

## COMPLETE MESOCOLIC EXCISION AND CENTRAL VASCULAR LIGATION IN COLON CANCER SURGERY. ANATOMY PRINCIPLES AND SURGICAL TECHNIQUE

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COMPLETE MESOCOLIC EXCISION AND CENTRAL VASCULAR LIGATION IN COLON CANCER SURGERY. ANATOMY PRINCIPLES AND SURGICAL TECHNIQUE (Abstract): Colon cancer continues to be a real public health problem despite recent advances. Surgery in colon cancer patients remains the only curative treatment, hence the importance of an adequate technical approach. Heald introduced, in 1982, the total mesorectum excision technique for rectal cancer patients, with subsequent improvement in oncologic results and reduced recurrence rates. Thus, total mesorectum excision technique represents today the gold standard in surgical resection of rectal malignancies. Based on this results, Hohenberger first applied in 2007 the total mesorectum excision principle in colon cancer surgery as complete mesocolon excision (ECM) and central vascular ligation (CVL). Complete mesocolic excision is based on a correct identification of the dissection plan between the mesofascial plane and the retroperitoneal fascia, central vascular ligation of the vessels to remove vertical lymph nodes and resection of the affected colonic segment. This paper aims to follow the principle of ECM and LVC in classic surgery and to correctly identify the anatomical dissection plans. In conclusion, applying the principles of CME and CVL in colon cancer surgery can improve cancer outcomes without increasing the incidence of postoperative complications. **Key words**: COMPLETE MESOCOLIC EXCISION, CENTRAL VASCULAR LIGATION, ANATOMICAL DISSECTION, COLONIC NEOPLASM, COLON CANCER SURGERY

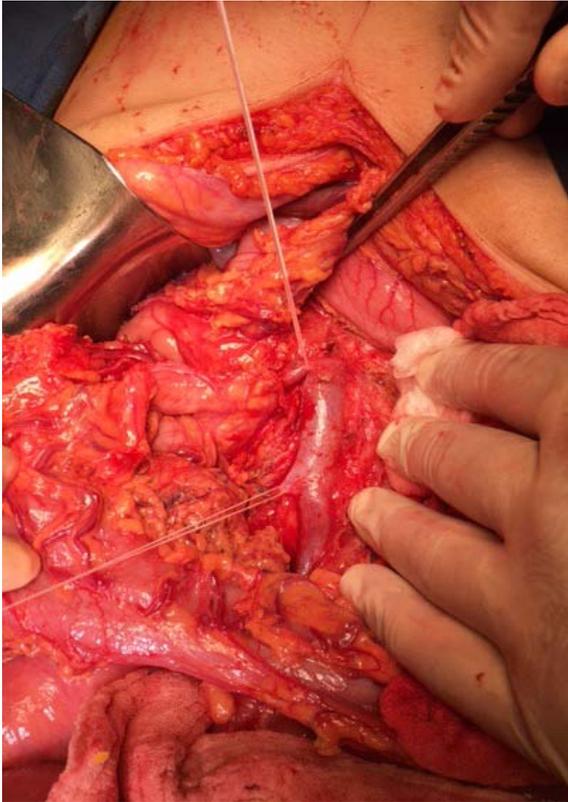
### INTRODUCTION

Colon cancer continues to be a major health problem worldwide, being the third most common type of cancer in men and the second in women<sup>1</sup>. Standard treatment of colon cancer is based on surgical resection of the affected colonic segment followed or not by chemotherapy. Even if important advances have been made regarding both surgical and oncological treatment, results are not always optimal. An adequate number of lymph nodes harvested is important for a correct stadialization of the disease, thereby the extension of the colonic resection remains controversial (1,2).

In rectal cancer patients, oncologic treatment was revolutionized after the complete mesorec-

tal excision technique was introduced by Heald & colab (3), in 1982. The procedure is based on an intact mesorectum excision along with the entire lympho-vascular surrounding tissue in which cancer cells can disseminate and form secondary lesions (2). The embracement of this surgical technique in rectal cancer patients has lead to increased overall survival (from 45% to 75%) while the local recurrence was significantly reduced (from 30% to 5-8%) (4).

Years later, the principles of complete mesorectal excision were extrapolated in colon cancer surgery and Hohenberger & colab (5). described for the first time in 2007 the complete mesocolic excision (CME) with central vascular ligation (CVL) concept. Complete mesocolic



**Fig. 1.** Central vascular ligation of right colic artery (superior) and ileo-colic artery (inferior)

excision and CVL refers to an *en bloc* removal of the affected colonic segment, excision of the corresponding mesocolon in a compact fascial layer and a high ligation of the tributary vessels along with all the perivascular lymph nodes developed on vertical direction (1,2,5). Reduced local recurrence and improved 5-year overall survival was observed in Erlangen after the CME with CVL technique was introduced by Hohenberger & colab. as standard of care (6).

Surgical treatment is inconsistent in different countries, even if similar principles are applied. In Asian countries for example, D3 lymphadenectomy technique which involves removal of the paracolic (D1), intermediate (D2) and main (D3) lymph nodes was implemented as standard of care in the surgical treatment of stage II and III colon cancer patients for 20 years (7,8).

No randomized trials exist in the literature comparing CME and CVL with the standard surgery procedure, but the novel principle described is based on a more anatomically approach that respects visceral and parietal peritoneal layers and can provide a more adequate oncologic specimen.



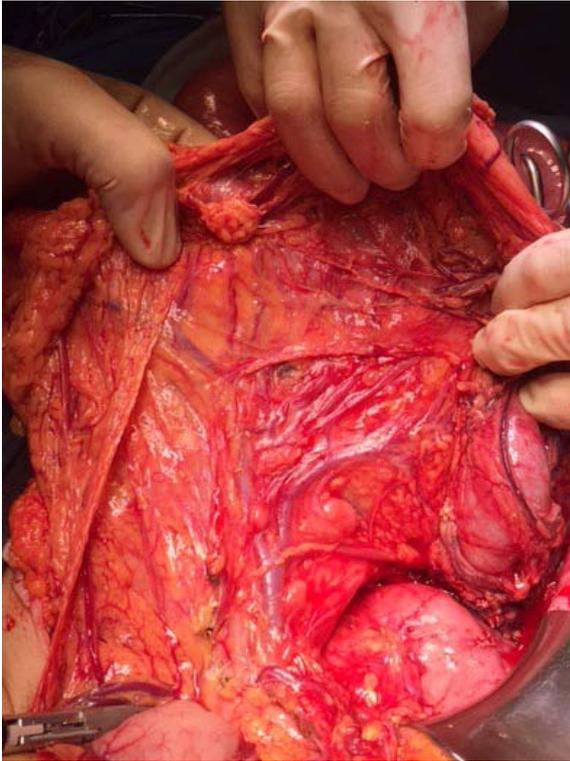
**Fig. 2.** Mesocolon mobilisation with duodenal visualisation

The importance of a correct standardization of the surgical technique along with an universal anatomic nomenclature is also an important step to achieve in order to have homogenous data of this patients.

#### MATERIAL AND METHODS

We aim to describe the complete mesocolic excision with central vascular ligation technique in “open surgeries” performed for colon cancer subjects and discuss applied anatomy and surgical technique.

For tumors of the cecum or ascending colon a right hemicolectomy is performed. The operation begins with dissection of the lateral peritoneal fold and continues medially in the mesofascial plane. A sharp dissection allows the correct mobilization of the mesocolon within an intact visceral peritoneal layer on both sides. After the entire right colon along with its mesocolon is mobilized from the underlying retroperitoneal fascia, ligation of the ileo-colic and right colic vessels at their origin is performed (Fig. 1). Radically mobilisation of the colonic segment is important for adequate high vessels ligation. The dissection must reach the duodenum and the uncinate process of the pancreas for adequate access to the superior mesenteric pedicle (Fig. 2). The right branch of the



**Fig. 3.** Transverse mesocolon elevated and middle colic pedicle exposed.

middle colic artery (Fig. 3) is ligated after gastro-colic sectioning and entrance of the lesser sac. From this point, the mesocolon of the transverse colon is sectioned vertically until it reaches the colon that is cut just above the middle colic vessels. The surgical specimen harvested will contain the entire regional lympho-ganglionic tissue in the thickness of the mesocolon and the lymph nodes distributed in vertical manner along the sectioned vessels (Fig. 4-5). The procedure ends with the anastomosis performed between the intestinal loop and the transverse colon.

Tumors of the hepatic flexure of the colon or third proximal of the transverse colon need, in addition, ligation of the gastro-epiploic vessels after lesser sac entrance, ligation of the middle colic artery at its origin from the abdominal aorta and, respectively, ligation of the omonim vein at the level of the trunk of Henle. Removal of the lymph nodes located at the inferior border of the pancreas and along the gastro-epiploic vessels must be done in case of more distally colon tumors (two third distal of the transverse colon or splenic flexure of the colon).

In left sided colon cancer tumors, surgery begins as well with the dissection of the lateral



**Fig. 4.** Complete excision of the mesocolon in an intact envelope of visceral peritoneum

peritoneal fold and continues medially in the mesofascial plane. The inferior mesenteric vein is ligated at the inferior border of the distal pancreas and, subsequently, the inferior mesenteric artery at its origin from the abdominal aorta (Fig. 6). Mobilisation of the distal colon, sigmoid colon and the superior third of the rectum is necessary for adequate complete mesocolic excision.

## RESULTS AND DISCUSSION

Complete mesocolic excision in colon cancer surgery is based on the same principles as total mesorectal excision in rectal cancer. Although rectal cancer treatment was revolutionized after introduction of this technique, CME and CVL is not universally accepted.

Complete mesocolic excision technique improves the quality of the colonic surgery and leads to a superior oncological specimen. The technique described aims for a more laborious surgery but it has the advantage of removing more tissue and, respectively more lympho-ganglionic nodes (1,9). Resection of the affected colon and the corresponding mesocolon must be performed within compact visceral peritoneal layers. The second component is the central vascular ligation (CVL) of the vessels



**Fig. 5.** Surgical specimen with intact visceral peritoneal layers



**Fig. 6.** Central vascular ligation of the inferior mesenteric artery at its origin from abdominal aorta.

in order to completely remove lymph-nodes distributed in the vertical direction.

Dissection in the correct anatomic plan can prevent tumor dissemination. Recent studies (2,9) revealed that the mesocolon is an individualized anatomical structure formed by adipocytes, lymph nodes and fibrous tissue arranged between two visceral peritoneal layers (10). The mentioned structures form a rich, superficial network separated from the ones that exist in Toldt's fascia or in the retroperitoneum. During surgery, in a medial-to-lateral approach, the dissection is performed either in a meso-fascial plane, between the posterior layer of the mesocolon and Toldt's fascia or in the retro-fascial plane that includes Toldt's fascia and leaves the retroperitoneal layer posterior<sup>2</sup>. A dissection performed in the correct anatomical plan, dissection that leads to intact visceral peritoneal layers around the resected mesocolon can prevent inoculation of the metastatic cells in the retroperitoneum. The released of the metastatic cells in the peritoneal cavity appears when lymphatic vessels are being sectioned<sup>2</sup> or in case of intense tumor manipulation.

In order to correctly apply CME technique, accurate classification of the surgical planes must be understood. Surgery is considered to

be in a poor plane if dissection is performed in the muscularis propria plane, in a moderate plane if it is performed in the intramesocolic plane and in a good dissection plane in case of an intact mesocolonic specimen (9). A mesocolic plane surgery reduces tumor dissemination and offers a more adequate oncologic specimen.

Lymph-node metastases in colon cancer may skip some ganglionic station and can appear, in 5% of the cases, only in the apical ones (11). If this patients would not benefit from a HVL procedure during colon cancer surgery, inappropriate stadialisation of the disease followed by incorrect chemotherapeutic treatment would occur.

Performing the surgery in the correct meso-fascial plane along with the high vascular ligation can improve oncologic outcomes through reduced local recurrence and increased disease-free and over-all survival (2,4,9). Moreover, applying the principles of CME and CVL in colon cancer surgery can improve cancer outcomes without increasing the incidence of post-operative complications (2-7).

## CONCLUSIONS

Adequate surgical treatment in colon cancer patients remains a crucial stage in the multidisciplinary

ciplinary treatment of the oncologic patients. Surgery in colon cancer patients remains the only curative treatment, hence the importance of an adequate technical approach Improved surgical technique can lead to a more accurate standardization of the patients and improved long-term outcomes due to a dissection performed in the correct oncologic plan.

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