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Hallmarks in colorectal cancer surgery

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Summary

Starting from the first attempts of artificial anus creation to the successful excision of the rectum for cancer, the lumbar colostomy and the creation of caecostomy and ileostomy, we present the major hallmarks in the history of colorectal cancer surgery.

Key words: artificial anus, colorectal cancer surgery, Jean-Zuléma Amussat, Paul-Mikulicz' operation, William Ernest Miles

Introduction

Up until the 19th century the surgical treatment of colorectal cancer was in a deplorable status because of the lack of general anesthesia and aseptic-antiseptic measures.

In the pre-anesthetic era, the most that could be offered to a patient with large bowel cancer was to relieve obstruction by means of a proximal stoma.

Colorectal surgery followed by an artificial anus

In the past, there were emergency conditions like obstructed hernias that urged the surgeons to perform surgical interventions at colonic level.

The acute intestinal obstruction by a strangulated hernia was the object of a surgical procedure followed by colostomy from Praxagoras' time (3rd century B.C.).

In Paris, in 1701, Jean Mery (1645-1722) performed in a patient, suffering from large bowel gangrene after a strangulated hernia, the first artificial anus, followed by François-Gigot de la Peyronie (1678-1747) who carried out the same intervention in 1723 and 1743, and Jean-Louis Petit (1674-1750), announcing in 1718 with success the same procedure.

Simultaneously, surgeons tried to create a colostomy not only in cases of intestinal obstruction due to hernias but also due to tumors. Two methods will appear having the same objective, but a different realization: the method of Callisen and the method of Littre [1].

One year after the death of François Broussais (1772-1838) from rectal cancer, the French surgeon Jean-Zuléma Amussat (1796-1856; Photo 1) who treated Broussais but didn't dare to realize on his master the technique which he proposed, in 1839, in the Gazette Médicale de Paris entitled *"Mémoire sur la possibilité d'établir un anus artificiel dans la région lombaire, sans pénétrer dans le péritoine"*, had the idea to perform an orifice for the fecal discharge by a section in the descending colon, in the left lumbar region [2]. The

Photo 1. Jean-Zuléma Amussat (1796-1856).

idea was not new, but it had been widely rejected. Adolf Callisen (1787-1866), Professor of Surgery at Copenhagen, conceived the lumbar colostomy in order to prevent the peritoneal penetration (extraperitoneal colostomy) but didn't realize it [3].

Amussat began by studying meticulously the anatomical region on which the operation was based. He realized that the left colon lacks peritoneum. Having tried on cadavers all the surgical procedures for colostomy proposed or executed until then and after numerous experiments on animals, Amussat decided to make a transverse section in the region. The first opportunity to apply his procedure in a patient appeared in 1839. It was the case of a woman presented with intestinal obstruction caused by a rectal growth and on June 2, 1839 Amussat carried out the first successfully extraperitoneal colostomy in the lumbar region.

One month later, the patient left for the countryside after a rigorous evaluation by the council of the Academy of Science, François Magendie (1783-1855) and Gilbert Breschet (1783-1845), who were able to notice that the colostomy functioned perfectly and the feces appeared regularly. Amussat practised a second operation on a 62-year-old man with cancer obstructing the upper half of the rectum, resistant to dilatation and cauterization. This operation was performed with the same technique and had the same success as the previous one [4].

Guillaume Dupuytren (1777-1835), Professor of Surgery at Hôtel-Dieu of Paris, in 1828, invented an enterotome (or cutting forceps) for use in colostomy operation. He proposed to establish an artificial anus on the left side when all other techniques have failed but he didn't dare to perform colostomy in the case of the famous actor François-Joseph Talma (1763-1826) who died after a bowel obstruction [3].

The therapeutic approach of large bowel obstruction (mainly of cancerous etiology) until the 19th century was extremely cautious; initially, rectal obstruction was treated by dilatation, cauterization, chemical burn, and if no improvement appeared, a surgical intervention was attempted.

The side-effects of a colostomy were known: undernutrition in upper intestine surgery and prolapse in lower intestine.

Although at that time colostomy for cases of congenital imperforation had not been discussed seriously, in 1710 Alexis Littre performed an autopsy on a child who died after anal imperforation; he was the first to propose a treatment by colostomy but he never tried to realize this operation. He had suggested: "It would be necessary to make an incision in the belly and to suture the two parts of the intestine or at least to put the upper part of the bowel to an exterior abdominal orifice that we will never close and which will function as an anus" [5,6]. The rifle-barrel colostomy and Hartmann's operation are based on this idea [7].

Pierre Duret (1745-1825), surgeon Major in Brest's navy, was the first surgeon to perform colostomy in a child. In 1793, thanks to an iliac colostomy, he saved the life of a child affected by anal imperforation [8].

The first colostomy to treat a cancer was a caecostomy and was performed by Pillore of Rouen (1724-1824) in 1770. The patient was a wine merchant suffering by large bowel obstruction due a scirrhous carcinoma located at the colorectal junction. The distended caecum was exposed through a transverse section, opened and fixed to the margins of the wound with a couple of sutures.

The operation produced great relief of the obstruction but the patient died on the 28th post-operative day because of necrosis of a loop of jejunum produced by the large amounts of mercury amounting to 2 lbs in weight that had been given in the original conservative attempts to overcome the obstruction [9].

This case went unnoticed, although the technique became well-known; an excellent technique and a good post-operative care thanks to a sponge maintained in the caecostomy allowing the faeces deposition.

Charles Louis Dumas (1765-1813) Professor of Anatomy and Physiology in Montpelier, then Dean of the Faculty and vice-chancellor of the University, ignoring the operation of Pillore, proposed the left colostomy in a case of rectal cancer (1797) [10], followed by Pierre Fine (1760-1814), chief surgeon of the General Hospital of Geneva, who carried out the first successful transverse colostomy in 1797. The patient, a woman aged 63 with a recto-sigmoid obstructing growth, lived for 3.5 months before dying of ascites [9,11]. These two case reports published in *Annales de la Société de Médecine de Montpellier* remained ignored.

The next successful case of an artificial anus creation in an adult took place in 1820 by Daniel Pring (1789-1859), a surgeon of Bath. His patient was a woman aged 64 who had complete obstruction due to a tumor in the upper rectum. Pring published the case in the *Medical and Physical Journal* the following year. Prior to recourse to the operation, he carried out every other measure he could think of. Worrying about the disadvantages of a colostomy, Pring wrote: "It may be worthwhile to observe that the inconveniences of an anus in this situation are not such as to have any cause to regret for having to submit to the operation; on the contrary, so far from her having any reason to lament this circumstance, I believe myself that it has afforded her of a moral as well as a physical advantage, for she is now at

no loss for an interest, and is provided for something to think of for the rest of her life" [12].

In 1879, Theodor Billroth (1829-1894), Professor of Surgery in Vienna, performed a colonic resection and brought the proximal end of the bowel out of the abdominal wound as a colostomy [13].

Surgery of colon without artificial anus

Jean-François Reybard (1790-1863), surgeon at Hôtel-Dieu of Lyon performed a successful resection of a sigmoid tumor with immediate anastomosis of the ends of the bowel, in 1833. This operation took place without an anesthetic and the patient, a man of 29, survived for a year [14].

In 1932, Barbock realized the first anastomosis with anal conservation. In 1933, Henri Hartmann (1860-1952) performed the two-stage colectomy [9].

However, it awaited the development of general anesthesia and the introduction of antiseptic surgery before a flood of reports of resections of large bowel tumors appeared in the literature. In 1879, Vincenz Czerny (1842-1916), Professor of Surgery at Freiberg successfully resected a colonic growth with end-to-end anastomosis [15].

By the end of 1899, the number of reported resections had raised to 57, with 19 operative deaths, a mortality of 37%. The majority of these deaths was due to peritonitis or from leakage or necrosis of the suture line. It was soon appreciated that resection and anastomosis of the colon, especially its left half, was much more dangerous than the same procedure elsewhere along the alimentary tract and surgeons turned their attention to the solution of this danger. An early approach was excision of the tumor with exteriorization. Initially, this comprised exteriorization of the colonic loop containing the tumor. At the second stage the protruding growth was removed, and at the third operation the resulting colostomy was closed [16].

The first successful case was reported by Walter Heinecke (1834-1901) of Erlangen, Germany. In 1895, Frank Thomas Paul (1851-1941) of Liverpool, published his technique in which he exteriorized the affected loop, sutured a glass tube into the bowel above and below the site of the tumor and then immediately excised the growth, thus reducing the operation to a two-stage procedure. Johannes von Mikulicz-Radecki (1850-1905; Photo 2), Professor of Surgery in Breslau, popularized this procedure in Europe and was able to show a reduction in operative mortality in his own cases from 43%, when he attempted primary anastomosis, to 12.5% for the exteriorization technique, which subsequently came to be termed the Paul-Mikulicz' operation [9].

Photo 2. Johannes von Mikulicz-Radecki (1850-1905).

Undoubtedly, the Paul-Mikulicz' operation represented a considerable advance in making colonic surgery safe. Its disadvantages were difficulty of the procedure when applied to bulky tumors in the non-mobile segments of the large bowel, and the fact that adequate resection of the areas of lymphatic drainage was impossible.

Surgery of the rectum

With its local symptoms and its easy detection by digital examination, rectal cancer was well known to the ancients but until comparatively recent times its treatment was entirely palliative - warm baths, emollient enemas, and dilatations with bougies.

Anorectal polyps were well known and often operated. Anorectal cancer was the subject of Frederik Ruysch's (1638-1731) research entitled "Observationum" [17], of Giovanni-Battista Morgagni (1682-1771) ("De sedibus") [18], of Antonio-Maria Valsalva (1666-1723) ("De aure") [19] and of Pierre-Joseph Desault (1738-1795) who gave an excellent description of anorectal cancer [20]. The first excision was done by Lisfranc in 1826 [4].

The resection for rectal cancer was illegally attributed to Faget (1739) and was performed by a partial excision: "Almost all the sphincter or the level of

circular fibers that surround the rectum was dissected" [21]. However, the extirpation of the rectum was practised in a complete way in 1826 by Jacques Lisfranc de Saint-Martin (1790-1847) [22]. Lisfranc, surgeon at La Pitié Hospital in Paris, in 1829, had performed 9 such operations. His procedure comprised an oval perianal incision, dissection of the distal rectum and its amputation above the growth. This resulted in the formation of an uncontrollable perineal colostomy [23].

In 1844, Charles-Pierre Denonvilliers (1808-1872) widens the section up to the coccyx and in 1845 Johann Friedrich Dieffenbach (1794-1847) lowers the rectum top which he stitches in the anus. In 1873, Aristide Verneuil (1823-1893) resects the coccyx to obtain a better result; nevertheless, mortality approaches 80% [4].

In 1874, now with the advantage of aseptic technique and anesthesia, Theodor Kocher (1841-1917; Photo 3), Professor of Surgery at Berne, performed preliminary closure of the anus with a purse string suture in order to prevent fecal contamination of the wound. He was also able to increase the extent of the operation by opening the peritoneal cavity from below with more adequate mobilization of the rectum [24].

In 1885, Paul Kraske (1851-1930), Professor of Surgery at Freiburg, introduced and, in 1887, perfected, his operation of sacral resection of the rectum, exposure being achieved by removing the coccyx and lower sacrum. The peritoneum was freely opened from below, the pelvic colon mobilized and brought down and, following removal of the tumor, an end-to-end anastomosis was carried out to the rectal stump. If the growth was too low to make this possible, a sacral colostomy was attempted. The Kraske' operation became extremely popular in Europe. It had the disadvantage of a high rate of anastomotic breakdown but had the advantage of a relatively low mortality and reasonable survival results. One review of nearly 1000 such operations gave a mortality of 11.6% and 30% 5-year survival [25,26].

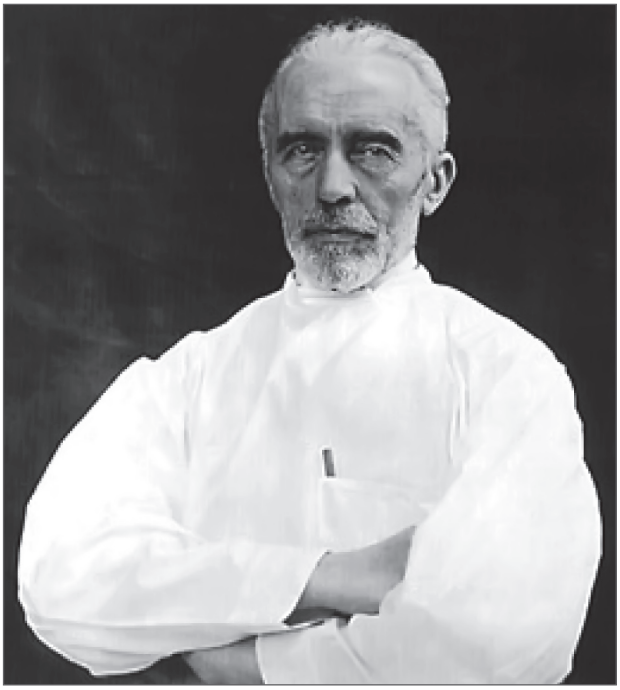

Photo 3. Theodor Kocher (1841-1917).

In 1907, J.P. Lockhart-Mummery (1875-1957), at St Mark's Hospital, London, developed an effective technique of perineal resection of the rectum. A preliminary laparotomy was performed and a loop colostomy fashioned. The perineal stage could be performed at once but was more usually delayed for 10 days and was carried out in the semi-prone position. The rectum was mobilized, the peritoneum opened from below and the superior rectal vessels were tied and divided as high as possible. The colon was then divided in the upper part of the wound and the blind stump closed. The peritoneum was sutured with catgut, leaving the stump of the sigmoid colon on the wound side of the pelvic diaphragm. The author stated that the operation should not take more than 45 min, the patient should be out of bed in 14 days and usually able to return home in 3 weeks. The operation had the disadvantage of leaving a blind stump of colon distal to the colostomy which might leak but it was a relatively adequate cancer operation and had the advantage, in the days of fairly primitive anesthesia and rarity of blood transfusion, of being relatively simple to perform and with a low mortality, in the region of 10%. Up to the 1930s, it was probably the most commonly employed technique [26].

Removal of the rectum by a combined abdominal and perineal operation was first performed by Czerny in 1884. This was not a planned procedure, but had to be carried out because an attempted sacral excision was found to be impossible to complete from below. Ernest Miles (1869-1947; Photo 4), appointed surgeon at both the Royal Cancer Hospital of Brompton and the Gordon Hospital for Diseases of the Rectum, first performed, in 1908, the one-stage operation of abdominoperineal resection for rectal cancer. Miles was disturbed by the high rate of early recurrence in his own experience of the perineal method of rectal excision. Careful postmortem examinations of patients dying with this disease convinced him of the importance of wide and extensive excision of the rectum, anal canal, the *levator ani* muscles and the draining lymph nodes. The disadvantage of this procedure at first was the high mortality. In Miles' first 62 cases, there were no less than 22 deaths, although this mortality was greatly reduced with the introduction of modern anesthesia, routine blood transfusion and antibiotics [3].

Photo 4. Sir William Ernest Miles (1869-1947).

The penalty of these procedures is the permanent colostomy. Nowadays, tumors other than those at the distal end of the rectum or the anal canal itself are treated by resection with anastomosis as low down as the anorectal ring. The introduction of the stapling gun has greatly increased the popularity of this operation [9].

Gradually, the operating conditions were improved thanks to the techniques of the resection in two phases of Bouilly-Volkmann or Hartmann (1933). Then the efforts were focused on the lower tumors and the preservation of the sphincter's function with the technique of Babcock (1932) modified by different authors, among which Bacon and Toupet.

The preparation of colon, the perfect asepsis, and the early diagnosis constitute a slowly acquired progress that contributed to the prognosis.

From the technical point of view, the return to the improved operating technique of Verneuil allows for an ultra-low anastomosis; the sphincter's preservation is made more effective with the use of automatic suture devices [27]. The surgical instruments of colostomies have finally achieved a remarkable progress, transforming what was for a long time a redoubtable infirmity into an acceptable constraint. The perfection of colostomies will require later a specific nursing education (teaching): the stomatherapy [28].

In 1950, Sir Alan Parks (1920-1982), proctologist at St. Mark's Hospital, described numerous interventions in the anorectal region and contributed significantly in the development of anorectal surgery [29].

Discussion

In the past, the radiographic examination of the colon gave the impression that colorectal cancer was detected at an early stage. Actually, it was a delusion because the images of stenosis and ulcerations usually corresponded to lesions having already penetrated the serosa. The immense and real progress was the understanding that before the manifestation of cancer there exists a mild, benign lesion, the polyp; its progressive transformation from adenomatous to adenovillous lesion precedes cancer's appearance.

In 1966, Morson establishes the degeneration in familial diffuse polyposis. Gilberstein in 1974, by monitoring for 25 years 18,000 persons by rectoscopy, and by excising the rectal polyps, obtained a decreased number of rectal cancers. The essential preventive treatment of colon cancer, the polyp's excision started. From then on, the discovery of early-stage cancer or better the recognition by colonoscopy and excision of polyps (polypectomy) became the gold standard for the prevention or cure of this malignancy.

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