

# A Experiência de um Serviço em Nefrolitotomia Percutânea: dois períodos diferentes, duas posições em supinação diferentes

*The Experience of a Department in Percutaneous Nephrolithotomy: two different periods, two different supine positions*

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## Resumo

**Objetivos:** Apresentar a experiência do nosso Serviço em nefrolitotomia percutânea (NLPC) estratificada por dois períodos consecutivos: um no qual as intervenções eram realizadas em posição de supinação modificada de Valdivia-Uría e outro período que lhe sucedeu em posição de decúbito dorsal total.

**Métodos:** Foram revistos todos os processos clínicos dos doentes submetidos a Nefrolitotomia Percutânea de 2008 a 2012. De cada paciente foram recolhidas as características sociais, fatores de risco litogénicos e detalhes intra-operatórios. Os doentes foram divididos em dois grupos: um grupo A correspondente aos pacientes submetidos a NLPC em posição de Valdivia-Uría e um grupo B de doentes cujo procedimento foi realizado em decúbito dorsal total. O *software* estatístico utilizado para analisar os dados foi a versão 20.0 do IBM® *Statistical Package for Social Sciences* (SPSS).

**Resultados:** De 2008 a 2012, 84 doentes foram submetidos a 94 NLPC's. De todos os procedimentos, 44 foram executados em posição de Valdivia-Uría (grupo A), e 50 em posição de decúbito dorsal total (grupo B). Os dois grupos eram comparáveis para a maioria das características à exceção da média do tamanho máximo dos cálculos (grupo A: 31 milímetros vs. Grupo B: 22.7 milímetros;  $p=0.003$ ), e morfologia (grupo A: 18 coraliformes vs. Grupo B:

7 coraliforme;  $p=0.007$ ). Foram encontradas diferenças entre os dois grupos em termos de tempo operatório (grupo A: 154 min. vs. grupo B: 102 min.;  $p<0.001$ ), tempo médio de drenagem por nefrostomia (grupo A: 6.1 dias vs. grupo B: 1.6 dias;  $p<0.001$ ) e tempo médio de internamento (grupo A: 9.7 dias vs. grupo B: 5 dias;  $p<0,001$ ). Não foram encontradas diferenças significativas em termos de taxa de *stone-free* após um primeiro procedimento (grupo A: 57.1% vs. grupo B: 67.4%;  $p= 0.36$ ) e em termos de complicações pós-operatórias (grupo A: 15.8% vs. grupo B: 26%;  $p=0.34$ ).

**Conclusões:** A taxa de *stone-free* e de complicações da nefrolitotomia percutânea em posição de Valdivia-Uría e em posição de decúbito dorsal total foram semelhantes. As características do cálculo e a experiência do cirurgião parecem ser os principais determinantes para melhores resultados ao longo do tempo.

## Abstract

**Aims:** To present the experience of our Department in percutaneous nephrolithotomy (PCNL) stratified by two consecutive periods: one in which the procedure was performed in the modified supine position of Valdivia-Uría and subsequently another one in total dorsal decubitus position.

**Methods:** The clinical files of all patients that underwent a PCNL procedure from 2008 to 2012, were

reviewed. For each patient we collected social characteristics, stone formation risk factors and surgery related data. The patients were divided in two different groups: group A included the patients that underwent PCNL in the Valdivia-Uría position and group B the patients for which the PCNL was performed in total dorsal decubitus position. The statistical software used for analyzing the data was the IBM® Statistical Package for Social Sciences (SPSS), version 20.0.

**Results:** From 2008 to 2012, 84 patients underwent 94 PCNL procedures. Of all procedures, 44 were performed in Valdivia-Uría position (group A), and 50 in total dorsal decubitus position (group B). The two groups were comparable in most characteristics with the exception of the mean maximum stone size (group A: 31 millimeters vs. group B: 22.7 millimeters;  $p=0.003$ ), and its morphology (group A: 18 staghorn vs. group B: 7 staghorn;  $p=0.007$ ). Significant differences were reported between the two groups on mean surgical time (group A: 154 min. vs. group B: 102 min.;  $p<0.001$ ), nephrostomy drainage time (group A: 6.1 days vs. group B: 1.6 days;  $p<0.001$ ) and mean hospital stay time (group A: 9.7 days vs. group B: 5 days;  $p<0.001$ ). No significant differences were found in terms of “stone-free” rate after a first procedure (group A: 57.1% vs. group B: 67.4%;  $p=0.36$ ) and in terms of postoperative complications (group A: 15.8% vs. group B: 26%;  $p=0.34$ ).

**Conclusions:** The “stone-free” and complication rates of percutaneous nephrolithotomy in Valdivia-Uría position and in total dorsal decubitus position were similar. The characteristics of the calculi and the surgeon’s experience seem to be the major determinants for better outcomes over time.

**Keywords:** Percutaneous nephrolithotomy, Valdivia-Uría position, total dorsal decubitus position, renal stones.

## Introduction

Percutaneous nephrolithotomy (PCNL) represents one of the most powerful therapeutic tools to treat large, multiple and inferior calyx stones<sup>1</sup>. The best position and technique to perform PCNL is still under intense debate. Between prone position, firstly described by Alken, and Valdivia-Uría position and its variants, it is possible to find advantages and disadvantages of each one. Nevertheless, no differences in success and morbidity outcomes seem to exist between both positions<sup>2</sup>. Furthermore, the complexity of this procedure turns the learning curve extremely important for

its efficacy<sup>3</sup>. Over the years, the experience of a Department should result in a continuous improvement of surgical technique, outcomes and complications.

There are few comparative studies between the original position of Valdivia-Uría with flank elevation and its variants, namely the total dorsal decubitus position. Bearing this in mind, the aim of this paper is to present five years of experience, progress and results of our Department in PCNL divided in two different periods of time: one in which the procedure was performed in the original position of Valdivia-Uría and subsequently another one in total dorsal decubitus.

## Materials and Methods

This was a retrospective unicenter study, that included data from patients treated in the Urology Department of *Unidade Local de Saúde de Matosinhos*.

The clinical files of all patients that underwent a PCNL procedure from 2008 to 2012, were reviewed. For each patient we collected socio-demographic data, and all clinical data regarding the PCNL procedure. The patients were divided in two different groups: group A included the patients that underwent PCNL in the Valdivia-Uría position and group B the patients for which the PCNL was performed in total dorsal decubitus position.

**Surgical technique** – Sterile urine was confirmed preoperatively and a first generation cephalosporin was administered to all patients thirty minutes before induction of general anesthesia in supine position. Under cystoscopic vision, a flush ureteral catheter was introduced to perform an ureteropyelography.

From 2008 to the end of 2010 at this Health Unit, surgeons adopted Valdivia-Uría position, in which patients were placed in a modified supine position with a 3 liters saline bag to lift the flank in about 30 to 45 degrees. From 2010, they adopted the total dorsal decubitus position, without any flank elevation, with the posterior axillary line perfectly exposed on the margin of the operating table. In both positions, the lower limb ipsilateral to the operated kidney was placed slightly abducted and with an elevation of about 15 to 30 degrees above the radiotransparent table. The contralateral limb was flexed in the hip (90 degrees) and abducted (30 degrees) as lithotomy position.

In all procedures and under fluoroscopic control, the renal calyces were punctured on the posterior axillary line. Access dilation was made using balloon, Alken (metal) or Amplatz (plastic) dilators to a diameter of 30Fr, allowing the introduction of a

nephroscope (26Fr). Stones were fragmented with a pneumatic, ultrasonic or laser lithotripter. Stone fragments removal was done with a metal clamp. A nephrostomy drainage catheter was usually inserted along the path at the end of the procedure. Occasionally, a ureteral catheter was left to prevent obstruction secondary to residual stones or clots.

**Result Analysis** – Social characteristics and some stone formation risk factors were collected for all patients. Stone size, number, location and morphology were also collected. Technical aspects as number of punctures and its sites, dilatation methods, stone fragmentation and postoperative drainage were also analyzed.

For each procedure, the surgery time, length of hospitalization and length of nephrostomy drainage was collected. The surgery time was defined as the time from the beginning of ureteral catheterization until the nephrostomy tube was placed and secured to the skin.

The success rate (or stone-free rate) was defined as “no visible stones or any fragments equal or inferior to 4 millimeters on imaging. Stone-free rates were assessed on the first postoperative day (normally with a kidney-ureters-bladder radiography), and at outpatient using computed tomography. The overall success rate was also stratified by stone size and morphology to improve the characterization of stone burden and its complexity. The postoperative complications were recorded under Clavien-Dindo classification<sup>5</sup>.

For statistical analyses, the IBM® Statistical Package for Social Sciences (SPSS), version 20, was

used. Fisher's exact test or the chi-square test as appropriate, were used for categorical variables. Age, stone size, operative time, hospital stay and length of nephrostomy drainage were compared using Student's t test for independent groups. Direct logistic regression was performed to assess the impact of a number of factors on the likelihood of success rate. The criterion for statistical significance was set at  $p < 0.05$  for all comparisons.

## Results

From January 2008 to December 2012, 84 patients underwent 94 PCNL procedures. Ten patients were re-operated, 6 on the same kidney and 4 on the contralateral one. Of all procedures, 44 were performed in the modified supine Valdivia-Uría position (group A), and 50 in total dorsal decubitus position (group B). The majority of procedures were performed by two experienced surgeons who trained in this area over the years.

The characteristics of the two groups of patients were comparable, with the exception of the mean maximum size of the calculi (group A: 31 mm vs. group B: 23.7 mm) and its morphology (staghorn, non-staghorn upper than 2 centimeters and non-staghorn lesser than 2 centimeters) in which statistically significant differences were identified between both groups ( $p < 0.05$ ) (table I).

The main details of intraoperative technique and postoperative care and outcomes are summarized in table II.

The mean surgical time was significantly lower on group B (group A: 154 min. vs. group B: 102

	Group A (Valdivia-Uría) 2008-2010	Group B (Total Dorsal Decubitus) 2011-2012	P	All sample
Total patients, n	38	46		84
Total procedures, n*	44	50		94
Male-to-female ratio, H:M*	19:25	21:29	1,0	40:54
Mean age, yr (SD)*	49 (14,5)	54 (16,0)	0,08	52 (15,5)
BMI $\geq 30$ , n (%)*	7 (15,9)	14 (28,0)	0,25	21 (22,3)
Previous stone surgery, n (%)*	4 (9,1)	5 (10)	1,0	9 (9,6)
Mean maximum stone diameter, mm (SD)*	31,0 (14,1)	22,7 (12,0)	0,003	26,6 (13,6)
Side, Right:Left*	20:24	21:29	0,90	41:53
Multiple stones, n (%)*	7 (15,9)	10 (20)	0,80	17 (18)
Stones morphology*			0,001	
Staghorn calculi, n (%)	18 (40,1)	7 (14)	0,007	25 (26,6)
Non-Staghorn (>2cm), n (%)	18 (40,1)	17 (34)	0,63	45 (47,9)
Non-Staghorn (up to 2cm), n (%)	8 (18,2)	26 (52)	0,001	34 (36,2)
Radiopaque stones, n (%)*	32 (72,7)	36 (72)	1,0	68 (72,3)

**Table 1** – Patient and stone characteristics

\* Inclusive adjuvant PCNL procedures in ipsilateral or contralateral kidney  
SD – Standard Deviation;  
BMI – Body Mass Index  
 $p < 0,05$  = statistically significant

	Group A (Valdivia-Uría) 2008-2010	Group B (Total Dorsal Decubitus) 2011-2012	P	All sample
Calyx Puncture				
Inferior, n (%)	35 (79,5)	28 (56,0)	-.*	63 (67)
Middle, n (%)	3 (6,8)	1 (2)	-.*	4 (4,2)
Upper, n (%)	1 (2,3)	2 (4)	-.*	3 (3,2)
Multiple calyx puncture, n (%)	5 (11,4)	19 (38,0)	0,007	24 (25,5)
Dilatation method				
Amplatz, n (%)	22 (50,0)	22 (44,0)	<0,001	44 (46,8)
Serial Metal, n (%)	6 (13,6)	23 (46,0)	0,002	29 (30,9)
Balloon, n (%)	16 (36,4)	5 (10,0)	0,005	21 (22,3)
Fragmentation/Stone removal				
Lithoclast, n (%)	38 (86,4)	35 (70,0)	-.*	73 (77,7)
Ultrasound, n (%)	6 (13,6)	1 (2,0)	-.*	7 (7,4)
Laser, n (%)	0 (0)	3 (6,0)	-.*	3 (3,2)
Lift out, n (%)	0 (0)	11 (22,0)	-.*	11 (11,7)
Mean operation time, min. (range)	154 (85-290)	102 (35-235)	<0,001	126 (35-290)
Concomitant ureterolithotripsy, n (%)	0 (0)	6 (12)	0,03	6 (6,4)
Total Tubeless	0 (0)	2 (4)	0,5	2 (2,1)
Ureteral catheterization	2 (4,5)	39 (78,0)	<0,001	41 (43,6)
Nephrostomy	44 (100)	42 (84,0)	0,006	86 (91,4)
Mean nephrostomy time, days (range)	6,1 (0-13)	1,6 (0-10)	<0,001	3,6 (0-13)
Mean hospitalization stay, days (range)	9,7 (4-22)	5,0 (1-21)	<0,001	7,2 (1-22)
Stone-free rate after a first procedure, n (%)	24 (57,1)	31 (67,4)	0,44	55 (61,1)
Stone-free rate after adjuvante procedures, n (%)	36 (81,8)	41 (82)	1,0	77 (81,9)
Postoperative complications, n (%)				
Clavien-Dindo I	7 (15,8)	13 (26)	-.*	21 (22)
Clavien-Dindo II	3 (6,8)	1 (2)	-.*	4 (4)
Clavien-Dindo III	2 (4,5)	6 (12)	-.*	9 (10)
Clavien-Dindo III	0 (0)	5 (10)	-.*	4 (4)
Clavien-Dindo IV	2 (4,5)	1 (2)	-.*	3 (3)

Table 2 – Intraoperative and postoperative parameters

p <0,05 = statistically significant  
 -\*No conclusions could be extracted because sample size limitations

min.; p<0,001). There were significant differences between both groups regarding ureteral catheterization (group A: 4.5% vs. group B: 78%; p<0,001) and postoperative nephrostomy drainage (group A: 44 patients vs. group B: 42 patients; p=0,006). The average time to remove the nephrostomy catheter was also significantly different between the two groups (group A: 6.1 days vs. group B: 1.6 days; p<0,001). The mean length of hospital stay was also significantly different (group A: 9.7 days vs. group B: 5.0 days; p<0,001).

Postoperative assessment showed a success rate of 57.1% (group A) vs. 67.4% (group B) between the two groups after a first procedure in the same kidney and a success rate of 81.8% (group A) vs. 82.0% (group B) after an adjuvant treatment. Although there was a trend towards improvement of the outcomes over time, no significant differences were reported among these groups. A total of 31 patients required complementary treatments after a first PCNL (figure 1). Figure 2 and figure 3 presents the overall stone-free rates according to

stone characteristics after a first procedure and after complementary procedures respectively. The main predictors of surgical success were stone morphology (odds ratio [OR]=5.57, p=0.04) and size in millimeters (OR=1.07; p=0.01), the absence of multiple calculi (OR=0.17; p=0,02) and surgical time in minutes (OR = 1.017; p=0,02).

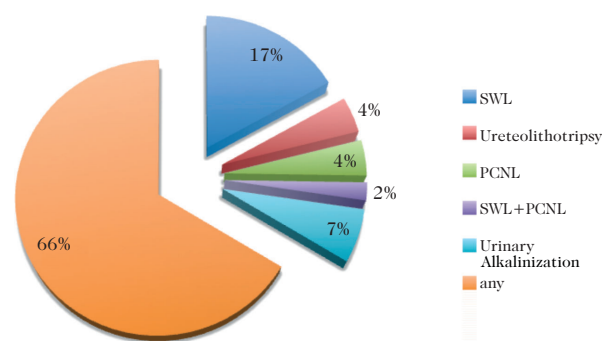


Fig.1 – Kind of adjuvant procedure after a first PCNL  
 PCNL – Percutaneous Nephrolithotomy  
 SWL – Extracorporeal Shock Wave Lithotripsy

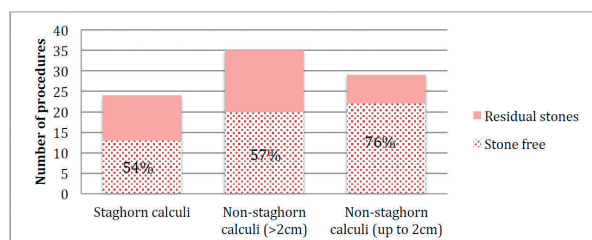


Fig. 2 – Stone free rate of all patients after a first procedure

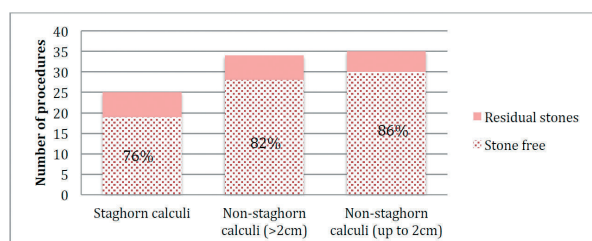


Fig. 3 – Stone free rate of all patients after adjuvant procedures

Overall, the postoperative complications rate was 22%. There were no significant differences between both groups ( $p=0.34$ ). Major complications (grades III and IV of Clavien-Dindo classification) were two acute coronary syndromes (2.1%) and a heart failure exacerbation (1%) requiring prolonged hospitalization in an intermediate care unit, a renocolic fistula (1%) requiring temporary colostomy, an arteriovenous fistula requiring percutaneous angioplasty (1%) and a urinary fistula (1%) and two complicated pyelonephritis (2.1%) requiring ureteral catheterization. The remained minor complications (grades I or II) were transient fever caused by uncomplicated postoperative infection (5.3%), blood transfusions (4.3%) and vagal symptoms or poorly controlled pain conditions (4%).

## Discussion

PCNL has been considered a unique and safe surgical technique to treat complex renal stones and motivated many urologists to acquire the necessary skills to perform this procedure<sup>1</sup>.

Before 2008, the experience of our Department in PCNL was scarce. Thereafter, two urologists started to perform it more often after taking part in specific training programs. Consequently, most of all, this study presents the experience and learning curve of a Department in this technique. It compares two consecutive periods of time also distinguished by two different supine positions.

Although the recent discussions about the advantages and disadvantages of ventral versus modified dorsal decubitus positioning (Valdivia-Uría)<sup>2</sup>, there are new and stronger evidences that PCNL can also be performed in total dorsal decubitus position<sup>5</sup>.

Until the end of 2010 we adopted Valdivia-Uría position with an ipsilateral flank elevation. The results of E. Melchert *et al*<sup>5</sup> prompted us to adopt total dorsal decubitus position to perform all PCNLs from 2011 until now.

Although the prone position seems similar to the supine position in terms of results and morbidity<sup>2</sup>, we emphasize the main advantage of the latter one: no interference with ventilation and venous return (especially in obese patients). Moreover, the authors believe that positioning in total dorsal decubitus is possibly more advantageous than Valdivia-Uría position. The supine position without any flank elevation permits (in an easy way) combined and concomitant antegrade and retrograde procedures in the usual position (ex: catheterization, ureterorenoscopy, ureterolithotripsy) without any need of patient repositioning not only with flexible ureteroscope but also with the semi-rigid one. It represents an extended capacity of contemporary treatment of renal and ureteral stones. Besides that, total dorsal decubitus position allows, not only, a quicker and easier access to both kidneys, but also, a better nephroscopic view with lower infusion pressures of liquid (lesser risk of fluid absorption) where also the gravity effect favors stone removal. Finally, the surgeon may be seated during the majority of the procedure<sup>5</sup>.

Rather than the positioning differences between the two groups, the authors believe that the surgical experience gained over the years in performing PCNL procedures was the main criteria to distinguish both groups in terms of intraoperative details. For example, multiple calyceal punctures were significantly higher in recent procedures ( $p<0,05$ ), which can be associated with a greater number of procedures in kidneys with multiple calculi, and also with a higher surgical experience. In both groups we avoided to puncture the superior calyces although it was feasible in this position. We privileged inferior calyx punctures to limit bleeding<sup>6</sup> to provide a better access to all calyces and to reduce the risk of lung, liver and spleen complications<sup>7</sup>. Significant differences were found regarding tract dilation. Our surgical experience determined our preferences towards the use of Amplatz (plastic) and Alken (metal) dilators. To fragment renal calculi, we privileged the pneumatic lithotripter (Lithoclast®) because it is effective regardless of the stone's composition. Concomitant ureterolithotripsy was extremely useful in 6 cases where percutaneous access alone would not be sufficient. All of them were performed in total dorsal decubitus, confirming the easy access to the ureter and kidney without any flank lift.

The operation time is gradually reduced as surgical skills increased<sup>3</sup>. Our surgical experience in PCNL

was also significantly higher over the years. Comparing both groups, the mean operation time dropped from 154 minutes until the end of 2010 to a mean of 102 minutes between 2011 and 2012, perfectly aligned with the mean time of other studies (117 min.)<sup>3</sup>. De Sio *et al* presented a mean operation time in supine position on his series of 43 minutes (ranging from 25-120 minutes) but patients with complex renal calculi were excluded<sup>2</sup>. A reduction in the mean removal time of nephrostomy and in the mean hospital stay between both groups was also significant. These last results are related with a higher percentage of patients with ureteral catheter after surgery and reduced placement and earlier removal time of nephrostomies over the years. Tubeless or total tubeless procedures are the main determinant to reduce the hospital stay, analgesic requirement and the time to return to normal activity<sup>8,9</sup>. Major complications (Clavien-Dindo III and IV) were responsible for extended hospital stays.

Although the stone-free rate and major complications are the most clinically relevant criteria, their assessment and comparison with other studies is hampered by the variability of success definitions and the rarity of major complications. A trend towards improved success rates in total dorsal decubitus was present in our experience after a first procedure, however, no significant differences were noted between both groups and we could not neglect the significant differences on stone size and morphology between both groups. The stone free rate after a first procedure was 61.1% for all patients, ranging from 54 to 76% according to stone size and morphology. These results fit those presented in other articles (51 a 100%<sup>4</sup>; 75.7%<sup>10</sup>). Adjuvant procedures (such as shock wave lithotripsy, transurethral ureterolithoextraction, PCNL and urinary alkalization) increased the stone-free rate to 82%, ranging from 76% to 86% according to calculi morphology and size. These differences highlight the importance of patient lithiasic history, renal anatomy and stone characteristics to surgical success rate<sup>11</sup>.

No significant differences were found between the two groups in terms of complications. Similar to other series<sup>12-14</sup>, our total percentage of postoperative complications was 22%, with only 7% major complications. The need for surgical reinterventions after PCNL occurred only on group B. These last outcomes led us to manage and plan carefully each procedure, reducing operative times and improving our postoperative care to rule out important complications.

The main aim of this article was to present our entire experience in PCNL. To compare the different periods of times and positions, there are some

important limitations to consider. First of all, the number of patients was low. Moreover, it represents a retrospective analysis preventing randomization. Finally, one of the major drawbacks of the current comparative analysis is that it was a comparison of the outcomes of two different periods of time in which different stone-free rates seem to be related with stone characteristics and surgeons' learning curve and not with patient positioning.

## Conclusion

According to our experience, the overall results and complications of this technique in Valdivia-Uría position and in total dorsal decubitus are similar. Both placements are safe and feasible. Although we consider total dorsal decubitus more advantageous with a slight impact (non-significant) in the results, stone characteristics and surgical experience outweigh the patient position. The operative time was gradually reduced as the number of procedures increased, however, continuous learning of percutaneous approach is needed to improve outcomes and reduce the number of complications. A prospective randomized study to demonstrate outcome differences according to patient supine position would be welcome.

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