JOJ
Urology & Nephrology
ISSN: 2476-0552

Research Article
Volume 2 Issue 3 – April 2017
DOI: 10.19080/JOJUN.2017.02.555590

JOJ uro & nephron

Laparoscopic Vs Open Anatrophic Nephrolithotomy Operative Outcomes and Comorbidities

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Submission: February 18, 2017; **Published:** April 11, 2017

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Abstract

Introduction: Management of staghorn calculi in terms of complete clearance and low morbidity is a technically challenging issue even with open surgery. The aim of the study is to compare laparoscopic surgery as a less invasive procedure than open surgery.

Methods: A control-case study was performed, all patients with staghorn calculi treated by laparoscopic or open anatrophic nephrolithotomy between 2014 and 2015 we included. Age, stone diameter, surgical time, warm ischemia time, blood loss, transfusion, waiting time for surgery, complications, stone-free rate and hospital stay were evaluated. Analysis was carried out in STATCAL Epi info 7.

Results: There were 15 patients that met inclusion criteria, 8 were undergone to laparoscopic and 7 to open surgery. Age range was 42.1 vs 49.5 years, stone size 52.63mm vs 44.7mm, surgical time 127.5 vs 121.4min, warm ischemia 29.5 vs 33min. (OR 10, p=>.05), blood loss 218.7 vs 837.1ml, transfusion rates were 0% vs. 57%, complications 25% vs 57.14% (OR .25, p= >.05) , hospitalization days 3.5 vs 6.14 days (OR 6, p=>.05) and stone-free rate was 75% vs 57% (OR 2.25, p=<.05) respectively.

Conclusion: Our results seems to show that laparoscopic nephrolithotomy have a higher stone free rate, less complication, warm ischemia rate and a short hospitalization stay compared with open surgery, although it is necessary a mayor sample of patients and prospective studies that corroborates this results.

Keywords: Anatrophic; Nephrolithotomy; Lithiasis; Calculi

Abbreviations: PCNL: Percutaneous Nephrolithotomy; SWL: Shock Wave Lithotripsy; AN: Anatrophic Nephrolithotomy; LAN: Laparoscopic Anatrophic Nephrolithotomy; OAN: Open Anatrophic Nephrolithotomy

Introduction

Even in this modern era of endourology where we have experienced mayor technological advances and technical improvements, management of staghorn calculi remains a big challenge especially in obtaining a stone-free status with low morbidity. By definition staghorn calculus occupies more than 80% of the collecting system or the renal pelvis and more than one single calyx [1]. It is not uncommon that a stone free status for a staghorn calculus is not achieved after several sessions with endourological techniques and even after an open, laparoscopic or robotic surgery.

In past decades percutaneous nephrolithotomy (PCNL) and shock wave lithotripsy (SWL) have revolutionized renal calculi management. It is because of its minimally invasive nature and high effectiveness with less morbidity that they have replaced open surgery for big renal calculi treatment. Nowadays, PCNL it is the first line treatment for renal calculi >2cm and for those in lower renal pole >10mm. However, in big renal calculi (staghorn calculi) PCNL could not get a stone free status even with more than one procedure [2]. Stone free rates for anatrophic nephrolithotomy (AN) could not be

depended on nephrolitometric mesurements like PCNL does and could reach success rates of 75-95% in a single procedure, this is the reason why in many centers AN continue to be a very attractive therapeutic option in patients with sthaghorn calculi [3,4]. Laparoscopic surgery has been used to replicate different open surgeries used for ureteral and renal stones management. Laparoscopic anatrophic nephrolithotomy (LAN) has been described as an effective, safe and reproducible method in experienced centers, however, it presents higher rates of complications compared to PCNL, and higher renal function loss (7-27%) in the affected kidney but could be less invasive and more effective than open anathrophic nephrolithotomy [4-6].

Material and Methods

A case-control study was carried out to compare laparoscopic to open nephrolithotomy. With this purpose all patients diagnosed with staghorn calculi that were undergone to laparoscopic or open anatrophic nephrolithotomy (OAN) at "The Antiguo Hospital Civil de Guadalajara", between 2014-2015 were included. Laparoscopic surgeries were performed by the same surgeon and open surgery was performed by 2 different surgeons. All patients were admitted the day before their surgery because of the administrative protocol of our hospital and all the patients received preoperative antibiotic prophylaxis. We performed the statistical analysis in STATCALC of Epi info 7and perform descriptive analyzes taking into account measures of central tendency and dispersion. The inferential analysis was performed using contingency tables (2x2) and x2 was calculated using the corrected Yates test. We performed the OR test, obtaining its value and as hypothesis test the confidence interval of 95%.

Laparoscopic technique

After general inhaled anesthesia a double "J" catheter was placed in all cases at the beginning of surgery in lithotomy position and then the patient was positioned in a lateral decubitus position. For left sided surgery we used 4 trocars and for right sided surgeries we added an extra 5mm trocar. First we place a 10mm trocar for a 30 degrees lens at the level of a imaginary pararectal line 3-4cm above the navel, then we place a second 10mm trocar at 8-9cm right sided of the first trocar, a third 5mm trocar is placed 8-9cm left sided of the first one trying to making up an imaginary triangle by these first trocars. Finally a fourth trocar is placed on the posterior axillary line as a support for renal retraction and If the procedure is on the right side an additional 5mm trocar is placed to retract the liver.

A transperitoneal approach was performed in all patients and the first step once all trocars are placed in their right position it is Told's fascia dissection and colon movilization. Then all anatomical structures such as duodenum or liver (if a right sided surgery), are dissected until renal hilum get adecuately exposed to be clamped. We continue with dissection of anterior and posterior perirenal fat until renal capsule get completely discovered and having adequate exposure of both sides of the kidney and renal hilum. Renal artery (only) get clamped with a bulldog clamp and the pneumoperitoneum pressure it is increased until reach 20mmHg to reduce risk of bleeding, a pneumoperitoneum pressure of 14mmHg the set for the rest of the surgery (Figure 1). A laparoscopic scalpel (blade number 11) to perform the incision in renal parenchyma. Incision was performed (3-4cm) trying to identify the avascular Brödel line in the kidney, a difficult issue because it is not a straight line and it has irregularities in its path [7]. Once the collector system is opened and the stone is exposed (Figure 2), an alice clamp is introduced to release the stone, always trying to remove it in one piece (Figure 3). Collector system is then explored with the 30 degree lens for residual stone. As a final step prior to removal of the bulldog clamp, the renal parenchyma is closed with 2-0 polyglactin with a hem-o-lock reinforcement (Figure 4). We remove bulldog clamp and hemostasia is controlled but if bleeding is observed, «X» suture points were placed as much as necessary, thereafter gelfoam (Figure 5) were placed at the site of the renal parenchyma incision. It is very important to keep warm ischemia time to a maximum of 30 minutes because prolonged ischemia causes a greater renal damage [7]. As a last step we introduced the stones in a bag (Figure 6). Then Jackson-Pratt type drainage was left in place.

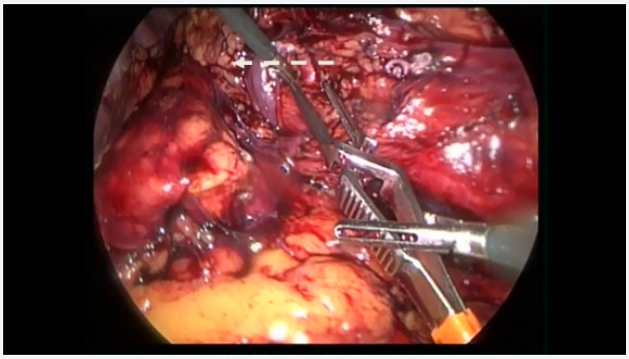

Figure 1: Renal artery (marked with an arrow) get clamped with a bulldog clamp.

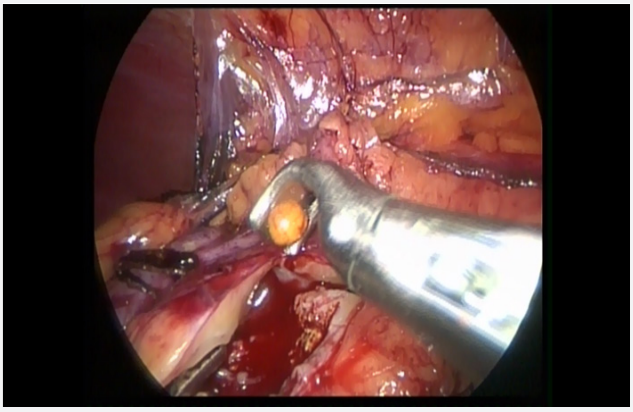

Figure 2: Stone exposition.

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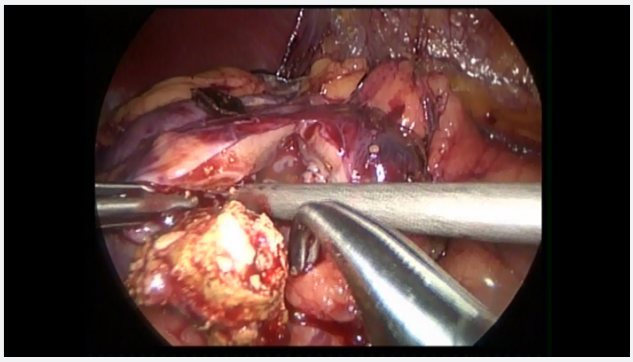

Figure 3: Alice clamp is introduced to release the Stone.

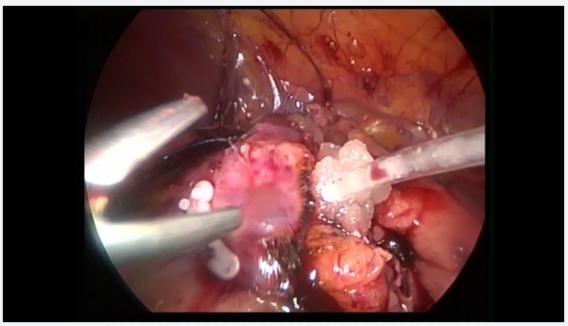

Figure 5: Gelfoam placed at the site of the renal parenchyma incision.

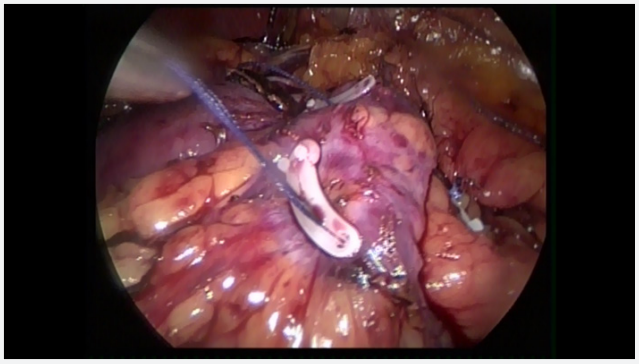

Figure 4: Renal parenchyma is closed with 2-0 polyglactin with a hem-o-lock reinforcement.

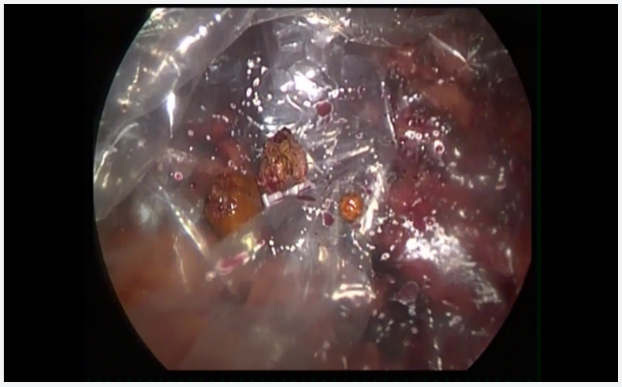

Figure 6: Introducing the stones in a bag.

Results

Table 1: Patient Characterisics.

Patient Charecteristics																
#Patient	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Mean
Surgery	LAP	LAP	LAP	LAP	LAP	LAP	LAP	LAP	OP	OP	OP	OP	OP	OP	OP	NV
Age	33	31	40	47	38	46	44	58	77	42	44	42	40	60	42	45.60
Stone Diameter (mm)	42	50	65	46	45	48	60	65	33	50	50	55	50	40	35	48.93
Side	LE	LE	RI	LE	RI	LE	LE	RI	LE	LE	RI	LE	LE	RI	LE	NV
Surgery Time	110	110	150	90	110	110	110	230	120	120	120	120	80	170	120	124.67
WIT	25	14	32	30	25	30	35	45	35	28	35	35	30	35	NA	31.00
Blood Loss	150	100	550	200	150	300	150	150	710	200	700	2200	100	150	1800	507.33
Transfusión	NO	NO	NO	NO	NO	NO	NO	NO	SI	NO	SI	SI	NO	NO	SI	NV
SWT	4	4	6	6	6	12	12	4	10	12	12	7	12	18	6	8.73
Complications	NO	NO	NO	NO	SI*	NO	NO	SI***	SI Ç	NO	NO	SI****	NO	SI &	SI **	NV
Stone Free Rate	SI	SI	SI	SI	SI	NO	SI	NV	SI	SI	NO	SI	NO	SI	NA	NV
HSD	4	3	3	3	4	4	4	3	5	5	6	4	3	5	15	4.73

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LAP: Laparoscopic; OP: Open; SWT: Surgery Waiting Time; HSD: Hospital Stay Days; WIT: Warm, Ischemia Time

*Late Nephrectomy 10 days after Surgery

**Nephrectomy for Incontrollable Bleeding

*** Nephrectomy for Prolonged Ischemia

****Vascular Injury (Vena Cava)

Ç: Splenic Injury

&: Ureter Injury

A total of 15 patients were undergone to anatrophic nephrolitotomy, 8 (53.3%) patients were submitted to laparoscopic and 7 (46.6%) to open suegery. No one patient that was undergone to laparoscopic surgery required conversion to open surgery (Table 1). Mean age in LAN was 42.1 years and OAN was 49.5 years and stone diameter was 52.6mm vs 44.7mm respectively. In the laparoscopic group 5 stones (62.5%) were found in left topography and 3 stones (37.5%) in right topography, mean while in the open group 5 stones (71.4%) in left topography and 2 stones (28.5%) in right side. Surgical time in LAN was 127.5 minutes and 121.4 minutes for OAN. The warm ischemia time in the LAN group was 29.5 minutes, it was performed a nephrectomy in a patient due to prolonged ischemia, in the OAN group an average of 33 minutes (OR 10, p=>0.05) was obtained, a patient was excluded from this parameter because a vascular injury at the moment of placing bulldog clamp, we decided to perform nephrectomy in this patient. The blood loss in the LAN group was 218.7ml and in the OAN group 837.14ml, with a percentage of transfusion for the LAN group of 0% and 57% respectively. The complications were classified as immediate complications: trans operative nephrectomy which represented 12.5% LAN group (one patient) and OAN group 14.2% (one patient), in the LAN group no splenic lesion was reported in OAN group one patient that represents 14.2%, ureteral lesion 0% in the LAN group and 14.2% OAN group (one patient), vascular injury (cava vein) 0% in LAN group and 14.2% OAN group. Late complications were present only in one patient in the LAN group, who presented at the emergency room with hematuria 9 days postoperatively, which did not yield to medical treatment, and performed emergence nephrectomy (OR .25, p=>.05) . The free stone rate, which was demonstrated with a simple tomography before hospital discharge, was 75% for LAN group was and 42.8% for OAN group (OR 2.25, p=<0.05). Hospital stay were lower for the LAN group, mean of 3.5 days, and for the OAN group, 6.1 days (OR 6, p=>0.05). (Table 2 & 3).

Table 2: Laparoscopic Vs Open.

Laparoscopic Vs Open		
	Laparoscopic	**Open**
#Patients	8	7
Age	42.13	49.5
Stone Diameter (mm)	52.63	44.7
Left Side	5	5
Right Side	3	2
Surgery Time	127.5	121.4
WIT	29.5	33*
Blood Loss	218.75	837.14
Transfusion	0	4 (57%)
SWT	6.75	11
Immedia Complications	1 (12.5%)	4 (57%)
Late Complications	1 (12.5%)	0
Free Stone Rate	75% (6)	57% (4)
DDH	3.5	6.14

SWT: Surgery Waiting Time

HSD: Hospital Stay Days

*We excluded a patient who presented vascular lesión, after placement of bulldog clamp

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Table 3: Analysis of anatomic nephrolithotomy variables.

Analysis of Anatomic Nephrolithotomy Variables							
Variables	SI		NO		OR	IC 95%	P
Complications	Fr	%	Fr	%			
Laparoscopic	2	25	6	75	0.25	0.02-2.23	>.05
Open	4	57.14	3	42.8	1		
	SI		NO		OR	IC 95%	P
Free Stone Rate	LAP	%	Fr	%			
Laparoscopic	6	75	2	25	2.25	0.25-20.13	<.05
Open	4	57.14	3	42.86	1		
	TIC (≤30)		TIC9>30)		OR	IC 95%	P
WIT	Fr	%	Fr	%			
Laparoscopic	5	62.5	3	37.5	10	0.77-128.78	>.05
Open	1	14.29	6	85.71	1		
	DDH (≤3)		DDH (>3)		OR	IC 95%	P
HSD	Fr	%	Fr	%			
Laparoscopic	4	50	4	50	6	0.47-75.34	>0.5
Open	1	14.29%	6	85.71%	1		

WIT: Warm Ischemia Time

HSD: Hospital Stay Days

Discussion

Nowadays the treatment of choice for renal stones >2cm is PCNL [9,10]. In 1968 smith and Boyce first described anatrophic nephrolithotomy but recently with the technology and urologic advances this technique had lost popularity. AN could be considered in some situations like these: failed endourological procedures, anatomical variations of the collecting system that difficult the percutaneous nephrolithotomy, neccessity of anatomical reconstruction of an uretero-pelvic junction structure, surgeon experience and trainin and skeletal abnormalities [11,12]. Reports has been shown that open surgery presents higher comorbidities compared to PCNL [13,14].

Melissourgos et al. [15] reported for open surgery a mean operation time of 180 minutes, 500ml blood loss and transfusion rate of 8.3% (2 patients), mean hospital stay 8.2 days, they made to 9 patients DMSA to determinate pre and post operative renal function and they observe that they loss only a 4% of function, stone free rate 83.3% [15]. We made a comparison between this results (Table 4).

Table 4: Comparison Open Surgery Resutls.

Comparison Open Surgery Results						
	N. Patients	**OPT**	**Blood loss**	**Transfusion**	**HOSD**	**FSR**
Meliss Orgos	24	180	500ml	0%	8.2	83$
Our Study	7	121.4	837.14ml	57%	6.14	57%

OPT: Operation Time; HOSD: Hosptial Stay Days; FSR: Free Stone Rate

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OPT: Operation Time; HOSD: Hosptial Stay Days; FSR: Free Stone Rate In the laparoscopic technique there's a few information published probably because the high grade complexity or a predominant percutaneous treatment. Zhou et al. has one of the biggest case series with 11 patients, the operative time range in all the studies we compared was 139-192 minutes, the ischemia range was 20.8-32.8, the stone diameter range 67.3-52mm, and the complications they report urinary leakage and vascular fistula [16-18] (Table 5).

Table 5: Perioperative results of the series of cases of laparoscopic anatomic nephrolithotomy.

Perioperative results of the series of cases of laparoscopic anatomic nephrolithotomy						
Study	**#Patients**	**Surgery Time**	**WIT**	**STDI**	**SFR**	**Complications**
Simforoosh (2008) [5]	5	170	32	53	60%	Niguna
Zhou (2011) [17]	11	139	31	52	90.90%	Urinary leakage (3)
Gieldmann (2012) [18]	8	142.5	20.8	53	62.50%	Vascular Fistula (1)
Amin Sharifi (2013) [4]	10	192	32.8	67.3	80%	Esplenic Injury
Nuestro estudio	8	127.5	29.5	52.6	85.70%	1 emergence nehprectomy y 1 late nephrectomy

STDI: Stone Diameter; SFR: Stone Free Rate; WIT: Warm Ischemia Time

Based on our analysis the stone free rate in a single staged procedure has better results with laparoscopic surgery than to open surgery.

Conclusion

Laparoscopic nephrolithotomy seems to have a higher stone free rate, less complication, warm ischemia time and hospital stay compared to open surgery. LAN could be a therapeutic option for renal staghorn calculi with high stone free rates in a single procedure in selected patients that are no candidates for PCNL, in centers with experience in laparoscopic surgery or those that PCNL is not available. However larger caser series and prospective studies are needed to compare all therapeutic options including PCNL and confirm these results.

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How to cite this article: Gómez-Regalado F, Manzo-Pérez B, Jimenéz-Avila J M, Arriaga A J, Almanzor-González O. Laparoscopic Vs Open Anatrophic Nephrolithotomy Operative Outcomes and Comorbidities. JOJ uro & nephron. 2017; 2(3): 555590. DOI: 10.19080/JOJUN.2017.02.555590.

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