

ORIGINAL RESEARCH

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Laparoscopic Heminephrectomy in Horseshoe kidney: single-center experience of four cases

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Abstract

Background: Horseshoe kidney (HSK) is the most common congenital fusion anomaly and found in 1 in 400 of the general population (Grainger et al. in *Ir Med J* 76:315–317, 1983 Jul). Impaired drainage due to anomalous anatomy leads to ureteric obstruction resulting in hydronephrosis and nonfunctioning kidney.

Conventionally heminephrectomy is done by open technique; however, in the era of minimally invasive surgery, laparoscopic heminephrectomy in HSK has been described. Kidney location, aberrant vasculature and isthmus division are the most common obstacle encountered by the operating surgeon. Here we report our single-center experience in laparoscopic heminephrectomy in four patients with HSK.

Methods: Retrospective data were analyzed for four cases of laparoscopic heminephrectomy for nonfunctioning moiety in HSK operated between 2012 and 2020. Of these four patients, one case was converted to open approach in view of intra-operative bleeding. Computed tomography urogram (CTU) was done pre-operatively in all patients. Laparoscopic surgery was performed via transperitoneal approach.

Results: The mean age of the patients was 37 ± 5.38 years. Flank pain was noted in all cases while dysuria seen in two patients and one patient had fever. Mean operative time was 145 ± 26.92 min and estimated blood loss was 85 ± 55 ml. Various techniques for isthmectomy and lower pole resection were used including use of monopolar hook in laparoscopic suite, Ligasure and bipolar scissor in minimal invasive milieu and monopolar cautery in laparoscopic conversion to open procedure. Histopathological examination revealed chronic pyelonephritis in three cases and squamous cell carcinoma of renal pelvis in one case which was converted to open.

Conclusions: Laparoscopic heminephrectomy in HSK is doable. Preoperative CT urography along with CT angiography may provide important anatomical and vascular information which reduces intra-operative risks of vascular injury or calyceal entry. Vascular control of isthmus and transection of dilated and thinned out lower pole with cauterization of pelvicalyceal mucosa will provide uneventful surgical course.

Keywords: Horse shoe kidney, Laparoscopic approach, Monopolar hook, Case series

1 Background

Horseshoe kidney (HSK) is the most common congenital fusion anomaly and found in 1 in 400 of the general population [1]. It is usually asymptomatic and is incidentally recognized in radiological imaging. Impaired drainage due to anomalous anatomy such as ureter entanglement on isthmus can cause urolithiasis and hydronephrosis thus giving rise to symptoms.

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With the advances in laparoscopic surgery, improved surgeon skill and patient preferences, minimal invasive management of such cases are favored. During laparoscopic heminephrectomy in HSK anomaly, ectopic kidney location, aberrant vasculature and isthmus division are the most common obstacle encountered by the operating surgeon [2, 3]. Here we report our single-center experience in laparoscopic heminephrectomy in four patients with HSK.

2 Methods

Between 2012 and 2020, 4 patients with HSK underwent heminephrectomy. Of these four patients, pure laparoscopic heminephrectomy was done in three patients while in one patient laparoscopic approach was converted to open approach in view of intra-operative bleeding. Data were retrospectively gathered from digital medical records. Computed tomography urogram (CTU) was done preoperatively and the split function was assessed with DTPA renogram. Laparoscopic surgery was performed via transperitoneal approach in all cases.

2.1 Case 1

A 30-year-old married female presented with right flank pain for past 2.5 months. Abdominal examination showed mass in right lumbar area. On ultrasound examination, lower pole could not be traced completely and appeared to go medially and therefore HSK was

suspected with severe 4 ports (2 ports of 12 mm and another 2 ports of 5 mm) in right lateral position. 12-mm camera port was placed at umbilicus, 5 mm port in mid-clavicular line below right costal margin, 5 mm in right iliac fossa and one liver retractor port 7 cm below xiphoid process.

After colonic deflection and Kocherization, dissection done at upper pole to move kidney away from liver. Multiple atretic vessels were noticed which were controlled with 10 mm Ligasure.

Demarcation between empty hydronephrotic sac and fleshy parenchyma was seen, and isthmus was transected with monopolar hook at this demarcation grade 4 hydronephrosis in right kidney. CTU confirmed HSK with right severe grade 4 hydronephrosis (Fig. 1a and b). DTPA scan showed 10.2% split function of right moiety. Initially right percutaneous nephrostomy (PCN) tube was passed under sonography guidance which drained approximately 700 ml of clear fluid. Subsequently she underwent laparoscopic right hemi-nephrectomy using line (Fig. 1c). Subsequent repair with 3-0 vicryl was done.

2.2 Case 2

A 40-year-old male presented with history of left flank pain for 6 months. He underwent left percutaneous nephrolithotripsy seven years back. On CTU HSK was confirmed along with enlarged left kidney with loss of normal architecture along with multiple enlarged

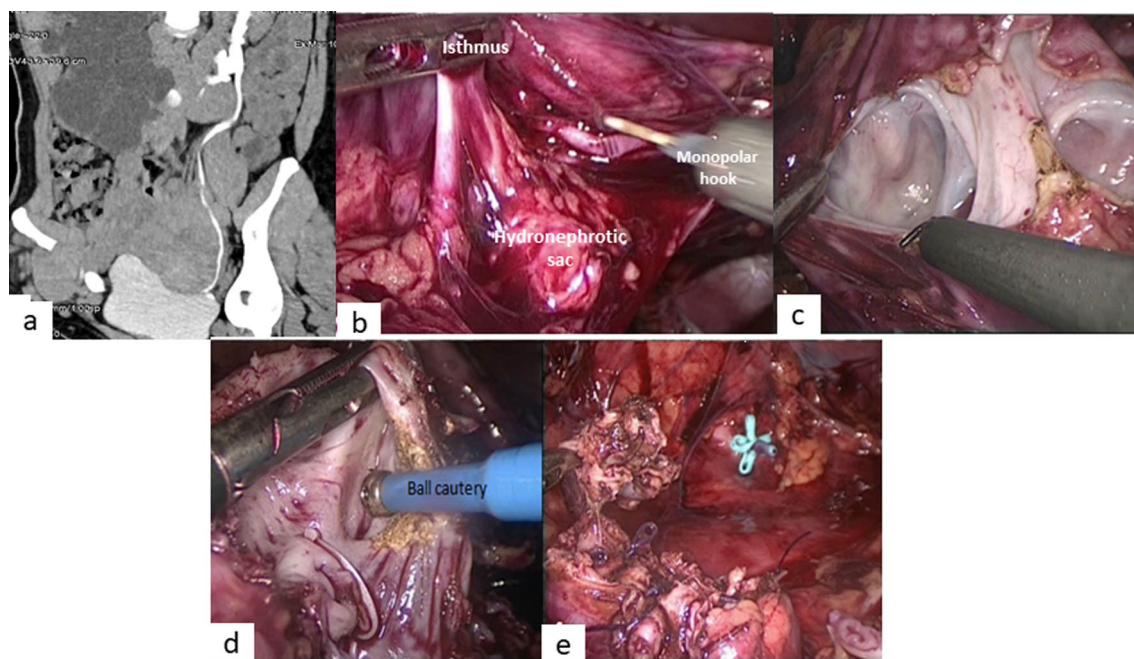


Fig. 1 a Coronal section showing junction between right hydronephrotic kidney and left normal kidney. b Isthmectomy is planned toward hydronephrotic sac by monopolar hook. c Dissection using monopolar hook. d Hemostasis using ball cautery. e Post-suturing status

para-aortic lymph nodes. No excretion of contrast was seen in 20 min delayed films (Fig. 2). Left laparoscopic heminephrectomy was attempted by transperitoneal approach with 4 ports placed. Dense adhesions were present with obliteration of tissue planes. After colonic reflection upper pole was freed from spleen by gradual adhesiolysis. Caudal to isthmus, uretero-gonadal packet was lifted from psoas, and posterolateral dissection was performed to lift the kidney from posterior abdominal wall. An inadvertent injury occurred in pelvis during dissection leading to pus spillage which was immediately suctioned out. Many aberrant vessels came across the dissection and were controlled with Hem-o-lok weck clips and Ligasure. While dissection around isthmus, injury to aberrant artery occurred which could not be controlled even with rescue stitch. Immediately open conversion was done, and bleeding was controlled followed by isthmectomy with monopolar cautery and the cut edges were sutured with 3-0 vicryl to achieve hemostasis. Surprisingly histopathological examination turned to be squamous cell carcinoma of renal pelvis with positive margin. Patient was advised for cisplatin-based chemotherapy and radiotherapy.

2.3 Case 3

A 44-year-old male was admitted with history of dysuria, fever with chills, right side flank pain and pyuria. Ultrasonography showed HSK with right severe grade 4

hydronephrosis. CTU revealed HSK with enlarged and severely grade 4 hydronephrotic right kidney (Fig. 3). DTPA scan showed split function of right kidney of 7%. Patient underwent laparoscopic right heminephrectomy. Ports were placed as in the first case. After colonic reflection two renal veins and one renal artery are seen entering kidney at hilum which were clipped with Hem-o-lok weck clips. Aberrant small vessels were dealt with 10 mm Ligasure. Huge hydronephrotic sac was decompressed with Veress needle. Isthmus was cut with Ligasure in direction more towards the right hydronephrotic kidney and thus avoiding left kidney parenchymal injury.

2.4 Case 4

A 34-year-old male presented with intermittent left flank pain with dysuria for nine months. The pain interfered with his activities of daily living. CTU revealed HSK with left side pelvic-ureteric junction obstruction (PUJO) causing severe grade 4 hydronephrosis (Fig. 4). Relative function on DTPA scan was 10.2%. Transperitoneal right laparoscopic heminephrectomy was performed using four ports. Spleen was moved away from upper pole and left ureter was divided below PUJ. A window created at cranial border of isthmus and main renal artery and lower polar accessory artery were clipped with Hem-o-lok clips. After vascular control posterolateral dissection was done. Isthmus was isolated and cut with bipolar

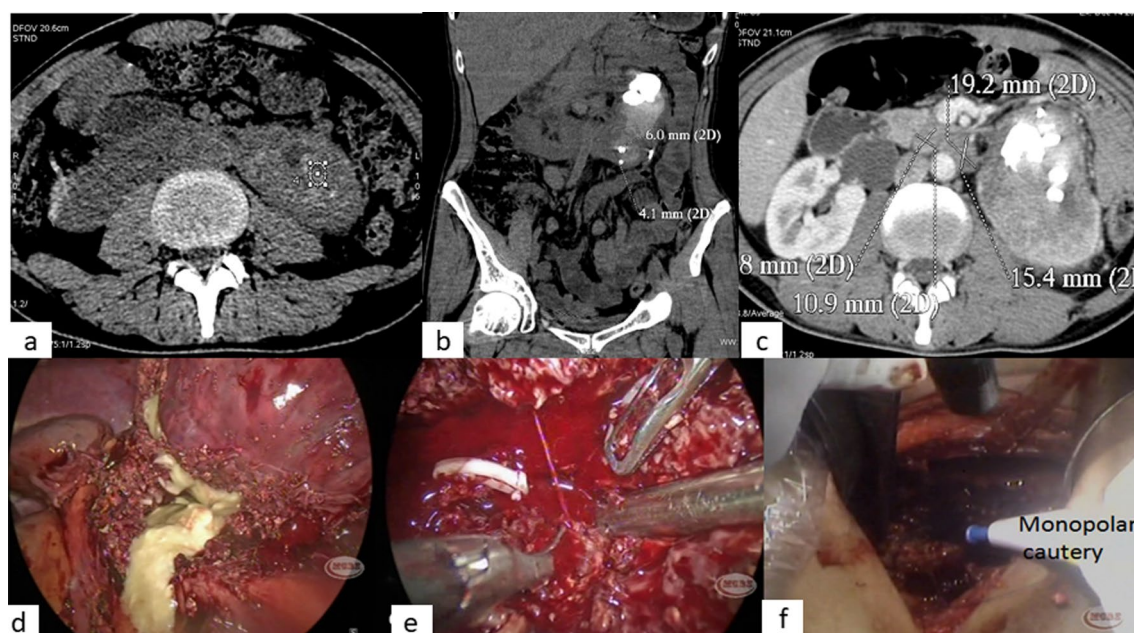


Fig. 2 **a** Fusion of lower pole of both kidneys, which are lying anterior to IVC and aorta. **b** Show loss of normal left renal architecture with no contrast excretion **c** Multiple enlarged para-aortic lymph nodes present. **d** Pus spillage. **e** Arterial injury during isthmus dissection leading to open conversion. **f** Open control using monopolar cautery

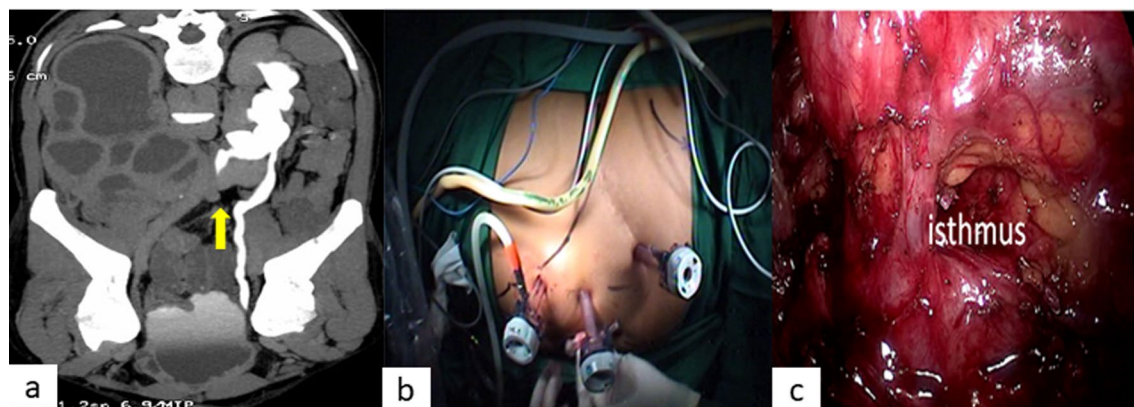


Fig. 3 **a** Coronal section showing isthmus (arrow) with normal excretory left kidney. **b** Port placement relatively caudally as HSK is inferiorly located than normal kidney. **c** Laparoscopic anatomy

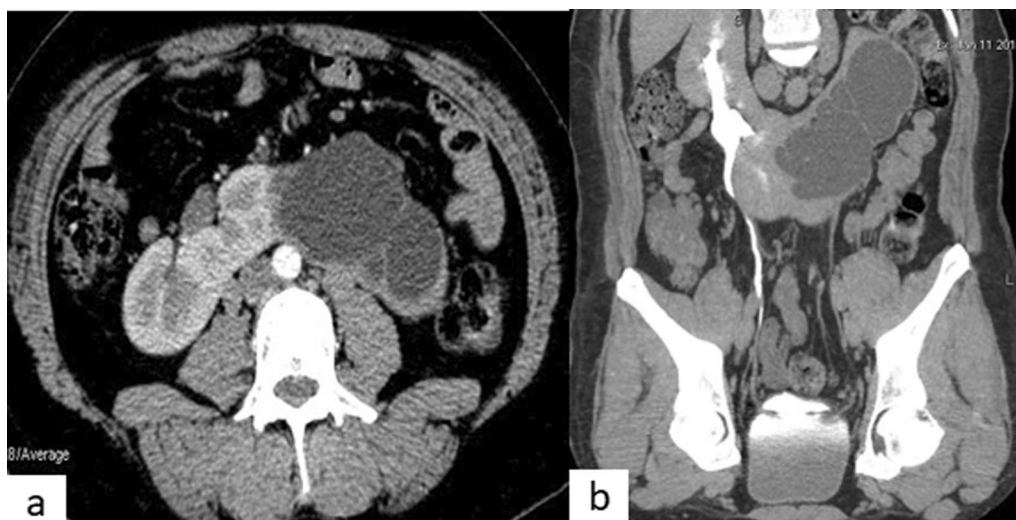


Fig. 4 **a** Horseshoe kidney is seen with a band of functioning renal tissue connecting the two kidneys. **b** Left kidney is small in size and shows the presence of marked hydronephrosis

scissor toward deflated hydronephrotic sac followed by suturing with V-loc sutures to combat edge bleeding.

3 Results

The mean age of the patients was 37 ± 5.38 years. Flank pain was noted in all cases while dysuria seen in two patients and one patient had fever. Mean operative time was 145 ± 26.92 min and estimated blood loss was 85 ± 55 ml. The mean hospital stay was 4.25 ± 1.63 days. Isthmectomy was done with different modalities in every case which included use of monopolar hook in laparoscopic suite, Ligasure and bipolar scissor in minimal invasive milieu and monopolar cautery in laparoscopic conversion to open procedure. Histopathological

examination revealed chronic pyelonephritis in three cases and squamous cell carcinoma of renal pelvis in one case (Table 1).

4 Discussion

Usually, one-third of all patients with HSK are asymptomatic and detected incidentally on radiological imaging [4]. In our cases, flank pain was seen in all patients, dysuria in 2 cases and fever in one case. Agrawal et al. in their case series of three cases reported pain in all and fever in one case as presenting symptoms [2]. Jarzowski also reported abdominal pain in all his four cases of HSK [5].

PUJO is the most common associated finding in HSK and account for 35% of cases [6]. Renal stones are also

Table 1 Intra-operative and postoperative parameters

Parameters	Case number			
	1	2	3	4
Operative Time(min)	130	190	140	120
Equipment for isthmectomy	Monopolar Hook	Monopolar cautery (open)		Bipolar scissor
Estimated blood loss (ml)	60	180	50	50
Hospitalization (Days)	3	7	4	3
Histopathological Examination	Chronic pyelonephritis	Squamous cell carcinoma in renal pelvis with invasion into renal parenchyma with positive resection margin	Chronic pyelonephritis	Chronic pyelonephritis with tubulo-papillary adenoma
Complications	None	Intra-operative bleeding leading to open conversion	None	None

common secondary to obstruction or recurrent infection. In HSK incidence of renal tumor is approximately 3 to 4 times higher than seen in normal population [6]. In our study, PUJO was seen in 3 cases and renal malignancy incidentally detected on histopathological examination in one case.

Unfamiliar abnormal anatomical location, vascular anomalies and isthmectomy are major impediment for laparoscopic heminephrectomy in HSK. During development while they are situated in the pelvic cavity, HSK may acquire branches from aberrant sources like the distal aorta, iliac or hypogastric arteries. Blood supply to isthmus can be from renal artery or a direct separate branch from aorta in 65% cases [2]. Graves described six basic arterial pattern of supply to HSK [7]. Glondy et al. found source of aberrant vessels can be common iliac artery, internal iliac artery, external iliac artery or lumbar artery in their 185 cases of HSK [3]. Along with artery multiple renal veins exist. In current scenario no standard classification of HSK vasculature exists. Three-dimensional computed tomography angiography (CTA) is proposed to look for vascular anomaly [2]. CTA was not done in our cases as all were non-functional kidney which have atrophic vessels. After retrospective analysis of laparoscopic converted open heminephrectomy case, we recommend having CTA preoperatively.

Various laparoscopic approaches like transperitoneal, retroperitoneal and hand-assisted have been described. Khan et al. found transperitoneal approach was the most common in their reviewed 23 case reports between 1995 and 2010 [6]. In our case series all patients underwent laparoscopic heminephrectomy via transperitoneal approach. Larger working space and more familiarity with anatomy make transperitoneal approach more commonly adapted by surgeons.

Port positions are similar to standard laparoscopic nephrectomy except for port placement little caudally

as the HSK is inferiorly located than normal kidney position. We prefer to secure the vessels prior to isthmectomy which allows more mobility and easy maneuverability of isthmus.

Various energy sources like Ligasure, harmonic scalpel, Endo GIA stapler, bipolar electrocautery and parenchymal suturing with argon beam coagulation have been utilized for division of isthmus [5, 6]. We used monopolar cautery and suturing in two cases, bipolar scissor in one case and 10 mm Ligasure in one case. We advocate division of isthmus toward hydronephrotic side and thus avoid inadvertent calyceal entry in opposite normal kidney and minimize parenchymal injury. We found hemostasis was most challenging with monopolar cautery. Sutures were used in all cases to close the isthmectomy wound.

5 Conclusions

Laparoscopic heminephrectomy in HSK is doable. Pre-operative CT urography along with CT angiography may provide important anatomical and vascular information which reduces intra-operative risks of vascular injury or calyceal entry.

Abbreviations

HSK: Horseshoe kidney; CTA: Computed tomography Angiography; CTU: Computed tomography urogram; PUJO: Pelvic-ureteric junction obstruction.

Acknowledgements

None.

Author contributions

SA: Writing manuscript, AA: Editing manuscript, AGS: Editing manuscript, RBS: Editing manuscript, MD: Editing manuscript. All authors read and approved the final manuscript.

Funding

The case study did not receive any funds from any source.

Availability of data and materials

All patient data are stored in our database.

Declarations

Ethics approval and consent to participate

Muljibhai Patel Society for Research in Nephro-Urology Ethics committee has approved this study – Reference No.: EC/502/2021. Consent for participation from all the patients have been taken.

Consent for publication

Written informed consent was obtained from all three patients for the anonymized information and the accompanying images to be published in this article.

Competing interests

The authors declare that there is no conflict of interest.

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Received: 24 November 2021 Accepted: 3 February 2022

Published online: 28 April 2022

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