Robotic hemi-levator excision for low rectal cancer: A novel technique for sphincter preservation

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Abstract

Introduction

Sphincter-saving procedures have been published as safe and feasible alternative approaches to radical abdominoperineal resection (APR). We considered that there is a subgroup of patients, between APR and intersphincter resection (ISR), in whom the sphincter could still be saved, without inferiority, in short- or long-term outcomes. Robotic hemi-levator excision is a new procedure based on the concept of saving the sphincter and improving the quality of life while providing oncological safety. This procedure is specific for tumours located at the level of the anorectal ring (levatorani); saving the sphincter at that level with a negative resection margin is challenging. We report our initial case experience, including the principles of the technique, its indication as well as safety and feasibility.

Methodology

This technique was performed prospectively in two selected patients at Yonsei University health system, South Korea. Selection criteria, technical tips, pathological reports and follow-ups have been prospectively reported.

Hemi-levator excision was performed on two male patients with ages of 52 and 70 years and tumour levels at 4 and 5 cm from anal verge, respectively. No residual tumour has been reported in the first case and safe margins were reported in the second one.

Discussion

The hemi-levator excision technique is a novel sphincter-preserving technique that can be used in select patients. It is safe and feasible in selected cases. However, long-term functional and oncological outcomes still need to be assessed.

Introduction

Abdominoperineal resection (APR) has been the gold-standard treatment for distal rectal cancer since Miles reported the technique in 1908. However, patient quality of life can be compromised by the social and psychological limitations of a permanent stoma. Furthermore, treatment by traditional APR has been reported to be associated with a poor oncological outcome. Pathological audits of APR specimens in patients with low rectal cancers have highlighted high rates of circumferential resection margin involvement1-4, specimen perforation3,4 and suboptimal mesorectal specimen quality5. This has been attributed to perineal dissection, which does not follow a well-defined anatomically distinct plane where the exposure of the muscle tube and tumour perforations, below the level of the total mesorectal excision (TME), commonly occur. Consequently, a more radical approach to APR has been proposed to improve results5-7. This enhanced extralevator APR (ELAPR) approach involves dissecting the levator muscles at their origin and removing them en bloc with the rectum and anus. However, this technique is associated with higher perineal morbidity8.

Schiessel et al.9 reported the first intersphincteric resection (ISR) with coloanal anastomosis (CAA) for low rectal cancers, and it has been adopted as an alternative to abdominoperineal excision. They succeeded in partially preserving the sphincter and avoiding the need for a permanent stoma. In ISR, the internal sphincter is completely or partially excised to obtain the necessary full-thickness distal rectal margin. This is followed by CAA, in which the colon is sutured to the remaining sphincter complex, using a transanal hand-sewn technique. Currently, patients with tumours at the level of the levator ani typically undergo APR, due to difficulty in the dissection, and to achieve a wide resection margin.

Do all tumours at that level need APR and a permanent colostomy or is there a way, at least in selected patients, to preserve the sphincter and improve the quality of life?

There is a subgroup of patients with low rectal cancer in which the levator ani muscle needs to be partially excised to obtain safe pathological negative resection margins. Those patients are best diagnosed using a coronal-axial MRI, which is helpful in determining the exact site of the tumour at that level. In the past, such patients were not well-defined. As a result, they typically underwent an extensive surgery (APR) when saving their sphincter might have been possible if they had received a multimodal treatment approach, including the hemi-levator excision (HLE) technique.

To this end, in this report, we provide our selection criteria for patients suitable for undergoing a partial levator excision and partial

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sphincter preservation to achieve good oncological and functional outcomes as well as a better quality of life. Also, we propose a technique for HLE for tumours located at the level of the levatorani.

Methodology

Written informed consent was obtained from the patient for publication of this methodology and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

This technique was performed prospectively in two selected patients at Yonsei University health system, South Korea. Selection criteria, technical tips, pathological reports and follow-ups have been prospectively reported.

Case presentation

We report on two patients referred to the colorectal clinic at Yonsei University Health System, Severance Hospital, South Korea. The first case was 52 years old and the second was 70 years old. Both were males and had histories of haematochezia and changes in the stool calibre of almost 1-month duration, but no history of incontinence.

The second patient had past history of hypertension while past surgical and family histories were negative for both. General examinations were normal. On rectal examinations, both patients showed normal resting and squeezing tone, and the tumours were located at 4 and 5 cm from anal verge at the left side of the rectal wall, respectively, with limited mobility in transverse access (Table 1).

Investigations

In addition to normal blood work, we did colonoscopies, TRUS, rectal MRI and CT scans. For the first patient, a biopsy showed high-grade villous adenoma with foci of adenocarcinoma in situ. Pre- and post-chemoradiation therapy, colonoscopy and MRI (Figure 1) showed the tumour was ulcerative, fungating, 4 cm in size at the level of levatorani and 4 cm from the anal verge on the left lateral side of the rectal wall. It occupied 40% of the circumference, with possible perforation and abscess formation of the inner third of the levatorani. After neoadjuvant chemoradiation therapy, the tumour decreased in size, and only a small amount of fluid collection at the site of the abscess remained, with prominent proctitis.

For the second patient, the tumour biopsy showed an adenocarcinoma with moderate differentiation. Pre- and post-chemoradiation therapy, the tumour downsized and abutting the left levatorani.

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<th>Table 1 Patient characteristics</th>
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Figure 1: A: Colonoscopy showed ulcerofungating lesion. B: MRI: the arrows point to site of the tumour in contact with the right levatorani. C: Colonoscopy: tumour downsized and scarred. D: MRI: tumour downsized and abutting the left levatorani.
colonic mobilization and vessel ligation. Then, we change the positions of the arms to perform the pelvic phase with dissection of the rectum following the principle of TME and nerve preservation. Dissection then continues to the pelvic floor (levator ani). We expose the puborectalis muscle at the contralateral side of the tumour and the dissection continues to the origin of the levator ani. The dissection continues to the levator ani muscle from where we enter the pelvic cavity (Figures 3 and 4).

Another approach to this side involves cutting the levator ani at the side of the tumour from the abdominal phase so that during the perineal phase, it can be pushed medially. In cases of difficulty, an extrapelvperineal parallel incision can be done to detach the levator ani (Figure 5).

On the contralateral side, where there is no tumour, the dissection on the anal side is in a plane medial to the external sphincter, and we enter the pelvic cavity medial to puborectalis muscle. So, a sleeve distal rectal resection, in which the proximal colon side on one side is divided longer than the other in a slope shape fashion, is the final end point.

Figure 2: A: Colonoscopy: an ulcerofungating lesion. B: MRI: blue arrow points to the site of the tumour abutting the right levator ani; the green arrow indicates the mesorectal lymph node. C: Colonoscopy: tumour downsized and scarred. D: MRI: the tumour was downsized, as was the lymph node, but still abutted the left levator ani (blue arrow).

Competing interests: none declared. Conflict of interests: none declared.

All authors contributed to conception and design, manuscript preparation, read and approved the final manuscript. All authors abide by the Association for Medical Ethics (AME) ethical rules of disclosure.
Two of 18 lymph nodes showed metastasis with perinodal soft-tissue extension and no lymphovascular invasion (ypT3 N1b M0).

**Follow-up**

The first case came to the clinic 1 month after surgery, and the wound had healed completely without complications (Figure 6). The patient could hold his mucous discharge. On digital examination, resting and squeezing tone were moderate. MRI showed a normal right levatorani and an absent left one without tumour recurrence. We are still waiting follow-up in the second case.

**Discussion**

Anal sphincter preservation is an important ultimate goal for patients with mid- and low rectal cancer. Multimodal treatment has brought advances in treating locally advanced rectal cancer over the last two decades. The use of preoperative chemoradiotherapy has resulted in significant downstaging and downsizing of tumours; this, in turn, has facilitated resections permitting sphincter preservation and CAA for patients who would otherwise not have been candidates for this type of surgery. Also, in comparison with APR, similar short- and long-term outcomes, better quality of life and fewer complications, avoiding permanent colostomy, have been achieved. In fact, CAA with and without ISR has become the procedure of choice in select cases.

Predicting tumour complete responses and the absence of residual cells remains challenging and may change the direction of surgery. Rectal cancer surgery presents major technical difficulties, especially in men, obese patients and patients with large tumours. The recent introduction of robotic surgical systems has revolutionized the field of minimally invasive surgery. Robotic systems have been used in CAA and ISR, as well as in APR.

The specimen was extracted anally and a coloanal hand-sewn anastomosis was performed. Both patients were diverted with a loop ileostomy.

**Pathology report**

For the first case, only fibrotic tissue was reported with no residual tumour and no lymph node metastasis (ypT0 N0 M0), while in the second case the tumour size was $2.5 \times 2.2$ cm, and the depth of invasion up to the subserosal layer; the proximal, distal and circumferential resection margins were free from tumour and were 15, 1 and 0.4 cm, respectively.

**Figure 3:** A: Tumour at the level of the levatorani before chemoradiation therapy. B: Tumour downsized after chemoradiation therapy: sleeve rectal resection (red arrow), intersphincteric resection (yellow arrow) and hemi-levator excision (blue arrow).

**Figure 4:** A: Yellow arrows point to the left levatorani. B: Yellow arrow pointing at the tumour. The blue arrow indicates the dentate line.
Methodology

Using a robotic system, an excellent stereoscopic view may be obtained with high illumination, and adequate traction and counter traction can be performed readily in a narrow pelvis using the endo-wrist function.

With advances in chemoradiation therapy, surgical instruments and excellent post-operative pathological reports, all of our patients are approached with a multidisciplinary team to make decisions as to which procedure to use for low rectal cancer and which is still a debatable and challenging issue, especially when you want to preserve the sphincter and to maintain oncological safety.

From a review of literature evidence, most low rectal cancer at or below the level of the levatorani have been treated with APR. Recently, CAA and ISR have provided better function and quality of life with similar oncological outcomes. However, there is still a subset of patients who, in our opinion, can benefit from a sphincter-saving procedure. These are patients where the tumour is located at the level of the levatorani unilaterally and they show a good tumour response to neoadjuvant therapy; for them, we propose our HLE technique. HLE for rectal cancer at the level of the levatorani is a new concept and technique that can help specific patients by improving their quality of life while maintaining oncological safety.

Our criteria for the technique are as follows:

- No preoperative or post-chemoradiation history of incontinence
- No preoperative or post-chemoradiation anal sphincter weakness upon digital examination
- Rectal cancer at the level of the levatorani (anorectal junction) by MRI (coronal–axial view)
- Tumour invades one side of the inner third of the upper internal sphincter and the levatorani or the upper third (deep) of the external sphincter
- Tumour has to show response to preoperative chemoradiotherapy endoscopically and radiologically, by MRI or TRUS
- Patient has to be motivated and accept the possibility of a permanent stoma in case of poor functional outcome or positive margins post-operatively with salvage surgery

Based on those criteria, we select our patients prospectively and we aim to compare them with standard APR in future and to assess their functional outcome after ileostomy closure. Technically, the procedure is challenging, but with the endo-wrist advantage of the robotic system, the abdominal phase becomes easier. Also, we can make the perineal phase dissection easy via an approach to the levatorani from the abdominal phase and divide it at its origin. This method allows a preferred shallow shape type of the levatorani plate where the perineal phase will be difficult, due to the high location of the levator origin. In the case of a flat-type levatorani, the perineal approach is not difficult (Figure 7). Additionally, a parallel incision was used in the first case due to difficulty in accessing the levatorani at its origin after we entered the ischiorectal fossa laterally.

Figure 5: Yellow arrow points to the coloanal anastomotic site. Blue arrow points to the extraspincteric parallel incision.

Figure 6: Case 1: A: Completely healed post-operative lateral incision (arrow) B: MRI with normal right levatorani (yellow arrow) and absent left one (red arrow). There was no tumour recurrence.
In both cases, we followed the patients prospectively and we were able to achieve excellent pathological results. There were no post-operative complications or mortality. Both patients had loop ileostomies and, after closure of the stoma, we planned to assess the patients’ quality of life, functional outcome and long-term oncological outcome.

For ISR, many authors have assessed oncological and functional outcomes and, in comparison with APR, quality of life is better, with acceptable functional outcome and similar oncological outcome.

A unilateral excision of the levator ani and deep part of the external sphincter through the intersphincteric plane is a little more advanced than ISR alone and less advanced than APR. For this, too, evaluation of quality of life and safe oncological outcome is paramount for future studies.

In one study by Chen et al. from China⁴⁹, a new technique of partial longitudinal resection of the anorectum and sphincter was reported for very low rectal adenocarcinomas, to avoid permanent colostomy. They reported 12 patients who were carefully selected to undergo the procedure. All were diagnosed with low rectal adenocarcinoma and one-sided invasion to the levator ani and/or external sphincter. Ten of them had preoperative chemoradiotherapy, and then they underwent partial resection of the external sphincter at the tumour site. Then, the patients were assessed functionally using objective and subjective parameters. Vector manometry, Wexner constipation score and Wexner incontinence score were used to assess the functional results. The quality of life was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30. There was no post-operative mortality, and 80 curative resection was confirmed in every case. Morbidity included anastomotic leakage in three patients, one of whom underwent reoperation, and stenosis was reported in 11 patients, which was successfully managed with dilatation. The 11 successful patients received biofeedback training for 14 months and underwent ileostomy closure 612 months after surgery. Fortunately, no patient had severe faecal incontinence after stoma closure.

No patients developed local recurrence during the median observation period (35.5 months). One patient had distant metastases at 24 months and underwent resection of the left liver. It was concluded that curability and acceptable anal function could be obtained by the partial longitudinal resection of the anorectum and sphincter in patients with very low rectal cancers. The technique was recommended as an alternative to APR in patients with external sphincter muscle invasion or tumours located below the dentate line.

Our technique differs from that of Chen et al. in that we use it for tumours at or above the dentate line at the level of the levator ani and deep external sphincter and not below the dentate line. Our sphincter resection part is also less invasive, in that we respect only the levator ani and deep external sphincter and leave the superficial and subcutaneous external sphincter on one side, as well as the levator ani and complete intact sphincter complex on the contralateral side.

**Conclusion**

After appropriate preoperative selection, our HLE technique appears promising, achieving curability and acceptable anal function. It is a novel sphincter-preserving technique that can be used in select patients. It is safe and feasible in selected cases. However, long-term functional and oncological outcomes still need to be assessed.

**Acknowledgements**

We thank research assistant Mr. Dong-Su Jang, Yonsei University College of Medicine, Seoul, Korea, for preparing the diagrams.

**Abbreviations list**

APR, abdominoperineal resection; CAA, coloanal anastomosis; ELAPR, extra-levator APR; HLE, hemilevator excision; ISR, intersphincter resection; TME, total mesorectal excision

**References**


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Methodology