Initial experience with percutaneous nephrolithotomy in the modified Valdivia position for surgical treatment of renal lithiasis patients

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Abstract

Background: Renal lithiasis is a very common pathology that has been described since Hippocrates. Its etiopathogenesis involves different theories on formation that include saturation, oversaturation, crystal nucleation, crystal growth, epitaxis, matrix, crystallization inhibitors, epidemiologic aspects, and heredity. Compared with classic lumbotomy, percutaneous nephrolithotomy is a less aggressive technique facilitating kidney stone treatment. Reduced hospital stay, low analgesic use, and a shorter recovery period make this a well-accepted surgical technique by patients and it is considered the first treatment option in many cases.

Aims: To present the experience at our institution with the modified version of the previously described technique.

Methods: All surgical notes on percutaneous nephrolithotomies in the modified Valdivia position performed within the time frame of January to August 2014 were reviewed.

Results: The mean age of the patients was 42 years. Of the 10 patients included in the study, 7 were men and 3 were women. Five of the patients presented with staghorn stones, 2 with pyelic stones, and the rest with pyelic and calyceal stones. Stone size ranged from 2 to 7 cm. A total of 2 (28.6%) stones were in the lower portion of the collecting system, 7 (64%) were in the middle portion, and one (7.1%) was in the upper portion. Estimated surgery duration was a mean of 120.5 min. The complication rate (Clavien-Dindo: I-IV) was 20%, one patient presented with bleeding that was controlled, and 80% of the patients were stone free.
Conclusions: In our experience, percutaneous nephrolithotomy with the modified Valdivia technique is a safe and effective option with a high success rate, anesthesiological advantages, and few complications.

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Introduction

Renal lithiasis is a very common pathology in the area of urology that has been described since Hippocrates. Its etiopathogenesis includes different theories as to its formation (saturation, oversaturation, nucleation of a crystal, growth of a crystal, epitaxis, matrix, crystallization inhibitors, epidemiologic aspects, and heredity). Stones are made up of different components (calcium oxalates, calcium phosphate, magnesium phosphate, uric acid, urates, cystine, and medications) and they can be found at different sites of the urinary tract (kidney, ureter, bladder, and urethra).

In 1974, Brantley and Bissada utilized a panendoscope and flexible forceps to extract kidney stones. Percutaneous nephrolithotomy (PNL) reached its highest degree of perfection in 1981 when the nephroscope, sonotrode, and fascial dilation telescopic set were presented. This equipment has made it possible to have percutaneous access to the kidney, break up the stone, and extract all its fragments in a single surgical act.

Compared with classic lumbotomy, PNL is a fairly unaggressive technique that facilitates the treatment of recurrent lithiasis. Shorter hospital stay, low analgesic medication intake, and shorter work-related recovery period make this surgical technique one that is well accepted by patients and it is considered the first surgical treatment option in many cases.

Percutaneous access to the kidney was originally described by Goodwin et al. in 1955 for performing a temporary nephrostomy in a patient with hydronephrosis. The patient was placed in the prone, ventral decubitus position, most likely in order to prevent colon injury. In 1976, Fernstrom and Johansson performed the first PNL.
The subsequent reports on percutaneous access to the kidney were all described with the patient in the same position for nephrostomy, as well as for kidney stone treatment.\(^5\)

This approach in the procedures of nephrostomy and nephrolithotomy was popularized and acclaimed and today is the criterion standard for different situations, even substituting open surgery in the treatment of complex stones.\(^2\)

Since their introduction and up to the present, percutaneous surgery and the equipment utilized have greatly progressed, incorporating technical modifications and modernized medical instruments.\(^7\)\(^-\)\(^8\)

In 1988, Valdivia-Uría et al. published a series of 557 nephroscopy cases, all performed with the patient in the supine dorsal decubitus position, creating an alternative for percutaneous kidney access.\(^3\)

After the publication of that article, percutaneous kidney surgery in the supine position has gained ground and modifications to the Valdivia technique have been incorporated in some endourology centers.\(^4\)

The aim of this study was to present a modification of the Valdivia-Uría technique in relation to the position of the patient.

**Description of the technique.** The patients were placed on the operating table in the total dorsal decubitus position, with the flank to be operated on at the edge of the table. No pillow or any other form of flank elevation was used.

The lower limb ipsilateral to the puncture location was slightly abducted with an approximate 15 cm elevation in relation to the table. The contralateral lower limb remained abducted, similar to the lithotomy position (fig. 1).

The upper limb on the opposite side from the puncture remained extended parallel to the torso. The ipsilateral upper limb was positioned in abduction.

We placed the surgical drapes, leaving the flank to be operated on exposed, where a sterile plastic bag to collect fluids was attached with the plastic adhesive drape (fig. 2).

The table and equipment in the operating room must be arranged so that they facilitate simultaneous cystoscopy and/or ureteroscopy with the percutaneous procedure, opposite the side of the percutaneous access; the radioscopy monitor in the upper area and the laser and video tower (with the video camera, monitor, light source, lithotripter, and recording system) in the lower area. The surgical instrument table is to the left of the surgeon (fig. 3).

All the procedures were performed under general anesthesia. We introduced a 6 Fr open-tipped catheter using a 22 Fr cystoscope. A 16 Fr Foley transurethral catheter was placed. In all the cases retrograde pyelography was carried out and the lower calyx was the puncture site in all the kidney units. Puncture was performed under fluoroscopy and there was no need to use other media, such as ultrasound, in any of the cases.
The puncture was made with a Chiba 22 G needle after which a hydrophylic guidewire was introduced and exteriorized through the opening of the Amplatz sheath. Dilation was carried out with Amplatz. The nephroscope was a 17 Fr Storz and lithotripsy was performed with Lithoclast equipment or Holmium laser.

Flexible nephroscopy was necessary in 3 of the cases to review the renal cavities. A nephrostomy catheter (16 Fr Foley catheter with a 3-5 cc balloon) was placed in all the patients and a double-J catheter was left in 3 patients. Eight patients were released 24 h after their procedure. Due to the number of consultations in our service, the patients were given a follow-up appointment one week later, in which the nephrostomy was removed, and double-J catheter removal was programmed for 15 days later.

The original technique was modified in order to have advantages such as: lower radiation exposure to the hands of the surgeon, an ergonomic position for the patient to prevent neurologic and orthopedic injuries, shorter surgery duration, fewer personnel for accommodating the patient, better anterograde and retrograde access to the urinary tract, greater ease for the anesthesiologist to approach the airway, and especially more effective access to the kidney unit to be treated.

**Methods**

A descriptive, analytic, cross-sectional study was conducted in which the surgical notes were reviewed from all the PNL procedures in the modified Valdivia position that were performed within the time frame of January to August 2014. Only patients with the complete protocol were included (table 1).

**Results**

A total of 10 patients were included in the study. The mean age was 42 years and 7 of the patients were men and 3 were women. Five of the patients presented with staghorn stones, 2 with pelvic stones, and the rest had both pelvic and calyceal stones. Stone size varied from 2-7 cm. Two stones (28.6%) were in the lower portion of the collecting system, 7 (64%) in the middle portion, and 1 (7.1%) in the upper portion. The estimated surgery duration was a mean 120.5 min. There was a 20% complication rate (Clavien-Dindo: i-iV) and one controlled hemorrhage. eighty percent of the patients were left stone free (table 1).

**Discussion**

Efficacy: PNL and open surgery are equally efficacious for the treatment of renal lithiasis. For example, in a study on 129 patients with kidney stones, we found that PNL and open kidney surgery were associated with a similar complication and success rate. An important difference is that PNL reduced hospitalization by 60% and enabled the patient to return to work in approximately one week.

**Table 1** Preoperative patient characteristics

<table>
<thead>
<tr>
<th>Age-years</th>
<th>MEAN/RANGE</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>45.7 (73-20) years</td>
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<table>
<thead>
<tr>
<th>Sex</th>
<th>n</th>
<th>Size, cm</th>
</tr>
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<tbody>
<tr>
<td>Men</td>
<td>7</td>
<td>1.71</td>
</tr>
<tr>
<td>Women</td>
<td>3</td>
<td>Greater than 3</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Location</th>
<th>n (%)</th>
</tr>
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<tbody>
<tr>
<td>Lower collecting system</td>
<td>2 (28.6)</td>
</tr>
<tr>
<td>Middle collecting system</td>
<td>7 (64)</td>
</tr>
<tr>
<td>Upper collecting system</td>
<td>1 (7.1)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Stone laterality</th>
<th>R/L/Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/4/1</td>
<td></td>
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</table>

| Surgery duration | 120.5 min |

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Postoperative results</th>
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<tbody>
<tr>
<td>Bleeding</td>
<td>167 cc</td>
</tr>
<tr>
<td>Hospital stay</td>
<td>3.07 days</td>
</tr>
<tr>
<td>Complications % (n)</td>
<td>Fever one patient one with sepsis</td>
</tr>
<tr>
<td>Stone-free rate</td>
<td>9 of the 10 patients 90%.</td>
</tr>
</tbody>
</table>

| Maximum 300 cc | Minimum 50 cc |
| 5 days | 2 days |
| Pain 50% 5 patients | Hemorrhage one patient |
| 90% in 3 patients | 80% in one patient |
compared with more than 3 weeks after open kidney surgery. This less invasive technique also costs 40% less than open kidney surgery.

As many punctures as needed are carried out to leave the kidney in a stone free state. They are facilitated by the distortion of the renal pelvis and calyces with the injection of physiologic solution or contrast when necessary. A hydrophilic guidewire is left in all the punctures for later dilation and it should be directed towards the ureter whenever possible. This makes the dilation of the percutaneous tract safer and reduces the risk for puncture miscalculation.

Whenever possible, a safety guidewire that can be positioned at the opening of the Amplatz sheath or outside it should be left in place for working. This facilitates the procedure and increases its safety.

The puncture made at the posterior axillary line is parallel to the infundibular vessels entering at the avascular “Brödel’s bloodless line”, thus reducing the possibility of vascular injury.

Obese patients benefit from the total supine position, mainly because of the anesthetic advantages, as well as not having to be moved after anesthetization. 6-9

Stone fragmentation can be performed with an ultrasound, ballistic, or laser lithotripter. The fragments are removed with a trident or foreign body forceps.

The risk for colon perforation with the patient in the supine position should be demythified, given that the colon is pushed against the kidney in the prone position, which theoretically can increase the possibility of an accident.10

In relation to the position of the patient and the Amplatz sheath, the infusion of a large quantity of high-pressure fluid is not necessary for visualization. We almost always work in a dry operating field, reducing the risk for water absorption, sepsis, and fragment mobilization for the ureter or other calyces. 7-10

The nephrostomy is left in place for 7 days and the double-J catheter for 15 days. The patient is released from the hospital 24-48 h after the operation. At 30 days the patient is seen for an imaging study and laboratory test follow-up.

The stone clearance rate reported in a meta-analysis of the most recent PNL case series is around 78%. In our study, we had an acceptable stone clearance rate of 80%, compared with the 93% reported with the original Valdivia et al. technique.1 In regard to complications, we should point out that there were significant differences both during the intervention and in the immediate postoperative period in the overall analysis. Surgery duration was a mean 120.5 min longer than that reported with the original Valdivia-Uría et al. technique (85 min),1 but that is still within an acceptable range, taking into account that ours in a teaching institution. Puncture through fluoroscopy costs less than under Endovision, as described in the original technique. Thanks to the modified position the arch is more easily and freely turned in a C to ensure fewer punctures in the kidney units to be treated. The Amplatz dilators are also re-sterilized, adding to the cost-benefit of the procedure.

The transfusion rate (1%) was similar to that described in the literature and the percentage concurred with that of other supine PNL case series or with the original technique, varying from 3 to 9%.3,8 On the other hand, it was slightly lower than the rate reported by a meta-analysis conducted by the AUA for case series of PNL in the prone position.10 We partially attribute this to our preference in using the high-pressure balloon as the system for dilating the nephrostomy tract.

There were no colonic injuries, the same as with the original technique, this being the great advantage over the prone position, in which the colon is displaced posteriorly and laterally.

And finally, we should point out that the postoperative period was similar in relation to hospital stay and analgesic doses in reference to other similar studies.

One of the main advantages, apart from those already mentioned, is the fact that our center is a teaching hospital, which allows urology residents to participate more actively in the procedure. They can simultaneously work the urinary tract in an anterograde and retrograde manner, optimizing surgery duration and the skills of the professionals in training.

Conclusions

Various modifications have been made on the original technique described 17 years ago, all of them basically in an effort to reduce cost and surgery duration. The benefits over the prone position are indisputable and clearly demonstrated. In our experience, despite being a small case series in relation to the original case series, the results were similar and within an acceptable range. It is our goal to be able to show more advantages in a future study with a larger number of cases and to propose this type of technique as an alternative for the urologic medical community. In our institution, both the prone and supine positions are managed, making it essential to compare the two and manifest the results.

Ethical responsibilities

Protection of persons and animals. The authors declare that no experiments were performed on humans or animals for this study.

Data confidentiality. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Financial disclosure

No financial support was received in relation to this article.

Conflict of interest

The authors declare that there is no conflict of interest.

References


