Case Report

Miniaturized Percutaneous Nephrolithotomy in the Supine Position under Regional Anesthesia to Remove Large Renal Calculi: A Case Report

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Background: Percutaneous nephrolithotomy (PCNL) is traditionally performed under general anesthesia, with the patient in the prone position. However, various concerns have been raised regarding the prone position, especially in morbidly obese patients with compromised cardiopulmonary status and comorbidity issues. Our aim was to demonstrate our experience with supine miniaturized PCNL performed under spinal anesthesia in a high-risk patient.

Case Report: A 76-year-old Thai woman with obesity and severe hyperglycemia presented with two large right kidney stones. She was scheduled for prone PCNL. During admission, she was in a severe hyperglycemic state, with a blood glucose level of 537 mg/dL. She required an intravenous insulin infusion and was monitored until stable. Because she had significant potential risk for general anesthesia, we decided to remove the stone by supine miniaturized PCNL under spinal anesthesia. She was placed in the Galdakao-modified supine Valdivia position. Cystoscopy was performed and a ureteric catheter was inserted into right ureteric orifice. The lower pole access was carefully punctured under ultrasonographic guidance. The tract was dilated with a metallic one-step dilator and a 12 Fr nephroscope was used. Lithotripsy was undertaken using a holmium laser through a 550 micron laser fiber. The procedure was completed with no deterioration of the patient.

Conclusion: A patient with kidney stones, obesity, and poor glycemic control has an increased risk of perioperative complications. We report the first case of supine miniaturized PCNL performed under spinal anesthesia in Thailand. It is a safe and feasible method that provides satisfactory positive clinical outcomes.

Keywords: Supine; Miniaturized percutaneous nephrolithotomy; Regional anesthesia

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Percutaneous nephrolithotomy (PCNL) is usually performed in the prone position under general anesthesia. The prone position is used worldwide because of its familiarity, the full understanding of the anatomy in this position, and the decreased risk of visceral organ injury. However, in high risk patients, including those with obesity and hyperglycemia, this traditional operative procedure may not be safe due to the increased risk of perioperative adverse events. For this reason, supine positioning with regional anesthesia is a more suitable technique for PCNL.

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Case Report

The authors present a case of a 76-year-old Thai female with a history of diabetes mellitus type 2 and obesity class 1 (body mass index (BMI) of 31 kg/m^2). She had asymptomatic pyuria. She was evaluated with ultrasound KUB (Kidneys, Ureter, Bladder) and demonstrated a large right kidney calculus. Then, she underwent a computerized tomography (CT) KUB scan which revealed two kidney stones, sized 0.7 and 2 centimeters (cm), in the mid-to-lower pole of the right side. At that time, the patient was scheduled for a prone PCNL. Her urine culture was sterile. At admission for pre-operation, she was in a simple hyperglycemic state (fasting blood sugar (FBS) 537 mg/dL). Given her condition, we consulted an endocrinologist and anesthesiologist for further management. The patient received an intravenous insulin infusion and was monitored until stable. Because of her blood glucose fluctuation, she was deemed a risk case for general anesthesia. After careful discussion with the multidisciplinary team, a decision was made for a miniaturized supine PCNL (mini PCNL) under spinal anesthesia.

In the operating theater, routine monitoring included heart rate, electrocardiogram, noninvasive blood pressure (BP),

and pulse oximetry; these parameters were all normal. A spinal block was performed at the L3/L4 space in the midline position with a 27-gauge needle and 2.4 milliliters (mL) 0.5% hydromorphone (HM) plus 20 micrograms (mcg) fentanyl were injected into the subarachnoid space. The sensory level of the block was detected at T6. The patient was then placed in the Galdakao-modified supine Valdivia (GMSV) position using a small pillow below the right flank. This elevated the right flank 20 degrees, causing the posterior calyx to project more laterally. Her right leg was extended, while her left leg was well flexed and abducted.

Cystoscopy was performed and a ureteric catheter was inserted into the right ureteric orifice up to right renal pelvis. An ultrasound-guided percutaneous puncture was performed using an 18 G metallic needle. A lower pole access was chosen. A Sensor hybrid guide wire (Boston Scientific, Natick, Massachusetts) was inserted into the pelvocalyceal system, and the access tract was dilated with a metallic one-step dilator. A 15/16F operating sheath was introduced, and a percutaneous 12 Fr nephroscope (minimal invasive PCNL system) (Karl Storz, Germany) was used to explore the renal pelvis. Stones were completely fragmented and extracted with a 550 micron Holmium: yttrium aluminum garnet (HOL: YAG) laser fiber at a power setting of 0.2 Joules (J) and a frequency of 50 Hertz (Hz), using a long pulse width (Pulse 120H, Lumenis Inc., San Jose, CA). A 6Fr double J stent was inserted via the ureteric catheter and properly placed in retrograde fashion under fluoroscopy guidance. The procedure was completed with no deterioration of the patient. The operative time was 90 minutes and the blood loss was 30 ml. Postoperatively, this patient had a fever, which subsided 36 hours later. Her blood glucose was well controlled. A film KUB on postoperative day 1 showed a proper position of the double J stent and no residual stone fragments. She was discharged on postoperative day 4. Her satisfaction was very good.

Discussion

Various surgical procedures can be considered for treatment of urolithiasis, depending on the stone and patient factors. Many studies have concluded that the results of ESWL are satisfactory if stones are smaller than 2 cm in diameter[1,2]. The gold-standard treatment for a large kidney stone is standard-sized percutaneous nephrolithotomy. However, this procedure can usually incur life-threatening complications, such as bleeding requiring a blood transfusion[3]. Traditionally, PCNL is done in the prone position due to the multiple advantages of this position, such as the wide operative field and familiarity to the surgeon, which can make puncturing and dilating the tracts much easier. However, this position has some disadvantages, including significant cardiovascular changes, especially in patients with obesity.

By contrast, the supine PCNL position is more advantageous to the cardiopulmonary system. It also allows both anterograde and retrograde access simultaneously. Manohar et al[4] concluded that performing supine PCNL is an effective and safe procedure in high-risk patients with obesity who require continuous monitoring[5]. In our case, we decided to decrease the influence of prone PCNL on the circulatory function by performing PCNL in the supine position.

As stated in the guidelines of both European Association of Urology (EAU) and the American Urological Association (AUA), the current consensus is that the indications for PCNL are renal stones greater than 20 mm, including complete staghorn and partial staghorn calculi[6]. Our patient had 0.7 cm and 2 cm renal stones, so we considered the option of a mini PCNL, as this is an alternative choice for patients with a small-to-medium-sized stones. It results in less blood loss, while having a higher chance of a tubeless procedure, similar overall complication rates, and shorter hospital stays compared to the standard PCNL[7]. Consequently, the mini PCNL is also cost effective.

Feracis et al[8] reported the successful treatment of children by mini PCNL, and they concluded that the procedure could also be safely applied in adults. Retrograde intrarenal surgery (RIRS) is a good option for stones smaller than 1.5 cm. However, the risk of sepsis is higher than with PCNL, depending on the stone size and the length of the operative time[9,10]. The risk was deemed greater in our patient due to her simple hyperglycemic state, as uncontrolled hyperglycemia has been associated with an increased infection risk[11]. Thus, RIRS was not considered for our patient.

The underlying condition of our patient, who had both obesity and hyperglycemia, created an increased risk for intraoperative and postoperative complications associated with general anesthesia. One risk was that our patient was likely to have a difficult airway because of her obesity. Another was that her fluctuating blood glucose could also increase the risk of infection due to the hyperglycemic response to surgical stresses. Some studies have shown that spinal anesthesia promotes glycemic control in the perioperative period. For example, Radaideh et al[12] reported a significantly greater effect on blood glucose level following general anesthesia than spinal anesthesia. Gottschalk et al[13] also reported that spinal anesthesia lessens the hyperglycemic response to surgical stimuli in patients with diabetes.

After discussion with the anesthesiology team, we agreed that general anesthesia was not the appropriate choice for our patient. We therefore decided to perform a mini PCNL under spinal anesthesia. The benefits of spinal anesthesia over general anesthesia include no airway intubation, profound analgesia, more stable hemodynamics, and likely a more stable blood glucose concentration.

In the operating theater, after successful spinal anesthesia, the patient underwent the surgery in the Galdakao-modified supine Valdivia (GMSV) position. An ultrasound-guided percutaneous puncture was performed with an 18 G metallic needle to the right lower pole calyx. A mini PCNL was performed with a 550 micron laser lithotripsy through a 12 Fr nephroscope. Complete stone dusting was achieved by setting the laser parameters at the “lower energy, higher

frequency, and long pulse duration" modes. The patient was stable throughout the intraoperative period and tolerated the procedure well. The spinal anesthesia was adequate, with no need to change to general anesthesia.

In summary, in a situation of kidney stones with obesity and poorly controlled blood sugar, the patient tends to have a higher potential risk for intraoperative and postoperative complications. This is the first report of a supine miniaturized PCNL performed under spinal anesthesia in Thailand. The results show this to be a feasible method that provides satisfactory and safe clinical outcomes.

What is already known on this topic?

Percutaneous nephrolithotomy (PCNL) is usually performed in the prone position under general anesthesia. The prone position is used worldwide because of its familiarity, the full understanding of the anatomy in this position, and the decreased risk of visceral organ injury. However, in high risk patients, including those with obesity and hyperglycemia, this traditional operative procedure may not be safe due to the increased risk of perioperative adverse events.

What this study adds?

In a situation of kidney stones with obesity and poorly controlled blood sugar, the patient tends to have a higher potential risk for intraoperative and postoperative complications. The results show that Supine miniaturized PCNL performed under spinal anesthesia is a feasible method that provides satisfactory and safe clinical outcomes.

Potential conflicts of interest

The authors declare no conflict of interest.

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