Surg Endosc (2015) 29:3712–3716
DOI 10.1007/s00464-015-4141-x

Hybrid NOTES transvaginal intraperitoneal onlay mesh in abdominal wall hernias: an alternative to traditional laparoscopic procedures

Alexandre Descloux[1] · Sebastian Pohle[1] · Antonio Nocito[1] · Andreas Keerl[1]

Received: 17 September 2014 / Accepted: 19 February 2015 / Published online: 12 March 2015

Abstract
Introduction Abdominal wall hernias are increasingly treated by laparoscopic placement of an intraperitoneal onlay mesh (IPOM). We present an alternative technique for women: the laparoscopic-assisted transvaginal IPOM.
Methods Before surgery, all patients underwent a gynecological examination. The patients agreed to IPOM repair via a transvaginal approach, and written informed consent for surgery was obtained. Pneumoperitoneum was established with a Veress needle at the umbilicus. This access was subsequently dilated to 5 mm (VersaStep), and a 5-mm laparoscope was inserted. Under laparoscopic view, the transvaginal trocars (12-mm VersaStep and 5-mm flexible accesses) were safely inserted after lifting the uterus with a uterus manipulator. After preparation of the falciform ligament, the ligamentum teres and the preperitoneal fat, a lightweight composite mesh was introduced through the transvaginal access and fixed with absorbable tacks using the double-crown technique.
Results From September 2011 to December 2012, we performed six laparoscopic-assisted transvaginal IPOM procedures (one epigastric, three umbilical, two combined epigastric and umbilical hernias; all were primary hernias). In the initial phase, only patients with small or medium primary abdominal wall hernia were selected (max. 3 cm diameter). Median hospital stay was 3 days (range 2–6 days). One minor complication occurred perioperatively (second-degree skin burn to the labia majora). At 1-year follow-up, we identified one recurrence in a high-risk patient with a body mass index higher than 35 kg/m^2. No infection and no mortality were observed.
Conclusion Although no final conclusion can be made regarding the presumed non-inferiority of this technique in terms of recurrence and mesh infection compared with traditional laparoscopic IPOM, laparoscopic-assisted transvaginal IPOM is a feasible alternative to treat abdominal wall hernias.

Keywords Transvaginal · NOTES · Mesh · IPOM · Abdominal wall hernia

Laparoscopic surgery requires intensive training and a high degree of manual and technical skill. Today, ventral and incisional abdominal wall hernias are increasingly treated by laparoscopic placement of an intraperitoneal onlay mesh (IPOM). In the last few years, minimally invasive surgery has continued to develop, further reducing abdominal wall trauma.

The major benefits of natural orifice transluminal endoscopic surgery (NOTES) include less postoperative pain, faster patient recovery and quicker return to the workplace and daily activities, as well as improved cosmesis [1]. The advantages of NOTES are mostly due to the avoidance of fascial trauma. When considering known complications of trocar hernias, an abdominal wall access alone might be a risk factor for hernia recurrence following traditional laparoscopic procedures. NOTES procedures can be divided in pure NOTES and hybrid NOTES interventions. For the hybrid NOTES technique, an additional umbilical trocar is performed for increased safety during the insertion of trocars through natural orifices.

The aim of this study was to assess the feasibility and safety of a hybrid NOTES technique in abdominal wall

✉ Alexandre Descloux
alexandre.descloux@ksb.ch

[1] Department of Surgery, Kantonsspital Baden, 5404 Baden, Switzerland

hernia repair. We aimed to minimize abdominal wall trauma during surgery, reducing secondary trocar site-related complications, such as pain, surgical site infections and trocar site hernia formation. We wanted to improve cosmesis and patient satisfaction.

Methods

This cohort study was conducted in a single center and was analyzed retrospectively. Between September 2011 and December 2012, we performed six laparoscopic-assisted transvaginal IPOM procedures. Before surgery, all patients underwent a gynecological examination. The patients agreed to IPOM repair via transvaginal approach, and written informed consent for surgery was obtained. The transvaginal access was approved by the IRB.

On the operating table, the patient was laid in modified lithotomy position, enabling transvaginal as well as the traditional laparoscopic approach. The patient was draped in standard sterile fashion, using betadine solution for the genital region and betaseptic solution for the abdomen. The urinary bladder was emptied using a single-use catheter at the beginning of the procedure. Antibiotic prophylaxis was assured with insertion of a 500 mg metronidazole ovule into the vagina before bedtime the evening before surgery and with 1.5 g of cefuroxime intravenous within 30 min prior to incision. General anesthesia was mandatory.

Pneumoperitoneum was established with a Veress needle at the umbilicus. CO2 was insufflated to a pressure of 12–14 mmHg. The transumbilical access was subsequently dilated to 5 mm (VersaStep, Covidien, Dublin, Ireland), and a 5-mm 30° laparoscope was inserted. The patient was then switched to the Trendelenburg position. The transvaginal trocars were inserted under laparoscopic view (12-mm VersaStep plus, Covidien, Dublin, Ireland and 5 mm flexible access) behind the cervix into the pouch of Douglas (posterior colpotomy). The second 10-mm 30° camera was inserted through the 12-mm transvaginal trocar. The falciform ligament, ligamentum teres and preperitoneal fat tissue around the hernia were dissected with electrosurgical cutting devices for optimal placement and proper fixation of the mesh in the fascia. The dissected fat tissue was removed using an Endobag specimen retrieval system. A lightweight composite mesh (Physiomesh, Ethicon, Somerville, NJ, USA) was then introduced into the abdominal cavity through the 12-mm transvaginal trocar, positioned centrally and fixed with absorbable tacks (AbsorbaTack™ Fixation Device, Covidien, Dublin, Ireland, or Ethicon SecureStrap™ Fixation Device, Johnson & Johnson, Cincinnati, OH, USA) using double-crown technique and overlapping the margin of the hernia opening with 5 cm of mesh. During mesh fixation, the pneumoperitoneum was reduced to 8–9 mmHg. Pressure was subsequently restored to 12–14 mmHg. We inspected the abdomen for hemostasis and removed all trocars. After evacuation of the pneumoperitoneum, no suturing of the abdominal wound was necessary, apart from skin closure (Monocryl 4-0, Ethicon, Somerville, NJ, USA). The 12-mm vaginal access was closed with absorbable sutures (coated Vicryl 2-0, Ethicon, Somerville, NJ, USA). The 5-mm vaginal wound did not require any further care. Every procedure was meticulously recorded with digital videodisc. Our surgical procedures fulfilled the high requirements of the International Endo Hernia Society (IEHS) and recently appeared in Surgical Endoscopy and Other Interventional Techniques [2].

In case of umbilical hernia, the first trocar was placed through the hernia opening. After insertion of the two transvaginal trocars under visualization, the transumbilical trocar could be removed. The rest of the procedure was performed in one-hand technique transvaginally with 5-mm instruments under transvaginal view, using a 10-mm 30° laparoscope. No additional abdominal trocar was necessary.

All patients were scheduled as inpatients. The analgesia was routinely assured by 4 g paracetamol and metamizole daily fix and 200 mg tramadol in reserve. Demissio was accorded by sufficient analgesia and evacuation of the bowels. In addition to normal postoperative surgical consultation, patients were seen by a gynecologist 3 weeks post-surgery.

Results

From September 2011 to December 2012, we selected six patients for laparoscopic-assisted transvaginal IPOM procedures. All patients agreed to the intervention via a transvaginal approach. In this initial phase, only patients with small or medium primary abdominal wall hernia openings were selected (max. 3 cm in diameter). Based on the European Hernia Society (EHS) classification for primary and incisional abdominal wall hernias, we repaired one epigastric, three umbilical and two combined epigastric and umbilical hernias [3]. Median age was 50 years (range 33–62 years). Median body mass index was 22.4 kg/m^2 (range 19.5–37.1 kg/m^2). Five patients had undergone previous abdominal surgery (one laparoscopic-assisted rectosigmoid resection, one direct closure of an umbilical hernia and two open inguinal hernia mesh repairs) and/or gynecological surgery (two Caesarian sections and two vaginal hysterectomies). Median operative time was 67 min (range 30–90 min.). Only one minor complication occurred perioperatively. A second-degree skin burn to the labia majora was observed. This incident

was due to a damaged isolation of a grasper. Median hospital stay was 3 days (range 2–6 days).

Outpatient control: The patients underwent an examination by a gynecological specialist 3 weeks post-surgery. No gynecological complications or dyspareunia were recorded. A follow-up consultation was organized at our institution (median 15 months, range 5.5–20 months). One recurrence occurred in the case of the patient with 37.1 kg/m^2 body mass index, implanted mesh of 25 × 20 cm and with combined hernia opening, epigastric (1.5 cm, small) and umbilical (3 cm, medium). No infection and no mortality were recorded.

Discussion

Since the first transvaginal cholecystectomy, surgical techniques that do not cause scarring have developed quickly [4]. In 2009, Jacobsen et al. [5] published the first case report of NOTES IPOM, followed by Bruna [6]. Last year, Wood published a small case series of six pure transvaginal ventral hernia repair procedures performed between November 2010 and February 2012 [7]. Others publications are known, but these describe transvaginal hernia repair in animals [8–11]. The IEHS even designated a chapter to the new technological developments in part 3 of the recently published Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias [12].

Our study has evident limitations, for example the retrospective design, the bias in patient selection and the small number of patients operated on with this innovative technique. However, we believe to be reporting the largest case series of hybrid transvaginal abdominal wall hernia repair in humans.

More practice in transvaginal surgery is required to ensure increased safety and the dexterity needed for this innovative method for IPOM. To date, we have completed over 500 hybrid NOTES transvaginal cholecystectomies at our institution. Despite our high level of expertise in transvaginal cholecystectomy and laparoscopic IPOM, we only selected small and medium hernias in an elective setting for this initial phase of hernia repair in NOTES technique.

As for transvaginal cholecystectomy, we always introduce the vaginal accesses under visual control through a 5-mm abdominal trocar. We agree with other authors that a blind insertion of trocar transvaginally would be too uncertain or present unnecessary danger to the patient [5, 13]. Safety has priority. However, this point of view remains contested [14].

The outcome of hernia repairs is calculated by recurrence, postoperative chronic pain and complications. The recurrence rate is probably the most critical parameter in terms of quality control. The recurrence rate for laparoscopic IPOM is similar to open ventral hernia repair [15].

Studies on trocar site hernia following surgery are mostly conducted on patients following laparoscopic cholecystectomy. Known patient-related risk factors are older age, high body mass index and diabetes. Hernia-related risk factors are recurrent hernia, intraoperative enlargement of trocar site for specimen extraction and postoperative surgical site infection [16, 17]. The use of large-size trocars (over 10 mm) and their insertion along the abdominal midline are also two of the greatest risk factors for developing a new hernia. A 5-mm trocar used in the abdomen does not seem to increase the risk of hernia [18].

In the review by Bunting with a large collective (5984 patients), the overall incidence of trocar site hernia was 1.7 %. However, the follow-up time of the seven included studies was very heterogeneous (range 1 month–5 years) [16]. In a more recently published single-center study on 241 patients with 3-year follow-up, the incidence of trocar site hernia rose to 25.9 % [17].

Such studies reinforced our conviction, on the one hand, that transvaginal cholecystectomy is a suitable approach and, on the other hand, that transvaginal abdominal wall hernia repair could be appropriate for future procedures.

One patient experienced a recurrence in our sample. The patient had a body mass index of 37.1 kg/m^2, an established risk factor according to IEHS guidelines (level 2B statement) [2]. Hers was the largest hernia opening of all the selected patients. It was a combined small epigastric (1.5 cm) and medium umbilical (3 cm) hernia, 8 cm removed from each other. The defects were covered with the biggest mesh (25 × 20 cm) of the group. Here again, in accordance with the IEHS guidelines for hernia repair in obese patients, we created a 5-cm overlap and used transfascial sutures as well as tacks with double-crown technique for mesh fixation [2]. There were no complications or technical problems during surgery. The patient was reoperated 19 months later. The mesh was adherent to the omentum majus in the epigastrium. In other words, non-ingrowth of the mesh with the abdominal wall was observed. The transfascial sutures were still in the correct initial position. We cut the mesh, closed the gap with permanent sutures and applied another mesh to cover the epigastric recurrence using the laparoscopic IPOM technique.

Laparoscopic hernia repairs lead to lower incidence of surgical site infections than open procedures [15]. Heniford reported an overall infection rate of 1.8 % in a 9-year follow-up of 850 laparoscopic ventral hernia repairs [19]. In contrast to open surgery, a surgical site infection after laparoscopy does not indicate mesh infection and does not

automatically require mesh removal. The non-inferiority of the transvaginal approach for abdominal wall hernia mesh repair must be investigated further.

Linke and Zerz et al. [20] demonstrated that vaginal disinfection significantly decreased vaginal bacterial load, leading mostly to sterile vaginal culture. In others studies on animals and humans, results demonstrated that transvaginal access for peritoneoscopy, peritoneal and liver biopsy or synthetic mesh placement could be superior in terms of sterility than if performed classically through skin incisions [21, 22]. Another study in NOTES transgastric hernia repair demonstrated a significant reduction in the percentage of contaminated surface area if the mesh insertion was performed with a modified esophageal stent delivery system, minimizing contact. Without protection, contamination was increased over 6000 times [8]. Therefore, the use of a protective device is essential to avoid mesh-skin and mesh-mucosa contact.

Sexual function and fertility are of greatest interest after transvaginal NOTES procedures [23]. Of sexually active patients, 95.5 % in the prospective, single-center, cohort study of Linke and Zerz [24] would agree to undergo the same procedure with a transvaginal approach again, especially young nulliparous women.

Conclusion

The hybrid NOTES technique in abdominal wall hernia repair not only offers the advantages of pure NOTES procedures, for example minimal abdominal wall trauma and any related complications as well as better cosmesis, but also improves cosmesis and patient satisfaction. The hybrid NOTES technique guarantees safety comparable to traditional laparoscopic hernia surgery during the insertion of trocars.

Thereby, laparoscopic-assisted transvaginal IPOM is a feasible alternative to treat abdominal wall hernias. No definite conclusion can be made regarding the presumed non-inferiority of this technique in terms of recurrence and mesh infection compared with traditional laparoscopic IPOM, but we believe it to be effective and reliable. Further investigation and prospective clinical trials are mandatory.

Disclosures Alexandre Descloux, Sebastian Pohle, Antonio Nocito and Andreas Keerl have no conflict of interest to declare.

References

1. Santos BF, Teitelbaum EN, Arafat FO, Milad MP, Soper NJ, Hungness ES (2012) Comparison of short-term outcomes between transvaginal hybrid NOTES cholecystectomy and laparoscopic cholecystectomy. Surg Endosc 26:3058–3066
2. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, Köckerling F, Kukleta J, LeBlanc K, Lomanto D, Misra MC, Morales-Conde S, Ramshaw B, Reinpold W, Rim S, Rohr M, Schrittwieser R, Simon TH, Smietanski M, Stechemesser B, Timoney M, Chowbey P (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias [International Endohernia Society (IEHS)]—part 1. Surg Endosc 28:2–29
3. Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, Chelala E, Dietz UA, Eker HH, El Nakadi I, Hauters P, Hidalgo Pascual M, Hoeferlin A, Klinge U, Montgomery A, Simmermacher RK, Simons MP, Smietański M, Sommeling C, Tollens T, Vierendeels T, Kingsnorth A (2009) Classification of primary and incisional abdominal wall hernias. Hernia 13(4):407–414
4. Marescaux J, Dallemagne B, Perretta S, Wattiez A, Mutter D, Coumaros D (2007) Surgery without scars: report of transluminal cholecystectomy in a human being. Arch Surg 142(9):823–826 discussion 826–827
5. Jacobsen GR, Thompson K, Spivack A, Fischer L, Wong B, Cullen J, Bosia J, Whitcomb E, Lucas E, Talamini M, Horgan S (2010) Initial experience with transvaginal incisional hernia repair. Hernia 14:89–91
6. Bruna M, Noguera J, Martinez I, Oviedo M (2013) Eventroplastia transvaginal hibrida. Cir Esp 91:539–541
7. Wood SG, Panait L, Bell RL, Duffy AJ, Roberts KE (2013) Pure transvaginal umbilical hernia repair. Surg Endosc 27:2966
8. Earle DB, Romanelli JR, McLawhorn T, Omotosho P, Wu P, Rossini C, Swayze H, Desilets DJ (2012) Prosthetic mesh contamination during NOTES transgastric hernia repair: a randomized controlled trial with swine explants. Hernia 16:689–695
9. Earle DB, Desilets DJ, Romanelli JR (2010) NOTES transgastric abdominal wall hernia repair in a porcine model. Hernia 14:517–522
10. Lomanto D, Dhir U, So JBY, Cheah WK, Moe MA, Ho KY (2009) Total transvaginal endoscopic abdominal wall hernia repair: a NOTES survival study. Hernia 13:415–419
11. Powell B, Whang SH, Bachman SL, Astudillo JA, Sporn E, Miedema BW, Thaler K (2010) Transvaginal Repair of a large chronic porcine ventral hernia with synthetic mesh using NOTES. JSLS 14:234–239
12. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, Köckerling F, Kukleta J, LeBlanc K, Lomanto D, Misra MC, Morales-Conde S, Ramshaw B, Reinpold W, Rim S, Rohr M, Schrittwieser R, Simon TH, Smietanski M, Stechemesser B, Timoney M, Chowbey P (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias [International Endohernia Society (IEHS)]—part III. Surg Endosc 28:380–404
13. Zornig C, Mofid H, Siemssen L, Wenck CH (2010) NOTES über den transvaginalen Zugang. Chirurg 81:426–430
14. Zorron R, Maggioni LC, Pombo L, Oliveira AL, Carvalho GL, Filgueiras M (2008) NOTES transvaginal cholecystectomy: preliminary clinical application. Surg Endosc 22(2):542–547
15. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, Köckerling F, Kukleta J, LeBlanc K, Lomanto D, Misra MC, Morales-Conde S, Ramshaw B, Reinpold W, Rim S, Rohr M, Schrittwieser R, Simon TH, Smietanski M, Stechemesser B, Timoney M, Chowbey P (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias [International Endohernia Society (IEHS)]—part 2. Surg Endosc 28:353–379
16. Bunting DM (2010) Port-site hernia following laparoscopic cholecystectomy. JSLS 14(4):490–497
17. Comajuncosas J, Hermoso J, Gris P, Jimeno J, Orbeal R, Vallverdú H, López Negre JL, Urgellés J, Estalella L, Parés D (2014)

Risk factors for umbilical trocar site incisional hernia in laparoscopic cholecystectomy: a prospective 3-year follow-up study. Am J Surg 207(1):1–6
18. Erdas E, Dazzi C, Secchi F, Aresu S, Pitzalis A, Barbarossa M, Garau A, Murgia A, Contu P, Licheri S, Pomata M, Farina G (2012) Incidence and risk factors for trocar site hernia following laparoscopic cholecystectomy: a long-term follow-up study. Hernia 16(4):431–437
19. Heniford BT, Park A, Ramshaw BJ, Voleller G (2003) Laparoscopic repair of ventral hernias: nine years' experience with 850 consecutive hernias. Ann Surg 238(3):391–400
20. Linke GR, Tarantino I, Bruderer T, Celeiro J, Warschkow R, Tarr PE, Müller-Stich BP, Zerz A (2012) Transvaginal access for NOTES: a cohort study of microbiological colonization and contamination. Endoscopy 44(7):684–689
21. Aimore Bonin E, Paggi Claus CM, Torres MF, Ligocki Campos AC, Totti Cavazzola L, de Paula Loureiro M (2013) Evaluation of bacterial contamination after "pure" (totally) transvaginal NOTES diagnostic peritoneoscopy with biopsies in swine: a comparative study with laparoscopy. Surg Endosc 27:421–427
22. Bates AT, Capes T, Krishan R, LaBombardi V, Pipia G, Jacob BP (2014) The prepped vaginal canal may be a sterile conduit for ventral hernia mesh insertion: a prospective comparative study. Surg Endosc 28:886–890
23. Jacobsen GR, Barajas-Gamboa JS, Coker AM, Cheverie J, Aitor Macias C, Sandler BJ, Talamini MA, Horgan S (2014) Transvaginal organ extraction: potential for broad clinical application. Surg Endosc 28:484–491
24. Linke GR, Luz S, Janczak J, Zerz A, Schmied BM, Siercks I, Warschkow R, Beutner U, Tarantino I (2013) Evaluation of sexual function in sexually active women 1 year after transvaginal NOTES: a prospective cohort study of 106 patients. Langenbecks Arch Surg 398(1):139–145