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Clinical outcomes of transperitoneal laparoscopic unroofing and fenestration under seminal vesiculoscopy for seminal vesicle cysts

Rui-Zhi Xue[1], Zheng-Yan Tang[1,2], Zhi Chen[1], Liang Huang[1,2]

Symptomatic seminal vesicle cysts (SVCs), especially those of a large size, can be removed by surgical treatments. Currently, open surgeries for SVC are rarely performed due to their extensive surgical trauma, and minimally invasive surgical therapies for treating seminal vesicle cysts are still in the early stages. In addition, relevant studies are mostly confined to case reports. In this study, we retrospectively reviewed 53 patients who had received transperitoneal laparoscopic unroofing or fenestration under seminal vesiculoscopy for SVC in our institution. Both surgeries decreased the cyst volume to a significant extent; however, according to the remnant lesion size after rechecking images, seminal vesiculoscopic fenestration tended to have a higher recurrence than laparoscopic unroofing. Regarding complications, two individuals in the laparoscopic unroofing group experienced ureteral injury and rectal injury, while patients in the fenestration group only had temporary hemospermia, which indicates that fenestration surgery tends to have less severe complications than laparoscopic unroofing. There was no solid evidence confirming semen improvement after these surgical therapies in our study. Future studies with a prospective design, larger sample size, and longer follow-up period are required to verify and further explore our findings.

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Keywords: cyst; fenestration; laparoscopy; seminal vesicle; unroofing; vesiculoscopy

INTRODUCTION

Seminal vesicle cyst (SVC) is a relatively rare condition in andrology, but it should not be overlooked. The most recent reported incidence among male individuals was 0.005%.[1,2] Related symptoms of SVC include perineal pain, hemospermia, infertility, and other prostatitis-like symptoms.[3,4] According to previous literature, large SVC could lead to urine retention, hydronephrosis, and even rectal obstruction.[5,6] Although watchful waiting is recommended for most asymptomatic SVC patients, it is not suitable for symptomatic patients with large-sized cysts. Open surgeries of seminal vesicle were once thought to be viable options, but extensive surgical trauma and high complication risks largely limited their applications.[7] Currently, although urologists have never ceased to explore innovative minimally invasive therapies for SVC, most studies have been confined to case reports. Here, by retrospectively studying 53 patients previously treated in our institution, we aim to introduce our experience and clinical outcomes of two kinds of minimally invasive surgeries including transperitoneal laparoscopic unroofing (TLU) and fenestration under seminal vesiculoscopy (FUSV) for patients with SVC.

PATIENTS AND METHODS

Patients

From January 2009 to September 2017, 33 SVC patients received TLU and 20 patients received FUSV in Department of Urology, Xiangya Hospital of Central South University, Changsha, China. With prostatitis-like symptoms, all the patients were diagnosed with SVC by preoperative imaging, and diameters of the cystic lesions ranged from 35 mm to 72 mm. The surgical procedures were performed by two senior chief surgeons of Xiangya Hospital of Central South University. Details of perioperative data are shown in **Table 1**.

Surgical procedures of TLU

Under general anesthesia, a ureteral catheter was inserted in the ipsilateral ureter, and a Foley catheter was placed to drain the bladder. Then, the patient was put in the Trendelenburg position after transperitoneal access was achieved through four laparoscopic ports including a 12 mm port in the umbilicus, a 12 mm port in McBurney's point, a 5 mm port at a point in the middle between the umbilicus and left anterior superior iliac spine, and a 5 mm port in the suprapubic area. We first incised the retroperitoneum and identified the ipsilateral vas deferens duct at the inguinal ring, after which we proceeded to dissect along the duct until the seminal vesicle was exposed (**Figure 1a**). After anterior retraction of the bladder and careful search of the rectovesical pouch area, the dilated cyst was located and fully exposed by clearing surrounding tissues. Finally, the cystic wall was excised as completely as possible, and the remnant lesion's margin was treated by electrocoagulation (**Figure 1b**). Before the end of the operation, the ureteral catheter was taken out. A drainage tube was placed in the

[1]Department of Urology, Xiangya Hospital of Central South University, Changsha 410000, China; [2]Provincial Laboratory for Diagnosis and Treatment of Genitourinary System Disease, Changsha 410000, China.
Correspondence: Dr. ZY Tang (doczhengyantang@163.com)
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Table 1: Demographic and perioperative data

Patient number	*Age (year)*	*Diameter of cyst[a] (mm)*	*Pre-CPSI*	*Pretotal sperm count/ total motile sperm count ($\times10^6$ ml^{-1})*	*Operation*	*Operative time (min)*	*Estimated blood loss (ml)*	*Complication*	*Duration of hospital stay (day)*	*Post-CPSI*	*Rechecking total sperm count/total motile sperm count ($\times10^6$ ml^{-1})*	*Rechecking diameter of cyst (mm)*
1	29	50	16	N	TLU	150	100	Scrotum emphysema	3	15	N	0
2	30	54	20	16.0/4.0	TLU	170	150	Postoperative flatulence	5	17	14.5/4.0	0
3	28	50	15	32.0/7.5	TLU	120	80	N	3	17	38.0/8.0	0
4	25	36	22	N	TLU	120	90	Scrotum emphysema	4	21	N	0
5	23	65	29	N	TLU	130	120	N	3	22	N	10
6	27	72	16	N	TLU	105	100	N	3	14	N	9
7	31	55	21	N	TLU	90	100	N	3	19	N	10
8	25	64	19	N	TLU	130	150	Rectal injury	10	15	N	0
9	37	47	23	44.0/12.0	TLU	120	120	Postoperative flatulence	4	20	40.0/12.0	0
10	29	35	25	N	TLU	100	110	N	3	22	N	0
11	39	50	15	N	TLU	90	80	N	3	17	N	15
12	44	45	16	9.5/1.5	TLU	100	120	Ureteral injury	5	15	10.5/2.0	8
13	19	40	23	N	TLU	100	90	Scrotum emphysema	4	22	N	0
14	32	56	17	N	TLU	90	50	N	3	15	N	0
15	23	47	22	29.5/8.0	TLU	150	100	N	5	18	33.0/7.5	9
16	32	55	26	N	TLU	135	100	N	3	18	N	5
17	40	45	29	N	TLU	130	110	N	3	25	N	5
18	42	50	27	N	TLU	100	90	N	3	23	N	10
19	23	38	26	N	TLU	110	100	Scrotum emphysema	4	23	N	0
20	33	40	27	N	TLU	100	110	N	3	24	N	0
21	37	50	24	N	TLU	140	100	Postoperative flatulence	5	23	N	0
22	25	36	26	N	TLU	120	90	N	3	19	N	0
23	30	44	30	N	TLU	130	110	N	3	21	N	5
24	31	55	26	N	TLU	120	100	Postoperative flatulence	4	22	N	5
25	27	38	23	N	TLU	100	80	N	3	20	N	0
26	24	40	19	N	TLU	100	90	N	3	18	N	0
27	41	52	29	N	TLU	130	100	N	4	18	N	10
28	33	46	26	N	TLU	120	100	Scrotum emphysema	3	26	N	5
29	41	50	24	N	TLU	100	90	N	3	16	N	0
30	53	55	30	N	TLU	130	110	Postoperative flatulence	5	24	N	5
31	27	46	27	N	TLU	110	100	N	3	24	N	0
32	32	40	26	N	TLU	100	100	N	4	21	N	0
33	26	44	21	N	TLU	120	100	N	3	18	N	0
34	25	53	18	8.0/1.5	FUSV	90	20	N	1	10	11.0/1.5	12
35	41	50	22	51.0/12.5	FUSV	50	30	Hemospermia	2	16	35.5/10.5	10
36	23	50	18	N	FUSV	60	20	N	2	16	N	10
37	27	40	27	N	FUSV	80	50	Hemospermia	2	22	N	5
38	20	55	27	20.5/4.0	FUSV	50	30	Hemospermia	2	18	32.5/6.5	12
39	33	35	23	36.0/7.0	FUSV	50	20	N	1	15	N	8
40	36	44	22	N	FUSV	60	15	N	2	15	N	15
41	26	52	25	N	FUSV	80	20	N	2	21	N	12
42	41	40	20	N	FUSV	50	30	N	1	15	N	8
43	36	44	21	N	FUSV	50	25	Hemospermia	2	18	N	6
44	43	46	20	N	FUSV	80	30	N	2	15	N	9
45	50	39	20	N	FUSV	60	20	Hemospermia	1	19	N	15
46	24	42	20	75.5/19.0	FUSV	40	25	N	2	18	N	18
47	36	44	19	27.0/5.5	FUSV	50	30	N	1	16	30.0/6.5	10
48	26	44	21	N	FUSV	60	15	Hemospermia	1	13	N	19
49	32	46	24	N	FUSV	70	10	Hemospermia	2	20	N	10
50	40	38	26	N	FUSV	60	10	N	2	24	N	5
51	25	40	27	N	FUSV	80	20	N	2	20	N	5
52	34	42	22	N	FUSV	60	20	N	2	17	N	10
53	52	44	26	N	FUSV	70	30	Hemospermia	2	24	N	15

[a]The rechecking diameter of cyst refers to the maximum diameter of recurrent lesion on MRI/CT images, and if no recurrent cyst is found, the diameter is recorded as 0. N: none; CPSI: chronic prostatitis symptom index; MRI: magnetic resonance imaging; CT: computed tomography; TLU: transperitoneal laparoscopic unroofing; FUSV: fenestration under seminal vesiculoscopy

surgical area and removed 2 days later, while the Foley catheter was removed in the 1st day after surgery.

Surgical procedures of FUSV

Under general anesthesia, the patient was placed in the lithotomy position, and a 6.0 Fr pediatric ureteroscope was inserted through the urethra. After locating the utricular orifice at the verumontanum, the ureteroscope was introduced into the utricular lumen under guidance of a 3.0 Fr ureteral catheter. Under regular conditions, the ejaculatory duct opening could be identified once the ureteroscope reached the utricular lumen; however, if it could not be found, the guiding ureteral catheter was used to penetrate the thin, transparent membrane at the posterolateral wall of the utricle lumen and establish a tunnel toward the seminal vesicle cavity. The seminal vesicle was then inspected, and the cyst was easily identified as a large bulging cystic lesion squeezing nearby chambers (**Figure 2a**). A holmium laser was then used to make a direct communicational fenestration at the lesion (**Figure 2b**), and the bulging cystic wall was removed to leave the opening of the fenestration as large as possible (**Figure 2c**). In the meantime, if blood clots or calculi were found in the cyst or seminal vesicle, they were removed directly under endoscopy, after which normal saline and antibiotics were used for irrigation to prevent possible infection. Finally, after hemostasis with the laser, a Foley catheter was placed for 3 days.

Measurements

Preoperative examinations and postoperative rechecks (6 months after surgery) of CT/MRI, semen analyses, and questionnaires of National Institutes of Health Chronic Prostatitis Symptom Index (NIH-CPSI) were routinely arranged for patients. The rechecking CT/MRI was mainly used for inspecting recurrence of cyst formation. If there was recurrence, the cyst's maximum diameter was recorded, and if no recurrent cyst was found, the diameter was recorded as 0. In addition, operative time, estimated blood loss, complications, and duration of hospital stay were also recorded. Relevant data were analyzed by SPSS 22.0 software (SPSS Inc., Chicago, IL, USA) with *t*-test; $P < 0.05$ was considered statistically significant.

RESULTS

All patients received surgeries on schedule, and the mean operative time, mean estimated blood loss, and duration of hospital stay of the TLU group were much greater than that of the FUSV group ($P < 0.001$). In the TLU group, five patients experienced scrotum emphysema and five patients had abdominal distension along with delayed time of exhausting. All of these patients were successfully treated by conservative therapies and early ambulation. Furthermore, it is noteworthy that two cases of severe complications also occurred in the TLU group, of which one had ipsilateral ureteral injury and one had rectal injury. Both cases were spotted intraoperatively, and remedial procedures were performed immediately. A double J stent was placed in the injured ureter and kept for 3 months. After removal of the stent, the patient showed no symptoms of urine leakage and recovered well. However, for the case of rectal injury, since the breaking hole on the rectum was very small (approximately 3 mm × 5 mm) and no intestinal content flowed out, we patched the break with two stitches simultaneously. After surgery, fasting and parenteral alimentation along with infection-preventing antibiotics were arranged for the patient to take for 1 week. Fortunately, this patient resumed a normal diet, and no major symptoms have occurred to date. A total of 8 patients in the FUSV group complained of hemospermia after the surgery, which disappeared spontaneously after 4 weeks, while no other complications occurred in the FUSV group.

After discharge, all patients were routinely provided with a follow-up plan, and the median follow-up period was 33.6 months. Regarding the results of rechecks, the scores of rechecking NIH-CPSI showed a significant decrease in both groups (average drop of 3.424 ± 2.958 in the LTU group and 4.800 ± 2.441 in the FUSV group) compared with their own preoperative scores ($P < 0.001$). On the other hand, all the cysts of the two groups showed a significant reduction

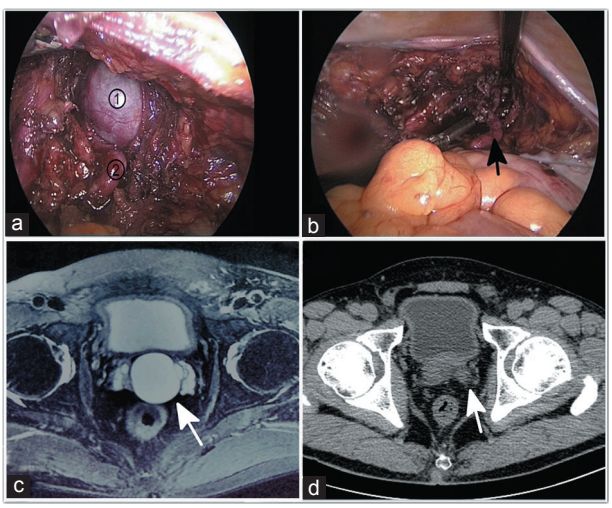

Figure 1: Surgical images and radiological data of transperitoneal laparoscopic unroofing. (**a**) The seminal cyst (1) was exposed under laparoscopic procedures, and vas deferens (2) was dissected and used as the guiding duct toward the cystic lesion. (**b**) The wall of seminal cyst was resected and remnant lesional rim was electrocoagulated. The vas deferens remained intact (arrow). (**c**) Preoperative CT image of the seminal cyst, the lesion was large and protruding into abdominal cavity (arrow). (**d**) The rechecking CT image took at 6 months after the laparoscopic surgery, and the cyst lesion was completed removed with no evidence of recurrence (arrow). CT: Computed tomography.

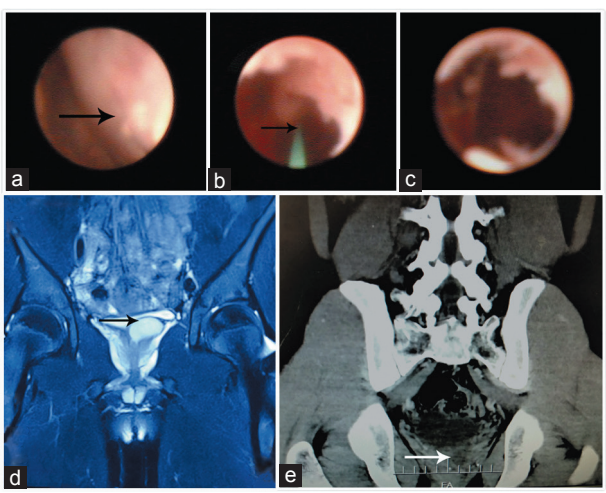

Figure 2: Surgical images and radiological data of fenestration under seminal vesiculoscopy. (**a**) The image of seminal vesiculoscopy and seminal cyst could be clearly identified by its bulging contour (arrow). (**b**) The process of fenestration by using holmium laser under seminal vesiculoscopy (arrow). (**c**) The final result of operation and most of the cyst wall was removed. (**d**) The preoperative MRI image of the seminal cyst (arrow). (**e**) Rechecking CT image took at 6 months after the surgery, and a recurrent cystic lesion could be found at the operating area (arrow). MRI: Magnetic resonance imaging; CT: Computed tomography.

in lesion diameter compared with preoperative data ($P < 0.001$). Interestingly, regarding the size of the postoperative, recurrent cystic lesion, the TLU group patients showed smaller lesion diameters in rechecks compared with those of the FUSV group ($P < 0.001$). Furthermore, among the 33 patients in the TLU group, 19 patients' postoperative rechecking images showed no cysts at all (**Figure 1c** and **1d**), while no individual in the FUSV group was confirmed to be free of cystic lesions (**Figure 2d** and **2e**).

Preoperative and postoperative semen examinations were routinely proposed for each patient in our institution; however, preoperative semen analysis was found only in five patients of the TLU group and six patients of the FUSV group, while two of these six patients refused to undergo recheck semen analyses after discharge. Total sperm count (TSC) and total motile sperm count (TMSC) of each examined patient were analyzed. The results revealed that, for these nine individuals, compared with their own preoperative semen data, no significant improvement occurred in TSC (for TLU: $P = 0.921$, for FUSV: $P = 0.602$) and TMSC (for TLU: $P = 0.718$, for FUSV: $P = 0.621$).

DISCUSSION

For many years, the SVC has been regarded as a benign and nonsurgical lesion that requires only close follow-up and conservative treatments.[8] Since the late 19th century, clinicians have realized that SVC is often accompanied by seminal outlet obstruction and that it can develop into a large lesion, leading to infertility, hydronephrosis, or even rectal obstruction.[9–11] Thereafter, surgical treatments have been considered as effective therapies for symptomatic SVCs. Although a number of surgical techniques have been proposed by researchers, minimally invasive surgeries are still rarely seen in the literature and are mostly confined to case reports. Under such circumstances, urologists are still faced with confusion and a lack of information when selecting surgical approaches for SVC. Here, we chose two representational and minimally invasive surgical methods – the TLU and FUSV – as research subjects. By introducing their respective outcomes and our experiences, we hope to offer some guidance to clinicians.

One of the most difficult issues that urologists confront when dealing with SVC is the recurrence rate of the cystic lesions, which has been claimed to be as high as 70%.[12] Although both of the methods reviewed in our research successfully decreased the volume of lesions to a significant extent, the results of rechecking diameters showed that the postoperative lesions in the TLU group were notably smaller than those of the FUSV group ($P < 0.001$). Furthermore, as the rechecking images showed, more than a half of patients in TLU group were confirmed no residual or recurrent cystic lesion at all, while no patient in FUSV group achieved such an outcome. Similar results were also found in the literature. Moudouni *et al*.[13] reviewed ten cases of TLU patients and conducted consistent follow-ups after their surgeries. None of the cases experienced cyst recurrence in the surgical area. According to Zhang *et al*.,[14] five of their seven patients who underwent the TLU operation remained symptom free, and not a single case of cyst recurrence occurred during the 18 to 84-month follow-up period. This seems to indicate that TLU operation may provide a more predictable outcome with little tendency for recurrence, which may be explained by the TLU operation's excellent visualization and radical removal of the cystic wall. SVC lesions are often hidden deep in the pelvic cavity. Although seminal vesiculoscopy can treat some cysts located close to the ejaculatory duct, it has limited usefulness in cases in which the SVC has protruded into the abdominal cavity or is located in the far-end chamber of the seminal vesicle. However, in transperitoneal laparoscopic surgeries, because the pelvic floor is clearly presented in the dilated operational space caused by the pneumoperitoneum, these cysts can be perfectly exposed. Moreover, fenestration under seminal vesiculoscopy usually only breaks a portion of the cystic wall, while the laparoscopic unroofing can achieve a more complete removal of the cystic wall through full exposure of the lesion. Therefore, on the basis of the above characteristics, a lower SVC recurrence rate can be expected in TLU patients than in FUSV patients. Nevertheless, due to the limitations of our nonrandom retrospective study, this conclusion should be further evaluated by future randomized controlled trials with a larger sample size.

TLU surgery is a sophisticated operation accompanied with a longer operating time and hospital stay, more blood loss, and higher risks of complication compared to FUSV surgery (**Table 1**). This is largely related to the different surgical approaches utilized by the two operations. Seminal vesiculoscopy reaches the cystic lesion through a natural lumen and orifice such as the urethral and ejaculatory duct. On the other hand, laparoscopic surgery's artificial tunnels must be established, and surrounding tissues must be carefully dissected before the exposure of lesion. Moreover, as stated above, fenestration mostly deals with only a small portion of the entire cystic wall, which requires much less time compared to TLU.

The complication risks of TLU surgery were much higher and more severe compared to FUSV operation. In our research, 12 patients of the TLU group had surgical complications, although most were common postlaparoscopic complications such as abdominal distension and scrotum emphysema. Nonetheless, we still had one case of ipsilateral ureteral injury and one case of rectal injury. There are numerous organs and tubular structures, including the bladder, colon, and ureter, in the adjacent areas of seminal vesicle, and their closely related anatomical locations increase complication risks. Thus, surgeons need to take extreme caution when dissecting to avoid surgical injuries to nearby organs. In our study, we routinely placed a ureteral catheter in the ipsilateral ureter before TLU operation. Thus, potential injuries to the ureter could be immediately confirmed by examining whether the inside catheter is exposed, which enables us to stop the dissection and initiate remedial procedures. Similarly, a regular digital rectal examination (using clean surgical gloves) was arranged when we detached the seminal vesicle from the rectum. If the glove was tainted with blood, then the rectal injuries were confirmed. It is worth mentioning that robotic-assisted laparoscopy shows significant advantages in shortening operative time and reducing complications.[15] A study reported successful removal of a large 17.2 cm SVC by robotic-assisted laparoscopy within 56 min of console time;[16] however, such reports are very few, and robotic-assisted laparoscopy is only equipped in a handful of hospitals currently.

FUSV operation was associated with very moderate complications of regular, postendoscopic self-healing hemospermia. In our experience, we think this outcome is related to the fact that seminal vesiculoscopy uses the transurethral approach and because all treating procedures were conducted inside the seminal vesicle, thus leaving the nearby normal organs separated and intact. In addition, the intracavity-treating characteristic of FUSV yields another advantage in that it could perform an overall check of the seminal vesicle and deal with calculi, hemorrhage, and suspicious tumors while also treating the cystic lesion.

As for the symptom-relieving effects, both operations presented a decrease in the NIH-CPSI scores compared with preoperative data; however, we noticed that the reduction of scores was relatively small and barely indicated significant improvements in symptoms. In addition, the standard deviation of our scores was very large and could obscure judgments on the effects of these surgeries. We had only

arranged one NIH-CPSI scores' assessment (6 months after surgery) for our patients, and thus long-term alleviation effects of the patients' symptoms are largely unknown. Therefore, future studies with a larger sample size and longer follow-up duration as well as frequent rechecks are required to further investigate the symptomatic remission effectiveness of these two surgeries.

Impairments in semen quality and fertility brought by SVC often make patients feel anxious, but the limited data we had reflected that neither of the two operations had a positive effect on sperm quality. Among the nine patients who received preoperative and postoperative semen analysis, TSC and TMSC of each patient showed no significant improvement compared with their own respective preoperative results. However, several previous researchers hold different opinions. Benyo *et al*.,[17] after studying two relevant cases of their own and reviewing seven similar cases in the literature, claimed that TLU could also enhance total motile sperm count and preserve fertility of SVC patients. Valla *et al*.[18] reported that TLU was able to preserve fertility of an infant who was confirmed with SVC. Thus, a more convincing study with a larger sample size of semen analysis and longer follow-up period is needed to address this issue.

CONCLUSION

TLU and FUSV are both effective surgical therapies for removing SVC lesions. Our study indicates that TLU has a better antirecurrence effect but requires skillful dissection and is associated with potential injuries of nearby organs. On the other hand, FUSV is a relatively easier procedure, but it is prone to postoperative lesion relapse. Due to the limitations of our study and the large standard deviation, there was no solid evidence confirming the symptom-relieving ability and semen improvement of these surgical therapies. Future studies with a prospective randomized design, larger sample size, and longer follow-up period are required to verify and further explore our findings.

AUTHOR CONTRIBUTIONS

RZX participated in its design and coordination and helped to draft the manuscript. ZYT carried out the concept of the study, participated in the statistical analysis, and drafted the manuscript. ZC performed relevant operations and collected patients' data. LH participated in the statistical analysis. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declare no competing interests.

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