

# Laparoscopic Surgery for Colorectal Cancer in Patients on Hemodialysis: A Propensity Score-matched Analysis

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**Abstract.** *Background/Aim:* Surgery on hemodialysis patients requires special attention, as the tissue of these patients is vulnerable and hemorrhagic. This study explored the feasibility of laparoscopic surgery for colorectal cancer in hemodialysis patients. *Patients and Methods:* This was a retrospective study of patients who underwent laparoscopic surgery for colorectal cancer in a single institute from April 2007 to December 2016. *Results:* A total of 2668 patients were included: 24 (0.9%) were on hemodialysis, and 2644 (99.1%) were not. After 1:1 propensity score matching, there were no significant differences in the short-term postoperative results, the disease-free survival rate ( $p=0.0813$ ) or the cancer-specific survival rate ( $p=0.555$ ). However, the overall survival rate was significantly lower in hemodialysis patients than in non-hemodialysis patients ( $p=0.0135$ ). *Conclusion:* Standard laparoscopic operative procedures can be safely performed for hemodialysis patients, and there was no marked difference in the long-term oncological outcomes between the two groups.

The life expectancy of patients with chronic renal failure has been prolonged thanks to advances in hemodialysis (HD) technology (1-4). However, the frequency of malignant tumors, including colorectal cancer, is higher in HD patients than in healthy people (5-8), so the number of cases of HD patients undergoing surgery for malignant tumors is expected to increase. The rate of laparoscopic surgery is rapidly increasing, especially for colorectal cancer (9-11). Therefore, the number of laparoscopic colorectal cancer surgeries for HD patients is also expected to increase in the near future. In HD patients, caution is required during surgery due to tissue fragility and easy bleeding. Furthermore, associated

comorbidities and poor healthcare in patients with HD carry a risk of more negative postoperative outcomes. Some studies have shown that preoperative dialysis was associated with postoperative mortality and complications after surgical procedures (12-14). However, there are few reports on the short- and long-term outcomes of colorectal cancer surgery for HD patients, especially using a laparoscopic approach. The present study explored the feasibility of laparoscopic surgery for colorectal cancer in patients on HD.

## Patients and Methods

We performed a retrospective study on the short- and long-term outcomes of HD patients who underwent laparoscopic surgery for colorectal cancer from April 2007 to December 2016 in our hospital. Propensity score matching (PSM) was used to balance the bias between the groups and included the age, gender, body mass index (BMI), preoperative carcinoembryonic antigen (CEA) levels, multiple cancers, tumor location, tumor size, cancer stage and observation period. Short-term postoperative results after matching were analyzed. Finally, the disease-free survival (DFS), cancer-specific survival (CSS) and overall survival (OS) of the two groups were observed.

Data analyses were performed using the statistical software program EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). The *t*-test, chi-squared test and Fisher's exact test were used as appropriate. The RFS, CSS and OS were estimated by the Kaplan-Meier method. Statistical significance was set at a *p*-value of  $<0.05$ .

This study was approved by the Ethics Committee at the Saitama Medical University International Medical Center (approval number 19-151). This study was a single-institutional retrospective study that used existing information obtained from hospital medical records.

## Results

There were 2668 patients who underwent laparoscopic surgery for primary colorectal cancers, excluding open approach surgery. Among these, 24 (0.9%) patients were on HD (HD+ group), and 2644 (99.1%) patients were not on

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Table I. Characteristics of hemodialysis (HD) + and HD- patient groups before and after propensity score matching.

Parameters	Before matching			After matching		
	HD –	HD +	p-Value	HD –	HD +	p-Value
Gender	2,644	24		24	24	
Male	1,594	15		16	15	
Female	1,05	9	1	8	9	1
Age (year)	66.7	72.7	<b>0.007</b>	72.4	72.7	0.873
BMI (kg/m <sup>2</sup> )	22.9	22.4	0.581	23.9	22.4	0.143
CEA (ng/ml)	33.9	9.1	0.774	4.83	9.09	0.142
Tumor size (cm)	4.25	3.45	0.075	4.04	3.45	0.297
Tumor location						
Colon	1,598	16		16	16	
Rectum	1,013	7		8	7	
Colon & rectum	33	1	0.223	0	1	1
Double cancers						
No	2,394	23		19	23	
Yes	253	1	0.737	5	1	0.188
Multiple cancers						
No	2,491	23		21	23	
Yes	153	1	1	3	1	0.609
Pathological stage						
0-II	1,498	18		13	18	
III-IV	1,144	6	0.16	11	6	0.262

Statistically significant p-Values are given in bold.

HD (HD- group). The baseline characteristics of the groups were compared by a univariate analysis before matching, showing that the HD+ group was significantly older than the HD- group (72.7 vs. 66.7 years old;  $p=0.007$ ) (Table I).

In the HD+ group, there were 15 males and 9 females. The average age at the operation was 72.7 years old, the average BMI was 22.4 kg/m<sup>2</sup>, and the average preoperative CEA levels were 9.1 ng/ml. Preoperative coexisting diseases were hypertension (14 cases), diabetes (10 cases), heart disease (4 cases) and cerebrovascular disease (2 cases). The main locations of tumors were the rectum in 8 (RS/Ra/Rb=3/3/2) and the colon in 16 (C/A/T/D/S=3/7/1/2/3). The average diameter of tumors was 3.45 cm, and the stage of cancer was I/II/III/IV in 12/6/4/2 cases, respectively. Two cases required conversion to open surgery because of adhesion in one case and invasion of the tumor to other organs in the other case. The degree of lymph node dissection was D3 and D2 or less in 12 each. The average operation time was 186 minutes, and the average amount of blood loss was 54.5 g. Postoperative complications were observed in 4 cases (16%) (anastomotic leakage in 2 cases (both needed conservative treatment), anastomotic hemorrhaging in 1 case, ileus in 1 case), and there were no perioperative deaths. Food intake was started on the third day after the operation, and the average postoperative hospital stay was 11 days.

Next, 1:1 PSM was performed (Table I), after which there were no significant differences in the categories between the

Table II. Postoperative results in the hemodialysis (HD) + and HD- groups after propensity score matching.

Variables	After matching		p-Value
	HD-	HD+	
Operative time (min)	207	186	0.454
Blood loss (ml)	45.5	54.5	0.797
Conversion to open approach, n	0/24	2/24	0.489
Blood transfusion, n	0/24	1/24	1
Resected lymph nodes, n	25.2	28	0.444
Resected intestine length (cm)			
Oral side	12.5	12.3	0.876
Anal side	8.3	7.4	0.454
Postoperative complications, n			
Bleeding	0/24	1/24	1
Deep SSI	1/24	2/24	1
Superficial SSI	0/24	0/24	NA
Ileus	1/24	1/24	1
Postoperative food intake (days)	3.2	3.4	0.401
Postoperative hospital stay (days)	8.4	11.6	0.116

two groups. In terms of the postoperative results, there were no significant differences between the HD+ and HD- groups in the duration of the operation (207 min vs. 186 min,  $p=0.454$ ), amount of intraoperative bleeding (45.5 ml vs. 54.5 ml,  $p=0.797$ ), conversion rate to an open approach

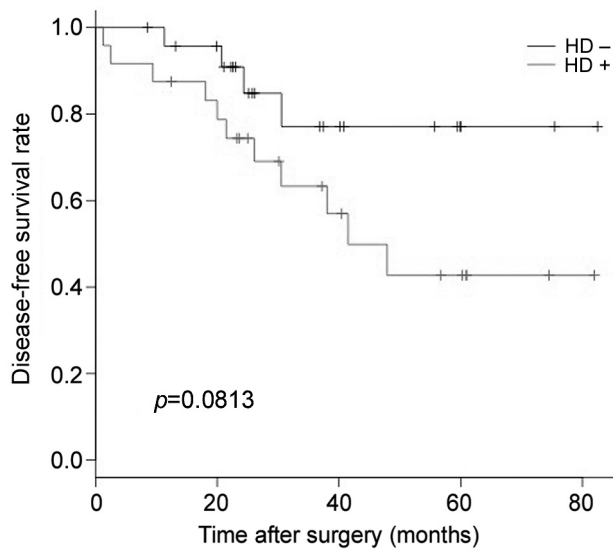


Figure 1. Disease-free survival with and without hemodialysis.

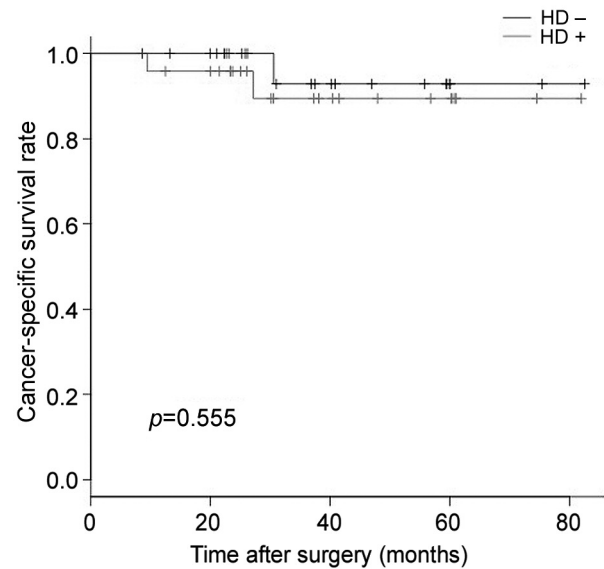


Figure 2. Cancer-specific survival with and without hemodialysis.

(0/24 vs. 2/24,  $p=0.489$ ), blood transfusion rate (0/24 vs. 1/24,  $p=1$ ), postoperative complication rate (bleeding, deep SSI(surgical site infection), superficial SSI, and ileus), average days from operation to food intake (3.2 days vs. 3.4 days,  $p=0.401$ ) or duration of postoperative hospital stay (8.4 days vs. 11.6 days,  $p=0.116$ ) (Table II). In addition, concerning the resected specimen, there were no significant differences between the HD+ and HD- groups in the number of resected lymph nodes (25.2 vs. 28.0 days,  $p=0.444$ ) and the length of resected intestine (oral side: 12.5 cm vs. 12.3 cm,  $p=0.876$ /anal side: 8.3 cm vs. 7.4 cm,  $p=0.454$ ).

Using a Kaplan-Meier analysis, we noted no significant difference in the DFS or CSS between the HD+ and HD- groups ( $p=0.0813$  and  $0.555$ , respectively) (Figures 1 and 2). However, the OS was significantly lower in the HD+ patients than in the HD- patients (Figure 3).

## Discussion

In the present study, we analyzed the influences of HD on laparoscopic colorectal surgery. We found that there were no marked differences in the short-term postoperative results or long-term oncological outcomes between the HD+ and HD- groups.

There have been few reports on laparoscopic surgery for HD patients, especially for those with colorectal cancer. Higashino *et al.* have reported that there were no significant differences in the OS or DSS between HD+ patients and HD- patients. However, the sample size was extremely small (14 patients), and the postoperative hospital stay was relatively long (HD-: 21.6 days/HD+: 16.5 days) (15).

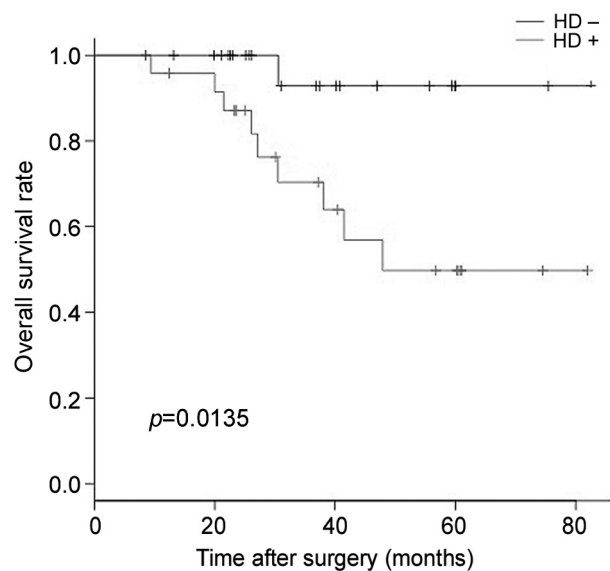


Figure 3. Overall survival with and without hemodialysis.

Therefore, our study includes the largest number of HD patients to date from a high-volume center for laparoscopic colorectal surgery in Japan.

The rates of perioperative complications and mortality are high in cases of colorectal cancer surgery among HD patients (12-14). Surgery in HD patients has many issues that need to be considered, including electrolyte imbalance, abnormal protein metabolism, decreased cardiopulmonary function, decreased local blood flow in organs, the fragility of tissues,

delayed wound healing, abnormal coagulation, susceptibility to infection and a decreased immune function (16-20). Factors associated with postoperative complications include the nutritional status, dialysis period, steroid use, cardiopulmonary function, presence of hypertension and diabetes and emergency surgery. Anastomotic failure and systemic complications have been reported to frequently occur in HD patients. For these reasons, some surgeons feel that it is not appropriate to perform D3 lymphadenectomy for HD patients, as this would increase the risk of postoperative complications. However, so far, there is no evidence supporting the safety and efficacy of chemotherapy for HD patients. Therefore, some surgeons feel that radical lymph node dissection should be performed in HD patients who can be successfully treated by surgery.

Although the risk of general anesthesia in HD patients is higher than usual (21), recent advances in perioperative management and anesthesia have improved the safety of surgery for HD patients.

Our study revealed a discrepancy in the OS and CSS between the two groups, suggesting that HD patients are more likely to die of other diseases than non-HD patients. There is room for consideration as to whether surgery for colorectal cancer needs to be curative.

Some studies reporting the negative influence of HD on colorectal surgery included a lower rate of laparoscopic cases (12). However, the present study, in which all patients underwent laparoscopic surgery, showed that laparoscopic surgery can be safely performed; similar postoperative results were found between the HD+ and HD- groups. Recently, some reports have also shown that laparoscopic surgery for colorectal cancers in HD patients is safe and feasible (13, 22). A laparoscopic approach might be safer than an open approach in HD patients, and its minimal invasiveness is considered a good indication for HD patients. As such, its application in this patient population is expected to increase in the near future.

This study has several limitations, including its retrospective nature and the small sample size of HD+ patients, and although bias was balanced after PSM, a great deal of information may have been missed. In addition, over 90% of patients underwent laparoscopic surgery in our institution, so we were unable to compare the laparoscopic approach with the open approach in HD patients. We expect that multicenter clinical trials will further clarify the feasibility of laparoscopic surgery for colorectal cancer in HD patients.

## Conclusion

Laparoscopic surgery for colorectal cancer was safe and feasible for HD patients. There were no significant differences in the long-term oncological outcomes between HD+ patients and HD- patients.

## Conflicts of Interest

The Authors declare no conflicts of interest associated with this manuscript.

## Authors' Contributions

NO, YH, TI, HK, KH, LW, MA, MI, and SY were the treating surgeons. NO drafted the manuscript. All Authors read and approved the final manuscript.

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