The Role of Tranexamic Acid in Controlling Bloodloss During PCNL for Staghorn Calculi

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The aim of this paper is to assess the efficiency and safety of the tranexamic acid in reducing blood loss and the need for transfusion in patients diagnosed with staghorn calculi treated by percutaneous nephrolithotomy. Percutaneous nephrolithotomy (PCNL) is a minimally invasive technique used for large kidney stones. Hemorrhagic complications and urinary sepsis are serious complications associated with this type of surgery. Tranexamic acid is an antifibrinolytic drug that has the property of reducing intra or postoperative bleeding. The experience with tranexamic acid in preventing blood loss during percutaneous nephrolithotomy for is limited. The use tranexamic acid in percutaneous nephrolithotomy for staghorn type stones is safe and is associated with reduced blood loss and a lower transfusion rate.

Key words: percutaneous nephrolithotomy, PCNL, staghorn calculi, tranexamic acid

The first percutaneous approach to the kidney was described in 1955 by Goodwin and colleagues [1]. Percutaneous nephrolithotomy (PCNL) has replaced in most cases open surgery for the treatment of large upper urinary tract calculi.

Percutaneous nephrolithotomy (PCNL) is a minimally invasive technique used for large kidney stones (>20mm). Hemorrhagic complications and urinary sepsis are serious complications associated with this type of surgery (see table 1). Staghorn calculi, ureteropelvic junction obstruction, renal anomalies and very hard stones (≥1000 Hounsfield units) are the main indications for PCNL.

Percutaneous nephrolithotomy (PCNL) is the gold standard for the management of large upper urinary tract calculi. The intra or postoperative bleeding is one of the most frequent complications of PCNL. Hemorrhages that require embolization after pCNL are between 0.3% and 1.4%; the blood transfusion rate for post PCNL blood loss varies from 3 to 23% [2,3].

Staghorn calculi are large stones that fill the renal pelvis and branch into several or all of the calyces (figs. 1 and 2). They are often composed of struvite (magnesium ammonium phosphate) and/or calcium carbonate apatite. These stones are often referred to as 'infection stones' since they are strongly associated with urinary tract infections caused by specific organisms that produce the enzyme urease that

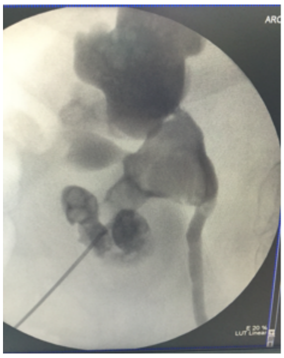

Fig. 1. PCNL for staghorn calculi - lower calyx puncture. This image is from the author's personal database.

Fig. 2. Complete staghorn calculi. This image is from the author's personal database

Table 1

THE MODIFIED CLAVIEN GRADING SYSTEM FOR PCNL COMPLICATIONS

Grade 1
Fever (> 38C)
Transient elevation of SCr (> 0.5 mg/dl)
Grade 2
Blood transfusion
Urine leakage < 24 hrs
Infections requiring additional antibiotics
Wound infection
Urinary tract infection
Pneumonia
Grade 3a
Renal hemorrhage requiring angioembolization
Postoperative double J stent placement for urine leakage
Hemo/pneumothorax requiring chest tube insertion
Retention due to blood clots
Grade 3b
Ureteric calculus
Collecting system perforation
Infundibular stricture
Urethral stricture
Retained PCNL tube requiring removal
Perinephric abscess
Grade 4a
Neighboring organ injury
Myocardial infarction
Acute renal failure
Grade 4b
Sepsis
Grade 5
Death

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promotes the generation of ammonia and hydroxide from urea [4].

PCNL surgery is preferred in the management of staghorn calculi to open surgery because of the lower morbidity, similar or superior stone-free rate and faster medical recovery.

An untreated staghorn calculus is likely to destroy the affected kidney or it can lead to urinary sepsis [5]. Stone removal is an important goal in order to relieve obstruction, sterilize any associated infection and preserve kidney function.

In urological surgeries, postoperative blood loss is thought to be associated with an increase in urinary fibrinolytic activity. Urine and urothelium contain high concentrations of plasminogen activators that facilitate the lysis of clots [6]. Therefore, administration of antifibrinolytic agents might be beneficial in reducing postoperative blood loss during and after urological surgeries [7].

Tranexamic acid is a synthetic derivative of the amino acid lysine that exerts its antifibrinolytic effect by reversible blockade of lysine binding sites on plasminogen molecules. The tranexamic acid can bind to plasminogen ten times more faster than aminocaproic acid, another analogue of lysine that has been used in the past. Tranexamic acid is usually well tolerated; diarrhea and nausea are frequent adverse events [8].

Tranexamic acid is used in the treatment of many haemorrhagic conditions. The drug is used in cardiac, orthopedic, general surgery or neurosurgeryto reduce postoperative blood loss and transfusion rate [9-11]. The experience with tranexamic acid in reducing blood loss in percutaneous nephrolithotomy is limited.

The uncertainties about the thromboembolic events and mortality caused by the use of the tranexamic acid still persist. Blood is an expensive resource and blood transfusion has its own not risks. The tranexamic acid safely reduces the need for blood transfusion in surgery with important health and economic implications [12].

Bleeding from the nephrostomy tract is the most frequent major complication associated with PCNL. The incidence of significant hemorrhage requiring transfusion in modern reported series of PCNL ranges from 10 to 25% [13,14].

The aim of this paper is to assess the efficiency and safety of the tranexamic acid in reducing blood loss and transfusion requirements in patients staghorn calculi treated by percutaneous nephrolithotomy.

Experimental part

The data of 42 patients diagnosed with staghorn lithiasis which underwent percutaneous nephrolithotomy between 1st october 2016 -1 st july 2018 was rewied. Nine patients were diagnosed with complete staghorn stones. Regional anesthesia was used in 36 cases (85.7%). A single percutaneous tract was used in most patients; 2 or more tracts were required in 5 cases. Second look PCNL was used in 3 cases; flexible ureteroscopy for residual fragments was performed in 2 cases. Exclusion criteria included coagulopathies, back problem disorders, neurological disorders with paresthesia and pacient refusal. Double J stenting for lumbar fistula was needed in 4 cases.

Lithotripsy was performed with ultrasonic or ballistic fragmentation (fig. 3). Plain renal X ray was used to measure stone diameter; abdominal ultrasound or computed tomography was used to measure the size of radiolucent stones. All the patients were worked up with contrast computed tomography or abdominal ultrasound; patients with positive urine cultures received profilactic antibiotic therapy.

Fig. 3. Resulting stone fragments after ultrasonic lithotripsy for staghorn calculi. This image is from the author's personal database

Postoperative evaluation at 72 h included abdominal ultrasound and plain renal X-ray. Patient evaluation at six weeks included abdominal ultrasound, plain renal X ray or contrast computed tomography. The patients were divided in two groups: 24 (group 1) received 1 g of tranexamic acid at induction followed by oral doses (500 mg at every 8 hours during the first 24 h), while 18 patients (group 2) did not receive the tranexamic acid. The clinical data of the patients were compared.

Most of the PCNL-s (85.7%) were performed under regional anesthesia because of better postoperative pain relief, more benign postoperative recovery and because of the inter-surgical communication with the patient.

All patients were premedicated before surgery with a light benzodiazepine. In this case 3 mg Midazolam was used. 1 hour prior to surgery 23 patients received 1 g Exacyl (tranexamic acid) in 250 mL saline solution 0.9% with slow infusion (1 hour); 12 h post surgery, infusion of tranexamic acid with the same posology was repeated.

The chosen anesthesia was spinal block. The patients were placed in sitting position on the operating table. Under aseptic conditions, using a 26-27 gauge Quincke spinal needle, the dural puncture was made at L2-L3 interspaces, median approach and 10 mg of hyperbaric Marcaine 0.5 % was administrated in subarachnoidal space. No complications were reported during the procedure.

Results and discussions

The mean age of the patients was 56 years and the mean stone burden was 37mm (range 29- 62 mm). The mean operative time was shorter for the tranexamic acid group (76 minutes) compared to the control group (83 min).

The stone free rate was 73.8%. The postoperative complications included postoperative pain (21,4%), hematuria (14.2%), fever (7.1%), urinary sepsis (2 cases - 4.7%). The mean hemoglobin drop in the tranexamic acid group was significantly lower than that of the control group (1.2 g vs 2.7 g). The transfusion rate was also higher in the control group (7 patients vs. 2 patients).

A review from 2001 presented data from 18 clinical trials and revealed that tranexamic acid reduces the probability of blood transfusion in elective surgery by 34% [15].

Kukreja and colleagues [16] analyzed the factors affecting blood loss during PCNL. The factors associated with significant blood loss during PCNL were multiple tracts, prolonged operative times and the frequency of intraoperative complications.

Ker and al. concluded in a meta-analisys that tranexamic acid can reduce the the transfusion requirements in surgery. This systematic review of the literature and cumulative meta-analysis published in 2012 showed that are strong evidence that tranexamic acid reduces the need for blood transfusion in surgery; however, the effect of tranexamic acid on thromboembolic events and mortality still remains uncertain [17].

Crescenti and al. reported for a reduction in transfusion rate of 21% and a relative risk of transfusion requirements for patients treated with tranexamic acid which underwent radical retropubic prostatectomy for prostate cancer [18].

The experience with tranexamic acid in preventing bloodloss during percutaneous nephrolithotomy is very limited .

In a retrospective study from 2017 Yao et al compared the efficacy of tranexamic acid versus etamsylate, another frequently used hemostatic agent, on hematuria duration in autosomal dominant polycystic kidney disease (ADPKD) patients with persistent gross hematuria.(Their conclusion was TXA with adjusted dosage can achieve hemostasis more effectively than etamsylate; this may result in a lower requirement of blood transfusions and less invasive procedures, protection of renal function and improvement in the quality of life of ADPKD patients [19].

Kumar et al published promising results in a prospective randomized controlled study in 2013; the mean hemoglobin drop and the need for transfusion were significantly lower in patients who received tranexamic acid [20].

Our study represents an innovative view on a challenging aspect of medical practice just as other studies in different medical fields (such as Orthopedics, Cardiovascular Surgery etc.) have strived to bring new information in well-documented areas of research [21-23].

The obtained clinical results recommend further research in some interdisciplinary areas [24 -30].

Conclusions

The use of tranexamic acid for reducing blood loss during and after percutaneous nephrolithotomy for staghorn lithiasisis a safe method with a lower transfusion rate. The present study has several limitations: it is a retrospective study and the sample size is small. More randomised controlled trials are required in order to establish the clear role of the tranexamic acid as a hemostatic agent in percutaneous nephrolithotomy for staghorn lithiasis.

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