UROLOGYPRACTICE

urologypracticejournal.com

Prospective Evaluation of Learning Curve of Urology Residents for Percutaneous Nephrolithotomy

Amit Garg,* Sher S. Yadav, Vinay Tomar, Shivam Priyadarshi, Vikas Giri, Nachiket Vyas and Neeraj Agarwal

From the Sawai Man Singh Medical College, Jaipur, Rajasthan, India

Abstract

Introduction: We studied the learning curve for percutaneous nephrolithotomy of urology residents according to stone complexity.

Methods: The learning curve of 8 residents with no previous experience of solo percutaneous nephrolithotomy was studied. Stones were classified according to complexity using the Guy stone score. Competence was reviewed using 4 markers, namely operative time, fluoroscopic time, complication rate using the modified Clavien grading system and success rate. Analysis was done in 3-month cohorts to determine how and when competence and excellence were achieved during 1 year of training for various grades of stone. The results of resident surgeons were compared with those of experienced endourologist.

Results: Resident surgeons achieved a plateau in mean operative time and fluoroscopic time for grade I stones after 30 to 35 cases but not for more complex stones. Similarly complications were decreased significantly only in grade I stone cases. Resident surgeons also achieve an almost excellent success rate of 87% for grade I stones only.

Conclusions: This study of the learning curve of residents suggests that competence and near excellence is reached after 30 to 35 cases for grade I stones. However the learning curve for complex stones (grades II to IV) is steeper and requires more experience.

Key Words: kidney calculi; internship and residency; nephrostomy, percutaneous; clinical competence; task performance and analysis

Abbreviations and Acronyms

GSS = Guy stone score

PCN = percutaneous nephrostomy

PCNL = percutaneous nephrolithotomy

Percutaneous nephrolithotomy is considered the treatment of choice for large renal stones (greater than 2 cm). PCNL is one of the difficult surgeries with long learning curve.[1]

To devise an optimum training program for PCNL its learning curve needs to be defined and determined. Learning curve has been defined as a concept that

Submitted for publication April 16, 2015.

No direct or indirect commercial incentive associated with publishing this article.

The corresponding author certifies that, when applicable, a statement(s) has been included in the manuscript documenting institutional review board, ethics committee or ethical review board study approval; principles of Helsinki Declaration were followed in lieu of formal ethics committee approval; institutional animal care and use committee approval; all human subjects provided written informed consent with guarantees of confidentiality; IRB approved protocol number; animal approved project number.

* Correspondence: Sawai Man Singh Medical College, Jaipur, Rajasthan, India (telephone; +918290775775; FAX: +911412619171; *e-mail address:* doctoramit1@gmail.com).

2352-0779/16/33-1/0 http://dx.doi.org/10.1016/j.urpr.2015.06.009
UROLOGY PRACTICE Vol. 3, 1-6, May 2016

Published by Elsevier

graphically represents surgeon performance by time.[2,3] Learning and competence are defined as the point at which the slope of the line changes and the point at which no further improvement is seen, respectively.[2–4] Only limited studies have investigated this and sparse data are available on the PCNL learning curve.[1–5] These studies used operative time and fluoroscopic time to determine the learning curve of a single surgeon without considering the complexity of stones.[3,5] However they are not the best indicators of clinical competence and still no consensus has been reached regarding the best practical clinical surrogate markers of performance in PCNL.[1,3,5] Moreover in these studies complications were described as minor and major only, and informative comparison of complications was lacking.[2]

We performed the current study at our institution with the aim of evaluating the PCNL learning curve of urology residents according to stone complexity based on the validated GSS.[6] This was done using various indicators of surgical performance, including total operative time, fluoroscopic time, success rate and complication rate.

Materials and Methods

The study was performed from July 2013 to June 2014 at our institution, which is a tertiary referral center with a high load of various urological procedures. An average of 5 or 6 PCNL operations are done each working day. Our department has an apprenticeship based working protocol for resident training in PCNL. The first year resident observes and assists the senior fellow with fluoroscopic guided PCN. The second year resident performs PCN independently and assists senior fellows with the PCNL procedure. The third year resident assists consultants and performs PCNL under supervision. Each third year resident performs about 30 to 35 PCNL cases under supervision.

This study was done in 8 third year urology residents who performed supervised operations. These resident had no previous experience with performing PCNL but they were experienced with fluoroscopy guided PCN. Only adult patients without any major comorbid illness were included in our study because resident physicians usually operate on simpler cases.

Preoperative routine investigations included a complete hemogram, serum creatinine, bleeding and coagulation profiles, and urine culture. The radiological investigations were ultrasonography, x-ray of the kidneys, ureters and bladder, excretory urography and as needed noncontrast computerized tomography. Stones were classified using GSS as grade I, II, III and IV (see Appendix).[6]

The operation was performed as the standard procedure practiced in our department. Under epidural/general anesthesia the patient was placed prone and pressure points were padded. The pelvicalyceal system was opacified by contrast agent and/or air using a ureteral catheter via a retrograde approach or by an antegrade route using stone guided puncture with a 22 gauge spinal needle under fluoroscopic guidance. The desired calyx was punctured with an 18 gauge initial puncture needle. As needed a supracostal puncture was made.

The tract was dilated by Alken telescopic metallic dilators over a j-tip polytetrafluoroethylene coated guide wire. After Amplatz sheath insertion nephroscopy was performed and stones were removed intact or after fragmentation. The procedure was completed with insertion of a 16Fr nephrostomy tube. A Double-J® stent was placed depending on need and surgeon decision.

Patients were followed by x-ray or ultrasonography of the kidneys, ureters and bladder at the time of discharge home. Data recorded included age, gender, stone size (calculated as the product of 2 maximal dimensions of the stone on preoperative x-ray), stone complexity (using GSS), puncture site (supracostal or infracostal), total operative time (defined as the time from the beginning of the pyelogram to nephrostomy tube placement), fluoroscopy time (total time of fluoroscopy use during the procedure), complications (using the modified Clavien grading system)[7] and success rate.

Failure criteria were any residual stone other than clinically insignificant residual stone fragments, defined as less than 4 mm, nonobstructive, noninfectious and asymptomatic residual fragments,[8] and a procedure in which the consultant had to scrub due to intraoperative difficulties faced by residents. In cases in which failure was due to mid time consultant intervention the total operative time and fluoroscopic time were considered up to the point at which the consultant intervened.

To compare outcomes between experienced and resident surgeons we also collected the same data on a senior consultant who had performed PCNL for more than 15 years, including cases done only by consultants. Outcomes were assessed according to stone complexity using the validated GSS system.[6] Total operative time, fluoroscopic time, complications and stone clearance rate were compared among various groups.

For statistical analyses SPSS® was used. All data are expressed as the mean ± SD. Total operative time and fluoroscopic time among cohorts were compared by ANOVA. Complication and success rate were compared by the chi-square test with $p < 0.05$ considered statistically significant.

Results

A total of 248 adult patients were operated on by 8 third year residents during the study period. The 1-year study