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Robotic Colorectal Surgery: A Single Tertiary Care Experience

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Over the past two decades, minimally invasive surgery has changed the perspective in the general surgery. The advantages of minimally invasive surgery are reduced postoperative pain, a shorter hospital stay, return to normal function, and better cosmesis.
Materials and Methods: This study includes 50 patients with clinically, radiologically, endoscopically, and pathologically confirmed adenocarcinoma who underwent robotic rectal cancer surgery.
Results: In this study of 50 patients who underwent Robotic rectal surgery we observed that the most common age group was above the age of 46 years with male predisposition. The most commonly performed Robotic surgery was Anterior Resection which was done in 43 among 50 patients. Commonly encountered T STAGE WAS T2 and T3 with 20 and 11 patients respectively, mean operative time in our study was 240 minutes and TME was performed more than in 95% of

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patients with median lymph node retrieval of 17. Analyzing the operative time BMI we found it to be statistically significant with P-value of less than 0.005 reflecting that less operative for patients lower BMI.

Conclusion: In this study we concluded that Robotic Rectal Surgery is safe, effective alternative in terms of short perioperative outcomes like reduced hospital stay, better recovery especially in lower BMI.

Keywords: Robotic colorectal; surgery; neurosurgery; laparoscopic.

1. INTRODUCTION

Over the past two decades, minimally invasive surgery has revolutionised general surgery. the advantages of minimally invasive surgery, including reduced postoperative pain, a shorter hospital stay, return to normal function, and better cosmesis [1]. By offering reliable 3-D views via a surgeon-controlled camera, angulated instruments with 7 degrees of freedom, noticeably enhanced ergonomics, and tremor filtering, robotic surgical systems were created to overcome the constraints of laparoscopic surgery. Over the past ten years, numerous surgical specialties have adopted robotic surgery as an approach modality for rectal cancer with good results [2]. Rectal cancer management has seen a significant wave of change during the past 20 years. The use of neoadjuvant multimodal chemoradiation therapy for locally advanced stage disease, optimization of surgical technique with nerve preservation techniques, and the advent of complete mesorectal excision were all transitions from open to minimally invasive and robotic procedures [3]. In addition to having lower conversion rates for rectal resections as compared to laparoscopic ones, robotic surgery also has a noticeably shorter learning curve and requires fewer patients to get oriented, especially for surgeons who are less experienced with laparoscopy [4].

1.1 Evolution of Robotic Surgery

Robotic surgery was first reported in 1985. This is when a delicate neurosurgery biopsy was performed using the PUMA 560 robotic surgical arm during a non-laparoscopic procedure. When employed in minimally invasive operations like laparoscopies, which commonly use flexible fibre optic cameras, the robotic system enabled a successful robotic surgery and the possibility for increased precision. The first laparoscopic robotic surgery, a cholecystectomy, was performed in 1987, The same PUMA system was employed the following year to complete a transurethral resection in robotic surgery. The first system to be authorized by the Food and Drug Administration for use in endoscopic surgery was the AESOP system created by Computer Motion in 1990. The da Vinci Surgery System created history in 2000 when it became the first robotic surgery system to be FDA-approved for general laparoscopic surgery.Its forerunners depended on endoscopes and a large number of surgical helpers to carry out operations. The da Vinci robotic surgery system's three-dimensional magnification screen provides doctors with a clean, high-resolution image of the operating site. From the early, large-armed systems like the PUMA 560, the one-centimeter surgical arms represent a tremendous advancement in robotic surgery. The operating arms' "endo-wrist" features exactly duplicate the surgeon's wrist movements at the controls, increasing precision in constrained operating environments. The ongoing addition of Artificial imtelligence to this machine has revolutionised the art of surgery to a next level and upcoming more advances in this field will lead to drastic frameshift in surgical approach and management of surgical pathologies.

1.2 Total Mesorectal Excision and Robotics

Greater than 1 mm distance from the tumour tissue to the surgical radial margin is referred to as a clear circumferential resection margin of rectal cancer. TME, according to consensus, is essential for positive oncological outcomes. In comparison to earlier traditional dissection, TME surgery had a decreased local recurrence (LR) rate < 10% [5]. Currently, TME surgery is regarded as the therapeutic approach for locally advanced rectal cancer when is paired with neoadjuvant chemoradiation . TME of lower rectal cancer is challenging even in the hands of skilled surgeons, particularly in patients with a narrow pelvis, men, obese patients, anteriorly placed lesions, large tumours, or patients who have received neoadjuvant chemoradiotherapy. Furthermore, even if the mesentery can be entirely removed, it is extremely difficult to

protect the pelvic nerve, inferior epigastric nerve, and superior epigastric nerve, which are essential for preserving sexual and urogenital function. These factors have greatly increased the recognition of robotic techniques in TME of lower rectal tumors [6].

2. MATERIALS AND METHODS

2.1 Data Collection

This study encompasses 50 patients who underwent Robotic rectal cancer surgery for adenocarcinoma that has been diagnosed via clinical, radiographic, endoscopic, and pathological means. This study was carried in KIMS (Krishna institute of medical science) Telengana India a tertiary care centre bestowed with wide armamentarium of advanced surgeries like transplant surgeries and Robotic procedures. Our institute is known for performing all advanced Robotic procedures. In this study we analyzed the baseline characteristics and short-term surgical outcomes of all elective patients undergoing robotic rectal cancer surgery. Data was prospectively collected from january 2018 to june 2022. Age, body mass index (BMI), gender, American Society of Anaesthesiologists grade, neoadjuvant radiation, the procedure that was performed, and pathological T stage were among the baseline parameters analysed. Operative time, and conversion to open were all included in the perioperative data (defined as any incision needed to either mobilise the colon or rectum or ligate the vessels). Length of stay (LOS), 30-day readmission, 30-day reoperation, 30-day mortality, and clinical anastomotic leak were among the postoperative clinical data reviewed (defined as an anastomotic leak requiring re-intervention such as a drain or further surgery). All patients requiring TME were subjected to defunctioning loop ileostomy resulting in low rates of anastomotic leak, pathological circumferential margins were noted and also the number of lymph nodes dissected. Apart from history, clinical examination and baseline blood parameters, a whole body computed tomography and a preoperative colonoscopy were performed on all patients. Patients who had rectum involvement additionally got MRI (magnetic resonance imaging) for additional staging. Neoadjuvant therapy was administered before surgery for all rectal cancers. preoperative bowel preparation, Prophylaxis for venous thromboembolism, perioperative control of antiplatelet and anticoagulant treatment, and antibiotic prophylaxis was given one hour prior to surgery.

2.2 Surgical Technique

All the surgeries were carried by a single surgeon to avoid bias who has more than 25 years of experience in oncological procedures and were carried in a single centre using the standardized dual-docking method robotic-Si system The first step of the procedure was medial to lateral dissection, which was followed by vascular control by ligating the major blood arteries, and then mobilising the splenic flexure. TME was done starting from posterior mobilization first. The day before surgery, all patients undergoing total TME surgery (i.e., for mid- and low-rectal tumours), received preoperative bowel preparation. Following surgery, all patients were managed with the Kehlet and Wilmore [7] improved recovery protocol. Patients were only sent home after safely fulfilling the requirements for discharge criteria.

2.3 Aims and Objectives

This study's main goal was to examine the overall short-term outcomes of all robotic rectal cancer cases. This was done to investigate whether robotic rectal surgery was safe and practical. The secondary goal was to compare the immediate results of resections done using the da Vinci si system.

2.3.1 Parameters evaluated were

- Demographic characteristics
- Operative time in minutes
- Pathological stage
- Conversion to open
- Length of hospital stay in days
- Anastomotic leak
- Time to recover of bowel function
- Distal margin from tumor

2.4 Inclusion Criteria

- Rectal adenocarcinoma distal extend <15 cm from anal canal
- Age < 75 and > 25 years
- ASA less than or equal to 3
- Procedure performed by the same surgeon

2.5 Exclusion Criteria

- Metastases or peritoneal carcinomatosis discovered during diagnostic laparoscopy
- ASA 4
- Extracorporeal anastomosis
- Concurrent colon or rectum malignancies
- benign disease
- Procedures carried out during emergency surgery.
- Unresectable tumor
- Malignant bowel obstruction
- Previous abdominal surgery

2.6 Statiscal Methods

Data was analysed using IBM SPSS version 24.

3. RESULTS

In this study of 50 patients who underwent Robotic rectal we observed the most frequent age group was above age of 46 years with male predisposition. The ASA (american society of anaesthesiology) class II was most common to be encountered. The most commonly performed Robotic surgery was Anterior Resection which was done in 43 among 50 patients. commonly encountered T STAGE T2 and T3 with 20 and 11 patients respectively, mean operative time in our study was 240 minutes with RO resection and TME performed more than in 95% of patients with median lymph node retrieval of 17. Analysing the data of operative time and BMI we found it to be statistically significant with P-value of less than 0.005 reflecting that less operative for patients lower BMI.

Table 1. Age distribution

Age group	Number of patients
26-35	6
36-45	12
>46	32

Mean age of the patient- 56.3

Table 2. Gender distributions

Gender distributions	Number of patients
Male	31
female	19

4. DISCUSSION

Approaches to Rectal surgeries from past few decades underwent an enormous gestures of remodeling, revisions and rework by various surgeons with the dream, objective, intent and ambition to have better, effortless and a safe oncological outcomes. With the advancement of engineering the shift from open to minimally invasive laparoscopic to the present day Robotic approaches is the zenith of human efforts in the surgical armamentarium regarding the same. Any novel surgical procedure must be demonstrated to be safe and must produce results that are equivalent to current practices before it can be regarded as an alternative. Since laparoscopy has been widely used for colorectal procedures, studies have shown that it can reduce hospital stays while producing an acceptable oncological resection with no obvious differences in postoperative complications or inpatient mortality when compared to a conventional open method. Although there are no published research indicating that robotic rectal surgery is preferable than the laparoscopic procedure, other reviews have already shown it to be safe and practicable. This is mostly because there are no randomized control trials [8]. Robotic surgery was developed to alleviate the drawbacks of laparoscopy (such as limited ergonomics in small spaces, tremor effect, and unnatural hand-eye coordination), and it has since been effectively used in urology, general and paediatric surgery, gynaecology, and other surgical specialties. Some benefits of robotic surgery include a quicker learning curve, 3-D views, improved ergonomics, higher wrist flexibility, decreased hand tremor, and reduced effort for surgeons. According to several research, laparoscopic surgery and robotic surgery both had the same perioperative and oncological outcomes [9].

Table 3. Asa grading

ASA Grading	Number of patients
I	6
II	34
III	10
IV	0

Table 4. Procedure performed

procedure	Number of patients
Anterior resection	43
Abdomino pelvic resection	7

Table 5. Pathological T stage

T stage	Number of patients
0	3
1	9
2	20
3	11
4	7

Table 6. N stage

N stage	Number of patients
0	28
1	13
2	9

Table 7. Post operative outcome

Mean operative time (in minutes)	240
R0 clearence	49
Total mesorectal excision	46
Median lymph nodes retreived	17
Permanent stoma	7
Diversion ileostomy	43
Mean hospital stay (in days)	5
Conversion to open	1
Clinical anastomotic leak	0
mortality	0
Reoperation	0

Table 8. Comparison of mean operative time with body mass index

Body mass index	Mean operative time
<25	224 min / 240 min
≥ 25	293 min / 240 min

P value of < 0.005

In this study we enrolled 50 patients at KIMS (Krishna institute of medical science) Telengana India from january 2018 to june 2022. Our institute performs more than 100 various Robotic procedures Annually. Our notion of this research work was to provide a glimpse on feasibility of Robotic approach of Rectal cancer surgery. In this study we found mean age of the patients were 63 with male predominance with ASA mostly encountered was II in 34 patients and II in 10 among 50 patients, neoadjuvant treatment was given in 18% of patients. Most frequent procedure performed was Robotic Anterior resection in 86% similar results were seen by Sofoklis Panteleimonitis [10] they found the majority of patients were male (66.7%) with ASA grade II in (70%), Anterior resection was done in 86% of patients and neoadjuvant treatment was instituted in 27.5% of patients these findings correlate with our study. Most common T stage encountered in our study was T2 in 40% of patients followed by T3 in 11, N0 stage was found in 56% and N1 was found in 13%, mean operative time in our study was 240 minutes, R0 resection was encountered in 49 with total mesorectal excision was proved pathologically in 46 patients, median lymph node retrieval 17, permanent stoma was created in 7 patients in which abdominoperineal resection was done, diversion ileostomy was created in 43, median hospital stay was 5 days, conversion to open done in 3 patients, clinical anastomotic leak was seen in none because of diversion ileostomy, there was no mortality and reoperation rates in our study. Study conducted by Yasser Debakey [11] revealed following results with most number of surgeries were anterior resection with mean operation time of 201 minutes, convertion to open was 4.8%, total mesorectal excision was performed in 85%, median lymph node retreival was 14, anastomotic leak was observed in 1 patient and no reoperation or mortality, which is similar to our results. In our study we observed as the BMI of the patient increases the mean operative time increases on statistical analysis results were significant with P- value of less than 0.005 patients with BMI less than 25 were having mean operative time 224 minutes and those who were having BMI ≥ 25 were having mean operative time of 293 minutes similar results were given by Abeer Eddib [12]. We also observed mean operative was more in those who were subjected to prior adjuvant treatment 270 minutes than upfront surgery 212 minutes which was statistically significant with P-value less than 0.005, similar observations were made by Tzu-Chun Chen [13] they concluded that Longer operation times (324.964 ± 83.435 vs. 246.232 ± 111.324 min, p < 0.001) after neoadjuvant treatment and with greater blood loss.

Table 9. Comparison of mean operative time with or without prior chemoradiation

Prior chemoradiation/total number of patients	Mean operative time (minutes)
Yes 9/50	270/240
no 41/50	212/240

P Value of < 0.005

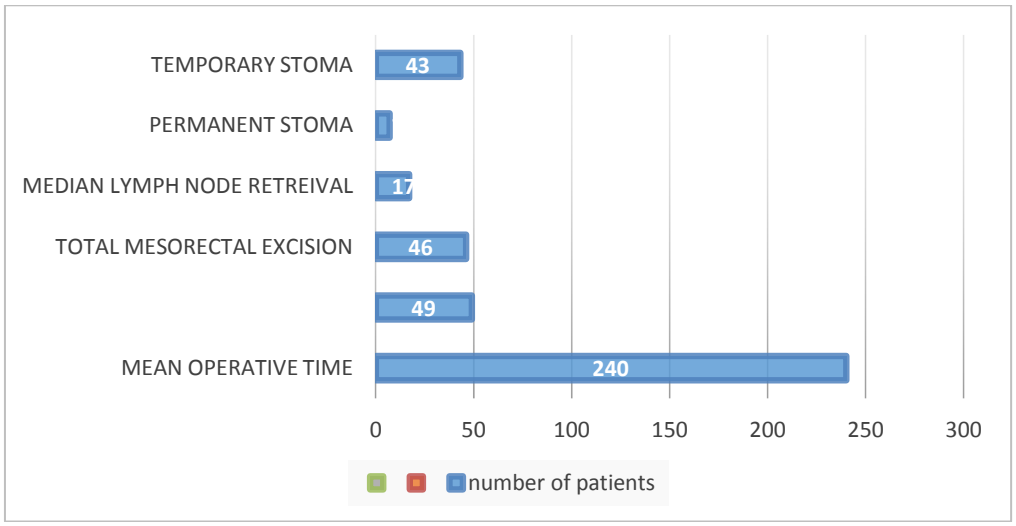

Fig. 1. Post operative outcome

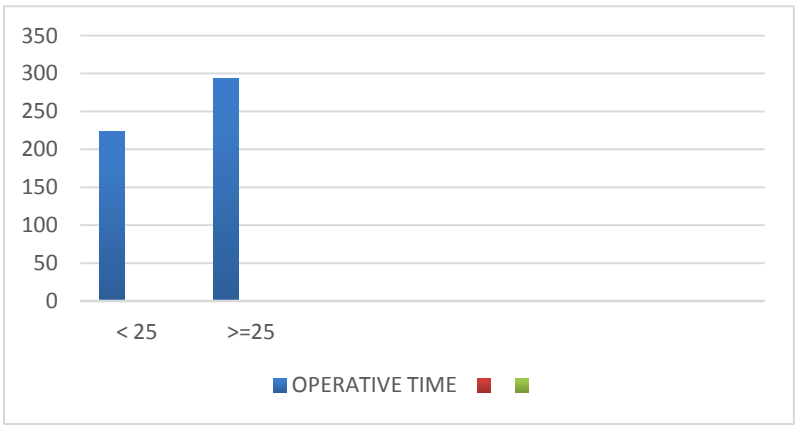

Fig. 2. Relationship of bmi with mean operative time

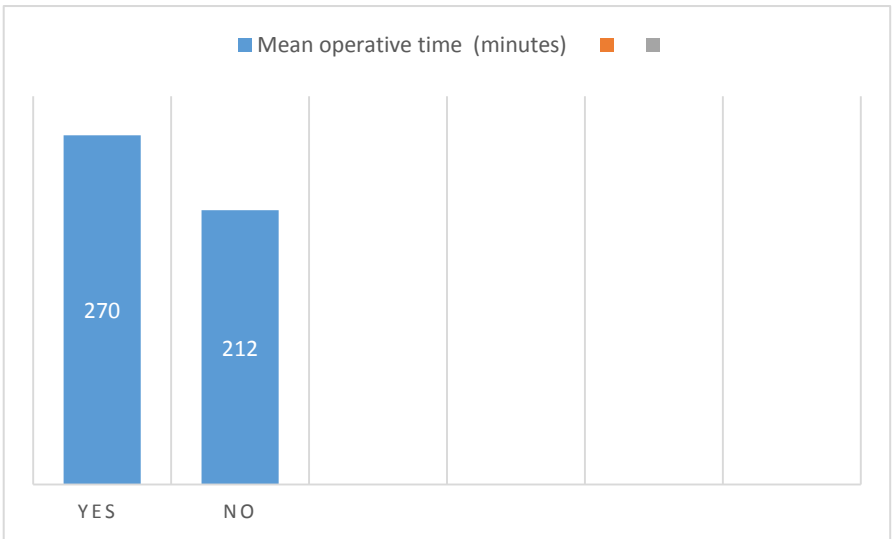

Fig. 3. Comparison of mean operative time with or without prior chemoradiation

5. CONCLUSION

In this study we concluded that dual docking Robotic Rectal Surgery is a safe, effective alternative in terms of short perioperative outcomes like reduced hospital stay, better recovery especially in lower BMI and upfront surgery patients. This new dimension of surgical approach has unarguably made a better intraoperative handling of tissues with wide range of maneuvers that undoubtedly leads to better oncological outcomes. With the upcoming advances of artificial intelligence in this dimension of surgical arsenal the future of Robotic surgeries will undeniably be the best surgical care endeavored to a patient.

CONSENT

Each patient who was included in the study gave their informed consent for the use of their data in research.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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