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Easier laparoscopic surgery in giant hydronephrosis: Intermittent drainage by percutaneous nephrostomy tube with simultaneous laparoscopic nephrectomy

Yunus Emre Göger,[1] Mehmet Serkan Özkent,[2] Muzaffer Tansel Kılınç,[1]
Hakan Hakkı Taşkapu[1]

[1]Department of Urology, Necmettin Erbakan University Meram Faculty of Medicine, Konya, Turkey
[2]Department of Urology, Konya City Hospital, Konya, Turkey

ABSTRACT

Introduction: The aim of the study is to describe intermittent drainage via percutaneous nephrostomy tube with simultaneous laparoscopic nephrectomy (LN) as a more feasible technique in giant hydronephrosis (GH).

Materials and Methods: All of the patients with GH who underwent LN between March 2016 and December 2019 in our tertiary center were retrospectively evaluated. Patient demographics, perioperative data, surgical technique, complications, and results were described. Ultrasound-guided percutaneous nephrostomy catheter was inserted on the operating table in order to provide collector system decompression. 20–30% of the measured volume was evacuated, and nephrostomy was clamped. As the renal sac was partially emptied, it contributed to the renal sac and other abdominal organs preservation during trocar insertion. 0–15% more urinary drainage was performed through nephrostomy in cases where the colon could not be assessed clearly with direct vision. During dissection, since the renal sac was partially filled, orientation was maintained and the renal pedicle was reached. In addition, it could be detected more easily in aberrant vessels. The remaining steps were similar to conventional transperitoneal LN.

Results: The total number of the participants was 11, four female, and seven male, with a mean age of 25.6 ± 6.9 years. The mean surgical intervention time was 72.7±16.9 min. The mean urine volume discharged from the kidney was 2331.8±760 ml. Hospitalization time was, on average, 3.5±0.6 days. Clavien 1 complication occurred only in one patient. There was no observed any complication-related nephrostomy.

Conclusion: This procedure is an easier way of dealing with a complicated surgical challenge. Intermittent drainage by percutaneous nephrostomy tube with simultaneous LN for GH is technically feasible and safe for selected patients.

Keywords: Giant hydronephrosis; intermittent drainage; laparoscopic nephrectomy.

Introduction

Giant hydronephrosis (GH) is defined as a renal pelvicalyceal system containing more than 1000 ml of urine or a kidney that accounts for more than 1.6% of total body weight.[1] Although mostly reported in infants and children, it also, though rarely, can be seen detected in adults.[2]

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Correspondence: Mehmet Serkan Özkent, M.D., Department of Urology, Konya City Hospital, Konya, Turkey
e-mail: msozkent@gmail.com

With the proliferation of imaging methods, most of the patients are treated without GH development in the early period, since it is mostly diagnosed during the antenatal period or childhood. However, hydronephrosis can occur in adult patients due to urinary tract stones, stone surgeries, and post-abdominal surgeries; but as it is treated early, it rarely can reach giant sizes.

The review of the relevant literature related to the GH has revealed that most of the publications are case reports.[3–8] Open surgery was preferred more often in the past in the surgical treatment of GH. However, nowadays, with the development of minimally invasive techniques, laparoscopic and robotic surgery has become feasible treatment modality in GH patients. However, some concerns still remain related to the minimally invasive techniques. These treatment modalities are mostly presented in case reports. Therefore, no standardized method of intervention has been defined so far.[3,7–10]

A novel surgical technique has been proposed based on the difficulties encountered during laparoscopic surgery leading to open surgery switch during our previous clinical experiences that are considered to be more practical and easily applicable. In the present study, the aim is to present our experiences with patients who applied to our clinic and were diagnosed with GH and treated with a percutaneous nephrostomy tube simultaneously during laparoscopic surgery.

Materials and Methods

Data of GH patients treated in our tertiary center Urology department between March 2016 and December 2019 were examined retrospectively.

Inclusion criteria were; clinical findings; urine in the upper urinary system more than 1 liter (L) or more than 1.6% of body weight; and radiological findings; kidneys crossing abdomen midline or kidney size larger than five vertebral bodies.

Eleven patients met the inclusion criteria. Suspected malignancy and history of oncological surgery were exclusion criteria in the present study. Contrast-abdominal computed tomography (CT) or magnetic resonance imaging (MRI) as a preoperative imaging method for rule out malignancy and possible additional intra-abdominal pathologies had been conducted to all patients.

Demographic features of patients, symptoms of admission, pathologies leading to GH, renal parenchymal thickness, kidney functions on scintigraphy, preoperative and postoperative hemogram values, and biochemical values, urinalysis parameters, surgical methods, time of surgery, intra-operative renal urine amount, postoperative complications, hospitalization times, and nephrectomy pathologies were evaluated.

Urine culture was taken from all patients before surgery. Patients with positive culture results were initially treated with antibiotics; surgery was only performed when their culture results became negative.

Surgical treatment was planned for patients whose kidney parenchyma thickness was <5 mm or whose differential renal function was below 15%. Patients with suspected urinary system tumors in their images, previous history of abdominal surgery, and oncology patients were excluded from the study.

Surgical technique; on the day of surgery, after maintaining preoperative sterilization, patients were positioned in the lateral decubitus position on the operating table. Ultrasound-guided percutaneous nephrostomy catheter was inserted in order to provide collector system decompression and to prevent infection. The preoperative urinary volume of the patient's kidneys was measured in their 3-dimensional images. On average, 20–30% of the measured volume was evacuated and nephrostomy clamped. As the renal sac was partially emptied, it helped to prevent injury of the renal sac and other abdominal organs during trocar insertion. After optic access, complications related to nephrostomy were evaluated. 10–15% more urinary drainage was performed through the nephrostomy in cases where the colon could not be assessed clearly with direct vision and in cases where the kidney was located medially in the midline of the abdomen, or when the kidney lower pole was under the iliac vascular junction (Fig. 1a–c). During dissection, since the renal sac is partially full, orientation is maintained and the renal pedicle is reached and released (Fig. 2a, b). In addition, it can be detected more easily in aberrant vessels. As deflation is performed with the nephrostomy tube during dissection, leakage of renal contents into the peritoneum is prevented. The remaining steps are similar to conventional transperitoneal laparoscopic nephrectomy (LN) (Fig. 3a, b). After the kidney is mobilized, it is taken into the endo-bag and removed from the trocar site.

In the postoperative period, we controlled all patients' hemogram and biochemistry values. When the amount from the drain dropped below 50 ml daily, the drain was

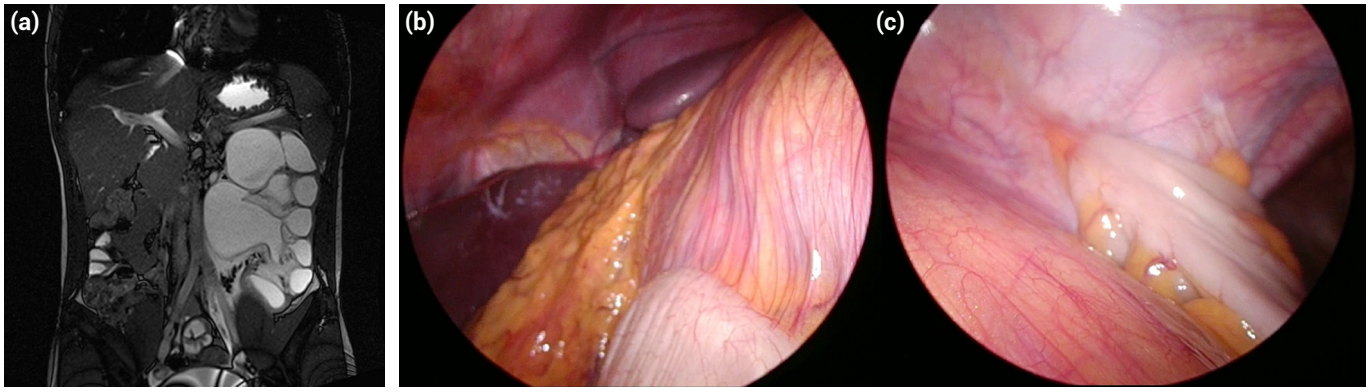

Figure 1. (a) MRI coronal image of an 18-year-old male patient with giant hydronephrosis. **(b)** Same patient giant hydronephrosis (GH) extending to the liver left lobe **(c)** Same patient GH extending to the left common iliac vessels.

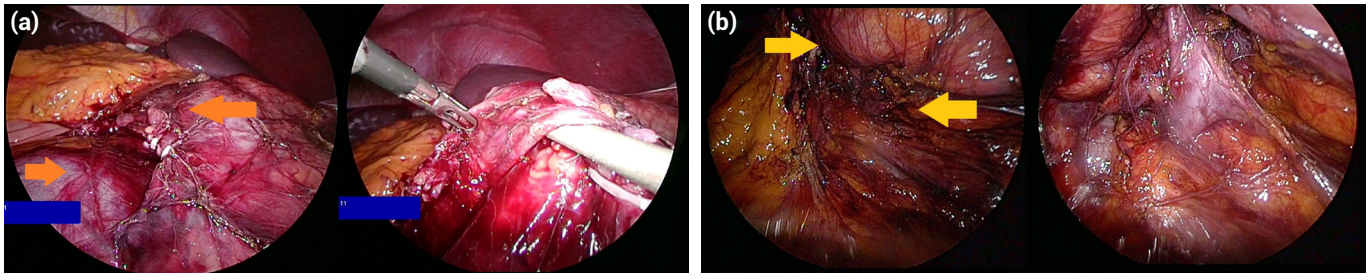

Figure 2. (a) Same patient far and close view of renal pedicle on giant hydronephrosis. **(b)** Another patient, far and close view of the renal pedicle under the giant hydronephrosis.

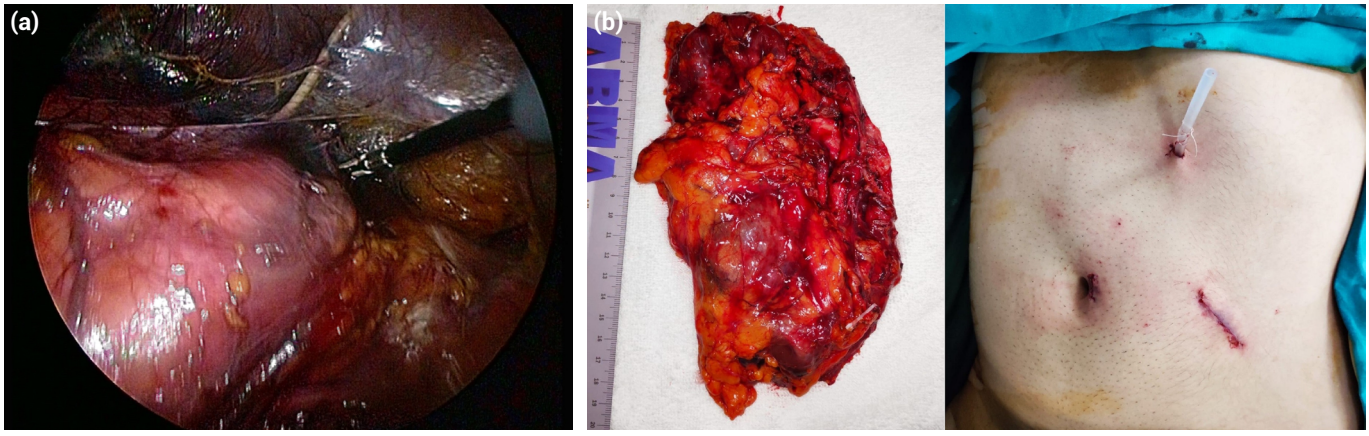

Figure 3. (a) Same patient, nephrostomy tube during retroperitoneal dissection. **(b)** Same patient post-operative image and renal morphological image.

removed, and the patients were discharged. Postoperative controls were performed in the 1st and 3rd months.

The institutional human research ethics committee approved the protocol 2020/2692 (Necmettin Erbakan University, Meram Medical Faculty Ethics Committee). The analysis and data collection were performed following the Declaration of Helsinki after written informed consent was obtained from all patients.

Statistical Analysis

Statistical Package for Social Sciences (SPSS), v.23.0 statistical software (SPSS, Inc., Chicago, IL, USA) was used for statistical analyses. Quantitative data were presented as mean±standard deviation. Descriptive analysis and Wilcoxon tests were used for quantitative data analysis. P values under 0.05 were considered to be statistically significant.

Results

Eleven patients who underwent LN for GH in our clinic were evaluated (Table 1 and 2). Four of the patients were female, and seven were male. All of the patients were

adults, and their mean age was 25.6±6.9 years. The mean weight of the patients was 62±5.1 kg, the average body mass index was 22.2 (20–25.7) kg/m². GH was present in the left kidney of seven patients, and in the right kidney of four patients.

The main complaints were flank pain in six patients, abdominal swelling, and dyspeptic complaints in four patients, while one patient was asymptomatic. Primary pathologies detected using abdomen MRI and CT were: Ureteropelvic junction (UPJ) obstruction in eight patients, UPJ stone in two patients. Furthermore, one patient' primary pathology was ureter ligation after cesarean section. According to preoperative contrast-abdominal CT and MRI, the mean renal parenchymal thickness was 3.6±1.1 mm. On scintigraphy, the mean Glomerular Filtration Rate was 7.1±4.4 ml/min, and the differential function of the affected kidney in all patients was below 15%. Preoperative mean creatinine (Cr) values of the patients were 0.9±0.1 mg/dl, and postoperative mean Cr values were 0.97±0.14 mg/dl (p=0.12). The preoperative mean hemo-

Table 1. Patients' characteristics and preoperative parameters

	Age (years)	Gender	Symptoms	Side	Etiology	Renal parenchymal thickness (mm)	Volume (ml)
Patient 1	29	F	Flank Pain	Right	UPJ Obstruction	5	1950
Patient 2	19	M	Dyspeptic Complaints	Right	UPJ Obstruction	2	1800
Patient 3	23	M	Flank Pain	Left	UPJ Obstruction	2	3800
Patient 4	38	F	Flank Pain	Left	Ureter Ligation	4	1350
Patient 5	18	M	Asymptomatic	Left	UPJ Obstruction	3	2100
Patient 6	35	F	Dyspeptic Complaints	Left	UPJ Stone	5	2400
Patient 7	20	F	Flank Pain	Left	UPJ Obstruction	4	1600
Patient 8	33	M	Flank Pain	Left	UPJ Stone	4	3500
Patient 9	22	M	Flank Pain	Right	UPJ Obstruction	3	2150
Patient 10	21	M	Dyspeptic Complaints	Right	UPJ Obstruction	3	2800
Patient 11	24	M	Dyspeptic Complaints	Left	UPJ Obstruction	5	2200

UPJ: Ureteropelvic junction; F: Female; M: Male.

Table 2. Patients' preoperative, operative, and postoperative parameters

	Operation time (min)	Blood loss (ml)	Hospitalization time (days)	Preop Hb (g/dl)	Postop Hb (g/dl)	Preop Cr (mg/dl)	Postop Cr (mg/dl)	Complication
Patient 1	90	40	3	11.6	10.5	0.77	0.76	
Patient 2	75	50	3	15.3	14.6	0.82	0.92	
Patient 3	55	60	3	15.2	14.5	1	0.9	
Patient 4	65	80	4	13	12.5	1.1	1.2	
Patient 5	70	50	3	14	13	0.8	1.1	
Patient 6	105	150	4	12	11.5	0.7	0.9	
Patient 7	60	90	4	12	12	0.8	0.8	
Patient 8	95	100	5	14.5	14	1	0.9	Clavien 1
Patient 9	55	110	3	13	13	1.1	1.2	
Patient 10	60	70	3	15	14.5	0.9	1	
Patient 11	70	90	4	14	13.5	1	1	

globin (Hb) value of the patients was 13.6±1.3 g/dl, and the postoperative mean Hb value was 13±1.3 g/dl (p=0.007). Significant changes in the preoperative and postoperative Hb values noted, but none of the patients required transfusion. Urine culture was requested for all patients before surgery. Patients with positive cultures results were first treated with antibiotics until the results became negative. The mean operation time was 72.7±16.9 min. The mean urine volume discharged from the kidney was 2331.8±760 ml. The mean blood loss during the operation was 80 ml (40–150 ml). Hospitalization time was 3.5±0.6 days on average. All patients were discharged after the removal of the drain when the drained amount fell below 50 ml/day on the 3rd day. Clavien 1 complication was detected in one patient during hospitalization. The patient had a fever on the postoperative 1st day which improved with medical therapy. There was no complication related the percutaneous drainage. Pathology reports did not indicate malignancy in any of the patients. No complications were observed during postoperative controls.

Discussion

GH is defined as a renal pelvicalyceal system containing more than 1000 ml of urine or a kidney that accounts for >1.6% of total body weight.[1,2] More than 600 GH cases have been reported worldwide.[2,11] Most of these reports are case reports and that were treated with open surgery mostly. Standardized minimally invasive surgical treatment modality has not been reported for GH. The present study describes a method that standardizes LN in GH from beginning to end. LN in GH is facilitated with the method described.

Nowadays, minimally invasive surgeries such as laparoscopic and robotic surgeries are preferred more.[12,13] However, laparoscopic surgery could lead to some problems in patients with GH due to vast space occupied by GH in the abdomen that could blur the anatomic borders and prevent a safe surgical area. In addition, previous urinary infections may cause intra-abdominal adhesions.[3] Hence, robotic and laparoscopic surgery could be feasible only in selected cases.[3,6,7] In some cases reported, laparoscopic intervention had been initiated; yet, open surgery was continued due to complications. The common aspect of all these studies was minimal invasive surgical cases were challenging.[11,14,15] There are some critical points to be considered during laparoscopy in GH.[3,7,14,16] One of these is the spread of renal sac content into the abdomen during evacuation and leading to subsequent infection. Hence, extra care is to be taken to prevent leakage of renal contents into the abdomen. The second is rapid renal sac discharge leading to lost orientation during the procedure as the collapsed renal sac is large and occupies a large area. These risks can be minimize easily with the technique described in the present article.

Although series with GH are limited in the literature. Wu et al.[17] performed surgical intervention on 22 patients with GH. In their surgical procedure, subsequent to the retroperitoneal approach, they deflated the hydronephrotic sac and completed the surgery with the help of long instruments.[17] However, access to instruments longer than standard sizes may not always be possible. In these cases, the surgeon's experience is essential because dissection in peripheral tissues and vessels due to adhesions can be difficult when working with long instruments in the narrow space. Hemal et al.[18] stated that when the kidney sac is evacuated, reorientation is required. As the collapsed renal sac is large, adequate retraction for further dissection cannot be achieved intracorporeally.[18] They proposed a separate port entry for retraction and taking a part of the kidney sac out of the port. Both studies stated that dissection was thus easier. However, both methods require surgeons' laparoscopic experience and extra surgical instruments.

In the present technique, placement of the nephrostomy catheter before the surgical intervention yields primarily two benefits. Firstly, evaluation of whether the urine was purulent or not, and secondly, since the catheter was inserted under anesthesia, nephrostomy procedure associated pain and anxiety was eliminated. We minimize the urine extravasation during dissection since the hydronephrotic sac is emptied by nephrostomy in a controlled manner. We tried to minimize renal contest leakage into the abdomen during the operation via the nephrostomy tube. In addition, with the semi-distended sac keeping the renal parenchymal surface stretched dissection can be done with easy sweeping movements. Thus, during the operation, orientation is maintained and anatomical landmarks preserved.

Vascular injury and visceral organ injury rate is 2.6–4.7% during laparoscopy.[16,19] Since GH takes up much space in the abdomen, visceral organ and bowel injury can be seen more during trocar insertion and dissection. Since we evacuated 20–30% of GH with nephrostomy beforehand, we placed the veress needle and the first trocar more safely. Controlled discharge of GH; We think that the borders of organs such as inferior vena cava, colon, duodenum would be better observed.

Another challenge encountered during laparoscopic modalities of GH is renal pedicle dissection. During laparoscopy, the renal pedicle becomes more medialized in GH, especially when it crosses the midline, and may be accompanied with aberrant vessels that cannot be detected on imaging. With our technique, we evaluated the kidney and surrounding structures better and ended the procedure without inflicting any harm to vascular structures and without complications. By completely emptying the hydronephrotic sac with a nephrostomy tube, we removed the kidney from a small incision in the endo-bag.

Another study using Nephrostomy tube in GH, Kaura et al.[14] included 35 patients. A nephrostomy tube was placed in 13 patients before the operation (2–6 weeks). Laparoscopic surgery was performed on the kidney sac that was evacuated before the operation with a nephrostomy tube. They mentioned that pre-operative nephrostomy catheters can increase adhesion. Although most of their cases were treated with open surgery, they did not encounter any major complications.[14] In the present study, no complications were encountered during laparoscopy as the nephrostomy catheter was inserted intraoperatively. In the study of Wu et al.,[17] nephrectomy duration was reported as 98 (77–146 min) min. In the present study, mean operative time was 72.7±16.9 min. The underlying reason for shorter intervention time in the present technique could be attributed to the controlled discharge of the kidney leading to easier dissection. However, comparative studies are needed for decisive results.

There are several studies in the literature reporting the amount of fluid discharged. In the study of Kaura et al.,[14] this amount was 3.5±0.6 L in adults. In some case reports, it exceeds 5 L.[4,16] In the present study, the volume of urine discharged was 2331.8±760 ml with cases up to 3.8 L. This fact could be explained by delayed presentation and the large capacity of the retroperitoneal area to absorb excess fluid in adults. Advantages of minimally invasive methods compared to open surgery are decreased risk of hemorrhage, decreased scar pain, shorter hospitalization time, and better cosmetic results. All interventions were laparoscopic, and on the 3rd postoperative day, all patients were discharged.

The most inherent limitations of the present study are limited number of cases and being not a comparative study. The presented technique was applied not only in selected cases, as in other studies, but these were all GH cases.

Conclusion

The GH is challenging cases for minimally invasive surgery. However, some tricks make difficult cases as easy as possible. The procedure proposed is easier, practical, and has a minimal risk of complications. The procedure proposed is superior in preventing renal content leakage into the abdomen and in preserving the orientation during the operation and determining anatomical landmarks. However, studies with larger patient series are needed to have a better understanding of the proposed method's effectiveness.

Disclosures

Ethichs Committee Approval: The study was approved by the Necmettin Erbakan University Meram Faculty of Medicine Ethics Committee (date: 03/07/2020, decision no: 2020/2692).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – Y.E.G., M.S.Ö., M.T.K.; Design – Y.E.G., M.S.Ö., M.T.K.; Supervision – Y.E.G., H.H.T.; Fundings: H.H.T.; Materials – M.S.Ö., M.T.K. H.H.T.; Data collection and/or processing – M.S.Ö., M.T.K. H.H.T.; Analysis and/ or interpretation – M.S.Ö.; Literature search – M.T.K.; Writing – Y.E.G., M.S.Ö., M.T.K.; Critical review – Y.E.G.

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