# Trainee-Associated Factors and Proficiency at Percutaneous Nephrolithotomy

**Seyed Mohammad Kazem Aghamir[1], Negar Behtash[1], Morteza Hamidi[1,2], Hasan Farahmand[1], Alborz Salavati[1], and Sara Mortaz Hejri[3]**

[1] *Department of Urology, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran*

[2] *Department of Urology, AJA University of Medical Sciences, Tehran, Iran*

[3] *Department of Medical Education, Helath Professions Education Research Center, Tehran University of Medical Sciences, Tehran, Iran*

***Received: 05 Jul. 2016; Accepted: 13 Apr. 2017***

**Abstract-** Percutaneous nephrolithotomy (PNL) is a complicated procedure for urology trainees. This study was designed to investigate the effect of trainees' ages and previous experience, as well as the number of operated cases, on proficiency at PNL by using patient outcomes. A cross sectional observational study was designed during a five-year period. Trainees in PNL fellowship programs were included. At the end of the program, the trainees' performance in PNL was assessed regarding five competencies and scored 1-5. If the overall score was 4 or above, the trainee was considered as proficient. The trainees' age at the beginning of the program and the years passed from their residency graduation were asked and recorded. Also, the number of PNL cases operated by each trainee was obtained via their logbooks. The age, years passed from graduation, and number of operated cases were compared between two groups of proficient and non-proficient trainees. Univariate and multivariate binary logistic regression analysis was applied to estimate the effect of aforementioned variables on the occurrence of the proficiency. Forty-two trainees were included in the study. The mean and standard deviation for the overall score were 3.40 (out of 5) and 0.67, respectively. Eleven trainees (26.2%) recognized as proficient in performing PNL. Univariate regression analysis indicated that each of three variables (age, years passed from graduation and number of operated cases) had statistically significant effect on proficiency. However, the multivariate regression analysis revealed that just the number of cases had significant effect on achieving proficiency. Although it might be assumed that trainees' age negatively correlates with their scores, in fact, it is their amount of practice that makes a difference. A certain number of cases is required to be operated by a trainee in order to reach the desired competency in PNL.

© 2017 Tehran University of Medical Sciences. All rights reserved.

*Acta Med Iran* 2017;55(7):459-463.

**Keywords:** Percutaneous nephrolithotomy; Proficiency; Education

## Introduction

The prevalence of renal stones has been reported as 0.9% in 15 to 29-year-old adults, and 8.2% in those aged 60 to 69 years (1), and percutaneous nephrolithotomy (PNL) is the standard procedure for more than 85% of all renal stones that are not manageable by less invasive shockwave lithotripsy or retrograde access techniques (2). Since PNL is a complicated procedure with several steps (3), many centers have adopted PNL training as a standard part of the urology residency program. Yet, for many urologists in-practice, fellowship training is needed, if they are going to deliver standard care independently.

Several studies have proposed and evaluated different training courses for PNL (4-6). Also, many other researchers have investigated the PNL learning curve and suggested that a certain number of PNL cases should be operated by a trainee to achieve the desirable competency (7-10). While in one of these studies, learning according to stone complexity has been inspected (11), to the best of our knowledge, none of the aforementioned studies have examined the effect of trainee associated factor, namely, age and surgeon experience, on PNL learning outcomes.

It should be mentioned that the association between clinicians' age and patient outcomes have been widely evaluated in different settings, including primary care environment or surgical units. Several studies suggest that older physicians and surgeons, compared to their younger colleagues, are more likely to show poorer performance (12-15). However, these investigations

**Corresponding Author:** S. Mortaz Hejri
Department of Medical Education, Helath Professions Education Research Center, Tehran University of Medical Sciences, Tehran, Iran
Tel: +98 21 88955712, Fax: +98 21 88955016, E-mail address: smortaz@tums.ac.ir

have been conducted after the clinicians started their independent practice as a health care provider, and not during the educational program.

The current study was designed to investigate the effect of trainees' ages and previous experience, as well as the number of operated cases, on proficiency at PNL by using patient outcomes.

## Materials and Methods

A cross sectional observational study was designed during a five-year period, from 2010 to 2015. The study population consisted of the trainees in PNL fellowship programs from two different centers (an academic center and a private one) in Tehran. Both centers delivered the same educational program, in which standard PNL and tubeless variants were performed in prone position under fluoroscopic retrograde pyelogram using triangulation and biplanar techniques.

At the end of the program, each trainee's performance in PNL was observed and assessed regarding five competencies. Each competency was scored from 1-5 by a supervisor (Table 1).

**Table 1. Definition of five competencies in performing PNL and the criteria for their assessment**

| Number | Competency | Definition | Likert |
|---|---|---|---|
| **1** | Selecting the proper patient | The trainees' clinical judgment to offer the PNL procedure for patients to whom the surgery is more beneficent than other modalities. | Poor=1<br>Bad=2<br>Fair=3<br>Good=4<br>Excellent=5 |
| **2** | Pre-operative preparations | Elective and emergent scheduling of prerequisite surgical procedures (e.g. stenting and nephrostomy), operation room setup and patient positioning. | Poor=1<br>Bad=2<br>Fair=3<br>Good=4<br>Excellent=5 |
| **3** | Dexterity | 3-1) Access acquisition<br>3-2) Lithotripsy and stone clearance. | Poor=1<br>Bad=2<br>Fair=3<br>Good=4<br>Excellent=5 |
| **4** | Request for help | According to the trainee's request for supervisor intervention | Routinely=1<br>Often=2<br>Sometimes=3<br>Rarely=4<br>Never=5 |
| **5** | Postoperative management | Ability to deliver standard care in case of postoperative complications | Poor=1<br>Bad=2<br>Fair=3<br>Good=4<br>Excellent=5 |

An overall score was reported by calculating the average of the five scores. The trainees with the overall score of 4 or above were considered as competent and were granted permission to perform PNL independently.

In addition, the trainees' age at the beginning of the program and the years passed from their residency graduation were asked and recorded. Since trainees were obligated to document their surgeries during the program, the number of PNL cases operated by each trainee was obtained via their logbooks.

### Statistical analysis

Means and standard deviations (SD) were reported for continuous variables, and frequency and percentage were calculated for discrete data. Independent t-test and Chi-square analysis were conducted to compare proficient and non-proficient groups. The correlations between trainees' scores with trainees' age, the years passed from their graduation, and the number of operated cases were calculated by Pearson correlation coefficient. In addition, univariate and multivariate binary logistic regression analysis was applied to estimate the effect of aforementioned variables on the occurrence of the proficiency. The significance level and the confidence interval (CI) were considered as 0.05 and 95%, respectively. Statistical analyses were performed using SPSS software Version 15 (SPSS Inc., Chicago, IL).

## Results

Over a five-year period, 48 male trainees from an academic center and a private clinic were identified, from whom 42 trainees were included in the study. The mean of age was found to be 41.6 years (SD=8.4). An average of 8.5 years (SD=5.7) had been passed from the trainees' graduation. The average number of operated cases by each trainee was 51.35 with a minimum and maximum of 24 and 110, respectively (Table 2).

**Table 2. Comparison of age, years passed from graduation, and number of operated cases in the proficient and non-proficient groups**

| Variable | | Minimum | Maximum | Mean | SD | *P* |
|---|---|---|---|---|---|---|
| **Age (years old)** | **All trainees (N=42)** | 28.00 | 60.00 | 41.67 | 8.41 | <0.001* |
| | **Proficient (N=11)** | 31.00 | 39.00 | 34.00 | 2.79 | |
| | **Non-proficient (N=31)** | 28.00 | 60.00 | 44.39 | 8.06 | |
| **Years passed from graduation** | **All trainees (N=42)** | 0 | 23 | 8.55 | 5.78 | <0.001** |
| | **Proficient (N=11)** | 1 | 7 | 3.18 | 2.27 | |
| | **Non-proficient (N=31)** | 0 | 23 | 10.45 | 5.45 | |
| **Cases number of operated** | **All trainees (N=42)** | 24 | 110 | 51.35 | 20.34 | 0.002** |
| | **Proficient (N=11)** | 37 | 110 | 71.81 | 22.40 | |
| | **Non-proficient (N=31)** | 24 | 61 | 44.09 | 13.80 | |

* T-test
** Chi-square

The trainees' mean scores (out of 5) in different competencies of PNL were as follows: selecting the proper patient: 3.60 (SD=0.73), pre-operative preparations 3.90 (SD=0.61), percutaneous renal access 3.21 (SD=0.71), lithotripsy 3.17 (SD=1.03), need for help 3.00 (SD=1.18), and postoperative management 3.52 (0.59). The minimum, maximum, mean, and SD for the overall score were 2.17, 4.67, 3.40 and o.67, respectively (Table 3).

**Table 3. Trainees' scores in different PNL competencies and their correlations to trainees' age, years passed from their graduation, and the number of operated cases**

| Competency | Score mean (Standard deviation) | Correlation with age (*P*) | Correlation with years passed from graduation (*P*) | Correlation with the number of operated cases (*P*) |
|---|---|---|---|---|
| **Selecting the proper patient** | 3.60 (0.73) | -0.33 (0.031) | -0.33 (0.032) | 0.01 (0.950) |
| **Pre-operative preparations** | 3.90 (0.61) | -0.47 (0.002) | -0.43 (0.004) | 0.20 (0.185) |
| **Dexterity: percutaneous renal access** | 3.21 (0.71) | -0.53 (<0.001) | -0.57 (<0.001) | 0.39 (0.010) |
| **Dexterity: lithotripsy** | 3.17 (1.03) | -0.46 (0.002) | -0.51 (<0.001) | 0.50 (0.001) |
| **Need for help** | 3.00 (1.18) | -0.35 (0.023) | -0.37 (0.014) | 0.38 (0.012) |
| **Post-operative management** | 3.52 (0.59) | -0.36 (0.016) | -0.41 (0.007) | 0.46 (0.002) |
| **Overall score** | 3.40 (0.67) | -0.50 (<0.001) | -0.53 (<0.001) | 0.41 (0.006) |

Considering the proficiency outcome, it was noted that at the end of the standard program, just 11 trainees (26.2%) were recognized as fully competent in performing PNL. Results of the comparison between proficient and non-proficient groups have been presented in table 2. It can be seen that age and also the average years passed from graduation differed significantly among two groups (for both $P<0.001$). Also, the average number of operated cases in the proficient group was 71.81, while non-proficient trainees operated 44.0 patients ($P=0.002$).

There was a statistically significant negative

correlation between trainees' overall score and their age (r = −0.50, *P*=0.001), as well as the number of years passed from their graduation (r=-0.53, *P*<0.001). It was noted that the correlation coefficient between trainees' score and the number of operated cases was positive and significant (r=0.41, *P*=0.006). The obtained correlation coefficients for each competency score and the above-mentioned variables are summarized in Table 3.

Findings of univariate regression analysis indicated that each of three variables (age, years passed from graduation, and number of operated cases) had statistically significant effect on proficiency (*P*=0.010, 0.003, and 0.002, respectively). Therefore, the multivariate regression analysis was conducted including all three variables. This analysis revealed that the odds of achieving proficiency increases by 12% (*P*=0.022) by any increase in the "number of operated cases". The age and years passed from graduation decreased the odds, but none of them had significant contribution (Table 4).

**Table 4. The effects of three independent factors on the proficiency outcome according to the univariate and multiple logistic regression analysis**

| | Univariate regression | | | Multiple regression | | |
|---|---|---|---|---|---|---|
| **Independent factor** | **Odds ratio** | **95% Confidence interval** | ***P*** | **Odds ratio** | **95% Confidence interval** | ***P*** |
| **Age** | 0.78 | 0.66-0.92 | 0.003 | 0.84 | 0.58-1.22 | 0.382 |
| **Years passed from graduation** | 0.67 | 0.52-0.87 | 0.002 | 0.81 | 0.48-1.36 | 0.434 |
| **Cut-off score** | 1.12 | 1.02-1.22 | 0.010 | 1.12 | 1.01-1.23 | 0.022 |

## Discussion

According to the findings of this study, trainees' age, years passed from graduation, and number of operated cases (when investigated individually), showed statistically significant correlation with trainees' score in the PNL. However, the only statistically significant contribution to the occurrence of proficiency at PNL was found to belong to the number of operated cases by each trainee.

The study results reveal that although it might be assumed the younger trainees have better performance at PNL, in fact, it is their amount of practice that matters. Ng by conducting a review of the current literature stated that since PNL is a complicated procedure, a certain number of cases should be operated by a trainee in order to reach the necessary experience and skills (16).

Several studies determined the minimum number of PNL operations required to achieve competence. Allen *et al.*, suggested that the mean surgery time of the novice surgeon fell to a plateau after 60 cases (7). Tanriverdi *et al.*, indicated that no decrease in the operation time was observed after case 60 (8). Ziaii and colleagues reported that the absence of complications was achieved after only 45 cases (9). Garg *et al.*, who studied the learning curve of 8 residents for PNL according to stone complexity, concluded that residents achieved competence in grade I stones after 30 to 35 operations, and more cases were needed for more complex stones (11). According to Song *et al.*, competence at performing ultrasound-guided PNL was reached after 60 cases (16). However, in our study, the non-proficient group had performed an average of 44 PNL surgeries that is fewer than the recommended cases. Interestingly, the older trainees in our study performed fewer surgeries than younger ones, and we could not find any particular reason for that. Perhaps these groups count on their previous experience and overestimate their abilities. However, according to the findings of this study, it seems that skills and competencies required for PNL are specific and have not being influenced by surgeon experience at general urology. Therefore, it deems necessary for program directors to assure the quality of training program specifically for this group of trainees. It should be noted that in a standard training program, the number of operated cases by each trainee has to be monitored and documented carefully.

Considering the outcome measures, this study had some limitations. Namely, surgery time could be a valuable outcome but was not investigated in our study. Also, the long-term patients' survival and complication rates could have been considered as the objective and important patient care outcomes.

Although it might be assumed that trainees' age negatively correlates with their scores, in fact, it is their amount of practice that makes a difference. A certain

number of cases are required to be operated by a trainee in order to reach the desired competency in PNL.

## References


1. Safarinejad MR. Adult urolithiasis in a population-based study in Iran: prevalence, incidence, and associated risk factors. Urol Res 2007;35:73-82.
2. Aghamir SM, Salavati A, Aloosh M, Farahmand H, Meysamie A, Pourmand G. Feasibility of totally tubeless percutaneous nephrolithotomy under the age of 14 years: a randomized clinical trial. J Endourol Soc 2012;26:621-4.
3. Ko R, Soucy F, Denstedt JD, Razvi H. Percutaneous nephrolithotomy made easier: a practical guide, tips and tricks. BJU Int 2008;101:535-9.
4. de la Rosette JJ, Laguna MP, Rassweiler JJ, Conort P. Training in percutaneous nephrolithotomy--a critical review. Eur Urol 2008;54:994-1001.
5. Mishra S, Jagtap J, Sabnis RB, Desai MR. Training in percutaneous nephrolithotomy. Curr Opin Urol 2013;23:147-51.
6. Kallidonis P, Kyriazis I, Vasilas M, Panagopoulos V, Georgiopoulos I, Ozsoy M, et al. Modular training for percutaneous nephrolithotripsy: The safe way to go. Arab J Urol 2015;13:270-6.
7. Allen D, O'Brien T, Tiptaft R, Glass J. Defining the learning curve for percutaneous nephrolithotomy. J Endourol Soc 2005;19:279-82.
8. Tanriverdi O, Boylu U, Kendirci M, Kadihasanoglu M, Horasanli K, Miroglu C. The learning curve in the training of percutaneous nephrolithotomy. Eur Urol 2007;52:206-12.
9. Ziaee SA, Sichani MM, Kashi AH, Samzadeh M. Evaluation of the learning curve for percutaneous nephrolithotomy. Urol J 2010;7:226-31.
10. Song Y, Ma Y, Song Y, Fei X. Evaluating the Learning Curve for Percutaneous Nephrolithotomy under Total Ultrasound Guidance. PloS One 2015;10:e0132986.
11. Garg A, Yadav SS, Tomar V, Priyadarshi S, Giri V, Vyas N, et al. Prospective Evaluation of Learning Curve of Urology Residents for Percutaneous Nephrolithotomy. Urol Pract 2016;3:230-5.
12. Waljee JF, Greenfield LJ, Dimick JB, Birkmeyer JD. Surgeon age and operative mortality in the United States. Ann Surg 2006;244:353-62.
13. Ho JD, Kuo NW, Tsai CY, Liou SW, Lin HC. Surgeon age and operative outcomes for primary rhegmatogenous retinal detachment: a 3-year nationwide population-based study. Eye 2010;24:290-6.
14. Chai CY, Chen CH, Lin HW, Lin HC. Association of increasing surgeon age with decreasing in-hospital mortality after coronary artery bypass graft surgery. World J Surg 2010;34:3-9.
15. Waljee JF, Zhong L, Shauver MJ, Chung KC. The influence of surgeon age on distal radius fracture treatment in the United States: a population-based study. J Hand Surg 2014;39:844-51.
16. Ng CF. Training in percutaneous nephrolithotomy: The learning curve and options. Arab J Urol 2014;12:54-7.