Laparoscopic Vs Open Anatrophic Nephrolithotomy
Operative Outcomes and Comorbidities

Gómez-Regalado Francisco*, Manzo-Pérez Braulio, Jimenéz-Avila José María, Arriaga Aguilar Juan and Almanzor-González Octavio

1Department of Urology, Hospital civil de guadalajara “Fray Antonio Alcalde” México
2Department of Urology, Hospital civil de guadalajara “Fray Antonio Alcalde” México
3Department of Urology, Universidad de Sonora, Sonora
4Department of Endourology, Hospital Regional de Alta Especialidad del Bajío, Gto
5Department of Orthopedic, Hospital Centro Medico de Occidente, Jalisco

Submission: February 18, 2017; Published: April 11, 2017
*Corresponding author: Gómez-Regalado Francisco, Department of Urology, Hospital civil de guadalajara “Fray Antonio Alcalde” México,
Email: f_gore87@hotmail.com

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 121.4 min, warm ischemia 29.5 vs 33 min. (OR 10, p=>.05), blood loss 218.7 vs 837.1 ml, 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 measuremements 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 staghorn 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 7 and 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 5 mm trocar. First we place a 10 mm 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 Toldt’s fascia dissection and colon mobilization. Then all anatomical structures such as duodenum or liver (if a right sided surgery), are dissected until renal hilum get adequately 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.
Results

Table 1: Patient Characteristics.

| Patient Characteristics | #Patient | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Mean |
|-------------------------|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|-------|
| Surgery                 | LAP      | LAP| LAP| LAP| LAP| LAP| OP| OP| OP| OP| 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| LE| LE| LE| LE| LE| 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| SI| SI| SI| SI| SI| NO| NO| SI| NV    |
| SWT                     | 4        | 4| 6| 12| 12| 4| 10| 12| 12| 7| 12| 18| 6| 8.73|
| Complications           | NO       | NO| NO| SI*| NO| NO| SI***| SI Ç| NO| NO| SI****| NO| SI &| SI**| NV    |
| Stone Free Rate         | SI       | SI| SI| SI| SI| SI| NO| SI| NV| SI| SI| NO| SI| NO| SI| NA| NV    |
| HSD                     | 4        | 3| 3| 4| 4| 4| 3| 5| 5| 6| 4| 3| 5| 15| 4.73|

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

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

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

Figure 6: Introducing the stones in a bag.
A total of 15 patients were undergone to anatrophic nephrolithotomy, 8 (53.3%) patients were submitted to laparoscopic and 7 (46.6%) to open surgery. 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. 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 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 | 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 lesion, after placement of bulldog clamp
**Table 3:** Analysis of anatomic nephrolithotomy variables.

| Variables                  | SI | NO | OR  | IC 95%  | P    |
|----------------------------|----|----|-----|---------|------|
| Complications              | Fr | %  | Fr  | %       |      |
| Laparoscopic               | 2  | 75 | 0.25| 0.02-2.23| >.05 |
| Open                       | 4  | 57.14 | 1 |
| Free Stone Rate            | LAP | Fr | %  | %       |      |
| Laparoscopic               | 6  | 75 | 2   | 2.25    | <.05 |
| Open                       | 4  | 57.14 | 1 |
| WIT                        | Fr | %  | Fr  | %       |      |
| Laparoscopic               | 5  | 62.5 | 10  | 0.77-128.78 | >.05 |
| Open                       | 1  | 14.29 | 6   | 85.71 | 1 |
| HSD                        | Fr | %  | Fr  | %       |      |
| Laparoscopic               | 4  | 50 | 6   | 0.47-75.34 | >.05 |
| Open                       | 1  | 14.29% | 6   | 85.71% | 1 |

**Discussion**

Nowadays, the treatment of choice for renal stones >2cm is PCNL [9,10]. In 1968, Smith and Boyce first described anatomic nephrolithotomy but recently with the technology and urologic advances this technique had lost popularity. AN could be considered in some situations as these: failed endourological procedures, anatomical variations of the collecting system that difficult the percutaneous nephrolithotomy, necessity of anatomical reconstruction of an uretero-pelvic junction structure, surgeon experience and training and skeletal abnormalities [11,12]. Reports have 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 determine 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 Results.

| N. Patients | OPT | Blood loss | Transfusion | HOSD | FSR |
|-------------|-----|------------|-------------|------|-----|
| Meliss Orgos| 24  | 180        | 500ml       | 0%   | 8.2 | 83$ |
| Our Study   | 7   | 121.4      | 83.14ml     | 57%  | 6.14| 57% |

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

| 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)       |
| Giedmann (2012) [18]   | 8         | 142.5        | 20.8| 53   | 62.50% | Vascular Fistula (1)      |
| AminSharifi (2013) [4] | 10        | 192          | 32.8| 67.3 | 80%  | Esplenic Injury            |
| Nuestro estudio        | 8         | 127.5        | 29.5| 52.6 | 85.70% | 1 emergence nephrectomy 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.

References

1. Aminsharifi A, Hadian P, Boweri K (2013) Laparoscopic Anatomic Nephrolithotomy for Management of Complete Staghorn Renal Stone: Clinical Efficacy and Intermediate-Term Functional Outcome. J Endourol 27(9): 573-579.
2. Mishra S, Sabnis RB, Desai M (2012) Staghorn morphometry: A new tool for clinical classification and prediction model for percutaneous nephrolithotomy monotherapy. J Endourol 26(1): 6-14.
3. Assimos DG (2001) Anatomic nephrolithotomy. Urolgy 57(1): 161-165.
4. Aminsharifi A, Irani D, Masoumi M, Goshastsi B, Aminsharifi A, et al. (2016) The management of large staghorn renal stones by percutaneous versus laparoscopic versus open nephrolithotomy: a comparative analysis of clinical efficacy and functional outcome. Urolithiasis 44(6): 551-557.
5. Simforoosh S, Radfar MH, Nourialzadeh A, Tabibi A, Basiri A, et al. (2013) Laparoscopic Anatomic Nephrolithotomy for Management of Staghorn Renal Calculi. J Laparoendosc Adv Surg Tech 23(4): 306-310.
6. Adamy A, Favaretto RL, Nogueira L, Savage C, Russo P, et al. (2010) Recovery of renal function after open and laparoscopic partial nephrectomy. Eur Urol 58(4): 596-601.
7. Bhupendra P, Urmila D (2013) Re: Laparoscopic Anatomic Nephrolithotomy: Developments of the Technique in the Era of Minimally Invasive Surgery. J Endourol 27(1): 108-109.
8. Kaouk JH, Gill IS, Desai MM, Banks KL, Raja SS, et al. (2003) Laparoscopic anatomic nephrolithotomy: Feasibility study in a chronic porcine model. J Urol 169(2): 691-696.
9. Tu’rek C, Petri’r’k A, Sarica K, Seitz C, Skolarikos A, et al. (2016) EAU guidelines on interventional treatment for urolithiasis. Eur Urol 69(3): 475-482.
10. Skenazy J, Ercole B, Lee C (2005) Nephrolithiasis: “Scope,” Shock or Scalpel? J Endourol 19(1): 45-49.
11. Swearingen R, Sood A, Madi R, Klaasen Z, Badani K, et al. (2016) Zero-fragment Nephrolithotomy: A Multi-center Evaluation of Robotic Pyelolithotomy and Nephrolithotomy for Treating Renal Stones. Euro urol pii: S0302-2838(16)30724-2.
12. Kijvikai K (2011) The role of laparoscopic surgery for renal calculi management. Ther Adv Urol 3(1): 13-18.
13. Albuquerque Lde A, Camilo-Silva DG, Feidler G, Corquinha GB, Paiva MM, et al. (2015) Review on renal recovery after anatrophic nephrectomy. World J Nephrol 4(1): 105-110.
14. Andrei Nadu, Oscar Schatloff, Roy Morag, Ramon J, Winkler H (2009) Laparoscopic Surgery for Renal Calculi: Is it Indicated in the Modern Endourology Era? Int Braz J Urol 35(1): 9-18.
15. Melissourgos N, Davilas E, Fragoulis A (2002) Modified Anatrophic Pyelolithotomy and Nephrolithotomy for Treating Renal Stones. Endourol 16: 475-482.
16. Swearingen R, Sood A, Madi R, Klaasen Z, Badani K, et al. (2016) Zero-fragment Nephrolithotomy: A Multi-center Evaluation of Robotic Pyelolithotomy and Nephrolithotomy for Treating Renal Stones. Euro urol pii: S0302-2838(16)30724-2.
17. Zhou L, Xuan Q, Wu B, et al. (2016) The management of large staghorn calculi. BJU Int 101(10): 1293-1296.
18. Zhou L, Xuan Q, Wu B, et al. (2016) The management of large staghorn calculi. BJU Int 101(10): 1293-1296.
19. Swearingen R, Sood A, Madi R, Klaasen Z, Badani K, et al. (2016) Zero-fragment Nephrolithotomy: A Multi-center Evaluation of Robotic Pyelolithotomy and Nephrolithotomy for Treating Renal Stones. Euro urol pii: S0302-2838(16)30724-2.
20. Giedelman C, Arriaga J, Carmona O, de Andrade R, Banda E, et al. (2012) Laparoscopic anatomic nephrolithotomy: Developments of the technique in the era of minimally invasive surgery. J Endourol 26(5): 444-450.
