

Original Article

Surgical Outcomes of Transanal Minimally Invasive Surgery for Neuroendocrine Tumor in Rectum: Single Center Experience

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Key Words

Transanal minimally invasive surgery;
TAMIS;
Rectum;
Neuroendocrine tumor;
Full-thickness local excision

Purpose. Rectal neuroendocrine tumors (NETs) originate from and are primarily confined to the submucosal layer of the rectum. Owing to the rarity of their occurrence, there are limited reports of surgical results for rectal NETs. With an increasing number of reports on transanal minimally invasive surgery (TAMIS) for rectal neoplasms, we present our findings on the outcomes of TAMIS for rectal NETs.

Method. From January 2016 to December 2023, 50 consecutive cases of colorectal NETs were reviewed retrospectively at our hospital. Of these, 38 underwent TAMIS for local excision of rectal NETs. Demographic data, tumor characteristics, and surgical outcomes were recorded and analyzed.

Results. A total of 36 patients underwent TAMIS with full-thickness local excision of rectal NETs. Two patients had metachronous rectal NETs and underwent TAMIS twice. The mean operation time was 62.6 min (20-120 min), and the mean postoperative stay was 1.2 days (1-4 days). The mean tumor size was 6.0 mm (2-10 mm), and the mean distance of the tumor from the anal verge was 8.2 cm (5-17 cm). One patient had a positive resection margin in the pathological report. During an average follow-up of 25.4 months (range 6-70 months), all patients maintained normal continence, and no recurrences were noted.

Conclusion. TAMIS offers a natural orifice approach and achieves excellent surgical and oncological outcomes for rectal NETs, even in patients requiring repeated TAMIS for metachronous tumors. The results of this study support TAMIS with full-thickness local excision as the preferred surgical method for treating rectal NETs.

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Rectal neuroendocrine tumors (NETs) are rare, with an incidence of 0.17% during screening colonoscopy, representing only 1-2% of all rectal tumors.¹⁻³ The most frequent site of NETs is the gastrointestinal tract, with the small intestine being the most common location, followed by the rectum. Although

uncommon, the incidence of rectal NETs has increased in past decades.^{4,5}

Most patients with rectal NETs are asymptomatic, and the tumors are accidentally discovered during colonoscopies performed for other purposes. Rectal NETs usually present as small, yellowish, hard submucosal

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lesions with intact overlying mucosa,⁶ with most of them smaller than 10 mm and limited to the submucosal layer. However, rectal NETs retain a neoplastic nature with varying potential for malignancy.^{7,8} The primary treatment for rectal NETs without evidence of lymphadenopathy or metastasis is en bloc excision with clear resection margins.^{6,9}

Since its introduction in 2010, transanal minimally invasive surgery (TAMIS) has emerged as a versatile technique for resecting rectal lesions, ranging from benign adenomatous to malignant tumors, as well as rectal submucosal tumors.¹⁰ The indications for utilizing TAMIS continue to expand. However, the use of TAMIS for the treatment of rectal NETs has rarely been reported in the literature. This study aimed to evaluate the safety, feasibility, and surgical outcomes of TAMIS for the management of rectal NETs at our institute.

Material and Methods

Participants

This study retrospectively reviewed 50 consecutive cases of colorectal neuroendocrine tumors between January 2016 and December 2023 at Taipei Tzu-Chi Hospital. Of these, 36 patients with 38 rectal NETs who underwent TAMIS were included in the study. The following exclusion criteria were applied: cases in which the NET was not located in the rectum (2 patients), patients receiving colonoscopic polypectomy only (7 patients), and those without treatment (3 patients) (Fig. 1).

Patient information, including sex, body mass index (BMI), age at the time of surgery, and preoperative ASA score, was collected from hospital records. Preoperative colonoscopy was regularly performed for primary assessment of tumor size and location. Operating times, amount of blood loss, duration of postoperative hospital stay, any reported complications, and tumor characteristics (such as size, grade, and margins) were also recorded. This study was approved by the Ethics Committee and Institutional Review Board (IRB) of Taipei Tzu-Chi Hospital (Taipei

City, Taiwan, Republic of China) (IRB No: 11-XD-109).

Surgical techniques for TAMIS

All patients underwent mechanical bowel preparation using polyethylene glycol solution the night before surgery and received enemas on the day of surgery. TAMIS was performed using a GelPOINT Path (Applied Medical, Rancho Santa Margarita, CA, USA) under general endotracheal anesthesia. The patients were typically positioned in the lithotomy stance and occasionally in the prone jackknife position, particularly if the tumor was anteriorly located (12 o'clock). The GelPOINT Path was inserted into the anal canal using a surgical clamp. The choice of port size (4, 5.5, or 9 cm) was based on the length of the patient's anal canal. Three accessory ports were attached to the GelPOINT Path, and the usual laparoscopic instruments were used. Rectal CO₂ insufflation was established, and a smoke evacuator was applied to the other side of the device. Excellent views were achieved using a high-definition, 3D laparoscope (Olympus) with a flexible tip, subsequent to adequate rectal expansion via CO₂ insufflation stabilization bag, maintaining an intrarectal pressure of 12 mmHg and a flow rate of 10 l/min. Wet gauze was inserted into the proximal side of the lesion to prevent the spread of CO₂ along the colon. A full-thickness rectal excision was performed using an endoscopic grasper and electric cautery. If a patient was prone to bleeding during surgery, a vessel-sealing device was used. After complete removal

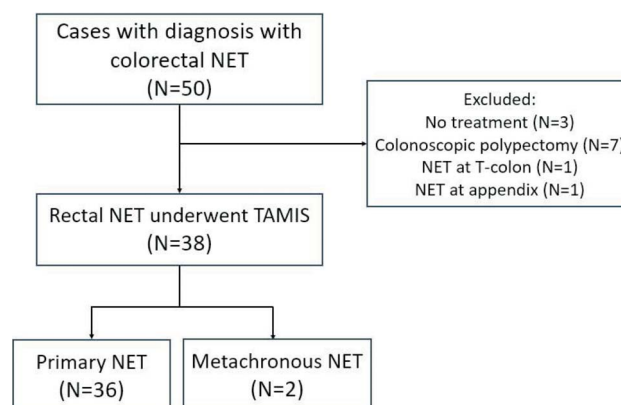


Fig. 1. Flow chart of patient selection.

of the lesion, the defect was irrigated with normal saline, and bleeding was monitored. In all cases, the rectal defect was closed using V-Loc barbed absorbable sutures (Covidien, New Haven, CT, USA). The gauze was removed after surgery.

Postoperatively, oral analgesics were prescribed for pain control. Patients resumed oral diet intake once they returned to the ward, with no postoperative requirement for NPO time for any patient. Most patients can be discharged post-surgery if they are hemodynamically stable and free from complications or other complaints, such as abdominal pain or rectal bleeding. Follow-up appointments with a colorectal surgeon in the outpatient department were scheduled for the first week after TAMIS. Anorectal wound was assessed by digital examination at first follow-up, and associated symptoms (such as anal pain, rectal bleeding, incontinence and urine retention) were evaluated via inquiry. Colonoscopy and abdominal CT scan were performed at the sixth and twelfth month after discharge and then were performed annually for at least five years, exceeding the follow-up principles that NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®)¹¹ had suggested.

Results

This study included 36 patients, 17 of whom were male (47%). The mean age of the patients at the time of surgery was 54.1 years (38-73 years), and the mean BMI was 25.1 kg/m² (16.8-35.9 kg/m²). Two patients had metachronous tumors and underwent TAMIS twice (Table 1).

Table 1. Demographic characteristics

Patients (N = 36)	Range
Sex	
Male	17 (44.7%)
Female	19 (55.3%)
Mean age (years)	54.1 (38-73)
Mean BMI (kg/m ²)	25.1 (16.8-35.9)
ASA score	
I	3
II	29
III	4

TAMIS was successfully performed in all cases. No major postoperative morbidity or mortality was reported. The mean operative time was 62.6 min (20-120 min), and the mean blood loss was 3.5 ml (1-30 ml) (Table 2). In 38 cases with rectal NETs, the mean tumor diameter was 6.3 mm (2-10 mm), and the mean distance from the anal verge was 8.6 cm (5-17 cm). Twelve patients underwent colonoscopic biopsy or polypectomy preoperatively, and eight patients showed no residual tumor in the pathological report. All neuroendocrine tumors were of G1 histological grade. Out of 38 cases, 29 (76%) were classified as T1a stage, while one case (2%) was categorized as T1b stage. None of the patients exhibited lymphatic or vascular invasion. One (2%) patient had pathologically confirmed positive surgical margins (Table 3).

Post-surgery, the mean hospital stay was 1.2 days (1-4 days), and no additional procedure or reoperation

Table 2. Surgical outcomes

Variables (N = 38)	Range
Operation time, min	62.6 (20-120)
Blood loss, ml	3.54 (1-30)
Postoperative hospital stay (days)	1.2 (0-4)
Metachronous tumor	2
Complication, n (%)	6 (15.8%)
Anal pain	5 (13.2%)
Urine retention	1 (2.6%)
Postoperative hemorrhage	0
Anal incontinence	0
Wound breakdown	0
Re-admission within 30 days	0
Re-operation within 30 days	0
Mortality	0

Table 3. Tumor characteristics and oncological outcomes

Variables (N = 38)	Range
Tumor size, mm	6.3 (2-10)
Distance from anal verge, cm	8.6 (5-17)
Pathology	
T1a	29 (76.3%)
T1b	1 (2.6%)
No residual tumor	8 (21.1%)
Lymphatic invasion	0
Vascular invasion	0
Surgical margin positive	1 (2.6%)
Recurrence	0

was required for any patient. The most common postoperative complication was anal pain (5/38, 13.2%), which improved after the use of oral analgesics and a topical ointment. One patient experienced postoperative urinary retention. A Foley catheter was inserted for symptom relief and removed the next day, with no subsequent difficulty in urination noted. All patients had no symptoms of wound bleeding or anal incontinence after digital examination and questioning during the first postoperative visit. The mean follow-up period was 25.4 months (6-70 months). Two patients developed metachronous rectal NETs at different rectal sites at 9 and 40 months, respectively, after the first surgery. Both patients underwent repeated TAMIS with smooth recovery. In all 38 cases, including one case with a positive resection margin, no tumor recurrence was identified during the follow-up period (Table 2).

Discussion

In this study, we included the single-center experience of 38 cases with rectal NETs who underwent TAMIS. The median surgery time was 60 minutes, and the median blood loss was minimal. Hayashi et al. reported a median surgery time of 80.5 minutes and a median blood loss of 1 ml.¹² Our results are similar to those of a previous report. Only one case (2.6%) had a positive resection margin, which was lower than the 7% in a large series of 200 patients by Lee et al.¹³ This patient then underwent follow-up at our OPD for 19 months. Colonoscopy and computerized tomography were performed regularly during this period, and no local recurrence was noted. The most common complication in our study was anal pain, which was observed in five patients at the first OPD follow up 1 week after discharge. This pain was alleviated after administering oral analgesics and topical ointment. One patient experienced urine retention requiring Foley catheterization post-surgery. After the Foley catheter was removed the following day, the patient had smooth urination and did not report any subsequent urinary symptoms. No major complications such as anal incontinence, hemorrhage, or wound breakdown were

reported in any patient. Two patients underwent TAMIS for rectal NETs twice in our study, and both had negative resection margins during the first operation. The time for reoperation of TAMIS for these two patients was 9 and 40 months, respectively, from the first operation. The new occurrence of NETs was at a different site than the previous surgery and thus was classified as a metachronous tumor rather than a local recurrence. These two patients underwent further follow-up for 27 and 28 months, respectively, and no local recurrence was found. The prognosis of rectal NETs is better than that of other neuroendocrine neoplasms of the gastrointestinal tract. Data from the Surveillance, Epidemiology, and End Results database indicated that the 5-year survival rate for rectal NETs was 95.6%.¹⁴ As for small rectal NETs less than 10 mm in size, the risk of distant metastasis was very low (< 3%), and long-term outcomes were excellent, with a 5-year survival rate of 98-100%.⁶ In our study, all 36 patients were alive as of the date of follow-up.

The treatment choice for rectal NETs depends on various features, including tumor size, grade of differentiation, depth of involvement, lymphatic and vascular invasion, and the risk of metastasis.⁹ The primary goal of treatment is to pursue complete resection without residual tumor or positive resection margins. Various endoscopic techniques — endoscopic polypectomy, endoscopic mucosal resection (EMR), endoscopic submucosal dissection (ESD) — and surgical techniques — transanal local excision (TALE), transanal endoscopic microsurgery (TEM), TAMIS — are employed to achieve complete tumor resection.⁶ TALE is a conventional surgical technique used to treat early rectal cancers, including NETs. The introduction of anal retractors to maintain exposure of the anal canal, coupled with the use of an operating light shining from outside the anal opening, can often restrict the surgical field of view. Thus, the TALE is typically employed solely for tumors located in the lower rectum, within 7 cm from the anal verge, and with a tumor size comprising less than one-third of the rectal circumference. The restricted exposure of TALE renders it unsuitable for tumors located in the higher rectum.^{9,15,16} TEM was first introduced in 1984 through a multi-channel metallic platform placed in

the anal canal and the use of specialized instruments, providing a minimally invasive method for complete resection of benign or T1 malignant rectal neoplasms, including submucosal tumors.¹⁷ It improved operative visualization and access to lesions higher in the rectum compared with those in TALE.¹⁸ However, owing to its steep learning curve, the high cost of instruments, and risk of anorectal function impairment, TEM has not been widely used.¹⁸⁻²⁰ Compared to the above-mentioned surgical techniques, TAMIS offers visualization of a larger portion of the rectum and is less expensive than TEM. Another advantage of TAMIS is the shorter length of the port, which enhances the working angle and extends the operative field compared to TEM.^{10,21,22}

TAMIS is reportedly safe and feasible in terms of not only oncological but also postoperative outcomes.¹⁹ While there are no large-scale randomized control studies till date comparing ESD/EMR to TAMIS, previous studies have compared TEM, which is similar to TAMIS, with ESD. Higher R0 and en bloc resection rates owing to full-thickness resection were observed in the TEM group, indicating that surgical resection is more advantageous than ESD.²³ Although there have been no randomized control trials comparing surgical results of TEM and TAMIS, especially on functional outcomes, several studies have reported increased Fecal Incontinence Severity Index or significantly worse quality of life after TEM.^{24,25} In a study by Jakubauskas et al., 38 of 132 patients (28.8%) experienced fecal incontinence after TEM (Wexner score of 3 or more), and they reported significantly worse quality of life in all tested life spheres.²⁴ A study by Verseveld et al. included 24 patients with rectal neoplasms who underwent TAMIS. Functional outcomes were assessed using the Fecal Incontinence Severity Index. Quality of life was measured using functional and general questionnaires. They found no detrimental effect of TAMIS on anorectal function.²⁶

This study had certain limitations. First, this was a retrospective study, and selection bias was inevitable. Second, although this study included a relatively large number of cases compared to similar studies on this subject, the rarity of rectal NETs resulted in a relatively small sample size.

Conclusion

The application of TAMIS in the treatment of rectal NETs in this study was demonstrated to be safe and feasible, with excellent surgical and oncological outcomes, even in patients undergoing repeated TAMIS for metachronous tumors. Hence, our study supports TAMIS with full-thickness local excision as the preferred surgical method for treating rectal NETs.

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原 著

經肛門微創手術對於直腸神經內分泌瘤之 手術結果：單一機構的經驗

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目的 直腸神經內分泌瘤 (NET) 發生率低，相關手術結果報告也不多。近年因使用經肛門微創手術 (TAMIS) 切除直腸腫瘤的病例數有所上升，因此我們彙整並分析我們醫院以經肛門微創手術切除直腸神經內分泌瘤的經驗。

方法 我們回顧性地收集自 2016 年 1 月至 2023 年 12 月連續五十例診斷為大腸直腸神經內分泌瘤的病例。其中，共有 38 個病例以經肛門微創手術進行直腸神經內分泌瘤的局部切除。我們將病例的人口統計資料、腫瘤的臨床及病理特徵、手術結果紀錄並統整及分析。

結果 總計有 36 位病人接受經肛門微創手術併全層直腸壁局部切除神經內分泌瘤。其中有兩位病人因繼發性 (metachronous) 直腸神經內分泌瘤接受第二次經肛門微創手術。平均手術時間為 62.6 (20-120) 分鐘，平均術後住院日為 1.2 (1-4) 天。腫瘤的平均大小為 6.0 (2-10) mm；腫瘤與肛門平均距離為 8.2 (5-17) 公分。所有病例病理報告均無淋巴或血管侵犯。術後平均追蹤 25.4 (6-70) 個月，所有的病人肛門功能正常且無復發。

結論 經肛門微創手術是經由自然孔洞進行的手術，其對於直腸神經內分泌瘤的局部切除在手術以及腫瘤預後均有良好結果。即使發生繼發性的腫瘤進行重複手術也不影響預後。這個研究結果可以支持經肛門微創手術併全層直腸壁局部切除為治療直腸神經內分泌瘤優先選擇的手術方式。

關鍵詞 經肛門微創手術、神經內分泌瘤、直腸、全層腸壁局部切除。