

# Transperitoneal laparoscopic heminephrectomy in duplex kidneys: a one centre experience

## Transperitoneale laparoskopische Heminephrektomie bei einer doppelt angelegten Niere: die Erfahrung eines Zentrums

### Abstract

**Purpose:** The standard treatment for a duplex kidney with poorly functioning upper pole moiety is ipsilateral upper pole heminephrectomy. This procedure is usually performed by open surgery, but with recent developments in techniques of uro-laparoscopy, it can be done with it, safely. In this study we evaluated the results and safety of laparoscopic heminephrectomy in our consecutive cases.

**Materials and Methods:** From February 2001 to May 2007 fourteen unilateral laparoscopic heminephrectomy were performed in our center. Patients' characteristics, presenting symptoms, operative time, and blood loss, early and late complications were all collected retrospectively. Using pre-operative ultrasonography, intravenous pyelography (IVP) and CT scanning, unilateral upper pole hydronephrosis was detected in all cases. By DMSA isotope scan hypofunctioning of ipsilateral moieties was detected in all cases.

**Results:** Mean operative time was  $203 \pm 80$  minutes. No major intraoperative or early complications were identified. Mean hospital stay was 4.1 days. On mean follow-up of 32 months no disturbing symptoms or episodes of urinary tract infections (UTIs) were detected. Atrophic kidney was detected in one case in post-operative IVP.

**Conclusion:** Laparoscopic heminephrectomy is a valuable minimal invasive procedure that can be performed safely in experienced hands without any important complication. Perfect renal pedicles vascular system manipulation is important for the preservation of renal function post-operatively.

**Keywords:** laparoscopy, heminephrectomy, duplex kidney, upper pole moiety, intravenous pyelography, IVP

### Zusammenfassung

**Ziel der Studie:** Bei doppelt angelegter Niere mit einer verminderten funktionierenden oberen Hälfte ist die ipsilaterale Heminephrektomie des oberen Pols Standard. Dieses Verfahren wird in der Regel im offenen Abdomen durchgeführt, aber neuere Entwicklungen in der Technik der mikroskopischen Laparoskopie zeigen, dass es auch laparoskopisch sicher durchgeführt werden kann. In dieser Studie wurden die Ergebnisse und die Sicherheit der laparoskopischen Heminephrektomie in den durchgeführten Fällen evaluiert.

**Material und Methoden:** Von Februar 2001 bis Mai 2007 wurden 14 unilaterale laparoskopische Heminephrektomien durchgeführt. Die Patientendaten mit den aufgezählten Symptomen, mit Operationsdauer, mit Blutverlust und die frühen und späten Komplikationen wurden retrospektiv erfasst. Mit Hilfe präoperativer Ultrasonographie, durch intravenöse Pyelographie (IVP) und mit CT-Untersuchungen wurde in allen Fällen eine unilaterale Hydronephrose im oberen Nierenpol festgestellt. Durch DMSA-Isotopescanning wurde auf der ipsilateralen Hälfte eine Unterfunktion in allen Fällen festgestellt.

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**Ergebnisse:** Die mittlere Operationsdauer betrug 203±80 Minuten. Es wurden keine größeren intraoperativen oder frühen Komplikationen festgestellt. Die mittlere Aufenthaltsdauer im Krankenhaus betrug 4,1 Tage. Die Nachfolgeuntersuchung über 32 Monate zeigte keine Symptome einer Störung oder Episoden von Harnwegsinfektionen, in einem Fall wurde postoperativ eine atrophierte Niere im intravenösen Pyelogramm festgestellt.

**Schlussfolgerung:** Die laparoskopische Heminephrektomie ist eine wertvolle minimal invasive Prozedur, die in erfahrenen Händen sicher und ohne Komplikationen durchgeführt werden kann. Eine perfekte Versorgung des renalen Gefäßsystems ist wichtig für die Erhaltung der Nierenfunktion im postoperativen Stadium.

**Schlüsselwörter:** Laparoskopie, Heminephrektomie, doppelte Niere, obere Polhälfte, intravenöse Pyelographie, IVP

## Introduction

Duplex kidney system is a relatively common anomaly in the renal system [1], [2], [3]. It is frequently asymptomatic but when being symptomatic the most presenting problems are flank pain and urinary tract infection with an atrophic upper pole which may also cause hypertension [3]. The standard treatment for a duplex kidney with a poorly functioning upper pole moiety is an upper pole heminephrectomy [3]. This procedure is usually performed by open surgery but with recent developments in endourology techniques and uro-laparoscopy, many attempts started to do this procedure laparoscopically [4], [5], [6]. There are few reports in laparoscopic heminephrectomy in children that are mainly done with retroperitoneal approach [4], [5], [6], and there is just one large series in adults with acceptable results [7]. In this article we describe our results and patients outcomes with laparoscopic Transperitoneal heminephrectomy in our consecutive cases.

## Materials and methods

From February 2001 to May 2007, 14 patients (10 females, 4 males) with complete duplex kidneys were presented with flank pain or UTI leading to final diagnosis of non functioning upper moiety which became candidate for Transperitoneal laparoscopic heminephrectomy. Patients did not have any previous history of ipsilateral renal surgery.

Prior to the procedure, complete radiologic evaluation including abdominopelvic sonography, intravenous urography (IVU) and abdomino-pelvic CT scan were contemplated in all patients to delineate renal anatomy and hydronephrosis. By DMSA isotope scan, hypofunctioning of this moiety was confirmed. In patients suspected of vesico-ureteral reflux, voiding cystourethrography (VCUG) was also performed. All patients were admitted the day before operation; received adequate bowel preparation and other needed medications. Renal function tests as well as complete blood count, urine analysis and culture were all performed during that period.

## Surgical technique

With the patients under general anesthesia, a foley catheter as well as a nasogastric tube was inserted and they were placed in a 60 degrees lateral decubitus position with minimal flexion of the operating table supported by adequate padding. The abdominal cavity was explored using 4 port transperitoneal approach for left side operation (a camera port at the level of umbilicus lateral to the rectus muscle, two 5 mm and one 10 mm trocars as working ports). For right side operation, the same trocar arrangement was employed but another 5 mm subxiphoid port was added for liver retraction.

After incising the white line of Toldt, superior retraction of spleen/liver and medial mobilization of colon (and duodenum: on right side), exposure to the renal pedicle was made possible. After complete dissection of both renal artery and vein, Gerota's fascia was incised and the kidney fully mobilized within the Gerota's fascia [7]. Afterwards, the dilated ureter of the corresponding nonfunctioning moiety was localized and carefully dissected to the renal hilum. Care was taken not to induce ureteral devascularization of the other healthy ureter. The diseased ureter was clipped and divided at the level of lower pole and used as a handle and guide to facilitate the dissection of segmental branches of renal artery and vein which supplied the nonfunctioning moiety. Such dissection was embarked as meticulous as possible trying not to induce any ischemia and/or injury to the healthy moiety. Then, the corresponding segmental renal artery and vein were doubly clipped and divided; the nonfunctioning renal moiety was incised and separated from the whole renal unit on the demarcated ischemic line, using a ureteric stamp as a handle which facilitated this part of the procedure. No collecting system reconstruction was made. The specimen was extracted from the abdominal cavity through a 10 mm port. The retroperitoneum irrigated and suctioned, hemostasis of the renal cut surface was ensured and an external drainage was placed with a tubular drain.

All patients received prophylactic peri-operative intravenous antibiotics as of our routine program [8]. Upon ambulation, Foley catheter was removed. Complete blood count and renal function tests were rechecked and assigned 6 hours after the operation as post-procedural analysis. If they were normal, daily evaluation was embarked. Surgical demographics such as operative time, blood loss, early and late complications were registered. Three-month follow-up IVP was performed in all patients to assess about the functional status of the remained ipsilateral renal moiety.

## Results

Fourteen patients (10 female, 4 males) underwent laparoscopic transperitoneal heminephrectomy. Ten cases (71.5%) were adults and 4 cases (28.5%) were children (ages 3, 3, 5, and 5 years). Overall mean age of the patients was  $24.2 \pm 16.8$  years old (adult age range: 18 to 52 years; pediatric age range (Table 1): 3 to 5 years). The main presenting symptoms were flank pain in 10 patients (71.4%) followed by urinary tract infection in three (21.4%). In one pediatric patient follow up of prenatal hydronephrosis confirmed the diagnosis of nonfunctioning upper pole moiety. Blood pressure was normal in all patients. In eight patients (57.14%) the atrophic part was located in the left side and in six patients (42.86%) in the right side. We had no case of bilateral anomalies.

The mean operative time was 203 min., SD  $\pm 80$  (range 95 to 360 min). Estimated blood loss was negligible. No major intra-operative or early complication was identified. Differences in pre-operative and post-operative hemoglobin and creatinine were not significant. Mean hospital stay was 4.1 days (range 2 to 7).

In one patient mild bleeding occurred due to injured abdominal wall vessels in the trocar site. On the second postoperative day the patient's hemoglobin level dropped from 11.1 g/dl to 9.2 g/dl and blood transfusion was performed. The patient's abdominal wall hematoma, observed by daily ultrasonography, resolved spontaneously within one week.

On patients' mean follow up of 32 months there was not any pain or episodes of recurrent urinary tract infection in any case. In all patients post-operative IVPs were done after 3 months. Follow-up IVPs showed ipsilateral functioning moieties with an intact collecting system in all cases (Figure 1, Figure 2) except our first patient in whom atrophic kidney was detected. In this patient and during the renal pedicle dissection the lower pole artery was injured because of vascular anomalies. No hypertension was detected in this case after long-term follow-up in spite of atrophic kidney.



**Figure 1:** Preoperative IVU shows dilated upper pole in right side in patient no. 7



**Figure 2:** Postoperative IVU in the same patient 3 months after surgery

**Table 1: Demographic data, presenting symptoms, and overall operative results of our cases**

No	Sex	Age (yr)	Symptoms	Side	Time (min)	Creatinine		Hemoglobin		Hospital stay (day)	Transfusion	Leak
						Pre	Post	Pre	Post			
1	Male	42	flank pain, hematuria	Right	360	0.9	0.9	18.5	16.2	7	no	no
2	Female	19	UTI	Left	300	1	1.2	13.5	12.5	6	no	no
3	Male	52	flank pain	Right	180	1.2	1.3	16.6	15.3	6	no	no
4	Female	5	UTI	Left	180	0.5	0.4	13.8	12.4	4	no	no
5	Male	34	flank pain	Right	260	0.7	0.7	15.9	14.6	5	no	no
6	Female	47	flank pain	Left	180	0.6	0.7	14.2	13.9	3	no	no
7	Female	30	flank pain, UTI	Left	270	0.7	0.7	15.9	14.6	4	no	no
8	Female	39	flank pain	Left	240	0.8	0.8	13.7	12.3	3	no	no
9	Female	18	flank pain	Right	270	1	1.1	12.1	10.4	5	no	no
10	Female	22	flank pain	Right	120	0.8	0.7	11.1	9.2	4	yes	no
11	Male	3	UTI	Left	95	0.4	0.4	13.2	11.8	3	no	no
12	Female	5	flank pain	Left	110	0.5	0.5	14.1	13.8	3	no	no
13	Female	3	prenatal hydronephrosis	Left	120	0.5	0.5	12.2	12	2	no	no
14	Female	21	flank pain	Right	160	0.8	0.9	12.5	12	3	no	no

## Discussion

Duplication of the ureter and renal pelvis is the most common anomaly of the upper urinary tract with an incidence of 1 in 125 or 0.8% [1], [2], [3]. The anomaly can often go unrecognized until adulthood [9]. The upper moiety is frequently obstructed, poor functioning, and can become symptomatic due to urinary tract infection or flank pain. The standard surgical treatment of a non-functioning symptomatic renal moiety is ipsilateral heminephrectomy. Recent advances in laparoscopic techniques have led to the selection of laparoscopic surgery for many if not most urological procedures. It can be done retroperitoneal or transperitoneally. The first case of a laparoscopic partial nephrectomy was reported by Winfield et al. in 1992 [10]. With further development of the technique, Jordan and Winslow performed the first laparoscopic upper pole heminephrectomy in 1993 [11]. Since then several reports on laparoscopic heminephrectomy have been published describing advantages, disadvantages and complications of the procedure. Based on the literature review, and regardless of applied techniques, the main complications of laparoscopic heminephrectomy are urinoma, urine leakage, recurrent urinary tract infections, postoperative hypertension, and functional loss of the remaining moiety [9], [12]. In our series just one case of functional loss of the remaining moiety was seen due to inadvertent injury of lower pole renal artery. This complication was detected as ipsilateral renal atrophy at follow-up IVP, 3 months after operation.

Almost all of the published series reported the efficacy of the procedure in pediatric patients. Series which have exclusively studied the efficacy of the procedure in adult cases have recently been published by Abouassaly et al. [9] and Gao et al. [12]. Abouassaly et al. described their experience with the procedure within a series of adult patients. None of their cases required conversion to open surgery. Development of an urinoma in one case was the only reported complication [9].

Another adult series was reported by Gao et al. [12]. In his series of 18 cases of transperitoneal laparoscopic heminephrectomy no major complication or open conversion occurred. The mean operative time was 142 min and the mean estimated blood loss was 196 mL. The mean hospital stay was 6 days. Only one case of postoperative urine leakage was reported in his series that was treated with prolonged urethral catheterization.

Castellan et al. published their experience in a series of 48 pediatric patients (mean age 4.08 years) who underwent transperitoneal and retroperitoneal laparoscopic heminephrectomy [13]. Mean operative time was 125 and 133 minutes for transperitoneal and retroperitoneal, respectively. Mean hospital stay was 2.6 days in the transperitoneal and 2.3 days in the retroperitoneal group. One retroperitoneal procedure required conversion to open surgery. In this largest series of laparoscopic heminephrectomy, complications were seen in 5 patients (10%), including urinary leak, urinoma, pneumothorax, recurrent urinary tract infection, and postoperative hyper-

tension. The authors found that laparoscopic heminephrectomy can be performed with minimal morbidity, improved cosmesis and short hospital stay.

Laparoscopic approach to heminephrectomy offers the patient the typical benefits of laparoscopy including shorter hospital stay, minimal morbidity, improved cosmesis, and lower need for analgesic use [4], [5], [6], [9], [14], [15]. Improved preservation of the functioning pole of kidney could be an advantage of laparoscopy specifically mentioned in this procedure. It is of worth noting that the objective of heminephrectomy is the safe maximal removal of the nonfunctioning moiety and simultaneous maximal preservation of the functioning pole. Laparoscopic approach enables an excellent differentiation of each hemirenal tissue, separating the ill kidney and preserving the maximal possible function for the other half-kidney [15].

Our series consists of a combination of children and adult patients. There was not any major or minor operative complication in our series except one in which blood transfusion was needed because of trocar site hemorrhage due to injured abdominal wall vessels. Operative time was reduced due to increased surgical team experience. Mean hospital stay was only 4 days which is much less than open series. In mean follow up period of 32 months, the remaining kidney functioned properly (Figure 1, Figure 2). Flank pain was also resolved in all patients during follow up.

## Conclusion

Laparoscopic procedures have become standard of care in some urologic disorders. Laparoscopic heminephrectomy has a valuable role in the treatment of duplex kidneys. It can be performed with minimal morbidity and acceptable results. Excellent visualization during laparoscopy helps better preservation of renal pedicle especially in pediatric age groups and offers a preferred approach for management of atrophic renal moieties in duplex systems.

## Notes

### Competing interests

The authors declare that they have no competing interests.

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