Transmesocolic approach for left side laparoscopic pyeloplasty – comparison to laterocolic approach in the initial learning period

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ABSTRACT

Transmesocolic approach for left side laparoscopic pyeloplasty – comparison to laterocolic approach in the initial learning period

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Objective: To evaluate the outcome of transmesocolic laparoscopic pyeloplasty compared to the conventional laterocolic procedure for surgeons with limited experience.

Methods: We adopted laparoscopic pyeloplasty for ureteropelvic junction obstruction in 2009. Since then, 21 patients of left side disease have undergone this surgery in our institution. To access the left ureteropelvic junction, we used the conventional laterocolic approach in 9 patients, while the transmesocolic approach was used in the remaining 12 patients. Subsequently, perioperative results and follow-up data were compared.

Results: The mean operative time using the transmesocolic approach was significantly shorter than using the conventional laterocolic approach (242 vs. 308 min, $p = 0.022$). There was no complication or open conversion. Postoperative pain was significantly decreased in the TMC group (2.8 vs. 4.0 points, measured using the visual analogue scale on the first postoperative day, $p = 0.009$). Postoperative complications were encountered in two patients. All patients were symptom-free after 1 year of follow-up, and radiologic success rates for each group were 92 and 89% respectively.

Conclusions: The direct exposure of the ureteropelvic junction via the mesocolon saves time during the colon mobilization procedure. The approach is safe and feasible even for beginning surgeons, with similar success rates compared to the conventional laterocolic approach.

Key words : Hydronephrosis; Laparoscopy; Surgical Procedures, Minimally Invasive; Ureter; Ureteral Obstruction.

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I. INTRODUCTION

Laparoscopic pyeloplasty (LP) has emerged as a feasible and reliable treatment option for ureteropelvic junction obstruction (UPJO), with a success rate equivalent to that of the classic open procedure[1-3]. In addition, LP offers benefits associated with minimally invasive techniques, including less pain, shorter hospitalization, and better cosmesis[1, 4, 5].

However, LP use is still limited because advanced laparoscopic skills are required[1, 6]. Several reports have discussed the stiff learning curve of LP[7-9]. In the report from Inagaki et al., it generally took over 5 hours for a surgeon to perform each of the initial 10 cases, and the time was decreased to 3.5 hours with experience[7]. Singh et al., in their report on a study of 100 LP patients, demonstrated the significance of the learning curve with regard to operative time and complication rates[10].

Consequently, a variety of modifications have been suggested to ease the technical difficulties associated with LP[1, 7-9, 11-13]. One suggestion is using the transmesocolic (TMC) approach. It is an alternative ureteropelvic junction (UPJ) approach that has been shown to reduce operative time compared to the standard laterocolic (LC) approach[14]. It offers a direct path to the left UPJ

through the mesocolon with less tissue dissection and bowel manipulation[14-17].

The TMC approach may ease the learning curve of laparoscopic repair[16]. However, the question remains whether this approach is superior to the LC approach even for surgeons not familiar with LP. Since we adopted LP in 2009, 26 patients with UPJO have undergone the procedure. From the beginning, we applied both the TMC and the conventional LC approaches. By analyzing those cases, we were able to compare both approaches in terms of the associated learning curve.

II. MATERIALS AND METHODS

Patients and diagnosis: Between March 2009 and February 2011, a total of 26 patients with UPJO underwent LP at our institution. Five patients had right UPJO and were excluded from this study. Among the remaining 21 patients, eighteen of them were male (86%) and the mean age of all patients was 26.5 years (range: 2-76 years). The presence of hydronephrosis was detected by ultrasound or computed tomography, and the diagnosis of UPJO was confirmed by diuretic radionuclide renography (delayed urinary excretion: $T_{1/2} > 20$ min). Two surgeons performed the whole series; each had prior laparoscopic experience (43 cases and 50 cases), but minimal experience with LP. The TMC apparoach was used in 12 patients. For the other 9 patients, the conventional LC pyeloplasty was performed. The decision to use TMC or LC approach was made intraoperatively (i.e. after achieving laparoscopic vision, the mesocoloic field was inspected. The TMC technique was selected if the mesocolon was bulged enough to identify the renal pelvis lying behind).

Technique for left TMC laparoscopic pyeloplasty: Under general anesthesia, each patient was placed in a dorsal lithotomy position for the cystoscopy and retrograde pyelogram. After visualizing the ureter and narrowed UPJ, a 5-Fr, open-ended ureteral catheter (4-Fr for small children) was placed in the ureter with the tip positioned a few centimeters below the narrowed UPJ. The distal end of the catheter was wrapped in a sterile sheath.

Each patient was then placed in the lateral decubitus position. For the first trocar insertion, a Veress needle was inserted next to the umbilicus, and a pneumoperitoneum (12 mmHg) was created. A 5-mm trocar was introduced paraumbilically. The peritoneal cavity was inspected using a 5-mm endoscope, and a 3-mm trocar was placed at the midclavicular line slightly caudal from the 5-mm port. Another 3-mm trocar was inserted at the lower third portion of the line between the xyphoid process and the umbilicus.

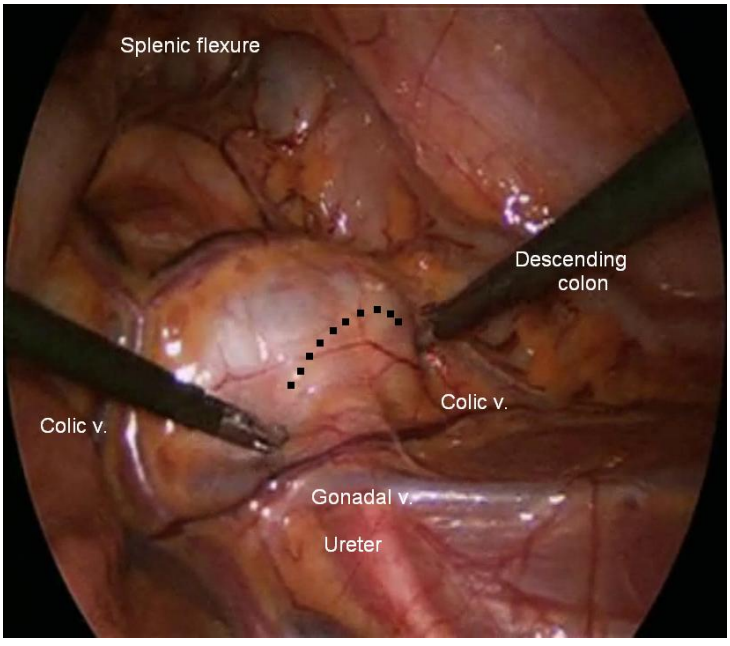

Figure 1. The mesenterocolic space, with landmarks
(dotted line: incision line)

By rotating the patient laterally, the small bowel loops naturally fell down while the underlying colon remained fixed to the lateral abdominal wall. The dilated left renal pelvis and UPJ were visible behind the mesocolon, bulging to varying degrees. The anatomical position of the mesenterocolic space was defined cranially by the splenic flexure, laterally by the descending colon, medially by the gonadal vessels, and caudally by the left colic vessels (Figure 1).

In this area, the mesocolon was incised by laparoscopic scissors approximately 15 mm in length. The dilated pelvis was exposed partially and grasped. The UPJ and the proximal ureter were lifted and the surrounding tissues were dissected to fully expose the narrowed segment (Figure 2a). Care was taken to preserve any accessory renal vessels supplying the lower renal pelvis and parenchyma. The lower renal pelvis was excised and a holding stitch was placed on the partially-excised pelvis. The stitch and its thread were taken out through the lateral 3-mm port (Figure 2b). This stitch worked as a renal pelvis traction tool and kept the renal pelvis out of the retroperitoneal space to stabilize it for completing the resection process and following sutures. It also prevented the operative field from sinking under the leaked urine and blood. After the narrowed UPJ portion was fully excised, it was displaced over the colon and the ureteral excision margin was spatulated for anastomosis.

The anastomosis suture was placed on the most dependent corner of the renal pelvis and the apex of the spatulated proximal ureter (Figure 2c). Using a 5/0 monofilament interrupted suture, the posterior side was closed first. For the placement of a double-J ureteral stent, a guide wire was introduced through the open-ended ureteral catheter, and grasped by atraumatic forceps. The guide wire tip was positioned inside the renal pelvis and the ureteral catheter was removed. Then, a 6-Fr double-J stent (4.7-Fr for small children) was inserted retrograde via the guide wire. The proximal J coil of the stent was positioned in the renal pelvis. The guide wire was removed. To prevent downward migration, the ureteral stent was grasped and held while the guide

wire was pulled out through the urethra.

The remaining anterior wall anastomosis was completed using an interrupted 5/0 monofilament stitch (Figure 2d). To verify the correct placement of the lower end of the stent, we performed cystoscopy in lithotomy position. The ureteral stent has a thread attached to its distal end, which aids in stent repositioning. If the stent's end was in the urethra, we pushed it inside the bladder by cystoscope. And if it was misplaced in the ureter and only the thread was seen, we pulled the thread back to reposition the stent. A perianastomotic drain was usually not necessary. A urethral Foley catheter was left in the bladder for 1-2 days. The double-J ureteral stent was removed 4-6 weeks postoperatively.

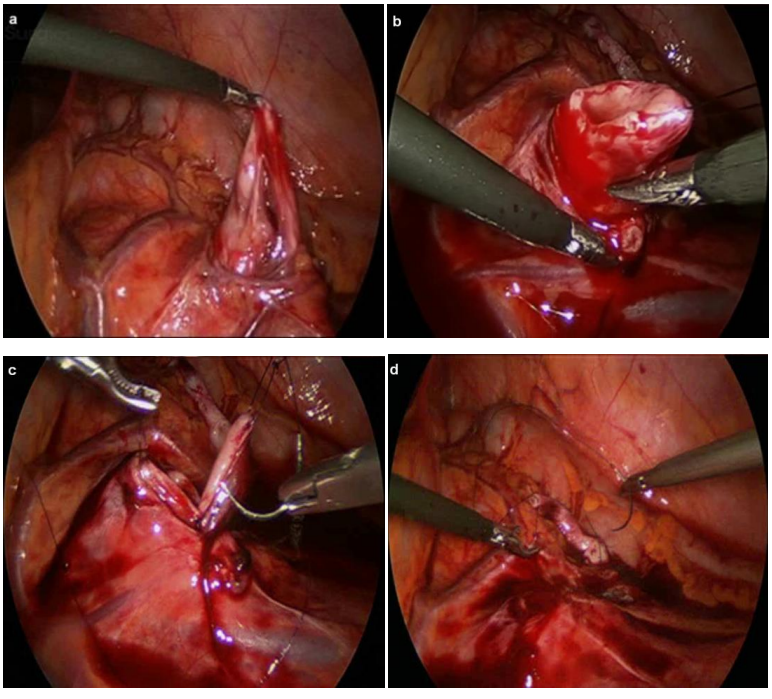

Figure 2. Transmesocolic approach (a);
Resection of pelvis and spatulation of ureter (b);
Anastomosis (c); Anastomosis completed (d).

Techniques for LC laparoscopic pyeloplasty: After general anesthesia, a cystoscopy and retrograde pyelogram were performed. The patient was placed in a modified flank position. A transperitoneal three-port for a left-sided and four-port (additional 3-mm subxyphoid port for liver retraction) for a right-sided approach was used. After mobilization and medial displacement of the colon, the ureter was dissected superiorly until the UPJ was identified. The remainder of the procedure duplicated the TMC laparoscopic procedure described above.

For postoperative pain control, Ketorolac (30mg, IV, every 12 hours) was given for all adult patients on the first postoperative day. Tramadol (50mg, IV) or Demerol (50mg, IV or IM) was used later on patient's demand. For pediatric patients, ibuprofen syrup (5mL for 2 year-old or younger, 8mL for 3 to 6 year-old, 10mL for older children) was given and ketorolac (0.5mg/kg, IV) was also used when required. Pain was recorded using the visual analogue scale (VAS) every 8 hours by the assistance of the nursing staff. It was checked on the first postoperative day morning and rechecked twice in the evening and night.

After institutional review board approval, surgical indication, operative time, complications, and outcomes were compared between the TMC patient group and the LC patient group. The operative time was measured from the start of cystoscopy to closure of the skin incision. Pain scale was estimated by using the mean value of VAS checked on the first postoperative day. Parameters determining success were clinical resolution of symptoms and improved drainage on diuretic radionuclide scanning ($T_{1/2}$ < 20 min) performed 1 year post-operatively (The last patient of our series (12th TMC case) underwent radiologic study 6 months post-operatively).

Statistical data were analyzed using SPSS, version 18 (SPSS Inc. Chicago, IL, USA). Fisher's exact test was used for categorical variables and the Wilcoxon rank sum test for continuous variables. Statistical significance was set at $p < 0.05$, and all reported p values were two-sided.

III. RESULTS

Patient characteristics are summarized in Table 1. TMC patients were generally younger than LC patients but the difference was not statistically significant (20.4 ± 19.2 years vs. 31.8 ± 22.3 years, $P = 0.423$). There were four pediatric patients (2 and 13 years old in TMC; 7 and 9 years old in LC). A dismembered Anderson-Hynes pyeloplasty was performed in all 21 patients. The TMC approach was used in 12 patients with left UPJO, and the LC approach was used in 9 patients. The other preoperative variables between the TMC and LC groups were not significantly different.

Table 1. Preoperative variables

Mean±SD or n (%)	TMC	LC	*P* value
Age, years (range)	20.4±19.2 (2-63)	31.8±22.3 (7-76)	0.175*
No. females/males	2/10	1/8	0.216**
BMI, kg/m^2	23.3±3.0	22.7±3.1	0.901**
Presenting symptoms			
Flank pain	9 (75.0)	5 (55.6)	
Hematuria	2 (16.7)	1 (7.1)	
Failed previous pyeloplasty	1 (8.3)	1 (7.1)	
Recurrent UTI		1 (7.1)	
Gastric discomfort		1 (7.1)	

BMI = body mass index; UTI = urinary tract infection; *Student t-test; **Fisher exact test;

A significantly shorter operation time was achieved in the TMC group (242 ± 63 vs. 308 ± 76 min, $p = 0.022$; Table 2). There were two cases of

redo-pyeloplasty. A 2-year-old boy underwent redo-pyeloplasty using the TMC approach, which took 270 min. A 28 year-old female patient also underwent redo-pyeloplasty using the conventional technique, which took 340 min. For a 53-year-old male patient who had an ipsilateral renal stone, intra-operative pyelolithotomy was performed with LC pyeloplasty.

No significant difference was noted for intra-operative estimated blood loss between the two groups (45 ± 64 vs. 157 ± 372 mL, $p = 0.34$). Two patients had a history of ipsilateral percutaneous nephrostomy before the surgery. As the dilatation of the renal pelvis was not enough to bulge out the mesocolon, the LC approach was used for them. The highest two estimated blood losses, 1400 mL and 200 mL, were recorded in those two operations. Crossing vessels were observed in 4 patients (19%). All colic vessels were saved. No other complication or open conversion occurred during the procedures.

Postoperative pain was evaluated by the VAS scale on the first postoperative day, which was significantly lower in the TMC group (2.8 ± 1.3 vs. 4.0 ± 1.9, $p = 0.009$). The mean hospital stay was similar for the TMC and LC groups (3.4 ± 1.8 days vs. 3.6 ± 1.7 days, $p = 0.923$). During the admission, one patient within the TMC group developed ileus. She was hospitalized for 8 days, which was longest period of time among the patients in the TMC group. She recovered without further complications.

Mean follow-up durations were 12.1 ± 5.9 months in the TMC and 12.4 ± 5.9 months in LC groups. The ureteral stent was removed 4 to 6 weeks after the surgery. During the follow-up, one LC patient developed a febrile urinary tract infection. He was admitted and treated with intravenous antibiotics. All patients reported symptomatic resolution or improvement. A radionuclide scan were performed 6 months to 1 year after the surgery, showing improved drainage in 11 of 12 TMC patients (91%) and 8 of 9 LC patients (89%).

Table 2. Perioperative and postoperative outcomes

Mean±SD (range) or n (%)	TMC	LC	*P* value
Operative time, min.	242±63	308±76	0.022*
median (range)	220 (164-349)	293 (181-416)	
No. crossing vessel (%)	2 (16.7)	2 (22.2)	0.652**
No. dismembered (%)	12 (100.0)	9 (100.0)	
No. LC conversion	0		
No. open conversion	0	0	
EBL†, mL	45±64	157±372	0.082*
Postoperative pain (VAS‡)	2.8±1.3	4.0±1.9	0.009*
Hospital stay, days	3.4±1.8	3.6±1.7	0.728*
Follow-up duration, months	12.1 ± 5.9 (6-24)	12.4 ± 5.9 (6-27)	0.856*
Complications (n)			
Intraoperative	None	None	
Postoperative	Ileus (1)	UTI (1)	
Success rate (%)			
Resolution of symptoms	12/12 (100)	9/9 (100)	
Radionuclide scan ($T_1/_2$ < 20 min)	11/12 (91.6)	8/9 (88.9)	

EBL = Estimated Blood Loss; VAS = Visual Analogue Scale;

*Student t-test; **Two-sided Fisher exact test

IV. DISCUSSION

Open pyeloplasty has been the standard treatment for UPJOs, but its associated significant morbidities have led to the development of minimally-invasive alternatives[18-20]. LP has already become the preferred treatment option in many centers[2, 11]. Because of its less-invasive nature, several advantages (decreased postoperative pain, reduced hospital stay, and better cosmesis) have been observed[7, 11]. In addition, it can be used for both intrinsic and extrinsic causes of UPJO in a manner similar to the open pyeloplasty, which other minimally-invasive alternatives lack[21].

However, there also have been reports suggesting technical difficulties and addressing the stiff learning curve of this complex reconstructive surgery[1, 9, 13]. In early reports, the operative time was significantly longer than that of the open procedure. For example, Moore et al. reported their initial 30 LP cases in 1997, and the mean operative time was 4.5 hours (range: 2.25 to 8 hours)[22]. Their report with 147 cases in 2005 recorded a mean operative time of 4 hours, which decreased with surgeon experience[7].

The technical difficulties of LP have been analyzed in several reports, and intracorporeal suturing is the most-commonly noted time-consuming step, especially for beginners of LP. Alternative methods of anastomosis have been suggested, such as fibrin glue and laser welding, but their long-term outcomes are not comparable[18-20].

Recently, a direct transperitoneal access to the left UPJ has been proposed as another shortcut for LP[14, 15, 17, 23]. Right sided pyeloplasties normally do not require extensive colonic mobilization. In contrast, the standard left side approach starts with a long vertical incision along the line of Toldt and subsequent dissection of the colonic flexure to move the colon medially and access the UPJ. This step generally consumes considerable time for beginners

and creates surgical smoke and bleeding in the field, which disrupts laparoscopic vision and consequently makes the procedure difficult[14, 16]. The new TMC technique offers faster and safer access to the UPJ by avoiding colonic mobilization. Especially in cases where a redundant pelvis is present, mesocolic fat of the descending colon may be very thin or even transparent. With simple dissection of the thin layer, the underlying UPJ can be accessed. By avoiding bowel manipulation, this approach diminishes operative time, minimizes surgical smoke and bleeding, and consequently offers a clearer operative field[16].

Romero et al. reported good success rates using both TMC and LC approaches. Specifically, the TMC approach offered a 22.5% reduction in operative time and a shorter hospital stay[14]. The results were similar in the subsequent reports of other groups[15, 17], even in surgeries involving children[24]. We applied the TMC approach in 12 patients and also achieved a significantly shorter operative time than the conventional LC technique. As our surgeon were inexperienced for both approaches, the shorter operative time of the TMC group can be explained mainly due to the simplicity of the TMC technique.

The TMC group reported significantly less postoperative pain than the LC group. For this finding there may be several explanations. The manipulation of the colon and adjacent abdominal wall can cause visceral pain, yet it generally influences less the overall pain experienced after laparoscopic surgery[16]. The longer operative time in the LC group may have caused more muscular pain (e.g., shoulder pain). Because there were no comparable data for analgesics used, the comparison may be of limited value. Castillo et al. suggested a better convalescence for TMC pyeloplasty by avoiding colon mobilization, but they reported no difference in hospital stay or postoperative pain between the TMC and LC pyeloplasty patients[15].

Surgical outcomes of LP vary with the amount of experience, and mastering the procedure generally takes 20 to 50 consecutive cases[7, 8, 21, 25]. Our

21 left side LP operations were performed by two urologic surgeons with laparoscopic experience (43 and 50 cases) when they started LP. The numbers increased to approximately 100 cases of experience for both surgeons by the time the 26th LP was performed. In the present study, the radigologic success rates were around 90% at the 1-year follow-up time point. And all preoperatively symptomatic patients (19 of 21 patients) were free of their initial symptoms. Although the cohorts were relatively small, the feasibility of the TMC approach was again proven, even for surgeons in their initial learning period of performing LPs. However, long-term follow-up is needed to confirm the observed advantages.

The TMC approach may encounter some problems. First of all, the mesocolic fat can be thick and disturb the identification of the renal pelvis. Especially in older or obese patients, it may be thicker, which would cause troublesome bleeding during dissection. However, Porpiglia et al. reviewed their 18 consecutive TMC LP cases and concluded that patient body habitus did not affect the outcome[16]. They successfully performed TMC pyeloplasty in two patients with a body mass index of 28 kg/m^2. In our study, we could easily identify the protruding shape of the dilated renal pelvis in all TMC patients, regardless of their age and body habitus. We used the laterocolic approach in four patients with previous ureteral stenting or percutaneous nephrostomy. Because their renal pelvises were not dilated enough, TMC access would have been difficult. Braga et al. have suggested intraoperative renal pelvis dilation by injecting saline through an ureteral catheter[26]. However, inserting an ureteral catheter preoperatively may interfere with the detection of a narrowed UPJ segment[27, 28]. Therefore, we used the LC approach in such cases.

The risk of losing grasp on the excised pelvis is another possible problem. We made a stitch on the pelvis before fully excising the UPJ. The thread was taken out through the lateral trocar and held externally. The stitch prevented sudden cephalad migration of the renal pelvis, and also worked as a

traction stabilizer during the anastomosis. Furthermore, leaked urine and blood from the opened renal pelvis made a blurring pool just under the operative field, and by pulling the renal pelvis upward with the holding stitch, the pelvis was prevented from sinking under.

We performed cystoscopy and retrograde ureteropyelography before the laparoscopic procedure. Instead of inserting the ureteral stent into the renal pelvis, we initially placed a 5-Fr open-ended catheter with its tip placed just distal to the narrowed UPJ. Theoretically, preoperative ureteral stent placement may decompress the renal pelvis and render its dissection and mobilization more difficult, and may also impede intraoperative identification of the stenosis27, 28. Therefore, the UPJ should remain un-catheterized until it is accessed and the obstructed segment is excised. Then the ureteral catheter can be moved upward and inserted to the renal pelvis. A guide wire can then be advanced retrograde through the catheter, and be later exchanged for a double-J ureteral stent.

V. CONCLUSION

The result of our study demonstrates that the TMC approach in LP had a comparable success rate to the LC approach in the initial period, with benefits of shorter operative time and less postoperative pain. This finding suggests that TMC pyeloplasty for left UPJO is better adopted by inexperienced surgeons than the LC approach. However, further experience is needed to verify the learning curves and long-term outcomes.

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APPENDICES

BMI = body mass index; EBL = Estimated Blood Loss;

LC = Laterocolic; LP = Laparoscopic pyeloplasty;

TMC = Transmesocolic;

UPJ = Ureteropelvic Junction; UPJO = Ureteropelvic junction obstruction;

UTI = Urinary Tract Infection; VAS = Visual Analogue Scale;

ABSTRACT (IN KOREAN)

복강경적 좌측 신우성형술에서 경결장간막 접근법 – 초기 학습 단계에서 측결장 접근법과의 비교 연구

<지도교수 정병하>

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한현호

연구 목적: 복강경적 신우성형술 경험이 적은 술자들에게서 시행시 경결장간막 접근법의 성과를 통상적인 측결장 접근법과 비교하여 평가하고자 하였다.

연구 방법: 2009년부터 2011년까지 좌측 신우요관이행부 폐색증의 진단으로 복강경적 신우성형술을 시행 받은 21명의 환자들을 대상으로 하였다. 9명 환자에서는 신우요관이행부 노출을 위해 통상적인 측결장 접근법을 사용하였으며, 12명의 환자에서는 경결장간막 접근법을 사용하였다. 신우 요관 이행부 접근방법에 따라 환자를 두 군으로 나누고 수술 전후 결과 및 추적 관찰 성적을 비교하였다.

연구 결과: 측결장 접근법에 비해 경결장간막 접근법의 평균 수술 시간이 유의하게 짧았다 (242분 vs 308분, $p = 0.022$). 수술 중 특별한 합병증이나 접근법의 전환, 개복 술식으로의 전환은 발생하지 않았다.

수술 후 1일 째 통증의 정도를 설문하였을 때, 측결장 접근법을 시행 받은 환자군에서 통증 정도가 유의하게 낮았다 (2.8점 vs. 4.0점, p = 0.009). 수술 후 재원 기간 중 2명의 환자에서 합병증이 발생하였다. 수술 후 1년이 되는 시점에서 평가하였을 때 모든 환자는 무증상이었으며, 방사선학적 성공률은 각각 92%, 89%로 나타났다.

결론: 결장간막을 통해 좌측 신우요관 이행부를 직접 노출시키는 술식은 복강경 신우성형술에서 통상적인 접근 방법에 비해 수술 시간을 단축하는 효과가 있다. 본 연구 결과 경결장간막 접근법을 복강경 신우성형술을 처음 시작하는 술자가 적용하였을 때도 안전하였으며 통상적인 측결장 접근법과 비교하였을 때 비슷하게 높은 성공률을 기대할 수 있었다.

핵심되는 말: 수신증; 복강경; 최소침습수술; 요관; 요관폐색.