Peritoneal closure using self-anchoring-barbed absorbable sutures during laparoscopic transabdominal preperitoneal inguinal hernioplasty: How to make it more safe?

Axel Gilbert¹, Fawaz Abo-Alhassan¹,², Pablo Ortega-Deballon¹, Nicolas Cheynel¹, Patrick Rat¹, Olivier Facy¹

Abstract:

CONTEXT: Peritoneal closure with a barbed suture during laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair is a controversial subject due to the risk of postoperative intestinal adhesions and occlusions formed by this type of suture. This risk, however, was only reported in several case reports. The purpose of this study is to determine the incidence of postoperative intestinal obstructions related to the use of barbed suture materials in laparoscopic hernia repair (TAPP).

PATIENTS AND METHODS: We included all patients that underwent laparoscopic TAPP inguinal hernia repair between October 2012 and October 2017. All peritoneal closures were accomplished using absorbable barbed sutures. Operative data were collected in a dedicated database and analyzed retrospectively.

RESULTS: Only 3 out of the 320 patients included (0.9%) presented with an early postoperative intestinal obstruction and required further surgery. Two of the three patients (0.6%) were found to have intestinal incarceration in the peritoneal defects initially created during the hernia repair. However, the last patient had an intestinal volvulus due to adhesions formed with the barbed suture. None of the patient characteristics collected were significant risk factors for developing postoperative intestinal obstructions.

CONCLUSION: In this study, peritoneal closure using barbed suture material did not increase the risk of early postoperative intestinal obstruction, in comparison to other suture materials reported in the literature. The use of barbed absorbable sutures for peritoneal closure during laparoscopic TAPP seems to be safe when sutures are cut short and covered by the peritoneum.

Keywords: Absorbable barbed suture, intestinal obstruction, peritonization, V-Loc

Introduction

One of the final steps of laparoscopic hernioplasty is the closure of the peritoneal defect that was created by covering the prosthetic mesh and to prevent any intestinal incarcerations.

Barbed sutures were proposed to be used for this peritoneal closure, however, several
case reports claimed intestinal obstructions due to adherions formed between the bowel and the barbed suture.\textsuperscript{[1]−[6]} This has led to the withdrawal of these suture materials from several surgical teams.\textsuperscript{[7]−[10]}

Therefore, the main focus of this study is to analyze the incidence of intestinal obstructions developing due to the use of barbed absorbable sutures in laparoscopic transabdominal preperitoneal (TAPP) hernioplasty.

**Patients and Methods**

**Inclusion criteria**

All unilateral or bilateral laparoscopic TAPP inguinal hernioplasties that were performed between October 2012 and October 2017 in Dijon University Hospital were retrospectively included in the study. Peritoneal closure of all patients included in this study was done using V-Loc\textsuperscript{TM} 180 3/0 (Covidien\textsuperscript{©}, Mansfield, USA). These interventions were carried out by senior surgeons or surgeons in training.

**Data collection**

Preoperative, peroperative, and postoperative data were collected. Preoperative characteristics for every patient included were age, sex, body mass index, American Society of Anesthesiologists score, abdominal surgical history, and whether the hernioplasty was a primary intervention or a recurrence.

Perioperative variables included whether the intervention was an emergency or elective procedure, unilateral or bilateral, and operative time.

Postoperative variables included length of stay, rates of rehospitalization, and postoperative morbidity classified according to the Clavien-Dindo (CD).\textsuperscript{[11]} These postoperative morbidities were subdivided into early (within the first 30 days) and late morbidities (during the 1\textsuperscript{st} year).

**Statistical analysis**

Statistical analysis was performed using R Software (R Development Core Team (2016), Vienne, Autriche). Results are expressed in frequency and percentages for qualitative variables. As for quantitative variables, mean and median with 95\% confidence interval were used.

**Results**

**Description of the population**

During the 5-year inclusion period, 810 hernioplasties were performed, including 173 bilateral hernioplasties, which represent a total of 983 hernioplasties. The open technique was carried out in 43.4\% of cases (353 procedures), while the rest (56.6\%) were done laparoscopically (320 procedure by TAPP and 137 by total extraperitoneal [TEP] technique).

Therefore, only 320 patients who had benefitted from TAPP hernioplasty were included in the study. Among those 320 patients, 85 were operated for bilateral hernioplasties, making a total of 405 hernias treated by TAPP. All clinical characteristics of these 405 hernias included, with their preoperative variables, are summarized in Tables 1 and 2. Conversion rate between laparoscopic techniques to open was zero.

**Primary endpoint**

Of the 320 patients included, three presented with intestinal obstruction in the early postoperative period (first 30 days postoperatively). All of these three patients required emergency surgical reintervention. Two out of the three reinterventions had intestinal incarcerations in the peritoneal defect at 5\textsuperscript{th} postoperative day (POD). The third patient had intestinal volvulus anchored on the barbed suture remnant at the 3\textsuperscript{rd} POD. None of the variables analyzed were significantly associated with risk factors for early postoperative intestinal obstruction.

| Table 1: Patient characteristics | Total (n=320) |
|---------------------------------|--------------|
| Age (years)                     | 58±2         |
| Sex, n (%)                      |              |
| Female                          | 59 (18)      |
| Male                            | 261 (82)     |
| BMI (kg/m\textsuperscript{2})   | 24.7±0.4     |
| ASA score                       | 2±0.1        |
| Surgical history, n (%)         |              |
| Abdominal                       | 133 (42)     |
| Ipsilateral hernia (recurrence) | 47 (15)      |
| Open technique                  | 44 (94)      |
| Laparoscopic technique          | 3 (6)        |

BMI: Body mass index, ASA: American Society of Anesthesiologists

| Table 2: Peroperative data      | Total (n=320), n (%) |
|---------------------------------|---------------------|
| Surgery, n (%)                  |                     |
| Emergency                       | 36 (11)             |
| Elective                        | 284 (89)            |
| Hernia side, n (%)              |                     |
| Unilateral                      | 235 (73)            |
| Left                            | 100 (43)            |
| Right                           | 135 (57)            |
| Bilateral                       | 85 (27)             |
| Operating time (min)            | 70±3                |
| Procedure, n (%)                |                     |
| Ambulatory                      | 167 (52)            |
| Hospitalization                 | 153 (48)            |
| Length of stay (n=153) (days)   | 2±0.7               |
Morbidity and mortality

Mortality rate was zero. A total of 261 (82%) patients were clinically followed up at 1 month following the surgery. Among these, 11 were readmitted during the first 30 PODs. Five patients were reoperated; in addition to the three patients mentioned above, the two remaining were reoperated for hernia recurrence (at 3 weeks postoperatively) and infected prosthetic mesh. The remaining six patients were rehospitalized (but not operated) due to complications such as:

- Pain (1 patient, treated by analgesics, CD1)
- Seroma (1 patient, CD1)
- Hematoma (1 patient treated by analgesics but also transfused CD2 and 1 patient [0.3%] treated with radiological embolization of superficial epigastric artery, CD 3)
- Acute urinary retention (1 patient which needed a urinary catheter placement, CD2)
- Iatrogenic bladder injury (1 patient treated with urinary catheter placement, CD2).

During the 1st-month postoperatively, 83 patients (26%) presented minor complications that did not need rehospitalization, such as:

- Pain (47 patients [15%), CD1)
- Seroma (15 patients [4.7%], CD 1)
- Hematoma (19 patients [5.9%], CD 1)
- Port-site abscess (2 patients [0.6%], CD1).

Following the 1st-month postoperatively, until 1 year after the surgery, 13 patients (4%) called their surgeon back because they presented with minor complications such as:

- Chronic pain (5 patients treated with analgesics, CD1)
- Hernia recurrence (4 patients reoperated, CD3, and one patient who refused surgical reintervention, CD1)
- Periumbilical incisional hernia (2 patients, one of which needed surgical reintervention CD3, while the other one did not, CD1)
- Dysuria (1 patient CD1).

Discussion

In our retrospective 5-year study, the number of laparoscopic TAPP hernioplasties performed was not considered high. This is due to the fact that some surgeons prefer the open technique, especially in an emergency setting or for large inguinoscrotal hernias, while some others prefer the TEP technique reducing the risk of postoperative intestinal obstruction.\[12\]-\[14\] The ratio between the three techniques, their operative time, and their complications remains comparable to those found in the literature.\[15\] Fifty-nine patients were not clinically followed up the 1st-month postoperatively; however, they were clearly informed to contact the surgeon if any complications occurred. This was either due to the fact that they were young patients who had benefitted from ambulatory surgery or for other reasons such as those who lived far away.

Postoperative rates of intestinal obstructions after laparoscopic TAPP hernioplasty were estimated according to the literature to be between 0% and 3.7%.\[16\]-\[19\] Certainly, the type of suture material used and the type of peritoneal closure used (simple or continuous sutures, surgical glue, and staples) were not always detailed. These intestinal obstructions are mostly due to intestinal incarcerations in the peritoneal defect created peroperatively which were supposed to be closed. Loosening of the suture or an incorrect surgical technique used for peritonization could be the reason for the persistence of these peritoneal defects leading to complications such as incarcerations.\[12,17,20\] Occlusions could then occur not only because of the small intestine strangulation into the peritoneal defect but also because of adhesions on the noncovered mesh. For that reason, a very careful closure of the peritoneal gap is necessary during laparoscopic TAPP inguinal hernioplasty. In addition, laparoscopic port-site hernias could also be another reason for postoperative intestinal obstruction.\[21,22\]

Closure of the peritoneal defect at the end of laparoscopic TAPP hernioplasty is highly facilitated by the rapidity of the use of barbed absorbable sutures, especially because knots are not required. This facility for suturing improves the laparoscopic learning curve of young training surgeons. In comparison with peritonization by surgical staples, the use of barbed sutures takes a longer time but concurrently minimizes postoperative pain.\[23\] The efficiency of this suture material has also been reported on closure of laparotomies performed on pigs,\[24\] cadavers,\[25\] and during pediatric surgical procedures.\[26\] These studies did not show any increase in the risk of postoperative wound dehiscence or incisional hernias, compared to classic nonbarbed sutures. Furthermore, a recent retrospective Japanese study concluded that V-Loc™ 180 could be used without increasing the risk of intestinal obstruction.\[27\]

The V-Loc™ 180 gets absorbed within 180 days on average. Hence, by definition, adhesions due to these barbed sutures should not occur after 6 months postoperatively. All three cases reported in our study occurred within the 1st month. After the 1st month, no patient that underwent laparoscopic TAPP hernioplasty was readmitted for intestinal obstruction. It could be stated here that there exists a bias as not all patients were systematically followed up after the 1st month postoperatively, even though most acute intestinal obstructions have been reported in the literature to occur during the first few days.
Barbed sutures have been described as being responsible for forming adhesions, especially when the distal extremity is left long. However, an animal study showed that adhesions were not necessarily more frequent with barbed suture than with the nonbarbed. Covering the extremity of these barbed sutures at the end of suturing [Figure 1] is actually recommended by the manufacturers. This can be achieved by making two or three back stitches at the end of the peritoneal closure, in such a way that after some traction and shortcut, the suture will retract under the peritoneum without any danger for opening. Some authors prefer to cover the extremities with absorbable hemostatic agents such as Surgicel or by the peritoneum using laparoscopic surgical staples. These tips and tricks, which are not time-consuming, could however minimize postoperative morbidities. In our experience, compliance with this recommendation and standardization of the surgical techniques have led to a low rate of postoperative intestinal obstructions.

Postoperative intestinal obstructions as a result of adhesion formations after laparoscopic hernioplasty should not be disregarded. To avoid acute intestinal perforation or ischemia, early surgical reintervention is almost always necessary. With a prosthetic mesh being placed during the hernioplasty, bacterial translocations should be avoided as much as possible. The management of an infected prosthetic mesh remains a challenge, which most often requires the mesh to be removed as early as possible.

These results require to be confirmed by a prospective randomized study comparing barbed sutures with other classic suture materials. This however will require a greater population size.

**Conclusion**

A very careful closure of the peritoneal gap is necessary during laparoscopic TAPP inguinal hernioplasty. The manufacturer’s recommendations for the use of barbed sutures should also be respected to avoid unnecessary postoperative complications, that is, the end of the suture must be cut as short as possible and covered by the peritoneum.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Filser J, Reibetanz J, Krajinovic K, Germer CT, Dietz UA, Seyfried F, et al. Small bowel volvulus after transabdominal preperitoneal hernia repair due to improper use of V‑loc barbed absorbable wire – Do we always “read the instructions first”? Int J Surg Case Rep 2015;6C: 193‑5.

2. Ovesen RJ, Friis‑Andersen H. Ileus caused by V‑loc sutures. Ugeskr Laeger 2014;176. pii: V03130165.

3. Köhler G, Mayer F, Lechner M, Bittner R. Small bowel obstruction after TAPP repair caused by a self‑anchoring barbed suture device for peritoneal closure: Case report and review of the literature. Hernia 2015;19:389‑94.

4. Thubert T, Pourcher G, Deffieux X. Small bowel volvulus following peritoneal closure using absorbable knotless device during laparoscopic sacral colpopexy. Int Urogynecol J 2011;22:761‑3.

5. Segura‑Sampedro JJ, Ashrafian H, Navarro‑Sánchez A, Jenkins JT, Morales‑Conde S, Martínez‑Isla A, et al. Small bowel obstruction due to laparoscopic barbed sutures: An unknown complication? Rev Esp Enferm Dig 2015;107:677‑80.

6. Buchs NC, Ostermann S, Hauser J, Roche B, Iselin CE, Morel P, et al. Intestinal obstruction following use of laparoscopic barbed suture: A new complication with new material? Minim Invasive Ther Allied Technol 2012;21:369‑71.

7. Quibel S, Roman H, Marpeau L. Volvulus following barbed suture. Gynecol Obstet Fertil 2012;40:382‑3. doi: 10.1016/j. yogobe.2012.04.003.

8. Deffieux X, Pachy F, Donnadieu A‑C, Trichot C, Faiivre E, Fernandez H. Péritionisation avec un fil cranté résorbable sans nœud encours de promontofixation laparoscopique. J Gynecol Obstet Biol Reprod (Paris). 2011;40:65‑7. doi: 10.1016/j.jgyn.2010.08.003.

9. Alessandri F, Remorgida V, Venturini PL, Ferrero S. Unidirectional barbed suture versus continuous suture with intracorporeal knots in laparoscopic myomectomy: A randomized study. J Minim Invasive Gynecol 2010;17:225‑9.

10. Einasson JI, Chavan NR, Suzuki Y, Jonsdottir G, Vellinga TT, Greenberg JA, et al. Use of bidirectional barbed suture in laparoscopic myomectomy: Evaluation of perioperative outcomes, safety, and efficacy. J Minim Invasive Gynecol 2011;18:92‑5.

11. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205‑13.

12. Bringman S, Blomqvist P. Intestinal obstruction after inguinal and femoral hernia repair: A study of 33,275 operations during 1992‑2000 in Sweden. Hernia 2005;9:178‑83.

13. Lodha K, Deans A, Bhattacharya P, Underwood JW. Obstructing internal hernia complicating totally extraperitoneal inguinal hernia repair. J Laparoendosc Adv Surg Tech A 1998;8:167‑8.

14. McKay R. Preperitoneal herniation and bowel obstruction post laparoscopic inguinal hernia repair: Case report and review of the literature. Hernia 2008;12:535‑7.

15. Hernia Surge Group. International guidelines for groin hernia management. Hernia 2018;22:1‑65.

16. Agresta F, Mazzarolo G, Bedin N. Inguinal hernia repair in a...
community hospital setting – Have attitudes changed because of laparoscopy? A review of a general surgeon’s experience over the last 5 years. Surg Laparosc Endosc Percutan Tech 2009;19:267-71.

17. Duron JJ, Hay JM, Msika S, Gaschard D, Demargue J, Gainant A, et al. Prevalence and mechanisms of small intestinal obstruction following laparoscopic abdominal surgery: A retrospective multicenter study. French association for surgical research. Arch Surg 2000;135:208-12.

18. Kapiris SA, Brough WA, Royston CM, O’Boyle C, Sedman PC. Laparoscopic transabdominal preperitoneal (TAPP) hernia repair. A 7-year two-center experience in 3017 patients. Surg Endosc 2001;15:972-5.

19. Wake BL, McCormack K, Fraser C, Vale L, Perez J, Grant AM, et al. Transabdominal pre-peritoneal (TAPP) vs. totally extraperitoneal (TEP) laparoscopic techniques for inguinal hernia repair. Cochrane Database Syst Rev 2005;1:CD004703.

20. Eugene JR, Gashpi M, Curras EB, Schwartz K, Edwards J. Small bowel obstruction as a complication of laparoscopic extraperitoneal inguinal hernia repair. J Am Osteopath Assoc 1998;98:510-1.

21. Wegener ME, Chung D, Crans C, Chung D. Small bowel obstruction secondary to incarcerated richter’s hernia from laparoscopic hernia repair. J Laparoendosc Surg 1993;3:173-6.

22. Patterson M, Walters D, Browder W. Postoperative bowel obstruction following laparoscopic surgery. Am Surg 1993;59:665-7.

23. Bittner R, Schmedt CG, Leibl BJ. Transabdominal pre-peritoneal approach. In: LeBlanc KA, editor. Laparoscopic Hernia Surgery. London: Arnold Publisher; 2003. p. 54-64.

24. Oni G, Brown SA, Kenkel JM. A comparison between barbed and nonbarbed absorbable suture for fascial closure in a porcine model. Plast Reconstr Surg 2012;130:535e-40e.

25. Patri P, Beran C, Stjepanovic J, Sandberg S, Tuchmann A, Christian H, et al. V-loc, a new wound closure device for peritoneal closure – Is it safe? A comparative study of different peritoneal closure systems. Surg Innov 2011;18:145-9.

26. Lukish J, Rasmussen S, Garrett D, Stewart D, Buck J, Abdullah F, et al. Utilization of a novel unidirectional knotless suture during minimal access procedures in pediatric surgery. J Pediatr Surg 2013;48:1445-9.

27. Chihara N, Suzuki H, Sukeyawa M, Watanabe M, Oyama R, Shimizu T, et al. Absorbable barbed suture device for laparoscopic peritoneal closure after hernia repair via the transabdominal preperitoneal approach: A single-center experience with 257 cases. Asian J Endosc Surg 2018. Doi: 10.1111/ases.12626.

28. Wu JJ, Way JA, Eslick GD, Cox MR. Transabdominal pre-peritoneal versus open repair for primary unilateral inguinal hernia: A meta-analysis. World J Surg 2018;42:1304-11.

29. Takayama S, Nakai N, Shiozaki M, Ogawa R, Sakamoto M, Takeyama H, et al. Use of barbed suture for peritoneal closure in transabdominal preperitoneal hernia repair. World J Gastrointest Surg 2012;4:177-9.

30. Demyttenaere SV, Nau P, Henn M, Beck C, Zaruby J, Primavera M, et al. Barbed suture for gastrointestinal closure: A randomized control trial. Surg Innov 2009;16:237-42.

31. Bassi A, Tulandi T. Evaluation of total laparoscopic hysterectomy with and without the use of barbed suture. J Obstet Gynaecol Can 2013;35:718-22.

32. Donnellan NM, Mansuria SM. Small bowel obstruction resulting from laparoscopic vaginal cuff closure with a barbed suture. J Minim Invasive Gynecol 2011;18:528-30.

33. Chen H, Hong MK, Ding DC. Acute small bowel obstruction caused by barbed suture on the second day after laparoscopic hysterectomy: A case report and literature review. Taiwan J Obstet Gynecol 2017;56:247-9.