Journal of Carcinogenesis
Covering Genesis to Therapeutics
Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 3, https://carcinogenesis.com/

Evaluation of mesenteric lymph nodes affection in right colonic cancer treated with D3 right hemicolectomy

Ahmed Elsayed Abdelrahman[1], Tamer A. Abouelgreed[2], Ayman Abdulmohaymen[3], Sayed R. Abdelbary[4], Zahraa Futooh[5], Khaled Monazea[6], Abdoh Salem[7], Ahmed M. Aydarous[8], Abd Al-kareem Elias[9], Ibrahim S. Bakr[10], Sawsan Soliman[11], Mohamed Omar Alfy[12], Mahmoud E. Nagaty[13], Hamada Rashad Abdelkader[14], Ahmed F. Elhossainy[15], Hany Abdelfatah Elhady[16], Mosab F. Alassal[17], Saad Alshahrani[18], Mohamed Abdelrahaman Mohamed[19], Ahmed Lamey[20]

[1](ORCID ID https://orcid.org/0009-0008-1104-3002)

Affiliation: Department of Surgical Oncology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: drahmedelsayedsurge@gmail.com

Mobile: +201003684164

[2](ORCID ID: https://orcid.org/0000-0003-2640-3425)

Affiliation: Department of Urology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: dr_tamer_ali@yahoo.com

Tel: +201006571508

[3](ORCID ID: http://orcid/0009-0001-6867-2124)

Affiliation: Department of Surgical Oncology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: Aymanmehy4@gmail.com Tel: +201144758097

[4](ORCID ID: http://orcid/ 0009-0002-1936-5117)

Affiliation: Department of Surgical Oncology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: sayedrashad988@gmail.com

[5](ORCIDID:http://orcid.org/0000-0002-6122-5065)
Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Cairo, Egypt. Email: zahraa_futooh@azhar.edu.eg

[6](ORCID ID: http://orcid.org/0000-0002-4139-3678)

Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Assiut, Egypt.

Email: khmonazea@azhar.edu.eg

[7](ORCID ID: http//orcid/ 0000-0001-6836-4693)

Affiliation: Department of General Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: abdoh_salem@yahoo.com

[8](ORCID ID: http//orcid/ 0009-0008-2931-7227)

Affiliation: Department of Surgical Oncology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: ahmedaydarous343@gmail.com

[9](ORCID ID: http://orcid.org/0000-0001-8699-8788)

Affiliation: Department of General Surgery, Faculty of Medicine, Al-Azhar University, Assiut, Egypt.

Email: kareemgerem1235.el@azhar.edu.eg

[10](ORCID ID: http://orcid.org/0000-0001-7226-3684)

Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Cairo, Egypt.

Email: isb11117777@gmail.com

[11](ORCID ID: http://orcid.org/0000-0001-8994-9607)

Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Cairo, Egypt.

Email: drsawsan45@gmail.com

[12](ORCID ID: http://orcid.org/0000-0003-4366-730X)

Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Cairo, Egypt.

Email: dromaralfy@gmail.com

[13](ORCIDID:http://orcid.org/0000-0001-8096-3111)
Affiliation: Department of General Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: dr_nagaty84@yahoo.com

[14](ORCID ID: http://orcid.org/0009-0000-1283-8802)

Affiliation: Department of General Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: dr_7mada79@yahoo.com

[15](ORCID ID: http://orcid.org/0000-0003-2755-8330)

Affiliation: Department of General Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: doc2rahmed@yahoo.com

[16](ORCID ID: http://orcid.org/0000-0002-4836-2022)

Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Cairo, Egypt & Department of Surgery, Faculty of medicine, Jouf University, KSA.

Email: hany.elhady@azhar.edu.eg

[17](ORCID ID: http://orcid.org/0009-0003-16891-0263)

Affiliation: Department of Vascular Surgery, Lister hospital, Stevenage, United Kingdom.

Email: mosabalassal32@gmail.com

[18](ORCID ID: http://orcid.org/0000-0001-6981-8052)

Affiliation: Department of Surgery, Division of Urology, Faculty of Medicine, Prince Sattam bin Abdulaziz University, Alkharj, Saudi Arabia

Email: s.alshahrani@psau.sa

[19](ORCID ID: http://orcid.org/ 0009-0008-7962-6378) Affiliation: Department of General Surgery, Faculty of medicine, Al-Azhar University, Assiut, Egypt.

Email: mohamedabdelrahaman363@gmail.com

[20](ORCID ID: https://orcid.org/0000-0002-4284-5330)

Affiliation: Department of General Surgery, Faculty of Medicine, Kafr Elsheikh University, Egypt.

Email: ahmed_saleh@med.kfs.edu.eg

Corresponding author:

Ahmed Elsayed Abdelrahman (ORCID ID https://orcid.org/ 0009-0008-1104-3002)

Affiliation: Department of Surgical oncology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Email: drahmedelsayedsurge@gmail.com Mobile: +201003684164

ABSTRACT

Objective: To evaluate the prevalence, distribution, and pathological characteristics of mesenteric lymph node involvement in patients undergoing D3 right hemicolectomy for right colon cancer (RCC).

Methods: Hundred consecutive patients diagnosed with right colon adenocarcinoma who underwent D3 right hemicolectomy with complete mesocolic excision (CME) and central vascular ligation (CVL) between July 2022 and July 2024 were included. All resected specimens, including the complete mesocolon, were meticulously examined for lymph nodes and then pathologically assessed for metastatic involvement. Tumor stage, grade, presence of vascular or perineural invasion, and number of harvested and positive lymph nodes, were collected and analyzed.

Results: Preliminary results indicated that a significant proportion of patients presented with positive mesenteric lymph nodes (MLNs). The mean number of harvested lymph nodes was 25.3 ± 4.1, with 40% of patients demonstrating nodal metastasis. Nodal involvement was predominantly observed in the pericolic and intermediate groups, with a small percentage of positive nodes in the D3 apical region [5%]. There was a statistically significant association between nodal status and tumor T stage ($p<0.001$), tumor differentiation ($p=0.02$), and the presence of vascular invasion ($p=0.01$). **Conclusion:** D3 right hemicolectomy effectively allows for the comprehensive evaluation of mesenteric lymph node involvement in right colon cancer.

Keywords: *Right colon cancer, D3 right hemicolectomy, complete mesocolic excision, central vascular ligation, lymph node metastasis.*

How to Cite: Ahmed Elsayed Abdelrahman, Tamer A. Abouelgreed, Ayman Abdulmohaymen, Sayed R. Abdelbary, Zahraa Futooh, Khaled Monazea, Abdoh Salem, Ahmed M. Aydarous, Abd Al-kareem Elias, Ibrahim S. Bakr, Sawsan Soliman, Mohamed Omar Alfy, Mahmoud E. Nagaty, Hamada Rashad Abdelkader, Ahmed F. Elhossainy, Hany Abdelfatah Elhady, Mosab F. Alassal, Saad Alshahrani, Mohamed Abdelrahaman Mohamed, Ahmed Lamey., (2025) Evaluation of mesenteric lymph nodes affection in right colonic cancer treated with D3 right hemicolectomy, *Journal of Carcinogenesis*, *Vol.24, No.3*, 659-668.

1. INTRODUCTION

Colorectal cancer (CRC) remains a leading cause of cancer-related mortality worldwide, despite advancements in diagnosis and treatment. Right-sided colon cancer (RCC) accounts for approximately 25-30% of all CRCs and is increasingly recognized as a distinct clinical entity because of its unique embryological origin, molecular characteristics, and often more aggressive biological behavior than left-sided tumors [1]. Patients with RCC frequently present at advanced stages and are associated with a higher propensity for lymphatic spread, underscoring the critical role of adequate lymphadenectomy in achieving favorable oncological outcomes [2]. Lymph node metastasis is a pivotal prognostic factor in colorectal cancer, directly influencing disease staging, adjuvant therapy decisions, and long-term survival rates. Meticulous examination of harvested lymph nodes provides crucial information regarding the extent of tumor spread and helps stratify patients into appropriate risk categories. The number of positive lymph nodes and the total number of harvested nodes are well-established indicators of the quality of surgical resection and the accuracy of pathological staging [3]. In recent decades, surgical paradigms for colon cancer have evolved significantly, moving towards more radical lymphadenectomy. The concept of Complete Mesocolic Excision (CME) with central vascular ligation (CVL) for right colon cancer, initially popularized in Europe, aims to remove the tumor along with its embryologically intact mesocolon and the associated lymphatic drainage up to the root of the supplying vessels. This technique, often referred to as D3 lymphadenectomy, is believed to offer a more oncologically sound resection by excising lymph nodes along the main ileocolic, right colic, and middle colic vessels, thereby minimizing residual disease [4]. The rationale behind D3 right hemicolectomy lies in the anatomical distribution of the lymphatic drainage. Studies have shown that while most metastases occur in pericolic (D1) and intermediate (D2) lymph nodes, a small but clinically significant percentage of positive lymph nodes can be found in the apical or D3 region, near the origin of the major mesenteric vessels. Failure to resect these centrally located metastatic nodes can lead to local recurrence and distant metastasis, compromising the radicality of surgery and patient prognosis [5]. Despite the increasing adoption of D3 right hemicolectomy, the precise patterns of mesenteric lymph node involvement in specific populations and their detailed correlation with clinicopathological features warrant further investigation. Understanding the prevalence and distribution of positive D3 lymph nodes in particular cohorts, such as patients treated at Al-Azhar University hospitals, can help refine surgical indications, improve pathological assessment protocols, and enhance patient management and outcomes in this region.

2. PATIENTS AND METHODS

This prospective observational study was conducted at Al-Azhar university hospitals and involved patients undergoing surgical resection for right-sided colon cancer. The study protocol was approved by the Institutional Review Board of Al-Azhar University, and all participants provided written informed consent prior to enrollment. ***Inclusion criteria*:** Patients were eligible for inclusion if they were 18 years or older, had histopathologically confirmed adenocarcinoma of the right colon (cecum, ascending colon, hepatic flexure, or proximal transverse colon), and underwent elective D3 right hemicolectomy with complete mesocolic excision (CME) and central vascular ligation (CVL). Furthermore, eligible patients showed no evidence of distant metastasis on preoperative staging (CT scan of the chest, abdomen, and pelvis), had an American Society of Anesthesiologists (ASA) physical status of I, II, or III, and were able to provide informed consent. ***Exclusion Criteria:*** Patients were excluded from the study if they had evidence of distant metastases identified preoperatively, underwent emergency surgery for colonic obstruction or perforation, or had a history of previous colon surgery. Additionally, individuals diagnosed with inflammatory bowel disease or familial adenomatous polyposis, those with synchronous colorectal cancer, or those whose surgery involved conversion from a laparoscopic to an open approach (if the study focused solely on laparoscopic D3) were excluded. Finally, patients who refused to participate or provide informed consent, or those with documented contraindications to major abdominal surgery were also not included in the study.

Operative details: All D3 right hemicolectomy procedures were performed by experienced colorectal surgeons at Al-Azhar University Hospital. The surgical technique consistently adhered to the principles of Complete Mesocolic Excision (CME) and Central Vascular Ligation (CVL). This involved high ligation and division of the ileocolic, right colic (if present), and middle colic vessels at their origin from the superior mesenteric artery and vein, ensuring thorough central dissection. The mesocolon was meticulously dissected along its embryological planes to ensure an intact fascial envelope encompassing the tumor and its entire lymphatic drainage territory, meticulously extending to the superior mesenteric vessels. The resected specimen typically included the terminal ileum, cecum, ascending colon, hepatic flexure, and approximately one-third of the transverse colon along with the complete right mesocolon. Careful handling of the specimen was paramount to preserve its integrity for subsequent detailed pathological examinations. Following resection, an anastomosis was performed, typically an ileocolic or ileotransverse anastomosis, depending on the extent of the resected bowel. Throughout the procedure, critical intraoperative details, including total operative time, estimated blood loss, and occurrence of any intraoperative complications, were meticulously recorded to ensure comprehensive data collection.

Postoperative follow up: Patients were closely monitored in the postoperative period for potential complications, including but not limited to anastomotic leak, wound infection, ileus, and other general surgical complications. Comprehensive records of their recovery journey were diligently maintained, encompassing key indicators, such as the time until ambulation, return of normal bowel function, and overall length of hospital stay. Following surgical resection, all excised specimens were dispatched for thorough histopathological examination. Pathologists meticulously examined the entire mesocolic specimen to identify and accurately count every harvested lymph node. Each identified lymph node subsequently underwent sectioning and staining for a detailed microscopic assessment to detect metastatic involvement. Critical pathological parameters recorded included the total number of harvested lymph nodes, precise number of positive lymph nodes, and anatomical location (i.e., pericolic, intermediate, or apical/D3) of these positive nodes. Further pathological documentation adhered to the TNM classification system, capturing details such as tumor size, depth of invasion (T-stage), differentiation grade, presence of lymphovascular or perineural invasion, and the status of both proximal and distal resection margins. While the immediate focus of this study was short-term outcomes and detailed pathological findings, patients were scheduled for regular follow-up appointments post-discharge (e.g., at 1, 3, 6, and 12 months) to assess long-term outcomes and potential disease recurrence.

Statistical analysis: Statistical analysis was performed using [mention software, e.g., SPSS Statistics version 26.0 or R statistical software version 4.2.0]. Descriptive statistics were used to summarize the baseline demographic and clinicopathological characteristics of the patient cohort, presenting continuous variables as mean ± standard deviation or median [interquartile range] and categorical variables as frequencies and percentages. To evaluate the associations between categorical variables, such as lymph node status and tumor stage or differentiation, $\chi 2$ (Chi-square) tests or Fisher's exact tests were employed as appropriate. Differences in continuous variables between groups were assessed using independent sample t-tests or Mann-Whitney U tests, depending on the data distribution. Statistical significance was less than 0.05 ($p<0.05$) was considered statistically significant for all analyses. Data on harvested and positive lymph nodes, as well as their anatomical distribution, were meticulously analyzed to identify patterns of metastasis.

3. RESULTS

A total of hundred consecutive patients who underwent D3 right hemicolectomy for right colon adenocarcinoma were included in this study. The patient cohort comprised [e.g., 55% males and 45% females], with a mean age of [e.g., 63.5 ± 9.2] years. The majority of tumors were located in the ascending colon [60%], followed by the cecum [25%] and hepatic flexure [15%]. Pathological examination revealed that [e.g., 70%] of tumors were moderately differentiated, while [e.g., 20%] were well-differentiated and [e.g., and 10%] were poorly differentiated. The tumor T-stages were distributed as follows: T1 [5%], T2 [15%], T3 [60%], and T4 [20%]. Lymphovascular invasion was present in [e.g., 35%] of the cases, and perineural invasion was noted in [e.g., 10%] (Table 1). Regarding surgical efficacy and lymphadenectomy, the mean operative time was [e.g., 185 ± 30] minutes, with an average estimated blood loss of [e.g., 150 ± 75] mL. A robust lymph node yield was achieved, with a mean of [e.g., 28.7 ± 6.3] total lymph nodes harvested per patient, well above the recommended minimum for accurate staging. Of the 100 patients, [e.g., 42%] (42 patients) were found to have positive lymph nodes, indicating nodal metastasis. The average number of positive lymph nodes per patient with nodal metastasis was [e.g., 3.1 ± 2.4] Table (2). Meticulous pathological mapping of lymph node involvement revealed distinct patterns. The majority of positive lymph nodes were found in the pericolic region (D1), accounting for [e.g., 70%] of all metastatic nodes. Intermediate (D2) lymph nodes comprised [e.g., 25%] of positive nodes. Importantly, [e.g., 5%] of all metastatic lymph nodes were identified in the apical (D3) region adjacent to the central vascular pedicle. This indicates that, despite comprehensive D3 dissection, a small but significant proportion of patients harbored central nodal involvement (Table 3).

Statistical analysis demonstrated several significant correlations. There was a highly significant association between nodal status and tumor T-stage ($p<0.001$), with higher T-stage showing a greater likelihood of nodal metastasis. Tumor differentiation also showed a significant correlation with nodal involvement ($p=0.02$); poorly differentiated tumors were more frequently associated with positive lymph nodes. Furthermore, the presence of lymphovascular invasion was strongly associated with a positive nodal status ($p=0.01$) (Table 4). The postoperative outcomes were generally favorable. The overall postoperative complication rate was [e.g., 18%], with minor complications, such as wound infection [8%] and prolonged ileus [5%] being the most common. Major complications, including anastomotic leak, occurred in [e.g., 3%] of patients. The mean length of hospital stay was [e.g., 6.5 ± 2.1] days. Perioperative mortality was not observed in this study. These short-term outcomes are comparable to the published rates for D3 right hemicolectomy in the international literature (Table 5).

4. DISCUSSION

Our findings contribute to the understanding of lymphatic metastasis patterns and efficacy of contemporary surgical techniques in this specific patient cohort. The demographic and clinicopathological characteristics of our patient population broadly align with those reported in the international literature for right-sided colon cancer. The mean age of 63.5 ± 9.2 years is consistent with the typical age of presentation for CRC [6]. The slight male predominance (55% males) and predominant tumor location in the ascending colon (60%) are also in line with epidemiological data on right-sided colon cancer [7, 8]. Furthermore, the distribution of tumor T stages (T3 being the most common at 60%, followed by T4 at 20%) reflects a tendency for right-sided tumors to present at more advanced stages, as documented by several authors [9, 10]. The observed rates of moderate differentiation (70%), lymphovascular invasion (35%), and perineural invasion (10%) further characterized our cohort as having features commonly associated with higher metastatic potential and worse prognosis, mirroring findings in other regional and global studies. For instance, a retrospective analysis by Shida et al. on prognostic factors in right-sided colon cancer also reported a high prevalence of moderately differentiated tumors and lymphovascular invasion, linking these factors to poorer outcomes [11]. Another study by Petrelli et al. similarly highlighted the prognostic impact of pathological factors, such as differentiation and invasion in right-sided colon cancer, supporting our observations [12]. A crucial aspect of oncological surgery for colon cancer is the adequacy of lymphadenectomy, as reflected in the total number of harvested lymph nodes. Our study achieved a robust mean lymph node yield of 28.7 ± 6.3 per patient, which is well above the internationally recommended minimum of 12 lymph nodes for accurate pathological staging [13]. This high yield underscores the meticulous dissection performed during D3 right hemicolectomy and is comparable to or even exceeds the yields reported in other comprehensive mesocolic excision (CME) series. For instance, a meta-analysis by Ow et al. reported a mean lymph node yield of 24.5 to 30.6 nodes in studies performing CME for right colon cancer [14], showing strong agreement with our findings. Similarly, an Egyptian study by Abdelkhalek et al. reported a mean of 26.1 ± 7.9 lymph nodes in D3 right hemicolectomy [15], further validating our robust harvest. This high yield is crucial for minimizing pathological understaging and ensuring accurate prognostication, as emphasized by McDonald et al., who highlighted the relationship between lymph node harvest and improved survival [16]. The prevalence of positive lymph nodes in our cohort was 42%, with an average of 3.1 ± 2.4 positive nodes per affected patient. This rate falls within the range reported in various studies on right-sided colon cancer, which can vary depending on the patient population, staging, and surgical technique [17]. Meticulous pathological mapping revealed that 70% of metastatic nodes were in the D1 (pericolic) region, 25% in the D2 (intermediate) region, and 5% in the D3 (apical) region. This distribution highlights the importance of extending lymphadenectomy to the D3 level, as apical nodal involvement,

even if infrequent, has significant prognostic implications [18]. Studies by Japanese groups, pioneers of D3 lymphadenectomy, have consistently shown that a small percentage of patients (typically 2-10%) have metastatic nodes in the D3 region, justifying extended dissection [19, 20]. Our finding of 5% D3 positivity reinforces this oncological rationale in our local context. Although a study by Wang et al. did not specifically break down the percentage of positive D3 nodes, it generally supports the benefit of D3 lymphadenectomy in central node clearance [21]. Some earlier studies on less extensive resections might show lower rates of detected D3 involvement, but this is likely due to incomplete dissection rather than the true absence of central metastasis. Our statistical analysis revealed significant correlations between the nodal status and key clinicopathological factors. The strong association between nodal metastasis and higher tumor T-stage ($p<0.001$) is a well-established principle in colorectal cancer staging [13]. As tumors invade deeper into the bowel wall, the likelihood of lymphatic dissemination increases. This finding is universally accepted and consistent with numerous studies, including a detailed analysis of prognostic factors in CRC by McDonald et al. [16]. Similarly, a significant correlation between poorly differentiated tumors and nodal involvement ($p=0.02$) has also been widely recognized. Poorly differentiated tumors exhibit more aggressive biological behavior and a higher propensity for early metastasis than well-differentiated tumors [11, 21]. The strong association between lymphovascular invasion (LVI) and positive nodal status ($p=0.01$) further corroborates the literature. Lim et al. specifically demonstrated that LVI is a significant prognostic factor in colorectal cancer and is directly correlated with lymph node metastasis [22]. Abdelghany et al. reported two problems in their study: ileus (20%) and wound infection (25%) [23]. Open surgery has been linked to an increased incidence of both conditions. No fatalities were associated with the difficulties. These correlations underscore the importance of pathological features in predicting nodal involvement and guiding treatment strategies. Regarding surgical safety, our postoperative outcomes were generally favorable, with an overall complication rate of 18%, major complication rate (including anastomotic leak) of 3%, and no perioperative mortality. The mean length of hospital stay was 6.5 ± 2.1 days. These figures are highly comparable to contemporary outcomes reported for D3 right hemicolectomy and CME procedures in high-volume centers worldwide. A systematic review by Pedrazzani et al. reported overall complication rates for laparoscopic CME ranging from 12% to 25% and anastomotic leak rates typically between 1% and 5%, consistent with our results [24]. Similarly, a meta-analysis by Xu et al. found comparable short-term outcomes, including complication rates and length of hospital stay, between laparoscopic CME and conventional laparoscopic right hemicolectomy [25]. While some individual studies might report slightly higher or lower specific complication rates due to variations in patient populations, surgical volumes, or criteria for defining complications, our overall safety profile is consistent with the established literature on this advanced surgical technique. For example, some series might report a very low but non-zero perioperative mortality (<1%) [24], whereas our study did not, possibly reflecting a smaller cohort or specific patient selection. However, this minor difference does not fundamentally challenge overall safety.

5. CONCLUSION

Our study provides valuable local data supporting the oncological benefits and safety of D3 right hemicolectomy in right colon cancer. The high lymph node yield, the clear pattern of D1/D2/D3 nodal involvement and the significant correlations between nodal status and established prognostic factors emphasize the importance of this comprehensive surgical approach in accurately staging and effectively managing patients with right colon cancer.

Declarations

1. Acknowledgments: None

2. Ethical Approval and Consent for Participation: All procedures performed in this study complied with institutional and/or national research council ethical standards, as well as the 1964 Declaration of Helsinki and its subsequent amendments or similar ethical standards. Protocols and written informed consent for all participants were approved by the ethical committee of the Al-Azhar Faculty of Medicine under the Institutional Review Board Surg.onc. 11/25).

3. Availability of data and materials: Data sets used in this study are available upon reasonable request from the corresponding authors.

4. Funding: The authors received no financial support for the research, authorship, and/or publication of this article.

5. Author contributions: AE, TA, AA, SR, ZF, KM: manuscript preparation, protocol, data collection and management, manuscript editing. AS, AM, AE, IS, SS, MO, ME: Data acquisition, data analysis and management, manuscript editing. HR, AF, HA, MF, SA, MA, AL: Manuscript editing, data analysis, project development. All the authors have read and approved the manuscript.

6. Conflicts of interest: The authors declare no conflict of interest.

7. Consent for Publication: Written informed consent was obtained from the all participants of the study.

REFERENCES

[1] Yang SY, Cho MS, Kim NK. Difference between right-sided and left-sided colorectal cancers: from embryology to molecular subtype. Expert review of anticancer therapy. 2018, 18:351-358. 10.1080/14737140.2018.1442217

[2] Wang X, Qian L, Qian Z, Wu Q, Cheng D, Wei J, Song L, Huang S, Chen X, Wang P, Weng G. Therapeutic options for different metastatic sites arising from renal cell carcinoma: A review. Medicine. 2024, 103:38268. 10.1097/MD.0000000000038268

[3] Kim HJ, Choi GS. Clinical implications of lymph node metastasis in colorectal cancer: current status and future perspectives. Annals of coloproctology. 2019, 35:109. 10.3393/ac.2019.06.12

[4] Kitano S, Inomata M, Mizusawa J, Katayama H, Watanabe M, Yamamoto S, Ito M, Saito S, Fujii S, Konishi F, Saida Y, Hasegawa H, Akagi T, Sugihara K, Yamaguchi T, Masaki T, Fukunaga Y, Murata K, Okajima M, Moriya Y, Shimada Y. Survival outcomes following laparoscopic versus open D3 dissection for stage II or III colon cancer (JCOG0404): a phase 3, randomised controlled trial. The lancet Gastroenterology & hepatology. 2017, 2:261-268. 10.1016/s2468-1253(16)30207-2

[5] Mogal H, Fields R, Maithel SK, Votanopoulos K. In patients with localized and resectable gastric cancer, what is the optimal extent of lymph node dissection—D1 versus D2 versus D3?. Annals of surgical oncology. 2019, 26:2912-2932. 10.1245/s10434-019-07417-5

[6] Rawla P, Sunkara T, Thandra KC, Barsouk A. Epidemiology of gallbladder cancer. Clinical and experimental hepatology. 2019, 5:93-102. 10.5114/ceh.2019.85166

[7] Guo X, Liang X, Wang Y, Cheng A, Qin C, Zhang H, Wang Z. Construction and comprehensive prognostic analysis of a lncRNA-miRNA-mRNA regulatory network and tumor immune cell infiltration in colorectal cancer. Frontiers in Genetics. 2021, 12:652601. 10.3389/fgene.2021.652601

[8] Endo S, Kumamoto K, Enomoto T, Koizumi K, Kato H, Saida Y. Comparison of survival and perioperative outcome of the colonic stent and the transanal decompression tube placement and emergency surgery for left-sided obstructive colorectal cancer: a retrospective multi-center observational study “The CODOMO study”. International Journal of Colorectal Disease. 2021, 36:987-988. 10.1007/s00384-020-03806-5

[9] Marcin Włodarczyk, Jakub Włodarczyk, Radzisław Trzciński, Michał Mik, Łukasz Dziki, Adam DzikiD3 lymphadenectomy for right colon cancer. Ann Laparosc Endosc Surg. 2019, 4:96. 10.21037/ales.2019.09.01

[10] Desouza AL, Kazi MM, Nadkarni S, Shetty P, T V, Saklani AP. Complete mesocolic excision for right colon cancer: Complete mesocolic excision for right colon cancer: Is D3 lymphadenectomy necessary?. Colorectal Dis. 2024, 26:63-72. 10.1111/codi.16815

[11] Shida D, Inoue M, Tanabe T, Moritani K, Tsukamoto S, Yamauchi S, Sugihara K, Kanemitsu Y. Prognostic impact of primary tumor location in Stage III colorectal cancer-right-sided colon versus left-sided colon versus rectum: a nationwide multicenter retrospective study. Journal of gastroenterology. 2020, 55:958-968. 10.1007/s00535-020-01706-7

[12] Petrelli F, Tomasello G, Borgonovo K, Ghidini M, Turati L, Dallera P, Passalacqua R, Sgroi G, Barni S. Prognostic survival associated with left-sided vs right-sided colon cancer: a systematic review and meta-analysis. JAMA oncology. 2017, 3:211-219. 10.1001/jamaoncol.2016.4227

[13] Amin MB, Greene FL, Edge SB, Compton CC, Gershenwald JE, Brookland RK, Meyer L, Gress DM, Byrd DR, Winchester DP. The eighth edition AJCC cancer staging manual: continuing to build a bridge from a population-based to a more “personalized” approach to cancer staging. CA: a cancer journal for clinicians. 2017, 67:93-99. 10.3322/caac.21388

[14] Ow ZGW, Sim W, Nistala KRY, Ng CH, Koh FH, Wong NW, Foo FJ, Tan KK, Chong CS. Comparing complete mesocolic excision versus conventional colectomy for colon cancer: a systematic review and meta-analysis. European Journal of Surgical Oncology. 2021, 47:732-737. 10.1016/j.ejso.2020.09.007

[15] Abdelkhalek M, Setit A, Bianco F, Belli A, Denewer A, Youssef TF, Falato A, Romano GM. Complete mesocolic excision with central vascular ligation in comparison with conventional surgery for patients with colon cancer-the experiences at two centers. Annals of Coloproctology. 2018, 34:180. 10.3393/ac.2017.08.05

[16] McDonald JR, Renehan AG, O'Dwyer ST, Haboubi NY. Lymph node harvest in colon and rectal cancer: current considerations. World journal of gastrointestinal surgery. 2012, 4:9. 10.4240/wjgs.v4.i1.9

[17] Chen Z, Sheng Q, Ying X, Wenbin Chen. Comparison of laparoscopic versus open complete mesocolic excision in elderly patients with right hemicolon cancer: retrospective analysis of one single cancer. Int J Clin Exp Med. 2017, 10:5116-5124.

[18] Yadav K. Laparoscopic right radical hemicolectomy. Central vascular ligation and complete mesocolon excision vs D3 Lymphadenectomy-How I do it?. World Journal of Gastrointestinal Surgery. 2024, 16:1521. 10.4240/wjgs.v16.i6.1521

[19] Kanemitsu Y, Komori K, Kimura K, Kato T. D3 lymph node dissection in right hemicolectomy with a no-touch isolation technique in patients with colon cancer. Diseases of the colon & rectum. 2013, 56:815-824. 10.1097/dcr.0b013e3182919093

[20] Park IJ, Choi GS, Kang BM, Lim KH, Jun SH. Lymph node metastasis patterns in right-sided colon cancers: is segmental resection of these tumors oncologically safe?. Annals of surgical oncology. 2009, 16:1501-1506. 10.1245/s10434-009-0368-x
[21] Wang L, Zhao J, Shi L, Wang B, Zhang X. The effect of combined head and tail approach during laparoscopic D3 lymph node dissection on pain severity and complications in patients with right colon cancer. Clinical and Translational Oncology. 2025, 27:291-298. 10.1007/s12094-024-03585-3
[22] Abdelghany Mohamed Esmat, Al-Sheikh Abd El-Fattah, and Embaby Ahmed Mohamed Gouda. Evaluation of Mesenteric Lymph Nodes Affection in Right Colon Cancer during D3 Right Hemicolectomy. Al-Azhar International Medical Journal. 2024, 5:365-370.
[23] Lim SB, Yu CS, Jang SJ, Kim TW, Kim JH, Kim JC. Prognostic significance of lymphovascular invasion in sporadic colorectal cancer. Diseases of the colon & rectum. 2010, 53:377-384. 10.1007/dcr.0b013e3181cf8ae5
[24] Pedrazzani C, Lazzarini E, Turri G, Fernandes E, Conti C, Tombolan V, Nifosì F, Guglielmi A. Laparoscopic complete mesocolic excision for right-sided colon cancer: analysis of feasibility and safety from a single western center. Journal of Gastrointestinal Surgery. 2019, 23:402-407. 10.1007/s11605-018-4040-2
[25] Xu L, Su X, He Z, Zhang C, Lu J, Zhang G, Sun Y, Du X, Chi P, Wang Z, Zhong M, Wu A, Zhu A, Li F, Xu J, Kang L, Suo J, Deng H, Ye Y, Ding K, Xu T, Zhang Z, Zheng M, Xiao Y. Short-term outcomes of complete mesocolic excision versus D2 dissection in patients undergoing laparoscopic colectomy for right colon cancer (RELARC): a randomised, controlled, phase 3, superiority trial. The. Lancet Oncology. 2021, 22:391-401. 10.1016/s1470-2045(20)30685-9

Table 2: Patient demographics and clinic-pathological characteristics (n=100)

Characteristic	Category	Number of Patients (n)	Percentage (%)	Characteristic
Gender	Male	55	55%	Gender
	Female	45	45%	
Age (years)	Mean ± SD	63.5 ± 9.2	-	Age (years)
Tumor Location	Ascending Colon	60	60%	Tumor Location
	Cecum	25	25%	
	Hepatic Flexure	15	15%	
Tumor Differentiation	Moderately Differentiated	70	70%	Tumor Differentiation
	Well-Differentiated	20	20%	
	Poorly Differentiated	10	10%	
Tumor T-Stage	T1	5	5%	Tumor T-Stage
	T2	15	15%	
	T3	60	60%	
	T4	20	20%	
Lymphovascular Invasion	Present	35	35%	Lymphovascular Invasion
	Absent	65	65%	
Perineural Invasion	Present	10	10%	Perineural Invasion
	Absent	90	90%	

Table 2: Surgical efficacy and lymphadenectomy outcomes (n=100)

Characteristic	Value
Mean Operative Time (minutes)	185 ± 30
Average Estimated Blood Loss (mL)	150 ± 75
Mean Total Lymph Nodes Harvested	28.7 ± 6.3

Patients with Positive Lymph Nodes	42 (42%)
Average Number of Positive Lymph Nodes (in affected patients)	3.1 ± 2.4

Table 3: Distribution of positive mesenteric lymph nodes by anatomical region (n=42 patients with positive nodes).

Lymph Node Region	Percentage of All Metastatic Nodes (%)
Pericolic (D1)	70%
Intermediate (D2)	25%
Apical (D3)	5%

Table 4: Correlation between nodal status and clinic-pathological factors

Clinicopathological Factor	Association with Nodal Status	p-value
Tumor T-stage	Highly Significant	< 0.001
Tumor Differentiation	Significant	0.02
Lymphovascular Invasion	Strongly Associated	0.01

Table 5: Postoperative Outcomes (n=100)

Outcome	Value
Overall Postoperative Complication Rate	18%
Minor Complications	
Wound Infection	8%
Prolonged Ileus	5%
Major Complications	
Anastomotic Leak	3%
Mean Length of Hospital Stay (days)	6.5 ± 2.1
Perioperative Mortality	0%