Original Article

"Caudal to cranial" versus "medial to lateral" approaches in laparoscopic right hemicolectomy: Retrospective comparative study

Omar Abdel-Raouf Hanafi, Tarek Youssef and Moustafa M. Emad

Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt.

ABSTRACT

Background: Laparoscopic right hemicolectomy (LRH) has emerged as the gold standard for the management of colorectal cancer involving the right colon. To optimize surgical outcomes, various techniques have been developed and implemented.

Objective: To compare the efficacy of medial-to-lateral and caudal-to-cranial approaches in LRH.

Patients and Methods: This retrospective study was conducted at the General Surgery Department, Ain Shams University Hospital, on 60 patients who underwent LRH last 2 years between June 2021 to June 2023.

Results: The mean surgical time for the medial-lateral was about 134 min, while in caudal-cranial was about 143 min, which has no significant difference. The mean amount of blood loss during caudal-cranial technique was about 413 ml and about 414 ml with the medial–lateral technique, with no significant difference between them. The mean total harvested lymph nodes with the caudal–cranial technique were about 22 lymph nodes, while the medial-lateral technique was 17 lymph nodes with a significant preference for caudal to cranial technique. The mean number of positive lymph nodes was about four in both techniques. Postoperative hospital stay with both techniques showed no significant difference by the mean of 7 days. The mean wound healing time in both techniques was about 12 days. The mean percentage of postoperative leakage in caudal-cranial was about 3%, while it was about 6% in the medial–lateral technique. The mean postoperative wound infection was 40% in the caudal-cranial technique and about 33% with the medial-lateral technique with no significant difference.

Conclusion: Both medial-to-lateral and caudal-to-cranial approaches to LRH demonstrate comparable outcomes in terms of operative time, blood loss, postoperative hospital stay, and wound healing. Caudal-to-cranial technique exhibited a higher lymph node yield, although the clinical significance of this finding remains uncertain. Further research is imperative to elucidate the optimal surgical approach for LRH and its impact on long-term patient outcomes.

Key Words: Caudal to cranial, laparoscopic right hemicolectomy, medial to lateral.

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Corresponding Author: Omar Abdel-Raouf Hanafi, MBBCh, Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt. **Tel.:** 01095845751, **E-mail:** omarhanafy3@gmail.com

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INTRODUCTION

Colorectal cancer represents the third most common type of tumor worldwide. The WHO estimates 1.93 million cases in 2020 worldwide and identifies it as the second cause of cancer death after lung cancer[1].

About 30% of colon cancer are located in the right colon, 5.8% in the transverse colon, and 64% in the left colon[2]. Surgery remains the standard of care in treating colon cancer, with a strong recommendation (Level 1A) for a "minimally invasive approach"[3].

For right-side colon cancer, in the early period, two main approaches have been reported regarding laparoscopic right hemicolectomy (LRH): the lateral to medial[4] and medial to lateral approaches[5]. The lateral-to-medial procedure is typically used in open surgery since the small operational space and the forceps' maneuverability make the lateral-to-medial approach, particularly challenging under laparoscopic conditions. The "no-touch" dissection and early vascular division are the key oncologic benefits of the common medial-to-lateral approach, which is the standard surgical method for LRH. The "caudal-to-cranial" approach treating LRH with complete mesocolic excision was first described in 2012[6].

The caudal-to-cranial approach was developed to solve the difficulty of dissecting and ligating the vessels rather than using the medial-to-lateral approach because of a deep view or "operating in the tunnel," especially when the right mesocolon is strongly affixed posteriorly or is broad and short[7].

Despite excellent work that has been done comparing different approaches in the treatment of colorectal disease, it still remains controversial which approach is superior in

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LRH. Besides, there is new emerging evidence favoring the caudal to cranial approach[8].

Aim

The study aims to evaluate the efficacy of the caudal-to-cranial approach in comparison to medial-to-lateral approach in LRH regarding. The feasibility and surgical outcomes caudal-to-cranial approach in comparison to medial-to-lateral approach, to compare safety between caudal-to-cranial approach and medial-to-lateral approach, what is the ideal surgical approach for LRH. Also, to detect the early complications of both techniques and length of hospital stay.

PATIENTS AND METHODS:

This retrospective study was conducted at the General Surgery Department, Ain Shams University Hospital, on 60 patients who underwent LRH last 2 years between June 2021 and June 2023.

This retrospective study was conducted on patients with right-sided colon cancer admitted to the General Surgery Department, Ain Shams University Hospital during the period of study. The patients were divided into two groups: group A: patients with right-sided colon cancer who underwent caudal to cranial approach in LRH. Group B: patients with right-sided colon cancer who underwent medial to lateral approach in LRH.

This study is conducted on patients with right colon cancer, irrespective to their age or sex, with resectable right-sided colon cancer and fit for anesthesia. While patients with right colon cancer with distant metastasis or local infiltration who refused to participate and those who converted to open surgery were excluded from the study.

Based on the results of Yi *et al*.[9], with a mean time of operation in the caudal-to-cranial group 170±16 min. While in the medial-to-lateral group 206±12 min, alpha error 5% and power of study 80%, the required sample size is 60 patients, 30 in each group.

Patients were subjected to history taking and oncological assessment with special emphasis on the site of the tumor, staging of the tumor, and histological diagnosis.

Procedure

In the caudal-to-cranial approach group, the patient was placed in the supine position with two legs apart and arms tucked beside the body. The surgeon stood between the patient's legs, with the assistant standing on the patient's left, the camera operator standing on the assistant's left side, and the scrub nurse standing on the patient's right side. The procedure required five trocars: a 10-mm trocar was placed 3 cm above the umbilicus for the 30°-angled telescope to get an adequate view. The incision was enlarged to extract the specimen and to perform anastomosis at the end of the procedure. A 12-mm trocar was introduced 5 cm below the telescope port for the surgeon's right-hand instrument. A 5-mm port was inserted at the McBurney's point for the surgeon's left-hand instrument. Additional two 5-mm trocars were placed at the opposite of McBurney's point and the right subcostal position, respectively, for the assistant to retract and display the colon and mesocolon. Identification of mesentery root and retro-mesenteric separation. Then, identification of the ileocolic pedicle and division of vessels. Mobilization of the transverse colon and the ascending colon and anastomosis (Fig. 1). Once the entire right colon was freed, it was pulled out through an enlargement of a 12-mm port site, and the wound had to be covered with wound protector. A side-to-side ileocolic anastomosis was performed using a transverse liner stapler, with the length of the incision being about 4–5 cm.

In medial-to-lateral approach group: The position of the patient was supine and tilted toward the left, and the operator and cameraman were on the left of the patient and the monitor on the right side of the patient. Ports positioned 10 mm above the umbilicus for the camera port for 30° telescope, 12 mm port left subcostal (right-hand working), 5 mm port in left iliac fossa (left-hand working) and 5 mm port in right iliac fossa for the assistant.

The first step included ligation of the ileocolic artery and then subsequent dissection of mesocolon off of the retroperitoneum (Fig. 2). The dissection was carried beyond the middle colic artery, resulting in ligation of the artery. After dissection of the mesocolon, the lateral attachments of the right colon were divided, and the flexure and proximal transverse colon mobilized. An extracorporeal anastomosis was constructed.

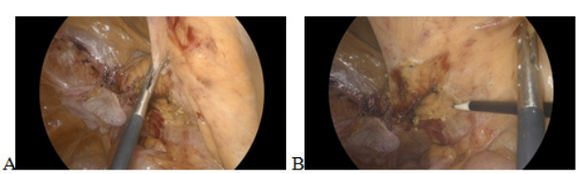

Fig. 1: (a) Caudal-to-cranial starting plane of dissection at the root of the mesentery. (b) Caudal-to-cranial separation of mesocolic fascia from tolds fascia at mesenteric root.

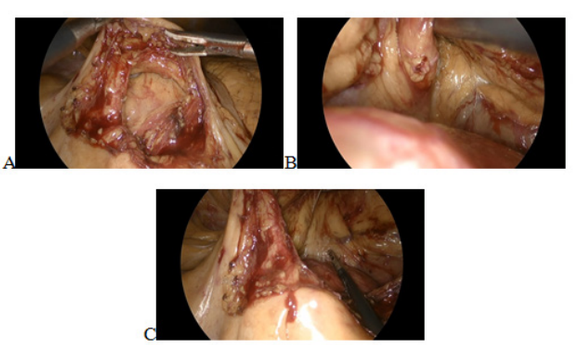

Fig. 2: (a) Medial-to-lateral entering the plane below ileocolic vessels. (b) Medial-to-lateral separation of duodenum and pancreas of the mesocolon. (c) Medial-to-lateral separation of gerota fascia of the right kidney.

Statistical analysis

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software, version 28.0, (IBM Corp., Chicago, Illinois, USA, 2021). Quantitative data was tested for normality using Shapiro–Wilk, then described as mean±SD as well as minimum and maximum of the range, and then compared using an independent t test (two independent groups). Qualitative data is described as numbers and percentages and then compared using χ^2 test as well as Fisher's exact test according to expected numbers. The level of significance was taken at *P value* less than or equal to 0.050 was significant, otherwise was nonsignificant.

RESULTS:

Table 1 shows informative data about the age, sex, BMI and medical, surgical history of population included in the study with no significant difference between them.

Table 2 shows informative data about TNM staging and site of tumor of study population.

Table 3 shows that the mean expected time of both surgical techniques, medial to lateral, revealed about 134 min, while caudal to cranial consumes more time by 9 min, which has no significant difference between both techniques. The mean amount of blood loss during the caudal to cranial technique is about 413 ml and about 414 ml with the medial to lateral technique, with no significant difference between both of them. Also, Table 3 shows no difference in the length of bowl resected between the two techniques, as the mean length resected in both techniques is about 18 cm. The mean total harvested lymph nodes with the caudal–cranial technique were about 22 lymph nodes, while the medial–lateral technique was 17 lymph nodes with a significant preference for caudal to cranial techniques. The mean number of positive lymph nodes was about four in the caudal to cranial technique and about three in the medial to lateral technique, with no significant difference between them (Table 3).

Postoperative hospital stay with both techniques showed no significant difference by the mean of a 7-day stay (Table 4). The mean wound healing time postcaudal to cranial technique was about 12 days, equal to the medial to lateral technique.

The mean percentage of postoperative leakage in caudal to cranial technique was about 3%, while it was relatively higher in medial to lateral technique which was about 6%. The mean postoperative wound infection was relatively higher in caudal to cranial technique, as it was 40% out of total cases and about 33% with medial to lateral technique with no significant difference (Table 5).

Table 5 no statistically significant difference between the studied groups regarding postoperative complications (2 weeks).

Table 1: Demographic and clinical characteristics between the studied groups

Variables	Caudal to cranial (total=30)	Medial to lateral (total=30)	*P* value
Age (years)			
Mean±SD	52.8±6.8	53.6±6.1	0.646^
Range	41.0–65.0	38.0–65.0	
Sex			
Male	24 (80.0)	19 (63.3)	0.152#
Female	6 (20.0)	11 (36.7)	
BMI (kg/m^2)			
Mean±SD	30.6±3.5	31.4±3.9	0.445^
Range	20.8–36.4	24.8–39.2	
Hypertension	7 (23.3)	9 (30.0)	0.559#
Diabetes mellitus	4 (13.3)	3 (10.0)	0.999§
History of appendectomy	3 (10.0)	3 (10.0)	0.999§
History of cholecystectomy	2 (6.7)	1 (3.3)	0.999§
History of cesarean section (females only)	2 (33.3)	3 (27.3)	0.999§
History of other surgeries	0	0	NA

Data presented as number (%) unless mentioned otherwise.
NA, not applicable.
^Independent t test.
#χ^2 test.
§Fisher's exact test.

Table 2: Characteristics of right colon cancer between the studied groups

Variables	Caudal to cranial (total=30)	Medial to lateral (total=30)	*P* value
Site			
Cecum	21 (70.0)	19 (63.3)	0.584#
Ascending colon	9 (30.0)	11 (36.7)	
T stage			
2	21 (70.0)	24 (80.0)	0.371#
3	9 (30.0)	6 (20.0)	
N stage			
0	12 (40.0)	10 (33.3)	
1	14 (46.7)	15 (50.0)	0.883§
2	4 (13.3)	5 (16.7)	
M stage			
0	30 (100.0)	30 (100.0)	NA
Histopathology			
Adenocarcinoma	30 (100.0)	30 (100.0)	NA

Data presented as number (%).
NA, not applicable.
#χ^2 test.
§Fisher's exact test.

Table 3: Operative findings between the studied groups

Variables	Caudal to cranial (total=30)	Medial to lateral (total=30)	*P* value
Operative time (min)			
Mean±SD	143.1±18.7	134.1±21.6	0.091^
Range	106.0–188.0	91.0–173.0	
Blood loss (ml)			
Mean±SD	413.2±44.8	414.6±43.4	0.898^
Range	339.0–512.0	309.0–475.0	
Length of resected bowel (cm)			
Mean±SD	18.7±1.3	18.6±1.4	0.608^
Range	16.8–22.2	16.1–21.2	
Total harvested nodes			
Mean±SD	21.8±4.9	16.8±2.2	<0.001*^
Range	12.0–30.0	12.0–21.0	
Number of positive nodes			
Mean±SD	3.9±3.8	3.1±3.0	0.389^
Range	0.0–9.0	0.0–8.0	

^Independent t test.
*Significant.

Table 4: Postoperative hospital stay and wound healing time between the studied groups with no significant difference

Variables	Caudal to cranial (total=30)	Medial to lateral (total=30)	*P* value
Hospital stay (days)			
Mean±SD	7.7±2.2	8.1±2.7	0.493^
Range	6.0–18.0	6.0–18.0	
Wound healing (days)			
Mean±SD	11.8±1.1	11.7±0.9	0.707^
Range	10.0–14.0	10.0–14.0	

^Independent t test.

Table 5: Postoperative complications between the studied groups with no significant difference

Variables	Caudal to cranial (total=30)	Medial to lateral (total=30)	*P* value
Leakage	1 (3.3)	2 (6.7)	0.999§
Bleeding	0	0	NA
Resurgery	0	0	NA
Wound infection	12 (40.0)	10 (33.3)	0.591#
Mortality	0	0	NA

Data presented as number (%).
NA, not applicable.
#χ^2 test.
§Fisher's exact test.

DISCUSSION

Medial-to-lateral approach entails a systematic dissection of the colon from its medial attachments towards the lateral aspect. This technique involves sequential mobilization of the right colon, identification, and preservation of the middle colic artery, followed by division of the ileocolic vessels.

The caudal-to-cranial approach, conversely, involves a downward dissection from the proximal to distal colon, with a focus on initial mobilization of the cecum and ascending colon. Subsequent dissection of the right colic artery and its branches is performed in a cranial direction.

Regarding operative time, our study showed that the medial to lateral approach consumed less operative time with a mean of 134 min than caudal to cranial with a mean of 143 min. Li *et al*.[8], showed the same results of our study and this slight difference may be due to there's more work on the main vessel's mesenteric roots in caudal to cranial approach but finally there is no detected significant difference between both approaches. another study of 175 patients done by Yi *et al*.[9] showed caudal to cranial approach consumed time less than medial to lateral (170 and 206 min, respectively), with statistically significant difference between both approaches (*P=0.001*).

Also, blood loss, which is considered a vital indicator of safety in the operation, showed that expected blood loss in the medial to lateral approach was mostly equal to that in the caudal to cranial approach, while Yi *et al*.[9] showed a relative preference for the medial to lateral approach with no significant difference from the caudal to cranial approach. Also Li *et al*.[8] and Liang *et al*.[10] showed the same results.

Also the length of resected bowel and a critical oncologic parameter was almost equal between the two groups, indicating adequate oncological resection with both techniques while Yi *et al*.[9] showed slight preference to caudal to cranial approach with no significant difference and Li *et al*.[8] did not mention this parameter in their study.

A notable preference was significantly higher number of harvested lymph nodes in the caudal-to-cranial group (mean: 21.8±4.9) compared to the medial-to-lateral group (mean: 16.8±2.2). This observation suggests a potential advantage of the caudal-to-cranial approach in terms of oncologic outcomes (*P=0.001*) and that returns to work on the main vessels from their roots in the caudal-to-cranial approach. However, the absence of a significant difference in the number of positive lymph nodes underscores the need for further investigation to determine the clinical implications of increased lymph node yield.

Yi *et al*.[9] and Zheng *et al*.[11] showed no significant difference between both approaches in harvested lymph nodes while Liang *et al*.[10] in study of 56 patients supported the preference of caudal-to-cranial approach.

Postoperative hospital stay, a crucial aspect of patient recovery, was similar between the two groups, with a mean of 7.7±2.2 days for the caudal-to-cranial group and 8.1±2.7 days for the medial-to-lateral group. Yi *et al*.[9] showed much longer hospital stay by about 5 days more than this study with no valuable difference between both approaches. This difference in our study referred to the higher rate of morbidity and ICU admission in the compared study.

Wound healing time, another important postoperative outcome, was also comparable between groups, with a mean of 11.8±1.1 days for the caudal-to-cranial group and 11.7±0.9 days for the medial-to-lateral group (*P=0.707*). These findings show that there's no significant difference, which may be due to no differences between the two groups regarding the comorbidities. Also Yi *et al*.[9] and Zheng *et al*.[11] showed the mean time of wound healing was 12 and 13 days respectively which match the results of our study.

While wound infection in the caudal-to-cranial group was slightly higher than in the medial-to-lateral group (40 and 33.3%, respectively), and this difference did not reach statistical significance (*P=0.591*). Other

studies, such as Liang *et al*.[10] and Li *et al*.[8] showed there was no difference between the two groups regarding wound infection factor.

Regarding postoperative complications, there were no recorded cases that developed bleeding, resurgery, or mortality rates between the two groups. However, a slightly higher incidence of postoperative leakage was observed in the medial-to-lateral group (6.7%) compared to the caudal-to-cranial group (3.3%), although this difference did not reach statistical significance (*P=0.999*) and those patients who developed leakage were treated conservatively. Li *et al*.[6] in a study of 80 patients showed the postoperative complications were not serious and also showed no statistically significant factor in the study.

This retrospective study has inherent limitations, including potential selection bias and the relatively small sample size. To provide more robust evidence, prospective randomized controlled trials with larger patient cohorts are warranted.

CONCLUSION

Both the medial-to-lateral and caudal-to-cranial approaches to LRH demonstrate comparable outcomes in terms of operative time, blood loss, postoperative hospital stay, and wound healing. The caudal-to-cranial technique exhibited a higher lymph node yield, although the clinical significance of this finding remains uncertain. Further research is imperative to delineate the optimal surgical approach for LRH and its impact on long-term patient outcomes.

CONFLICT OF INTEREST

There are no conflicts of interest.

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