STONE CLEARANCE RATE OF PERCUTANEOUS NEPHROLITHOTOMY WITH INTRAOPERATIVE FLEXIBLE NEPHROSCOPY AT IIUM MEDICAL CENTRE, KUANTAN, PAHANG

BY

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ABSTRACT

Percutaneous Nephrolithotomy (PCNL) is mainstay management of large renal stone. The advent of flexible nephroscopy during PCNL has improved its stone clearance rate in many literature reviews. This study aims to look for stone clearance rate of PCNL in IIUM Medical Centre, a teaching hospital with intra-operative flexible nephroscopy (IFN). A single-centre, cross-sectional study was conducted in all patients who underwent PCNL with IFN between December 2017 to October 2020. All patients that had IFN performed during PCNL recruited (n=19). We looked at our local stone clearance rate and factors that contribute to stone clearance and evaluate the complications rate, hospitalization period with IFN during PCNL. The stone clearance rate is 74%. We analysed the demographics (gender, ethnicity, comorbid), stone profile (size, counts, location, appearance), intraoperative puncture for nephrolithotomy access were not significantly associated with stone clearance rate. Mean duration for op was 146 minutes and about three-quarter of our patient had three days or less of hospitalization. In our sub-analysis of the detection rate of residual stone, we found that IFN can increase to detection rate up to 37% (n=7) and hence increased the final stone clearance rate about 16%. The increased detection rate of residual stone during PCNL with IFN is statistically significant with stone clearance rate (p=0.2) by bivariate analysis. A further analysis of the association of stone profile with increased detection rate of residual stone was not statistically significant. In conclusion, in our study, IFN proved to significantly detect residual stone during PCNL and improved stone clearance rate. The finding is crucial, where IFN able to facilitate in achieving maximal stone clearance in a staghorn or complex renal stone disease as it helps to alleviate the patients from the complication of renal stone such worsening renal function, recurrent pain and infection and may help to improve quality of life after PCNL.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of General Surgery.

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Islah Munjih Ab Rashid
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Dean, Kulliyyah of Medicine

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Mohd Fahmi Abd Aziz

Signature ..... Date 24/06/2022

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This thesis is dedicated to my parents, my wife, my siblings whose support has always been unwavering, whose patience, endless and whose love, unconditional.

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LIST OF ABBREVIATIONS

IFN	Intraoperative Flexible Nephroscopy
PCNL	Percutaneous Nephrolithotomy
KDIGO	Kidney Disease Improving Global Outcome
SCR	Stone Clearance Rate
SWL	Shockwave Lithotripsy
AKI	Acute Kidney Injury
BMI	Body Mass Index
UTI	Urinary Tract Infection
eGFR	estimated Glomerular Filtration Rate
CTU	Computer Topogram Urography
KUB	Kidney, Ureter, Bladder

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Percutaneous Nephrolithotomy (PCNL) has been first described in the literature in 1970s (Patel & Nakada, 2015). It involved serial dilatation of renal calyces over several days before stone was extracted with technique of dormia basket. Later with advent of modern operative device, advancement in radiological imaging and high success rate for dealing with high stone burden has put PCNL as standard operative management for large renal stone (more than 2cm) and management of staghorn calculi (stone that occupies pelvis and one or more renal calyces) (Harraz et al., 2017). A standard stone clearance rate post-conventional PCNL reaches about 60-70% (Gücük, Kemahlı, et al., 2013) in a small prospective study.

Intraoperative flexible nephroscopy later introduced as an adjunct at PCNL to improve stone clearance (Gücük et al., 2013).

1.2 RESEARCH QUESTION

i. Is introduction of intraoperative flexible nephroscopy (IFN) at percutaneous nephrolithotomy (PCNL) improve stone clearance rate?

ii. Has intraoperative flexible nephroscopy (IFN) similar complication rate as conventional PCNL?

iii. Is intraoperative flexible nephroscopy at PCNL cost effective?

1.3 RESEARCH OBJECTIVE

1.3.1 Primary Objective

To determine stone clearance-rate (SCR) after introduction of intraoperative flexible nephroscopy (IFN) at Percutaneous Nephrolithotomy (PCNL).

1.3.2 Secondary Objectives

i. To evaluate common postoperative complications, after percutaneous nephrolithotomy with IFN.

ii. To evaluate the operative time and postoperative length of stay in PCNL with IFN.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Malaysia is located within the stone forming belt stretch which comprise of West Asia, Southeast Asia, South Asia and South Korea and Japan. The prevalence of urolithiasis in this stretch belt ranging between 5%- 19% (Y. Liu et al., 2018). A retrospective study in Hospital Universiti Sains Malaysia in Kelantan, Malaysia concluded prevalence in patient diagnosed with urolithiasis treated at their centre was 1.8% (Nouri & Hassali, 2018).

2.2 DEFINITION

Standard PCNL involves a retrograde pyelogram procedure (RPG) to assess the radiopaque stone intraoperatively before commencement of the PCNL procedure. The patient is positioned either prone or supine for the next part of PCNL procedure. The renal calyces is percutaneously assessed via catheter sheath using rigid nephroscopy and clearance with ultrasonic stone extractor. Then clearance is determined with visual stone disappearance through rigid nephroscope and no evidence of filling defect at fluoroscopy before the nephrostomy tube is inserted to allow for access for subsequent second look procedure to be performed if residuals present postoperatively. Currently, the adjunct intraoperative flexible nephroscopy is not commonly done at PCNL.

There was no significant difference in term of stone clearance rate (SCR), length of stay and common complication (bleeding, infection) between the surgical approach of prone or supine for PCNL except only longer operative duration in the prone group but with better exposure at PCNL for all renal calyces (Mak et al., 2016).

Nonetheless, despite satisfactory stone clearance rate at standard PCNL, an auxiliary procedure such as ESWL or second look nephroscopy is required to achieve clinically significant stone clearance rate in standard PCNL procedure using rigid nephroscope. This auxiliary procedure comes at the expense of risk associated with procedures and contributes to longer hospital stay post PCNL before second look PCNL with flexible nephroscopy is taken place (Ganpule & Desai, 2009). Knudsen proposed using flexible nephroscopy in PCNL to reduce the need for second-look procedure to achieve a good stone clearance rate (Knudsen, 2009).

A prospective randomised trial in Europe had been performed in stone size (mean value of 770mm2), and the study revealed a clearance rate as high as 95% post intraoperative flexible nephroscopy in comparison to the PCNL alone which achieved of 70% clearance rate followed up with radio-imagings at 3months postoperative (Gücük, Kemahlı, et al., 2013).

2.3 OUTCOME

The success of PCNL is primarily defined by stone-clearance status. In turn, stone-clearance status affected by its location (Turna, Umul, et al., 2007). The most common site for residual stone is at lower calyces in both staghorn and large renal stone (Portis et al., 2006). Portis et al. reported that high-resolution fluoroscopy, combined with flexible nephroscopy increased the rates of detecting and treating residual stones (Portis et al., 2006).

Pertinent to this issue, intraoperative flexible nephroscopy is introduced at the same setting of PCNL. Many retrospective studies specifically looking at the introduction of examination via flexible nephroscopy at the end of PCNL concluded better stone clearance rate postoperatively, (Gücük, Kemahlı, et al., 2013) (Goktug et al., 2015b).

Also, it reports early hospital discharge and low complication rate such as infection and bleeding (Goktug et al., 2015b). It also revealed that second look flexible nephroscopy postoperatively has not cost advantageous in smaller stone residual measures less <4mm when the patient has to stay longer in hospital.

2.4 COMPLICATIONS

PCNL is generally a safe treatment option with low but specific complications (Michel et al., 2007). Bleeding at PCNL commonly from the nephrostomy tract itself. Bleeding can be prevented by strictly puncturing at calyx and using flexible nephroscope to avoid extensive angulation (Michel et al., 2007). On the other side, septicemia can occur because of surgical access or if the stone is infected. Patient with preoperative renal insufficiency has increased risk of septicaemia postoperatively (Michel et al., 2007). Thus, in all PCNL cases, prophylactic antibiotic is mandatory. Urosepsis is defined as urinary tract infection that is life-threatening with organ dysfunction caused by a dysregulated host response to infection, and it accounts for up to 20-30% of sepsis cases (Bonkat et al., 2019). Sepsis post nephrolithotomy however ranging between 0.97% to 4.7%.

CHAPTER THREE

METHODOLOGY

3.1 STUDY DESIGN

3.1.1 Study Type

A single centre cross-sectional study that involved all patients that underwent Percutaneous Nephrolithotomy with intraoperative flexible nephroscopy.

3.1.2 Study Area

This study was conducted at IIUM Medical Centre (Sultan Ahmad Shah Medical Centre @ IIUM) Kuantan, Pahang.

3.1.3 Study Period

The study period was from December 2017 to October 2020.

3.2 SELECTION CRITERIA

3.2.1 Target Population

All patients who attended the urology clinic at IIUM Medical Centre for renal stone required PCNL operative intervention as a treatment mode.

3.2.2 Study Population

All urology patients diagnosed with renal stone and indicated for PCNL procedure between December 2017 and October 2020.

3.2.3 Sampling

Sampling was performed based on universal sampling for this cross-sectional study. Data was recorded in all patients who underwent PCNL and Intraoperative Flexible Nephroscopy.

3.2.4 Inclusion Criteria

All patients that underwent PCNL with intraoperative flexible nephroscopy between December 2017 and October 2020.

3.2.5 Exclusion Criteria

The subject that PCNL was not attempted by the surgeon given failed cannulation tract to PCNL, presence of pus intraoperative and bleeding that obscured vision at PCNL.

3.2.6 Sample Size

This study's sample was a universal sampling of all patients who underwent the PCNL within the stipulated period.

3.3 DATA COLLECTION

3.3.1 Study Instrument

This study used cross-sectional data collection method. Each patient who met the following inclusion criteria identified, and all the data will be recorded in the customised form.

3.3.2 Validity And Reliability

In addition to the observation of patient clinical condition at the time of presentation, the data obtained from the patient's medical record to ensure the data's validity. Each data was recorded by trained medical personnel in the urology unit.

3.4 FLOWCHART

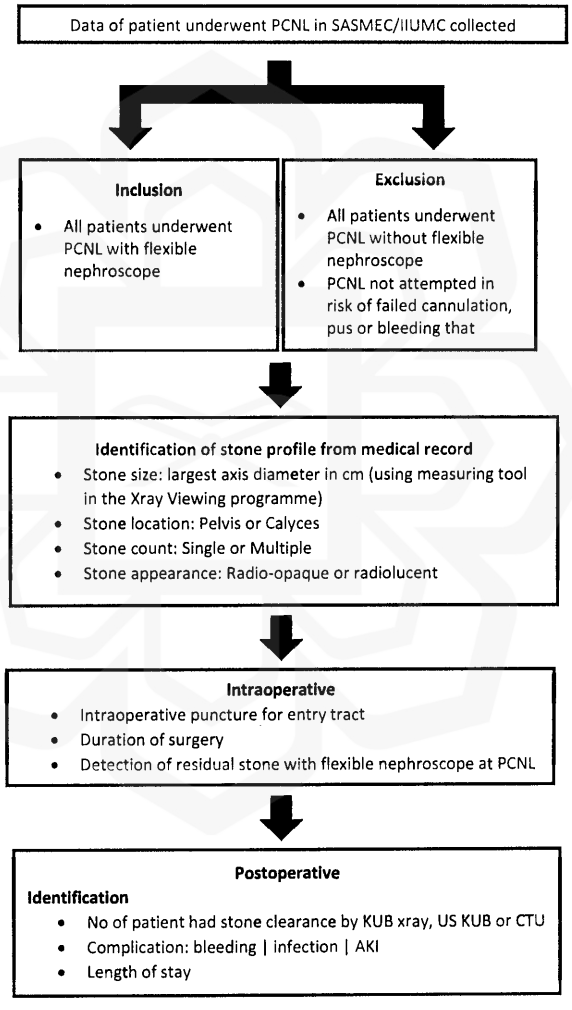

Figure 1: Study Flowchart

3.5 OUTCOME VARIABLE

3.5.1 Stone Clearance Rate

The stone clearance rate is achieved when the residual stone ≤ 4mm that assessed by either postoperative KUB x-ray, US KUB or CTU.

3.5.2 Demographic

All demographic data collected from the medical notes. Demographics include Gender, Age, Co-morbid (Diabetes Mellitus, Hypertension).

3.5.3 Stone Profile and Perioperative Imaging

Patients underwent PCNL had their stone size, location, and counts assessed by CTU preoperatively (grouped as stone profile) as in other standard PCNL workups. Ultrasound (US) KUB performed by credential sonographer for stone size measurement for radiolucent stone. Xray KUB otherwise, was performed in radiopaque stone and measured via computerised imaging system.

Residual stone was assessed by US KUB, Xray KUB or CTU postoperative for clearance.

3.5.4 Intraoperative Puncture

The number of punctures required to access the renal system during PCNL for stone fragmentations and clearance using a pneumatic lithotripter, laser, or ultrasonic device.

3.5.5 Operative Duration

The timing of PCNL was measured from the beginning of needle puncture until the insertion of a nephrostomy tube as the end of the procedure.

3.5.6 Postoperative Complications

a. Bleeding postoperative in subject who required pack cells transfusion determined by operating surgeon and clinically significant drop in Hemoglobin.

b. Infection postoperative was when the subject treated as urosepsis post PCNL.

c. Acute kidney injury (AKI) as defined by KDIGO classification where we employed serum elevation of more 1.5x the baseline or increment by 26.5umol/L. Postoperative complications will be graded based on the Clavien - Dindo classification.

3.5.7 Length Of Stay

Length of stay was calculated in days, from the postoperative period until discharge.

3.6 STUDY VARIABLE

Demographic Variables

- Age
- Gender
- Sex
- Race
- Risk Factors (comorbidities)

Outcome Variables

- Stone clearance
- Postoperative bleeding- that required blood transfusion.
- Postoperative Acute Kidney Injury.
- Postoperative infection (urosepsis).
- Period of stay in the hospital for treatment.

STUDY OUTCOME

The outcomes of the study include:

1. Rate of stone clearance after the introduction of intraoperative flexible nephroscopy at PCNL.
2. Stone profiles effect on stone clearance rate.
3. The improve of the residual stone detection rate of flexible nephroscopy during PCNL.
4. Postoperative Acute Kidney Injury. (Number of patients with postoperative AKI based on the change in serum creatinine level based on KDIGO classification.).
5. Postoperative bleeding. (Number of patients who had a significant reduction in Haemoglobin level and required blood transfusion).
6. Postoperative infection. (Number of patients that developed urosepsis postoperative and treated).
7. Length of stay. (Number of days patient admitted after the procedure until discharge).

3.7 DATA ANALYSIS

The collected data were analysed using IBM SPSS Statistics (Version 26). The stone clearance rate and stone detection rate in this PCNL study with flexible nephroscopy was recorded in frequency and percentage. The association of stone profile, intraoperative puncture, and increment of stone detection rate with stone clearance were analysed using the Fisher exact, Chi-square. The association between stone clearance with outcomes of PCNL with intraoperative flexible nephroscopy were analysed using Pearson's Chi-square test. A p-value of <0.05 was considered statistically significant.