

## Is Two Better Than One? A Retrospective Study on Colorectal Surgery Outcomes Using the Da Vinci® Dual-Console Robot

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### ABSTRACT

**Introduction.** The da Vinci® surgical system has become standard in many specialties. The dual-console system has increased console time for residents during their training. This study evaluated patient outcomes using the single- versus dual-console system in resident training.

**Methods.** A retrospective case-control study was conducted of patients who underwent various colorectal surgeries using either the single- or dual-console da Vinci® system. Patient demographics, comorbidities, and outcomes were collected.

**Results.** Seventy-one patients (54.2%) utilized the single-console and 60 (45.8%) utilized the dual-console. There were no statistically significant differences in patient demographics, procedures performed, conversion to open, ICU admissions, total length of stay, need for blood transfusion, adequacy of surgical margin, number of lymph nodes harvested, anastomotic leak, discharge disposition, or readmission, wound infection, or need for reoperation within 30 days. There was a nonsignificant decrease in operative time with the dual-console system (200.6 vs. 220.2 minutes,  $p = 0.111$ ).

**Conclusions.** While this study showed no statistically significant differences between patient outcomes utilizing the single- versus dual-consoles, it showed that it is safe for use in training, and that more research is needed in this area. *Kans J Med* 2022;15:418-421

### INTRODUCTION

Since the first robotic surgery in 1997, the robot has quickly established its foothold in not only general surgery, but across almost every surgical specialty. Estimates showed approximately 877,000 surgical procedures were performed with the da Vinci® Surgical System in 2017, an increase of approximately 16% from the year before.<sup>1</sup> More surgeons are using the da Vinci® system to perform the majority of their colorectal surgeries which traditionally were done laparoscopically. As the technology evolves, improvements continue in patient outcomes and decreases in costs.<sup>2,3</sup>

With the improved accessibility and functionality of newer models, surgeons are able to perform procedures more easily that were technically difficult to perform laparoscopically. Additionally, with the increased maneuverability and three-dimensional visualization afforded by the robot, the learning curve for these surgeries is declining sharply.<sup>3-5</sup> This is also becoming important to resident surgeons and surgical education. While these technical surgeries are difficult to perform laparoscopically, surgical residents are able to grasp the technique more

quickly and safely with the advent of robotics.<sup>6,7</sup> Improvements for both medical students and residents in surgical technique were noted when using the robotic training system.<sup>6,7</sup>

With the implementation of the dual-console robotic system introduced by Intuitive® in 2009, surgical education was changed forever. This technology allowed both trainee and instructor to sit side-by-side working simultaneously controlling the robotic arms, allowing real time critiques and better functionality of the working pair. Additionally, the quality of the robot as a teaching tool was improved by allowing surgeon and resident to interact more fluidly.<sup>7,8</sup>

While there are studies showing no change in patient outcomes between single- and dual-console robotic surgery, there appeared to be a lack of these studies in the colorectal literature.<sup>3,8</sup> It was the goal of this study to evaluate outcomes of single- versus dual-console robotic colorectal surgery at our Residency Review Committee accredited general surgery program. It was hypothesized that patient outcomes would be comparable or improved with the da Vinci® Xi dual-console robotic system implementation as compared to the single-console.

### METHODS

This study was approved by the Ascension Vis Christi Hospitals, Wichita, Inc. Institutional Review Board with a waiver of informed consent. A retrospective chart review was conducted of 131 patients undergoing colorectal surgery using the da Vinci® Xi single- or dual-console surgical system. All procedures were performed by a single surgeon with six years of experience with the da Vinci® system, operating with a general surgery resident between March 5, 2017 to March 5, 2019. All data collected for the single-console group were from procedures performed between March 5, 2017 to March 5, 2018, and all data for the dual-console group were from procedures between March 6, 2018 to March 6, 2019. Similar calendar time-periods were utilized so that resident experience would be similar across study periods.

Once eligibility was determined, data were abstracted from each patient's medical record and included: demographic information (age, gender, and race), single- or dual-console robotic system, procedure performed, diagnosis, and comorbidities. These variables were used to assess for potential confounders and effect modifiers. Outcome variables included intensive care unit (ICU) admission, hospital length of stay, operative time, adequacy of surgical margin, number of lymph nodes, anastomotic leak, discharge status, readmission within 30 days, wound infection within 30 days, need for reoperation within 30 days, and conversion to open.

Data were summarized by calculating means and standard deviations for normally distributed continuous data, medians and interquartile ranges for skewed continuous data, and proportions for categorical data. An Independent Samples t-test was used to compare normally distributed continuous data. The Mann-Whitney U-Test was used to compare skewed continuous data, and Chi-square was used to compare categorical data. All analyses were run as two-tailed tests, and results of analyses were considered significant if the resultant p value was less than or equal to 0.05. Analyses were run using SPSS release 19.0 (IBM Corp., Armonk, NY).

## RESULTS

A total of 131 patients who underwent colorectal surgery utilizing the da Vinci® surgical system were evaluated during the study period. Of the patients studied, 71 (54.2%) underwent surgery using the single-console and 60 (45.8%) using the dual-console robotic system. Patient ages for the single- and dual-console groups were  $58.8 \pm 13.9$  years and  $59.9 \pm 15.6$  years, respectively. Proportion of women and Caucasian patients in the single- and dual-console groups were 56.3% (n = 40) vs. 45.0% (n = 27) and 87.3% (n = 62) vs. 90.0% (n = 45), respectively. Patient demographics were equivalent between the study groups with the majority of the patients being Caucasian (88.5%, n = 116) and female (51.1%, n = 67) with a mean patient age of  $59.3 \pm 14.7$  years.

The most common diagnosis was colon cancer (34.4%) followed by diverticulitis (17.6%; Table 1). The most common listed procedure was colon resection (85.5%) followed by colon resection with diversion (6.9%; Table 2). There were no significant differences in demographics, diagnosis, or procedure performed between groups. Furthermore, when evaluating the two groups there was no significant differences noted when comparing the procedure details and outcomes (Table 3).

When comparing the two arms one might anticipate finding differences in operative time, seeing as there would be less time in transit between the patient bed and console. While there was no statistically significant difference in operative time (single 220 min vs. dual 200 min;  $p = 0.111$ ), there was a notable numerical decrease toward the dual-console arm having a shorter operative time. Additionally, when comparing nodes harvested, there were on average 2.4 more lymph nodes harvested with the dual-console system (single 17.1 vs. dual 19.5;  $p = 0.266$ ), although this was not statistically significant. The other measured values in Table 3 revealed no statistically significant differences between the single- and dual-console arms in need for ICU admission (4.2% vs. 8.3%;  $p = 0.496$ ), total length of stay (three vs. two days;  $p = 0.102$ ), requirement for blood transfusion (4.2% vs. 3.3%;  $p = 1.000$ ), adequacy of surgical margin (positive margin 1.4% vs. 1.7%;  $p = 0.953$ ), and anastomotic leak (2.8% vs. 3.3%;  $p = 1.000$ ).

**Table 1. Comparison of patient diagnoses between patients undergoing colorectal procedures using either a single- or dual-console robotic system.\***

Diagnosis Category	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Diagnosis categories				0.823
Colon cancer	45 (34.4%)	23 (32.4%)	22 (36.7%)	
Diverticulitis	23 (17.6%)	11 (15.5%)	12 (20.0%)	
Unresectable polyp	16 (12.2%)	8 (11.3%)	8 (13.3%)	
Rectal cancer	12 (9.2%)	7 (9.9%)	5 (8.3%)	
Colon mass	11 (8.4%)	7 (9.9%)	4 (6.7%)	
Fistula	10 (7.6%)	5 (7.0%)	5 (8.3%)	
Other	14 (10.7%)	10 (14.1%)	4 (6.7%)	

\* Values are presented as number (%) or mean  $\pm$  standard deviation.

**Table 2. Comparison of primary procedure performed between patients undergoing colorectal procedures using either a single- or dual-console robotic system.\***

Primary Procedure	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Colon resection	112 (85.5%)	57 (80.3%)	55 (91.7%)	0.522
Colon resection with diversion	9 (6.9%)	6 (8.5%)	3 (5.0%)	
Abdominoperineal resection	2 (1.5%)	1 (1.4%)	1 (1.7%)	
Rectopexy	2 (1.5%)	2 (2.8%)	0 (0.0%)	
Tamis	2 (1.5%)	1 (1.4%)	1 (1.7%)	
Total colectomy	2 (1.5%)	2 (2.8%)	0 (0.0%)	
Colostomy reversal with parastomal hernia repair	1 (0.8%)	1 (1.4%)	0 (0.0%)	
Proctocolectomy	1 (0.8%)	1 (1.4%)	0 (0.0%)	

\* Values are presented as number (%).

**Table 3. Comparison of procedure details and outcomes between patients undergoing colorectal procedures using either a single- or dual-console robotic system.\***

Parameter	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Need for ICU admission	8 (6.1%)	3 (4.2%)	5 (8.3%)	0.469
Total length of stay (days)	3 (2-4)	3 (2-4)	2 (2-4)	0.102
Blood transfusion required	5 (3.8%)	3 (4.2%)	2 (3.3%)	1.000
Operative time (min)	$211.2 \pm 69.2$	$220.0 \pm 74.5$	$200.6 \pm 61.5$	0.111
Adequacy of surgical margin				0.953
Negative	88 (67.2%)	47 (66.2%)	41 (68.3%)	
Positive	2 (1.5%)	1 (1.4%)	1 (1.7%)	
N/A	41 (31.3%)	23 (32.4%)	18 (30.0%)	
Number of lymph nodes harvested	$18.3 \pm 10.7$	$17.1 \pm 9.2$	$19.5 \pm 12.1$	0.266
Anastomotic leak	4 (3.1%)	2 (2.8%)	2 (3.3%)	1.000

\* Values are presented as number (%), median (IQR), or mean  $\pm$  standard deviation.

With regards to discharge and 30-day post-discharge parameters, there were no statistically significant differences between the two study arms (Table 4). The majority of patients were discharged to home in both study arms (single 94.4% vs. dual 83.3%;  $p = 0.077$ ). Readmission within 30 days, wound infection within 30 days, need for reoperation within 30 days, and conversion to open were similar between the study arms. Reasons for conversion to an open procedure were tracked and listed in Table 5.

**Table 4. Comparison of discharge destination and 30-day post-discharge parameters between patients undergoing colorectal procedures using either a single- or dual-console robotic system.\***

Parameter	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Discharge status				0.077
Home	117 (89.3%)	67 (94.4%)	50 (83.3%)	
Home health	7 (5.3%)	1 (1.4%)	6 (10.0%)	
Rehabilitation	1 (0.8%)	1 (1.4%)	0 (0.0%)	
Skilled nursing unit	6 (4.6%)	2 (2.8%)	4 (6.7%)	
Readmission within 30 days	14 (10.7%)	10 (14.1%)	4 (6.7%)	0.257
Wound infection within 30 days	11 (8.4%)	7 (9.9%)	4 (6.7%)	0.548
Reoperation within 30 days	4 (3.1%)	1 (1.4%)	3 (5.0%)	0.332
Conversion to open	11 (8.4%)	4 (5.6%)	7 (11.7%)	0.344

\* Values are presented as number (%).

**Table 5. Conversion to open reasons.**

Single-Console	Dual-Console
Adhesions	Adhesions
Body habitus, obesity, bowel distension	Bleeding, fistula
Difficult anatomy	Dense adhesions
Tumor adherent to retroperitoneum	Dense adhesions
	Difficult dissection
	Initial positive margin
	Tumor size and local invasion

## DISCUSSION

Laparoscopic assisted robotic surgery is becoming more common as robotic surgical systems become more readily available in hospital settings. With the implementation of the da Vinci® dual-console system, two surgeons may be at the console working simultaneously. This provides closer observation and direct feedback during residency training. While robotic surgical systems have been around since 1997, the dual-console system is a newer tool in the surgeon's arsenal, first being implemented in 2009.

Our study showed that when comparing outcomes for one colorectal surgeon performing colorectal surgery with a surgical resident at a single facility, there were no statistically significant differences between

the two groups. While this did not show a clear benefit in using the dual-console over the single-console system, other studies have shown the benefit of the robotic dual-console system in surgical training.<sup>6</sup> A study in the obstetrics and gynecology literature showed that training programs with dual console systems were more likely to obtain robotic certification for the residents upon graduation, as well as having more residents perform the cases prior to graduation vs. programs with the single console.<sup>6</sup> Additionally, while not statistically significant, the overall operative time, nodal harvest, and 30-day readmission rates were improved in the dual-console arm. A higher-powered study might have shown statistically significant improvements with regards to these measures.

Our outcomes were similar to those in the literature with regards to patient morbidity and oncologic outcomes.<sup>9-12</sup> The current guidelines in colorectal surgery recommended a nodal harvest of at least 12 lymph nodes. In our study, both arms averaged more with  $17.1 \pm 9.2$  in the single-console arm and  $19.5 \pm 12.1$  in the dual-console arm, showing adequacy of the robotic platform with regards to this measure.<sup>10</sup> Our anastomotic leak rates were not statistically different between the two groups; 2.8% in the single-console and 3.3% in the dual-console, but were acceptable when compared to national data which quote the acceptable leak rate between 3-6%.<sup>11</sup> In evaluating our 30-day outcomes, our rates were comparable with a 30-day readmission rate of 10.7% overall with other studies showing 10.5% as an acceptable rate.<sup>12</sup> Comparing our outcome measures with the data from the literature endorsed the safety and feasibility of performing these surgeries robotically.

**Limitations.** The current study had limitations. It was a retrospective chart review of cases performed by a single surgeon at a single facility. As such, the results may not be generalizable to other surgeons or facilities. Evaluating other surgeons/specialties/communities would help to extrapolate the data. Secondly, a larger study size would delineate the significance of our findings and increase the overall power of the study. It was also difficult to determine confounding factors such as actual resident operating time. It also would be beneficial to extend this data to three and five years to evaluate overall oncologic outcomes to compare differences, but not limited to, cancer related mortality, recurrence, need for adjuvant chemoradiation, and interval free survival. Additionally, while further studies may show improved outcomes with the da Vinci® robotic system, it is important to factor cost into the overall picture, and further studies comparing the overall cost between robotic and laparoscopic surgeries would be beneficial to discuss.

## CONCLUSIONS

The da Vinci® surgical system is becoming a standard part of many surgical practices. The dual-console surgical system is a valuable tool for resident education, allowing closer monitoring by the attending during surgery, with increased autonomy for the resident. While autonomy during residency is important for training, autonomy cannot be more important than patient safety and patient outcomes.

Our study showed that for our patient population there were equal outcomes when comparing the single- and dual-console systems in a single colorectal surgeon's practice. There appeared to be a possible trend in more nodes harvested and shorter operative times with the dual-console system, though further studies with higher number of

patients and in different communities may be able to determine if this is just an anomaly or if there is any significance to it. Additionally, this type of study could be performed with different specialties in different educational and private settings to compare outcomes.

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