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Final Outcome of Hybrid Laparoscopic for Colorectal Cancer: A Literature Review

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Introduction

Colorectal cancer is one of the third most common malignancies in the world.^{1,2} The incidence and mortality have slightly decreased in the last 20 years; however, it remained to cause a significant number of cancer-related mortalities in 2014.² The etiology is multifactorial, including genetics, environment, diet, and inflammation in the intestinal tract.^{1,2} Based on geographic location, the highest incidences of colorectal cancer are in Northern America, Australia, New Zealand, Western Europe, and Japan.¹ Meanwhile, Asia and Africa have a lower incidence rate.¹ Surgery is the only definitive management for colorectal cancer.

Conventional or laparotomy with a minimal invasive procedure (total laparoscopic and hybrid laparoscopic) is the alternative method of treatment. Hybrid laparoscopic surgery has progressively replaced laparotomy in the last decades related to its short beneficial outcomes, such as decreased pain, reduced blood loss, and enhanced recovery time. In a few cases of tumor mass removal, hybrid laparoscopic surgery can be done without performing laparotomy. Generally, a hybrid laparoscopic procedure can improve postoperative pain compared to laparotomy, reduce hospital length of stay, enhance recovery, and lower the conversion rate. From the perspective of oncology, the procedure also has a lower rate of tumor recurrence and morbidity.³ However, some studies showed the disadvantages of hybrid laparoscopy. Wang's review noted that the limitation of hybrid procedures includes increased operating time, additional patient costs, and learning curves for surgeons limiting the appeal of hybrid laparoscopic techniques for rectal cancer.³ There are arguments on the use of TME laparoscopy, but the study shows a higher conversion rate with this procedure. Oktar et al. reported a conversion rate of 6.4% on 513 laparoscopic surgeries performed on rectal cancer. They found that converted patients have a higher risk of complication and recurrence, so the hybrid technique is recommended to resolve this limitation.³ In contrast, some studies showed the safety and effectiveness.

Colorectal cancer and the management

Colorectal cancer is the third most commonly diagnosed cancer and contributing to 9% of all cancer incidence globally. In Asia, colorectal cancer is the third most common malignancy in men and women.^{2,8} Risk factors of colorectal cancer are categorized into modifiable and non-modifiable factors, including inactivity, obesity, high consumption of red meat, smoking, and alcohol consumption. Non-modifiable factors, including individual or family history of colorectal or adenoma polyps and individual history of chronic bowel inflammatory disease.^{9,12} The

common clinical features, including weight loss, pain (in this case is in abdominal), and anemia (due to chronic disease). Another source of anemia is bleeding, usually seen on the rectum. Colon cancer from the right-sided usually had no bleeding due to the absence of the rectum. Thus, colorectal cancer tends to be coming from the left side of the colon.

As with other disturbances, the examination on the patient may be physical with additional further investigation. Physical examinations include general tests (signs of weight loss and anemia), abdominal examination (pain, local mass, lymph node enlargement, and digital rectal exam). Another supporting investigation involves an occult blood test for feces, as the blood may not be noticed initially due to the small number of blood drops in it. Some tests like blood profile, iron profile, and blood smear may also be performed. Imaging examinations, like CT-Scan and MRI, are recommended for detecting colorectal cancer. Histopathology examination should be carried out but may be skipped if other investigations provide a valuable information to determine the diagnosis. The grading of colorectal cancer follows the TMN system made by the American Joint Committee on Cancer (AJCC) and International Union Against Cancer (UICC).

Curative surgery carried out if there are no symptoms and signs of metastasis, either local or systemic. If distant metastasis constituted, resection in primary tumor will prevent symptoms and signs such as obstruction, bleeding, anemia, incontinence, fistula, and pain.¹⁰⁻¹² The type of resection is based on tumor location and followed by an end-to-end anastomosis. Right hemicolectomy is performed for tumors located in the cecum or ascending colon. Tumors located in hepatic flexure and transverse colon are treated by extended right hemicolectomy. Tumors in the descending and sigmoid colon were treated by left hemicolectomy and sigmoidectomy (anterior resection) consecutively. Tumor in the middle one-third of the rectum, low anterior resection is performed. Meanwhile, in distal one-third, abdominoperineal resection (Miles procedure) is chosen.⁹⁻¹²

Development of hybrid laparoscopic on colorectal cancer

Primary tumor resection with *en bloc* shows lower recurrence and better survival rate.^{2,5} Laparoscopic colorectal surgery is a gold standard for colorectal cancer.⁵ Morbidity and mortality are considerable problems in colorectal surgery. However, minimally invasive surgery may reduce postoperative pain, shorter hospital length of stay, and better long-term outcome.^{2,3,7,13,14} Laparoscopic surgery on colorectal cancer was first performed in 1990. It is a minimally invasive procedure by camera and gas insertion into the peritoneal cavity to perform intraabdominal resection. However, it was not well accepted due to several factors, such

as; 1) recurrence in the location of trocar insertion, 2) doubted oncologic margin, 3) complication from pneumoperitoneum, and 4) longer learning curve compared to cholecystectomy laparoscopy.^{13,15}

However, study by Wang showed the disadvantage may limit the hybrid laparoscopy. The disadvantages include longer duration of operation additional costs, and surgeons' experience. All of these limit the usage of hybrid laparoscopic for rectal cancer.³ Total mesorectal excision (TME) laparoscopy can also be considered a choice, but the study shows a higher conversion rate with this procedure. Oktar et al. reported a conversion rate of 6.4% on 513 laparoscopic surgeries performed on rectal cancer. They found that converted patients have a higher risk of complication and recurrence. But then again, a hybrid technique is recommended to resolve the limitation provided by the TME laparoscopy.³

The indication has grown rapidly from additional resection in grade II colorectal cancer to curative radical resection for advanced grade II/III and palliative surgery for grade IV.¹⁶ However, laparoscopic colorectal surgeries (LACs) is limited to an emergency surgical case such as complete bowel obstruction due to left bowel cancer and patients requiring partial tumor resection that infiltrate other organs such as the bladder. Furthermore, it also needs a longer duration of the operation. To overcome this problem, we design hybrid 2-port hand-assisted laparoscopic surgery (HALS) or Mukai operation that involves HALS using small incision 45-55 mm.¹⁶

"Hybrid" bottom anterior resection technique is performed in the lithotomic position. The patients' hands are located next to the body, with an adjustable bean bag being tucked away near the hands. Gel or foam pads are used over the pressure points and in the shoulder. The shoulder protector is located near the bean bag, and the patient with the bean bag is safely brought to the operating table with an adhesive pipe in the patient's chest.¹⁷ Abdomen is inflated with Veress needle, and 12-mm trocar for the camera is located higher and right to the umbilicus. Initially, the abdomen is examined using a laparoscopic camera. Three ports for robot arms are placed using an 8-mm robotic canula. The first port is placed laterally in the right lower quadrant and superomedial to the anterior superior iliac spine. The second port is placed in the same location as the left side of the abdomen. The third one is placed in the left lower quadrant (between the lateral port and port for the camera) and the line between the umbilicus and anterior superior iliac spine). An additional 5-mm port is placed in the right upper quadrant for retraction by the assistant. Last, a small Pfannenstiel incision and hand port are made.¹⁷

Hybrid laparoscopic methods are more developed to handle patients who are not well with pain after surgery. It will also reduce the number of death and also fasten the healing time.^{1,2,3} The method becomes the choice for the management of early stages in colon adenoma, or colon cancer,^{2,3} and progressively replace laparotomy in the last few decades with significant short-term results, like pain reduction, reducing blood loss, and increasing healing efficiency.^{2,3,8}

The outcome of hybrid laparoscopic on colorectal cancer

Some clinical trials showed the short-term benefits of laparoscopic. These benefits include pain reduction post-surgery to reduce the need for analgesics, faster recovery both anatomically and physiologically, reduced length of hospital stay, and safety from oncologists' perspectives. Furthermore, the patients may be able to return to daily activities significantly after the hybrid laparoscopic method.^{1,2,4} In contrast to the advantages, some disadvantages noted, including adhesion and incisional hernia, are two of the most significant

complications, which cause considerable comorbidity in the long run post abdominal surgery. However, even these complications are still not fully understood. The next long-term step is to create a standard to say that adhesion and an incisional hernia had happened because there is no objective standard for them until now. Prediction of adhesion on a human body is challenging and may need reoperation.^{7,12,13} Studies focused on the incisional hernia and reoperation due to adhesion remains found.⁷ It needs to be underlined that the worsening rates of colon cancer and rectal cancer are different. Colon cancer patients show local metastasis and distant metastasis; each is 2% and 10%, compared to rectal cancer at 10% and 20%. It happened due to the blood flow, which is much more in the rectum than in the colon. Another reason is that by location, operation on the rectum is more challenging. Still, some studies show similar worsening rates in both patients.^{12,13}

Authors reviewed the articles focused on hybrid laparoscopy found through literature searches on some databases (Cochrane, NICE, PubMed) according to PRISMA protocol, and all papers are then appraised. A total of 16 articles found; 11 articles from PubMed and five articles from Cochrane. PRISMA method steps are used to filter out the articles found. On filtering, only five articles inlined to the criteria; 3 cohort studies, 1 case report, and one randomized control trial study (RCT). The articles were appraised critically and extracted. Critical appraisal carried out using the VIA method (i.e. validity, importance, and applicability).

Table 1. Studies focused on hybrid laparoscopy on colorectal cancer

Study	Design	Colorectal Cancer	Hybrid Laparoscopy	Level of Evidence
Leung 2013	RCT	70	35	1
Mukai 2010	Case Series	8	7	4
Ellis-Clark 2010	Cohort	117	74	2
Mukai 2009	Cohort	108	108	2
Vithiananthan 2001	Cohort	56	31	2

Study of Ellis-Clark et al. showed a prospective database from all colorectal procedures conducted by three authors from 1991 until June 2007; more than 2500 patients had been recorded inside this database. A total of 177 patients, 66 females and 111 males with an average age of 61, were included in this study. According to the data, 74 patients had total mesorectal excision with/without rectum transaction using Pfannen-stiel or hybrid lower midline incision. The laparoscopic procedure with an incision in the left iliac fossa or Pfannen-stiel for specimen taking was performed in 103 patients. Patients were followed up until October 2007, with an average time of 28 months (4 to 188 months). Before 2003, only 17 patients underwent the procedure; 12 laparoscopies and five hybrid techniques. A total of 16 out of these patients had a low anterior resection, and only one had a very low anterior resection and hybrid open transection. After that year, technique and experience were improving, which lead to more procedures to be done. With those experiences, resection of rectum carcinoma with laparoscopy became standard treatment. We stand that this hybrid procedure has lower morbidity and mortality than the laparoscopy method. A large proportion of patients could be reached with their benefit. It is the first paper that compared both of the techniques. Future researches are needed to choose between them. After that year, practice and experience were improving, which lead to more procedures to be done. We stand that this hybrid procedure has lower morbidity and mortality than the laparoscopy method. A large proportion of patients could be reached with its benefit. The article referred to the first paper, which compared both of the techniques. Future researches are needed to choose between them.

Mukai et al. reported 108 patients with primary colorectal cancer who underwent 2-port hybrid laparoscopic from June 2007 to June 2009. In the colon cancer group, the mean operation time was 2 hours and 26 minutes, with 166,3 mL average blood loss and 12.6 days of hospital stays. Postoperatively, five patients have surgical site infection (8,6%), three postoperative ileus (5,2%), and one anastomosis stricture (1,73%). In the rectum cancer group, the length of operation time was 3 hours and 38 minutes, with 238,8 mL blood loss average and 19,1 days of hospital stays. Surgical site infection found in 6 patients (12,0%), anastomosis leakage in 3 patients (8,6%), anastomosis stricture in 3 patients (6,4%), postoperative ileus in 3 patients (6,0%), and conversion to open conventional laparotomy in 1 patient (2,0%). Intraoperative stoma closing was also carried out in 12 patients (25,5%). These findings concluded that 2-port hybrid laparoscopic might become a standard method for colorectal cancer treatment. Future detailed long-term results have to be compared with standard laparotomy.

Another study by Mukai et al. reported eight patients were found to have complete ileus obstructive caused by a left colon or rectum cancer. The obstruction located in the left transversal colon in one patient, descending colon in 2 patients, sigmoid colon in 2 patients, and rectum in 3 patients. Total laparoscopic colectomy (TLC) carried out in the left transversal and sigmoid colon, both in 4 cases. Left hemicolectomy in 3 patients, sigmoidectomy in 2 patients, low anterior resection in 1 patient, and Hartmann procedure in 3 patients conducted with 2-port hybrid HALS (Mukai's operation). Another patient did not continue the next procedure due to distance metastases. The average operation time was 3 hours and 7 minutes, average blood loss was 146,4 mL (7-354 mL), average construction of TLC to HALS time was 11,3 days (8 to 16 days), and length of hospital stays after HALS was 13,9 days (9 to 20 days). Postoperative complication infection, including light wound infection, was found in two patients (28,6%) and ileus in one patient (14,3%). There was no anastomosis leakage, anastomosis stricture, and conversion to standard open laparotomy. The study performed from June 2009 to June 2012 enrolled patients with left colorectal cancer from splenic flexure to upper rectum with B4 size of the tumor. The exclusion criteria include (1) 4cm size tumor, (2) tumor in the middle or lower rectum, (3) anal stricture, (4) acute abdomen, (5) patients with tumor or polyp. Study results in 3 years enrolled 70 patients (35 per group). There is no significant difference between the group who underwent hybrid NOTES Colectomy Versus Conventional Laparoscopic Colectomy in their duration of surgery ($p = 0.851$), number of blood loss ($p = 0.954$), or hospital stays ($p = 0.990$). The maximum pain score in the first week was significantly lower in the HNC group ($p = 0.017$). There was no surgical site infection in the HNC group, neither with four patients in the CL group ($p = 0,005$). With this NOTES hybrid technique, patients with left colon cancer could benefit from minimal invasive surgery with lower pain and rate of wound infection than the CL group of patients.

Hybrid laparoscopic flexure takedown and open procedure for rectal resection are associated with a significantly shorter length of stay than equivalent open resection by Vithiananthan is a 2001-published cohort study. It aimed to compare the result of open hybrid from the same operation team. It depended on operation characteristics, extension and resection for neoplasm, and short-term outcomes. The laparoscopic method is beneficial for patients with benign colon tumors in increasing lung function, lowering pain scale, and shortening hospital stays. With Mukkai's NOTES hybrid technique, patients with left colon cancer could benefit from minimal invasive surgery with lower pain and wound infection rates than the CL group of patients. There was light wound infection in two patients (28,6%) and ileus in one patient (14,3%). There was no anastomosis leakage, anastomosis stricture, and conversion to standard open laparotomy. Vithiananthan, a cohort study in 2001, aimed

to compare the result of open hybrid from the same operation team. It depended on operation characteristics, extension and resection for neoplasm, and short-term outcomes. Novel result of it showed increased tumor recurrence in a similar location of incision before. Therefore, even if it is still in debate, the tumor's location is not a focus of discussion in the laparoscopic method. We prefer concerned with five-year survival, local and distal recurrence tumors from the randomized trial study. From 1991 to June 2007, Ellis-Clark et al. underwent a hybrid procedure with more susceptible morbidity and mortality than laparoscopy. A more significant portion of the population accepted more benefit than patients with laparoscopy.

Summary

Colorectal cancer may be treated by the hybrid laparoscopic method is safe and effective for colorectal cancer that provides better outcomes and lower complications rate. Those with colorectal cancer of stage I and II are better treated by hybrid laparoscopy to achieve better outcomes, lower postoperative pain, a short length of hospital stays, and meet the criteria of oncology perspective

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