



## Results of laparoscopic management of stones in horseshoe kidney at a tertiary referral hospital

### Resultados del manejo laparoscópico de cálculos en riñón en herradura en un hospital de tercer nivel

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#### Abstract

The management of kidney stones in patients with horseshoe kidney is a challenge for all urologists, given the low prevalence of the anomaly. There are very few reports of treatment through laparoscopic pyelolithotomy in the literature. Our aim was to share the results and experience obtained in the treatment of stones in horseshoe kidney through transperitoneal laparoscopic pyelolithotomy.

**Methodology:** A retrospective, observational, cross-sectional, analytic study was conducted on patients diagnosed with horseshoe kidney and kidney stones, confirmed by non-contrast abdominal tomography, and treated through transperitoneal laparoscopic pyelolithotomy, within the time frame of January 2010 and January 2020.

**Results:** There were 4 cases of renal pelvic stones in horseshoe kidney, all of which were men. Mean patient age was 33.5 years, mean BMI 32.25 kg/m<sup>2</sup>, mean surgery duration 125 minutes, mean blood loss 55 ml, and mean hospital stay 2.75 days. The stone-free rate was 100 %. Blood loss and age, blood loss and stone size, and BMI and surgery duration were significantly correlated.

**Conclusions:** Based on our experience, transperitoneal laparoscopic pyelolithotomy is an excellent alternative for treating kidney stones in patients with horseshoe kidney.

#### Keywords:

Horseshoe kidney,  
kidney stone,  
laparoscopic  
pyelolithotomy

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## Resumen

El manejo de los cálculos renales en pacientes con riñón en herradura es un desafío para todo urólogo, dada la baja prevalencia de la anomalía. Hay muy pocos informes de tratamiento mediante pielolitomía laparoscópica en la literatura. Nuestro objetivo fue compartir los resultados y la experiencia obtenidos en el tratamiento de cálculos en riñón en herradura mediante pielolitomía laparoscópica transperitoneal.

**Metodología:** Se realizó un estudio analítico, observacional, transversal, retrospectivo, de pacientes diagnosticados con riñón en herradura y cálculos renales, confirmados mediante tomografía abdominal sin contraste, y tratados mediante pielolitomía laparoscópica transperitoneal, en el período comprendido entre enero de 2010 y enero de 2020.

**Resultados:** Hubo 4 casos de cálculos pélvicos renales en riñón en herradura, todos ellos hombres. La edad media de los pacientes fue de 33.5 años, el IMC promedio de 32.25 kg/m<sup>2</sup>, duración media de la cirugía de 125 minutos, pérdida promedio de sangre de 55 ml y la estancia hospitalaria promedio de 2.75 días. La tasa de ausencia de cálculos fue del 100 %. La pérdida de sangre y la edad, la pérdida de sangre y el tamaño de los cálculos, el IMC y la duración de la cirugía se correlacionaron significativamente.

**Conclusiones:** Según nuestra experiencia, la pielolitomía laparoscópica transperitoneal es una excelente alternativa para el tratamiento de cálculos renales en pacientes con riñón en herradura.

### Palabras clave:

Riñón en herradura,  
cálculo renal,  
pielolitomía  
laparoscópica

## Introduction

Horseshoe kidney is the most frequent congenital renal fusion anomaly, with an incidence of 1 in 400.<sup>(1,2)</sup> The majority of cases present in males, and 95% of the cases involve fusion of the lower poles.<sup>(2)</sup>

Patients with horseshoe kidney are usually asymptomatic, but there are certain metabolic alterations and anatomic modifications that predispose to impaired urinary drainage, with an increase in urinary stasis, infections, and the formation of stones and obstructions.<sup>(1-3)</sup>

Urolithiasis is the most common complication in horseshoe kidney, with a reported

incidence of 21 to 60 %.<sup>(4)</sup> It is also the most common cause of surgical indication in those patients.<sup>(2)</sup>

Its approach and treatment are a challenge for urologists. Traditionally, stones are treated depending on their location and size through endourologic techniques, such as flexible ureteroscopy, percutaneous nephrolithotomy (PNL), and extracorporeal shock wave lithotripsy (ESWL), with varied results. Considerable complications have resulted from PNL.<sup>(1,2)</sup>

Technologic advances in new procedures, such as laparoscopic pyelolithotomy (LP), in its

different modalities, have been of aid in kidney stone management. Very few case series and case reports on the treatment of kidney stones in patients with horseshoe kidney have been published in the literature, thus, whether the new technique can be replicated or standardized in those patients is unknown. Consequently, our aim was to share the results and experience obtained from the treatment of kidney stones in patients with horseshoe kidney, through transperitoneal laparoscopic pyelolithotomy, adding our results to those in the medical literature.

## Material and methods

A retrospective, observational, cross-sectional, analytic study was conducted on patients seen at the *Hospital General de México "Dr. Eduardo Liceaga" O.D.*, within the time frame of January 2010 and January 2020, that were diagnosed with horseshoe kidney and kidney stones, confirmed by non-contrast abdominal tomography, and treated through transperitoneal laparoscopic pyelolithotomy. Their medical records were complete and obtained from the hospital archive.

The statistical analysis was carried out utilizing the Microsoft Excel version 16.44 and IBM SPSS v.22.0 (Statistical Package for Social Sciences Inc.) programs for Macintosh.

A descriptive analysis was performed, obtaining simple frequencies and measures of central tendency. The correlation between variables was carried out through inferential statistics, employing the Pearson correlation coefficient. Correlation was considered significant with a p value of 0.05.

## Results

Fifty laparoscopic procedures were performed within the time frame of 2010 and 2020 for managing urolithiasis. Only 4 of those cases (8 %) were patients with horseshoe kidney.

The stones in 100 % of the cases with horseshoe kidney were located in the renal pelvis, with a mean size of 3 cm (1.4 SD). Laterality was the right side in 2 patients and the left side in 2 patients.

Regarding the variables analyzed, 100 % of the patients were men, with a mean age of 33.5 years (10.78 SD), ranging from 24 to 49 years. Mean body mass index (BMI) was 32.25 kg/m<sup>2</sup> (12.9 SD), ranging from 18.7 to 49.8 kg/m<sup>2</sup>; mean surgery duration was 125 minutes (54.4 SD), ranging from 80 to 200 minutes; and the intraoperative blood loss reported was 55 ml (83.3 SD). A stone-free rate of 100 % was achieved, there were no complications, and mean hospital stay was 2.75 days (0.5 SD). A 6 Fr 24 cm double-J ureteral catheter was placed in all 4 patients and removed on postoperative day 28 (7 SD) (**Table 1**).

**Table 1. Clinical characteristics and surgical results**

	Mean	Standard deviation
<b>Sex:</b>		
Male	100%	
Female	0%	
<b>Laterality</b>		
Left	50%	
Right	50%	
Age	33.50	10.786
Hospital Stay	2.75	.50
Stone Size (cm)	3.00	1.41
Intraoperative Blood Loss (ml)	55.00	83.3
Body Mass Index (kg/m <sup>2</sup> )	32.25	12.9
Surgery Duration (Min)	125	54.4
Stone-Free Rate	100%	
Intraoperative Complications	0%	

The Pearson correlation coefficient produced a correlation of 94.7 % ( $p=0.05$ ) between intraoperative blood loss and stone size; a correlation of 96.4 % ( $p=0.03$ ) between surgery duration and BMI; and a correlation of 95.3% ( $p=0.04$ ) between intraoperative blood loss and age.

## Discussion

Horseshoe kidney, the most frequent congenital fusion anomaly, has an incidence of 1 in 400.<sup>(1,2)</sup> The majority of cases present in males, and 95 % involve fusion of the lower poles of the two kidneys.<sup>(2)</sup> In our case series, 100 % of the cases of horseshoe kidney were in males.

The patients that present with horseshoe kidney usually are asymptomatic, but certain anatomic modifications, such as renal malrotation, with anterior displacement of the collecting system and the renal pelvis, situating the pelvis in front of the kidney, with the ureter inserted into the pelvis at a higher level than its normal insertion site.<sup>(1,2)</sup> Those types of alterations predispose patients to impaired urinary drainage, with an increase in urinary stasis, infections, stone formation, and obstruction.<sup>(1,2)</sup> In addition to the anatomic alterations that predispose to stone formation, treated metabolic alterations in patients with horseshoe kidney have been reported to predispose to stone formation, as well.<sup>(3)</sup>

Urolithiasis is the most common complication in horseshoe kidney, with a reported

incidence of 21 to 60 %, <sup>(4)</sup> and is also the most common indication for surgery in those patients. <sup>(2)</sup>

Kidney stones are a common benign urologic pathology and the approach and treatment employed have progressed over time. <sup>(5)</sup> The majority of surgical treatments of kidney stones in anatomically normal kidneys and in horseshoe kidneys have been developed as endourologic procedures. Percutaneous nephrolithotomy (PNL) and extracorporeal shock wave lithotripsy (ESWL) are the methods most commonly reported for treating stones in horseshoe kidneys. More recently, flexible ureteroscopy and laparoscopic pyelolithotomy (LP) have also been shown to be effective and valuable management options, along with increasingly less performance of open surgery. <sup>(1)</sup> The success rates vary, depending on stone burden, stone location, and the treatment employed.

PNL has been the most widely accepted treatment for large pelvic stones (> 2cm), but both transperitoneal laparoscopic pyelolithotomy and retroperitoneal laparoscopic pyelolithotomy have gained ground and attention, <sup>(4)</sup> since the first report by Gaur *et al.* <sup>(6)</sup> In 1994, on 5 patients. Current evidence suggests the two techniques are safe and effective for treating solitary renal pelvic stones larger than 2 cm. <sup>(4)</sup> Studies have compared PNL with laparoscopic pyelolithotomy (LP), such as the meta-analysis by Wang *et al.* Those authors found that PNL was associated with shorter surgery duration and hospital stay, whereas LP was associated with less blood loss, higher stone-free rates (reported up to 93 %), and fewer cases of postoperative fever. <sup>(4,7)</sup> Severe complications in kidneys with anatomic anomalies have been reported in patients that underwent PNL.

In our study, transperitoneal pyelolithotomy resulted in a stone-free rate in 100 % of the cases, there were no intraoperative complications, hospital stay was short (mean 2.7 days), and the mean blood loss was 55 ml. Stone size and intraoperative blood loss were significantly correlated, as were age and blood loss.

Laparoscopic management of kidney stones in patients with horseshoe kidney was first performed by Maheshwari *et al.* in 2004. <sup>(8)</sup> LP can be an adequate alternative in cases of stones larger than 2 cm and ureteropelvic junction stricture, in patients with abnormal kidneys, and in individuals with morbid obesity, in which ESWL and other endourologic interventions have lower success rates. <sup>(4,9)</sup> Traditionally, all laparoscopic operations for stones are performed retroperitoneally to prevent contamination of the peritoneal cavity with potentially infected urine. Nevertheless, there are reports stating that if patients receive the appropriate preoperative and intraoperative antibiotics, and peritoneal cavity contamination is kept at a minimum by preventing urine spillage, the transperitoneal approach can be equally as safe. <sup>(8)</sup> Regarding the treatment of pelvic stones in horseshoe kidney, Ölçücüoğlu *et al.* reported good results and low complication rates. <sup>(2)</sup> Likewise, in our case series, 100% of the cases were performed with the transperitoneal approach, with good results. There were no intraoperative complications or impact on hospital stay.

LP can be performed with different approaches, through the transperitoneal, retroperitoneal, and hand-assisted techniques, or through single-port surgery, as reported by Cabrera *et al.* Those authors considered it a beneficial option for patients, offering rapid recovery and excellent functional results, as

well as the favorable cosmetic results of a single scar.<sup>(10)</sup>

LP is not expected to replace the other minimally invasive techniques for treating kidney stones, such as flexible ureteroscopy, ESWL, or PNL, but rather to be a complement or alternative to those procedures.<sup>(10)</sup> Haghighi *et al.* described a case of laparoscopy-assisted transperitoneal percutaneous nephrolithotomy (LA-TPNL) with no fluoroscopy, considering it a useful and reliable surgery, with a short operative time.<sup>(11)</sup>

We found transperitoneal LP to be an excellent option for treating renal pelvic stones in patients with horseshoe kidney. It is an alternative to different forms of endoscopic treatment, with a high stone-free rate, no radiation, short hospital stay, and a considerably short surgery duration in experienced hands, albeit operative time can be affected by the BMI of the patient.

## Conclusion

The incidence of patients with horseshoe kidney is low, making the diagnosis and treatment of kidney stones in those cases a diagnostic and treatment challenge for all urologists. Treatment should be carried out according to stone size and location, as well as to the preference and skill of the surgeon. Flexible ureteroscopy, PNL, ESWL, and LP are therapeutic options. We consider transperitoneal laparoscopic pyelolithotomy an excellent alternative for treating renal pelvic stones in patients with horseshoe kidney. Nevertheless, more studies should be conducted to compare the results of different techniques, thus providing support for making the best decision in the treatment of those patients.

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## Conflict of interest

None of the authors have any conflicts of interest or financial ties to disclose.

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