

Mobilization of the Splenic Flexure: A Standard in Laparoscopic Left Colon and Rectum Resections!

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Abstract: The importance of routine mobilization of the left flexure within laparoscopic resections of the left colon is discussed controversially. In the opinion, it should be applied as a standard in these surgical operations. The data of the prospective evaluation of all laparoscopic colectomies were evaluated for a period between 1993 and 2005 with 1091 resections of the left colon or rectum with 72 conversions to an open procedure (conversion rate 6.6%) included. The left flexure was mobilized in 79.2% of all operations. There were no significant differences between the groups regarding the duration, loss of blood and other parameters. The anastomotic leakage rate was 2.2% in this study. A number of resection-rectopexies were included in the percentage of interventions without mobilization of the flexure. The mobilization of the left flexure can be applied as a routine part of left colic resections in a teaching hospital with a large number of participating surgeons and procedures. Using a standardized operation technique with subtle preparation and partially extreme positions of the patient during surgery the mobilization is possible without relevant loss of time and without increased complication rate and a remarkably low leakage rate.

Key words: Colorectal, laparoscopy, left flexure, leakage rate, technique, surgery

INTRODUCTION

The mobilization of the splenic flexure as a standard in laparoscopic resections of the left colon and the rectum is discussed controversially (Bergamaschi and Arnaud, 1997; Sigel *et al.*, 2004; Tuech *et al.*, 2000; Woeste *et al.*, 2005). Advantages of the mobilization of the left flexure as a standard procedure are supposed to be the better mobility of the remaining colon with a tension-free construction of the anastomoses. The increased preparation necessary associated with additional complication potential is regarded as a disadvantage. In addition, a mobilization of the flexure is not necessary in many cases to guarantee an unstressed anastomosis.

Different procedures are described for mobilization of the splenic flexure, most frequently the lateral access and the medial access are used. Within the lateral access, the colon is mobilized by incision of the lateral peritoneum of the sigmoid and the descending colon. After preparation of the omentum from the distal transverse colon and the left flexure, the flexure and the entire left colon are mobilized on Gerota's fascia (Schiedeck *et al.*, 1998).

In case of the medial access, the mesentery is opened medially with complete separation of the vessels. Thereafter, the left flexure is mobilized with the left colon

(Sigel *et al.*, 2004). While in oncologic resections of the left colon the mobilization of the left flexure is obligatory, a sufficient tension-free anastomosis can be achieved for example in sigmoid resection due to diverticulitis without mobilization of the flexure. Nevertheless in case of an anastomosis under tension, the mobilization of the flexure after completion of the anastomosis can be technically difficult. An additional risk-factor can arise through tensile stress on the anastomosis during subsequent preparation. In the department, the mobilization of the left flexure is proposed as the standard for left colon and rectal-resections. Therefore, the lateral access is preferred. In case of benign indications, the inferior mesenteric artery and the superior rectal artery are preserved and a tubular resection is carried out.

The technique and results are presented employing the prospective database of laparoscopic colorectal resections with special focus on intraoperative complications, conversion rate, operation time and other parameters. With this data, we demonstrate that mobilization of the splenic flexure can be established as a routine procedure in >1000 subsequent operations by nearly 30 surgeons and on the other hand with excellent results regarding anastomotic leakage and other complication rates.

MATERIALS AND METHODS

The data of all patients undergoing an elective resection of the left colon or the rectum since the introduction of the method (January, 1993 until December, 2005) in the Department of Surgery of the University Clinic Schleswig-Holstein, Campus Luebeck were included in a computer based prospective database and retrospectively analyzed. For analysis of the results, the group of surgeries with mobilized flexure (group 1) was evaluated and compared to the group without mobilization of the flexure (group 2). The comparison included age, sex, diagnoses, surgery, conversion rate, intra and postoperative complications, surgery duration, complication rate differentiated in major (requiring re-operation) and minor (treated conservatively) complications, duration of intensive care treatment, duration of hospital treatment and mortality, data after discharge from the hospital were included when available. A conversion was defined as an unforeseen laparotomy or an incision longer or earlier than planned (Schwandner *et al.*, 1999).

The preoperative preparation is standardized. During the observation period, an oral colonic irrigation and a perioperative antibiotic application are carried out as single shot-prophylaxis or therapy for some days depending on the indication. All patients, receive a thrombosis prophylaxis.

The laparoscopic operations are carried out in lithotomy position under general anaesthesia, a urine-catheter is obligatory. The positioning of the patient on the operation table is safeguarded by shoulder and side support mounted on the operating table. This prevents sliding even in extreme positions of the operating table. A four trocar laparoscopy is performed with access to the abdomen in open technique. The camera is located above the umbilicus.

Two 10/12 mm trocars are positioned in the right and left lower abdomen at the level of the spina iliaca anterior superior as well as a 5 mm trocar in the middle of the right abdomen.

The pneumoperitoneum is established with CO₂ with a pressure of 12-15 mm Hg. After a diagnostic laparoscopy the trocars are brought in under direct vision. Operation starts in deep Trendelenburg position and slight right side rotation with complete separation of the lateral adhesion of the sigmoid. After incision of the peritoneum the left ureter is demonstrated in order to avoid any injury during the operation. The peritoneum is incised laterally to the colon and the flexure for the mobilization of the left colon and the left flexure. For mobilization of the flexure the operating table is moved to

a head-up position (reverse-Trendelenburg). The left flexure is mobilized by sharp complete separation of the suspensions to the spleen and by preparation of the omentum from the colon with opening of the Bursa omentalis to the middle of the transverse colon until the left colon is mobilized on Gerota's fascia.

This mobilization of the flexure is the standard procedure; the only exceptions are resections-rectopexies in which the flexure is not mobilized to maintain some suspension of the left colon depending on the intraoperative site.

The dissection of the mesentery depends on the diagnosis. In case of benign diseases (for example diverticulitis), the complete separation of the mesentery occurs tubular under preservation of the superior rectal artery. In case of oncologic resections, the vessels are dissected with high tie ligation according to the rules of oncologic surgery.

After mobilization and mesenteric dissection, a posterior wash-out with cyto-toxic solution is carried out below an intestine clip proximal to the resection line and the colon or rectum is divided intracorporally with a linear cutter. In most cases, the trocar incision in the left lower abdomen is enlarged to gain a minilaparotomy. In case of oncologic interventions, the abdominal wall is protected with a special plastic foil.

The specimen is resected outside the abdomen, the head of the stapler is inserted and an intracorporeal stapler anastomosis is performed. Only in the 1st time of the investigated period some anastomoses were hand-sewn extracorporally. At the end of the operation, an easy flow-drainage is placed. The fascia is then sutured in 10 mm incisions. The operation technique is published in detail elsewhere (Bruch *et al.*, 1997, 2003; Herold *et al.*, 1994; Schwandner *et al.*, 1997, 1999, 2003, 2004).

RESULTS

In the evaluated period, total 1091 left colon or rectum resections were done, about 72 of which had to be converted to the open procedure (conversion rate 6.6%). The diagnoses and the frequency of each indication leading to operation is shown in Table 1. Within the procedures sigmoid resections (50.2%), anterior resections (19.9%) and resection-rectopexies (18.5%) were the most frequent interventions (Table 2 and Fig. 1).

There were various indications for surgery of which diverticulitis was the most frequent (46.2%). Among the 1091 treated patients, 30.5% were men and 69.5% women. The average age was 61.2 years the average Body Mass Index (BMI) was 25.9 kg m⁻² with a range of 15.8-45.8 kg m⁻². Among all laparoscopically, completed

Table 1: Diagnoses of the operated patients

Diagnosis	N	Percent
Diverticulitis	504	46.2
Outlet-obstruction	139	12.7
Prolapse	114	10.5
Colon-carcinoma	110	10.1
Rectal-carcinoma	77	7.1
Diverticulitis+outlet-obstruction	58	5.3
Diverticulitis+prolapse	27	2.5
Colon-adenoma	25	2.3
Chronic constipation	10	0.9
Colitis/crohn	9	0.8
Others	18	1.5

Table 2: Number and type of operations analyzed

Surgical procedure	N	Percent
Sigmoid resection	548	50.2
Anterior resection	217	19.9
Left hemicolectomy	111	10.2
Resection-rectopexie	215	19.7

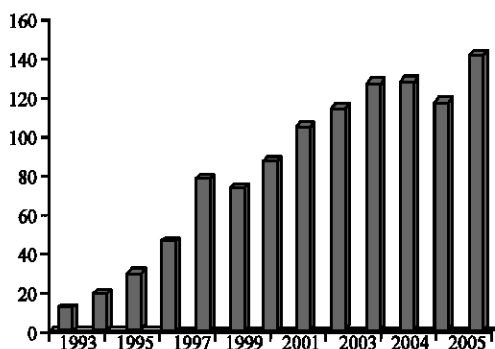


Fig. 1: Number of operations per year

operations included in this evaluation the left flexure was mobilized in 77.7% in 1.5% splenic and hepatic flexure were mobilized due to extended colonic mobilization to avoid tension on the anastomosis. In 20.8%, the left flexure was not mobilized. Intraoperative complications are documented in 3.4% of the operations.

In 79.4% of the interventions no postoperative complications were recorded in 13.1% minor complications occurred in 7.5% (n = 76) a revision was necessary due to a major complication. Within hemorrhage complications 3.5% were requiring revision and 1.4% were controlled conservatively.

Laparotomies were necessary due to re-operation-requiring complications in 34 patients (3.3%), the remaining re-operations were carried out laparoscopically. The average operation time was 191.73 min with a range of 45-510 min. A postoperative supervision and/or treatment in the intensive care unit was necessary for 0.83 days on average. Following the operation, the patients took liquid food after 2.45 days and regular food after 6.24 days on average. The mean postoperative hospital stay was 11.75 days with a range of 4-83 days (Table 3). About 4 of the 1019 patients died after laparoscopic resection, this

Table 3: Average, standard deviation, minimum und maximum for age, Body Mass Index (BMI), surgery duration (OP-time) time on an Intensive Care Unit (ICU) first liquid and first regular food intake and length of postoperative hospitalization

Tools	Age (years)	BMI (kg m ⁻²)	OP-time (min)	Intensive care (days)
Average	61.2	25.9	191.73	0.83
Std.-deviation	13.2	4.2	65.91	4.06
Minimum	20.0	15.8	45.00	0.00
Maximum	91.0	45.8	510.00	57.00

	Liquid food (days)	Regular food (days)	Postoperative hospitalization (days)
Average	2.45	6.24	11.75
Std.-deviation	2.31	3.35	6.47
Minimum	1.00	1.00	4.00
Maximum	47.00	56.00	83.00

Table 4: Comparison of the groups for the averages of age, surgery duration, BMI, no. of blood transfusions and length of Intensive Care Unit (ICU) care group 1 with mobilization of the flexure, group 2 without mobilization of the flexure

Factors	Rate	Group 1 (n = 864)	Group 2 (n = 227)
Age	Average	59.51 years	61.58 years
Surgery duration	Average	205.92 min	186.53 min
BMI	Average	24.942 kg m ⁻²	26.103 kg m ⁻²
Tranfusion units	Average	0.47 units	0.68 units
ICU	Average	0.33 day	0.93 days

p>0.05

Table 5: Comparison of conversion and complication rates between the 2 groups. Group 1: with mobilization of the flexure, group 2 without mobilization of the flexure

Factors	Group 1 (%)	Group 2 (%)
Conversion rate	4.2	6.0
Minor complications	14.6	13.9
Major complication	4.4	6.9
Major hemorrhage complications	2.5	2.8
Leakage rate	1.9	3.5

p>0.05

represents a mortality rate of 0.4%. The operations were carried out by 28 different surgeons in total. The left flexure was mobilized in 77.7% of 1091 operations including resection-rectopexies in which the mobilization of the flexure is not recommended, representing 19.7% of all operations. In the remaining 876 operations (resection-rectopexies excluded) the left flexure was mobilized in 87.5% of the interventions.

No statistical significant differences are found between the group of patients with mobilization of the flexure (group 1) and the group of patients without mobilization (group 2). The mean age is 59.51 years in group 1 and 61.58 years in group 2. The mean operation time was 205.9 min in group 1 and 186.53 min in group 2, a difference considered insignificant (p>0.05). The body mass index was also not different. None of the remaining analyzed parameters did show any significant differences between the groups either (Table 4). It was rarely necessary to convert to open operation without significant difference in both groups. Even the complication rates were without significant differences in the 2 groups (Table 5). The frequency of anastomotic

leakage was not significantly different in the 2 groups. In total 24 anastomotic leakages occurred (2.2%), total 16 of them in the group with mobilization of the left flexure (1.9%).

DISCUSSION

The mobilization of the left colonic flexure as a standard procedure in resections of the left colon and the rectum is discussed controversial, in particular in laparoscopic surgery. Tuech *et al.* (2000) and Woeste *et al.* (2005) advocate regular mobilization of the left flexure while, Bergamaschi and Arnaud (1997) proposes mobilization of the flexure after consideration of the individual length of the remaining colon following resection of the specimen.

While the mobilization of the left flexure in low anterior resection is regarded obligatory by many surgeons (Farke and Gogler, 2000) the necessity of this procedure is still discussed in sigmoid and anterior resections. Arguments against a routine mobilization of the left flexure are the increased effort and the possibility to perform a tension-free anastomosis without a release of the flexure in many cases.

In the opinion, the mobilization of the left flexure should be considered the standard procedure for left colon resections in the technique described previous. Resection-rectopexies are an exception from this standard. This evaluation demonstrates that a regular mobilization of the left flexure can be kept as a standard even in the large series of a teaching hospital and over a long period. With the left flexure mobilized in the majority of the operations the reported complication and anastomotic leakage rates are considerably low, compared to the literature (Farke and Gogler, 2000; Hyman *et al.*, 2007; Merad *et al.*, 1998; Millan *et al.*, 2006).

The second aim of this study was the comparison of the patients with and without mobilization of the flexure. The amount of about 80% of the operations with mobilization of the left flexure (resp. about 90% with resection-rectopexies excluded) confirms that this procedure represents a hospital standard. This high percentage is realized over an observation period of 13 years beginning with the introduction of the method. It thus contains also the general learning curve for the procedure as well as the individual learning curves of the numerous involved surgeons. The large number of surgeons, performing the interventions argues for maximal standardization of the procedure in a teaching hospital and also for the mobilization of the left flexure in left colon resections as part of a standard procedure. Maximum mobilization of the colon is achieved through this standardization in order to establish a tension-free

anastomosis even in case of less experienced operating surgeons. Generally, tension is regarded to be an essential risk factor for anastomotic leakage (Farke *et al.*, 2005). The intraoperative site will be assessed correctly by experienced laparoscopic colorectal surgeons in most cases who decide whether an anastomosis without tension can be created even without mobilization of the left flexure. A mobilization of the flexure due to tension after completion of the anastomosis may be difficult and can lead to subsequent anastomotic complications by intermittent tension. The comparison of the data does not show any significant differences between 2 groups with and without mobilization of the flexure. Therefore, the argument of a higher effort with resultant prolonged surgery time and increased complication rate during the mobilization of the left flexure can be rejected for the series. With the mobilization of the splenic flexure as the standard procedure in nearly 90% of the operations (resection-rectopexies excluded), no difference in anastomotic leakage rates could be demonstrated. This result was expected otherwise, there must have been mistakes in the decisions not to mobilize the flexure. But regarding the anastomotic leakages a rate of 2.2% in a large group of left colon and rectal resections including low anterior resections is quite low compared to the literature (Hyman *et al.*, 2007; Merad *et al.*, 1998). This is achieved without increased complications and with the learning curve of the procedure itself and the learning curves of 28 surgeons represented in this data. Hyman *et al.* (2007) reports a comparable leakage rate in 1223 operated patients with 2.7%. But in this data also small bowel resections and right colic resections known to have low leakage rates are included with >500 operations. On the other hand, only 2 surgeons performed the operations in this series. Merad reports a leakage rate of 4.7% resp. 4.9% in both groups of a randomized comparison of anastomoses with or without omentoplasty also including right colectomies and excluding low anterior resections (Millan *et al.*, 2006).

It is impossible to proof that the remarkable rate is a result of the routine mobilization of the splenic flexure with this data therefore, a randomized trial is needed. Nevertheless, the routine mobilization of the left colic flexure is no disadvantage for patient or surgeon according to the results and can lead to excellent results like very low leakage and complication rates.

CONCLUSION

The mobilization of the left flexure can be established as standard within the large series of a teaching hospital with many practicing surgeons and over a long time period. Application of this standard shows no increase in

operation time and complication rates and leads to a low leakage rate compared to the literature. Even for the less experienced surgeon an optimal mobilization of the colon for tension-free anastomosis is facilitated by maximum standardization of the procedure.

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