

## The history of digestive endoscopy in the last century of the second millenium

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### Endoscopy : the early attempts

In recent years, there has been a renewed interest on the history of digestive endoscopy, fostered by the development of endoscopic organizations (1,2).

Although probably other people before him had tried to insert devices in the human body, most medical historians mention Phillip Bozzini as the first physician who tried to inspect abdominal cavities by means of appropriate instruments (3). Bozzini was born in Mainz in 1775 and died in Frankfurt a.M. in 1809, in spite of this short life-span, he led a very productive life ; he designed an illuminated speculum, the "Lichleiter" (Light conductor) which consisted of a sort of a vase provided with a candle fixed to the lower part of the instrument for light, and a series of specula of various widths fixed to one side to allow inspection of specific orifices.

Around 1853 A.J. Desormeaux (4), a French urologist devised an instrument, possibly based on Bozzini's light conductor, which included several attachments which could be introduced into the urethra and the rectum. A relatively potent illumination was provided by a bright lamp flame obtained by burning a mixture of alcohol and turpentine. Many consider Desormeaux as the father of endoscopy.

However, the first instrument using electricity by means of a lamp made of platinum wire was conceived by another urologist, Max Nitze, together with Joseph Leiter, an instrument maker from Vienna. Later, the incandescent Edison lamp became available and was fitted into the instrument. Nitze's cystoscope was the source of all modern endoscopic instrumentation (1).

Old German gastroenterology published before the 1914-1918 World war document many impressive attempts to visualize the oesophagus and the stomach by means of instruments inspired on Nitze's cystoscope. Many of these instruments can be inspected in the Endoscopy Museum of the University of Vienna as well as at the Max Nitze museum for Endoscopy in Stuttgart.

The first rigid gastroscope was devised by Kussmaul in 1868 (5). According to tradition, Kussmaul was inspired by the observation of a sword swallower performing his act. The modern era of endoscopy, however, began with a report written by von Mikulicz (6) in 1881 where most problems inherent to endoscopy, such as

illumination, orientation and visual accessibility were thoroughly discussed. The Mikulicz gastroscope, made in Vienna by Leiter was a rigid metal device, slightly angled distally which allowed partial visualization of the gastric cavity. Among other lesions, Mikulicz diagnosed with it two gastric ulcers and a pyloric carcinoma. Other rigid instruments devised by Elsner (7), Kelling (8), Rosenheim (9) and others, were difficult to introduce, badly tolerated by the patients and caused a sizeable morbidity and mortality. Mikulicz administered morphine to his patients to provide sedation. The quest for flexible gastroscopes began in 1897 with Kelling, a German surgeon, who was also the first to perform laparoscopy. The Kelling instrument was made of metal coils which allowed visualization only when straightened. This and other similar instruments were abandoned because of difficulties in obtaining satisfactory lighting. The last attempt to construct a flexible scope was made by Sussmann in 1912 (10).

The rigid prototypes such as the Elsner gastroscope, although cumbersome and dangerous, were favored because of the improved illumination and remained in use sporadically until the Thirties. The Elsner instrument consisted of a rigid side-viewing tube which included a thin inner tube provided with a lens system which permitted photography.

### Early gastrophotography

However, the pursuit for an acceptable instrument continued. Objective photographic documentation began already at the end of the Nineteenth Century. In 1898, Lange and Meltzing (11) published in Munich the details of a gastrocamera, which is surprisingly similar to the one devised by the Japanese half a century later. Using also a version of the early gastrocamera, other authors, particularly Heilpern (12), were able to take photographs of the stomach. Using his own gastroscope, Elsner obtained objective photographic documents in 1926. In 1931, Norbert Henning made relatively clear black and white pictures with a modified Elsner instrument, among them instances of erosive gastritis (13).

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## The Schindler era

A landmark in the history of gastrointestinal endoscopy was contributed by Rudolf Schindler (14) who devised a semi-flexible instrument constructed by the Wolf company, which remained in use with some modifications until the emergence of fiberoptics. This entirely new instrument consisted of a curved flexible tube about 78 cm in length and 12 mm in diameter in its flexible part which was filled with a large number of optical lenses of short focal distance which allowed a remarkable visualization of about two-thirds of the stomach. Light was provided by a removable 8 volt electric lamp and a prism objective which allowed 90° side viewing and a visual field of 60 degrees. Insufflation of the stomach walls could be done by means of a balloon attached to the proximal end of the instrument. Gastroscopy was popularized by Schindler who received in Munich many foreign students who introduced gastroscopy in their own countries. Among them, M. Royer (Argentina), Moskowicz (Austria), Graulich (Belgium), Moutier (France), author of a well-known textbook (15), von Friedrich (Hungary), Brunetti and Torrigiani (Italy), Morales Noriega (Spain), Bloom (Netherlands), H. Kapp (Switzerland). The advent of Hitler and nazism obliged Schindler to emigrate to the United States where he developed a long and fruitful collaboration with Drs. Walter Palmer and Josep Kirsner at the University of Chicago. He taught endoscopy there and later on in California and Brazil (Belo Horizonte). Schindler was instrumental in creating the first endoscopic society, the American Gastroscopic Club which in time, would become the A.S.G.E.

Gastroscopic documentation however, had to rely on drawings and watercolours made by artists looking at the images shown by the endoscopist. The most remarkable of them was probably J. Alemany, who worked for many years in my own hospital de San Pablo in Barcelona and later on for Dr. H.L. Bockus and the Saunders Company in Philadelphia.

Several instruments based on the Schindler's gastro-scope were also used in other centers, such as the bulky Hermon-Taylor and the Benedict gastroscopes (14) which included a biopsy channel, and the French O.P.L. instrument made by Optique Levallois for Charles Debray (16). This instrument provided excellent images with an outstanding definition and permitted a better view of the stomach walls as the flexible part was somewhat longer than that of other instruments. Moreover, the OPL instrument could be fitted with a distal electronic flash and a proximal camera providing photographs of very good quality (17). However, gastroscopy with semiflexible instruments remained the realm of only a few endoscopists in each country, as radiological techniques had been developed to a high degree of accuracy in France, Germany and Japan.

## The gastrocamera

Around 1950, colour films with adequate sensitivity and electronic flash bulbs were available; Uji and Hayashida (18). perfected diminutive photographic cameras that were made by the Olympus company in Japan. The so-called "gastrocamera" consisted of a small camera equipped with a wide-angle lens, a flash-light connected to a control unit by means of a flexible tube made of a metal coil covered by vinyl and a wire system device which allowed moving the camera inside the stomach and for advancing the film. The instrument took small, high quality pictures of the gastric mucosa. The instrument was introduced blindly and pushed as near as possible to the pylorus; it was then pulled slowly and a series of pictures taken in succession in order to sample most of the gastric cavity. However, developing the films was cumbersome, at least in Spain, and although beautiful images were presented in meetings and outstanding atlases were published (19), the gastrocamera did not gain much favour in Europe, except in some centres, particularly in Germany and Italy. A Gastrocamera Society was founded which later became the European Association for Gastroenterology and Hepatology. In time the new fiberscopes replaced the gastrocamera which could be also attached to the tip of some of the Olympus fiberscopes.

## The early diagnosis of G.I. bleeding.

Although the Wolf-Schindler gastroscope allowed good visualization only of some two-thirds of the stomach, several gastroenterologists tried to use it for the diagnosis of upper G.I. bleeding. Among the European proponents of early diagnosis of haemorrhage, the names of F. Avery Jones in the U.K., Jean Jacques Desneux in Belgium and Pierre Housset in France, should be particularly mentioned. The pioneer and champion of early endoscopy for bleeders has been Eddie Palmer who used with advantage the Eder-Hufford endoscopes. A rigid oesophagoscope was introduced first for the detection of varices, ulcerations or tears, and through its lumen a thin gastroscope was pushed into the stomach. Palmer started his "vigorous approach" to bleeding as early as 1944 and published his 25 year experience with this techniques in 1969 (20).

Attempts had also been made to control oesophageal variceal bleeding secondary to portal hypertension as early as 1939. Probably the first attempt to treat variceal haemorrhage by endoscopic injection was done by Crafoord, the renowned Swedish thoracic surgeon (21). His paper was published in an O.R.L. journal, as at that time most oesophagoscopies with rigid instruments were performed by otolaryngologists. Crafoord used a long needle introduced through the lumen of the oesophagoscope and injected, with apparent success, a sclerosing agent (a quinine compound) used to treat

haemorrhoids. It was not until 1990 that the impact of early endoscopy in the management of upper gastrointestinal bleeding began to be assessed objectively (22).

### The advent of fiberscopy

The development of fiberoptics and its application to endoscopy has been a long and controversial one. It is beautifully described in Hecht's book "City of Lights" (23). Following the pioneer work of Heinrich Lamm in Germany, Moller-Hansen in Denmark and Van Heel in the Netherlands, Hopkins and Kapany (24) published a seminal paper on a flexible fiberscope (1954). However, the practical development of fiberoptics for endoscopy is largely due to the insistence of Basil Hirschowitz, who after visiting Hopkins in 1954, settled in Ann Arbor where he was able to organize a team, which included a bright physicist by name Lawrence Curtiss. The first endoscopic prototype was tested on a patient in 1957. The new fiberscope was presented at the meeting in Colorado Springs of the American Gastroscopic Society, and a detailed report on the instrument was published in 1958 (25). The first fiberscopes had numerous problems : poor lighting, lack of mobility, breaking of fibers, difficulties for cleaning the instruments which were not watertight, lateral view only, no biopsy channels. It was not until several Japanese firms entered the field that more advanced designs became available, including frontal view oesophago-gastrosopes, biopsy and cytology facilities, improved lighting and photographic equipments (26).

Endoscopy coupled with biopsy was able to study several conditions which until then had been poorly identified : 1) the grading of oesophagitis, 2) Barrett's oesophagus, 3) gastric varices, 4) acute gastric mucosal lesions, 5) *Helicobacter pylori* infection 6) an accurate topography of gastritis 7) the "watermelon" stomach 8) colonic polyps and flat adenomas, 9) intestinal angiodysplasia.

Special recognition should be given to endoscopic cytology by lavage or brushing which allowed a firm diagnosis of oesophageal and gastric cancer in about 90 per cent of cases. Impressive results with endoscopic cytology of the oesophagus and the stomach were published by Japanese and European endoscopists. Among them, Vicente Cabré-Fiol from Spain, who achieved the largest series of carcinomas studied in Europe (27). The progress of biopsy techniques and particularly the increase in the number of samples taken, limited since the usefulness of cytological examinations.

### Sigmoidoscopy and colonoscopy

For many years gastroenterologists had examined the rectum and part of the sigmoid colon by means of rigid instruments consisting of hollow metal tubes containing a rod with an electric lamp at its distal end, later on, proximal lighting was provided by several manufactur-

ers, as often distal lamps were obstructed by faecal material. The cold light systems based on Hopkins designs allowed taking excellent pictures of the colon. However, the rigid instruments had many limitations. It was not until 1963-1966 that Bergein Overholt (28) started using a fiberscope for the successful examination of the sigmoid, which allowed him to diagnose colon carcinomas. The quest for total colonoscopy was a long one and many instruments and procedures were tried including pull-through techniques with wires, threads etc. until colonoscopes were made that could by means of cable systems twist and bend so that they could be introduced beyond the colonic flexures. In 1971 colonoscopy started being used widely, and colonic polyps were removed after the pioneer work of Wolff and Shinya in New York (29). A new era had started and polypectomy has become a standard procedure which is done by gastroenterologists all over the World and is an indispensable part of the training of new specialists.

The American National polyp study has finally demonstrated that surveillance coupled with polypectomy may reduce colorectal cancer incidence by 76-90%. (D.D.W. San Diego 2000).

### Cholangiopancreatography

The development of new instruments by Japanese makers allowed a more easy passage into the duodenum down to its second portion. The direct observation of the papilla of Vater was first reported by Oi, Takemoto and Kondo (30) during the 1970 World Congress of Gastroenterology in Copenhagen. Later in the year, the first cholangiopancreatography was published by the same group (31) at the Woman's Medical College in Tokyo. But it was not until three years later, in 1973 that Ludwig Demling (32) from the University of Erlangen in Germany, described a papillotome which was used for the first time in 1974 by Meinhard Classen and Demling (33) succeeding in the removal of a common duct stone. Almost simultaneously, Keiichi Kawai using a different technique did a papillotomy in Kyoto (34). Endoscopic sphincterotomy has become the standard procedure for the treatment of common duct stones. Technical advances and experience have decreased considerably the risk of the procedure, now practiced widely, even in small infants. (Cremer, personal communication).

### Video- endoscopy

At the Digestive Disease Week meeting in 1983 a new technical achievement which caused a great impression was the presentation by the firm Welch-Alleyn of a video -endoscope provided with a microchip sensor of a few mm. in diameter attached to the tip of the endoscope. The glass fibers of the instrument transmitted only light, while the sensor sent clear images to a video monitor. The so-called CCD chip (Charge Couple Device) started a new era of endoscopy, greatly facilitat-

ing all kinds of endoscopic surgery which could be seen by several observers (1).

### The development of Laparoscopy

The paternity of laparoscopy is generally attributed to Georg Kelling who had already devised a flexible gastroscope, using a modified Nitze's cystoscope (35). At about the same time, Jacobeus, a Swedish thoracic surgeon, used also a similar instrument to do thoracoscopies and laparoscopies (36). A fierce fight for priority ensued which is still unsettled. However, the real winners were German endoscopists, among them Heinz Kalk, who at the Municipal Hospital in Kassel developed laparoscopy to an outstanding degree of accuracy (37). Kalk wrote several books on laparoscopy and received many alumni from many countries, in particular Belgium, Holland, Italy, Spain and France. Two German firms made most instruments in Europe, Wolf and Storz. Other instruments that should be mentioned are the operating laparoscope devised by Jacobs and Palmer (38) which permitted easy manipulation and biopsy of abdominal organs. The first attempts to do laparoscopic photography were made by Fourès working in Caroli's service in Paris, working with Caroli, using an internal electronic flash introduced through a thin laparoscope.

Again we are indebted to Hopkins. Glass fibers were used after 1970 as light transmitting media which enabled the use of high intensity cold light sources which provided excellent illumination and the possibility of taking pictures and films with great ease and accuracy eliminating intraabdominal light bulbs, and obviously any need for intraabdominal electronic flash lights. An electronically configured tube of glass interrupted at intervals by thin air spaces designed by Hopkins provided a light transmission far superior to the existing lens systems resulting in a greatly improved imaging and contrast. Most laparoscopic medical diagnosis has been based on this type of instruments (39). However, the great progress of laparoscopy from the surgical standpoint has originated in similar optical devices as video fiberscopy. The first laparoscopic appendectomy was performed and published by Semm (40), a gynecologist in 1983, a few years later, the first cholecystectomy was done by Philippe Mouret from Lyon (41). Since then, the impact of laparoscopic surgery in gastroenterological practice has been enormous.

### The emergence of international endoscopy organizations

The oldest society dealing exclusively with gastroenterological endoscopy was the American Gastroscopic Club established by Schindler and his colleagues in 1941; it later became the A.S.G.E. The first European meeting on digestive endoscopy took place in Leiden in

1960 at the time of the Sixth European Congress of Gastroenterology (ASNEMGE). It consisted of a half day session in which several papers were presented, mainly on gastroscopy. After that session, a "European Gastroscopic Club" later called "European Endoscopic Club" was founded by A. Wiebenga (Amsterdam), E. Jacobs (Brussels), Z. Maratka (Prague), S. Segal (Reims) and S. Stoichita (Bucarest). At the following European Congress of Gastroenterology (Brussels, 1964) a full day formal session on digestive endoscopy was chaired by F. Vilardell (Barcelona) and R. Le Cluyse and E. Jacobs (Brussels) (42). There was a huge attendance and the European Society of Gastrointestinal Endoscopy (ESGE) was founded by Ch. Debray (Paris), K. Heinkel (Erlangen), S. Stoichita (Bucarest), R. Le Cluyse (Brussels), E. Jacobs (Brussels), Z. Maratka (Prague) and F. Vilardell (Spain). The first official president of the Society was A. Wiebenga; a World Congress of Endoscopy took place in Tokyo in 1966; During the World Gastroenterology Congress in Copenhagen in 1970, a World Congress of Gastrointestinal Endoscopy was organized by the ESGE. A new Governing Council of ESGE was elected, Statutes were drafted and approved; the first ESGE Bulletin was published in January 1972 and widely distributed (43).

The standardization of endoscopic terminology was one of the priorities of ESGE. The efforts of Z. Maratka from Prague and the Terminology Committee have made possible the publication of an Endoscopic Nomenclature which has been translated into several languages and is periodically revised (44). The World Organization of Digestive Endoscopy (OMED) took shape more slowly, its Governing Council comprised members of the three Continental Organizations, the ESGE, the American and the Asian Pacific associations. The first OMED president was Dr. Sadataka Tasaka from Japan. Definitive OMED statutes were approved at the World Congress in Mexico in 1974.

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