uneventful recovery. How surgery evolved over time to the present standard operation, pyloromyotomy, is a story of surgeons familiar with adult conditions gradually discovering a condition specific to infancy and arriving at a correspondingly unique operation.

Patrick Blair, a Scottish surgeon, described a case of an infant who appeared to have pyloric stenosis in 1717.[1] Harald Hirschprung made the first specific description of pyloric stenosis in 1888: "the mucosa showed six ledge-like parallel columnae protruding along the entire length of the canal. These ledges form a rosette, which projected into the cavity."[2] Pyloric muscle hypertrophy was identified as the cause of gastric obstruction. Of note, Hirschprung's first two cases were in female infants, though pyloric stenosis is 4-5 times more likely in males.[3, 4]

Before Frédet

Early authors believed that the muscle hypertrophy was due to pyloric spasm. Management therefore proposed methods to decrease gastric contractions. Approaches included application of electrical current and antispasmodic medications such as atropine and belladonna. Other interventions were neutralization of gastric acid with bicarbonate solution lavage, and refeeding of emesis to ameliorate dehydration and electrolyte imbalances. These measures were frustrating to apply, but were the only means to nurse infants over the course of the six months or so required for gradual resolution of the condition, its natural history. Many infants died before then from dehydration and inanition.[2, 5]

Surgery became an option once it became accepted that pyloric hypertrophy, not spasm, was the cause of the pathology. (One century late molecular technology found the pyloric musculature in infants with pyloric muscle lacked nitric oxide synthase, the enzyme involved in the release of nitric oxide, a mediator of smooth muscle relaxation.[6]) The infants were poor candidates for surgery, inflicted with dehydration, malnourishment, and severe acid-base and electrolyte imbalances. Open drop anesthesia made depth of anesthesia uncertain, made worse by induction in a baby with a full stomach and gastric obstruction. The distended stomach was especially troublesome since once opened, discharged its contents into the field and peritoneal cavity. The contamination was a potential disaster in the era before antibiotics and routine preoperative drainage through a catheter passed from the nose or mouth. Mortality for surgery was correspondingly high, up to 61 percent in early reports.[5]

Lobker first employed gastroenterostomy successfully in 1898 in infants[3, 5], an operation first employed by Billroth's assistant Woelfler for obstructing cancers of the stomach in adults in 1881[5]. The following year James Nicholl dilated the pylorus from an incision in the stomach, which he paired with a gastroenterostomy.[3, 5] He adopted the procedure from Loreta from Italy, who used the operation in 1884 for the treatment of adults with pyloric strictures.[7]

Addressing gastric outlet obstruction from acid-peptic disease in adults Heineke in 1886 and Mikulicz-Radecki in 1887 independently devised their classic operation, the longitudinal incision across the pylorus and its closure in a transverse direction. On June 10, 1902, Clinton Dent in London applied the operation to infants with pyloric stenosis. In his report he noted that some of his contemporaries recognized the difficulty of closing a longitudinal incision in the required transverse direction, given the thickness of the pyloric muscle. Dent claimed that he did not encounter any difficulty in performing a Heineke-Mikulicz procedure on infantile disease. In fact, he claimed, the procedure was easier in infants than in the pyloric

inflammation found in adults. Among the 21 patients in his series there were some who underwent gastroenterostomy and resection of the pylorus. He had some successes, but his overall mortality was near 50 percent.[8]

Frédet

Pierre Frédet is widely credited as performing the first "extramucosal pyloroplasty" on October 12, 1907 in which the mucosa was left intact during division of the pyloric muscle.[2] One month earlier he had tried a Heineke-Mikulicz pyloroplasty on a full-thickness incision of both muscularis and mucosa. His sutures cut through the duodenal mucosa, forcing him to attempt to suture the layer to the antral side of the incision. After the operation the infant began to vomit blood, and died the next day. The lesson learned, Frédet resolved to stay out of the lumen in his next operation, completing the pyloroplasty without violating the submucosal layer. Five years before Dent had brushed off a suggestion that such an operation might be successful.[8] Fredet disagreed; just a month later before the Societe Medicale des Hopitaux de Paris he reported:

One considers a pyloroplasty, an operation which seems a priority, the easiest and least dangerous with an incision about 2 cm long on the axis of the pylorus in the middle of the superior aspect. This longitudinal incision carries through the peritoneum and the muscularis to the exclusion of the mucosa. The bistoury cuts a white tissue, edematous and very hard, creaking under the instrument, having every appearance of certain uterine myomas. The incision cuts entirely through the sphincter to a depth of several millimeters, and the lips of the wound are gently spread. A series of sutures of linen, placed according to the method of Heinecke and Mikulicz, transform a longitudinal wound into a transverse wound, a plastic procedure, which manifestly enlarges the pylorus. The sutures, to the number of 6 or 7, take the entire thickness of the muscle mass and are tied successively to avoid their cutting through.[2]

In part due to avoiding free spillage of gastric contents, mortality fell to 17%.[2, 3, 7] The next year in 1908 Weber from Germany performed an identical operation.[7]

James Nicholl, who previously had tried both Lobker's operation and gastroenterostomy[7], developed an extramucosal pyloroplasty before Frédet, the former's first case taking place almost three years before the latter's first success. Nicholl published a series of six a year before Frédet's presentation to his Parisian colleagues. He used a V-Y pyloroplasty oriented transversely. At first he dilated the pylorus through a separate gastrotomy, but eventually found that he could open the pyloric channel by grasping opposite sides of the incision and pulling them apart.[9] Taylor noted that Nicholl was the forgotten figure in the history of pyloric stenosis. "Nicholl of Glasgow," he wrote, "seems never to have obtained rightful credit for his work."[7]

Frédet doubted the reliability of his operation. He felt that it should not be used in all situations, especially in those patients with large pyloric muscle where he could not close the muscularis. He did not trust leaving the mucosa exposed, so he would instead revert to a gastrenterostomy in those situations. In a 1921 review 9 of his cases had received gastroenterostomies.[2]

Frédet spent a great deal of his career studying pyloric stenosis. Among his lasting contributions was the phrase "projectile vomiting" as a trigger phrase associated with pyloric stenosis. He also described the nonbilious emesis and visible peristalsis as signs indicating the diagnosis. From his hard experience he learned the necessity of preoperative gastric decompression, keeping the baby warm during and after operation, and maintaining hydration through clysis (subcutaneous injection of fluid).[2]

Dent was probably the only surgeon willing to publicly state that closing a pyloroplasty was easy. All other surgeons tackling pyloric stenosis, especially Frédet and Nicholl, had problems getting the thick muscularis to close in a transverse direction without sutures cutting through the tissue.

Ramstedt

On August 23, 1911, Dr. Conrad Ramstedt began an operation for pyloric stenosis with the intention of performing a pyloroplasty. He was already nervous before he started; it was his first such case, and the patient was the son of a famous nobleman.[7] After he weighed his options he decided on pyloroplasty as recently described by Frédet, despite not having seen nor done one.[10] Ramstedt recalled the operation more decades later:

After I had split the tumor down to the mucosa for a distance of about two cm, I had the impression that the stenosis had been relieved. I still tried, however, to accomplish the previously described plastic procedure by transverse suture of the muscle edges. However, the tension on the sutures was so very strong that the first one cut through immediately. Then the thought shot through my head, 'A plastic alteration of the cut edges is completely unnecessary; the stenosis seems to be already relieved by a simple splitting of the pyloric muscle and coincidentally the spasm as well, which is the characteristic basis of the disease.' I did not complete the plastic operation on the muscle which had been originally planned but left the cut gaping, covering it with a tab of omentum for safety's sake and ended the operation. The little one vomited a few times for the first few days which I attributed to the sutures placed at the beginning, but he recovered promptly and completely to the great joy of his parents .

His next case came the next year on June 18, 1912. Using the same operation he successfully treated the infant son of parents who had already suffered through pyloric stenosis in

three other children, two of whom had died.[7] After Ramstedt reported his cases at the Natural Science Assembly at Münster in September, his operation became widely adopted. In the U.S. series of respectable size began to appear by 1916. It was not until the end of the war approached in 1918 that the operation was attempted in England. The initial British attempt was successful and surprisingly easy to perform, being completed in just seven minutes.[7]

Conclusion

The history of treatment of pyloric stenosis is doubly gratifying, the story of an operation elegant in conception and so effective that it has been called, "the most consistently successful operation ever described."[4] Surgeons tried to apply operations designed for adult pathology, only to arrive at one that was unique to a condition seen only infancy. For a condition that was once fatal in nearly all cases, recovery from pyloric stenosis is today the norm, after only a brief operation and a short hospital stay. Now commonplace, pyloric stenosis is one of the overlooked triumphs of pediatric surgery.

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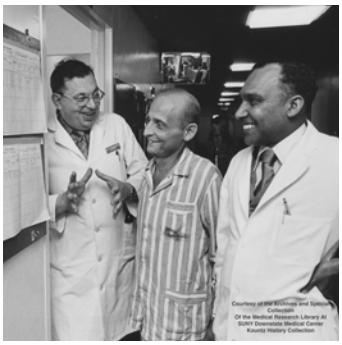

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Samuel Kountz: Transplantation pioneer who provided access to life-saving renal replacement therapy

American College of Surgeons
Inspiring Quality:
Highest Standards, Better Outcomes
100+*years*

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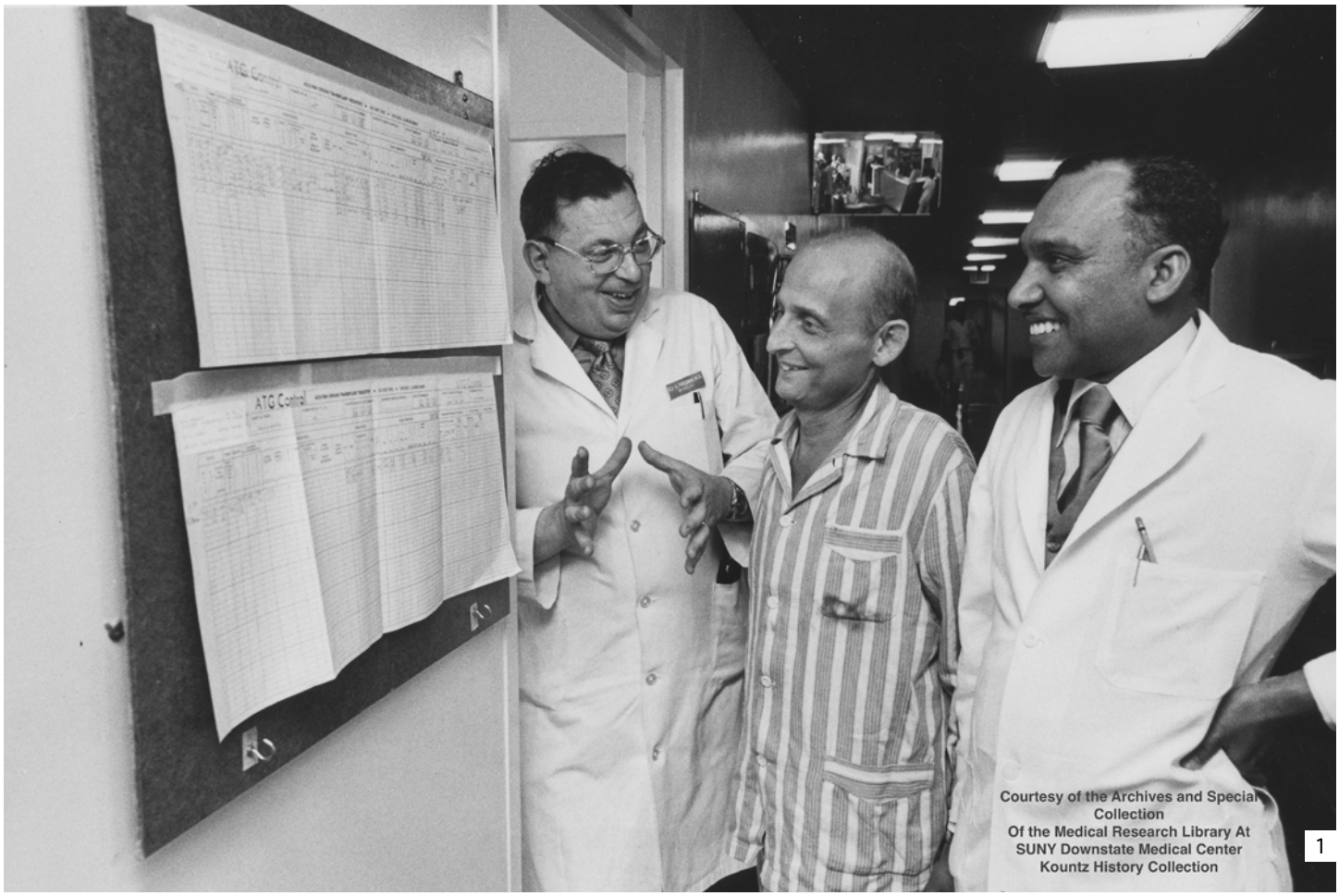
Samuel Kountz, MD, had spectacular professional career in renal transplantation in a life tragically cut short by a debilitating illness and early death at age 51 (Figures 1 and 2). He performed groundbreaking research in organ preservation and the management of graft rejection. As chair of surgery at Downstate Medical Center in Brooklyn he created a leading transplant center in an inner city hospital. He supported nationwide reforms to assure that minority and underserved populations had access to renal replacement therapy and transplantation.[1]

Early life and education

Born in Lexa, Arkansas, on October 20, 1930, Kountz was one of two blacks to graduate from the University of Arkansas School of Medicine in 1958. During his residency at Stanford University in 1961, he participated in the first non-identical twin renal transplant in the United States with Roy Cohn.[2] Inspired to enter the field he received the Giannini Fellowship Award to conduct research in transplantation and immunology at Hammersmith Hospital in London.[3]

Revolutionizing renal transplantation

Kountz was appointed Assistant Professor of Surgery at Stanford after residency training. Under an appointment as a Fulbright Scholar he performed Egypt's first kidney transplant in 1965.[3] Folkert Belzer recruited him across town to the University of California, San Francisco (UCSF) to serve as his associate and assist in the development of a renal transplantation team that performed more than 200 renal transplants, researched tissue typing, and developed standard procedures to prevent and treat graft rejection. Their most enduring contributions were in the area of organ preservation. Their work led to preservation solutions and perfusion devices that are standard procedures in renal transplantation today.[4]



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Leader in surgery and transplantation

Kountz earned an international reputation in academic surgery and transplantation. He published 154 peer-reviewed articles, with key research in nearly every area important to clinical renal transplantation: Use of methylprednisolone to prevent acute renal allograft rejection,[5] measurement of GFR and creatinine in monitoring for allograft rejection,[6] donor tissue typing,[4] and preservation of deceased donor kidneys.[7]

He was named president of the Society of University Surgeons and received honorary doctorates from the University of Arkansas and UCSF. In 1972, he was named chair of surgery at Downstate Medical Center in Brooklyn. He transformed an inner city facility into a leading transplant center.[3] With Kountz as its chief of surgery, the hospital, at the time thought to be the busiest center in the nation, performed more than 500 transplantations.[8]

In an era where the high cost of transplantation made it unavailable to the urban poor, especially the black community, Kountz used his fame to support federal funding for the treatment of end-stage renal disease, including kidney transplantation.[9] As part of his campaign to increase awareness of the need for living donors in renal transplantation, Kountz performed a living donor renal transplant on NBC's Today television show in 1976. After its airing some 20,000 offered to serve as living donors nationwide.[3]

A Lasting Legacy

Kountz died in 1981 after a debilitating illness contacted during a visiting professorship in South Africa in 1977.[8] Remembered by colleagues long after his death, his legacy continues in schools, scholarships and awards named in his honor. The National Association for the Advancement of Colored People presents an Afro-Academic, Technological and Scientific Olympic program award annually in his memory.[3]

Acknowledgements

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Legends

1 Samuel Kountz (right) making rounds. Courtesy Archives and Special Collections of the Medical Research Library at SUNY Downstate Medical Center.

2 Kountz at surgery.

13

The wisdom of Theodor Billroth: Lessons for today's surgeons

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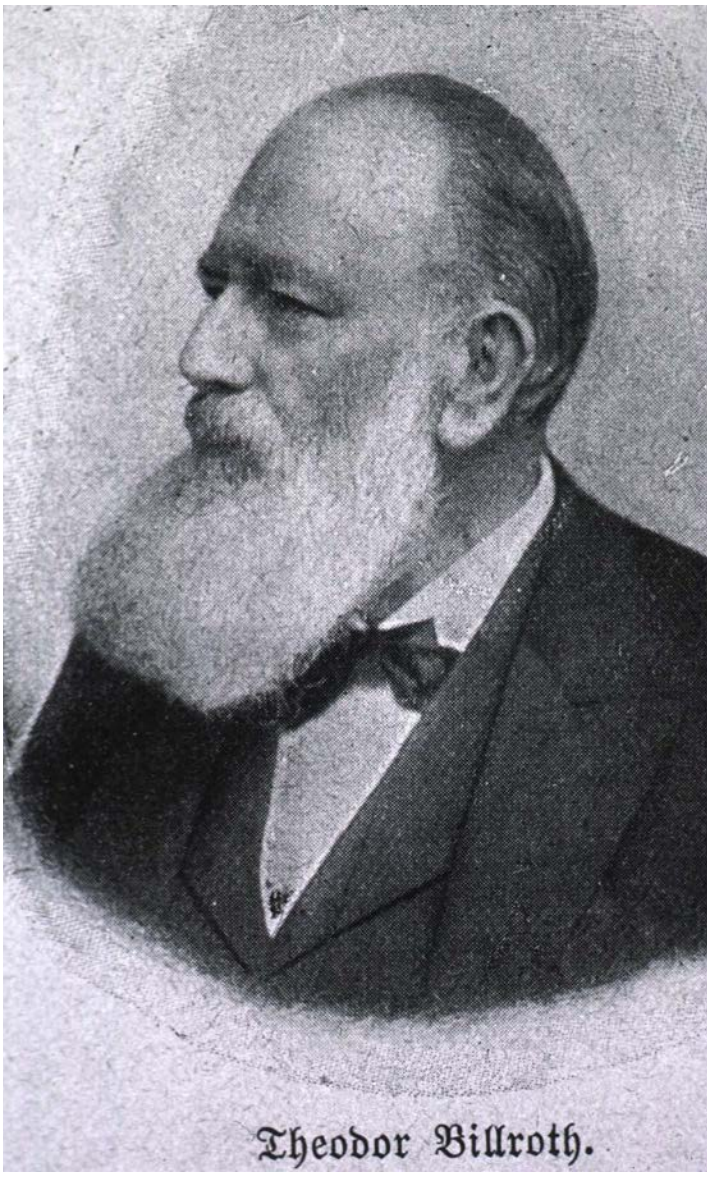
Theodor Billroth (1829–1894; Figure), one of the most revered surgeons in the history of the surgery, serves as a model for the modern surgeon. Each year new Fellows of the American College of Surgeons enter a profession rocked with challenges never seen before. They may ask whether they can succeed in an environment of such rapid change and uncertainty. Facing such questions, it may be a helpful exercise to look back to the tests faced by our surgical forefathers for inspiration and guidance. Study of Billroth's life, lived entirely in the 19th century, reveals timeless attributes that have thoroughly 21st century relevance to today's surgeon.



Challenge convention with transparency

Billroth embraced transparency in communication, today widely recognized as the basis for honesty and trust. He valued honest discourse in medical decision making and the necessity of meticulous documentation. He published his unabridged operative results, including negative outcomes, so that others could benefit from his experiences and to establish baselines for progress[1]. At his inaugural lecture as the head of the Second Surgical Department in Vienna in 1867, Billroth said

He who cannot quote his therapeutic experiences in numbers is a charlatan; be truthful for clarity's sake, do not hesitate to admit failures as they must show the mode and places of improvement.[2]

Billroth firmly believed that a school's purpose was not unification and propagation of a uniform school of thought and practice, but serve as a venue of controversy and challenge.[2] Controversy engendered investigation that of necessity created more controversy, a cycle that would never disappear. He said

The principle, method and the goal of investigations is recognition of truth, even though the truth may be in conflict with our social, ethical and political circumstances.[2]

New facts that emerge from the most recent research regularly challenge established dogma. Clinicians must be alert to how knowledge shifts in response to new information. In today's environment of electronic media such medical information is readily available. Patients are informed as never before. It is important to respect their knowledge and opinions when coming to any decision regarding their care.

The power of restraint

Despite his technical gifts Billroth exercised restraint in clinical surgery. He waited years before attempting the operations that would make him famous. His approach was methodical, first establishing an animal model of the condition in the laboratory, then spending time studying the effects of corrective surgery.[3] From more than 61,000 autopsies where he characterized cases of pyloric carcinoma, Billroth carefully noted the cases with metastases and identified those that might have benefitted from resection.[4] He used histology and pathophysiology of disease and tried to correlate the survival benefit of surgery, an approach that was well ahead of the time. While many of his peers were competing to be the first to perform daring procedures, Billroth took care to establish the proper timing and context of surgical intervention.

He was cautious in his career decisions as well. Early in his career he turned down several positions as chair of pathology in several universities, deciding instead to develop his fields of interest and clinical expertise as he waited for the right opportunity in a department of surgery.[3] He published 11

manuscripts on normal and pathological histology as he waited. When Billroth accepted positions at first Zurich then Vienna, the positions were ones that he chose and were appropriate to his reputation. His patience in adhering to his long term goals led to professional success, a paragon for any surgeon first embarking on an academic career.

The surgeon as a scientist

As important as technical execution is to a surgical operation, Billroth recognized that science is the foundation of surgery. He epitomized the scientific surgeon, the modern attitude that basic science is a necessary component of clinical practice.[5] He boasted that he spent as many hours behind the microscope as at the operating table.[6] He was adamant that a surgical operation required acumen in both pathology and clinical diagnosis. Many scholars attributed his professional success to his command of histology and pathology.[7]

Billroth's reputation as a researcher rests not on the total number of his 156 publications, but the integrity of his work. He emphasized honesty in the use of statistics. He wrote, "Statistics are like women, mirrors of purest virtue and truth, or like whores to use as one pleases,"[8] a blunt metaphor now considered inappropriate but typical for his era. His attitude is relevant in the current era where faculty is under pressure to publish, especially when data fails to undergo appropriate analysis or is falsified entirely.

Work-life balance outside the operating room

Famed for scientific discovery and technical prowess, Billroth's passion was music. He believed his interest in music was inseparable to his ability as a surgeon.[9] He said, "Science and art are derived from the same source: Fantasy [and] imagination."[10] Part of his daily routine, music appeared to be his source of energy, permeating every aspect of his life, including surgery. The first to perform a laryngectomy in 1873, he undertook the reconstruction of an artificial larynx as a musical challenge.[11]

Billroth's pursuit of activities aside from medicine is an important example for the modern surgeon. Medicine easily can overtake every aspect of a physician's life. Burnout is a widespread phenomenon among doctors. Successful physicians have investments in areas outside of their field. Music served was both an outlet and source of inspiration for the master. In Vienna his day consisted of scientific research and surgery, followed by music in the evening, and finally the completion of scientific manuscripts late at night.[2] "I may have been married to Medicine," Billroth said, "but Music was always my mistress."[6]

Conclusion

A list of Billroth's achievements reflects creativity, innovation, and technical prowess. Beyond his eponymous procedures reveals habits and ethics that are equally timeless and inspiring. Important parts of his professional success came from outside the operating room. Reminiscent of Shakespeare's famous phrase, "What's past is prologue,"[12] Billroth's accomplishments, but especially the way he approached his life and work, have inspired generations of surgeons and have led to the achievements of today.

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Legends

Theodor Billroth. Image from National Library of Medicine.

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William Stewart Halsted: Father of the model for our current surgical training programs

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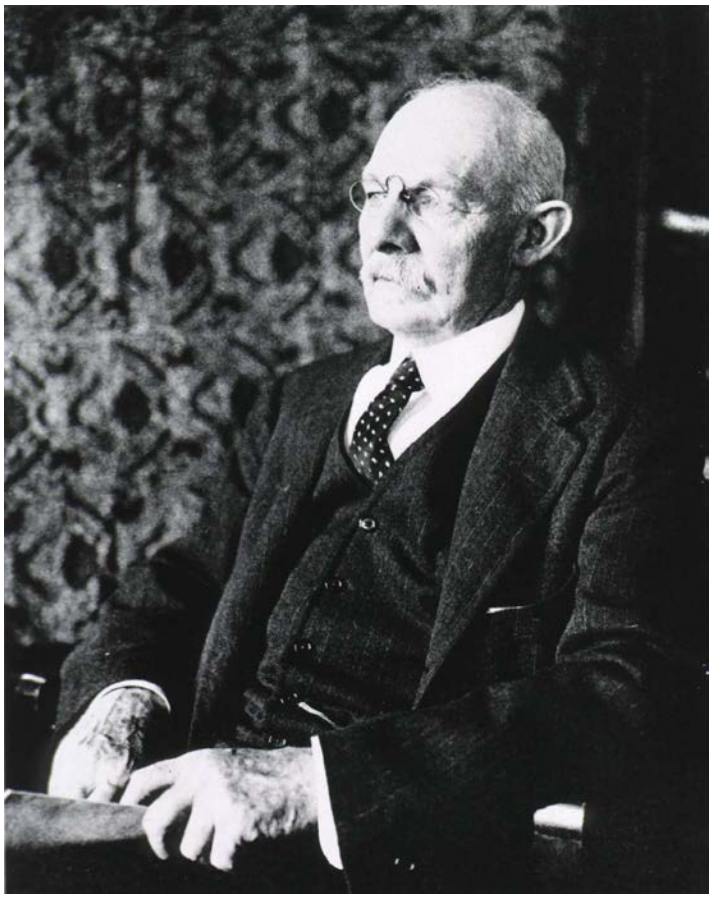
One of the legendary figures of surgery, William Stewart Halsted (Figure) made contributions that are, in using John Cameron's word, "staggering."[1] His novel surgical techniques influenced surgeons for decades in such wide-ranging areas as breast cancer, hernia repair, intestinal anastomosis, and internal fixation of fractures. He was one of the early American proponents of aseptic surgery. Among his novel contributions were surgical gloves and regional anesthesia. His lasting contribution is his model for surgical training that he established at the Johns Hopkins Hospital. Always on the forefront of medicine, Halsted's independent thinking, scientific knowledge, and solid reasoning motivated practices and innovations that endure as foundations of modern surgical practice.

There are a number of authoritative articles about Halsted and a recent book by Gerald Imber, *Genius on the Edge*.[2] There is enough in his story to attract Hollywood (Amiels J, Begler M, creators. *The Knick*. Anonymous Productions, 2014–2015). This article uses John Cameron's authoritative profile extensively, with all of the details of his biography coming from his article unless otherwise noted.[1]



Background and education

Halsted was born in 1852 in New York City. Educated at home until he was 10, he attended private preparatory schools first in Monson, Mass., and at Phillips Academy in Andover. Before entering Yale University Halsted returned to New York to receive private tutoring in Latin and Greek. His interests at Yale were not solely academic, as he excelled in athletics and competitive sports. In his senior year his interests focused on medicine after discovering the famous anatomy and physiology books of Henry Gray and John C. Dalton. Resolved to pursue a medical career, Halsted returned to New York to enter the College of Physicians and Surgeons.[3]

With natural ability and an inventive mind, Halsted had the opportunity to learn from the leading physicians in the city. Despite being a year short of graduation he took the internship examination for Bellevue Hospital in New York. He did so well he was offered a post, completing his internship the same year as his graduation in 1877.[1]

With a year at New York Hospital as a house physician Halsted completed all the formal training that was available in America. With the financial means of his family in 1878, Halsted set sail to further his medical education at the European centers of surgery and medical scholarship. In Vienna, Würzburg, Halle, and Hamburg he studied with

some of the most notable figures in medical history, such as Zuckerkandl, Billroth, Chiari, von Bergmann, and Volkmann. He established lifelong friendships with Billroth's young assistants Woelfler (first gastroenterostomy, 1881) and Mikulicz (first operation for perforation of the stomach, 1880; operation for pyloric stenosis, 1887).[1]

Early career and addiction

After two years abroad Halsted returned to New York where he established an extraordinarily successful practice at the Roosevelt Hospital in 1880. He had a dispensary that became so busy that it met seven days a week and prompted hospital trustees to construct a building devoted to outpatients. He accepted an appointment at the College of Physicians and Surgeons. Bellevue Hospital erected a tent-like surgical pavilion for his sole use to accommodate his demand for a facility where he could properly conduct antiseptic operations.

Indefatigable, he became chief of surgery to the Emigrant Hospital at Ward Island. As visiting surgeon at Charity Hospital at Blackwell's Island he did his operations at night because he was so overcommitted elsewhere. He was a popular teacher, conducting "quizzes," regular review sessions for students cramming for their internship examinations [1] He wrote papers that he presented to the New York Surgical Society. In 1882 he found time to attend to his sick mother, performing a cholecystostomy to remove stones that were causing sepsis and jaundice.[1]

In 1884, only four years into his active career, Halsted read an account of the effects of cocaine in an account of an ophthalmology meeting in Heidelberg reported in the Medical Record. He began to experiment with the drug, his extraordinary knowledge of anatomy allowing him to anesthetize peripheral nerves precisely, and recording the effects of various dilutions.[2] During this work he became psychologically and physically addicted to cocaine, a dependency that would afflict him the rest of his life.[4]

He attempted to shake his dependency by taking a two-month-long sailboat trip to the Windward Islands. Unable to wean his addiction, he broke into the captain's stores to get more of the drug. At his family's urging he was committed to the Butler Hospital in 1886 for a seven-month hospitalization. The facility was able to rid him of a cocaine addiction by giving him morphine injections.[1]

Appointment at Hopkins

During his year at New York Hospital Halsted met William H. Welch, at the time a pathologist at Bellevue. Upon his return to America the two became friends, the latter among those alarmed at the effects of his surgical colleague's cocaine addiction. In 1884 Welch was the first physician recruited to the newly-organized Johns Hopkins School of Medicine, established the year before as the first American medical school committed to graduate education and research. According to Cameron, Welch may have accompanied Halsted on his Windward Island cruise. At the end of Halsted's confinement at Butler Hospital in late 1886, Welch invited his friend to join him in Baltimore.[1]

Halsted began work in Welch's lab, where he determined the submucosa as the crucial strength layer capable of holding suture in the intestine. The discovery established the basis for gastrointestinal surgery, providing a structural basis for sutured anastomosis.[5] On that basis Halsted could be considered the father of surgery on the alimentary tract.[1]

Only weeks after presenting his work in Boston 1887, Halsted was back in Butler Hospital, again for a months-long hospitalization. Upon his release in 1888 he returned to Welch's laboratory and began to see patients.[1] When the new Johns Hopkins Hospital opened in 1889 Halsted received the tentative appointment as associate professor in the medical school, surgeon-in-chief of the dispensary, and acting surgeon to the hospital. When the trustees' first choice for surgeon-in-chief to the hospital fell through, Welch had to convince them that Halsted's addiction was sufficiently controlled to allow him to function. Halsted won the appointment in 1890, then was named professor two years later.

As professor and chair of the department of surgery Halsted entered into a period of "monumental productivity…likely never again to be duplicated in American surgery."[1] Cameron lists some of his contributions. Aside from his work on local anesthesia and his work on intestinal suture while drying out in Welch's lab, he continued to perfect his work on inguinal hernia[2] and mastectomy for breast cancer[6] that he started in New York. He did the first successful resection for periampulary cancer and the first choledochotomy in the country. He was active in vascular surgery, being the first to resect a subclavian aneurysm, and attempting operations to control aortic aneurysm.

Famously inventing surgical gloves to protect the hands of his scrub nurse, Caroline Hampton, who would become his wife, he pioneered other practices that promoted "safe surgery."[1] Speed and boldness in surgery were still stubborn vestiges of an era before pre-anesthesia when surgeons wore frock coats soaked with blood and body fluids. Halsted recognized that anesthesia allowed patient and careful dissection and gentle handling of tissues to avoid creating devitalized areas prone to infection. Dead space was closed and preferably avoided altogether. Asepsis allowed the use of fine silk suture without a significant increase in the risk of infection rather than catgut, heavy and clumsy in comparison. He demanded other surgeons in his department to follow his concepts.[2]

Surgical education

As important as Halsted's innovative procedures and surgical techniques, many consider his most important accomplishment to be his model for surgical training. The system would train surgeons and leaders in the field to the present day.

Halsted was among the fortunate that could supplement his medical education with a hospital internship, a year's appointment as house officer, then travel visiting surgical clinics abroad. Medical school graduates could practice with the knowledge they had, or enter an apprenticeship if wanted to further their knowledge in a given area. There were no rules, regulations, or guidelines. The length of the relationship was determined by the trainee, and terminated when money ran out or nothing more could be learned. Mentors had varying abilities and experience, leaving their trainees with uncertain levels of experience. Surgeons in particular had no interest in training someone who might open a practice next door.

While in Europe, Halsted saw more structured training programs. His time in Europe is widely thought of to be the source of his concepts of surgical training.

Soon after his promotion to surgeon-in-chief of the Johns Hopkins Hospital in 1889 Halsted organized the first surgical training program in the U.S. He was uncompromising in his standards. Trainees had to be available 24 hours a day, seven days a week.[7] Naturally this meant they had to reside in the hospital and be unmarried. Only men were accepted into the residency. There was no set length of training. It was Halsted's decision when a trainee was ready for practice, a decision made on his own assessment of capabilities, talent, and skill.

A key feature of Halsted's system was "graduated responsibility." He established a hierarchy of junior assistant residents, assistant residents, and finally a single trainee referred to as simply, "the resident," second only to Halsted who stood at the apex. As trainees advanced, they would adopt increasing responsibility. Not every trainee started as junior assistant resident, and promotion was not assured. Not all assistant residents advanced to the top post. Halsted selected only the best candidates for his residency, and most importantly to him, only the best would finish.

Future of the Halsted model

Just as Halsted modified the German system, today's training programs are the result of important changes in his system. Abandoned are the severe culling process of the pyramidal junior assistant – senior assistant – resident framework and the indeterminate length of training. Presence in the hospital is limited to 80 hours a week, the 24-hour, 7-day presence in the hospital a long-forgotten relic. Women training in surgery are now commonplace. Struggling to be preserved is the "graduated responsibility" ethic; while trainees participate in operations of increasing complexity as they progress through their training, none have the opportunity to exercise independent decision-making and have sole responsibility in the operating room.

Halsted's system for surgical training is a durable framework. Surgeons will undergo training in residencies under the supervision of more senior trainees and attending surgeons. Some procedures are the same, many more are different, and the technology is unimaginably different. Many of the rules are different, but its basic structure bears the imprint of its founder.

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Legends

Figure. William Stewart Halsted. Image from the National Library of Medicine.

15

The Surgeon's Duty to Serve: The forgotten life of Paul F Eve, MD

American College of Surgeons
Inspiring Quality:
Highest Standards, Better Outcomes
100+years

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Paul Fitzsimmons Eve was one of the great surgeons in the South during the 19th century.[1] He completed his surgical training in Europe and served in several foreign wars as well as the American Civil War. He published more than 500 articles, introduced 14 operations to America, was president of the American Medical Association, and edited the Southern Medical and Surgical Journal and Nashville Journal of Medicine and Surgery. Additionally, he held the chair of surgery at 5 different medical schools and was the first professor of operative and clinical surgery at Vanderbilt University. Eve led a rich and colorful life; however, his legacy has been largely forgotten, even by surgeons in the South.

1

Early years

Born on June 27, 1806, in Forest Hall, GA, on the Savannah River, 6 miles south of Augusta, Paul Eve was the son of Captain Oswell and Aphra Ann Eve and was the youngest of 11 children. His father, a merchant and rice planter by trade, served as captain of a Pennsylvania company during the American Revolution. While growing up in Pennsylvania, Oswell Eve was classmates with Benjamin Rush, a founding father who signed the Declaration of Independence, and William Shippen, Jr., the second surgeon general in George Washington's Continental Army.[2]

After preparatory school, Eve attended Franklin College in Athens, GA, which would later become the University of Georgia. Eve received his degree in August 1826 and elected to attend medical school at the University of Pennsylvania due to his father's connections within the medical profession in Philadelphia.

After 2 years of studies, Eve received his medical degree in 1828 and chose to pursue surgical training in Europe. Bound for England in 1829, Eve sailed for 28 days across the North Atlantic aboard a ship loaded with cotton. While in London, he attended lectures by Astley Cooper, James Paget, and James Abernathy. In 1830, Eve traveled to Paris, France and studied for 18 months under surgical giants of the early 19th century: Larrey, Dupuytren, Roux, Lisfranc, Cruveilhier, and Velpeau.[3] He made lasting relationships with these surgeons and would correspond with them over his lifetime.[2]

Eve was in Paris on July 26, 1830, when the French monarch, Charles X, was overthrown by his cousin, Louis-Philippe, the Duke of Orleans. During this July Revolution, as it would become known, Eve gained his first experience in treating combat casualties.4 Later that same year, while Eve was still in Paris, Polish nationalists revolted against their Russian occupiers and ignited the November Uprising, or Polish-Russian War of 1830–1831.

Service to Poland

The Polish officer, Casimir Pulaski, had come to America's aid during the Revolutionary War, and Eve felt he should "repay Poland for the heroic Pulaski, who died during the siege of Savannah in our Revolutionary War.[5] Pulaski, known as the "Father of the American Cavalry," was killed in action at the Battle of Savannah while leading a cavalry charge against British forces. The Polish general died near Eve's home in Georgia, and Eve was likely familiar with the account of Pulaski from his childhood.

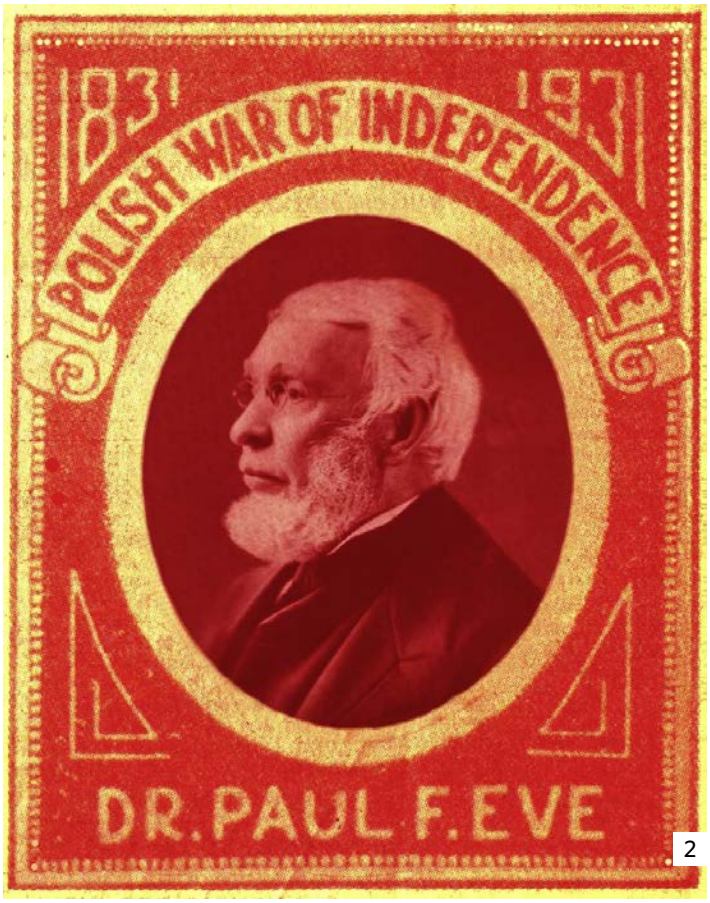
Aided by letters from his friend and consummate defender of liberty, the Marquis de Lafayette, Eve traveled to Warsaw from Paris. Reaching Poland in the spring of 1831, he first served in a hospital and was later sent to the front as surgeon to

General Turner's division.[6] The war lasted only a few months and Warsaw fell to Russian forces in 1831. Eve was captured in neighboring Prussia. After developing cholera, Eve was able to obtain his release by letters again written on his behalf by General Lafayette.

Before traveling to Warsaw, Eve had formed a committee in Paris to raise funds to support the rebellion in Poland. After the conflict, the committee formally recorded its "admiration and praise for the zeal of Dr. Paul F. Eve of Georgia, who sacrificed his abilities, his time and even his own person for the Polish cause."[5]

During the November Uprising, on the recommendation of Count Place, chief of the Army Medical Service, Eve was awarded the Gold Cross of Honor of Poland, or Virtuti Militari.[7] One of the oldest military decorations still in use, the Virtuti Militari is awarded for bravery and service and is similar to America's Congressional Medal of Honor. Eve was no mercenary; he refused payment for his service to Poland during the uprising.

In 1931, to celebrate the centennial of the November Uprising, the Polish government honored Eve's service by erecting a memorial on Greene Street in Augusta, GA (Figure 1). The American ambassador to Poland at the time, John North Willys, attended the event and remarked that Eve's "pioneer labor in establishing good relations has made easier the task of those following him now."[7] The Polish government also issued a commemorative postage stamp in his honor (Figure 2), and the Polish Army Medical Corps dedicated a plaque in Eve's memory at the Military Medical School in Warsaw.[6]



2


3

Eve returned to America in 1832, and was appointed professor of surgery at the newly opened Medical College of Georgia (Figure 3). He served on faculty in Augusta for 17 years and was elected vice president of the American Medical Association in 1847.

Mexican-American War and Second War of Italian Independence

In 1846, the Republic of Texas was annexed by the United States, leading to the Mexican-American War. Eve was the first physician to volunteer his services, and he entered Mexico with a Georgia regiment.[4] He was given command of hospitals that received combat casualties from the Battles of Monterrey (May 1846) and Cerro-Gordo (April 1847). Eve recorded a vivid account of a penetrating chest wound suffered by General James Shields at the Battle of Cerro-Gordo.[8] General Shields would survive the injury and go on to serve in the Civil War.

After the Mexican-American War, Eve succeeded Samuel D Gross as professor of surgery at Louisville Medical Institute in 1849. However, on learning that Gross was dissatisfied with his appointment at the University of the City of New York and wished to return to Louisville, Eve returned the chair in

surgery to Gross. In 1851, Eve joined the faculty of the Medical Department of the University of Nashville and succeeded AH Buchanan as professor of surgery. Eve cultivated surgical excellence in Nashville and was elected president of the American Medical Association in 1857, the first Tennessean given this distinction.

Eve returned to Europe in 1859 during the Second War of Italian Independence, a conflict involving the Second French Empire and the Austrian Empire. He visited the battlefields at Magenta (June 4, 1859) and Solferino (June 24, 1859), and also toured hospitals in Turin, Italy. Eve recorded several accounts of his travels during this war in the Nashville Journal of Medicine and Surgery.[9,10] Additionally, he left copies of the Nashville Journal of Medicine and Surgery in Paris for his friend, Felix Larrey, son of Dominique Jean Larrey and surgeon to Napoleon III.[2]

American Civil War

When the American Civil War started, Eve was 55. In the spring of 1861, before Tennessee had seceded, he was appointed Surgeon General of the provisional Army of Tennessee: but he declined the position, preferring instead to enlist as a private in the Rock City Guards.[11] He continued to treat combat casualties in Nashville hospitals. After Tennessee's secession, he was finally appointed surgeon in the Confederate States Army on December 20, 1861.

4

On February 6, 1862, Fort Henry on the Cumberland River fell to General Ulysses S. Grant's forces. With the invasion of Nashville imminent, Eve fled in the middle of the night on February 16, 1862, taking with him an instrument case from the University of Nashville. His family had already left the city, and he joined them in Augusta, GA. Within a week, Eve was made commander and surgeon of the Gate City Hospital in Atlanta. The 400-bed hospital, originally a hotel, was constantly overcrowded due to its proximity to a train depot. In just the first few months of 1863, Eve documented that the Gate City Hospital had already treated 1,253 casualties.[12]

After the war, he returned to the University of Nashville to resume his clinical activities. He left Nashville briefly in 1868 to take a position at the Missouri Medical School in St Louis. However, he soon returned to Nashville to become the first professor of operative and clinical surgery at the newly opened Vanderbilt University (Figure 4).

Contributions to surgery

In an era when surgery was notoriously dangerous, Eve successfully performed the principal operations of his day with low mortality. In 1846, he published his outcomes after 51 consecutive amputations, including 14 of the lower extremity. Although mortality rates in some European series, including those of Larrey, Roux, and Dupuytren, approached 50%, Eve had not lost a single patient.[13] He described nothing "peculiar" about his method of amputation but put great importance on the compress placed over the wound.

Eve was perhaps best known for his work on lithotomy, an ancient operation to remove urinary calculi in the bladder. Eve's 100 cases of lithotomy were presented to the American Medical Association's annual meeting in San Francisco in 1867. He recorded only 8 deaths in 100 operations, a feat unparalleled at the time. The significance of this publication was not lost on Eve, who stated, "This may be the most complete synopsis ever made on the subject, certainly in our country."[14]

In 1850, Eve performed the first successful hysterectomy in the United States. Charles D. Meigs, professor of obstetrics at Jefferson Medical College, remarked that this operation had previously been attempted in Europe only 19 times. On April 24, 1850, Eve was called to see a 28-year old woman with an "incomprehensible mass" in her pelvis. After obtaining the patient's consent, he elected to resect the mass by a vaginal approach. During the operation he discovered the mass involved the uterus, and only after the hysterectomy was complete did Eve clearly see the cancer originated at the cervical os. The young woman lived for 3 months afterward, later dying from metastatic disease.[15]

Eve, it is said, introduced 14 new operations to America, 16 including removal of the crista galli to treat a skull fracture,[17]

removal of a nail from the left bronchus by tracheotomy,[18] myotomy for the treatment of lower extremity deformity,[19] trephination over the lateral sinus for a depressed skull fracture,[20] and the vaginal hysterectomy.[15] Additionally, Eve's A Collection of Remarkable Cases in Surgery, an 823-page tome representing "uncommon events and strange circumstances," was meant to provide surgeons and trainees at least "one practical lesson: that is, not to be easily discouraged in desperate surgical cases."[21]

Legacy of service

Eve died suddenly on his way home after visiting a patient on November 8, 1877, at the age of 71, and was buried in Augusta, GA. After his death, memorial services were held at medical schools across the world and lecturers stopped their classes to pay respect to Dr Eve.[16] His close friend, Samuel D Gross, said, "The history of my whole life presents no warmer friendship than that which it held for this great and good man."[16]

Eve was a model of distinguished service to community, country, and his fellow man. He diligently attended to his patients until his last day, and he advanced our understanding of surgical diseases and their management. Eve served his fellow man in Polanddborne out of duty to Poles for the efforts of General Pulaski. He aided his own country and its combatants in the Mexican-American War, and he served the South during the Civil War. Furthermore, Eve elevated the safety and reputation of surgery, and at a time when all American doctors were generalists, he helped establish surgery as a discipline in medicine. His undying spirit to serve was evident even late in life when he noted, "This head may have grown gray in hard service, and the evidence of old age has become apparent, but cut a little deeper, look within, and see if the fire kindled on the professional altar nearly a half century ago is not burning as brightly, as cheerily, and as vigorously as ever."[22]

Perhaps Eve's most cherished appointment was his selection as a centennial representative to the International Medical Congress at Philadelphia convened in 1876 to celebrate the signing of the Declaration of Independence.[3] In preparation for his speech, Eve wrote, "This great branch of the 'Healing Art' will not suffer, nor retrograde, at the hands of those to whose care it is confidently committed. Using the idea of the great Nelson at the Battle of Trafalgar, we would say that 'Surgery expects every man to do his duty.'"[23]

The deep sense of duty that stirred Eve to serve continues to inspire 21st century surgeons. Duty binds us all to our patients and communities. Some surgeons labor in underserved areas of America and others are committed to resource-poor regions abroad.[24,25] Today's surgeons treat combat casualties on the battlefield as members of the United States Military Health System, in addition to serving active-duty personnel and their families.[26] Duty moves many to care for the veterans who have aided our country in times of conflict.[27] The promise of increasingly effective and safer therapies drives us to innovate for the benefit of humanity. Finally, duty to our colleagues pushes us to invest in the future by training the next generation of surgeons. Embracing a sense of duty to our community, country, and humankind, so embodied by Paul F. Eve, should be a part of professional life in medicine in the 21st century and is his chief legacy to us.

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Legends

Figure 1. Unveiling of the memorial honoring Eve for his service during the Polish-Russian War of 1830-1831. (Photo courtesy of the Tennessee Historical Society and the Tennessee State Library and Archives.)

Figure 2. Commemorative postage stamp honoring Eve's service to Poland during the Polish-Russian War of 1830-1831. (Photo courtesy of Eskind Biomedical Library, Historical Collections. Photo has been modified from the original.)

Figure 3. A young Paul Eve while professor of surgery at the Medical College of Georgia. (Photo courtesy of the Tennessee Historical Society and the Tennessee State Library and Archives.)

Figure 4. A rare photograph of Eve in his later years while in Nashville. (Photo courtesy of the Tennessee Historical Society and the Tennessee State Library and Archives.)