Optimal Colonic Cancer Surgery- the Concept of Complete Mesocolic Excision

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Abstract

Although colorectal cancer is one of the most common malignancies worldwide, the colon cancer related mortality significantly decreased in the last decades due to the wide implementation of screening programs and due to a better therapeutic approach. Once Heald introduced the concept of total mesorectal excision and demonstrated its’ benefits in terms of oncological outcomes, attention was focused on the possibility of implementation of a similar technique for patients with colon cancer. This is how the concept of complete mesocolic excision appeared. This is a literature review regarding the surgical technique and oncologic outcomes of complete mesocolic excision.

Keywords: Colon cancer; Mesocolic excision; Survival

Introduction

Colorectal cancer is a major health problem, being the third most frequent cancer in men (764,000 cases/year) and the second in women (614,000 cases/year) [1]. The mortality decreased with almost 30% from 1990 until 2007 due to screening programs and to better therapeutic approaches. Over recent years, patient outcomes after colonic cancer resection have not improved to the same degree as for rectal cancer. Emil Theodor Kocher first theorized that oncologic resection is removal not only of the organ but also of its lymphatic drainage, a concept substantiated by Miles [2], Jamieson and Dobson [3] for colorectal cancers. After 70 years, a new revolution in radical surgery was performed by Heald et al. [4], who introduced the concept of total mesorectal excision (TME), the primitive embryological dorsal mesentery of the rectum, reaching significant local control, 5-year overall survival and disease-free survival [5]. The benefits in terms of long survival rates after applying the technique of TME were widely demonstrated: while in the 1980’s patients with colon cancer were thought to have a significantly better outcome in terms of overall survival, once the TME has been implemented, better outcomes were reported among patients with rectal cancer [6,7]. Once the benefit of TME has been widely demonstrated, a new surgical technique for colon cancer has been suggested. The procedure, known under the generic name of total mesocolic excision, consists of an extended dissection of the affected colic segment carried out in the embryologically defined mesocolic planes in order to remove all the lymphatic trunks situated along the vessels which provide the blood supply of the region [4]. In this way the resected specimen is characterized by a greater distance between the tumor and the site of ligation of the main blood vessels [8]. However, initially the method remained controversial [8]. For example, in Denmark the concept of complete mesocolic excision for colon cancer was implemented in 2008 in a single center (Hillerod) while the other three centers in the Capital Region of Denmark refused the implementation of the technique. One year later, the quality of the specimens in the four centers was examined by the pathologists and significant differences in terms of resected lymph nodes and of distance between the tumor and the vascular tie being reported between the two groups [8].

The concept of complete mesocolic excision

In 2009, translating the concept of TME, came the first report and description of the complete mesocolic excision (CME) with central vascular ligation (CVL) from the Erlanger group of Hohenberger with impressive oncological outcomes and an overall 5 year survival reaching up to 70% for stage III colon cancer patients. They also demonstrated that this is a safe and feasible technique with at least the same morbidity and mortality as the “so called” standard technique. The concept of CME with CVL consists of creating an intact specimen encompassing the primary neoplasia along with all the potential pathways of tumor spread through central ligation of the main artery at its origin [9,10]. CME with CVL consists of two main components: the preservation of intact fasciae of the mesocolon between which relevant lymph nodes are contained in association with ligation of the blood vessels that supply the tumor colon site at their origin: at the level of the superior mesenteric vein for right sided neoplasms and at the level of their origin in the inferior mesenteric artery for left sided neoplasm [11]. Other studies advocate that there are three separate components defining the optimal CME surgery: the first one refers to the preservation of the integrity of the
mesocolic plane during dissection, the second one refers to
the central ligation of the tumor feeding blood vessel while the
third refers to the removal of an appropriate length of large
bowel on both sides of the tumor [12]. However, while the first
component is widely accepted, the other two references have
been contested by some authors: although some authors
strongly sustain the benefits of central vein ligation [13,14],
other studies show no difference between high and low
ligation [15,16]. As for the length of removed colon, the
Japanese studies propose alternative principles regarding the
amount of normal colon resected [17].

In 2012 Culligan et al. [18] published a study regarding the
anatomic landmarks of the mesocolic which should be
respected in patients undergoing mesocolic excision for
malignant tumors. In a more recent study conducted by the
same author it is demonstrated that the classic affirmation
that the term of mesocolon should be applied only for the
freely mobile segments of the colon is in fact a misconception,
both right and left colon presenting a proper mesocolon which
present in adulthood in almost all cases [19]. However, this
aspect was first described by Carl Toldt in 1879 in “An Atlas of
Human Anatomy for Students and Physicians” [20,21];
according to the anatomical studies, Toldt’s fascia should be
considered as the landmark between the apposed portions of
the mesocolon and the underlying retroperitoneum.
Demonstrating the mesocolic continuity and the presence
of Toldt’s fascia located between the apposed portions of
the mesocolon and the retroperitoneum, rationalize dissection
in this plan during colonic resection. The concept for CME is
the consequent surgical mobilization by sharp dissection of
the visceral fascia layer from the parietal one resulting in complete
removal of the entire mesocolon covered by an intact visceral
fascia layer, providing in this way a safe exposure and a proper
ligation of the supplying arteries at their origin [18].

The extent of the surgical procedures is determined by the
location of the cancer and the pattern of potential spread. For
right sided tumors the procedure includes performing a Kocher
maneuver and identifying the mesenteric root up to the origin
of the superior mesenteric artery and exposure of superior
mesenteric vein. During these surgical steps the integrity of
the mesocolon should be strictly preserved [22]. Intact
mesocolon in colon cancer resections is associated with a 15%
better overall survival at 5 years compared with cases with
mesocolic defects [23].

In the study conducted by Munkedal et al. [12] evaluating
the effectiveness of the introduction of the concept of CME
conducted in Aarhus University Hospital, Denmark, 209
patients with colon cancer were introduced. According to the
integrity of mesocolon, the resected specimens were classified
in three groups: the mesocolic plane – the specimen has an
intact mesocolon with peritoneal-lined surface and no
defects deeper than 5 mm, the intramesocolic plane – the
specimen has a moderate amount of mesocolon, with deeper
than 5 mm defects, none of them reaching the muscularis
propria and the muscularis propria plane – the specimen
presents a small amount of mesocolon with disruptions
exposing the muscularis propria. The histopathological studies
revealed that an intact mesocolic plane was achieved in 61% of
cases, an intramesocolic plane was achieved in 36% of cases
while in the other 3% of cases the dissection was performed in
the muscularis propria plane. The rate of cases in which an
intact mesocolic plane was found was slightly higher for
patients with right sided tumors when compared to those with
left sided tumors (p=0.075) [12].

In the study conducted by Bertelsen et al. [8] the authors
compared the results obtained in a group of 364 patients with
colic cancer submitted to CME with those obtained in a similar
group of 1031 patients in whom the technique of CME was not
applied. The 4 year disease free survival rate was significantly
higher for patients submitted to CME among all UICC (Union
for International Cancer Control) stages of the disease.
Although it did not reach statistical significance, the 5 year
overall survival rate was higher for patients submitted to CME
versus cases with non-CME surgery 97.49% versus 69.8%,
p=0.12) [8].

The surgical resection of colon cancer continues to lack
international standardization. In centers undertaking
meticulous mesocolic dissection with optimal lymph node
clearance, outcomes are significantly better, with 5-year
cancer-related survival of up to 89%. Thus, CME with CVL
improves the quality of the specimen and oncologic results
without increasing the postoperative complication or mortality
rates [17].

According to NCCN-2016, for resectable non-metastatic
colon cancer, the preferred surgical procedure is colectomy
with en bloc removal of the regional lymph nodes. The extent
of colectomy should be based on the tumour location,
resecting the portion of the bowel and arterial arcade
containing the regional lymph nodes. Other nodes, such as
those at the origin of the vessels feeding the tumor (ie, apical
lymph node), and suspicious lymph nodes outside the field
of resection, should also be biopsied or removed if possible.
Resection must be complete to be considered curative, and
positive lymph nodes left behind indicate an incomplete (R2)
resection [24,25].

The extent of the lymph node dissection

Longitudinal spread greater than 10 cm beyond the tumor is
extremely rare, 1% to 4% for right-sided tumors and 0% for
left-sided tumors [26]. The location of nodal metastases
influences survival. Involved nodes situated along the major
vessels have a worse prognosis than involved pericolic nodes,
and this is independent of the number of nodes involved
[27,28]. The Japanese Society for Cancer of the Colon and
Rectum (JSCCR) advocates careful dissection along
embryologic tissue planes, the radicality of the lymph node
dissection being determinate by the clinical preoperative
staging. It is recommended a D2 resection (standard low tie)
for early stage tumors (stage I ) and a D3resection (high tie) for
more advanced disease (stage II and III) [29]. The D2-level
lymph node dissection consists in the ligation of the ileocolic
artery and right colic artery (if present) on the right side of the
superior mesenteric vein with the removal of the epocolic,
paracolic and intermediate lymph nodes. In D3 level
dissection, the division of the ileocolic artery and right colic artery is performed to the left side of the superior mesenteric vein with additional removal of the main lymph nodes, where metastasis has been found to occur in 8% to 17% of the cases [26,30]. Precise evaluation of lymph nodes in the surgical specimen is crucial for the staging and subsequent decision about the adjuvant therapy in colorectal cancer.

D3 dissection was reported significantly superior to D2 dissection in terms of overall survival for patients with T3 and T4 colon cancer [31]. Excellent longterm outcome of D3 dissection in right hemicolectomy were reported by Kanemitsu and colleagues [32] from a single-institute non-randomized retrospective study in Japan. Japanese D3 surgery is based on similar principles to CME with CVL, both aiming to follow embryologic tissue planes with central ligation of the feeding arteries. Lymph node yield has been proposed as a marker for metastasis has been found to occur in 8% to 17% of the cases [33]. A higher nodal yield is consistently noted in right-sided tumors compared with left-sided tumors, partially due to a combination of greater tumor size, immune stimulation by microsatellite unstable tumors, and the anatomic presence of two vascular arcades in right-sided specimens as compared with left-sided specimen.

The establishment of CME with CVL in the mind of many, at first skeptical, colorectal surgeons came when the leading group of pathologist from Leeds [9], which is involved in almost all the techniques used by pathologist to assess and measure surgical quality in rectal surgery, published the first morphometric criteria of macroscopical and microscopical assessment of colon cancer specimens. In this way, the superiority of CME with CVL, as far as the quality of the surgical specimen is concerned, was proven.

Conclusions

Standardized oncologic surgery shows particular importance by reducing the rate of local recurrence and achieving increased survival. It is important to remember that colon cancer treatment today is multimodal and that the improvement in patients’ survival in the last decades is surely linked with the improvement in chemotherapy and the advances in the agents used. However, optimal surgery is with no doubt an important element of good oncologic outcome, as the experience with rectal cancer treatment has taught us.

References


