Published in final edited form as:

Cancer Treat Commun. 2016 ; 8: 1–4. doi:10.1016/j.ctrc.2016.03.006.

Analyzing clinical outcomes in laparoscopic right vs. left colectomy in colon cancer patients using the NSQIP database

Valentine Nfonsam^{a,*}, Hassan Aziz^a, Viraj Pandit^a, Mazhar Khalil^a, Jana Jandova^{a,b}, and Bellal Joseph^a

^aDepartment of Surgery, Division of Surgical Oncology, University of Arizona, Tucson, AZ, United States

^bDepartment of Pathology, University of Arizona, Tucson, AZ, United States

Abstract

Introduction—Optimization of surgical outcomes after colectomy continues to be actively studied, but most studies group right-sided and left-sided colectomies together. The aim of our study was to determine whether the complication rate differs between right-sided and left-sided colectomies for cancer.

Methods—We identified patients who underwent laparoscopic colectomy for colon cancer between 2005 and 2010 in the American College of Surgeons National Surgical Quality Improvement Program database and stratified cases by right and left side. The two groups were matched using propensity score matching for demographics, previous abdominal surgery, pre-operative chemotherapy and radiotherapy, and preoperative laboratory data. Outcome measures were: 30-day mortality and morbidity.

Results—We identified 2512 patients who underwent elective laparoscopic colectomy for right-sided or left-sided colon cancer. The two groups were similar in demographics, and pre-operative characteristics. There was no difference in overall morbidity (15% vs. 17.7%; p value < 0.08) or 30-day mortality (1.5% vs. 1.5%; p value < 0.9) between the two groups. Sub-analysis revealed higher surgical site infection rates (9% vs. 6%; p value < 0.04), higher incidence of ureteral injury (0.6% vs. 0.4%; p value < 0.04), higher conversion rate to open colectomy (51% vs. 30%; p value < 0.01) and a longer hospital length of stay (10.5 ± 4 vs. 7.1 ± 1.3 days; p value < 0.02) in patients undergoing laparoscopic left colectomy.

Conclusion—Our study highlights the difference in complications between right-sided and left-sided colectomies for cancer. Further research on outcomes after colectomy should incorporate right vs. left side colon resection as a potential pre-operative risk factor.

*Correspondence to: Division of Surgical Oncology, 1501 N. Campbell Ave, #4334, Tucson, AZ 85724, United States. vnfonsam@surgery.arizona.edu (V. Nfonsam).

Author contributions

HA, VN, and MK were involved in study conception and design, BJ, JJ performed analysis and interpretation, HA and MK performed the data collection, HA and VP wrote the article, BJ, JJ and VN performed critical revision of the article and obtaining funding. This study has not been supported by anyone.

The authors have no financial or proprietary interest in the subject matter or materials discussed in the manuscript.

Keywords

Laparoscopic colectomy; Colon cancer

1. Introduction

Laparoscopic colectomy is a common surgical procedure for both the benign and malignant diseases of the colon [1,2]. Patient's characteristics, comorbidities, nature of the disease process, and nutritional status have all been shown to affect surgical outcomes after colon resections [3]. Patients with right-sided colon cancer are significantly older, predominantly women, with a higher rate of comorbidities [4]. Similarly, surgical techniques, details and nature of the surgery also play important roles in determining the operative outcomes [5]. In a surgical community, it is a common belief that left colectomy, which is often more technically challenging and requires a colocolic or colorectal anastomosis, has a significantly higher incidence of anastomotic leakage, wound infection, overall complication rate, and longer length of hospital stay than right colectomy, which utilizes an ileocolic anastomosis with an adequate blood supply [6–8].

To our knowledge, most studies do not differentiate between right-sided and left-sided colectomies. As a result, our objective was to evaluate the differences in patient characteristics and perioperative outcomes between elective right colectomy and left colectomy for colon cancer.

2. Methods

We identified patients who underwent laparoscopic colectomy for colon cancer between 2005 and 2010 in the American College of Surgeons National Surgical Quality Improvement Program database and stratified cases by the right and left side.

2.1. Inclusion

Patients who underwent a right-sided colectomy were defined as those patients who had a partial colectomy with ileocolic anastomosis (CPT code 44160 or 44205) and had an *International Classification of Diseases, Ninth Revision* diagnosis code for malignancy of the cecum (153.4), ascending colon (153.6), or hepatic flexure (153.0). Patients who underwent left-sided colectomy were defined as those who had a partial colectomy with anastomosis (CPT codes 44140, 44204, 44145, or 44207) and had an *International Classification of Diseases, Ninth Revision* diagnosis code for malignant neoplasm of the descending colon (153.2) or sigmoid colon (153.3).

2.2. Exclusion

Patients who underwent colectomy for non-malignant etiologies were excluded. Also, patients who underwent an emergency procedure were excluded. Patients who did not have an anastomosis were excluded from the study as well.

2.3. Outcome measures

Primary outcome measure was mortality. Secondary outcome measure was post-operative complications. Complications were defined as deep incisional infection, organ-space SSI, wound disruption, pneumonia, reintubation, pulmonary embolism, progressive renal insufficiency, acute renal failure, cerebrovascular accident, coma, cardiac arrest, myocardial infarction, sepsis, septic shock, the need for return to the operating room, or more than 48 h on a ventilator. Major complications did not include superficial SSI, deep venous thrombosis, or urinary tract infection. Cardiac disease was defined as history of congestive heart failure, MI, angina within 1 month of surgery, PCI, or cardiac surgery. Pulmonary disease was defined as dyspnea with moderate exertion or at rest, history of severe COPD, or current pneumonia. Renal failure was defined acute renal failure in the 24 h prior to surgery or preoperative acute or chronic hemodialysis. Superficial SSI involves only skin or subcutaneous tissue and at least one of the following: purulent drainage, with or without laboratory confirmation, pain or tenderness, localized swelling, redness, or heat. Deep SSI was defined as Incisional SSI that extends into the fascial and muscle layers.

2.4. Statistical analysis

A propensity score was generated for each patient based on all the confounding factors using a logistic regression model. In our study, the two groups were matched in 1:1 ratio. The two groups were matched using propensity score matching for demographics, previous abdominal surgery, pre-operative chemotherapy and radiotherapy, and pre-operative laboratory data. The groups were also matched for intraoperative blood transfusions and wound classifications. We quantified the accuracy of the model based on the area under the Receiver Operator characteristic curve.

Data are reported as mean (SD) for continuous variables, median (range) for ordinal variables and as proportions for categorical variables. To explore the differences between two groups, Mann–Whitney *U* test and Student's *t*-test for continuous variables and χ^2 test for categorical variables were performed. Univariate analysis was performed to compare the outcomes among patients. *p*-values less than 0.05 were considered statistically significant. All statistical analyses were performed using SPSS (version 18, SPSS, IBM Inc., Armonk, NY). The groups were matched using propensity score matching for demographics, operative time, previous abdominal surgery, pre-operative chemotherapy and radiotherapy, and pre-operative laboratory data.

3. Results

We identified 2512 patients who underwent elective laparoscopic colectomy for right-sided or left-sided colon cancer. The two groups were similar in demographics, and pre-operative characteristics. Table 1 highlights the admission characteristics. The groups were also similar in the type of wound. Table 2 highlights the intra-operative characteristics. There was none in 30-day mortality (1.5% vs. 1.5%; *p*-value = 0.9) between the two groups. Sub-analysis revealed higher surgical site infection rates (9% vs. 6%; *p*-value = 0.04), higher incidence of ureteral injury (0.6% vs. 0.49%; *p*-value = 0.04), and a longer hospital length of stay (10.5 ± 4 vs. 7.1 ± 1.3 days; *p*-value = 0.02) in patients undergoing laparoscopic left

colectomy. Table 3 highlights the differences in clinical outcomes between the two groups. In terms of wound complication, the most common wound complication in both groups was wound dehiscence (10% vs. 10%, p -value = 0.8). The re-operation rates for wound infections were statistically significant in patients who had left colon resection (56% vs. 35%, p -value = 0.01). Table 4 highlights the wound complications between the two groups.

4. Discussion

Our study highlights the differences in outcomes between right and left colectomy in colon cancer patients. Although, we found no differences in mortality between the two groups, we did find higher wound infections, higher risk for ureteral injury, higher conversion rate, and subsequently longer hospital length of stay in patients undergoing left colectomy.

Higher incidence of wound infections was observed in patients undergoing left colectomy. We believe that the higher wound infection in these patients is due to an increase in bacterial load in left colon. This result is however contradictory to a study published by Masoomi et al. using the NIS [9]. This study showed a higher rate of complications including wound infections in patients undergoing right colectomy. The reason behind this difference is that in the study mentioned above they did not use propensity score matching to match the two cohorts, and the patients who underwent right colectomy were older with more prehospital comorbidities.

We also found a higher incidence of ureteral injury in patients undergoing left colectomy. In a recent study published by Zafar et al. [10], the incidence of ureteral injury was higher in patients undergoing laparoscopic colectomy as compared to open procedure (0.66% vs. 0.53%). The study however does not discuss the results in terms of type of colectomy that was performed.

To our knowledge this is the first national study which highlights the higher rate of ureteral injury in patients undergoing left colectomy. We believe that ureter is most vulnerable during division of lateral ligament, mobilization of rectum, and ligation of inferior mesenteric artery which may explain higher rates during left colon resection. Ureteral injuries in patient undergoing colorectal operations have shown to be independently associated with higher mortality, and morbidity, explaining the longer length of stay in patients who underwent left colectomy in our analysis. Similarly, Halabi et al. have shown that the use of laparoscopy and right colectomy are protective for ureteral injuries [11]. We found a higher conversion rate in patients undergoing left colectomy.

Our results have implications for future analyses of outcomes after colectomy for cancer. Thus, whether a colon resection is right-sided or left-sided should be incorporated into risk-adjustment tools that impact an institution's serious complication rate. On the other hand, in an era during which health care-associated infections are targeted by pay for performance and public reporting policies, it is important to know that right-sided colectomies have a different rates of wound infections than left-sided colectomies.

5. Conclusion

This study highlights the difference in complications between right-sided and left-sided colectomies for cancer. Further research on outcomes after colectomy should incorporate right vs. left side colon resection as a potential pre-operative risk factor.

References

1. Longo WE, Virgo KS, Johnson FE, Oprian CA, Vernava AM, Wade TP, Phelan MA, Henderson WG, Daley J, Khuri SF. Risk factors for morbidity and mortality after colectomy for colon cancer. *Dis Colon Rectum*. 2000; 43(1):83–91. [PubMed: 10813129]
2. Audisio RA. Risk factors for morbidity and mortality after colectomy for colon cancer. *Tech Coloproctol*. 2001; 5(3):177–179.
3. Buchs NC, Gervaz P, Secic M, Bucher P, Mugnier-Konrad B, Morel P. Incidence, consequences, and risk factors for anastomotic dehiscence after colorectal surgery: a prospective monocentric study. *Int J Colorectal Dis*. 2008; 23(3):265–270. <http://dx.doi.org/10.1007/s00384-007-0399-3>. [PubMed: 18034250]
4. McConnell YJ, Johnson PM, Porter GA. Surgical site infections following colorectal surgery in patients with diabetes: association with postoperative hyperglycemia. *J Gastrointest Surg*. 2009; 13(3):508–515. <http://dx.doi.org/10.1007/s11605-008-0734-1>. [PubMed: 19002535]
5. Kiran RP, El-Gazzaz GH, Vogel JD, Remzi FH. Laparoscopic approach significantly reduces surgical site infections after colorectal surgery: data from national surgical quality improvement program. *J Am Coll Surg*. 2010; 211(2):232–238. <http://dx.doi.org/10.1016/j.jamcollsurg.2010.03.028>. [PubMed: 20670861]
6. Bokey EL, Chapuis PH, Fung C, Hughes WJ, Koorey SG, Brewer D, Newland RC. Postoperative morbidity and mortality following resection of the colon and rectum for cancer. *Dis Colon Rectum*. 1995; 38(5):480–487. <http://dx.doi.org/10.1007/Bf02148847>. [PubMed: 7736878]
7. Kwaan MR, Al-Refaie WB, Parsons HM, Chow CJ, Rothenberger DA, Habermann EB. Are right-sided colectomy outcomes different from left-sided colectomy outcomes?: study of patients with colon cancer in the ACS NSQIP database. *JAMA Surg*. 2013; 148(6):504–510. <http://dx.doi.org/10.1001/ja-masurg.2013.1205>. [PubMed: 23754534]
8. Veyrie N, Ata T, Muscari F, Couchard AC, Msika S, Hay JM, Fingerhut A, Dziri C, Res FAS. Anastomotic leakage after elective right versus left colectomy for cancer: prevalence and independent risk factors. *J Am Coll Surg*. 2007; 205(6):785–793. <http://dx.doi.org/10.1016/j.jamcollsurg.2007.06.284>. [PubMed: 18035262]
9. Masoomi H, Buchberg B, Dang P, Carmichael JC, Mills S, Stamos MJ. Outcomes of Right vs. Left Colectomy for Colon Cancer. *J Gastrointest Surg*. 2011; 15(11):2023–2028. <http://dx.doi.org/10.1007/s11605-011-1655-y>. [PubMed: 21845511]
10. Zafar SN, Ahaghotu CA, Libuit L, Ortega G, Coleman PW, Cornwell EE, Tran DD, Fullum TM. Ureteral injury after laparoscopic versus open colectomy. *J Soc Laparoendosc*. 2014; 18(3) doi: ARTN e2014.00158DOI 10.4293/JLS.2014.00158.
11. Halabi WJ, Jafari MD, Nguyen VQ, Carmichael JC, Mills S, Pigazzi A, Stamos MJ. Ureteral injuries in colorectal surgery: an analysis of trends, outcomes, and risk factors over a 10-year period in the United States. *Dis Colon Rectum*. 2014; 57(2):179–186. <http://dx.doi.org/10.1097/Dcr.000000000000033>. [PubMed: 24401879]

Table 1

The admission characteristics of patients that underwent right and left colectomy.

Variables	Right colectomy (n = 1256)	Left colectomy (n = 1256)	p-value
Age, mean $\pm$ SD	65 $\pm$ 19	65 $\pm$ 21	0.9
Male (%)	51%	50%	0.8
White (%)	71%	70.5%	0.7
ASA > 3 (%)	41%	42%	0.6
BMI > 35 (%)	12.5%	13.3%	0.7
Smoker (%)	10%	11.3%	0.8
Abdominal surgery (%)	12%	13.1%	0.9
Frail (%)	13%	12.5%	0.7
Diabetic (%)	19%	17.9%	0.9
Cardiac disease (%)	16.3%	16.7%	0.8
Renal failure (%)	11.3%	10%	0.9
Pre-op chemotherapy (%)	13.1%	12%	0.8
Albumin < 3 (%)	17%	16.3%	0.9
WBC > 11 (%)	11%	10.9%	0.8
Platelet count < 150 (%)	7%	6.5%	0.7

Table 2

The intra-operative characteristics for the patients with right and left colectomy.

Variables	Right colectomy (n = 1256)	Left colectomy (n = 1256)	p-value
Clean/Contaminated (%)	91%	90%	0.8
Contaminated (%)	6%	6%	0.8
Dirty (%)	3%	4%	0.8
Operative time (mean $\pm$ SD)	140 $\pm$ 60	180 $\pm$ 40	0.03
Transfusion			
None	85%	78%	0.02
1–2 units	14%	13%	0.8

Table 3

Differences in clinical outcome measures in two groups, right and left colectomy.

Variables	Right colectomy (<i>n</i> = 1256)	Left colectomy (<i>n</i> = 1256)	<i>p</i> -value	OR [95%CI]
Wound infection (%)	6%	9%	0.01	1.3 [1.1–4.1]
Ureteral injury (%)	0.49%	0.6%	0.03	1.9 [1.34–4.1]
MI/cardiac arrest (%)	18%	16%	0.1	1.1 [0.7–3.9]
Stroke (%)	30%	20%	0.03	2.9 [1.3–3.4]
Renal failure (%)	23%	13%	0.02	2.1 [1.9–4.1]
PE (%)	11%	17%	0.04	1.7 [1.4–2.5]

PE: Pulmonary embolism.

Table 4

Differences in outcome measures for wound complications between the groups of left and right colectomy patients.

Variables	Right colectomy (<i>n</i> = 1256)	Left Colectomy (<i>n</i> = 1256)	<i>p</i> -value	<i>OR</i> [95% <i>CI</i>]
Superficial SSI (%)	6%	9.1%	0.01	1.3 [1.1–4.1]
Deep SSI (%)	0.7%	0.8%	0.6	1.4 [0.84–4.1]
Organ space SSI (%)	2.1%	2.4%	0.3	1.1 [0.79–2.1]
Wound dehiscence (%)	10%	10%	0.8	0.9 [0.89–1.8]
Re-operation (%)	35%	56%	0.01	2.1 [1.4–2.9]

SSI: Surgical Site Infection.