Robotic Transanal Surgery

23

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Introduction

Over recent years, new techniques for local excision of benign- and early-stage, well-selected neoplasms of the rectum have been developed. Transanal minimally invasive surgery (TAMIS) was pioneered in 2009 as a method for local excision of rectal neoplasia, and preliminary experience shows that TAMIS provides high-quality local excision, comparable to transanal endoscopic microsurgery (TEM) [1–4].

TAMIS uses ordinary laparoscopic instruments to perform intraluminal full-thickness local excision in combination with FDA-approved single ports, such as the SILS Port (Covidien, Mansfield, MA) or the GelPOINT path transanal access platform (Applied Medical, Inc.). The success with this approach was met with such enthusiasm that soon after its development, investigation began into the use of robotics with the TAMIS platform.

In 2010, it was learned that the da Vinci Robotic Surgical System (Intuitive Surgical, Inc., Synnyvale, CA) could be used to perform transanal surgery. Initial experiments were conducted in a dry lab and using a cadaveric model [5]. This approach was also shown to be feasible using a specialized glove port [6]. Subsequent to this, robotic transanal surgery (RTS) was successfully performed for local excision of a rectal neoplasm in a live patient [7].

Patient Selection

The indications for RTS are the same as for TAMIS and TEM. They include resection of benign rectal neoplasms and, for curative-intent surgery, well-selected T1 carcinomas, with histologically favorable features, where the risk of nodal metastasis is low [8]. The indication for RTS may also be broadened to include local excision of cT0 lesions in patients with locally advanced rectal cancer after neoadjuvant therapy for the purpose of confirming mural cPR (ypT0). This can be considered a valid option since the risk of occult node positivity for ypT0 lesions is low, at 3–6 % [9–14]. While most segments of the rectum can be reached with RTS, this approach is most suited for mid-rectal lesions (5–10 cm from the anal verge).

RTS should not be considered as an alternative to standard oncologic resection for locally advanced tumors. The lesion should not occupy more than 40 % of the luminal diameter. RTS may have special applications beyond local excision, such as for transanal repair of complex fistulae, such as for

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repair of a rectourethral fistula. This, in fact, has been attempted with limited success.

Preoperative Workup

All patients who have been selected to undergo RTS resection must have also undergone colonoscopy to assess for synchronous lesions and to obtain a biopsy of the rectal lesion. For malignant, early-stage tumors of the rectum, endorectal ultrasound is performed to determine preoperative T and N stage. Pelvic 3-Tesla (3 T) MRI is a valid alternative. Currently, only patients with histologically favorable, early-stage malignancy (uTis or uT1uN0M0 cancer) are considered candidates for TAMIS. More advanced lesions require standard resection (APR vs. LAR) except in patients who are not medically fit to undergo major surgery. CEA level and CT body imaging is also performed to assess for tumor metastasis. Patients with stage IV disease or locally advanced lesions are not candidates for RTS unless the objective is palliation.

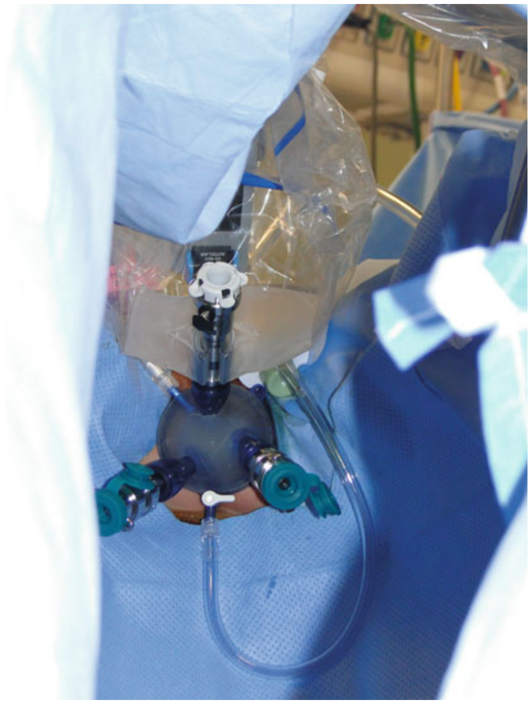

Fig. 23.1 The robotic trocar is introduced into the GelPOINT Path TAMIS port via three cannulas. The cannulas are placed into the TAMIS port gelatinous lid which is then placed and secured onto its sheath (not shown)

Operating Room

The patient is brought into the operating theater and positioned modified lithotomy in Allen stirrups. This position is recommended based on initial, cadaveric studies, which have demonstrated this position to be optimal for robotic access [5]. This is preferred, regardless of the position of the lesion in the rectal wall. A downward-angled lens is preferred for posterior lesions, and an upward-angled lens is preferred for anterior lesions.

The operating room should be fitted with standard laparoscopic equipment, including light source, video monitor, and CO_2 insufflator, as well as the da Vinci Robotic System. We strongly recommend general anesthesia with muscle paralysis to avoid collapse of the rectal wall, which often occurs with diaphragmatic excursion.

Parenteral antibiotics are administered 30 min prior to incision (our preference is single-dose ertapenem 1 g intravenously). The patient must undergo mechanical bowel prep preoperatively as well. The patient is then prepped and draped in the usual fashion. The abdomen should also be prepped, in the event that the lesion cannot be excised locally, or should abdominal access become necessary.

For RTS, the GelPOINT path transanal access platform is used (Applied Medical, Rancho Santa Margarita, CA). The device consists of a rigid cylindrical sleeve, which helps protect against injury to the sphincter mechanism. The sleeve is lubricated with petroleum jelly and introduced into the anal canal using an obturator provided by the manufacturer. Once seated above the anorectal ring, the sleeve is sutured to the skin with 2-0 silk stay sutures.

For both TAMIS and RTS, patients are pharmacologically paralyzed to prevent rectal lumen collapse, and humidified CO_2 is used with the pressure set to 15 mmHg. With the GelPOINT path port seated in place and pneumorectum established, a laparoscope is introduced to perform cursory visualization of the target lesion and to assess the rectum for luminal expansion.

Next, three GelPOINT path cannulas are introduced at an equilateral distance (Fig. 23.1). The

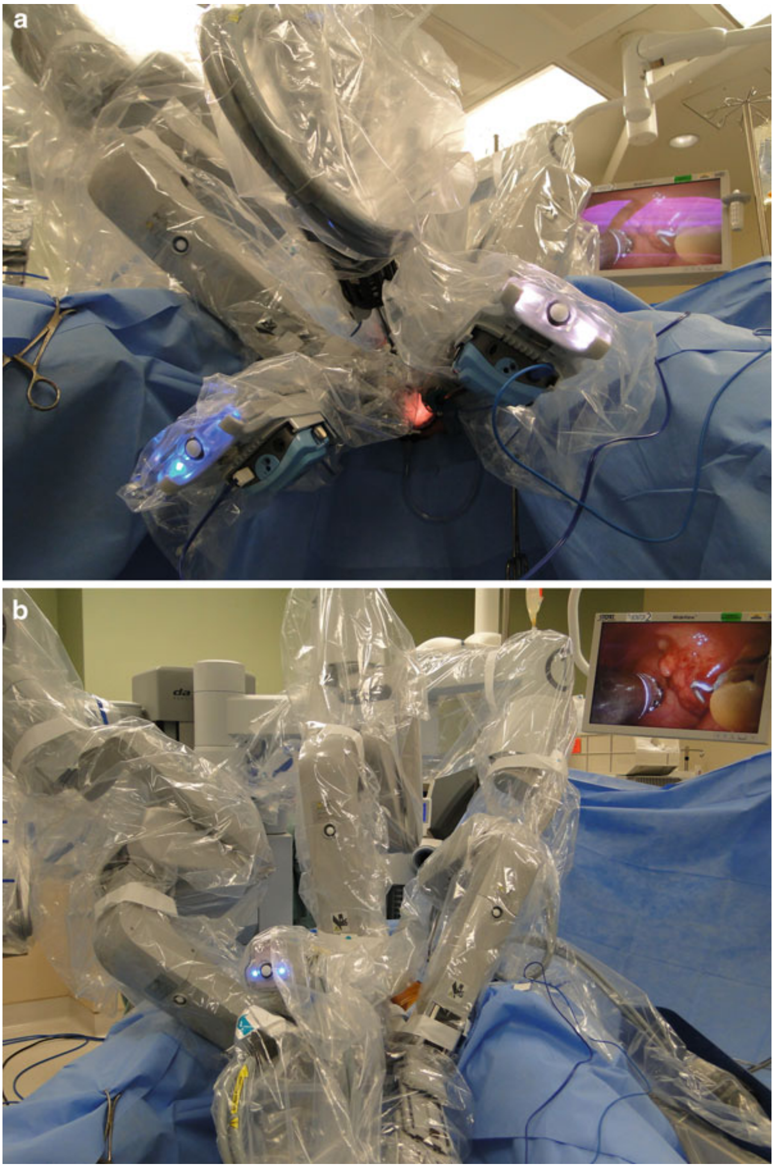

Fig. 23.2 The setup for RTS. The robotic cart is docked over the left (or right) shoulder with the patient positioned modified lithotomy in Allen stirrups. A bedside assistant operates a suction irrigator device to assist with smoke evacuation. The robotic arms are configured using either an 8-mm or 15-mm lens with 8-mm working arms

da Vinci robotic 8-mm trocars are then placed into these cannulas. The GelPOINT path lid is next placed onto the sleeve, which had already been seated in position, and the robotic cart is then docked over the patient's right shoulder (Fig. 23.2a, b). Next, a robotic hook cautery and Maryland grasper are secured (Fig. 23.3). The console surgeon then performs a full-thickness local excision. Resection using RTS is typically performed by demarcating the perimeter of the lesion, providing an appropriate margin. This is done using thermal energy. For evacuation of smoke, a bedside assistant uses a 5-mm laparoscopic suction-irregator device; this is passed directly into the GelPOINT path lid, without the need for a trocar (Fig. 23.4). We find that a simple

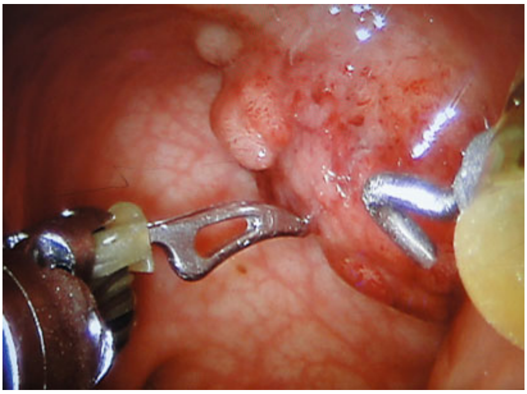

Fig. 23.3 A T1 well-differentiated adenocarcinoma arising from a tubulovillous adenoma measure 3 cm is shown being removed during RTS for local excision

short burst of suction maintains image clarity without collapsing the rectal lumen. The specimen may be tented gently using a robotic Maryland grasper while hook cautery allows for full-thickness excision (Fig. 23.5). Importantly, the CO_2 insufflation provides a natural "pneumodissection" thereby augmenting the ease and clarity of local excision using RTS.

To retrieve the resected specimen, the robot must be dismounted from the GelPOINT path interface. The lesion can be retrieved with a 5-mm grasper, the lid to the port simply removed allowing for specimen extraction.

The next step is closure of the full-thickness rectal wall defect, which is always recommended.

Fig. 23.4 The robot is now docked transanally. The console surgeon performs the excision, assisted only by the need for periodic smoke evacuation. A 5-mm laparoscopic smoke evacuator can be operated by a bedside assistant

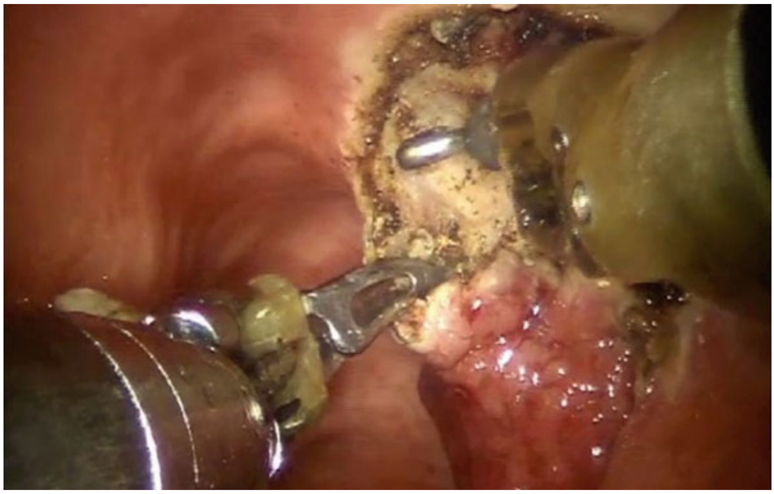

Fig. 23.5 The tumor is now visible and a hook cautery and Maryland grasper are all that are needed to complete the RTS local excision of rectal neoplasm

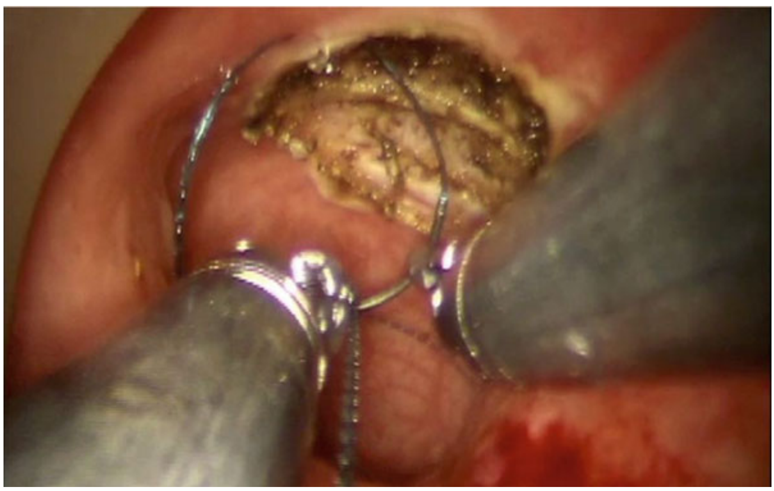

Fig. 23.6 Once local excision has been completed, the full-thickness defect is closed using needle drivers and a V-Loc suture, obviating the need for knot tying

To do this, the hook cautery and Maryland grasper are exchanged with two robotic needle drivers. Robotic intraluminal suturing is then carried out using a V-Loc 180 Absorbable Wound Closure Device (Covidien, Mansfield, MA). This allowed for suturing without the need for intraluminal knot tying, since the unidirectional barbs on the suture self-lock as they pass through the rectal wall. The defect can be closed with a single running V-Loc stitch, thereby completing the operation (Fig. 23.6).

Discussion

RTS illustrates a novel approach to the resection of well-selected and appropriately staged rectal neoplasia. A key advantage of RTS over TAMIS or TEM is that the console surgeon is able to perform intricate surgery more easily within the narrow, cylindrical lumen. The EndoWrist movement allows for greater intraluminal dexterity. This, together with magnified 3D optics, enhances the surgeon's ability to perform transanal local excision with improved precision. This also improves the ability to successfully complete complex tasks, such as intraluminal suturing. RTS is a new approach to transanal access, and its ability to accomplish intricate tasks with ease makes this method suitable for complex cases, where local excision or other advanced transanal procedures (such as transanal repair of rectourethral fistulae) may prove difficult with TAMIS or TEM.

Although greatly advantageous, RTS increases operative cost substantially, and therefore this approach should be reserved for more complex cases, where standard TAMIS and TEM are not possible. RTS is a technique still in its infancy, and its application for rectal surgery has not yet been fully defined. RTS is currently undergoing further investigation, and more data are necessary to establish its efficacy and practicality. A comparative analysis of the available platforms for advanced transanal surgery would be useful.

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