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Original Article

Laparoscopic transvesical vesicovaginal fistula repair with the least invasive way: Only three trocars and a limited posterior cystotomy

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Abstract *Objective:* Two conventional approaches for vesicovaginal fistula (VVF) repair are transabdominal repair for supratrigonal VVF and transvaginal approach for low lying fistulae. Laparoscopic surgery was introduced to duplicate the surgical steps of the transabdominal approach with reduction in morbidity. We report a series of patients treated with a modified laparoscopic technique which includes the use of only three trocars and a limited posterior cystotomy.

Methods: We retrospectively reviewed the data of eight patients who underwent laparoscopic VVF repair with our standardized technique from January 2015 to April 2018. Only cases with a supratrigonal fistula were included. We constantly used only three trocars. A limited 2 cm midline posterior cystotomy was performed using ultrasonic energy. A stay suture on a straight needle was passed percutaneously in the abdomen, then on either side of the cystotomy and finally was exteriorized to maintain countertraction. The cystotomy was extended downwards to include the fistula site. The fistula was dissected circumferentially to raise the bladder and vaginal flaps. The vaginal defect was closed in a transverse fashion and the cystotomy was closed vertically.

Results: Mean operative time was 178±31.6 min and estimated blood loss was 60±18.7 mL. Flap interposition was performed in six cases. No intraoperative complications were recorded. Mean hospital stay was 2.25±0.89 days. During hospitalization two patients experienced postoperative complications (Clavien grade I). Mean follow-up was 20.9±11.1 months (6.0–39.0 months). All patients remained continent during the follow-up period.

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Conclusions: This minimally invasive laparoscopic approach with only three trocars and limited posterior cystotomy provides excellent results with minimum morbidity.

1. Introduction

In developed countries vesicovaginal fistula (VVF) is usually associated with gynecologic surgery and is the most common type of urinary tract fistula [1]. These fistulae represent a complication that generally occurs after an iatrogenic injury during hysterectomy and lower segment caesarean section. Other causes include obstructed labor, pelvic malignancies, radiation necrosis and less frequently other radical pelvic surgeries [1]. The incidence of VVF varies between 0.3% and 2% [2].

Two conventional approaches for VVF repair are transabdominal repair for supratrigonal VVF and transvaginal approach for low lying fistulae [3]. Irrespective of the approach, the basic principles remain the same: Good separation of bladder and vagina, closure of the fistula in two separate layers, tissue interposition and urinary drainage [4]. The transabdominal approach for VVF repair is more versatile, but it is associated with its own intra-operative complications and post-operative morbidities such as the risk of hemorrhage, bowel injury and abdominal trauma. The transvaginal approach minimizes these but is mostly adequate for infratrigonal fistulae, and for those cases without need for concomitant ureteric reimplantation [3,5].

Laparoscopic surgery for VVF repair was introduced to duplicate the surgical steps of the transabdominal approach with reduction in morbidity and length of hospital stay. The first reported case of laparoscopic VVF repair was published in 1994 [6]. Since then several groups demonstrated its reproducibility, safety and efficacy with a good success rate and less morbidity compared with those of open surgery [1—3]. Robot-assisted series have also reported excellent results for VVF repair utilizing various surgical techniques [4]. In a systematic review of the literature by Miklos et al. [7], it was identified that most articles published reviewed outcomes of case reports and case series without standardization of technique, outcomes or follow-up. Therefore, it seems that repair of VVF either with pure laparoscopy or robot-assisted laparoscopy can still be improved with further reduction of its morbidity. In the present study we report a series of patients treated with a modified laparoscopic technique which includes the use of only three trocars, limited posterior cystotomy, complete dissection of the posterior bladder wall from the anterior vaginal wall and separate closure of the two defects.

2. Materials and methods

2.1. Patient selection and preoperative evaluation

After Institute's Review Board approval (University Hospital of Alexandroupolis, Greece) we retrospectively reviewed the data of eight patients who underwent laparoscopic VVF repair with our standardized technique from January 2015 to April 2018. Only cases with a supratrigonal fistula without concomitant ureteric fistula were treated with this technique and were included in the present study. Gynecologic surgery was the cause of the VVF. Out of eight patients, five had open abdominal hysterectomy for malignant disease, two had laparoscopic hysterectomy for benign diseases of uterus unrelated to pregnancy, and one had transvaginal hysterectomy for benign disease. None of the patients with malignant disease had received radiation therapy. All patients had a trial of bladder catheter for 3—4 weeks and one patient had two failed attempts of transvaginal VVF closure. Patients' characteristics are shown in Table 1. Workup of the patients included a thorough history, physical examination, and pelvic examination. Cystoscopy and vaginoscopy were performed to characterize the site, size and number of the fistula. Radiological imaging included intravenous urography (IVU) and computerized tomography (CT). Retrograde pyelography was done in selected cases when concomitant ureteral injury was suspected on IVU or CT. Cases with infratrigonal or concomitant ureteric fistulae were excluded from the present study.

Operative data included total operating time, estimated blood loss and any intraoperative event or complication. Postoperative data included complications, length of stay and duration of urinary tract drainage. Success was defined as the absence of incontinence after catheter removal.

2.2. Surgical technique

All patients received general anesthesia and were placed in the lithotomy position. Cystoscopy was performed and pigtail stents were inserted in both ureters to aim in constant identification of ureteral orifices during the procedure. A tamponade was inserted into the vagina to prevent loss of pneumoperitoneum. We constantly used only three trocars. Trocars' size and port configuration are shown in Fig. 1. The patient was then placed in a slight Trendelenburg position with a 20°—30° tilt. Initial 10-mm trocar was placed at the upper lip of the umbilicus by the open method. In case of adhesions from previous surgery adhesiolysis was performed using a combination of sharp and blunt dissection to expose the vaginal stump and the posterior aspect of the bladder. The bladder was filled with approximately 150 mL saline. A limited 2 cm midline posterior cystotomy was performed using ultrasonic energy (Ultracision, Ethicon, Cincinnati, OH, USA). A stay nylon 0/0 suture on a straight needle was passed percutaneously in the abdomen, then on either side of the cystotomy and finally was exteriorized to maintain countertraction (Fig. 2A). This maneuver obviates

Table 1 Demographic and clinical data.

Characteristic	Value
Age, mean±SD, year	49±8.5
BMI (kg/m^2), *n* (%)	
Underweight (<18.50)	0 (0)
Normal range (18.50–24.99)	3 (37.5)
Overweight (25.00–29.99)	4 (50)
Obese (≥30)	1 (12.5)
Etiology, *n* (%)	
Abdominal hysterectomy	5 (62.5)
Laparoscopic hysterectomy	2 (25)
Transvaginal hysterectomy	1 (12.5)
Size of fistula, mean (range), mm	6.6 (3–15)
Fistula type, *n* (%)	
Primary	7 (87.5)
Recurrent	1 (12.5)
Fistula site, *n* (%)	
Supratrigonal	8 (100)
Trigonal	0 (0)
Infratrigonal	0 (0)
Interval between gynecologic injury and VVF surgery, mean (range),[a] month	3.25 (2–6)

BMI, body mass index; VVF, vesicovaginal fistula.
[a] For the seven primary cases.

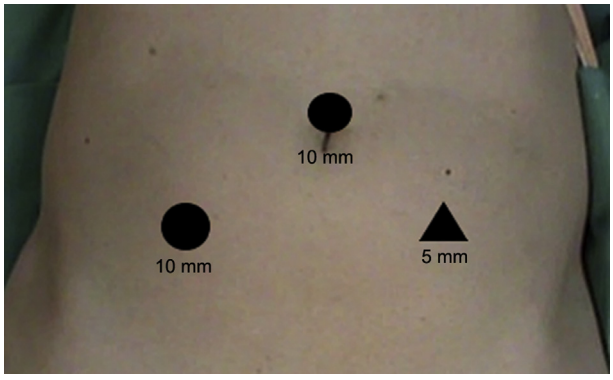

Figure 1 Port configuration.

the need for additional trocars to use graspers and limits the number of trocars to a minimum number of three. Subsequently the cystotomy was extended downwards to include the fistula site (Fig. 2B). Using sharp and blunt dissection the fistula was dissected circumferentially to raise the bladder and vaginal flaps (Fig. 3). The scarred tissue which remains on the vaginal edges was excised in all cases. The vaginal defect was closed with a running 2/0 polyglactin suture in a transverse fashion (Fig. 4A). The cystotomy was closed vertically with a running 0/0 polyglactin suture in a single layer (Fig. 4B). Depending on the availability of tissue, either an omental flap, or appendices epiploicae of the sigmoid colon was interposed between the bladder and vagina. A drain was placed at the completion of surgery.

3. Results

The procedure was completed successfully in all cases. Patient characteristics and results are summarized in Tables 1 and 2. Mean age was 49.0±8.5 years (range 35–60 years). Patients were referred to our department between 6 and 20 weeks following the gynecologic surgery which caused the VVF. In one case two failed attempts of transvaginal VVF closure had been performed and laparoscopic surgery was done 3 months following the last attempt. For the remaining seven cases repairs were performed at a mean of 3.25±1.25 months following the gynecologic injury. Fistula size ranged from 3.0 to 15.0 mm (mean 6.6±3.7 mm). BMI was 26.7±2.3 kg/m^2 (range 22.3–32.5 kg/m^2).

Mean operative time was 178.0±31.6 min (range 133–240 min) and estimated blood loss was 60.0±18.7 mL (range 35–90 mL). Flap interposition was performed in 6 cases (Table 2). No intraoperative complications were recorded. Mean hospital stay was 2.25±0.89 days (range 1–4 days). During hospitalization two patients experienced postoperative complications (Clavien grade I). One patient had a prolonged paralytic ileus, which resolved spontaneously and the other suffered from mild bladder spasms which were treated with anticholinergic drugs.

The drain were removed on the first postoperative day in all cases. Bladder catheter was removed at a mean of 3.37±0.70 weeks (range 2–4 weeks). In all cases a cystogram was performed before catheter removal to ensure that there was no bladder leakage. The pig-tail stents were removed at a mean of 4.4±0.7 weeks (range 4–6 weeks). Sexual intercourse was allowed after 12 weeks. Mean follow-up was 20.9±11.1 months (6–39 months). All patients remained continent during the follow-up period.

4. Discussion

In the present study we demonstrate the feasibility to perform laparoscopic repair of VVF with the use of only three trocars combined with a limited posterior cystotomy. This laparoscopic approach allows the repair of a VVF with the least invasive way. In the era of minimally invasive surgery the least possible trauma to the patient is certainly one of the main goals. This trend is expressed by the efforts to perform complex laparoscopic and robotic surgeries utilizing single-port access [8,9] and mini-laparoscopic procedures with 2.5–3.0 mm instruments [9]. If we accept the value of the above mentioned techniques then it seems equally logical that we should try to keep the number of trocars to a minimum and reduce the extent of surgical trauma in every conventional laparoscopic procedure. The key point for this goal in our technique is the use of stay sutures, which are placed on either side of the cystotomy and subsequently are exteriorized to maintain countertraction (Fig. 2A). Therefore, additional trocars for assistance were not needed in any of our cases. Recently, laparoendoscopic single site surgery (LESS) for extravesical repair of vesicovaginal fistula has been reported [10,11]. Furthermore, there is one publication describing the suprapubic transvesical LESS approach [12]. The advantages of LESS are the improved cosmesis and decreased incision

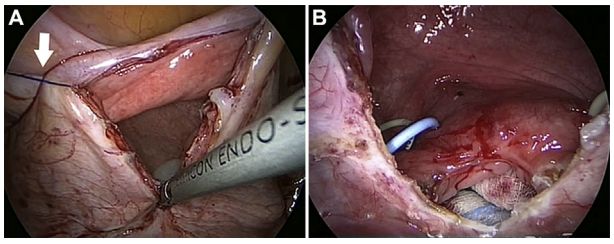

Figure 2 Limited posterior cystotomy. (A) Note the stay suture on either side of the cystotomy that was exteriorized to maintain countertraction (white arrow); (B) Cystotomy is extended downwards to include the fistula site.

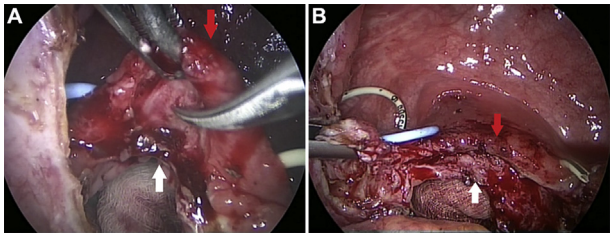

Figure 3 Dissection of the fistulous tract. (A) Using scissors the bladder wall (red arrow) is dissected off the vaginal wall (white arrow) circumferentially around the fistula site; (B) Complete separation of the posterior bladder wall (red arrow) from the anterior vaginal wall (white arrow).

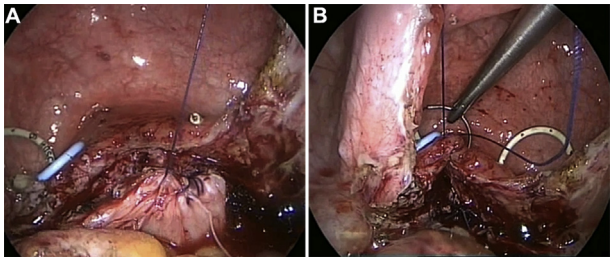

Figure 4 Closure of the defects. (A) The vaginal defect is closed with a running suture in a transverse fashion; (B) The cystotomy is closed vertically with a running suture in a single layer.

site morbidity. The disadvantages include the need for specialized access ports and equipment and loss of triangulation resulting in clashing of instruments. Specifically, for the direct suprapubic transvesical LESS approach additional disadvantages are the limited space which makes the maneuverability of instruments more difficult in the single port platform and, the inability to interpose a flap such as omentum, between bladder and vagina [12]. The standard laparoscopic technique is more versatile and certainly easier to perform for the average laparoscopic surgeon even if he/she uses only three trocars.

The second point is the limited posterior cystotomy. The classic open transvesical approach described by O'Connor and Sokol [13] included a liberal incision extending from bladder dome till fistulous tract. This large cystotomy was done to allow the easy identification of both ureteric orifices and the fistula. However, in transabdominal laparoscopic surgery, the entrance of the laparoscope posteriorly to the bladder combined with the optical magnification makes this large incision obsolete. In our experience, the smaller size of the cystotomy not only helped to reduce the operative time till fistula dissection but also allowed a quick closure of the bladder wall at the end of the procedure. Besides, a small cystotomy may easily be extended as required. Although one might argue that a small cystotomy could make the exposure of the fistulous tract and the identification of the ureteric orifices difficult this is not the case as shown initially by Rizvi et al. [14]. We never had a problem to identify the fistula through the limited posterior cystotomy. The assistant's index finger placed in the vagina and elevating the anterior vaginal wall brings the VVF into view easily as the surgeon takes advantage of the optical magnification offered by the laparoscope. Increase of the pneumoperitoneum up to 20 mmHg creates a stream of air coming out from the fistula which can be felt by the index finger in the vagina. Identification of fistula intraoperatively has been described by various methods such as use of light from a cystoscope focused on the fistula while the robotic or laparoscopic camera light is switched off. Others have used a Foley catheter or a Fogarty catheter placed across the fistula into the bladder [15]. Bora et al. [5] have described a simple technique of using a ureteric catheter across the fistula tract and in the vagina. Although these manoeuvres may be useful in extravesical approaches, according to our experience they are not necessary in the transvesical approach. This is also reported by Ghosh et al. [16] who were able to identify the fistula without difficulty despite using a small initial cystotomy.

Identification of the ureteral orifices is also an issue during surgery for VVF. Again the magnified view of the laparoscope offers significant advantage over traditional open surgery. Placement of pig-tail stents preoperatively further facilitates proper and continuous identification of the orifices. Some authors do not recommend routine ureteric catheterization when the orifices are more than 1 cm away from the fistula [14]. In our experience the presence of pig-tail stents

Table 2 Intraoperative and postoperative results.

Factor	Value
Operative time, mean±SD, min	178±31.6
Blood loss, mean±SD, mL	60±18.7
Flap interposition, *n* (%)	
Omentum	3 (37.5)
Sigmoid epiploicae	3 (37.5)
Nothing	2 (25)
Hospital stay, mean±SD, day	2.25±0.89
Complications, *n* (%)	
Clavien grade I	2 (25)
Clavien grade II–V	0 (0)
Duration of bladder catheterization, mean±SD, week	3.37±0.7
Duration of stents *in situ*, mean±SD, week	4.4±0.7
Follow-up, mean±SD, month	20.9±11.1
Success, *n* (%)	8 (100)

prevents a possible ureteric injury during dissection of the fistulous tract and most importantly during bladder closure. Additionally, we leave the stents indwelling for approximately 4 weeks to avoid potential obstruction from surrounding tissue edema and/or hematoma. Our policy is not evidence-based since there is no data in the literature about the duration of stenting in VVF repairs. We continue to follow this strategy because we have obtained good results so far. However, one might consider removing the stents earlier, most likely without sequelae. Theoretically the transvesical approach allows easier identification of the ureteric orifices compared to the extravesical approach. The latter has the benefit of avoiding cystotomy with reduced operative time and possible postoperative voiding dysfunction; however, in those studies with extravesical approach, the authors described increased fear of injury to ureteric orifices [17,18].

Generally, although the debate between transvesical and extravesical approaches regarding superiority is still open, both approaches are equally effective. To date, there are no randomized or comparative trials comparing transvesical and extravesical laparoscopic VVF repair. In the review by Miklos et al. [7], there were 19 studies that utilized an extravesical technique ($n=103$), and 22 studies utilized a transvesical (conventional) O'Conor technique ($n=146$), and one study described using both techniques. The success rates of the transvesical and extravesical techniques were 95.9% and 98.0% respectively (relative risk, 0.98; 95% confidence interval, 0.94—1.02). As a result, conclusion on the best surgical technique of laparoscopic VVF repair cannot be drawn. Both approaches are acceptable as long as the surgeon is familiar with them.

Irrespectively of the chosen approach the final outcome depends on the adherence to the technical steps for fistula repair, namely good separation of the vaginal and bladder wall, closure of the two defects preferably perpendicular to each other, tissue interposition if possible and adequate urinary drainage. We excised the scarred tissue in all cases although this step has been debated in discussions on VVF repair. Rizvi et al. [14] did not excise the edges of the fistula in any of their cases, based on the theoretic risk of enlarging the fistula in case of failure of the repair. The latter however was never proven to be true. Closure of the vaginal defect is one of the basic steps of the procedure. Javali et al. [19] in their "simplified laparoscopic approach" did not close the vaginal opening separately but they covered it with an omental flap that was held in place with a single bite of 3-0 V-Loc barbed suture. In our experience closure of the vaginal defect is rapidly performed with a running suture and we believe most surgeons would not feel safe to omit it. Besides, omental flap is not always available. Finally, we performed bladder closure in one layer with a running suture which certainly reduces the operative time. There are minimal data with regard to the number of layers of bladder repair with fistula surgery. Although in various series closure of the bladder in a double layer has been described, the review by Miklos et al. [7] revealed similar success rates for laparoscopic and robotic VVF repair following single-layered or double layered closure of the bladder.

Flap interposition is another controversial issue in VVF repair. Most frequently used healthy tissues for this purpose are omentum, sigmoid colon epiploicae and peritoneal flaps [20]. Recently, the use of flaps has been brought into question. Goyal et al. [21], in a retrospective analysis of 252 cases, concluded that simple and small fistulae should be repaired with layered closure only, challenging the liberal use of flaps. However for complicated fistulae the authors recommended repair with tissue interposition or tissue graft [21]. Another study of 43 patients treated with laparoscopic extravesical approach showed a 98% cure rate without interpositional grafts [18]. As it is shown in Table 2 we have used omental flaps in three cases, sigmoid epiploicae in three cases and no flap in two cases. We do not have any specific indications to omit flap interposition. Simply, a flap was not readily available in those two cases. Generally, we try to use a flap in all cases of VVF because it is not difficult or time consuming and offers an additional barrier between the two organs. However, one should not try hard to use a flap if it is not readily available, because in the literature it is not clear that flaps can really make a difference especially in patients who have not undergone radiation treatment [20]. In a review by Miklos et al. [7] the authors did not find significantly different cure rates with the use of interposition flaps and concluded that it is the actual repair of the fistula rather than the use of an interposition flap that determines success, especially in patients with a simple VVF.

Our study has included only supratrigonal fistulae, non-irradiated patients and mainly primary cases, since only one patient had previous failed attempts for VVF repair. The above selection criteria are the main limitations of the present study. However, we did not encounter significant difficulties during the recurrent fistula repair, despite the fact that the patient had two previous failed surgeries. Based on our overall experience from the present series we believe that this laparoscopic approach is applicable even in more complex cases, like recurrent fistulae and can be adopted by most laparoscopic surgeons with moderate experience in laparoscopic procedures. Therefore we recommend this approach as the initial laparoscopic procedure for all cases of VVF scheduled for a transabdominal laparoscopic repair. It is the least invasive way to perform a standard laparoscopic procedure for VVF repair but it is versatile as well. The latter means that depending on the situation, additional trocars can be placed or a more extended cystotomy can be employed.

5. Conclusion

The laparoscopic transvesical approach with the use of only three trocars and a limited posterior cystotomy is technically feasible, effective and offers all the advantages of laparoscopic surgery for VVF with the least possible trauma and hence further reduction in morbidity.

Authors' contribution

Protocol/project development: Stilianos Giannakopoulos, Stavros Touloupidis, Christos Kalaitzis.
Data collection or management: Halil Arif, Zisis Nastos, Apostolos Liapis, Stilianos Giannakopoulos.
Data analysis: Stilianos Giannakopoulos, Halil Arif.
Manuscript writing/editing: Stilianos Giannakopoulos, Christos Kalaitzis, Stavros Touloupidis.
Critical revision: Stavros Touloupidis.

Conflicts of interest

The authors declare no conflict of interest.

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