UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE

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ROLUL ACIDULUI TRANEXAMIC ÎN CONTROLUL HEMORAGIILOR PRIMARE ÎN NEFROLITOTOMIA PERCUTANATĂ

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CONTENT

Introduction

The renal lithiasis, a disease known since antiquity, has a special place in urology due to her high incidence, frequent recurrences and bag prognosis when it's not treated properly. It affects between 2-4% of general population, with an incidence rate of renal calculi at 5 years of 15-40% of cases, depending on the applied treatment. The introduction of minimimally invasive treatments allowed the reduction of complication rates and an increase in the treatments's efficiency.

Percutaneous nephrolithotomy is the first line of surgical treatment for complex renal lithiasis, being the treatment of choice due to its low morbidity, shorter hospitalisation, shorter operative time and low costs. It represents the maine altervative for open renal surgery. Its main indication according to AUA (American Association of Urology) guidelines is the treatment of renal stones over 2 cm.

Although is an efficient and fast minimally invasive procedure, it has some risks and complications. Bleeding is one of the most frequent complications associated with percutaneous nephrolithotomy. This can occur during surgery, or during the postoperative period.

The tranexamic acid is an antifibrinolytic agent with a role of competitive blocking the activation of plasminogen into plasmine. The administration of the tranexamic acid in the first 3 hours before surgery can block fibrinolysis before the coagulopathy secondary to bleeding. Although the complete mechanism is yet unknown, the tranexamic acid has antiiinflamatory properties.

The present paper wants to evaluate the efficiency of tranexamic acid administration with the purpose of preventing and reducing the bleeding incidence during anf after percutaneous nephrolithotomy for complex renal lithiasis. In order to achieve the research goals, i used the tranexamic acid prophilaxy just after anesthesia before the renal puncture and then 12 hours after surgery in order to study, analyse and record the incidence of bleeding in patients who underwent percutaneous nephrolithotomy.

The main objective of this study was the necessity to evaluate the safety profile and the efficiency of sistemic tranexamic acid administration to reduce bleeding incidence in patients with renal lithiasis treated by percutaneous nephrolithotomy . The choice of this study is justified once by the high risk of bleeding, one of the most frequent serious complications of this type of surgery, and twice by the direct causal action of this hemostatic agent.

The tranexamic acid used topical or sistemic is associated with a decrease of mortality and transfusion requirements in surgical or trauma patients.

A second original element is the fact that although the tranxamic acid was used in the profilaxy of intraoperative bleeding during orthopedic surgery, its efficiency in urology during percutaneous nephrolithotomy is still unknown.

Acidul tranexamic is a synthetic derivative of the aminoacid lysine with antifibrinolytic effect which reversibly blocks the plasminogen molecules at specific sites. Usually is well tolarated and the adverse events incidence is pretty low. The most common side effects include nausea and diarrhea.

The incidence of tromboembolic events and the high thrombosis risk associated in theory with this drug have not been revealed so far in published papers.

In order to achieve the research objectives and to verify the hypothesis, i used the the tranexamic acid prophilaxy to reduce the incidence of intraoperative bleeding in patients with renal lithiasis who underwent percutaneous nephrolithotomy.

Percutaneous nephrolithotomy in the last two decades remains the gold standard of minimally invasive treatment for patients with larger kidney stones, but it still has a high bllegin incidence when compared with alternative methods like semirigid and flexible ureteroscopy or extracorporeal schockwave lithotripsy.

Patients and methods

In this study 127 patients were included. Ad admission the patient work-up included complete blood count, creatinine, urea, coagulation and urine culture. ECG was performed, and in some cases interdisciplinary consults of cardiology, pneumology and neurology were requested according to specific pathologies. In indicated cases specific tests were ordered for each problem.

Preanesthetic consult was performed in order to evaluate the patients regarding medical history, clinical examination and various tests, and the patients signed the informed consent. The anesthetic risk was established using ASA score (American Society of Anesthesiologists).

Of 127 patients, locoregional anesthesy was performed in 105 cases. 22 patients received general anesthesia, the main reason being their refusal for locoregional technique.

Mandatory intraoperative monitoring included 2 derivation ECG-ul (DII and V5), pulse oximeter and non invasive arterial monitoring set at 5 minutes or faster depending on the case. Also during the surgical intervetion patients received oxygen therapy through nose canula with a flux of 2-4 l/min. A Dragger Fabius GS premium anesthesy machine was used.

After two 18 G peripheral venous catheters were placed in position, in the operating room the patients were premedicated with 3mg Midazolam. This dosage was adjusted according to patient's status. Before puncture, patients received 500ml Ringer solution. The chosen local anesthetic was bupivacaine clorhydrate 0.5% 5mg/ml (Marcaine heavy Astra Zeneca), dosage ajusted according to age, physical status and patient weight. During locoregional anesthesia maneuvers, sedation was completed with 20-30 mg bolus iv of Propofol (according to patient's weight).

During surgery, the grade of patient's analgesia was evaluated with the analogue visual scale or SAV. This scale is a visual representation of pain intensity that the patient feels.

For monitoring the motor block level Bromage scale was used during surgery and after it so that at 6 hours after surgery the patients had a good motor function. The sensitive block was evaluated using the Pinprick method and the cold technique. Proper intraoperative muscular relaxation was assured.

All patients received proper intraoperative antibiotics with skin test before, according to antibiogram urine culture, no matter when the treatment was initiated.

During repositioning in prone position, 65 patients were given 1g tranexamic acid in 250 ml saline solution. This dosage was repeated at 12 hours after surgery. All 65 patients had no contraindication for tranexamic acid usage.

During the percutaneous nephrolithotomy the vital functions were monitored in dynamic (respiratory, hemodynamic functions, temperature and diuresis). The respiratory function was assesed by pulse oxymetry and respiration frequency, while the hemodynamic function was monitored by non invasive arterial blodd pressure measurement at 5 minutes, and by continuous 2 derivation ECG monitoring.

Of 127 patients, 22 patients received general anesthesia. In these cases, the patients were premedicated with 10 mg Metoclopramid , 20 mg Dexamethasone 20mg and 40mgg Pantoprazol. For induction was used Midazolam 0.1-0.4 mg/kgc, Fentanyl 5microg/kgc, Propofol 2-2.5 mg/kgc, Lysthenon (suxametonium chloride) 100 mg.

All patients were admitted in TIIP (compartimentul de terapie intermediary care compartimentpostoperative care) for 24/48 hours. Biochemistry parameters were evaluated at 6, 12, 24 and 48 hours with complete blood count, creatinine, urea, ionogram and procalcitonine.

After surgery the patients received solutions for restoration of fluid and electrolitic balance, gastric protection, low molecular weight heparines for thrombosis prophilaxy,, diuretics, analgetics, anti-inflammatory drugs, antiemetic drugs, blood transfusion when

required, specific medication for different conditions (betablockers, angiotensin converting enzyme inhibitors, antiParkinson drugs, bronchodilator drugs, insulin therapy, psychotropic drugs etc.).

Postoperative medication included systemic administration of 1g tranexamic acid in 250 ml saline solution at 12 hours for 65 de patients.

A retrospective, descriptive, randomised study was performed during a period of 5 years. In this study I analysed the records of 127 de patients(56 women and 71 men) diagnosed with renal lithiasis who underwent percutaneous nephrolithotomy between în perioada 1st october 2016-1st april 2022, în Colentina Clinical Hospital Urology Department.

During the 2020-2022 period, due to Sars Cov2 infection, the hospital treated exclusively only Covid patients.

The selected patients for this study were followed for a period of about 3 years, beginnning with october 2016, which stopped during the pandemic, when selective surgery were postponed.

At the beginnning of 2016, we started using tranexamic acid in patients with intraoperative and postoperative bleeding. Starting from analysing medical literature for the role of the tranexamic acis in preventing bloodloss during surgery in different surgery fields we decided to use this drug in our clinic.

During 2020/2021, the study was interrupted , Colentina Clinical Hospital becoming an exclusive SARS Cov2 patients hospital. During this period, the urology department only performed emergency surgeries.

The study was concluded in 2022, and the data was centralised in 2023.

In this study the research method was analytic - I analysed and cuantified the clinical and biological parameters.

In this retrospectiv study I followed 127 patients diagnosed with renal lithiasis who underwent percutaneous nephrolithotomy. The patients were randomised in two groups : group 1 - 65 patients who received tranexamic acid and group și 2 - 62 patientswho didnt receive tranexamic acid.

Patients general charateritics are shown in the next table (Fig. 1)

Fig. 1 Patients' characteristics

Characteristics		**Range**
Mean age (years)	52.3±9.8	22-75
Gender		
Male	71 (53.9%)	
Female	56 (44,1%)	
Stone medium surface(mm^2)	389.6±273	104.6-1020.5
Stone mean density (UH)	802±283.5	412-1390
Guy's Score		
1	8 (6.2%)	
2	21 (16,6%)	
3	62 (48.8%)	
4	36 (28.4%)	
Stone main location		
Inferior calyx	25(19.7%)	
Pyelic	48 (37.8%)	
Staghorn calculi	54 (42.5%)	
Number of stones		
1	71 (56%)	
2	25(19,7%)	
>2	31 (24.3%)	

The informed consent was obtained from all the patients included in the study. The stone characteritics, the operative time, the fragmentation time, the stone free rate, complications, transfusion rate, the mean hemoglobin drop and hospital stay were evaluated.

The stones dimensions were measured using abdomen and pelvis computed tomography in two diameters, resoectively x = the longitudinal diameter and y= transvers diameter in milimeters. The transverse cross section area of the calculi was calculated using the formula for the area of an elipse, respectively π*a/2*b/2. Using the computed tomography the number, location and stone density in Houndsfield units was evaluated. Stone complexity was evaluated using the Guy score.

All surgeries were performed in prone position. Most patients received locoregional anesthesia. In general a solitary percutaneous tract was used (115 cases - 90,5%); in 9,5% of cases (12) two or mare tracts were required. A nephrostomy tube was placed at the end of the procedure in all cases. The staghorn versus non staghorn calculi ratio was 0,74:1.

Ballistic, ultrasonic or the two combined or used as lithotripsy methods. In 9 cases (7%) a double J stent was placed at the end of surgery; in other 6 cases (4,7%) a double J stent placement was required for lumbar fistula . Second-look percutaneous nephrolithotomy was used in 2 cases (1,5%) while flexible ureteroscopy for residual fragments was used in 3 cases (2,3%).

The stone free status was evaluated at the end of surgery by direct visual inspection of the pyelocalyceal system ot by fluoroscopy and at 48 hours after surgery by abdominal ultrasound or plain renal X-ray; the 1 month follow up included plain abdominal X ray, abdominal ultrasound or computed tomography to asses the residual stones.

The two groups were divided like this:

Group I - included 65 de patients who received Exacyl (tranexamic acid) in 250 ml saline solution 0.9%, in slow infusion for 1 hour during surgery, same dosage repeated at 12 hours after surgery

Group II - included 62 de patients who didnt receive tranexamic acid.

The exclusion criteria were patients with coagulation disorders, neurological diseases with parestesia, significant cardiology problems and patient refusal.

The patients from the two groups were diagnosed before admission using imagistic methods. At admisssion the standard tests included complete blood count, urea, creatinine,

coagulation. ionogram, urine culture. The data for every patient was recorded according to the normal values.

In the present study patients from both genders were included, both from cities or country area, with a female preponderence (56% versus 44%). The age range was between 20 and 70 years old, with most patients in the 30-39 years segment, the extreme ranges - youngsters between 20 and 29 years and the old people with a single case of 70 years - being the least represented groups.

The main objectives of this retrospective study was the comparative analysis between the two groups of the mean hemoglobin drop, the transfusion rate and the stone free rates.

The secondary objectives of this study were the comparative analysis of the side effects of the systemic administration of tranexamic acid (including possible tromboembolic events), minor and major surgical complication, mean operative time and the average hospital stay.

All these parameters were statistically evaluated using thel ANOVA Single Factor program and the chi-square test.

The postoperative bloodloss was evaluated by monitoring the mean hemoglobin drop at 12, respectively 24 and 48 hours after surgery. The patients in the tranexamic acid group had a mean hemoglobin drop statistically significant lower than the control group in the first 48 hours after surgery (1,1 g versus 2,6g; p<0,0017 - figures 2 and 3).

Fig. 2 The evolution of the hemoglobin level

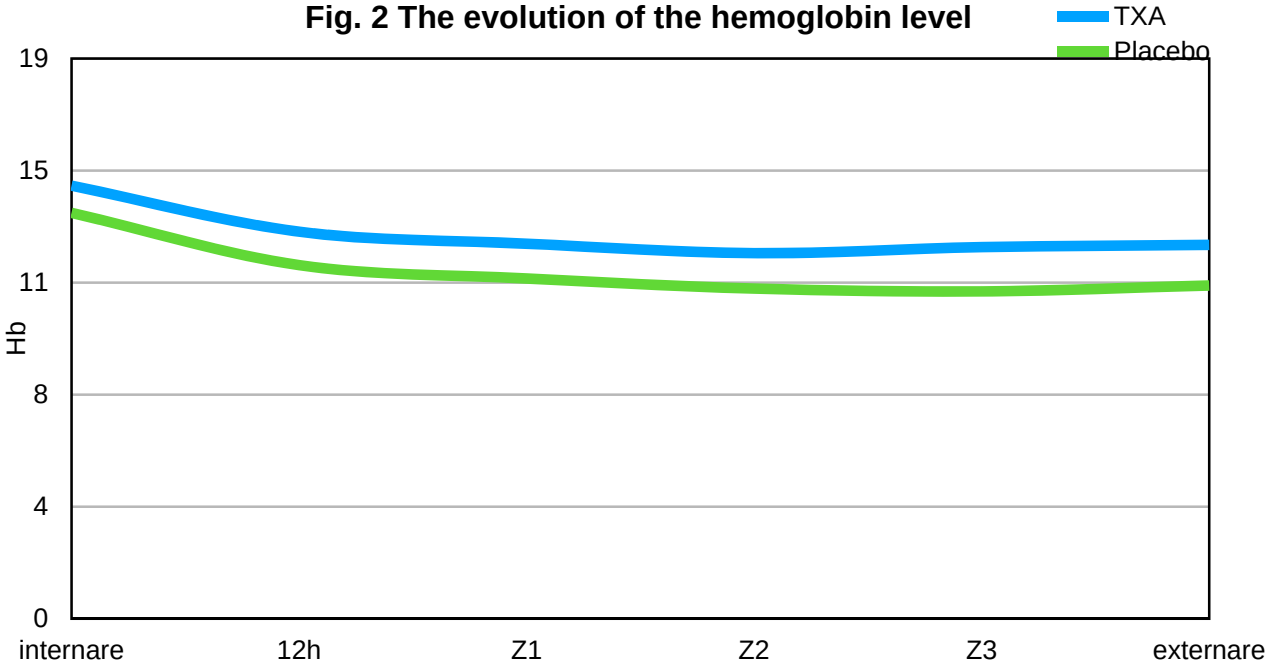
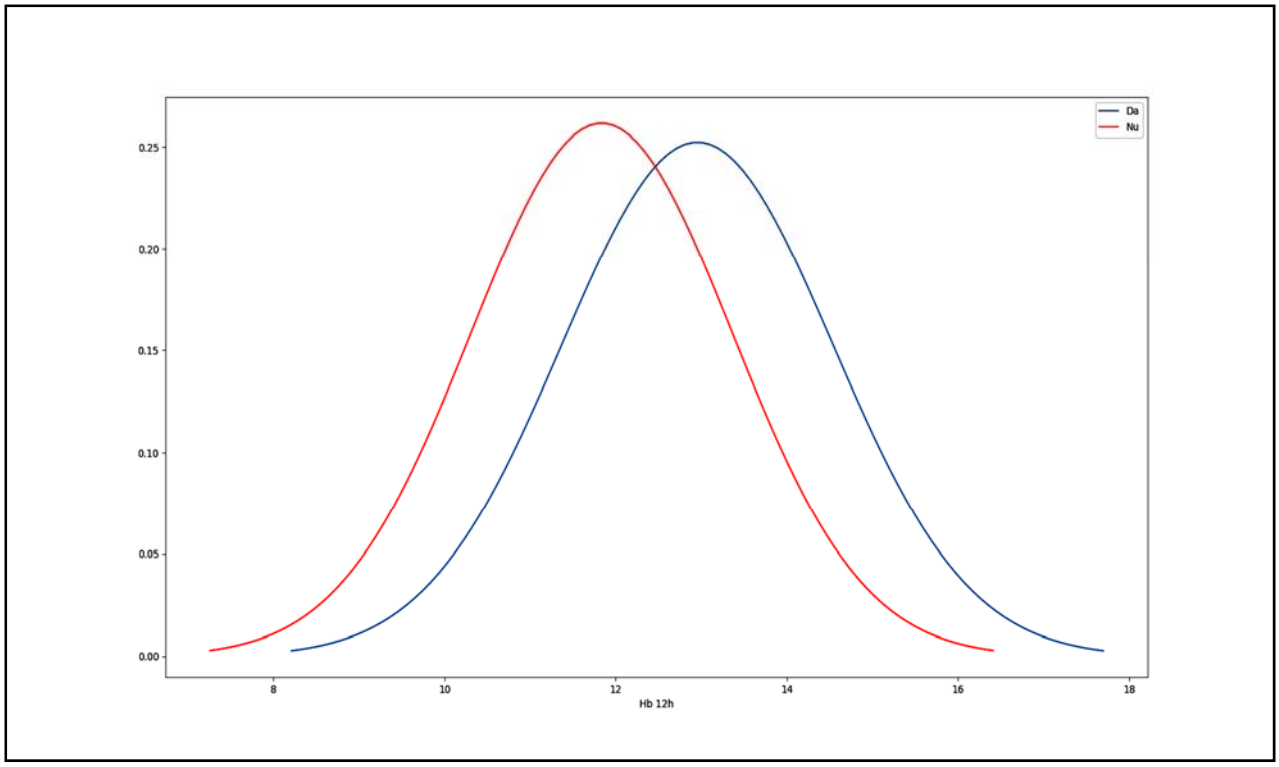


Fig. 3 The comparative analysis of the mean hemoglobin level at 12 hours after surgery

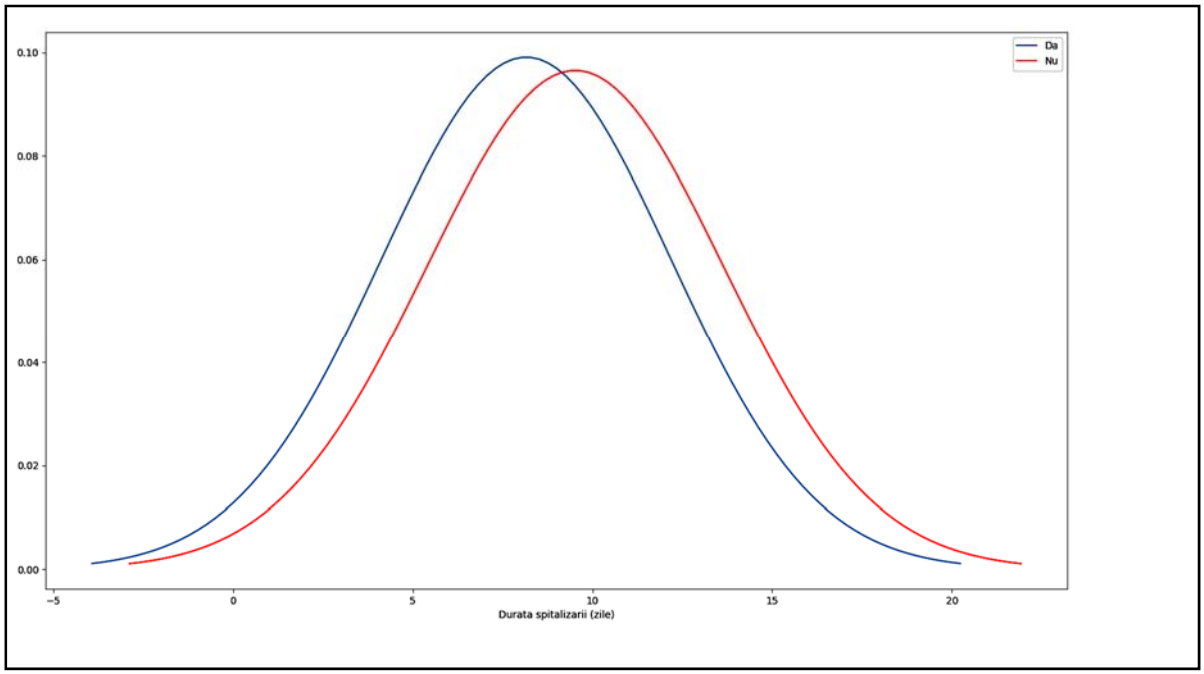


Also, there were statistically significant differences between the two groups regarding the transfusion rate and the stone free rate. The tranexamic acid group had just a 3% transfusion rate compared with the control group (12,9%) (p p<0,000,1).

The stone free rates were superiorin the tranexamic acid group at 48 hours after surgery and at 1 month - 78,4% and 81,5 % respectively compared to 70,9% and 74,1% respectively in the placebo group(p <0,0021).

As the secondary objectives of the study there were no statiscally significant differences between the two groups regarding the hospital stay (p =0,07) (Fig. 4)

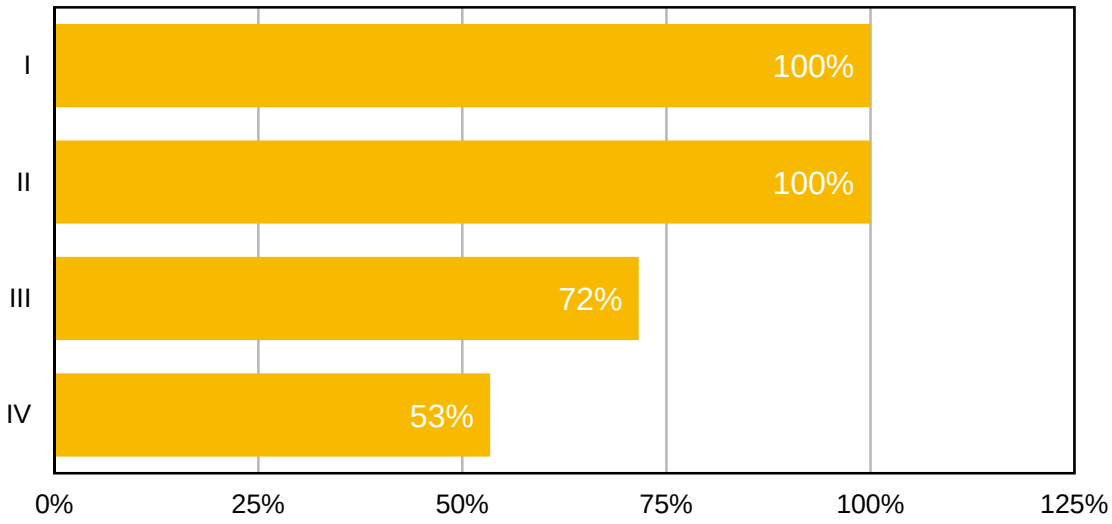
Fig. 4 Comparative analysis of the hospital stay



There were no statiscally significant differences between the two groups regarding the operative time (p =0,4) or the complexity of the stone - calculi with a Guy score of 1-2 versus calculi with Guy score 3-4 (p =0,055) .

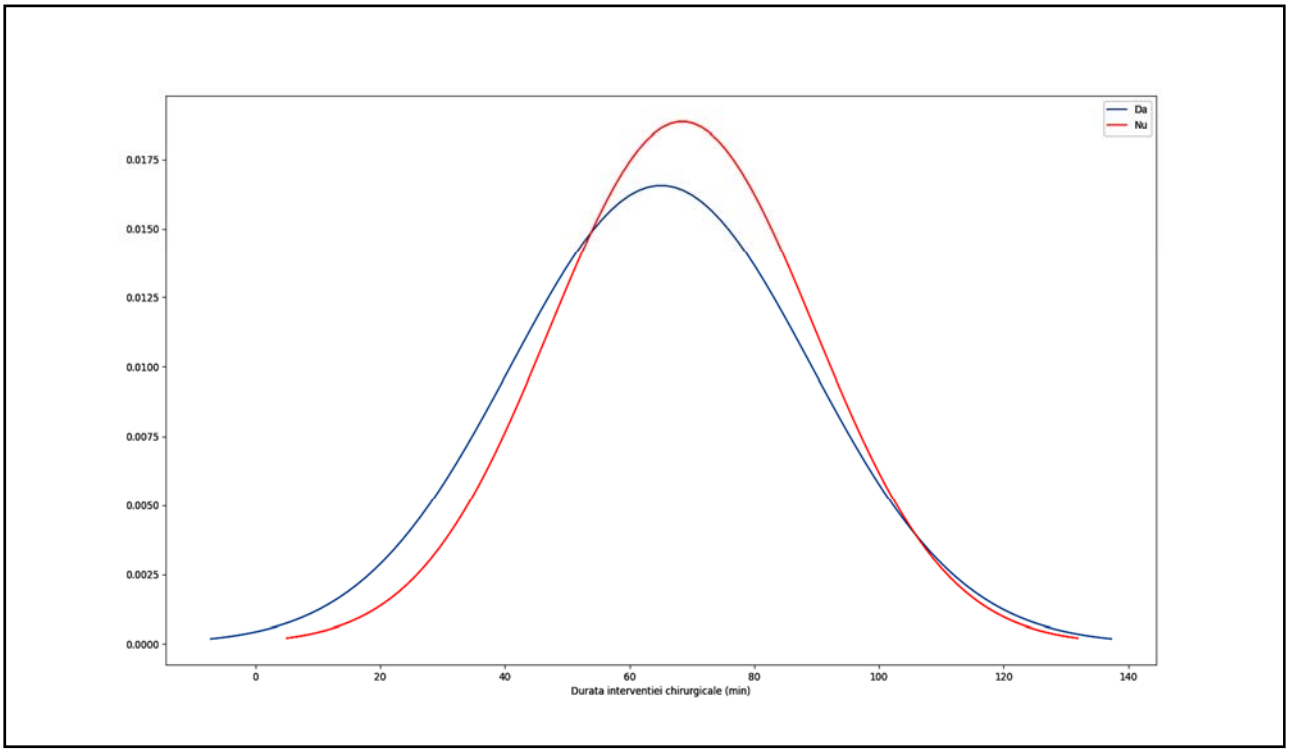
The stone free rates according to Guy score were 100% for stones type I and II and 71,6 % and 53,4% for stones type III and IV (Fig5).

Fig 5. The stone free rates according to Guy's score



The mean operative time in the tranexamic acid group was 49.3 minutes (range 30 -110 minutes) compared with the control group 57, 4 minutes (range 42- 122) (Fig. 6).

Fig. 6. Comparative analysis of the mean operative time



The overall complication rate was 18,1%. Most complication were minor Clavien type I (transitory serum creatinine level increase - 2 cases, fever- 2 cases) and II (tblood tranfusion - 10 cases and 2 cases with additional antibiotics). Type Clavien IIIa complications included 6 cases that required a double J stent placement for lumbar fistula after nephrostomy tube extraction and 1 case with postoperative bleeding that required supraselective angioembolisation. There were 2 cases of urinary sepsis (Clavien IV b type) who were managed in a conservative fashion.

Discussions

The tranexamic acid was used with success as an anfibrinolytic agent during cardiovascular surgery, neurosurgery, orthopedic surgery or general surgery.

At first the tranexamic acid was used to reduce the incidence of postoperative bleeding during cardiovascular surgery.

There are many published studies and metaanalysis for the use of the tranexamic acid compared with aprotinine for reducing the bleeding risk and mortality.

Even though the tranexamic acid side effects are in general minor, there are some studies that evaluate the high risk of neurological complications by comparation with other anfibrinolytic drugs.

The anfibrinolytic drugs in general and the tranexamic acid especially were frequently used during cardiovascular surgery with the goal of reducing bloodloss because this type of surgery usually requires allogene blood transfusion.

Dietrich and allies published in 2008 a double blind prospective,randomised comparative clinical trial in which they highlighted the effects of tranexamic acid compared to aprotinine in patients with primary coronary artery revascularisation (coronary artery bypass or aortic valve replacement).

This study included a number of 220 patients randomised in groups of 20 who received either tranexamic acid (a 6g total dose) or a total dose of aprotinine (5-6 x 10(6) Kallikrein Inhibiting Units) in which the tranfusion requirements and postoperative bleeding in the first 24 hours were evaluated. There were no statiscally significant differences between the two groups regarding the postoperative bleeding in the first 24 hours , although it was lower in patients who received aprotinine and underwent coronary artery bypass (500, 350-750 mL vs 650, 475-875 mL; P = 0.039).

Also there were no statiscally significant differences for the anfibrinolytic activity at the end of surgery evaluated by D-dimers test. This study has shown a reduction in the transfusion requirements in the aprotinine group when compared with the tranexamic acid group (47% versus 61%, P = 0.036). The conclusions of this study were that the tranexamic acid is slightly inferior as an antifibrinolytic drug when compared to aprotinine in patients with coronary artery bypass indication, a type of surgery with a higher bleeding risk than aortic valve replacement, group in which there were no statiscally significant differences.

Dunn and Goa published a comparative retrospetive analysis for the antifibrinolytic effectsand the impact of tranexamic acid use in different patients categories. This study showed

a relative reduction of postoperative bleeding and transfusion requirements in cardiovascular surgery patients with cardiopulmonar bypass (29% versus 54% in the placebo group) who received a dose of 10mg/kg tranexamic acid at inducion, followed by a slow infusion of 1mg/kg/hour.

After the initial use as an antifibrinolytic drug together with aprotinine in cardiovascular surgery, the tranexamic acid was used with success in neurosurgery, orthopedic surgery or general surgery.

In urology the tranexamic acid was used with promising results during radical prostatectomy or the transurethral resection of the prostate. Crescenti and allies reported in 2011 the conclusions of double blind,randomised, placebo controlled study regarding the efficiency of the intraoperative usage of small doses of tranexamic acid in patients with radical retropubic prostatectomy. Patients received a charging dose of 500 mg of tranexamic acid 20 minutes prior to surgery followed by 250mg/per hour during surgery. The results were a reduction of the absolute blood transfusion rate with 21% (55% in the control group versus 34%) and a relative blood transfusion rate of 0.62, with no statiscally significant differences between the two groups regarding the thromboembolic complications or mortality, with a follow up period of 6 months.

A first serious retrospective metaanalysis for the effect of the tranexamic acid given to surgical patients on transfusion requirements, mortality and thromboembolic events (myocardial infarction, cerebral vascular stroke, deep vein thrombosis and pulmonary trombembolism) was published by Kerr and allies in 2012.

A systemic review of a 129 de clinical studies who included 10 488 patients over a period of almost 40 years (1972-2011). This cumulative metaanalysis has proven the efficiency of the tranexamic acid as an antifibrinolytic agent in reducing the transfusion requirements; however the effects of the tranexamic acid for the thromboembolic events and mortality remain uncertain.

The hemostatic properties of the tranexamic acid was proven even for the topical applications. The topical appilcation of the tranexamic acid seems to be efficient in different types of bleeding.

The use of the tranexamic acid for preventing postoperative and intraoperative bleeding complications during percutaneous nephrolithotomy is pretty limited. In the last 5 years the number of retrospective metaanalysis published has increased and even a series of clinical randomised trials have tried to establish the role of the tranexamic acid in preventing bloodloss which occurs during and after percutaneous nephrolithotomy.

Kumar and allies reported encouraging results from a study published in 2013. The study was conducted on a group of 200 patients randomised in 2 groups which underwent percutaneous nephrolithotomy, the patients in the tranexamic acid group receiving a 1g deose of tranexamic acid followed by 3 oral doses of 500mg in the next 24 hours .

The mean hemoglobin drop was significantly lower in the tranexamic acid group compared with the control group (1.39 versus 2.31 gm/dl, $p < 0.0001$), same as the relative transfusion rate (2% versus 11%, $p = 0.018$) and the complication incidence (33% versus 59%, $p < 0.0001$). The stone clearance rate was similar for the two groups (91% versus 82%, $p = 0.06$) with a mean operative time significantly lower for in the tranexamic acid groupc (48,3 versus 70,8 minute, $p < 0.0001$).

In 2021 Kallidonis and allies published a systematic review and a metaanalysis for the efficiency and safety of tranexamic acid systemic use in patients with percutaneous nephrolithotomy. This study was conducted accorsing to the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-analyses). In this extensive metaanalysis were included 6 randomised clinical trials performed on a number of 1262 patients after the evaluation of more than 2500 de published papers.

The main objectives of this retrospective analysis were the assesment of the transfusion rate, the mean hemoglobin drop and the intraoperative and postoperative bleeding complications; the secondary objectives were represented by the operative time, the stone free rate, the mean hospital stay and overall complications. The published results showed a mean hemoglobin drop lower in the tranexamic acid group compared with the control group with a mean difference of 0.65 ($p < 0.0001$), a lower hemorrhagic complications incidence post PCNL with an odds ratio - OR of 0.32 ($p < 0.00001$) and a lower tranfusion rate for the tranexamic acid group (OR of 0.34 ($p = 0.0007$)). Also the mean hospital stay was significantly lower in the tranexamic acid group with a MD - mean deviation of 1.38 ($p = 0.005$) with a lower complication rate.

The perioperative use of the tranexamic acid seems to contribute to lowering the hemorrhagic complications incidence, the bloodloss in general and the hospital stay; it looks like a hemostatic drug with a good safety profile and is well tolerated in general.

Another metanalysis conducted by Hinojosa-Gonzalez and allies evaluated the impact of the tranexamic acid given before surgery in patients with percutaneous nephrolithotomy for bloodloss, transfusion rate and the stone free rate. In this metaanalysis there were selected a numbar of 8 s randomised prospective clinical trails performed on 1201 patients from whom

598 received tranexamic acid and 603 wre given placebo; the patient data was analyed with the Review Manager versiopn 5.3 software.

Concerning the results, this metanalysis concluded that the use of tranexamic acid during percutaneous nephrolithotomy proved a statistically significant reduction of the mean hemoglobin drop, tranfusion rate, complication rates, operative time and hospital stasy while maintaining a superior stone-free rate. Regarding the safety of tranexamic acid use there were 2 cases of pulmonary thromobembolism in a single study in the tranexamic acid group.

A recent metanalysis published in 2023 by Prasad and allies evaluated the safety profile and the efficiency of the tranexamic acid during percutaneous surgery. 6 clinical randomised trails were evaluated who included 1323 patients. The main goal of this retrospective analysis was to asses the blood transfusion requirements with or without perioperative usage of tranexamic acid.

The conclusion of this study was that tranexamic acid is safe and efficeint during percutaneous nephrolithotomy with a reduction of 67% of transfusional requirements (although intra and postoperative bloodloss was comparable betwenn thw two group). There were no Nu au fost thromboembolic events in the tranexamic acid group; the overall complication rate was lower in the tranexamic acid group, while the stone-free was higher in the same group compared to the control group.

One of the most complete and extensive analysis for the tranexamic acid usage was published last year by Cleveland and allies. In this complexe metaanalysis there were slected all the randomised clinical trials that included patients who underwent percutaneous nephrolithotomy and had tranexamic acid given versus placebo with results published before may 2023. According to the inclusion criteria 10 clinical trials were slected who evaluated the results of 1883 randomised patients; the studies with topical administration of the tranexamic acid as a hemostatic drug weren't taken into consideration.

The main followed parameters were the transfusion requirements, the stone free rate and the thromboembolic events; the secondary objectives of this study were the adverse events of tranexamic acid usage, secondary surgical interventions, minor and major complications, the mean hopital stay and unplanned patient admission. The transfusion rate was 5,7 %in the placebo group compared to 3,1% (range 14 - 42), while the stone-free rate was higher in the tranexamic acid group. Also the systemic use of the tranexamic acid seems to reduce the incidence of major and minor complications and hospital stay.

However the tranexamic acid increases the frequency of adverse events (98 in the tranexamic acid group versus 23 in the placebo group for a 1000 patients), although no

thromboembolice events haven't been reported in the trails selected for this retrospective analysis.

Batagello and allies have published in 2022 the results of a double blind randomised clinical trial placebo controlled which supervised the systemic usage of tranexamic acid in patients with complexe renal lithiasis and percutaneous nephrolithotomy indication. This study was conducted on a study group of 192 patients randomised with a 1:1 ratio. All patients were diagnosed with complexe renal lithiasis (Guy score III-IV); the patients in the tranexamic acid group received a 1g tranexamic acid dose at induction.

The main study objective was the tranfusion rate, the secondary objectives including bloodloss, operative time, complications and the sonte free rate. The relative blood transfusion rate was lower in the tranexamic acid group compared with the control group (2.2% versus 10.4%). The immediate stone free rate and at 3 moths post surgery was superior in the tranexamic acid group; there were no statiscally significant differences between the two groups for the operaitve time or complications.

The authors have concluded that systemic administration of the tranxamic acid in in patients with complexe renal lithiasis and ercutaneous nephrolithotomy can reduce up to 5 times the need for blood transfusion, while conserving a superior stone free rate without increasing the complication rate.

Conclusions

The use of tranexamic acid for preventing hemorrhagic complications during percutaneous nephrolithotomy is relatively limited. The aim of this study was to evaluate the effciency and the safety profile of the tranexamic acid in preventing hemorrhagic complications and the tarnsfusion requirements in patients diagnosed with renal lithiasis who underwent percutaneous nephrolithotomy.

Percutaneous nephrolithotomy is still the gold standard for the trearment of large renal lithiasis. It is a minimally invasive durgical procedure who replaces almost completely open surgery in the treatment of complexe renal lithiasis due to lower complication rates and shorter hospital stay. However it remains a surgical intervention with serious complications. The most severe complications of this type of surgery remain the intra and psotoperative bleeding and the urianry sepsis.

If the urinary sepsis can be managed in a conservative manner due to targeted

antiobiotherapy, rarely imposing a surgical procedure for removing the infectious hotspot, the bleeding which occur during or after percutaneous nephrolithotomy still command a surgical intervention for accomplishing hemostasis, often by losing the treated kidney by salvage nephrectomy. The hemorrhage incidence which requires blood transfusion varies in many studies between 7 and 25% of cases.

With all the progress of the surgical instrumenst (the miniaturization of the nephroscopes and Amplatz sheats) and the surgical technique evolution (percutaneous nephrolithotomy in supine or lateral position supinație sau decubit lateral, endoscopic combined intrarenal surgery) the bleeding reamins the more frequent serious complication of the percutaneous nephrolithotomy.

This study has its limits - is a retrospective study conducted on a medium numabr of patients. More randomised clinical trials are required in order to establish the clear role of the tranexamic acid as an antifibrinolytic drug in the prevention of hemorrhagic complications during percutaneous nephrolithotomy.

Also there are needed more randomiased clinical trials to evaluate the adverse events for the systemic use of tranexamic acid, especially regarding the possible thromboembolic events, complication with a major impacy on the evolution of the patient.

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