Cohort Study

ANNALS OF MEDICINE & SURGERY

OPEN

Outcomes of medial to lateral vs. lateral to medial approaches in laparoscopic colorectal cancer resections

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Introduction: Bowel cancer is a significant global health concern, ranking as the third most prevalent cancer worldwide. Laparoscopic resections have become a standard treatment modality for resectable colorectal cancer. This study aimed to compare the clinical and oncological outcomes of medial to lateral (ML) vs lateral to medial (LM) approaches in laparoscopic colorectal cancer resections.

Methods: A retrospective cohort study was conducted at a UK district general hospital from 2015 to 2019, including 402 patients meeting specific criteria. Demographic, clinical, operative, postoperative, and oncological data were collected. Participants were categorised into LM and ML groups. The primary outcome was 30-day complications, and secondary outcomes included operative duration, length of stay, lymph node harvest, and 3-year survival.

Results: A total of 402 patients (55.7% males) were included: 102 (51.6% females) in the lateral mobilisation (LM) group and 280 (58.9% males) in the medial mobilisation (ML) group. Right hemicolectomy ($n = 157$, 39.1%) and anterior resection ($n = 150$, 37.3%) were the most performed procedures. The LM group had a shorter operative time for right hemicolectomy (median 165 vs. 225 min, $P < 0.001$) and anterior resection (median 230 vs. 300 min, $P < 0.001$). There was no significant difference between the two groups in terms of wound infection ($P = 0.443$), anastomotic leak ($P = 0.981$), postoperative ileus ($P = 0.596$), length of stay ($P = 0.446$), lymph node yield ($P = 0.848$) or 3-year overall survival rate (Log-rank 0.759).

Discussion: The study contributes to the limited evidence on ML vs LM approaches. A shorter operative time in the LM group was noted in this study, contrary to some literature. Postoperative outcomes were comparable, with a non-significant increase in postoperative ileus in the LM group. The study emphasises the safety and feasibility of both approaches.

Keywords: approach, cancer, colorectal, surgery

Introduction

Bowel cancer stands as the third most prevalent global cancer and ranks fourth in the United Kingdom (UK), representing the second leading cause of cancer-related mortality. Annually, around 43 000 individuals in the UK receive a bowel cancer diagnosis, constituting 11% of total cancer cases[1]. The adoption of laparoscopic colorectal resections has become widespread, offering outcomes comparable to open procedures[2].

HIGHLIGHTS

- A lateral to medial operative approach is strongly associated with shorter operative times for right hemicolectomy and anterior resection procedures.
- No difference is shown between these two approaches in terms of wound infection, anastomotic leak, postoperative ileus, length of stay, lymph node yield, or 3-year overall survival rate.
- The study emphasises the safety and feasibility of both approaches.

Endorsement from both the Association of Coloproctology of Great Britain and Ireland (ACPGBI)[3] and the American Society of Colon and Rectal Surgeons (ASCRS)[4] solidifies laparoscopic surgery as the preferred approach for colorectal cancer resections.

The core principle guiding oncological resection in bowel cancer focuses on tumour removal with sufficient margins and the retrieval of lymph nodes in the mesentery along the draining blood vessels. Despite randomized trials not demonstrating a superior lymph node harvest with laparoscopic surgery compared to open techniques[2,5], ACPGBI advocates for quality mesocolic excision to improve oncological outcomes in colon cancer resections. This discrepancy in outcomes has raised questions about the efficacy of various laparoscopic techniques.

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Annals of Medicine & Surgery (2024) 86:5024–5033

Received 11 February 2024; Accepted 16 July 2024

Published online 7 August 2024

http://dx.doi.org/10.1097/MS9.0000000000002429

Historically, the lateral to medial approach prevailed during the era of open surgery. However, with technological advancements and the advent of laparoscopic surgery, the medial to lateral approach gained prominence and is practised widely.

The medial to lateral approach involves the exploration, identification, and proximal division of mesenteric vessels, followed by the division of lateral peritoneal attachments. In contrast, the lateral to medial approach follows the sequence employed in open procedures, involving the division of lateral peritoneal attachments before exploring the medial mesentery and performing the proximal division of the identified blood vessels[6]. In 2004, the European Association of Endoscopic Surgeons (EAES) consensus statement recommended that the medial to lateral approach is the preferred choice for mesocolic dissection[7].

This study aims to compare the clinical and oncological outcomes of the medial to lateral (ML) versus lateral to medial (LM) approach in laparoscopic colorectal cancer resections.

Methods

This was a retrospective cohort study conducted at a district general hospital in the United Kingdom. The study encompassed consecutive patients meeting specific inclusion and exclusion criteria over a 5-year period from January 2015 to December 2019.

Table 1

Clinical demographics

Clinical demographic	Variable	Total ($n = 402$)	Lateral to medial (LM) ($n = 122$)	Medial to lateral (ML) ($n = 280$)	*P*
Age (year); Mean (SD)		68.3 (11.7)	70.7 (11.9)	67.3 (11.5)	0.007
Sex, *n* (%)	Female	178 (44.3)	63 (51.6)	115 (41.1)	0.050
	Male	224 (55.7)	59 (48.4)	165 (58.9)	
BMI; Mean (SD)		28.1 (5.1)	27.9 (5.1)	28.2 (5.2)	0.625
ASA, *n* (%)	Score 1	58 (14.4)	17 (13.9)	41 (14.6)	0.574
	Score 2	232 (57.7)	70 (57.4)	162 (57.9)	
	Score 3	108 (26.9)	35 (28.7)	73 (26.1)	
	Score 4	4 (1.0)	0 (0)	4 (1.4)	
Co-morbidities, *n* (%)	Hypertension	181 (45.0)	57 (46.7)	124 (44.3)	0.652
	Diabetes mellitus	57 (14.2)	17 (13.9)	40 (14.3)	0.926
	Asthma	30 (7.5)	7 (5.7)	23 (8.2)	0.385
	COPD	25 (6.2)	5 (4.1)	20 (7.1)	0.245
	AF	20 (5.0)	6 (4.9)	14 (5.0)	0.976
	Heart failure	15 (3.7)	7 (5.7)	8 (2.9)	0.161
Presenting symptoms, *n* (%)	CIBH	108 (26.9)	41 (33.6)	67 (23.9)	0.044
	PR bleeding	120 (29.9)	34 (27.9)	86 (30.7)	0.567
	Abdominal pain	74 (18.4)	24 (19.7)	50 (17.9)	0.666
	IDA	96 (23.9)	38 (31.1)	58 (20.7)	0.024
	Weight loss	41 (10.2)	16 (13.1)	25 (8.9)	0.202
	Constipation	24 (6.0)	10 (8.2)	14 (5.0)	0.214
	Obstruction	11 (2.7)	4 (3.3)	7 (2.5)	0.660
Tumour location, *n* (%)	Appendix	2 (0.5)	0 (0)	2 (0.7)	0.048
	Caecum	62 (15.4)	26 (21.3)	36 (12.9)	
	Ascending colon	64 (15.9)	24 (19.7)	40 (14.3)	
	Hepatic flexure	22 (5.5)	8 (6.6)	14 (5.0)	
	Transverse colon	21 (5.2)	7 (5.7)	14 (5.0)	
	Splenic flexure	6 (1.5)	2 (1.6)	4 (1.4)	
	Descending colon	8 (2.0)	1 (0.8)	7 (2.5)	
	Sigmoid colon	87 (21.6)	13 (10.7)	74 (26.4)	
	Rectosigmoid	1 (0.2)	0 (0)	1 (0.4)	
	Rectum	125 (31.1)	39 (31.9))	86 (30.7)	
	Anus	4 (1.0)	2 (1.6)	2 (0.7)	
Operation mode, *n* (%)	Laparoscopic	364 (90.5)	112 (91.8)	252 (90.0)	0.570
	Converted open	38 (9.5)	10 (8.2)	28 (10.0)	
Operation name, *n* (%)	Right hemicolectomy	157 (39.1)	64 (40.7)	93 (59.3)	0.003
	Extended right hemi	20 (5.0)	3 (15.0)	17 (85.0)	
	Left hemicolectomy	8 (2.0)	1 (12.5)	7 (87.5)	
	Sigmoid colectomy	27 (6.7)	2 (7.4)	25 (92.6)	
	Hartman's	9 (2.2)	1 (11.1)	8 (88.9)	
	Subtotal colectomy	3 (0.7)	1 (33.3)	2 (66.7)	
	Pan proctocolectomy	2 (0.5)	2 (100.0)	0 (0)	
	Anterior resection	150 (37.3)	41 (27.3)	109 (72.7)	
	APER	20 (5.0)	5 (25.0)	15 (75.0)	
	ELAPE	6 (1.5)	2 (33.3)	4 (66.7)	

AF, atrial fibrillation; APER, abdominoperineal excision of rectum; ASA, American Society of Anaesthesiologists; CIBH, change in bowel habits; COPD, chronic obstructive pulmonary disease; ELAPE, extralevator abdominoperineal excision; IDA, iron deficiency anaemia.

Table 2

30-day outcomes (complications, Clavien–Dindo grading, re-admissions)

Clinical demographic	Variable	Total $N=402$	Lateral to Medial (LM) $N=122$	Medial to Lateral (ML) $N=280$	*P*
Complications, *n* (%)	Wound infection	18 (4.8)	4 (3.2)	14 (5.0)	0.443
	Anastomotic leak	10 (2.5)	3 (2.5)	7 (2.5)	0.981
	Return to theatre	16 (4.0)	5 (4.1)	11 (3.9)	0.936
	Ileus	35 (8.7)	22 (18.0)	13 (4.6)	0.596
	AKI	4 (1.0)	1 (0.8)	3 (1.1)	
	Pulmonary complication	14 (3.5)	4 (3.2)	10 (3.6)	
	Sepsis	3 (0.7)	0	3 (1.1)	
	Abdominal collection	8 (2.0)	3 (2.5)	5 (1.8)	
	UTI	4 (1.0)	2 (1.6)	2 (0.7)	
	Ureter injury	1 (0.2)	0	1 (0.4)	
	Bleeding	1 (0.2)	0	3 (1.1)	
	High stoma output	3 (0.7)	1 (0.8)	2 (0.7)	
	Death	3 (0.7)	1 (0.8)	2 (0.7)	0.910
Clavien–Dindo Grade, *n* (%)	No complication	319 (79.3)	94 (77.0)	225 (80.4)	0.764
	1	38 (9.5)	15 (12.3)	23 (8.2)	
	2	26 (6.5)	8 (6.6)	18 (6.4)	
	3	16 (4.0)	4 (3.3)	12 (4.3)	
	4	0	0	0	
	5	3 (0.7)	1 (0.8)	2 (0.7)	
Re-admission, *n* (%)		38 (9.5)	11 (9.0)	27 (9.6)	0.844

AKI, acute kidney injury; UTI, urinary tract infection.

Inclusion criteria comprised patients aged 18 years or older, of any sex, with a diagnosis of colorectal and anal cancer undergoing elective laparoscopic cancer resection with curative intent. Laparoscopic to open conversion was included only if mesenteric or colonic mobilisation was completed laparoscopically. All patients included had preoperative discussion in the colorectal Multi-Disciplinary Meeting (MDT). Exclusion criteria encompassed patients under 18 years, elective open colorectal cancer resections, laparoscopic to open conversion without laparoscopic mobilisation, emergency colorectal cancer resections, patients undergoing palliative procedures and patients with previous colonic stenting. All surgeries were performed by experienced colorectal surgeons with at least a consultant surgeon present throughout the operation. Complete mesocolic excisions were not performed in any of the cases in our study population.

Table 4

Operative duration of individual operations (min)

Operation	Mean (min)	Range (min)	IQR (min)	Median (min)	*P*
Right hemicolectomy					
Medial to lateral	223	100–420	75	225	< 0.001
Lateral to medial	176	320–100	54	165	
Extended right hemicolectomy					
Medial to lateral	234	125–360	108	240	0.603
Lateral to medial	258	205–360	—	210	
Left hemicolectomy					
Medial to lateral	263	110–385	190	305	0.948
Lateral to medial					
Sigmoid colectomy					
Medial to lateral	265	135–480	133	245	0.703
Lateral to medial	240	180–300	—	240	
Hartmann's Procedure					
Medial to lateral	298	120–520	184	318	0.267
Lateral to medial					
Subtotal colectomy					
Medial to lateral	408	210–605	—	408	0.789
Lateral to medial					
Pan proctocolectomy					
Medial to lateral	405	240–570	—	405	NA
Lateral to medial					
Anterior resection					
Medial to lateral	303	105–625	113	300	< 0.001
Lateral to medial	246	160–485	75	230	
APER					
Medial to lateral	404	300–600	120	410	< 0.001
Lateral to medial	219	160–250	71	233	
ELAPE					
Medial to lateral	380	160–520	300	420	0.730
Lateral to medial	425	410–440	—	425	
Right-sided resections					
Medial to lateral	225	100–420	75	225	< 0.001
Lateral to medial	180	100–360	60	165	
Left-sided resections					
Medial to lateral	271	110–520	164	283	0.299
Lateral to medial	218	135–300	143	218	
Anorectal resections					
Medial to lateral	317	105–625	114	300	< 0.001
Lateral to medial	252	160–485	80	240	

APER, abdominoperineal excision of rectum; ELAPE, extralevator abdominoperineal excision; IQR, interquartile range, NA, not applicable.

Patients diagnosed with colorectal cancer were identified from a prospectively maintained local cancer office database. After applying the inclusion and exclusion criteria, a finalised patient list was developed. A password-encrypted data collection sheet was created, detailing demographic, clinical, and oncological variables. The local hospital cancer database and electronic medical records were accessed to collect data. Demographic data

Table 3

Overall operative duration in the two groups (min)

	Lateral to medial (LM) (min)	Medial to lateral (ML) (min)	*P*
Operation duration (min) mean (SD)	213.6 (80.8)	274.9 (94.9)	< 0.001
Median (IQR, range)	195 (85, 100–570)	255 (118, 100–625)	

IQR, interquartile range.

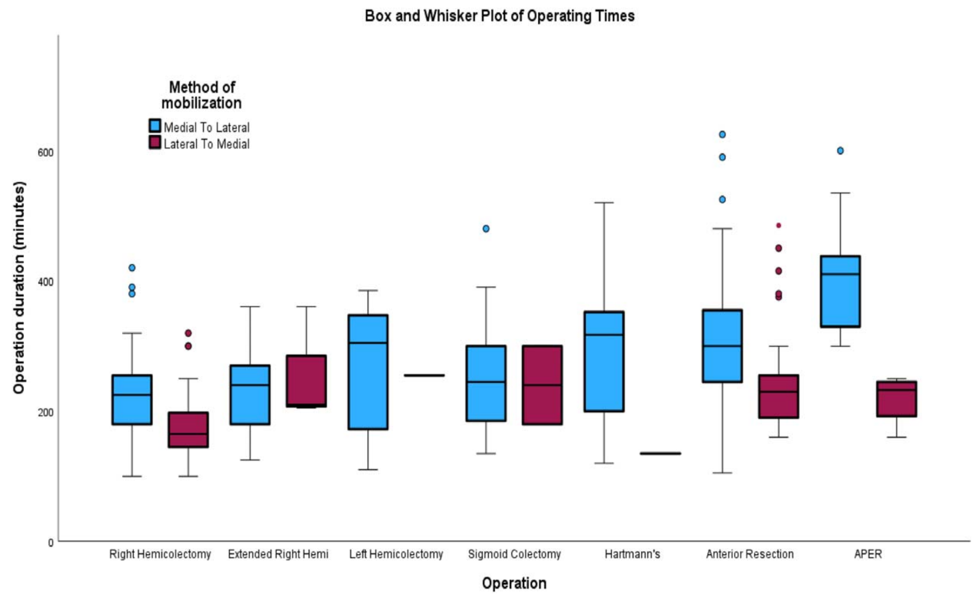

Figure 1. Box and Whisker plot of operating times (individual operations). APER, abdominoperineal excision of rectum.

included age at presentation, gender, American Society of Anaesthesiologists (ASA) grade, Body Mass Index (BMI), and comorbidities (Hypertension, Diabetes Mellitus, Asthma, Chronic obstructive pulmonary disease, Atrial fibrillation, and Heart failure).

Clinical data were divided into preoperative, operative, and postoperative sets. Preoperative data included presenting symptoms and tumour location. The tumour location was based on preoperative imaging (CT scan or MRI), and MDT discussions confirmed curative resection intent. Operative data were reviewed from individual operation notes and theatre electronic records, documenting the operation name, mode (laparoscopic, laparoscopic converted to open), and method of mobilisation (medial to lateral, lateral to medial). For converted procedures, the laparoscopic completion of mobilisation was assessed. Postoperative data included length of stay, 30-day complications, re-admissions, and 3-year survival rates. Oncological data were collected from histopathology reports and postoperative MDT records, encompassing histology, grade of differentiation, Dukes' stage, TNM stage, lymph node yield, and resection margins.

Participants were categorised into two groups based on the method of colon or mesenteric mobilisation: lateral to medial group (LM) and medial to lateral group (ML). We provide a comprehensive comparison of medial to lateral (ML) versus

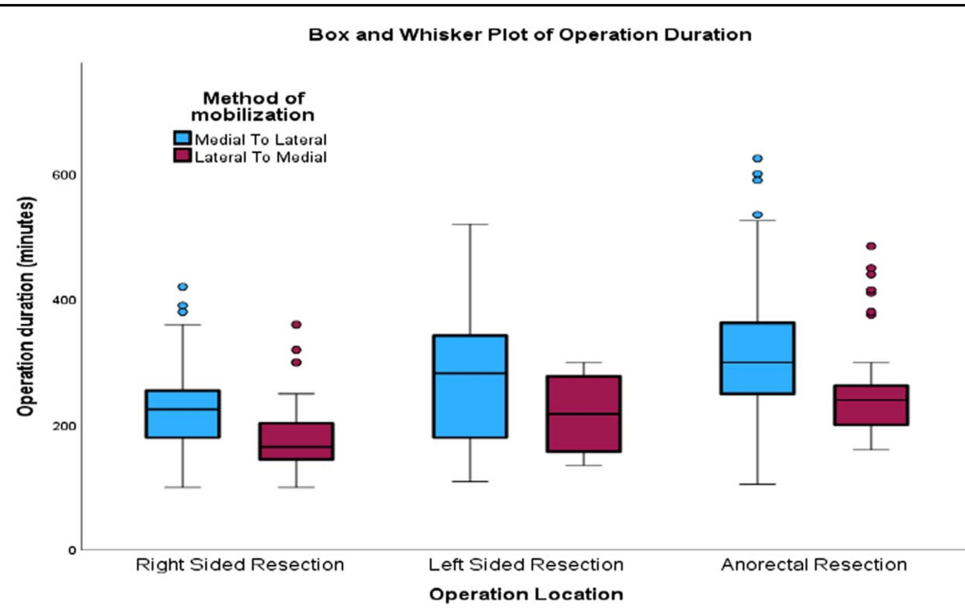

Figure 2. Box and Whisker plot of operating times based on side of resection.

Table 5

Length of stay (overall and individual operations)

Operation		Lateral to medial (LM)	Medial to lateral (ML)	*P*
Overall				
Mean (SD)	8.0 (4)	8.5 (7)	7.9 (7.1)	0.446
Median (IQR, range)	6 (5, 2–54)	6 (5, 2–45)	5 (4, 2–54)	
Right hemicolectomy				
Mean (SD)		7.8 (6.8)	6.7 (6.9)	0.322
Median (IQR, range)		6 (5, 2–37)	5 (2, 2–42)	
Extended right hemicolectomy				
Mean (SD)		12.3 (9.5)	8.3 (5.4)	0.311
Median (IQR, range)		9 (—, 5–23)	7 (6, 2–21)	
Left hemicolectomy				
Mean (SD)		2 (—)	7 (4.7)	0.361
Median (IQR, range)		—	5 (5, 4–17)	
Sigmoid colectomy				
Mean (SD)		4 (—)	5.9 (4.1)	0.513
Median (IQR, range)			5 (2, 3–21)	
Hartmann's				
Mean (SD)		9 (—-)	14.8 (9.3)	0.569
Median (IQR, range)			14 (15, 4–32)	
Anterior resection				
Mean (SD)		8.3 (5.5)	8.5 (7.8)	0.848
Median (IQR, range)		7 (6, 2–23)	6 (5, 3–54)	
APER				
Mean (SD)		15.6 (16.6)	9.1 (6.5)	0.209
Median (IQR, range)		9 (23, 5–45)	6 (6, 3–22)	
ELAPE				
Mean (SD)		15.5 (4.9)	9.5 (4.8)	0.225
Median (IQR, range)		16 (—, 12–19)	10 (9, 4–14)	

APER, abdominoperineal excision of rectum; ELAPE, extralevator abdominoperineal excision; IQR, interquartile range.

Table 6

Post-operative histology outcomes

Postoperative Outcome	Variable	Total $N=402$	Lateral to medial (LM) $N=122$	Medial to lateral (ML) $N=280$	*P*
Histology, *n* (%)	Adenocarcinoma	379 (94.2)	114 (93.4)	265 (94.6)	0.480
	Mucinous adenocarcinoma	10 (2.5)	3 (2.5)	7 (2.5)	
	Neuroendocrine	3 (0.7)	0	3 (1.1)	
	No residual malignancy	7 (1.7)	3 (2.5)	4 (1.4)	
	Signet ring cell carcinoma	1 (0.2)	1 (0.8)	0	
	Tubulovillous adenoma	2 (0.4)	1 (0.8)	1 (0.4)	
Grade of differentiation, *n* (%)	Well	45 (11.2)	14 (11.5)	31 (11.1)	0.826
	Moderate	303 (75.4)	94 (77.0)	209 (74.6)	
	Poor	45 (11.2)	11 (9.0)	34 (12.1)	
	Not graded	9 (2.2)	3 (2.5)	6 (2.1)	
Duke's stage, *n* (%)	A	65 (16.2)	19 (15.6)	46 (16.4)	0.200
	B	177 (44.0)	56 (45.9)	121 (43.2)	
	C1	130 (32.3)	33 (27.0)	97 (34.6)	
	C2	6 (1.5)	3 (2.5)	3 (1.1)	
	D	12 (3.0)	7 (5.7)	5 (1.8)	
	No grade	12 (3.0)	4 (3.3)	8 (2.9)	
TNM, *n* (%)	T0	11 (2.7)	4 (3.3)	7 (2.5)	0.566
	T1	42 (10.4)	9 (7.4)	33 (11.8)	
	T2	76 (18.9)	27 (22.1)	49 (17.5)	
	T3	208 (51.7)	61 (50.0)	147 (52.5)	
	T4	65 (16.2)	21 (17.2)	44 (15.7)	
	N0	263 (65.4)	87 (71.3)	176 (62.9)	0.567
	N1	95 (23.6)	27 (22.1)	68 (24.3)	
	N2	44 (10.9)	11 (9.0)	33 (11.8)	
	M0	380 (94.5)	113 (92.6)	267 (95.4)	0.259
	M1	22 (5.5)	9 (7.4)	13 (4.6)	
R, *n* (%)	R0	393 (97.8)	118 (96.7)	275 (98.2)	0.352
	R1	9 (2.2)	4 (3.3)	5 (1.8)	

Table 7

Lymph node yield—individual operations

Operation name	Lateral to medial	Medial to lateral	*P*
Overall			
Mean (SD)	18 (7)	18 (7)	0.848
Median (IQR, range)	17 (8, 0–51)	17 (10, 0–51)	
Right hemicolectomy			
Mean (SD)	18 (8)	20 (7)	0.200
Median (IQR, range)	17 (8, 0–42)	19 (9, 0–44)	
Extended right hemicolectomy			
Mean (SD)	31 (18)	19 (6)	0.021
Median (IQR, range)	26 (—, 17–51)	17 (9, 11–30)	
Left hemicolectomy			
Mean (SD)	19 (—)	14 (4)	0.301
Median (IQR, range)	—	15 (6, 9–21)	
Sigmoid colectomy			
Mean (SD)	13 (6)	15 (6)	0.789
Median (IQR, range)	13 (—, 9–18)	14 (7, 5–31)	
Hartmann's			
Mean (SD)	14 (—)	18 (6)	0.586
Median (IQR, range)	—	15 (12, 12–29)	
Subtotal colectomy			
Mean (SD)	37 (—)	17 (1)	0.055
Median (IQR, range)	—	17 (—, 16–18)	
Pan proctocolectomy			
Mean (SD)	19 (2)	0	0
Median (IQR, range)	19 (—, 18–21)		
Anterior resection			
Mean (SD)	16 (6)	18 (9)	0.285
Median (IQR, range)	17 (8, 0–29)	16 (9, 0–51)	
APER			
Mean (SD)	17 (5)	18 (6)	0.849
Median (IQR, range)	17 (8, 12–24)	17 (8, 10–35)	
ELAPE			
Mean (SD)	9 (3)	10 (2)	0.523
Median (IQR, range)	9 (—, 6–11)	9 (3, 9–13)	

APER, abdominoperineal excision of rectum; ELAPE, extralevator abdominoperineal excision; IQR, interquartile range.

lateral to medial (LM) approaches across various types of colorectal resections. This approach reflects real-world clinical practice where surgeons utilise both ML and LM techniques for different types of colorectal surgeries. The primary outcome was 30-day complication occurrence, classified according to Clavien–Dindo classifications[8]. Secondary outcomes included operative duration, length of hospital stay, lymph node harvest, and 3-year survival.

Data were analysed using SPSS v 28, with significance set at *P* less than 0.05. Significance testing was performed only for variables that coincided with our study outcomes. Categorical variables were presented as numbers and percentages, analysed using χ^2 or Fisher's exact test. Continuous variables were presented as median and Interquartile range, with the Mann–Whitney U test for comparison. Kaplan–Meier survival analysis and Cox regression analysis were performed to determine hazard ratios. This work has been reported in line with the STROCSS criteria[8].

Results

During the study period, colorectal cancer resection was performed on 586 patients, following predefined criteria, resulting in the exclusion of 176 patients. An additional eight patients were excluded due to incomplete data, yielding a final analysis comprising 402 patients.

Clinical demographics are presented in Table 1, illustrating that 30.3% were in the lateral to medial (LM) group and 69.7% in the medial to lateral (ML) group. The mean age (SD) was 68.3 (11.7) years, showing a comparable distribution in both groups. Males constituted 55.7% of the overall cohort, with a higher proportion of females in the LM group (51.6%) and males in the ML group (58.9%). The overall mean BMI (SD) was 28.1 (5.1), with no significant difference between the groups ($P=0.625$). The majority of patients were ASA 2 (57.7%) or ASA 3 (26.9%), with similar distributions across groups ($P=0.574$). Common co-morbidities included hypertension (45.0%) and diabetes mellitus (14.2%), with consistent prevalence across both groups. Predominant presenting symptoms included bleeding per rectum (29.9%), change in bowel habits (26.9%), and iron deficiency anaemia (23.9%). Tumour distribution revealed the rectum as the most common site (31.1%), followed by the sigmoid colon (21.6%), ascending colon (15.9%), and caecum (15.4%). The LM group exhibited similar trends, while the ML group demonstrated different frequencies, with the rectum (30.7%) being most frequent, followed by the sigmoid colon (26.4%), ascending colon (14.3%), and caecum (12.9%). The majority of operations were completed laparoscopically (90.5%), with comparable proportions in both groups ($P=0.570$). Right hemicolectomy was the most common operation (39.1%), followed by anterior resection (37.3%).

Table 2 details the 30-day outcomes, with 79.3% experiencing no complications (77% in LM vs. 80% in ML). The most common Clavien–Dindo complication grades were Grade 1 (9.5%) and Grade 2 (6.5%), with similar reflections across both groups. There was no statistically significant difference between the two groups ($P=0.764$). Wound infection occurred in 5% (14/280) and 3.2% (4/122) of patients in the ML and LM groups, respectively ($P=0.443$). The anastomotic leak rate was similar in the two groups (2.5%: $P=0.981$). Five patients (4.1%) returned to theatre in the LM group compared to 11 (3.9%) in the ML group ($P=0.936$). Ileus was more commonly observed in the LM group ($n=22$, 18%) than the ML group ($n=13$, 4.6%), though the result was not statistically significant ($P=0.596$). The overall 30-day readmission rate was 9.5% (38/402), with 9.0% and 9.6% in LM and ML groups, respectively ($P=0.844$).

Table 3 demonstrates the operative duration in the LM group to be significantly shorter compared to the ML group ($P<0.001$). The mean (SD) operative time in the LM and ML groups was 213 (80.8) and 274 (94.9) minutes, respectively, while the median (IQR, range) in the two groups was 195 (85, 100–570) and 255 (118, 100–625) min, respectively (Table 3). Subgroup analysis was performed on individual operations comparing the two groups. Right hemicolectomy had a much shorter operative duration in the LM group compared to the ML group (Median 165 vs. 225 min), and this was statistically significant ($P<0.001$). Similar trends of shorter operative time were identified in the LM group in anterior resections (Median 230 vs. 300 min: $P\leq 0.001$) and APER (Median 233 vs. 410 min: $P<0.001$), as shown in Table 4 and Figure 1.

Figure 2 demonstrates operations grouped into 'right-sided resection' (right hemicolectomy and extended right hemicolectomy), 'left-sided resection' (left hemicolectomy, sigmoid colectomy, and Hartmann's), and 'anorectal resections' (anterior resection and Extralevator abdominoperineal excision). Both

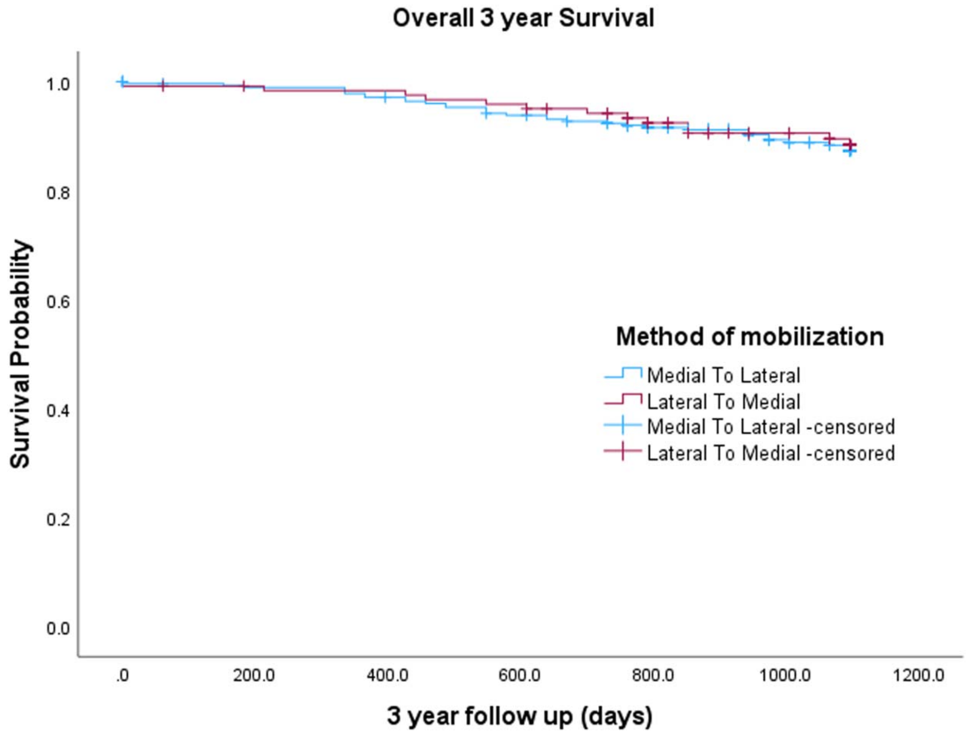

Figure 3. Kaplan–Meier curve for 3-year survival (overall).

right-sided resections (Median 165 vs. 225 min) and anorectal resections (Median 240 vs. 300 min) had a shorter operative duration in the LM group, and this was statistically significant ($P < 0.001$). Although left-sided resections also had a shorter operative duration in the LM group (Median 218 vs. 283 min), this was not statistically significant ($P = 0.299$). Overall, the mean (SD) length of stay was 8 (4) days with a median (IQR, range) of 6 (5, 2–54) days. The mean length of stay in the LM and ML groups was 8.5 and 7.9 days, respectively, and this was not statistically significant ($P = 0.446$). Comparison of the length of stay of individual operations among the two groups is shown in Table 5, and the results were not statistically significant.

Adenocarcinoma was the most common histology in either group, with 93.4% in LM or 94.6% in ML. Most tumours were moderately differentiated, with 77% in the LM and 74.8% in ML groups. Dukes' and TNM staging were comparable in the two groups. A total of 3.3% (4/122) in the LM and 1.8% (5/280) in the ML group had R1 resection, but this was not statistically significant ($P = 0.352$), as shown in Table 6. The mean and median lymph node yield in the two groups were comparable, with no statistically significant difference ($P = 0.848$). Table 7 demonstrates the overall and individual operation lymph node yield in the two groups, with no statistically significant difference observed. The 3-year overall survival rate was analysed between the two groups. In the LM group, 13 patients (10.7%) died over a 3-year period compared to 32 patients (11.4%) in the ML group. A Log-rank test was used to ascertain any difference between the two groups. Overall 3-year survival was similar in the two groups (Log-rank 0.759) in Figure 3. Cox regression analysis is depicted in Table 8 to ascertain the significant co-variants between the two groups, including demographics, side of resection, symptoms, co-morbidities, and postoperative histology. None of the co-variants had a statistically significant difference.

Discussion

This study aimed to compare the outcomes of medial to lateral (ML) versus lateral to medial (LM) mobilisation approaches in laparoscopic colorectal cancer resections, contributing to the limited existing evidence on this topic. Traditionally, the lateral to medial approach dominated colorectal cancer resections during the open surgery era, transitioning to laparoscopic surgery with a subsequent trend toward ML approach, which is widely adopted today[9]. This retrospective study, involving 402 patients analysed prospectively collected data, contains the second largest study population compared to previous studies[10–12]. Our results demonstrated a shorter operative duration in the LM group, a finding not entirely consistent with existing literature[6]. The incidence of right colon and rectal cancers in the study reflected a gradual increase reported in recent studies.

In contrast to some prior research, our study noted a significantly reduced operative time in the LM group[12–14]. Subgroup analysis highlighted the consistency of this finding in both right-sided and anorectal resections. The shorter operative time observed in the LM group could be attributed to the surgeon's transition from a traditional lateral to medial approach in the open era[5]. This familiarity may have facilitated quicker adoption and implementation of the laparoscopic technique, compared to performing the entire operation using a novel approach.

The study revealed comparable 30-day postoperative outcomes between the LM and ML groups, with a non-significant

Table 8

Cox regression analysis between two groups

Variable adjusted	Unadjusted hazards ratio (95% CI)	*P*	Adjusted hazards ratio (95% CI)	*P*
Lateral to medial	0.90 (0.48–1.72)	0.760	0.95 (0.44–2.04)	0.897
Age at diagnosis	1.03 (1.01–1.06)	0.019	1.05 (1.01–1.08)	0.007
Sex (female vs. male)	1.07 (0.59–1.91)	0.833	0.93 (0.45–1.94)	0.851
BMI	1.02 (0.96–1.08)	0.627	1.01 (0.95–1.08)	0.666
Tumour location	0.93 (0.83–1.03)	0.144	0.93 (0.81–1.06)	0.284
Operation mode (lap vs. open)	0.74 (0.29–1.87)	0.534	0.68 (0.23–2.01)	0.489
Operation Duration	1.00 (0.98–1.01)	0.879	1.01 (0.99–1.02)	0.269
Lateral to medial	0.90 (0.48–1.72)	0.760	0.95 (0.44–2.04)	0.897
Right-sided resections	1.63 (0.91–2.94)	0.102		
Left-sided resections	1.27 (0.54–2.99)	0.589		
Anorectal resections	0.56 (0.29–1.05)	0.069		
Lateral to medial	0.90 (0.48–1.72)	0.760	0.79 (0.41–1.55)	0.504
CIBH	1.65 (0.90–3.01)	0.104	1.77 (0.92–3.39)	0.089
Rectal bleeding	0.91 (0.48–1.73)	0.772	0.86 (0.43–1.72)	0.664
Abdominal pain	1.77 (0.91–3.43)	0.091	1.22 (0.55–2.69)	0.621
IDA	1.12 (0.57–2.20)	0.753	1.19 (0.59–2.42)	0.629
Weight loss	2.01 (0.94–4.32)	0.073	1.59 (0.70–3.65)	0.265
Constipation	1.10 (0.34–3.56)	0.869	0.69 (0.19–2.46)	0.574
Bowel obstruction	4.03 (1.44–11.26)	0.008	3.35 (0.99–11.27)	0.051
Lateral to medial	0.90 (0.48–1.72)	0.760	0.96 (0.49–1.84)	0.891
Hypertension	0.99 (0.55–1.78)	0.976	1.04 (0.56–1.93)	0.899
Diabetes mellitus	0.59 (0.21–1.65)	0.317	0.57 (0.19–1.63)	0.290
Asthma	1.74 (0.69–4.41)	0.243	1.79 (0.70–4.61)	0.223
COPD	3.00 (1.34–6.73)	0.008	2.93 (1.23–6.63)	0.010
Atrial Fibrillation	2.11 (0.75–5.89)	0.156	1.98 (0.68–5.79)	0.212
Heart failure	1.34 (0.33–5.54)	0.685	1.33 (0.29–6.05)	0.710
Lateral to medial	0.90 (0.48–1.72)	0.760	0.79 (0.39–1.57)	0.503
Non-adenocarcinoma	1.00			
Adenocarcinoma	1.45 (0.35–5.98)	0.609	1.06 (0.23–4.89)	0.939
Grade of differentiation				
Well	1.00			
Moderate	0.88 (0.34–2.28)	0.795	0.65 (0.24–1.74)	0.389
Poor	2.73 (0.95–7.87)	0.063	1.34 (0.43–4.16)	0.615
Dukes stage				
A	1.00			
B	0.88 (0.27–2.84)	0.825	0.54 (0.11–2.67)	0.447
C	3.93 (1.38–11.2)	0.011	0.98 (0.11–9.10)	0.987
D	8.73 (2.17–35.02)	0.002	3.32 (0.26–42.15)	0.355
T stage				
T1	1.00			
T2	0.69 (0.16–3.11)	0.634	0.82 (0.17–3.90)	0.804
T3	1.50 (0.45–5.01)	0.510	1.37 (0.27–6.91)	0.705
T4	4.46 (1.29–15.31)	0.018	2.52 (0.47–13.59)	0.281
N stage				
N0	1.00			
N1	3.28 (1.60–6.73)	0.001	1.72 (0.32–9.35)	0.532
N2	7.26 (3.49–15.05)	< 0.001	3.00 (0.51–17.65)	0.224
M stage				
M0	1.00			
M1	3.90 (1.74–8.75)	< 0.001	0.89 (0.27–2.98)	0.859
R malignancy				
R0	1.00			
R1	2.59 (0.63–10.69)	0.189	1.31 (0.29–6.00)	0.731

CIBH, change in bowel habits; COPD, chronic obstructive pulmonary disease; IDA, iron deficiency anaemia.

increase in postoperative ileus in the LM group, similar to the results in another retrospective cohort study[11]. The absence of significant intraoperative complications aligns with the overall safety of both approaches. However, the incidence of ileus may be influenced by technical aspects, such as the initial dissection starting laterally in the LM approach, potentially causing increased traction on the colon[15]. Notably, no significant differences were identified in terms of 30-day complication rates, operative blood loss, and length of hospital stay between the two groups, although the median length of stay was slightly shorter in the ML group. One explanation of less blood loss in ML group as mentioned by in previous studies[10] can be that in the ML technique the vessels are ligated and divided early thus reducing the risk of bleeding. Furthermore, the reduced median length of stay may be attributed to the reduced incidence of postoperative ileus and earlier return of bowel function[10,11].

The median number of lymph nodes obtained in the two groups in our study was 17 ($P = 0.848$). Even on subgroup analysis based on the operation, we did not identify any statistically significant difference between the two groups (Table 7). One previous study also did not identify any difference in the lymph node yield in the two groups[16]; however other this was contrasted with increased lymph node yield in the medial group in other papers[10,17]. This may emphasise on factors such as the proximal ligation of the pedicle and the method of mesenteric division may influence the outcome on lymph node yield[14]. In our study we did not specifically investigate these factors related to lymph node yield, but what is an adequate lymphadenectomy is still subject to debate[18,19]. The 3-year overall survival rates did not exhibit significant differences between the LM and ML groups, aligning with similar findings in the literature[6].

There are some limitations of this study. Firstly, it being a retrospective study, with the potential for selection bias. To mitigate this effect, a clear and precise inclusion and exclusion criterion were used. In addition, due to the retrospective nature of the study equal group sizes were not maintained, which can also contribute to the possible selection bias. Secondly, the operations were performed by a number of surgeons with variable experience and potentially variable operative times which may require further sub-analysis in future studies. This may have been a confounding factor between the two groups. Thirdly, as mentioned above, there are several factors that can affect lymph node yield, but this was not included in the study. Another limitation is the survival follow-up. The overall survival was reported and not disease-free survival or recurrence. Lastly, the length of follow-up would ideally have been at least 5 years duration.

In conclusion, this study, the second largest of its kind, contributes valuable insights to the ongoing debate on the optimal mobilisation approach in colorectal cancer resections. While it did not conclusively demonstrate superiority of ML over LM, it did reveal a shorter operative time in the LM group and a reduced incidence of postoperative ileus in the ML group. Large-scale randomized controlled trials with extended follow-up periods are warranted to provide a more definitive understanding of the comparative efficacy and outcomes associated with each approach. Nonetheless, the study suggests that both ML and LM approaches are acceptable and offer favourable outcomes in laparoscopic colorectal cancer resections.

Ethical approval

Ethical approval was not required for this study as no participants were recruited for this study and no clinical intervention was implemented. This purely a retrospective data analysis within retrospectively maintained databases within the hospital trust and therefore this project was deemed as a service improvement project.

Consent

No consent required for this study as this was deemed a service improvement project.

Source of funding

Not applicable.

Author contribution

M.I.: study concept, design, data collection, data analysis, manuscript writing. K.A.: data analysis, manuscript writing. S.P.: data collection and analysis. W.C.: data collection and analysis. W.R.: data collection and analysis. S.-J.W.: project supervisor.

Conflicts of interest disclosure

The authors declare no conflicts of interest.

Research registration unique identifying number (UIN)

researchregistry9956.

Guarantor

Muhammad Rafaih Iqbal.

Data availability statement

Data sharing is not applicable to this article.

Provenance and peer review

Not applicable.

Acknowledgement

The authors acknowledge the Norfolk and Norwich University Hospital library facilities for their availability and helpful staff.

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