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Origin of Laparoscopy: Coincidence or Surgical Interdisciplinary Thought?

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Abstract. The history of laparoscopy illustrates the interaction between the many areas of medicine and technology; in fact, the development of that technique is a cummulative effort of internists, gynecologists, and surgeons. At the beginning of our century, however, neither group was particularly open to the idea of scholarly exchange. In this respect, an early pioneer of laparoscopy, Georg Kelling (1866–1945) of Dresden and the story surrounding the invention of the laparoscopy are interesting exceptions. Although Kelling regarded himself a surgeon, he devoted a great deal of energy to the development of "nonsurgical" methods of treatment. He spent a great part of his life determining stomach capacity, constructing a semiflexible tube endoscope (straightened after the insertion), and attempting to alleviate gastrointestinal bleeding by means of high-pressure pneumoperitoneum (*lufttamponade*). To observe the effects of insufflation on abdominal organs, Kelling introduced a cystoscope into the abdominal cavity. In fact, the invention of "celioscopy" or laparoscopy (1901) can be called a synthesis of Kelling's work with insufflation and his fascination with endoscopy.

Every great advance in science has issued from a new audacity of imagination —John Dewey, 1929

During the 1840s and 1850s the pace of intellectual change in the German states quickened as German universities developed new scientific approaches to research. German medicine thrived on this combination of scientific inquiry with clinically based research and teaching. All that was new and important in physiology, pathology, and medical chemistry, as well as in clinical medicine, was the work of German scientists and physicians. Rudolf Virchow (1821–1902), founder of cellular pathology, transformed thinking in nearly every branch of medicine. Robert Koch (1843–1910) isolated the tuberculosis bacillus. Bernhard von Langenbeck (1810–1887) founded an important German school of surgery with emphasis on physiology. Among his students were Friedrich Trendelenburg (1844–1924) and Theodor Billroth (1829–1894) [1, 2].

After the U.S. Civil War ended in 1865, students from the United States, many of them of German origin, enrolled in German universities. Most of the students from North America took part in private postgraduate clinical courses, many of which, especially in Berlin and Vienna, were taught in English. According to Kelly's *Dictionary of American Medical Biography* (1928), 40% of American physicians born between 1850 and 1890 received their training in Germany. William S. Halsted (1852–1922), for example, spent 2 years in Europe where he worked with Billroth in Vienna, Ernst von Bergmann (1836–1907) in Berlin, and Johannes Mikulicz (1850–1905) in Breslau. He also took courses in embryology and histology. When Halsted returned to the United States, he modeled the residential training program at Johns Hopkins after the German system, the first program of its kind in the United States.

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Medical Science in Leipzig

Georg Kelling studied medicine at the University of Leipzig, one of the oldest Universities in Europe (established in 1409). During the 1880s the Leipzig medical faculty enjoyed worldwide fame in basic medical science. In particular, the physiology laboratory of Carl Ludwig (1816–1895) was a magnet for German and non-German students alike. Ludwig, sometimes called the greatest physiology teacher of all time, introduced the graphic method, devised a number of new instruments, explained urinary secretion and lymph formation, discovered the innervation of the salivary glands, and contributed to the knowledge of circulation. Among the Americans who worked in Ludwig's laboratory during the 1870s and 1880s were anatomist Charles S. Minot (1852–1914), physiologist Henry P. Bowditch (1840–1911), who later established the first institute for experimental medicine in the United States, and John J. Abel (1857–1938), a pioneer pharmacologist. Another Ludwig student was pathologist William H. Welch (1850–1934).

Stomach Capacity, Endoscopy, and High-Pressure Insufflation

Although Kelling regarded himself a surgeon, his research was clearly influenced by the physiologic concept and Ludwig's impressive results in particular. For example, Kelling was convinced that determining stomach volume could have practical significance for healing diseases caused by hardening of the stomach walls. He conducted more than 100 experiments on animals and cadavers in which he insufflated air into the stomach and established the exact quantity needed to fill the stomach [3].

Kelling's experiments with stomach insufflation encouraged the young physician to inspect this organ in a more direct way. An optical exploration could help him recognize pathologic changes and diagnose diseases more effectively than was possible through

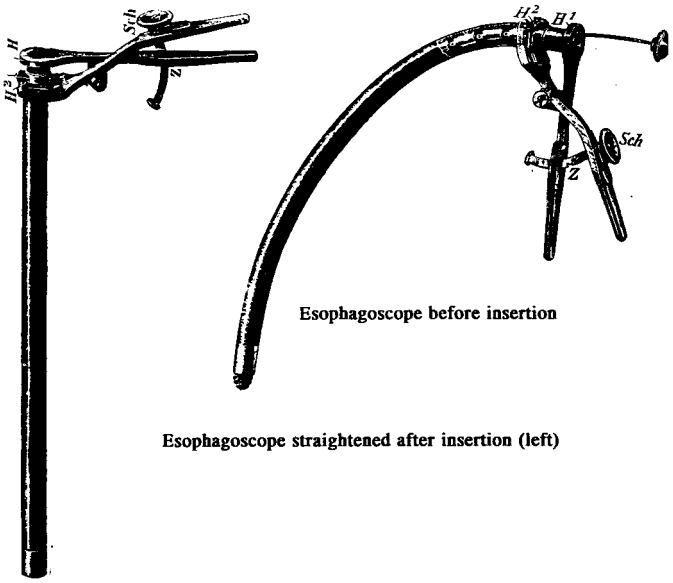

Fig. 1. Kelling's esophagoscope (1897–1898). (From Litynski [10].

insufflation. During the 1890s Kelling (against the skepticism of his colleagues) came up with the idea of combining a rigid proximal part with a flexible distal part using the optical system designed by Nitze. He refined his endoscopic skills with his "semiflexible tube endoscope" (Fig. 1) under the leadership of Johannes Mikulicz of Breslau, the inventor of clinical eosophagoscopy and gastroscopy. Also in Breslau, to examine the viability of gastroenterostomy, Kelling performed high-pressure gastrointestinal insufflations [4].

Lufttamponade

At the turn of the century Kelling focused his attention on the problem of gastrointestinal bleeding into the abdominal cavity, which at that time was fatal for most patients. Loss of blood into the abdominal cavity was extremely dangerous, Kelling pointed out, because physicians could not identify the source of the bleeding either by the vomiting of blood or by bloody stools. At that time, the only available method to establish a diagnosis and provide treatment was laparotomy. However, as the German surgeon observed, opening the abdomen could worsen the patient's condition. (It must be remembered that without blood banks, anticoagulants, and effective means for controlling infections, lengthy operations presented serious risks at that time.)

To halt blood seepage into the abdomen, Kelling proposed a nonsurgical treatment: high-pressure insufflation of air into the abdominal cavity. He called this technique the *lufttamponade* (air tamponade) (Fig. 2). In 1901 Kelling used both his own experiments with insufflation and the physiologic experiments of other European scientists to calculate that a pressure of about 50 mmHg could alleviate bleeding into the abdomen. Kelling carried out numerous experiments on live dogs, insufflating air up to a pressure of 100 mmHg (Fig. 3)! (At that time the pathophysiology of pneumoperitoneum was still unknown.) Although some of his 20 dogs died as a result of his experiments, Kelling proclaimed the procedure to be perfectly harmless. "After an examination, a dog is as cheerful as it was before," he wrote [5].

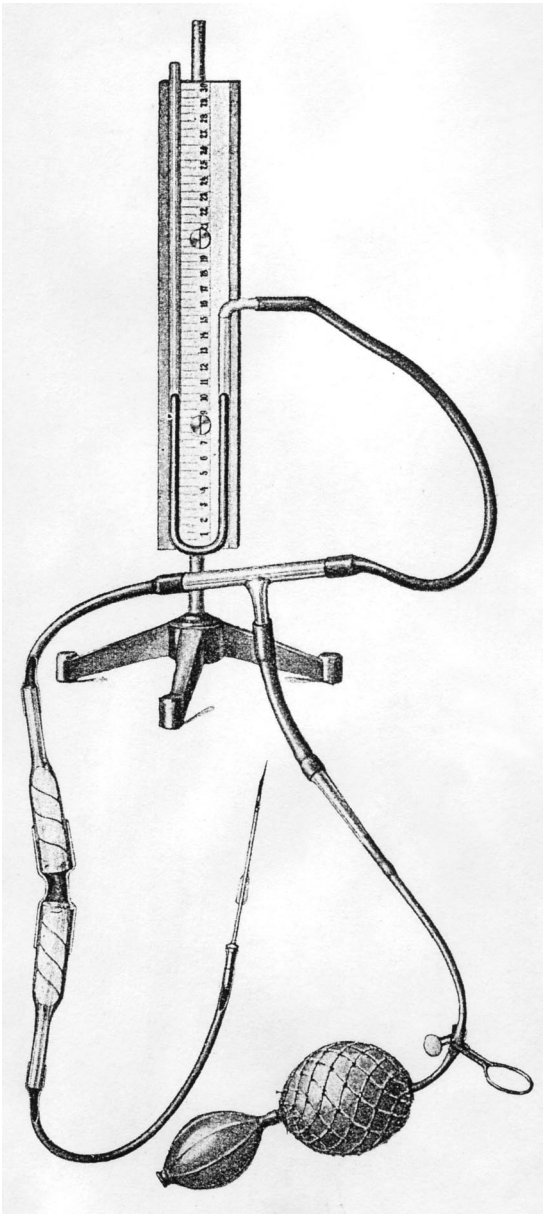

Fig. 2. Apparatus for creating *Lufttamponade* (1901). (From Litynski [10].

Lufttamponade and Lack of Clinical Experience

The mixed results of his experiments on animals did not deter Kelling from his desire to conduct clinical trials on living patients. During the summer of 1901 he twice tried to practice his new method on people. The first potential patient suffered from enormous stomach bleeding. Kelling presented his concept of the *lufttamponade* to the patient's relatives. They remained skeptical of Kelling's pioneering treatment and rejected his intervention in the hope that the patient would recover, as he had survived such bleeding once before. "But this time they were wrong, and the patient died a short time afterward," stated Kelling with a slight note of satisfaction. The next patient had undergone a painful, disappointing treatment of gelatin injections, and the patient

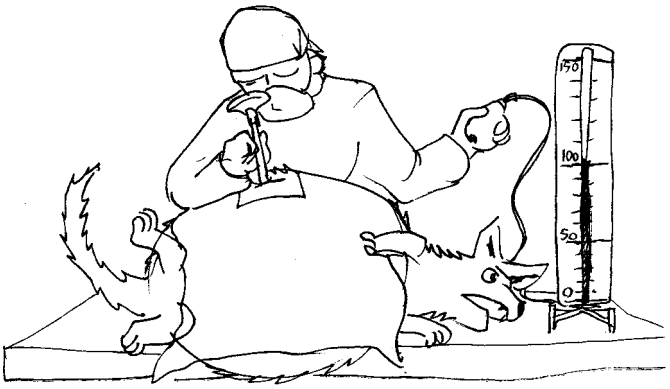

Fig. 3. Kelling carried out numerous experiments on live dogs, insufflating air up to a pressure of 100 mmHg. "After an examination, a dog is as cheerful as it was before," he wrote in 1901.

refused to cooperate further with any physician. Kelling's new technology did not convince him.

"Celioscopy"

Kelling wanted also to observe the effects of his insufflation efforts. "I asked myself, how do the organs react to the introduction of air? To find out, I devised a method of using an endoscope on an unopened abdominal cavity [celioscopy]," he stated. To visualize the effects of the high-pressure *lufttamponade* on the abdominal organs, Kelling introduced a Nitze cystoscope directly through the abdominal wall. Given the force of the air pressure, it came as no surprise, Kelling observed, that the abdominal organs were colorless and smaller than normal.

First Publications about "Celioscopy"

A two-part paper about *lufttamponade* appeared in the German medical press in September 1901, the same month the 73rd Congress of German Natural Scientists and Physicians opened. On the second day of the congress, Kelling gave his paper, "On Viewing the Esophagus and Stomach by Means of Flexible Instruments." Kelling made clear his belief in the applicability of the endoscopic method for understanding diseases and their treatment. At the end, Kelling mentioned his latest endoscopic procedure, "celioscopy," and demonstrated this method on a live dog [6].

The congress proceedings were published in January 1902 in the *Muenchener Medicinische Wochenschrift*. Interestingly, Kelling changed the title of his Hamburg paper by adding the word celioscopy [7]. The revised title read: "On Esophagoscopy, Gastroscopy, and Celioscopy." In a footnote Kelling promised to publish details about the new procedure in the near future, but as he mentioned 8 years later he never wrote the article [8]. During the following years Kelling did not return to celioscopy but directed his efforts to the problem of cancer [9].

Final Remarks

Although Kelling regarded himself a surgeon, he devoted a great deal of energy to the development of nonsurgical methods of treatment. In fact, celioscopy, or laparoscopy, can be called a synthesis of Kelling's work with insufflation and his fascination with endoscopy. There is a measure of irony in the fact that a short description of celioscopy introduced Kelling's name into the history of medicine. It is important to note, however, that although celioscopy was created as an additional method to view the effects of *lufttamponde*, not as an endoscopic method itself, Kelling presented the technique in Hamburg as an endoscopic procedure.

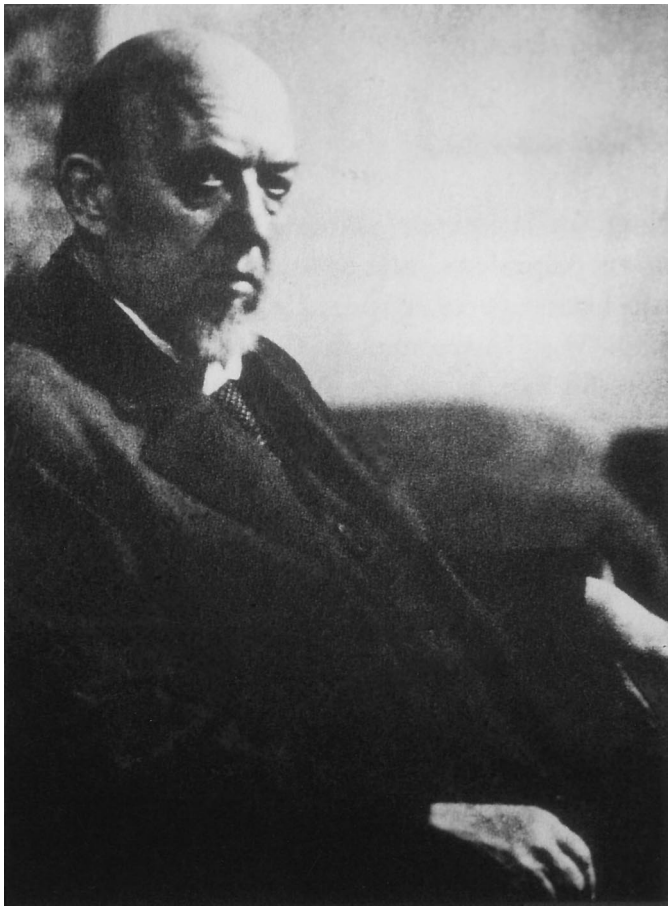

Fig. 4. Georg Kelling (1866–1945). (From Litynski [9].

In 1901 Kelling (Fig. 4) saw little future in the technique, and he did not pursue it. He was limited by the knowledge and techniques available to him at the time. Further advances of technology (i.e., cold-light, Hopkins optical system, "video-endoscopy") and the work of numerous scientists all over the world (e.g., Jacobaeus, Kalk, Ruddock, Palmer, Semm, Berci, Muhe, Troidl, Dubois, Perissat, Olsen, and Reddick) paved the way to the laparoscopic revolution of the late 1980s [10].

Résumé

L'histoire de la laparoscopie illustre bien l'interaction possible entre plusieurs domaines de la médecine et la technologie; en réalité, le développement de cette technique est le résultat d'un effort collectif d'internistes, de gynécologues et de chirurgiens. Au début du siècle, cependant, ni le milieu médical ni le milieu

technologique n'envisageait la possibilité d'un échange scientifique. Georg Kelling (1866–1945) de Dresde, un des premiers pionniers de la laparoscopie et l'histoire qui entoure l'invention de la laparoscopie, sont des exceptions dignes d'intérêt. Bien que Kelling était chirurgien, il consacrait beaucoup de son énergie au développement des méthodes thérapeutiques «non-chirurgicales». Passioné par l'étude de la capacité gastrique, il a construit un endoscope sémi-flexible (devenant un instrument droit après insertion) et a essayé de traiter l'hémorragie gastro-intestinale par la création d'un pneumopéritoine à haute pression, ce qu'il appelait «Lufftamponade». Afin d'observer les effets de l'insufflation sur les organes abdominaux, Kelling a introduit un cystoscope dans la cavité abdominale. L'invention de la «coelioscopie» ou de la laparoscopie (1901) est la synthèse de son travail sur l'insufflation et sa fascination pour l'endoscope.

Resumen

La historia de la laparoscopia ilustra la interacción entre las muchas áreas de la medicina y la tecnología; de hecho, el desarrollo de esta técnica es el resultado de un esfuerzo acumulativo por parte de internistas, ginecólogos y cirujanos. Sin embargo, a comienzos del siglo ninguno de estos grupos se encontraba particularmente abierto al intercambio intelectual. A este respecto, aparecen como una excepción interesante tanto la figura de un pionero de la laparoscopia, George Kelling (1866–1945) de Dresden, como la historia alrededor del invento de la laparoscopia. Aunque Killing se presentaba como un cirujano, él dedicó una gran cantidad de energía al desarrollo de métodos de tratamiento "no quirurgicos". Pasó gran parte de su vida determinando la capacidad del estómago, construyendo un endoscopio de tubo semiflexible (el cual se hacía recto luego de ser insertado) y tratando de controlar las hemorragias gastrointestinales por medio de neumoperitoneo de alta presión, o *lufttamponade.* Con el fin de observar los efectos de la insuflación sobre los órganos abdominales, Kelling introducía un cistoscopio en la cavidad abdominal. En realidad, la invención de la celioscopia o laparoscopia (1901) puede ser llamada una síntesis del trabajo de Kelling con la insuflación y de su fascinación con la endoscopia.

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