Original Article

Minimally Invasive Surgery of Colorectal Cancer for Patients with End-stage Renal Disease

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Purpose. To present the clinical outcome of the patient with end-stage renal disease (ESRD) who underwent minimally invasive colectomy.
Materials and Methods. We retrospectively reviewed the patients with ESRD receiving laparoscopic or robotic surgery for colorectal cancer from Jan. 2007 to Jun. 2018 in a single institute. We analyzed the characteristics of the patients, intraoperative and postoperative variables, intensive care unit (ICU) stay, hospitalization, 30-day morbidity, and mortality rates.
Results. Twenty patients were included in this study. The overall mortality rate was 5%. The morbidity rate within 30 days was 30%, with four of these patients having fluid overload caused by their renal disease. Two patients had surgery-related morbidity and both resolved without any deficit. The 5-year survival rate was 58.1%.
Conclusion. This study showed low morbidity and mortality rates in patients with ESRD. Minimally invasive approach for colorectal cancer in ESRD patients is a safe and feasible method.
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Key Words
ESRD;
Colorectal cancer;
Minimally invasive surgery

The prevalence of colorectal cancer is increasing, especially in an aging society. It is reported that about 145,600 new cases per year are diagnosed in the United States.[1] In Taiwan, there are more than 15,000 newly diagnosed colorectal cancers every year.[2] Surgery is the main curative treatment for resectable colorectal cancer. However, patients with chronic kidney disease (CKD) have an increased complication rate after major surgery of the abdomen. Some postoperative complications, such as postoperative infection, wound dehiscence, unplanned intubation, septic shock, and mortality rates, decrease in the laparoscopic method. Furthermore, laparoscopic surgery does not impair the renal function in the CKD group.[3-6] Iannuzzi et al. also revealed that elective minimally invasive surgery could reduce postoperative morbidity and mortality if the condition of comorbidities was optimized preoperatively.[7] It suggests that elective laparoscopic surgery might be the most appropriate treatment for colorectal cancer in CKD patients.

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Therefore, in patients with stage 5 CKD, also known as end-stage renal disease (ESRD), colorectal surgery showed poor outcome in wound healing and postoperative infection. Compared with the normal population, mortality rates increased from 1-6% to 22-26%.[3,4] However, the laparoscopic approach for colorectal cancer in ESRD patients only accounted for 17.3% in Sirany et al.'s study.[8]

Material and Methods

After approval by the Institutional Review Board of our hospital, we retrospectively reviewed the patients with ESRD receiving elective laparoscopic or robotic radical surgery for colorectal cancer from Jan. 2007 to Jun. 2018 in a single institute. If the intra-abdominal lesion was not derived from the colon or rectum, the patient was excluded. We also excluded the patients who did not follow-up at our outpatient clinic. Patient's characteristics, comorbidities, length of dialysis, intensive care unit (ICU) stay, intraoperative variables, hospitalization, 30-day morbidity, and mortality rates were collected.

Most of these patients received hemodialysis, but some of them preferred peritoneal dialysis before the surgery. Hemodialysis was performed 1 day before the surgery. For patients who underwent peritoneal dialysis, we removed the Tenckhoff catheter during the surgery, and hemodialysis was applied to these patients via the permcath, temporally. A further arteriovenous shunt was performed after the patient recovered from abdominal surgery.

Results

There were 20 patients included in this study. Nine patients were male, and 11 patients were female. The mean age was 70.5 years. More than half of these patients had hypertension and/or diabetes. Other comorbidities are shown in Table 1. Eight patients received laparoscopic right hemicolectomy, and two received laparoscopic left hemicolectomy. Robotic low anterior resection was performed in one patient. Other patients received laparoscopic anterior resection/low anterior resection. We performed six protective ostomies for patients who received concurrent chemoradiotherapy (CCRT) and poor blood perfusion of the intestine, noted intraoperatively.

The median volume of intraoperative blood loss was 200 mL. One patient had blood loss around 2000 mL because of staple failure. The median ICU stay was 2 days. We did not request the patient to resume oral intake immediately. After bowel movement was recorded, the patients could try a liquid diet and then resume a low-residue diet for 1 month. Patients were discharged on postoperative day (POD) 13.3, on average, if no complication, otherwise it elevated to POD 26.1.

The histology of 17 patients showed adenocarcinoma (stage I: 6, stage IIA: 4, stage IIIA: 2, stage IIIB: 5). Two patients were diagnosed with tubulovillous adenoma. The other patient had ypStage 0 disease after CCRT. The resection margins were free from malignant cells.

We had four patients with complications due to ESRD-related morbidity. Two patients had pulmonary edema, requiring additional hemodialysis and an ex-

Table 1. Patient characteristics

Character	
Age	70.5 years old (54-86)
Gender	M:F = 9:11
Comorbidity	
Hypertension	16
Diabetes	11
Dyslipidemia	3
Anemia	6
Coronary arterial disease	4
Chronic heart failure	3
Surgery	
Laparoscopic right hemicolectomy	8
Laparoscopic left hemicolectomy	2
Laparoscopic low anterior resection	9
Robotic low anterior resection	1
Protective ostomy	6
Blood loss, median (range)	200 mL (100-375)
ICU stay, median (range)	2 days (1-3)
Hospitalization, mean (SD)	18 days (11)
Without complication, mean (SD)	13.3 days (3.7)
With complication, mean (SD)	26.1 days (14.8)

tended ICU stay. One of them experienced unplanned intubation. The other two patients had pleural effusion treated by thoracentesis.

Two patients had surgically-related comorbidity. Prolonged postoperative ileus was found in one patient, resulting in prolonged hospitalization, and the patient was discharged on POD 38. The other patient had intra-abdominal abscess formation and repeated fever. After good drainage of the abscess and antibiotics treatment, this patient was discharged on POD 51.

There was one mortality case in our patients. The patient's respiratory condition did not recover well after the operation, and she remained in the ICU postoperatively. We tried nasogastric tube feeding after bowel movement. However, anastomotic site leakage with severe intra-abdominal infection was discovered, complicated with septic shock. We re-explored the peritoneal cavity on POD 32, and a loop ileostomy was created after massive lavage with normal saline. Multiple organ failure still developed, and the patient passed away on POD 42.

There was no clinical factor that influenced the surgical or ESRD-related complications by multiple logistic regression analysis (Table 2 and 3). The patient with dyslipidemia had more blood loss during operation than the other patients (Table 4). Patients who received peritoneal dialysis before operation experienced both a longer time of bowel recovery ($\beta = 5.10$, $p = 0.0209$) and ICU stay ($\beta = 23.13$, $p = 0.0344$) after operation relative to the other patients (Table 5 and 6). The 5-year overall survival rate was 58.1% (Fig. 1).

Table 2. Associations between clinical factors and ESRD related complication

Variables	OR (95% CI)	*p*-value
Age	1.07 (0.93-1.23)	0.3325
Gender	1.29 (0.14-11.54)	0.8224
Hypertension	0.69 (0.05-9.21)	0.7805
Diabetes	3.00 (0.26-35.33)	0.3826
Coronary arterial disease	–	
Anemia	3.00 (0.31-28.84)	0.3414
Dyslipidemia	2.33 (0.16-34.89)	0.5393
Hemodialysis	1.00 (0.08-12.56)	1.000
Peritoneal dialysis	–	
L. LAR vs. L. Right hemicolectomy	0.33 (0.03-4.40)	0.4040

Table 3. Associations between clinical factors and surgical complication

Variables	OR (95% CI)	*p*-value
Age	0.93 (0.80-1.08)	0.3171
Gender	2.86 (0.22-37.99)	0.4265
Hypertension	–	
Diabetes	1.78 (0.13-23.52)	0.6624
Coronary arterial disease	2.33 (0.16-34.89)	0.5393
Anemia	–	
Dyslipidemia	3.75 (0.22-62.77)	0.3579
Hemodialysis	0.62 (0.04-8.70)	0.7194
Peritoneal dialysis	8.00 (0.35-184.36)	0.1939

Table 4. Associations between clinical factors and blood loss

Variables	Univariate analysis		Multivariate analysis	
	β	*p*-value	β	*p*-value
Age	-9.14	0.4257		
Gender	214.65	0.2905		
Hypertension	171.88	0.5002		
Diabetes	179.29	0.3796		
Coronary arterial disease	93.75	0.7143		
Anemia	-160.71	0.4698		
Dyslipidemia	779.41	0.0020	808.13	0.0138
Hemodialysis	90.00	0.7036		
Peritoneal dialysis	-13.90	0.9676		
L. LAR vs. L. Right hemicolectomy	-137.50	0.5502		
Stage				
-I vs. 0	-91.67	0.7737		
-II vs. 0	345.83	0.3223		
-III vs. 0	-59.52	0.8482		

Table 5. Associations between clinical factors and bowel movement

Variables	Univariate analysis		Multivariate analysis	
	β	*p*-value	β	*p*-value
Age	-0.05	0.3240		
Gender	0.26	0.7784		
Hypertension	-1.05	0.3390		
Diabetes	0.08	0.9310		
Coronary arterial disease	0.10	0.9284		
Anemia	0.12	0.9059		
Dyslipidemia	-0.10	0.9333		
Hemodialysis	-0.73	0.5073		
Peritoneal dialysis	4.83	0.0085	5.10	0.0209
L. LAR vs. L. Right hemicolectomy	0.31	0.7622		
Stage				
-I vs. 0	-2.33	0.1600		
-II vs. 0	-1.50	0.3844		
-III vs. 0	-1.43	0.3712		

Table 6. Associations between clinical factors and ICU stay

Variables	Univariate analysis		Multivariate analysis	
	β	*p*-value	β	*p*-value
Age	0.06	0.7846		
Gender	-4.38	0.2917		
Hypertension	2.88	0.5826		
Diabetes	-4.10	0.3249		
Coronary arterial disease	-2.56	0.6245		
Anemia	-0.281	0.5379		
Dyslipidemia	-2.71	0.6447		
Hemodialysis	-8.67	0.0605		
Peritoneal dialysis	19.11	0.0018	23.13	0.0344
L. LAR vs. L. Right hemicolectomy	-6.75	0.1903		

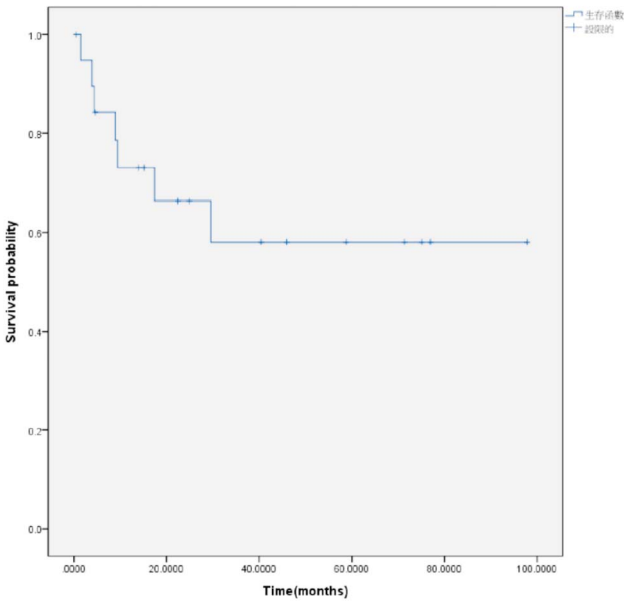

Fig. 1. Kaplan-Meier survival analysis.

Discussion

The survival of ESRD patients can be increased by good development of dialysis and general health care. In ESRD patients, the 5-year cumulative incidence rate of colorectal cancer is 1.18%, which is higher than that in the general population.[9] In Taiwan, the estimated ESRD patients are more than 80,000. Surgery is the main curative therapy for colorectal cancer. As a result, more and more ESRD patients will need to undergo colorectal surgery. However, these patients have more complications after abdominal surgery.

In previous studies, the morbidity and mortality rates improved if these patients received minimally invasive surgery.[3-7] We retrospectively reviewed our patients receiving laparoscopic and robotic colorectal surgery. The overall morbidity rate was 30%. Surgical

complications accounted for 10.5%, and others were ESRD-related complications. The morbidity rate was 58.3% and 47.9% in the study by Iannuzzi et al.[7] and Sirany et al.,[8] respectively.

During the treatment course, most patients stayed in the ICU for than 3 days. We consulted a nephrologist for the arrangement of dialysis. Some patients received hemodialysis in the ICU and others in the dialytic unit. Dialysis might result in unsteady control of body fluid. Therefore, the morbidity rate could be minimized if optimal fluid control is gained. Iannuzzi et al. argued that if the condition of comorbidities could be optimized pre-operatively, the mortality rate will reduce.[7] Furthermore, a multidisciplinary patient-oriented plan is required before surgery for optimizing the preoperative comorbidities.

Dyslipidemia affected intraoperative blood loss, but this result might have been influenced by staple failure during surgery, resulting in massive bleeding. In addition, dyslipidemia might not be easily controlled immediately after diagnosis of colorectal cancer, and so atherosclerosis should be a concern. The surgeon should be attentive and meticulous during vascular dissection.

Patients treated with peritoneal dialysis before surgery required an extended time to recover their bowel movement. It is considered that the peritoneal cavity becomes chronically inflamed during peritoneal dialysis. As a result, recovery of peristalsis is different in those receiving hemodialysis. For these patients, fluid control is important because the different way of renal replacement therapy will be performed perioperatively, which might affect the ICU stay and hospitalization.

The surgical mortality rate was 5%, which is much lower than previously reported (22-26%).[3,4]

Conclusion

Although more prospective randomized controlled studies are needed, we find that minimally invasive surgery for colorectal cancer in ESRD patients could be a safe and feasible method. In addition, if possible, it might be arranged electively, and multidisciplinary patient care is needed.

Conflicts of Interests

The authors declare no conflicts of interests.

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原　著

末期腎衰竭病患罹患大腸直腸癌接受微創手術之成效

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目的　藉由本研究呈現微創手術使用於末期腎衰竭病患罹患大腸直腸癌之治療成效。

方法　我們回溯性蒐集單一醫學中心末期腎衰竭病患於 2007 年 1 月至 2018 年 6 月間罹患大腸直腸腫瘤並經腹腔鏡或機器人輔助大腸直腸腫瘤切除之案例。病患之臨床資訊、術中及術後臨床資料、加護病房住院日數、總住院日數、三十日內併發症及死亡率皆同步蒐集並加以分析。

結果　共計二十名病患被納入此篇研究。手術相關死亡率為 5%，手術後出現併發症機率為 30%。其中，四位病患出現體內體液過多之併發症，需經血液透析與插管呼吸治療。另有兩位病患出現手術相關併發症，經治療後皆順利出院且無後遺症。五年存活率為 58.1%。

結論　本研究顯示末期腎衰竭病患罹患大腸直腸癌後經微創手術治療，其手術併發症發生機率與死亡率為可接受的。

關鍵詞　末期腎衰竭、大腸直腸癌、微創手術。