Critical surgical errors by junior fellows and trainees in low rectal cancer surgery: How to overcome? (A cross-sectional study)

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ABSTRACT

Aim: Technical difficulties are usually reported in low rectal cancer (LRC) surgery. Moreover inadvertent surgical errors could happen mostly due to lack of experience of the assisting surgeons. Unfortunately, these errors may end up with raising a permanent stoma. In this study we are reporting seven inadvertent surgical mishaps during surgeries for LRC which resulted in failure of the planned circular end to end anastomosis and how we approached them by different salvage techniques.

Patients and methods: All surgical mistakes were salvaged by two of our senior consultants with intraoperative decision to shift to another approach to attain intestinal continuity. Two patients had direct handsewn coloanal anastomosis, three received colon pull through and two with redo stapled circular end to end anastomosis after shifting to the anterior perineal plane. Postoperative assessment of the functional state using wexner score was done for all cases.

Results: All surgical mistakes had been overcomed after shifting to the transanal and/or perineal approach and we were able to regain intestinal continuity in all cases. Circumferential and distal margins were free in all specimens. Two patients showed optimal continence with wexner score 3,5 respectively, Two had suboptimal continence Wexner 6,7. Female patient with iatrogenic rectovaginal fistula suffered from poor quality of life and asked for permanent stoma.

Conclusion: All trainees and junior fellows in should receive a clearly defined training program and focused education with different staplers; additionally they should work under supervision of the senior consultants who should be sufficiently experienced with different salvage approaches.

1. Introduction

Despite the technical feasibility of surgery in most cases of rectal cancer, surgery for low rectal cancer (LRC) is still demanding even in the hands of experienced colorectal surgeons [1] It has two major objectives, first the deep pelvic dissection to ensure curative resection, and second, restoration of colorectal/anal continuity [2]. Although low anterior resection (LAR) with circular end to end anastomosis is now the standard sphincter saving surgery in LRC, however technical difficulties are usually reported especially with males narrow pelvis, morbidly obese patients, previous pelvic sepsis and neoadjvant radiotherapy [3, 4]. Moreover inadvertent surgical errors could happen either due to lack of experience of the assisting surgeons, or at the final steps of a lengthy procedure where most of the surgical team becomes exhausted. Unfortunately, these errors may end up with failure of completing the stapling procedure and the unhappy decision of raising a permanent stoma.

Many salvage procedures which could help in such critical circumstances to restore intestinal continuity and avoid raising a permanent stoma have been described. Most of these techniques did not gain popularity, which may be attributed to the rapid progression in stapling devices technology.

In this study we are reporting seven inadvertent surgical mishaps during surgeries for LRC which resulted in failure of the planned circular end to end anastomosis and how we approached them to avoid raising a permanent stoma.

2. Patient and method

2.1. Patient selection

This is a cross-sectional analysis focusing on 7 cases (4 laparoscopic and 3 open) who underwent successful curative resections for low rectal cancer.
cancer that ended up with unintended intraoperative surgical mistakes with failure to complete the circular end to end anastomosis. We defined surgical mistakes as technical error by one of the surgical team, That resulted in failure of regaining colorectal/coloanal continuity by the planned original procedure and resorting to another salvage technique to regain intestinal continuity. We excluded patients with stapler related failures. Our work has been reported in line with the STROCSS criteria [5].

All surgeries were done in the Colorectal Surgery Unit between January 2014 to January 2020 after multidisciplinary team (MDT) evaluation. In the same study period, 372 elective surgeries (228 male, 144 females) for rectal cancer (0–14 cm from the anal verge) were done. Successful resection was achieved in 348 patients (curative in 338, palliative in 10), 260 patients had low anterior resection with double stapled technique, 24 with intersphincteric resection (ISR), 46 had abdominopерineal resection and 18 with Hartmann’s procedure. Laparoscopic procedure was completed successfully in 188 cases with 28 cases converted to open while 160 had open surgery from the start. The data were collected and published upon approval of the ethical committee of our university. We registered through Research Registry with registration unique identifying number (URN): 5914.

Surgeries were planned 6–8 weeks after finishing the neoadyvant chemoradiation with the routine metastatic work up according to our protocols in the unit (chest and pelvi-abdominal CT, pelvic MRI with rectal protocol).

### 2.2. Patients details and surgical procedure

The demographic data, planned procedure and pathology of all patients are shown in Table 1. Seven patients were enrolled in the study (5 males and 2 females, age range 41–65y). One male patient had history of severe pelvic trauma after motor car accident which resulted in abnormally narrow pelvis, One male patient with chron’s disease gave history for open small intestinal resection and surgical drainage of pelvic abscess ten years ago which impacted the outcome of surgery for rectal cancer. All surgical mistakes were salvaged by two of our senior consultants with intraoperative decision to shift to another approach to attain intestinal continuity. Covering loop ileostomy was constructed in all cases. We followed up our patients in the colorectal clinic every three months after closure of the covering loop ileostomy for assessment of the functional state using wexner score and any reported recurrence (locoregional or systemic). The detaileds of outcome for all patients, follow up and salvage technique are shown in Table 2.

Two male patients after having successful laparoscopic low anterior resection with total mesorectal excision and rectal transection using endo-GIA stapler, the circular stapler was introduced forcefully by the assistant with complete disruption of the stapled anal stump. The anal stump was short and attempts to redo the stapled anastomosis failed due to stump retraction. The procedure was completed transanally in the two patients, one patient had direct handsewn straight coloanal anastomosis (CAA), and one had colon pullthrough (PT), the protruded colon was auto-amputated on the 8th day postoperative.

One male patient had successful open resection for low rectal cancer. While the patient was put in the lithotomy position to complete the stapled coloanal anastomosis, a forceful digital rectal examination was mistakenly done by one of the junior residents disrupting the stapled anal stump, The patient had a severely contracted narrow pelvis and short anal canal, and the patient was salvaged by pull through coloanal anastomosis.

One female patient, after completing her open anterior resection successfully, had iatrogenic rectovaginal fistula by false introduction of the circular stapler transvaginally by a trainee. This was not discovered till doing routine air leak test we observed air bubbles from the vagina, Digital rectal and vaginal examination confirmed the presence of a defect between the anterior rectal wall and posterior wall of the vagina. Two stay sutures were taken at the angle of the stapled rectal stump and transabdominal dissection in rectovaginal plane was done till the fistula was reached. However extra rectal stump length was needed to redo the stapling safely. We decided to use the transtapival approach. The patient was put in the lithotomy position and a curvilinear incision was made midway between the anal verge and the vagina after injecting saline/adrenaline (1/200000), we carefully dissected the external anal sphincter and transverse prenii muscle then we continued cephalic in the rectovaginal plane with left index finger applied transvaginally to avoid further injury to the wall of the vagina till we reached our dissection plane created transabdominal. Repair of the posterior wall of the vagina was done with continuous absorbable sutures (vicryl 2/0) then TA stapler was applied transperineal distal to fistula then stapled circular end to end anastomosis was done. Closure of the perineal wound with interrupted absorbable sutures.

A male patient had laparoscopic low anterior resection and the rectum was transected using a contour stapler. Unfortunately during draping of the perianal region the senior surgeon unintentionally introduced the long sterilizing sponge clamp trans-anally with complete opening of the stapled anal canal which was short to grasp and redo the stapled anastomosis, So we go for direct handsewn coloanal anastomosis (see Fig. 1).

A female patient underwent curative laparoscopic resection for rectal cancer, pursestring sutures were taken by one of our new fellows in our team, circular end to end anastomosis was constructed, yet the proximal doughnut was incomplete, air-leak test was positive, the pfenniastel incision was extended with double check of the leaking point trans-abdominally combined with digital rectal and proctoscopic examination, unfortunately more than 50% of the staple line was incomplete, we dismantle the disrupted anastomosis for redo, Yet extralength with further dissection was needed distally which was difficult trans-abdominal, So we shift to the anterior perineal plane. Dissection continue in recto-vaginal plane as described before till we reach our plane created transabdominally then TA stapler was applied transperineal just distal to disrupted anastomosis followed by successful stapled circular end to end anastomosis.

A male patient underwent successful open rectal resection for LRC, however during firing of the circular stapler the assistant inadvertently missed the safety plate with consequent fracture of the stapler which was hardly extracted with full thickness avulsion in posterior wall of anal stump which was repaired by transanal interrupted absorbable sutures, redo of the circular anastomosis was extremely difficult as male

| No. | Age | Sex | Planned procedure | Pathology | TNM stage |
|-----|-----|-----|-------------------|-----------|-----------|
| 1   | 46  | Male| Laparoscopic (LAR) | Invasive mucinous carcinoma | ypT3, ypN0, M0 |
| 2   | 51  | Male| Open (LAR)        | Infiltrating mucinous adenocarcinoma | ypT3, ypN0, M0 |
| 3   | 55  | Male| Laparoscopic (LAR) | Infiltrating adenocarcinoma | ypT2, ypN0, M0 |
| 4   | 41  | Male| Open (LAR)        | Moderately differentiated adenocarcinoma | ypT3, ypN0, M0 |
| 5   | 47  | Male| Laparoscopic (LAR) | Moderately differentiated adenocarcinoma | ypT3, ypN1c, M0 |
| 6   | 65  | Female| Open (LAR)      | Uterosacral mass (3 cm) | ypT3, ypN0, M0 |
| 7   | 58  | Female| Laparoscopic (LAR) | Uterosacral mass (3 cm) | ypT2, ypN0, M0 |

LAR: Low anterior resection.

Table 1

Patient’s demographic data, planned procedure, pathology and TNM stage.
patient with history of pelvic trauma 20 years ago so we considered
colon pull through as saving procedure with second stage resection of
the exteriorized colon 8 weeks postoperative.

3. Results

All surgical mistakes had been overcome with successful salvage
procedure after shifting to the transanal and/or perineal approach and
we were able to regain intestinal continuity in all cases. Circumferential
and distal margins were free in all specimens. All patients received
adjuvant chemotherapy, No local or systemic recurrences were reported
except for one patient developed liver and lung nodules after 18 months
in the follow up.

Two patients had direct handsewn coloanal anastomosis, three
received colon pull through and two with redo stapled circular end
to end anastomosis after shifting to the anterior perineal plane.

All anastomoses were covered by proximal loop ileostomy. Stoma
was closed in five patients with follow up from 5 to 26 months (mean
duration 14 months) Two patients (one with handsewn CAA and other
had colon pullthrough) showed optimal continence with wexner score
3,5 respectively, Two had suboptimal continence Wexner 6,7 (one with
pull through and other with anterior perineal plane respectively). Fe-
male patient with iatrogenic rectovaginal fistula) suffered from poor
quality of life after stoma closure and asked for permanent stoma.

All patients are still alive except for one male (55 years, diabetic,
BMI = 52) who developed massive pulmonary embolism (PE) on 5th day
post-operative in spite of full anticoagulation. One patient is still under
adjuvant chemotherapy.

4. Discussion

In the present study, seven patients were reported for unacceptable
intraoperative surgical mistakes during low rectal cancer surgery. We
believe that three golden prerequisites are essential for any colo-
proctologist to operate on such challenging cases, First to know how to
do safe and curative resection, Second to be aware of the different
updated surgical devices, staplers and how to use them correctly, Third
to have enough experience with the different restorative and salvage
sphincter saving techniques. Resection margins were negative in all
patients in the present study denoting that the first prerequisite was
successfully achieved. Thus we would like to highlight in the present
study on the second and third prerequisites.

Surgeries for low rectal pathologies were greatly enriched by the
introduction of circular staplers by Steichen and Ravitch to the oper-
ating theatre which facilitates the surgeons to go deeper in the pelvis
creating an easy and safe anastomoses which were not possible by the
traditional techniques and accordingly saving many patients from per-
manent stomas with abdominoperineal resection [6].

The double stapled technique (DST) was invented by Knight and

Table 2
Distance of the tumor from anal verge, surgical error, salvage procedure and wexner score.

| No. | Distance from anal verge | Surgical error | Salvage procedure | Follow up after closure of stoma (month) | Wexner score | Others |
|-----|--------------------------|----------------|------------------|-----------------------------------------|-------------|--------|
| 1   | 6 cm                     | Inadvertent trans-anal introduction of long sponge clamp during drapping of the perineum | Handsewn coloanal anastomosis | 5 | – | Stoma not closed. |
| 2   | 7 cm                     | False PR examination of stapled anal stump | Colon pullthrough | 12 | 5 | Optimal function |
| 3   | 5 cm                     | Forceful introduction of the circular stapler | Colon pullthrough | – | – | Died 5th day post-operative due to massive PE |
| 4   | 6 cm                     | Missing of safety plate | Colon pullthrough | 18 | 6 | History of pelvic trauma |
| 5   | 7 cm                     | Forceful introduction of the circular stapler | Handsewn coloanal anastomosis | 13 | 3 | Developed liver, lung nodules after 18 months |
| 6   | 9 cm                     | Transvaginal introduction of the circular stapler with iatrogenic rectovaginal fistula | Combined abdomino-perineal approach | 10 | 15 | Requested permanent stoma |
| 7   | 8 cm                     | Inadequate pursestring sutures | Combined abdomino-perineal approach | 26 | 7 | Suboptimal function |

PE: Pulmonary embolism.
with two stage repair. Rex and Khubchandani [14] reviewed 57 patients with RVF and stated that 53 had circular stapled anastomosis.

Although purserting seems to be simple for the junior surgeons, However if placed inadequately with missing its principles (A full thickness sliding monofilament sutures including the whole bowel circumference) an incomplete donuts will be inevitable result, we showed one case with positive air leak test with incomplete donuts due to inadequate purserting by one of our residents, Offodile et al. [10] reported 13 cases with incomplete donuts, Kyszer et al. [11] experienced 5 patients with failure of purserting clamp and one with incomplete tying.

Surgical errors are not limited to co-surgeons or assistants only, but senior consultants may be the one responsible for the mistake, we showed one error done by the consultant himself during perianal draping with accidental transanal application of the long sterilizing clamp with disruption of the stapled anal canal. We explain this as our consultant had lack of confidence in the surgical team doing every step by himself and thus unintended mistakes could happen especially with lengthy operations, no similar cases were found in the literature, however it could happen especially at the final steps when the surgeon becomes exhausted.

The third requisite we believe that colorectal surgeons should be aware with the different salvage procedures in surgeries for different rectal pathologies.

Many novel techniques were described for restoration of coloanal continuity with sphincter preservation. In our analysis three different approaches were utilized to overcome the accompanying technical mistakes (Direct handsewen coloanal anastomosis, colon pull through and combined abdomino-perineal approach), all of them succeeded in restoration of coloanal continuity with acceptable degree of continence.

The direct handsewen coloanal anastomosis was first introduced by Parks [15] in 1972 which become one of the ideal salvage procedures especially with short anal stump and/or failure of stapled techniques, this was utilized in two of our patients with optimal functional outcome in one of them, the continence degree with handsewen CAA was accepted in the literatures [16,17] which may be attributed to better inhibitory anal reflex due to better nerve growth [18]. Additionally Warner et al. [19] stated that although tumors were nearer to the anal verge in the handsewen group, There was no difference between stapled and handsewen coloanal anastomosis as regards low anterior resection syndrome, Conversely Ptekkis reported higher Wexner score in patients with handsewen coloanal anastomosis [20].

The technical mistakes in our analysis were saved in 3 patients by the pull through technique with adequate continence and oncologically safe results. Although pullthrough gained popularity due to acceptable functional outcome, lower rate of leakage and avoidance of stoma, However some limitations were reported in rectal cancer with suspicions of positive circumferential margins or risk of anal sphincter avulsion with large tumors [21], additionally evolution of stapled colo-anal anastomosis and the necessity to have exteriorized colon decreased the popularity of this technique, However the technique reappears again in the literatures as one of the sphincter salvage technique, in retrospective analysis for 100 cases with pull through and delayed coloanal anastomosis Jarry and coll. Reported 36% morbidity and a mean Wexner score of 7.8 was reported in the second year postoperative [22], also Remzi et al. [23] reported comparable functional outcome between immediate coloanal anastomosis and pullthrough. In retrospective analysis Abou-zeid [24] published 28 cases with two stage pullthrough with marked improvement in the continence after 6 months follow up and concluded that pullthrough is saving option in challenging situations with staple failure, anastomotic stricture, leak with pelvic sepsis and pelvic anatomical difficulties.

Resection of the distal rectum using the anterior perineal plane was first described by Cuneo [25] in 1908 then reports of sixty patients were published in 1988 [26], however the technique was not taken into consideration by colorectal surgeons. It comes back again in the...
literature in 2007 by Abouzeid [27] for a case with difficult reversal of Hartman, then Williams [28] published 14 cases received the technique with acceptable oncological and functional outcomes with mean Wexner score of 5. We used the perineal plane to approach the distal stump in two patients after iatrogenic RVF and redo of coloanal anastomosis, however the former had poor functional outcome. Abouzeid et al. [29] reported that optimal continence was achieved in minority of patients. Minor complications were reported in our cases, One patient developed pelvic sepsis after pull through that was managed conservatively and another showed perineal wound infection and wound dehiscence with conservative management.

There are two major limitations in the current study: First, the small number of the patients enrolled in the study but we explain that such surgical mistakes are rare to occur, and second, the difficulty in collecting data for highly selected patients among hundreds of reports in our colorectal unit however we carefully excluded all patients reports not matching our inclusion criteria.

Although trainees and fellows are responsible for most of the surgical errors in our study, However consultants are not excused from liability as they should inspect their residents step by step intraoperative with clarified explanation for the procedure details, Technical tips and tricks in order to avoid such errors.

In our analysis we went over a critical issue in rectal cancer surgery which is not reviewed enough in the literatures except for some case reports published for surgical mistakes and therefore we would like to highlight some golden rules for colorectal surgeons in order to reduce the possibility of such errors [10,12]:

1 Junior surgeons must be joined to the consultants without barriers.
2 Consultants should master different salvage and sphincter saving procedures.
3 Workshops should be offered to the residents with a focus on updated devices and technology in surgery.
4 Staplers are double-edged sword with the possibility of irreversible errors with inexperienced surgeon.
5 Teamwork is important in such exhausting lengthy operations.
6 Complications should be discussed clearly with the patient before surgery with an emphasis on the possibility of raising permanent stoma especially with low rectal cancer patients.
7 Many of historical approaches in rectal surgery proven efficiency as saving procedures in critical situations.

5. Conclusion

All trainees and junior fellows in colorectal units should receive a clearly defined training program and focused education with different staplers, additionally they should work under supervision of the senior consultants who should be sufficiently experienced with different salvage approaches and how to correct unexpected surgical errors, moreover it should be noted that staplers are an aid only to skilled and well trained surgeons.

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Authors contributions

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Declaration of competing interest

The authors declare that there are no conflicts of interests throughout all listed work and data in this study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jamsu.2021.01.078.

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