Surgery for Gastric Cancer

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Part I

History of Gastric Cancer Surgery

History of Gastric Cancer Surgery

1

Keiichi Maruyama

We have many dramatic and exciting stories in the history of surgery [1–4]. I would like to recommend my colleagues to read such interesting books, for example, *Das Jahrhundert der Chirurgen* (*The Century of the Surgeon* (English edition)) [5] and *Das Weltreich der Chirurgen* (*The Triumph of Surgery* (English edition)) [6] written by Jurgen Thorwald.

Progress of Supportive Background for Gastric Cancer Surgery

Progress of the following supportive technologies was essential in the development of gastric cancer surgery.

Anesthesia

The dawn of surgery was broken by development of anesthesia [7, 8]. By the late 1830s, it was widely known that nitrous oxide and ether produced drunken condition, and they were used for amusement such as "ether frolics." An American dentist in Boston Horace Wells (1815–1848) (Fig. 1.1a) used nitrous oxide for a painless dental extraction in 1845 [9]. His business partner and fellow dentist William T. G Morton (1819–1868) (Fig. 1.1b, e) used dimethyl ether also for dental extractions. He expanded the use for general surgery. He demonstrated his method for neck tumor resection to the prominent surgeon John Collins Warren at the Massachusetts General Hospital on the 16th of October 1846 (Fig. 1.1e) [10]. The next year, a Scottish obstetrician James Young Simpson (1811–1870) (Fig. 1.1e) of Edinburgh used chloroform for general anesthesia [11]. Chloroform anesthesia was rapidly popularized after the application for Queen Victoria's labor in 1853. These developments released patients from terrible pain and fear during surgery.

Aseptic Method

A Hungarian obstetrician Ignaz Fulop Semmelweis (1818–1865) (Fig. 1.1d) noticed that a clean condition reduced maternal death. He reported in 1847 that the death rate went dramatically down by handwashing and rinsing of medical instruments and linens with chlorinated lime solution at the Vienna General Hospital [12]. Semmelweis's work was furthered by a Scottish surgeon Joseph Lister (1827–1912) (Fig. 1.2a). He used phenol (carbolic acid) to clean surgical gauze at the Glasgow Royal

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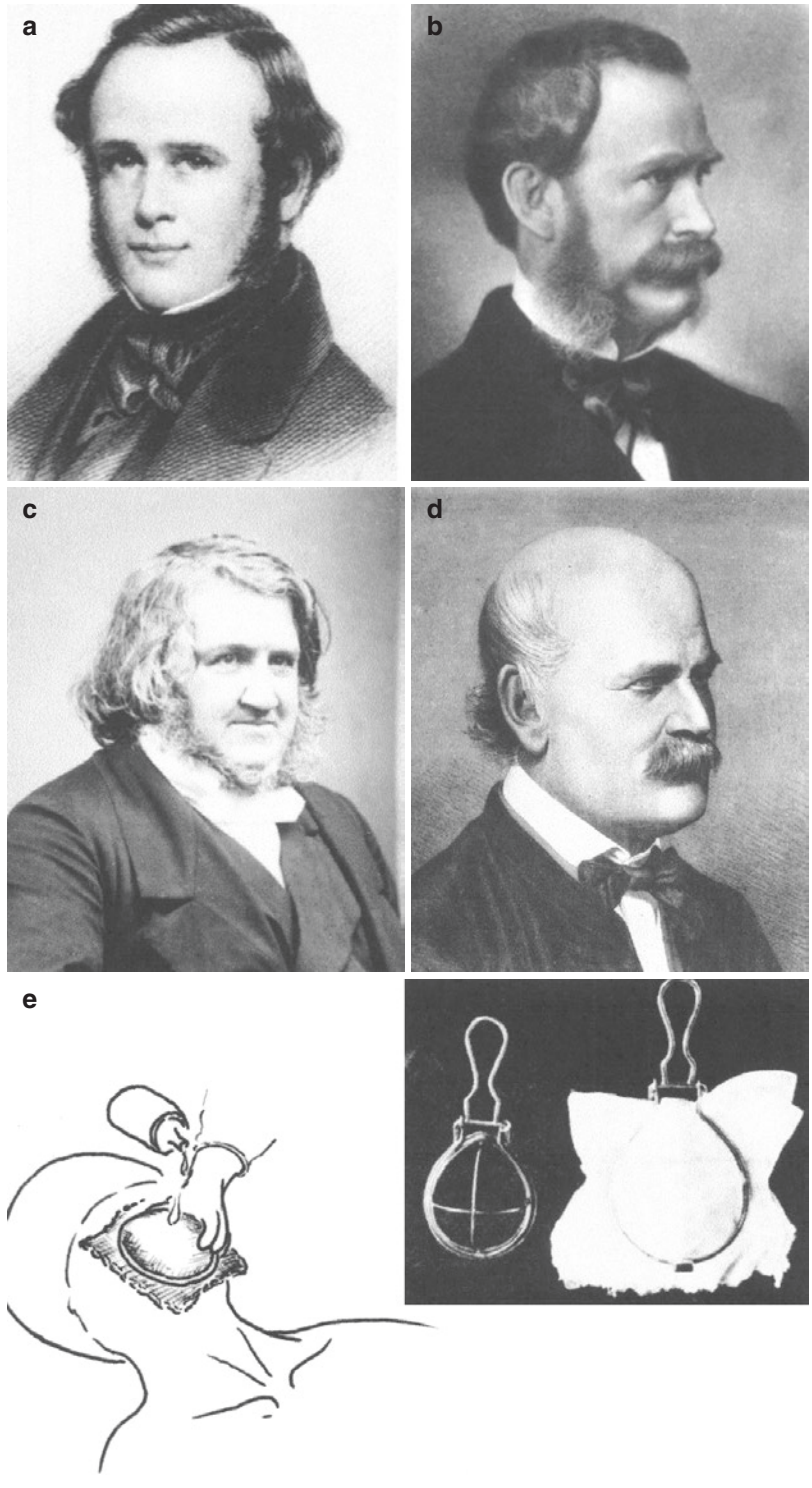


Fig. 1.1 (**a–f**) Historical leaders, pictures of ether anesthesia, and Lister's aseptic method. (**a**) Horace Wells: nitrous oxide anesthesia, (**b**) William T.G. Morton: ether anesthesia, (**c**) James Young Simpson: chloroform anesthesia, (**d**) Ignaz F. Semmelweis: chlorinated lime wash, (**e**) ether mask for inhalation anesthesia (ether solution was dropped on the mask with gauze), (**f**) Lister's aseptic method (carbolic acid solution was used for washing and spray)

Fig. 1.1 (continued)

Infirmary of Edinburgh from 1866. And he introduced phenol vapor to clean his operating room (Fig. 1.1f) [13]. Ernst von Bergmann (1836–1907) (Fig. 1.2b), professor of surgery in the University of Berlin, and his coworker Curt Schimmelbusch (1860–1895) developed a heat sterilization method for surgical instruments in 1886 (Fig. 1.2g) [14]. We have a very romantic history in development of the surgical rubber glove. The world famous surgeon, William Stewart Halsted (1852–1922) (Fig.1.2c) of the Johns Hopkins Hospital, USA, used strictly Lister's method using carbolic acid. This antiseptic solution produced severe hand skin damage of the head nurse of the operation theater, Miss Caroline Hampton. He ordered special thin skin rubber gloves for her from the Goodyear Tire and Rubber Company in 1890 [15]. They got married in 1890. An Austrian surgeon Antonio Grossich (1849–1926) (Fig. 1.2d) introduced iodine tincture for rapid skin sterilization of the surgical field in 1908 [16]. These aseptic strategies were scientifically supported by the discovery of "microorganisms." Louis Pasteur (1822–1895) (Fig. 1.2e) of the Ecole Nationale Superieure des Beaux-Arts, Paris, confirmed that the microorganisms caused the fermentation and putrefaction in 1847 [17]. Robert H. H. Koch (1843–1910) (Fig. 1.2f), a Nobel Prize microbiologist in the University of Berlin, found the bacteria which caused various infectious diseases in 1878 [18]. These developments reduced dramatically fatal surgical infections.

Antibacterial Agents

The next significant progress appeared on antibacterial agents. Bayer chemists (German) Gerhard Domagk (1895–1964) (Fig. 1.3a) and Josef Klarer (1898–1953) synthesized "sulfonamide," a strong anti-gram-positive cocci substance, in 1935 [19]. A Scottish Nobel Prize scientist Alexander Fleming (1881–1955) (Fig. 1.3b) discovered penicillin at St Mary's Hospital, London, in 1928 [20]. He actually opened a new era in medicine. Penicillin was purified by Howard Walter Florey (1898–1968) and Ernst Boris Chain (1906–1979) of the University of Oxford in 1941 [21]. Penicillin showed miraculous effectiveness during the World War II. Nowadays, we have various antibacterial agents.

Intravenous Infusion Therapy

This treatment offered a non-oral route administration of fluid, minerals, calories, and drugs to the patient. Using the infusion therapy, the patient can stop drinking and eating after surgery. Thomas Latta (1796–1833), a surgeon in Leith, Scotland, developed this technology for patients with cholera in 1832 [22]. Stanley J. Dudrick of the University of Pennsylvania, USA, developed parenteral nutrition in 1968, and this method was widely used particularly through the central venous route [23].

Suture Materials and Surgical Instruments

In the 1850s, the popular suture materials were linen, cotton, catgut, and silk. They were now completely disappeared except silk. Various synthesized absorbable sutures with atraumatic needle are now in use. Mechanical anastomotic instruments showed remarkable development. The first reliable liner stapler was developed by a Hungarian surgeon Aladar von Petz (1888–1956) of the Trinity Hospital in Györ in 1921 (Fig. 1.3c) [24]. The first circular stapler was developed by Masaru Mine of the Kyoto Prefectural Medical University, Japan, in 1962 [25]. The improved models, SPTU and PKS-25 M, were provided by a Russian company (Fig. 1.3d). An American company, the United States Surgical Corporation, bought the license from Russia and supplied the

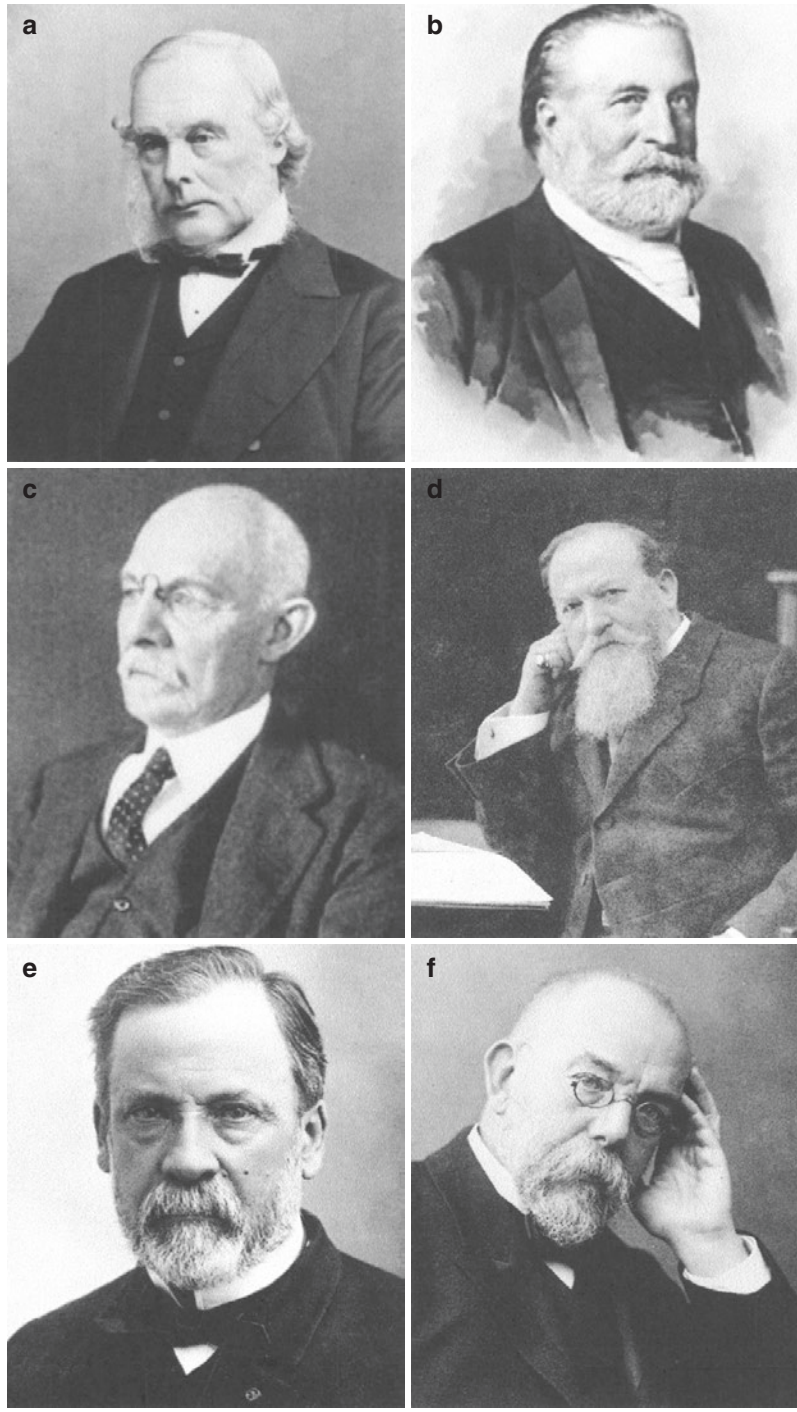
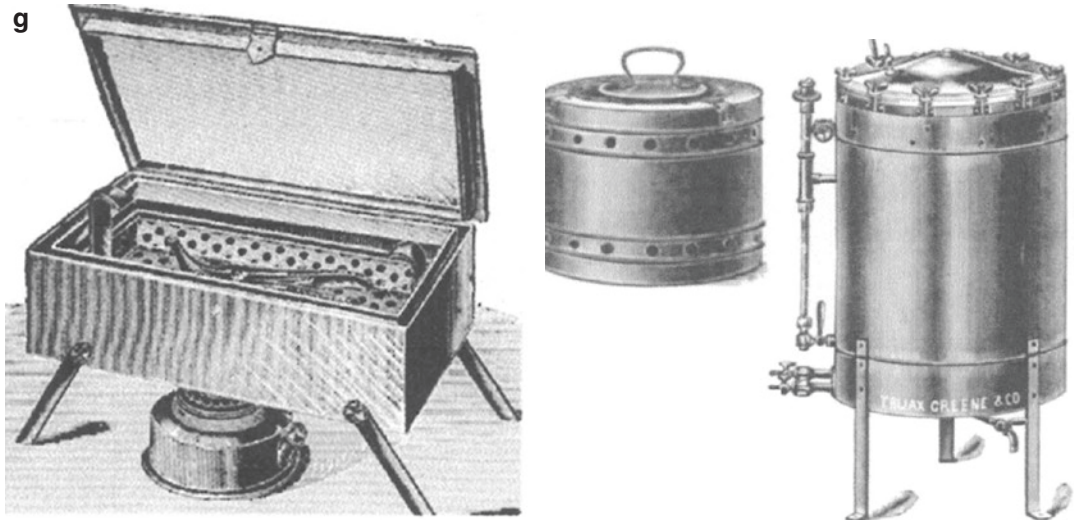


Fig. 1.2 (**a–g**) Historical leaders and Schimmelbusch sterilization apparatus. (**a**) Joseph Lister: carbolic acid antiseptic, (**b**) Ernst von Bergmann: heat sterilization, (**c**) William Stewart Halsted: surgical glove, (**d**) Antonio Grossich: iodine tincture, (**e**) Louis Pasteur: microorganisms, (**f**) Robert Koch: infectious bacteria, (**g**) Schimmelbusch heat sterilization system: for medical instruments



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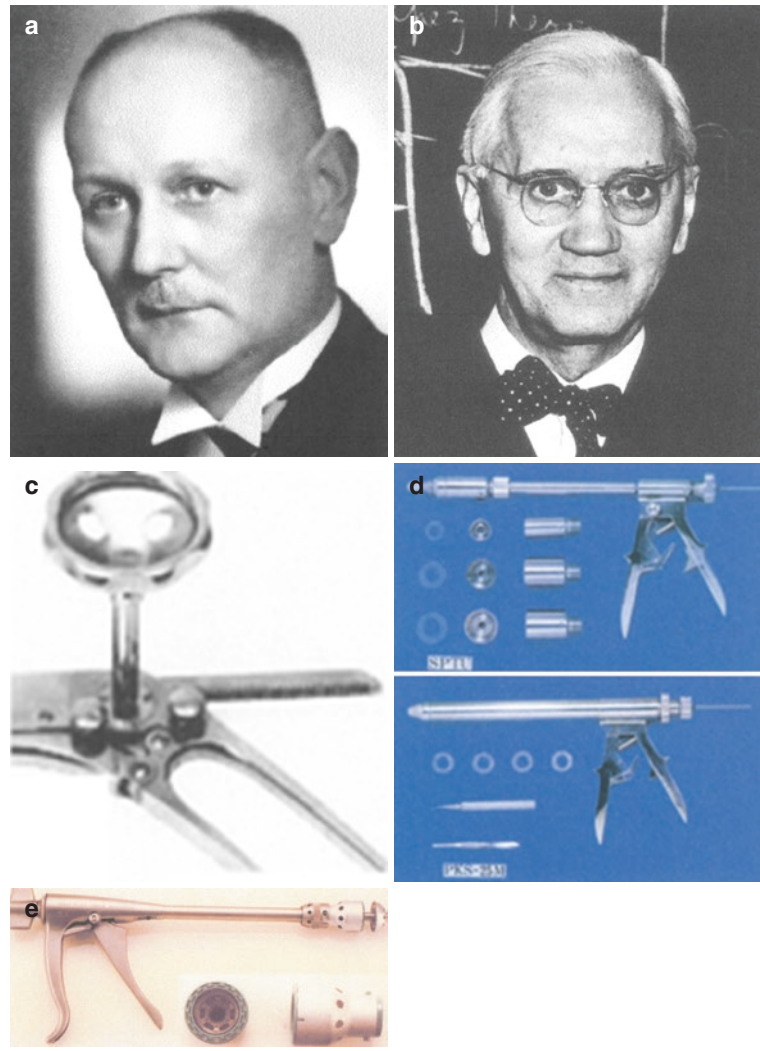

Fig. 1.3 (**a–e**) Historical leaders and various mechanical staplers. (**a**) Gerhard Domagk: antibiotic sulfonamide; (**b**) Alexander Fleming: antibiotic penicillin; (**c**) von Petz linear stapler; (**d**) Russian circular stapler, SPTU; (**e**) United States Surgical Corporation, EEA stapler

improved and disposable devices of TA, GIA, and EEA (Fig. 1.3e). Electrocautery was also improved, and we have now various devices for different procedures. The other progress was laparoscopic instruments and robot surgery machines. Minimally invasive surgery becomes popular supported by these progress.

Advancement in Pathological Knowledge

Pathology of gastric cancer showed a remarkable advancement. A German pathologist R. Borrmann in Bremen published a famous textbook about gastric cancer in 1926 [26]. He described the macroscopic-type so-called Borrmann's classification. Detailed and huge follow-up data informed us the characteristics of the disease. The data supported the establishment of rational treatments.

Progress of Diagnostic Methods

Preoperative assessment of cancer extension and biological characteristics became significantly accurate by endoscopy (Fig. 1.4a, b, c), endoscopic biopsy, double-contrast XP study, CT, ultrasonography, tumor markers, etc. Nowadays surgeons can make the most appropriate treatment plan for each individual patient based on these information.

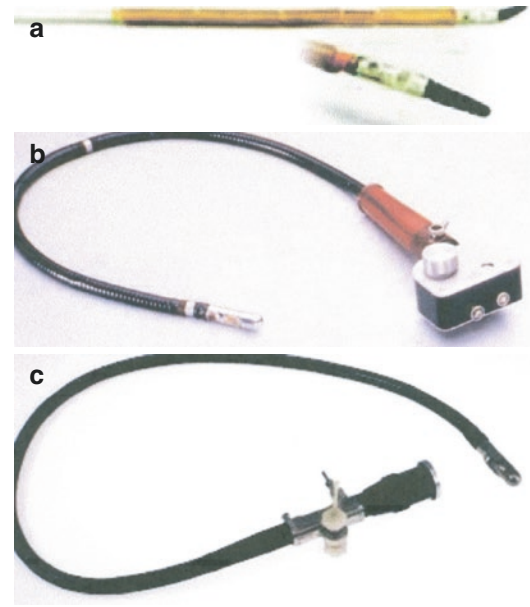

Fig. 1.4 (**a–c**) Development of gastroendoscope. (**a**) Schindler's prism flexible gastroscope, 1932; (**b**) Olympus gastrocamera, 1950; (**c**) Hirschowitz gastrofiberscope, 1964

Challengers of Gastric Resection

Before the introduction of anesthesia and antiseptic method, a few successful gastric surgeries were reported. Most of them were removal of foreign body such as swallowed knife from the stomach [27, 28].

Three great pioneers performed the memorial gastric resections for pyloric cancer in the short period between 1879 and 1981. Jules-Émile Péan (1830–1898) (Fig. 1.5a) of St Louis Hospital, Paris, performed the first distal gastric resection (actually a pylorus resection) for a pyloroduodenal cancer with stenosis on 9 April 1879 [29]. The procedures lasted two hours and half under a 13-cm-long paraumbilical incision. The patient died on the fifth postoperative day but autopsy was denied. Pe'an did not leave the detailed medical record, and the cause of death was not clear. But mismatched blood transfusion or anastomotic leakage caused by catgut suture was speculated.

The Polish surgeon Ludwik Rydygier (1850–1920) (Fig. 1.5b) carried out the second gastric resection for a 64-year-old bugle soldier with pylorus stenosis on 16 November 1880. He was a research-oriented surgeon and he left the exact and detailed record [30, 31]. He made a series of animal experiments on gastric resection and reconstruction techniques. He applied Lister's carbolic acid sterilization for hands, instruments, and linens by washing and air spraying. He carried out the surgery at his private clinic with 25 beds in Kulm, Poland. Rydygier performed the surgery very carefully taking four hours and half under an upper midline incision using 60 stitches for gastroduodenal anastomosis (Fig. 1.5c). The

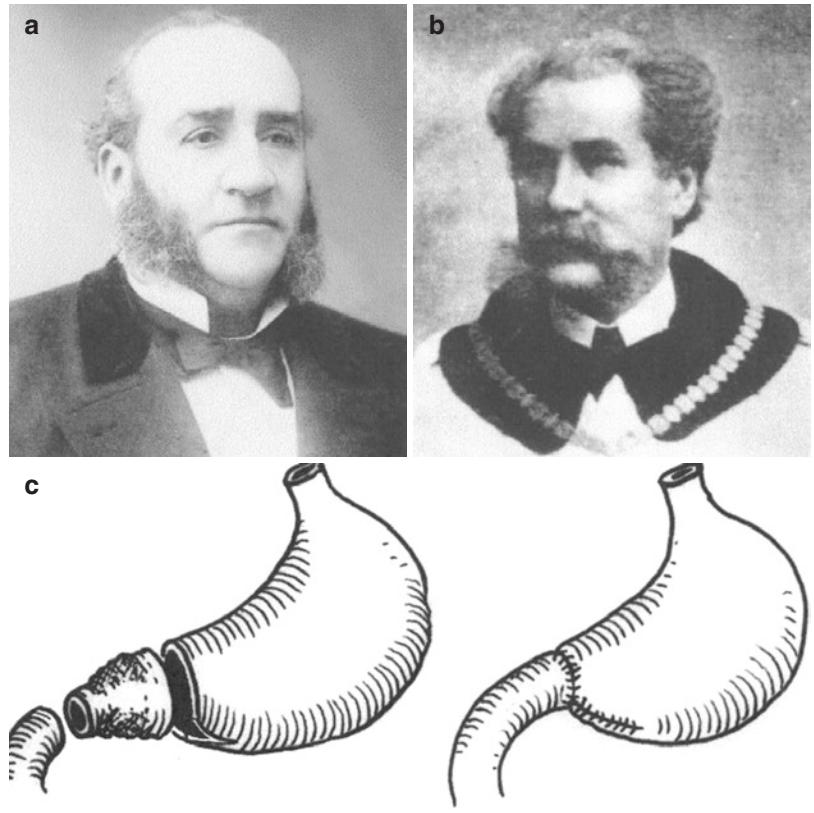

Fig. 1.5 (**a–c**) Historical leaders and Rydygier's operation. (**a**) Jules-Émile Péan: first gastric resection, (**b**) Ludwik Rydygier: second gastric resection, (**c**) pyloric resection procedure by Rydygier in 1880 (the tumor was located close to the pylorus. It was resected and a two-layer gastroduodenal anastomosis was made at the lesser curvature side). (From S. Sokół's drawing [161])

patient had smooth recovery after the surgery but suddenly died in the early morning of the first postoperative day. The cause of death would be collapse brought by the preoperative poor condition. The autopsy revealed no residual tumor and no infection. Anastomotic leakage was denied by water inflation test of the resected material.

The honor of the first successful gastric resection was given to Theodor Billroth (1829–1894) (Fig. 1.6a), professor of surgery at the University of Vienna and chairman of the Second Surgical Clinic of the Wien Allgemeines Krankenhaus (Vienna General Hospital) (Fig. 1.6c). He prepared his surgery very carefully. His two staffs, Carl Gussenbauer (1842–1903) and Alexander von Winiwarter (1848–1917), made animal experiments on the surgical techniques of gastric resection and anastomosis using dogs [32]. They also made detailed research on pyloric cancer behavior and possibility of curative resection using 542 autopsy records. Gussenbauer was the successor of Billroth at the University of Vienna, and Winiwarter became a professor of surgery at the University of Liege, Belgium. Billroth sent his staffs to the Royal Infirmary of Edinburgh and King's College Hospital, London, for introducing Lister's aseptic method. On 29 January 1881, Billroth performed distal gastric resection on Therese Heller, a 43-year-old Vienna housewife having eight children.

Billroth wrote a letter to Professor L. Wittelshöfer, the publisher of the *Wiener Medizinische Wochenschrift* (*Vienna Medical Weekly*), by himself informing his historical gastric resection [33]. And his operation record was published by his colleague Anton Wölfler (1850–1917) (Fig. 1.6b) [34], and the record was studied in detail by Herbert Ziegler (Fig. 1.6d) [35]. On the day, his team applied Lister's aseptic procedures except carbolic acid vapor spray method. The surgical instruments; suture material, silk thread and linens were sterilized with carbolic acid solution. They did not use catgut. Before starting the operation, her stomach was irrigated