

Robotic interposition of the mesorectum during low anterior resection of the rectum for endometriosis using tissue perfusion assessment with indocyanine green

Robotická interpozice mezorekta při nízké resekci rekta pro endometriózu s využitím kontroly perfuze tkání pomocí indocyaninové zeleně

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Summary: Introduction: Rectal endometriosis is a serious disease, and its surgical treatment belongs among demanding procedures, often requiring a multidisciplinary approach. It is associated with a significant risk of peri- and postoperative complications, the most serious being the development of rectovaginal fistula, which may occur in up to 10% of resections for rectal endometriosis. Preventive measures include the choice of surgical technique, such as a two-stage procedure (resection with terminal stoma followed by stoma closure and bowel anastomosis), which is not optimal for the patient due to the necessity of having two surgeries. Another option is the interposition of the patient's vital tissues into the site of anastomosis or intestinal wall suture. For this purpose, an omental flap is often used, or part of the mesorectum may be utilized. The ability to verify the vitality of such a flap should be considered crucial in preventing anastomotic leakage. **Methods:** A patient underwent robotic-assisted laparoscopic segmental resection of severe rectal endometriosis involving the rectovaginal septum and vagina, classified as #ENZIAN A3 and C3, with interposition of the mesorectum and intraoperative tissue perfusion assessment using indocyanine green. **Conclusion:** The use of tissue perfusion assessment when performing interposition of patient-derived flaps may, in the future, improve surgical precision, enhance success rates, and contribute to the prevention of rectovaginal fistula formation.

Key words: deep rectal endometriosis – segmental resection – rectovaginal fistula – mesorectum – tissue perfusion – indocyanine green

Souhrn: Úvod: Endometrióza rekta je závažné onemocnění a její chirurgická léčba patří mezi náročné výkony, často s nutností multidisciplinárního přístupu. Je spojena se značným rizikem peri- a pooperačních komplikací. Mezi nejzávažnější patří tvorba rektovaginální píštěle. Může se vyskytovat s frekvencí až 10 % z celkového počtu resekčních výkonů endometriózy rekta. Mezi možné preventivní faktory patří volba operačního postupu; jednak provedením dvojstupňového výkonu (resekce s terminální stomii a následně zanoření stomie se střevní anastomózou), což není vzhledem nutnosti dvou operačních výkonů z pohledu pacienta optimální, a jednak snahou o interpozici vitální tkáně pacienta do místa anastomózy, respektive místa sutury střevní stěny. K tomuto účelu bývá využíván lalok omenta, event. může být k tomuto účelu použita i část mezorekta. Možnost ověření vitality takového laloku by měla být považována za zásadní z hlediska prevence insuficience anastomózy. **Metodika:** Pacientka s roboticky asistovanou laparoskopickou segmentární resekcí těžké formy endometriózy rekta, rektovaginálního septa a pochvy dle #ENZIAN klasifikace A3 a C3 s využitím interpozice mezorekta a použitím kontroly perfuze tkání pomocí indocyaninové zeleně. **Závěr:** Použití hodnocení perfuze tkáně při provádění interpozice laloků tkáně může do budoucna přinést zpřesnění práce chirurgů, přispět k úspěšnosti provedení těchto výkonů a k zajištění prevence vzniku rektovaginální píštěle.

Klíčová slova: hluboká endometrióza rekta – segmentární resekce – rektovaginální píštěl – mezorektum – tkáňová perfuze – indocyaninová zeleň

Introduction

Endometriosis affects 7–10% of women of reproductive age [1]. The most severe manifestation is deep infiltrating endometriosis, occurring in 5–12% of patients with the disease [2]. It most commonly involves the posterior compartment, including the cervix and vaginal fornix, with secondary infiltration of the anterior rectal wall [1]. Pharmacological treatment may suppress symptoms but does not cure the disease. Surgical excision is often the only option to relieve symptoms affecting urinary, intestinal, sexual, and reproductive function [1].

The gold standard consists of three surgical techniques: rectal shaving (nodule excision), discoid resection, and segmental resection. No consensus exists on the optimal procedure, and selection remains debated, with significant room for individualized approaches depending on findings and

patient symptoms. Given complication risks and recurrence of pain, nodule excision is the least burdensome procedure, while segmental resection is the most demanding. However, this may be explained by the fact that segmental resections are often reserved for the most severe cases [1].

Surgery can be performed via open, laparoscopic, or robot-assisted approaches. Although no significant differences in patient outcomes were found when comparing laparoscopy and robot-assisted laparoscopy [3], the robotic approach offers surgeons better visualization and increased ergonomic comfort.

The most frequent complications of segmental resection, regardless of approach, are rectovaginal fistula and anastomotic leakage [1], with reported risk rates up to 10% [1]. Risk factors include the level of rectal involvement, with higher risk with the lesion near the

anorectal junction accompanied with the intraoperative vaginal opening [1], excessive use of electrocoagulation in the posterior fornix with associated ischemia [4], and the lesion size greater than 4 cm [4], although the latter remains debated [2].

Preventive measures include interposition of patient tissue between resection margins, with or without protective stoma, or performing the surgery in two stages [5]. Omental flap has been used with some success but this is technically challenging due to anatomical position of omentum [6]. Therefore mesorectal flap has been used as substitute [6]. Since endometriosis is a benign disease, total mesorectal excision (TME) is not necessary, and the mesorectum can be preserved *in situ*. Intraoperative evaluation of tissue vitality can be facilitated by indocyanine green (ICG), a fluorescent dye used for perfusion assessment [7].

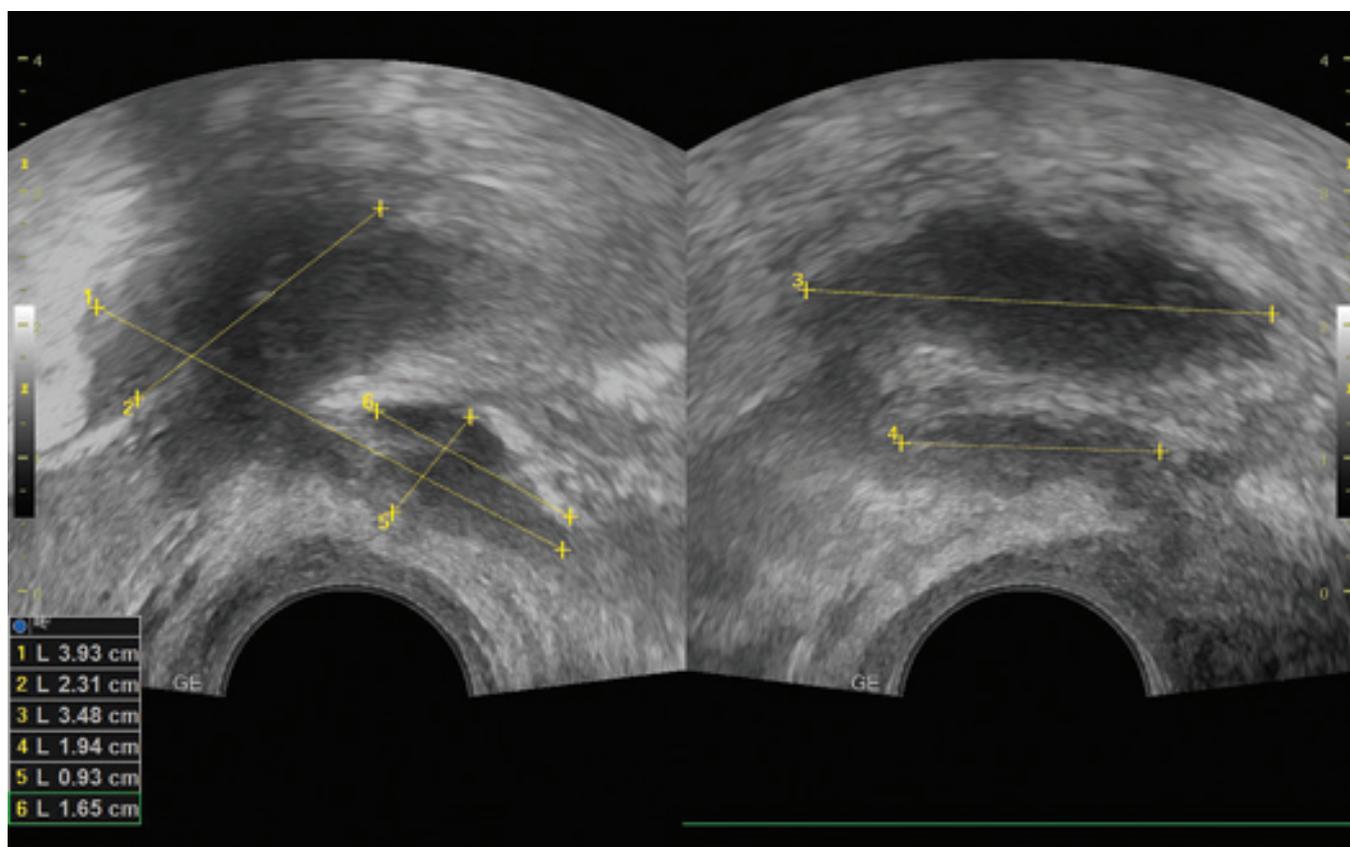


Fig. 1. Ultrasound depiction of the nodules in rectum, rectovaginal septum and vaginal apex.

Obr. 1. Ultrazvukové zobrazení uzlů v oblasti rekta, rektovaginálního septa a poševního apexu.

After intravenous application, it emits near-infrared radiation when excited. It has good bioavailability, a short half-life, and a unique safety profile, and has been used in medicine for nearly 70 years [7].

Material and method

A 39-year-old nulligravida, nullipara in care of a center for assisted reproduction. Her history included three laparoscopic surgeries for endometriosis including the major resection of deep infiltrating endometriosis of the vaginal fornix in 2023. She attempted pregnancy approximately one and a half years since her last surgery. She was referred to our department from the fertility center after two natural cycles. Preoperative tests showed low AMH levels. A recurrent endometriotic nodule was found in the posterior fornix, rectum, and sigmoid colon (#ENZIAN (u) A3, C3, T2/x, FI) (Fig. 1), confirmed by MRI. Clinically, she reported minimal to no symptoms. Due to the findings and planned IVF and after discussion with the patient we agreed on a robotic-assisted laparoscopic segmental resection of the rectum and vaginal fornix.

The procedure was performed under general anesthesia using the Da Vinci Xi

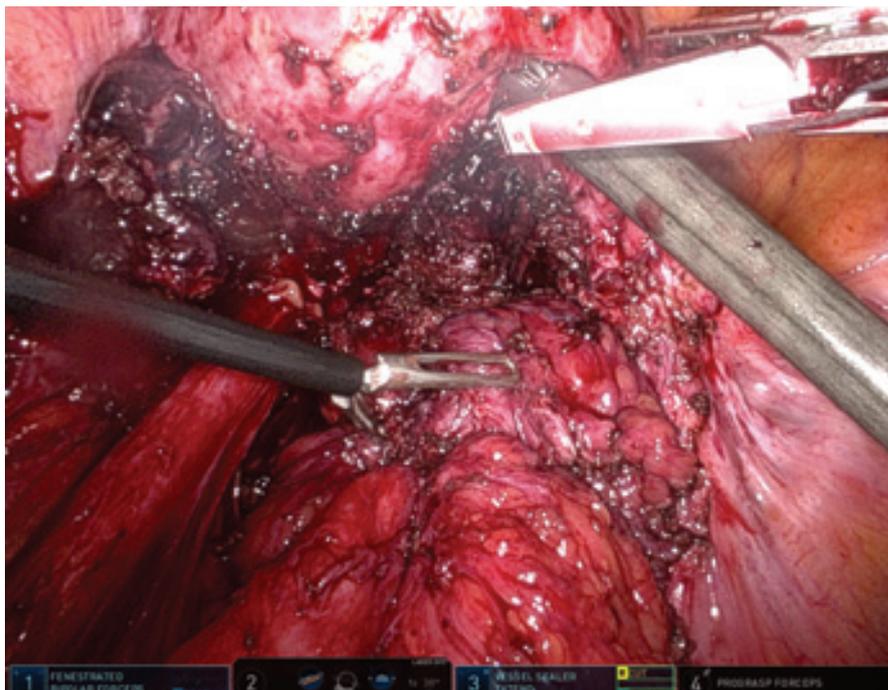


Fig. 2. Finding after adhesiolysis before resection of the rectum.

Obr. 2. Nález po uvolnění adhezí před resekcí rekta.

system, with the participation of the colorectal surgeon.

Intraoperative finding was classified as #ENZIAN(s) A3, C3, T3/2, FI (Fig. 2). Extensive adhesiolysis (grade IV) was necessary. After mobilization of the rectosigmoid, resection of the posterior

vaginal fornix was performed (provided with suture), followed by low anterior resection of the rectum with end-to-end anastomosis using a 31 mm circular stapler. The level of resection was confirmed using perfusion assessment of the intestinal wall with bolus intravenous

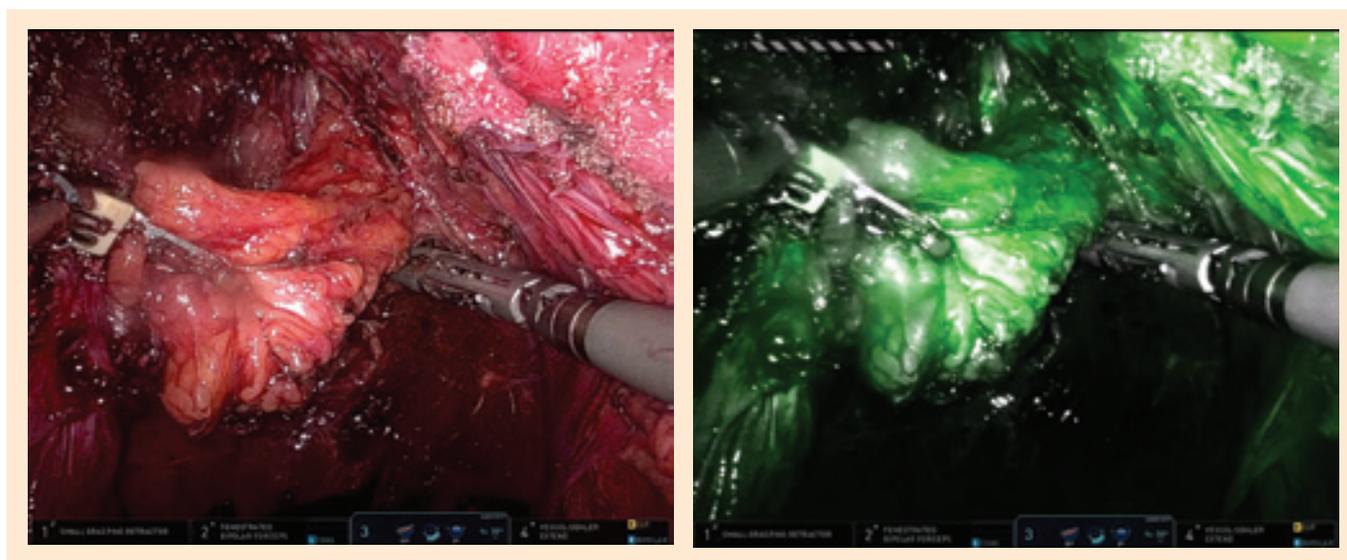


Fig. 3. Mesorectum in visible light and NIR (near infra red).

Obr. 3. Mesorektum ve viditelném světle a v NIR (near infra red) zobrazení.

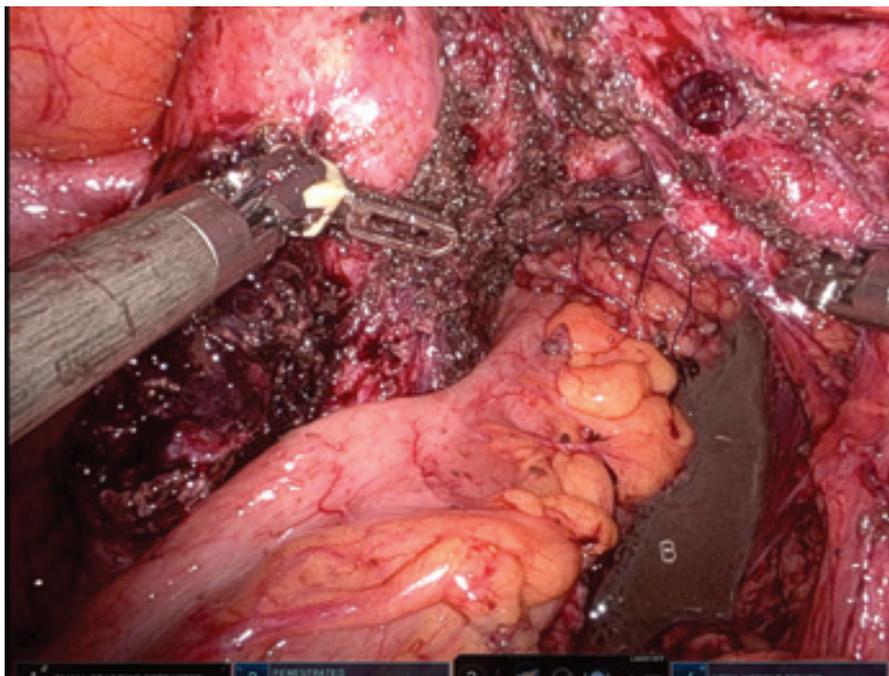


Fig. 4. Postoperative finding.

Obr. 4. Pooperační nález.

application of 25 mg of indocyanine green [7]. The rectal specimen was removed and stapler head constructed through a mini-laparotomy in the left lower abdomen. After construction of the end-to-end anastomosis, a mesorectal flap was prepared and after confirming its perfusion with indocyanine

green (the same observation window as mentioned above) (Fig. 3), was interposed and fixed with absorbable sutures do interstitial wall, between the vaginal suture and the intestinal anastomosis (Fig. 4). A rectal tube was placed across the anastomosis for 48 hours.



Fig. 5. Specimen of the rectosigma, in upper part with stenosis, lower part nodule of the rectum with vagina.

Obr. 5. Resekát rekrosigmatu, v horní části stenotizující ložisko na sigmatu, v dolní části rektální uzel s částí pochvy

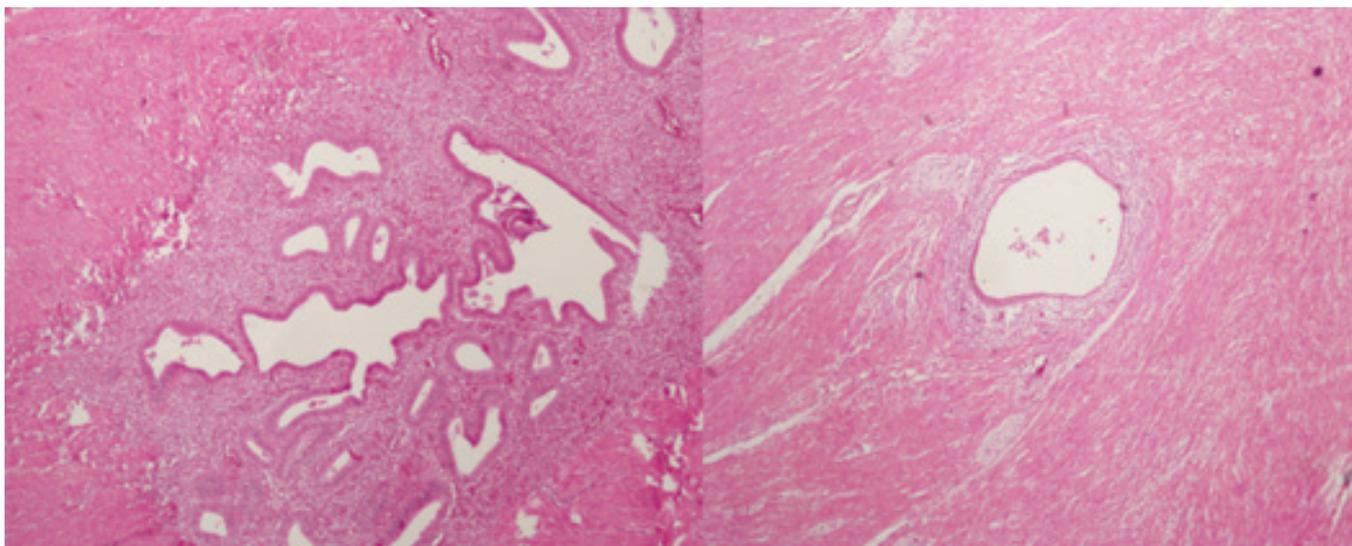


Fig. 6. Specimen in hematoxylin eosin, rectum left, vagina right.

Obr. 6. Preparát v hematosylin-eosinu, vlevo rektum, vpravo pochva.

The rectosigmoid specimen contained two nodules: one in the rectum measuring 5 × 3 cm (consistent with ultrasound findings) and another about 12 cm proximal, measuring 4 × 3 cm, which narrowed the sigmoid lumen to 2 cm (Fig. 5, 6).

Postoperative recovery was uneventful, with passage of gases and stool on days 2 and 4, resp. The patient was discharged on 7th postoperative day. Follow-up every 14 days up to 6 weeks showed no complications. The presence of the mesorectal flap was confirmed postoperatively by ultrasound via the posterior fornix.

Five months after the surgery, the patient conceived through assisted reproduction with a donated oocyte, but the pregnancy ended as an anembryonic gestation, with the necessity for instrumental revision.

Discussion

Decision-making regarding which surgical procedure to perform in such patients is extremely challenging, with no clear consensus. An individualized approach is preferred. Some authors have attempted to propose algorithms based on clinical experience and expertise, considering symptomatology, lesion size, and number of lesions. Shaving is recommended for unifocal nodules up to 2–3 cm, discoid resection for incomplete shaving, and segmental resection for multifocal lesions [1]. Another factor is the depth of invasion, which is difficult to assess preoperatively. Lesions affecting 40% or more of the bowel circumference have an 89.3% probability of involvement of the submucosal and mucosal layers, though this has only been confirmed in resection specimens, not preoperatively by ultrasound or magnetic resonance imaging [8].

Another factor to consider is the risk of residual disease. Due to complication risks, less invasive procedures (shaving) may be preferable [1]. However, after



Fig. 7. Ultrasound picture of the mesorectum between rectum and vagina.

Obr. 7. Ultrazvukové zobrazení pooperačního nálezu kaliperů nastaveny na mesorektum mezi stěnou rekta a pochvy.

nodule excision, residual disease may remain in more than 19.2% of cases [9], and in 14.6% of colorectal resections, residual disease may even be present at the resection margin [10]. Although this does not seem to have effect in short-term outcomes [10]. In most of the cases, especially in larger nodules, the nodule margin contains fibrosis and metaplastic smooth muscle with a hypoperfusion pattern, which may be assessed by using fluorescent dye during nodule excision [7].

Conclusion

Ischemia plays a key role in the pathogenesis of rectovaginal fistulas. Preventing ischemia through minimally destructive resection techniques and real-time perfusion assessment with indocyanine green may help to prevent rectovaginal fistulas and other complications associated with postoperative ischemia in the affected area.

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Submitted/Doručeno: 5. 10. 2025

Accepted/Přijato: 8. 10. 2025

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Publication ethics: The Editorial Board declares that the manuscript met the ICMJE uniform requirements for biomedical papers.

Publikační etika: Redakční rada potvrzuje, že rukopis práce splnil ICMJE kritéria pro publikace zasílané do biomedicínských časopisů.

Conflict of interests: The authors declare they have no potential conflicts of interest concerning the drugs, products or services used in the study.

Konflikt zájmů: Autoři deklarují, že v souvislosti s předmětem studie/práce nemají žádný konflikt zájmů
