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Introduction

After more than 30 years, percutaneous stone removal still stands the test of time as treatment of choice for large and/or complex urolithiasis. In fact, instead of becoming obsolete over the decades, percutaneous nephrolithotomy (PCNL) underwent considerable evolution since its introduction in 1976, progressively acquiring a new configuration and accordingly improving its efficacy and safety in expert hands. The old static procedure has become a technically updated and really mini-invasive approach thanks to a great deal of consistent advances regarding imaging techniques, anesthetic skills, patient positioning, renal access creation, antegrade and retrograde use of semirigid and flexible endoscopes with better technology and vision, choice among a variety of accessories and intracorporeal lithotripsy devices, and postoperative renal drainage [1, 2].

The rather recent debate on patient positioning certainly contributed to the new life of PCNL [3, 4]. The prone position was the one used by Goodwin and collaborators when they gained the first percutaneous renal access in 1955, and by Fernström and Johansson when they described the percutaneous pyelolithotomy technique in 1976; therefore, it became the traditional one.

Of course the prone position provides a wide surgical field for renal puncture and adequate nephroscopic manipulation, easier upper pole puncture with a lower risk of lung, pleura, and liver/spleen injury, a good distension of the collecting system and feasibility of bilateral procedures.

On the other hand, the anesthetic concerns of the prone position (especially in morbidly obese patients, those with compromised cardiopulmonary status or skeletal deformities) and the difficulty of obtaining a combined antegrade and retrograde access to the renal cavities when needed are issues that have been overlooked for a long time. A lot of modified positions have been proposed over the years, including the reverse lithotomy position of Lehman and Scarpa, the lateral decubitus of Grasso and Kerbl and the supine position of Valdivia Uriá, but none of them ever threatened the supremacy of the usual prone position until recently. In particular, Valdivia Uriá described already in the late 1980s his experience with the supine approach for PCNL, publishing consistent clinical data on the efficacy and safety of this technique, but his results did not obtain the deserved consensus within the endourological community [3, 5].

The idea of combining percutaneous and retrograde approach during the same surgical procedure is not new at all. Initial blind attempts were described in the early 1980s with the transcutaneous retrograde nephrostomies of Hawkins-Hunter and of Lawson [6, 7]; few years later a simultaneous nephroscopic and ureteroscopic access with the patient in the “reverse lithotomy

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position” was occasionally needed to solve particular clinical situations [8]. In the late 1980s Ibarluzea and coworkers progressively changed the supine Valdivia position associating a modified lithotomic arrangement of the lower limbs, giving birth to the handy and ergonomic Galdakao-modified supine Valdivia (GMSV) position, which appeared in the Spanish literature in 2001 but only in 2007 in an international publication [5]. The GMSV position optimally supports ECIRS (Endoscopic Combined IntraRenal Surgery), a novel combined antegrade and retrograde approach to the upper urinary tract for the treatment of large and/or complex urolithiasis, involving the synergic use of rigid and flexible endoscopes, various accessories and lithotripsy energies, and a synergic cooperation among all the operators (two surgeons, anesthesiologist, scrub nurse, nurses, radiology technician) with the relative armamentaries [2–5, 9–15]. This was really the first time that retrograde ureteroscopy was employed not only as an occasional complement to PCNL but rather as an essential part of it, with an infeasible active role for an optimal outcome. Scoffone and Scarpa made a big effort for popularizing ECIRS in the GMSV position [9] via congresses, publications, and live surgeries. The same did Daels [10] and Hoznek [11], who largely contributed to the technical standardization and improvement of ECIRS, whereas Frattini gained a wide experience with this combined approach in children with optimal results [12].

The supine positions for PCNL are not the unique alternatives to the prone position, as demonstrated by the bulk of recent literature [3, 13], proposing lateral, flank, split-leg modified lateral, flank prone, prone flexed, supine oblique, semisupine positions, and many others. The relevant aspect is that all these authors made their proposals in a common effort to improve their surgical percutaneous practice. Of course, feasibility, efficacy, and safety of PCNL performed in any alternative position have been compared to those of the prone PCNL, by now with substantially equivalent urological outcomes (in terms of stone-free rates, operative time, hospital stay, complication rates).

Among the advantages of PCNL performed in the GMSV position we number anesthesiological,

management and urological advantages, which have been widely reported [2–5, 9–15]. The cardiovascular, ventilatory, neuroendocrine, and pharmacokinetic problems of the prone position [9, 14] are overcome in the supine positions, with better access to the airways and the cardiovascular system. This is particularly true for special patients, including children, elderly, obese, kyphotic/scoliotic, and debilitated patients. Management advantages include easy and comfortable patient positioning, no need for intraoperative repositioning of the anesthetized patient (with less need of nurses in the operating room, less occupational risk due to shifting of heavy loads, less risk of pressure injuries due to inaccurate repositioning responsible for ligament lesions, visual problems, and neurological deficits, a single definitive sterile draping of the patient), the possibility for the surgeon to work sitting down and with his hands out of the fluoroscopic field. Urological advantages include an easier puncture of the kidney lying nearer to the skin, the possibility of an Endovision-assisted renal puncture and tract dilation, a demonstrated decreased risk of colon injury, a great versatility in the combined stone manipulation, a better descending drainage and retrieval of stone fragments from lithotripsy because of the downward position of the Amplatz sheath, low intrarenal pressures implying less pyelovenous backflow and of postoperative infectious risk.

Description of the Supine Technique

We will focus our attention on two issues which characterize ECIRS, combining supine PCNL and retrograde access to the upper urinary tract: patient positioning and organization of the operating room and the role of retrograde ureteroscopy during PCNL.

Patient Positioning and Organization of the Operating Room

The posterior axillary line is drawn on the skin with the patient standing; subsequently the patient undergoes general anesthesia in the supine position.



Fig. 2.1 Patient in the GMSV position, with the two jelly pillows under the thorax and the ankle



Fig. 2.2 Patient in the GMSV position, with the inflatable balloon under the flank

The flank to be operated leans out of the border of the operating table and has to be raised and slightly rotated by a single underlying 3-l saline bag, or by two separated jelly pillows put under the

thorax and the ankle (Fig. 2.1), or by a particular balloon that can be inflated and deflated according to the requirements after inserting its flat part under the back of the patient (Fig. 2.2).



Fig. 2.3 Sterile draping of the patient and organization of the operating room

The ipsilateral arm is laid on the thorax, while venous access is assured on the contralateral arm; the remaining landmarks, i.e., 12th rib and iliac crest, are then drawn on the skin (Figs. 2.1 and 2.2). Subsequently the lower limbs are arranged in a modified lithotomic position, typical of the GMSV position, with the leg of the operated side extended and the contralateral one well abducted. Care is taken to prevent pressure injuries, accurately padding the legs stirrups (Figs. 2.1 and 2.2). Once the positioning of the patient is completed a single sterile draping is applied, standardized according to the individual requirements (Fig. 2.3). Both percutaneous and retrograde accesses should be simultaneously accessible, the movements of the endoscopic instruments not hindered (Fig. 2.4), all the monitors (endoscopic, ultrasound, fluoroscopic) visible by both surgeons, and the rest of the armamentarium (like lithotripsy energy sources) handy for the operators. This means that also the organization of the operating room should be standardized according to the space available, and common schemes should be followed (Fig. 2.3).

Preliminary Retrograde Ureteroscopic Evaluation

The possibility of obtaining a combined approach to the upper urinary tract allows to do something more than the cystoscopic application of a guide-wire and of a ureteral catheter for pyelography or renal cavities distension with saline, which is the first step of prone PCNL.

The initial retrograde ureteroscopic control follows a mandatory preoperative CT scan, and allows to assess:

- The anatomical features of the lower urinary tract.
- The anatomical features of the ureteral meatus and of the ureter (a thin or a spastic ureter would need smaller caliber ureteroscopes and/or ureteral sheaths).
- The presence of ureteral stones or strictures to be contextually treated.
- Pyelic and calyceal morphology, in normal conditions as well as in known congenital renal malformations or outcomes of previous renal surgeries.

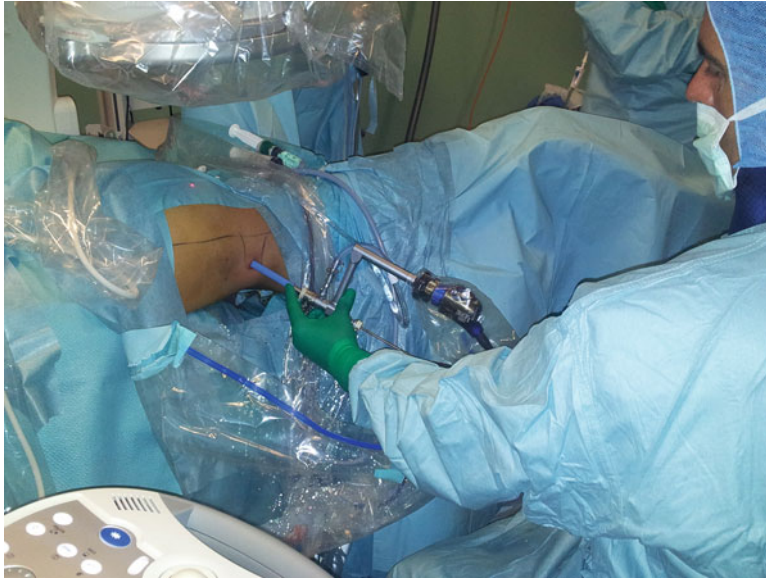


Fig. 2.4 The resulting freedom of movements of the rigid nephroscope in the GMSV position

- Stone accessibility, position, mobility, hardness, and peculiarities (intraparenchymal calcifications rather than Randall’s plaques), with a possible change in indication from percutaneous to ureteroscopic treatment.
- The course of the Endovision-assisted fluoroscopic and ultrasound-guided renal puncture, with the possibility of controlling/correcting the exiting of the needle through the tip of the renal papilla after passing through the Brodel’s avascular line, thus minimizing the risk of bleeding (Fig. 2.5).
- The course of the Endovision-assisted percutaneous tract dilation and of the Amplatz sheath application, minimizing radiation exposure.
- The preparation of the “kebab” (skewered) patient for absolute procedural safety: the guidewire entering the kidney through the percutaneous tract is retrogradely extracted with forceps and exits through the external urethral meatus; vice versa, the main guidewire (or an auxiliary one) may be inserted via the ureteroscope and externalized through the Amplatz sheath.



Fig. 2.5 Endovision-assisted renal puncture, with the entry of the needle within the renal cavities through the tip of the renal papilla

Intraoperative Retrograde Ureteroscopy

Nowadays we can exactly acknowledge all the critical PCNL steps that may greatly benefit from a retrograde ureteroscopic assistance:

- Retrieval of stone fragments from calices parallel to the access tract or within narrow infundibula by means of flexible ureteroscopy, retrograde in situ laser lithotripsy, or dislodgement in sites more suitable for antegrade lithotripsy (this avoids the need for multiple percutaneous tracts and related hemorrhagic risk, optimizing stone-free rates).
- Control of the ongoing lithotripsy, avoiding the descent of stone fragments along the ureter and transiently increasing the irrigation to improve visibility only when needed, without the risks of a constantly high intrarenal pressure and related infectious risks.
- Cooperation with flexible nephroscopy in the final visual assessment of the stone-free status (with reduced intraoperative fluoroscopic exposure and postoperative need for CT scan), with the possibility of completing the procedure or of planning kind and timing of a second look treatment of the residual stone burden, and in the decision for a tubeless procedure (in absence of bleeding or upper urinary tract perforation/lesion).
- Final endoscopic evaluation of the meatus, the ureter, and the ureteropelvic junction in order to decide for a stentless PCNL (in the absence of edema, bleeding, clots, stone fragments, wall lesions, or strictures) or about the timing of a double J stent (short- or long-term application).

According to our personal experience (unpublished data), in a series of 55 consecutive patients who underwent ECIRS in our Department during 2011 and the first term of 2012 for large and/or complex urolithiasis ureteroscopy was carried out in 84 % of cases (76 % semirigid 6–7.5 Ch ureteroscopy, 37 % associated flexible ureteroscopy, 7 % only flexible ureteroscopy, 44 % of total flexible ureteroscopies, 10 % application of a ureteral sheath). The stone-free rate after a first treatment was 90, 94 % after a second early treatment (second PCNL or retrograde ureteroscopy). The mean operative time was 88 min including patient positioning. The Endovision aid to the renal puncture was feasible in 29 % of the procedures, the combined treatment of ureteral stones, calculi in calices parallel to the percutaneous tract or impacted in infundibula, calyceal diverticula and

double districts in 48 % of cases. Evaluation for final application of a double J stent lead to a 35 % of stentless (but not tubeless) ECIRS; of the 65 % ECIRS concluded with the application of a double J stent 50 % had a string for facilitated removal after few days [1–3]. There were no ureteral lesions at all, and an overall complication rate of 5.5 % (two fevers responsive to antibiotic treatment and one self-limiting bleeding). Therefore, the complication rate of ECIRS is not the sum of those of PCNL and retrograde ureteroscopy; on the contrary, retrograde ureteroscopy contributes to minimize the more relevant PCNL complications (mainly bleeding and infection).

Conclusions

For sure ECIRS is not the unique new gold standard for percutaneous renal stones treatment, but may be is a candidate, representing a new comprehensive attitude of the urologist toward the various PCNL steps, exploiting the surgeon's versatility for an optimal outcome in terms of safety and effectiveness. Among the merits of ECIRS we recognize the large amount of thorough critical analysis of the PCNL procedure triggered by its proposal, as demonstrated by the bulk of literature published on this argument, which has led to the standardization of each surgical step for a shorter learning curve and a better replicability, and extended its positive influence on the standardization of the prone procedure as well. The GMSV position allowing ECIRS is very handy and ergonomic, but first of all very safe from an anesthesiological point of view. In conclusion, ECIRS passwords are "synergy, versatility, and standardization," for an optimal outcome of the percutaneous treatment of large and/or complex renal stones.

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