

Original Article

Risk Factors of Surgical Complications in Laparoscopic Right Hemicolectomy with D3 Lymphadenectomy

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Key Words

D3 lymph node dissection;
Laparoscopic right hemicolectomy;
Chylous ascites;
Complications;
Risk factors

Background. D3 lymph node dissection is a key component of colorectal cancer surgery, aiming to improve oncologic outcomes. However, this technique may increase the risk of postoperative complications.

Objective. To evaluate the incidence and risk factors of postoperative complications in patients undergoing laparoscopic right hemicolectomy with D3 lymph node dissection.

Methods. This retrospective study included 88 patients who underwent laparoscopic right hemicolectomy with D3 lymph node dissection for right-sided colon adenocarcinoma between May 2019 and June 2023. Demographic, surgical, and postoperative data were collected. Logistic regression analyses were used to identify risk factors for complications and prolonged hospital stay.

Results. The median patient age was 74 years, with most classified as ASA < 3 (61.3%) and having a Charlson Comorbidity Index > 3 (96.7%). The median number of harvested lymph nodes was 24. Postoperative complications occurred in 39.8% of patients, all classified as minor (Clavien-Dindo grade < 3). Chyle ascites was the most common complication, occurring in 26.1% of cases, while no anastomotic leakage was observed. Univariate and multivariate analyses identified no significant predictors of overall postoperative complications. Chyle ascites was associated with lymph node count in univariate analysis, but not multivariate analysis. ASA classification was the only independent predictor of prolonged hospital stay.

Conclusions. D3 lymph node dissection during laparoscopic right hemicolectomy has a low rate of severe complications. Chyle ascites was not independently associated with the number of harvested lymph nodes. However, a higher preoperative ASA classification was an independent predictor of prolonged hospital stay, emphasizing its role in perioperative risk assessment.

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Since 1977, Japanese guidelines have recommended incorporating D3 lymph node dissection into the surgical treatment of colorectal cancer,¹ as a growing

body of evidence suggests a positive correlation between the number of harvested lymph nodes and overall patient survival.²⁻⁴ Compared to D2 lymph node dissec-

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tion, the primary goal of D3 lymphadenectomy is to thoroughly excise the intermediate vessels, along with the removal of intermediate and pericolic lymph nodes, as well as part of the main lymph nodes.⁵ During the operation, dissection was performed along the superior mesenteric vein (SMV) until the gastrocolic trunk and middle colic vessels were exposed in our institution. However, studies have indicated that D3 lymph node dissection might result in complications, including chyle leakage, anastomotic leakage, and vascular injury.^{6,7}

This study aimed to evaluate the incidence and characteristics of surgical complications in patients undergoing laparoscopic right hemicolectomy with D3 lymph node dissection and identify and analyze the potential risk factors contributing to their development.

Methods

Patient selection

Patients were included if they underwent laparoscopic right hemicolectomy with D3 lymph node dissection for pathologically confirmed right-sided colon adenocarcinoma between May 2019 and June 2023.

Inclusion criteria

- Patients aged 18 years and older.
- Histologically confirmed adenocarcinoma of the right colon.
- Tumor located from the cecum to the proximal transverse colon.

Exclusion criteria

- Open or robotic surgery.
- Patients with incomplete medical records.
- Pathology revealed lesions other than adenocarcinoma, such as adenoma, dysplasia, or appendiceal mucinous neoplasm.

Data collection

The collected demographic data included age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, history of ab-

dominal surgeries, pathological TNM staging, and tumor location. Short-term outcomes assessed encompassed intraoperative blood loss, operative time, length of postoperative hospital stay, postoperative complication rate, and 30-day readmission rate. Evaluated surgical complications included wound infection, urinary tract infection (UTI), bowel obstruction, anastomotic leakage, and chyle ascites, all classified according to the Clavien-Dindo classification system.

Definition of complications

- Wound Infection: An infection occurring within 30 days after surgery, affecting the surgical incision or deep tissue at the operation site.
- Urinary Tract Infection (UTI): Diagnosed by symptomatic dysuria accompanied by pyuria on urinalysis during hospitalization.
- Bowel Obstruction: Characterized by the need for nil per os (NPO) status, nasogastric (NG) decompression, or radiologic confirmation of intestinal obstruction.
- Anastomotic Leakage: Identified by uncontrolled infection, abnormal drain output, or confirmation via computed tomography (CT) imaging.⁸
- Chyle Ascites: Diagnosed when ascitic fluid contains a triglyceride (TG) concentration exceeding 110 mg/dL.⁹

Statistical analysis

Categorical and continuous variables were analyzed using nonparametric methods. Risk factors for surgical complications were initially assessed through univariate logistic regression analysis. Variables with a p -value < 0.3 in the univariate analysis were then incorporated into a multivariate logistic regression model to identify independent predictors. Statistical significance was defined as a p -value < 0.05 . All analyses were conducted using SPSS software, version 25.0 (IBM Corp., Chicago, IL, USA).

Results

Initially, 130 patients who underwent right hemicolectomy with D3 lymph node dissection were identified. Thirty-eight patients underwent surgery using

the open method, two patients underwent the robotic method, and the remaining two were ultimately diagnosed other than adenocarcinoma. After applying pre-defined exclusion criteria, 88 patients remained in the final analysis (Fig. 1). The cohort was predominantly female (53.4%), with a median age of 74. Most patients (96.6%) had a Charlson Comorbidity Index (CCI) greater than 3, indicating a significant burden of comorbidities. Additionally, 62.5% were classified as ASA physical status class I or II, reflecting relatively stable preoperative conditions.

Pathological analysis revealed that tumors were most frequently located in the ascending colon (47.7%). Advanced tumor stages (T3 and T4) were predominant (78.4%), while the majority of patients exhibited no regional lymph node involvement (N0) and no distant metastasis (M0). The median number of harvested lymph nodes was 24, with a median of four retrieved from the D3 region. The D3 region lymph node positivity rate was 2.7% (Table 1).

Postoperative complications occurred in 39.8% of patients, with chyle leakage being the most frequently observed event. Notably, no cases of anastomotic leakage were recorded during the study period. According to the Clavien-Dindo classification system, all com-

plications were classified as grade I or II. The median length of the postoperative hospital stay was 9 days (Table 2).

When evaluating potential predictors of postoperative complications, no significant associations were found between patient baseline characteristics (e.g., age, sex, BMI, ASA score, comorbidities) and complications (Table 3). Both univariate and multivariate logistic regression analyses failed to identify any independent risk factors associated with overall postoperative complications (Table 4).

Subgroup analysis focusing on specific complications revealed that chyle ascites was significantly associated with the number of harvested lymph nodes in univariate analysis (Table 5). However, this association lost statistical significance in the multivariate model. No significant predictors were identified for other complications, including postoperative ileus, wound infection, or UTI.

In the hospital length of stay analysis, univariate analysis showed that older age, higher CCI, and higher ASA classification were significantly associated with prolonged hospitalization (> 9 days). Among these factors, only ASA classification remained a statistically significant independent predictor in the multivariate

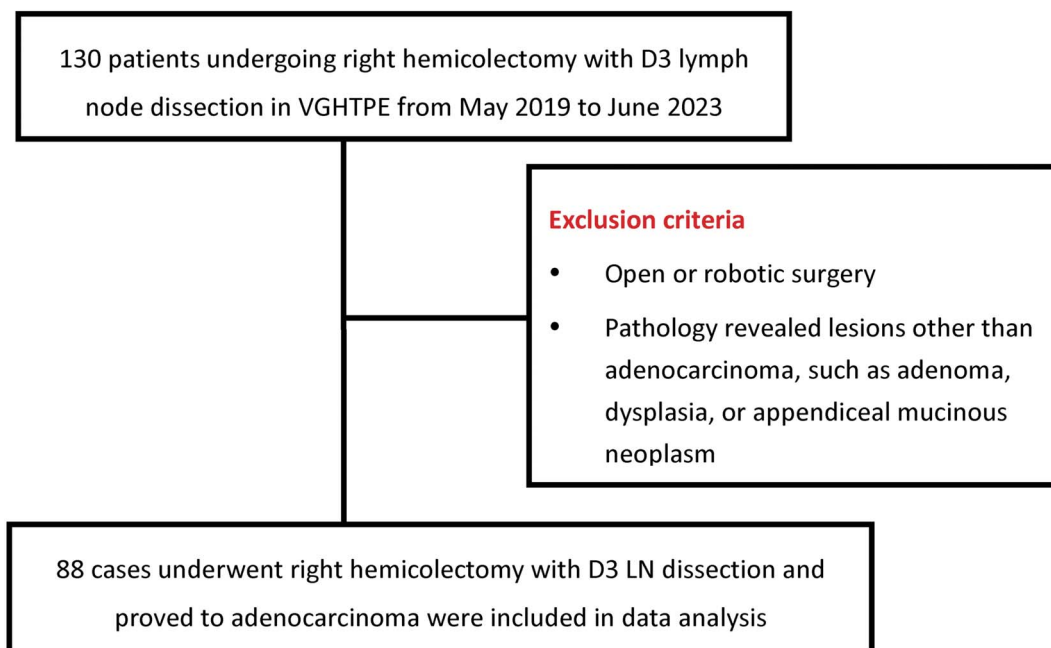


Fig. 1. Flowchart meeting the study selection.

Table 1. Patient characteristics

Male	41 (46.6%)
Age (years)	74 [64-82] (32-99)
< 80 (%)	61 (69.3%)
≥ 80 (%)	27 (30.6%)
BMI (Kg/m ²)	23.5 [21.43-26.48]
< 20 (%)	14 (15.9%)
20 ≤ BMI < 25 (%)	42 (47.7%)
≥ 25 (%)	32 (36.3%)
Charlson comorbidity index	
1-2	3 (3.4%)
≥ 3	85 (96.6%)
Previous abdominal surgery history	23 (25%)
Tumor marker	
CEA, mean	3.5 [1.8-6.4]
CA-199, mean	12.72 [5.98-25.41]
ASA	
I-II	55 (62.5%)
III-IV	33 (37.5%)
Tumor location	
Cecum	24 (27.2%)
Ascending colon	42 (47.7%)
Hepatic flexure	10 (11.4%)
Transverse colon	12 (13.6%)
T stage	
0, 1, 2	19 (21.6%)
3, 4	69 (78.4%)
N stage	
0	51 (57.9%)
1, 2	37 (42.0%)
M stage	
0	75 (85.2%)
1	13 (14.8%)
Tumor differentiation	
Well	3 (3.4%)
Moderate	78 (88.6%)
Poor	7 (8.0%)
Operation time (Hr.)	4 [3.25-5]
Blood loss	
≤ 200	84 (95.5%)
> 200	4 (4.5%)
Harvested lymph node	24 [19-31]
D1	14 [10-18]
D2	5 [3-8]
D3	4 [3-8]
Regional lymph node metastasis rate	
D1	139/1320 (10.5%)
D2	31/560 (5.5%)
D3	14/519 (2.7%)

analysis, emphasizing its utility as a prognostic indicator for prolonged hospital stay (> 9 days) (Table 6).

Table 2. Postoperative complication incidence

Postoperative complication	35 (39.8%)
Wound infection	3 (3.4%)
Urinary tract infection	1 (1.1%)
Bowel obstruction	10 (11.4%)
Anastomosis leakage	0 (0%)
Chyle ascites	23 (26.1%)
Clavien-Dindo classification	
No complication	53 (60.2%)
Minor (I, II)	35 (39.8%)
Major (III, IV, V)	0 (0%)
Hospital stays	9 [7.25-12.00]

Discussion

The results of our study revealed a high complications rate associated with D3 dissection during laparoscopic right hemicolectomy. However, these complications were minor, with chylous ascites being the most common cause.

This study found no significant link between baseline patient characteristics and the overall incidence of postoperative complications. Interestingly, female patients exhibited a higher complication rate, differing from previous research findings. This discrepancy may stem from the limited sample size, which could have influenced statistical power and subgroup representation.

Compared to larger trials on surgical complications^{10,11} — such as the RELARC trial,^{12,13} which examined complication rates between D2 and D3 lymph node dissections — our findings showed a predominance of minor complications, primarily classified as Clavien-Dindo grade I-II. Most were successfully managed with conservative treatment, avoiding the need for reoperation or intensive interventions.

Our study demonstrated a relatively higher incidence of postoperative ileus and chyle leakage, which may be attributed to differences in patient demographics. The cohort included more elderly individuals, females, and patients with higher ASA physical status classifications — factors previously linked to increased postoperative vulnerability in the literature.

Although no independent risk factors for overall postoperative complications were identified in univariate or multivariate logistic regression analyses,

Table 3. Association of patient characteristics and operative factors with postoperative complications

	Postoperative complications		<i>p</i> value
	Present	Absent	
Gender			
Male	13 (31%)	28 (68%)	0.062
Female	22 (47%)	25 (53%)	
Age	74 [67-83]	72 [62-82]	0.300
BMI	23.4 [20.2-26.5]	23.6 [21.7-26.4]	0.484
Charlson comorbidity index			
1-2	7 (29.2%)	17 (70.8%)	0.216
≥ 3	28 (43.8%)	36 (56.3%)	
Previous abdominal surgery history	8 (36.3%)	14 (63.6%)	0.708
ASA			
I-II	22 (40.7%)	32 (59.2%)	0.816
III-IV	13 (38.2%)	21 (61.8%)	
Tumor size (cm)	4.5 [3.4-6.5]	4.1 [2.55-6.0]	0.176
Tumor location			
Cecum	9 (39.1%)	14 (60.9%)	0.923
Ascending colon	17 (40.4%)	25 (59.5%)	
Hepatic flexure	3 (30%)	7 (70%)	
Transverse colon	6 (46.1%)	7 (53.8%)	
Operation time (hr.)			
≤ 4	19 (41.3%)	27 (58.7%)	0.760
> 4	16 (38.1%)	26 (61.9%)	
Blood loss			
≤ 200	34 (40%)	51 (60%)	0.818
> 200	1 (33.3%)	2 (66.7%)	
Harvested lymph node	26 [19-33]	25 [20-30]	0.492
Lymph node metastasis	0 [0-2]	0 [0-3]	0.536

Table 4. Univariate and multivariate logistic regression models of postoperative complications

	Univariate analysis			Multivariate analysis		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Male	0.469	0.179-1.044	0.062	0.459	0.184-1.141	0.094
Age	1.012	0.979-1.047	0.482			
BMI	0.966	0.871-1.071	0.510			
Charlson comorbidity index	1.889	0.688-5.182	0.217	1.873	0.634-5.530	0.256
previous abdominal operation history	0.825	0.304-2.238	0.706			
ASA	0.900	0.374-2.169	0.815			
Tumor size	1.158	0.962-1.393	0.121	1.119	0.917-1.365	0.268
Tumor location	1.042	0.672-1.616	0.853			
Operation time	0.874	0.372-2.058	0.759			
Blood loss	0.750	0.065-8.599	0.817			
Harvested lymph node	1.030	0.983-1.080	0.219	1.031	0.980-1.085	0.233
Lymph node metastasis	0.972	0.871-1.083	0.603			

further subgroup analysis revealed a significant association between chyle ascites and the number of harvested lymph nodes in the univariate model. This as-

sociation did not persist in the multivariate analysis.

Concerning the length of hospital stay, univariate analysis indicated that older age, higher CCI, and ele-

Table 5. Univariate and multivariate logistic regression model of chyle ascites

	Univariate analysis			Multivariate analysis		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Male	0.399	0.145-1.098	0.075	0.412	0.143-1.190	0.101
Age	0.990	0.954-1.027	0.603			
BMI	1.009	0.903-1.128	0.870			
Charlson comorbidity index	1.487	0.482-4.584	0.490			
previous abdominal operation history	0.784	0.252-2.440	0.675			
ASA	0.800	0.297-2.156	0.659			
Tumor size	1.212	0.993-1.479	0.058	1.149	0.932-1.416	0.192
Tumor location	0.915	0.557-1.505	0.727			
Operation time	1.005	0.388-2.605	0.991			
Blood loss	1.432	0.124-16.576	0.774			
Harvested lymph node	1.062	1.007-1.120	0.027	1.055	0.999-1.114	0.053
Lymph node metastasis	1.005	0.897-1.125	0.935			

Table 6. Univariate and multivariate logistic regression model of prolong hospital stays

	Univariate analysis			Multivariate analysis		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Male	0.427	0.181-1.009	0.052	0.239	0.078-0.731	0.120
Age	1.061	1.021-1.103	0.003	1.013	0.961-1.069	0.625
BMI	0.929	0.836-1.031	0.167	0.893	0.788-1.012	0.076
Charlson comorbidity index	5.207	1.728-15.691	0.003	1.908	0.426-8.550	0.398
Previous abdominal operation history	0.538	0.119-1.453	0.221	1.540	0.380-6.330	0.090
ASA	4.8	1.894-12.162	0.001	5.830	1.679-20.250	0.006
Tumor size	1.065	0.891-1.274	0.489			
Tumor location	1.039	0.676-1.598	0.861			
Operation time	1.430	0.617-3.314	0.404			
Blood loss	2.315	0.000-20.00	0.999			
Harvested lymph node	0.962	0.916-1.010	0.122	0.933	0.868-1.033	0.060
Lymph node metastasis	1.025	0.926-1.135	0.637			

vated ASA classification were significantly associated with prolonged hospitalization. Among these, only the ASA classification remained a statistically significant predictor in the multivariate model.

Limitations

This study has several limitations that should be acknowledged. First, it was conducted as a single-center retrospective study, which may have introduced selection bias and limited the generalizability of the findings to other institutions or populations. Second, the small sample size may have reduced the statistical power to detect significant associations, particularly in subgroup analyses. Lastly, all included cases were

performed by only two surgeons, which may have limited the applicability of the results to broader surgical practice and may not fully capture variability in surgical technique or decision-making across different practitioners.

Conclusion

In summary, among patients undergoing laparoscopic right hemicolectomy with D3 lymph node dissection, chyle leakage incidence was not significantly linked to the number of harvested lymph nodes. However, a higher preoperative ASA classification independently predicted prolonged hospital stay. These

findings highlight the importance of preoperative risk assessment in anticipating postoperative recovery and optimizing perioperative management.

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原 著

腹腔鏡右側結腸切除併 D3 淋巴結清除手術之 手術併發症發生率與危險因子

謝邑東 林楨國 林資琛 陳維熊 姜正愷 楊純豪 張世慶 王煥昇
藍苑慈 林春吉 林宏鑫 黃聖捷 楊逸文 林育如 張哲源 鄭厚軒

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背景 D3 淋巴結清除手術為大腸癌手術之重要技術，旨在提升腫瘤學預後，但可能增加術後併發症風險。

目的 評估接受腹腔鏡右半結腸切除合併 D3 淋巴結清除手術患者之術後併發症發生率及其危險因子。

方法 本回溯性研究納入 2019 年 5 月至 2023 年 6 月於台北榮民總醫院接受腹腔鏡右半結腸切除並行 D3 淋巴結清除手術之 88 位右側結腸腺癌患者。收集患者基本資訊、手術及術後資料，並以邏輯式回歸分析併發症及延長住院天數之相關因子。

結果 患者年齡中位數為 74 歲，61.3% 患者之 ASA 分級是小於 3，96.7% 患者 Charlson 共病指數大於 3。淋巴結清除中位數為 24 顆。術後併發症發生率為 39.8%，均屬輕度 (Clavien-Dindo 分級 < 3)，以乳糜漏最為常見 (26.1%)，未見任何吻合口滲漏的個案。單變量及多變量分析均未發現併發症之顯著預測因子。乳糜漏於單變量分析中與清掃淋巴結數相關，惟多變量分析中無統計學意義。ASA 分級則為住院天數延長之唯一獨立預測因子。

結論 腹腔鏡右半結腸切除合併 D3 淋巴結清掃併發重度併發症之風險低。乳糜漏與清除淋巴結數無獨立關聯。較高 ASA 分級為住院天數延長之獨立預測因子，術前 ASA 評估對於手術風險預測具重要意義。

關鍵詞 D3 淋巴結清除手術、腹腔鏡右側結腸切除手術、乳糜漏、併發症、危險因子。