THE MAGNIFICENT CENTURY OF CARDIOTHORACIC SURGERY

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Part 1
To Open The Chest

"We only see so far because we stand on the shoulders of giants"
Sir Issac Newton

Introduction

Theodore Billroth (1821-1894): *'Any surgeon who would attempt operation on the heart should lose the respect of his colleagues'.*

The 20th century will go in the history of cardiology and cardiac surgery as the period in which magnificent pioneer steps and sound and significant foundations were established. The great achievements of the pioneers in this field can only be appreciated if we consider the general feeling in the medical field about approaching the heart by the end of the 19th century. At that time, some towering medical figures, such as Theodore Billroth in Germany (1821-1894) and Sir Stephen Paget (1855-1929) considered surgical approach to the heart as unethical and unprofessional. The following statement by Billroth is frequently quoted: "Any surgeon who would attempt operation on the heart should lose the respect of his colleagues". Some authors debate that such a statement was actually mentioned in any of his published reports. Yet, some of his students said that he did refer to such a concept. Sir Stephen Paget, in his textbook, Surgery of the Chest, published in 1896, predicted that "surgery of the heart has probably reached the limits set by Nature to all surgery; no new method, and no new discovery, can overcome the natural difficulties that attend a wound of the heart". Against such a strong front current, courageous pioneers with inspired vision proceeded slowly in exploring this mysterious unknown ground – the heart.

In this series of articles, I shall attempt to narrate the achievements of these pioneers, especially those who laid the ground for cardiac surgery. I will approach each aspect of modern cardiac surgery as we practice it today, and trace it back in history, so that young doctors may have a feel of the great effort behind the procedures they take for granted these days. To start with, let us explore the problem of attempting to open the chest.

"Stop at the Pleura"

The command of the German physician, geologist and naturalist, Ernest Dieffenbach (1811-1855) to "stop at the pleura" was obeyed by all prudent surgeons of his time. It was strongly believed that to open the chest was to kill the patient. Surgeons believed that once a hole in the chest wall larger than the laryngeal aperture was created, ventilation would effectively cease.

In 1882, H. M. Block, a young brilliant surgeon from Poland, presented his animal lab experimental studies of pulmonary resection at the Congress of the German Society for Surgery in Berlin. He rapidly attempted to apply his skills on a young female relative patient with a diagnosis of bilateral pulmonary tuberculosis. He performed thoracotomy under the usual general anesthesia method commonly used in those days, i.e., open drop method with ether or chloroform with spontaneous breathing. Although the details of the operation were not known, it was reported that the patient died during the operation, and there was no evidence of tuberculosis in the resected specimen. A public investigation was held, and a few days later, the short brilliant career of H. M. Block ended with a self-inflicted gunshot wound to the head. A contemporary lecturer in 1883 indicated that: "The first attempt of this kind had such an

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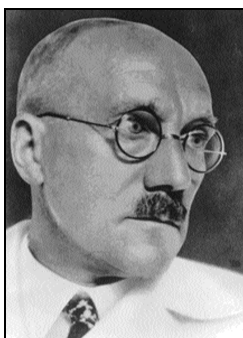
exceedingly tragic ending that every sensible surgeon should be warned to resist the temptation to make any future trial of the method".

The development of general anesthesia and the principles of antisepsis in the 19th century led to great advances in all surgical fields. But the pleura remained a difficult wall to cross, and thoracic surgery remained a difficult area to explore. Open anesthesia techniques would not allow safe opening of the chest to do anything more than just to drain infected collections in the chest wall, lung, or pleura.

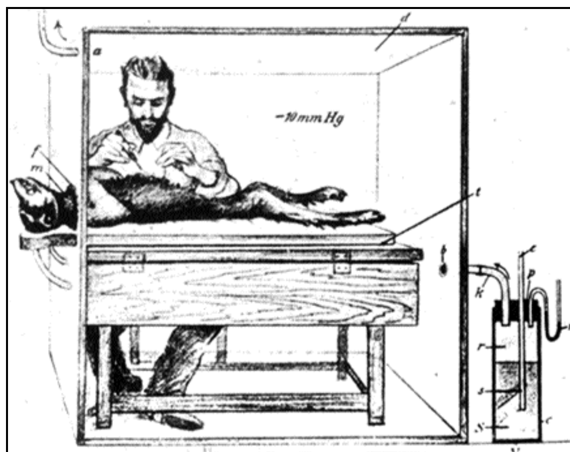
How can we breathe with an open chest?



Ferdinand Sauerbruch (1875-1951). Introduced his method of "unterdruck" (low pressure) ventilation in 1904, and developed negative pressure operation theaters for open chest surgery.

In 1904, two new anesthesia techniques were suggested to solve the open chest problem. Ferdinand Sauerbruch (1875-1951), from the surgical clinic of the famous von Mikulicz-Radecki (1850-1905) in Germany, introduced his method of "unterdruck" (low pressure) ventilation, where the lung was maintained expanded during thoracotomy by keeping the patient's entire body inside a negative pressure chamber (at -15 cm H2O), while the patient's head remained outside the chamber at atmospheric pressure. The other approach, "uberdruck" (high pressure), was to keep the lung expanded by placing the patient's head in a positive pressure chamber. Naturally, unterdruck method took the early lead, and was advanced by the eminent Sauerbruch who proceeded to build negative pressure whole operation theaters large enough to accommodate the entire surgical team dressed in suits and helmets connected to outside atmospheric pressure while successfully performing open chest operations. Sauerbruch became the acknowledged leader of thoracic surgery in Europe, and the Surgeon-General of the German army during World War II.

In 1908, Sauerbruch visited the USA to present his negative pressure chamber at the meeting of the American Medical Association. At

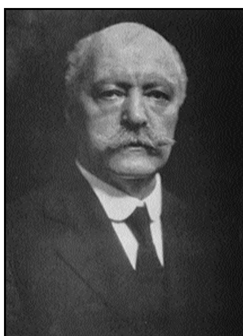


Negative pressure chamber for open chest operations (Sauerbruch - 1904).

the end of his visit he did not take the bulky theater back to Berlin, but left it with the prominent New York thoracic surgeon, Willy Meyer (1858-1922), an unconditional advocate of the concept. Meyer and his brother Julius, an engineer, continued research and designed what they called a "universal chamber", allowing either negative pressure with the surgeon inside, or positive pressure by a small box for the patient's head, the surgical team working on the open chest outside at atmospheric pressure. In 1911 this highly complex construction was installed, and used for a series of operations at the thoracic surgical service of the Lenox Hill - Hospital during World War I. During the 1920s and 1930s, Sauerbruch at the famous Charité Hospital in Berlin was the most famous thoracic surgeon in the World, and for many young American surgeons, a visit to Sauerbruch in Berlin was a must. His textbook "Die Chirurgie der Brustorgane", first published in 1918, remained the classical bible of thoracic surgery until 1930.

Intubation

Meanwhile, in 1909, at the Rockefeller Research Institute, Samuel Meltzer (1851-1921) and his son-in-law John Auer (1875-1948) developed the logical solution of "intra-tracheal positive pressure ventilation", a method which was applied clinically to solve the problem of pneumothorax during open chest operations. In 1910, the young surgeon Elseberg (1871-1948) was the first to use intra-tracheal positive pressure anesthesia for a thoracotomy operation at the Mount Sinai Hospital in New York. Meyer however, was too intelligent a man not to



Samuel Meltzer (1851-1921). Inventor of intratracheal anesthesia at the physiology laboratory of the Rockefeller Institute. First President of the American Association for Thoracic Surgery (AATS).

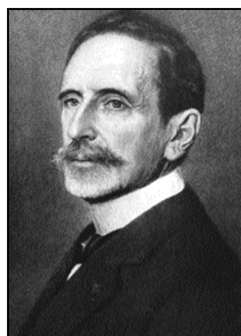
recognize eventually the superiority of Meltzer's positive pressure ventilation by intra-tracheal intubation. The "universal chamber", which had taken so much of Meyer's time and energy was dismantled and sold, as scrap metal in 1928 because the growing Lenox Hill hospital had no space for it. Interestingly, Avicenna (980-1037) described the first oro-tracheal intubation in the management of dyspnea in his legendary book "the Canon of Medicine".

The famous French surgeon Theodore Tuffier (1857-1929) and several other French and American surgeons used positive pressure breathing during thoracotomy operations in the last decade of the 19th century. However, the use of endotracheal tube and positive pressure endotracheal insufflation was established on experimental and clinical ground by Meltzer. In Germany, Franz Kuhn (1866-1929) described nasal and oral intubation using flexible metal endotracheal tubes and topical cocaine analgesia. The Austrian physician Victor Eisenmenger (1864-1932) described a cuffed endotracheal tube, and Tuffier did experiments to determine safe levels of positive pressure ventilation. By the third decade of the 20th century, endotracheal intubation was common.

The use of mechanical ventilators started in Sweden with the Freckner "Spiropulsator" in 1938, and curare as a muscle relaxant was introduced in 1942 to facilitate operative controlled ventilation. Safe and reliable positive pressure ventilation anesthesia enabled thoracic surgeons to perform more complex open chest procedures.

From parts to whole lung

The French surgeon Theodore Tuffier (1857-1929), should be considered as one of the amazing pioneers in thoracic and cardiovascular surgery. Not only was he an outstanding clinical surgeon, but also he was constantly involved in experimental research in Paris, as well as at the New York Rockefeller Institute with Alexis Carrel (1873-1944). His most remarkable contributions were in the field of intratracheal anesthesia, pulmonary resection and experimental cardiac surgery.



Theodore Tuffier (1857-1929). Outstanding French pioneer in pulmonary and cardiac surgery. First partial lung resection (1891). intratracheal intubation with an inflatable cuff tube (1896).

In 1891, Tuffier performed the first partial lung resection, and in 1896, he published his experiments on artificial respiration using intratracheal intubation with an inflatable cuff tube. Tuffier was also the first to describe extrapleural pneumothorax with plombage by autologenous fat for collapsotherapy of tuberculous cavities. Extrapleural pneumothorax with or without plombage later became a frequent, less traumatic alternative, to thoracoplasty in the treatment of pulmonary tuberculosis. In 1891, using this technique of extrapleural pneumonolysis, he performed the first ever pulmonary resection for tuberculosis. To avoid the complications of an open pneumothorax Tuffier freed the tuberculous pulmonary apex extrapleurally before clamping the diseased lung tissue including the parietal pleura. He then resected the tuberculous apex finishing by a continuous suture over the clamp. It was certainly not a difficult operation, nor a recommended one by today's standards, but in Tuffier's days one had to have imagination to conceive the technique.

In collaboration with Alexis Carrel in 1914, Tuffier published his amazing paper on experimental open-heart surgery in animals. Many operations on cardiac valves were performed with caval occlusion. Although the heart did tolerate most of these aggressive procedures, all animals died of cerebral anoxia due to the caval occlusion. Tuffier should be considered a real pioneer in clinical and experimental cardio-thoracic surgery. Tuffier's partial lung resection (1891) was followed some decades later by the pioneer work of general thoracic surgeons between the two World Wars such as John Alexander, Tudor Edwards, Edward Churchill, Evarts Graham, Alfred Blalock, and Robert Gross, to name only a few.

Rudolf Nissen (1899-1981) Professor of surgery in Basel performed the first total

pneumonectomy for benign disease in 1932. The first pneumonectomy for cancer was performed in 1933 by Evarts Graham (1883-1957). Before these more dangerous and exceptional total pneumonectomies, a series of partial lobectomies were reported by Howard Lilienthal (1861-1946) at the Mount Sinai Hospital in New York. Most of these early lung resections were done by the fairly crude tourniquet method. The anatomical hilar dissection pneumonectomies by Rienhof, Archibald and Overholt, were reported in 1933 a few weeks after the one by Graham. Remarkably, as early as 1912, Hugh Morriston Davies (1879-1965) in London, performed the first anatomic dissection lobectomy for a tumor in the right lower lobe of the lung, and he was decades ahead of his time. Unfortunately, the patient died of infection 8 days after the operation. Davies also used chest radiography, and positive pressure intra-tracheal anesthesia.

The first total esophagectomy for cancer was reported by Franz Torek (1861-1938) in 1913. Incidentally this operation somehow led to the founding of the American Association for Thoracic Surgery (AATS). When the New York surgeon Willy Meyer, an associate of Torek, presented this extraordinary case before an uninterested auditorium (no discussion) at the annual meeting of the American Medical Association, he felt that thoracic surgeons needed a forum of their own. Therefore, he first started the New York Association, followed immediately by the foundation of the American Association for Thoracic Surgery (AATS) in 1917 along with Meyer and others. Meltzer was elected as the first president of AATS. As for Torek, he never repeated his operation, and well-defined esophageal surgery had to wait another 25 years.

The Birthday of Cardiac Surgery

On September 9th,1896, about the same time when Billroth and Paget were flashing their strong warning statements against surgical approach to the heart, the German surgeon Ludwig Rehn (1849-1930) performed the first successful cardiac operation. He repaired a right ventricular stab wound, and the patient survived. Thus, the year 1896 is considered by many historians as the birthday of cardiac surgery. Eleven years later, Rehn reported 124 cases of suture of cardiac wounds with a survival rate of 40 %. By the end of World War II, Dwight Harken (1910-1993) reported 134 operations in which he and his team removed bullets and shrapnel from the heart and great vessels without a single mortality. Modern cardiac surgery was born in the battle field – in blood and trauma.

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THE WISDOM OF YEMEN

“Faith comes from Yemen
Divine Right comes from Yemen
And from Yemen comes the Wisdom.”

Hadith (Sayings of the Prophet Muhammad)