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Hands on wet lab and live surgery training in PCNL: Any impact to surgical skills of attending surgeons?

Iason Kyriazis [1], Panagiotis Kallidonis [1], Eleni Kyrkopoulou [2], Theodoros Spinos [1], Evangelos Liatsikos [1]

[1] Department of Urology, University of Patras, Greece;
[2] Department of Economics, Athens University of Economics and Business, Greece.

Summary *Objectives: The clinical value and efficiency of hands-on training courses in percutaneous nephrolithotomy (PCNL) remains undocumented. During the last 9 years, a two-day international intensive hands-on training course in fluoroscopic guided prone PCNL is taking place in our department on a monthly basis. Course includes wet lab training in the porcine model and live surgery training. In this work we report the outcomes of a survey send to course participants questioning the impact of the course to their clinical practice.*
Materials and methods: A survey consisting of 26 questions was distributed online to a total of 91 trainees that had completed the course. Comparison of pre and post course surgical practices was performed using the "N-1" Chi-squared test.
Results: A total of 64 trainees responded to our online survey with 55.6% and 41.3% reporting a modest or major impact to their practice accordingly. Notable changes in puncture and dilation technique were evidenced while a uniform reduction in puncture and operative times was documented. 79.4% responded that the course increased the safety of their procedure, 73% that it reduced operating times, 39.7% that increased their stone free rates, 23.8% that reduced their complications and 23.8% that induced to change their instrumentation with respect of that they were using in the past. Subgroup analysis including only well experienced surgeons revealed a similar impact to their practice.
Conclusions: In the proper setting, an intensive hands-on PCNL course can have a significant impact on attending physicians. Participation to such events even for experienced surgeons should be encouraged.

KEY WORDS: *PCNL; Hands-on; Wet lab; Training; Surgical skills.*

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INTRODUCTION

Proper training in *percutaneous nephrolithotripsy* (PCNL) is of outmost importance to ensure high efficacy of PCNL and reduce its potential morbidity (1). Currently, PCNL training is provided by structured residency and fellowship programs worldwide and is further supported by individual theoretical and hands on training courses. Nevertheless, the clinical value and efficiency of the latter short-term courses has never been investigated.
During the last 9 years, in the *University Hospital of Patras in Greece*, a two-day international intensive hands on training course in fluoroscopic guided prone PCNL is taking place on a monthly basis. The course is usually supporting 2-3 international trainees per course and includes one day of wet lab training in pigs and one full day of live surgery, where trainees are participating as first and assisting surgeons in the operation of several PCNL cases under the proctoring of a highly skilled surgeon. After the training of more than 90 physicians we conducted an online survey examining whether particular training course and PCNL intensive hands on training courses in general have any impact in the daily surgical practice of attending trainees.

MATERIALS AND METHODS

Survey and training physician characteristics: A survey consisting of 26 questions (2x demographic information, 10x pre and 10x post training experience and surgical preferences, 4x overall impressions from the course) was distributed online to a total of 91 trainees that had completed the course. All attending physicians were certified urologists with various previous experience in PCNL. Their ethnicity varied from Europe (Germany:15, France:11, United Kingdom:8, Austria:8, Poland:8, Russia:7, Bulgaria:5, Switzerland:4, Greece:4, Netherlands:4, Cyprus:3, Italy:2, Slovenia:2, Hungary:1, Serbia/Montenegro:1, Spain:1), Africa (South Africa:2, Morocco:1) and middle East (Qatar:2, Kuwait:1, Lebanon:1). A total of 64 trainees responded to our online survey leading to a 70.3% response rate. Mean age of responding physicians was 44 years (range: 32-68). Self reported experience prior to the course was poor (defined as < 10 cases) in 31.3%, intermediate (defined as > 10 and < 50 cases) in 28.1% and good (defined as > 50 cases) in 40.6% of attending surgeons.
Hands on Wet lab training protocol: A female pig weighting more than 30 Kg was anesthetized and placed in the supine position. Under cystoscopic and fluoroscopic guidance a 7 Fr ureteral catheter was advanced to each kidney. The animal was then placed in prone position and a retrograde pyelography was performed. C-arm was then placed at 30 degrees perpendicular to the long axis of the pig and target calyx or renal pelvis was selected. Following a small skin incision an 18G diamond tip needle was advanced towards target in a bull's eye fashion. After adequate penetration of the needle, the C-arm was rotated to zero degrees and the depth of puncture was

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accessed. When needle reached or overpassed the target at zero-degree projection, needle introducer was removed and a 20cc syringe was connected to the needle sheath. Under constant aspiration needle sheath was retrieved slowly until urine and contrast was aspirated verifying entrance into the system. A hydrophilic guidewire was then introduced to the system and directed down the ureter. The same process was repeated several times (usually 5-6 punctures per kidney) until all trainees had mastered the technique. A track dilation was then performed over each guidewire using a two-step (16Fr and 30Fr) Amplatz dilation protocol and a 30Fr percutaneous access sheath was developed over the last 30Fr dilator. Each trainee performed at least one track dilation until all attending physicians felt comfortable with the technique. Hands on Live surgery training: On the next day, all attending physicians participated on the hands-on live surgery course. Several cases (mean 7, range 5-10) scheduled to be operated on the regular program of the *Department of Urology of the University Hospital of Patras in Greece* underwent PCNL by a leading highly experienced surgeon (E.L.). All patients had provided an informed consent. Under close supervision trainees performed the percutaneous punctures and track dilations of all operated cases. Each trainee had the chance to assist in 2-3 cases per course.

Surgical technique

Our technique has been previously described in details (2, 3). After a retrograde insertion of a ureteral catheter the patient was placed in prone position. Puncture target selection and puncture was performed under fluoroscopic guidance with the C-arm at 30 degrees perpendicular to the long axis of the patient. According to the demonstrated technique in the course, the whole pelvicalyceal system including tip of the calyces, infundibulum and joint of calyces to the pelvis could be safely targeted and dilated according to the given stone scenario. Needle was advanced parallel to C-arm view in a bull's eye fashion and its depth of penetration was assessed by rotating C-arm at zero degrees. Ones entrance into the system was achieved a hydrophilic guidewire was inserted and directed down the ureter. Special focus on the importance of advancing the wire down the ureter was made. Needle was retrieved and an 8Fr, 20 cm polyethylene dilator was inserted over the wire reaching the ureter. The hydrophilic guidewire was removed and a super stiff guidewire was introduced inside 8Fr dilator until its end coil into the bladder. The short dilator was removed and exchanged over the wire with a 84 cm long *polytetrafluoroethylene* (PTFE) 8Fr catheter above which a two-step Amplatz dilation took place by dilating track sequentially to 16Fr and 30Fr accordingly. A 30Fr PTFE sheath was deployed over the last dilator and its proper placement inside the system was verified fluoroscopically. The last, 30Fr dilator, was removed leaving the stiff safety guidewire in place passing through the percutaneous sheath. A 26Fr rigid nephroscope was introduced and lithotripsy was performed using an ultrasonic lithotriptor. Large stone fragments up to 1cm long were grasped and removed in one piece using graspers. Flexible nephroscopy was employed if necessary to reach distant calyces from the initial access and verify stone free status. After the procedure an 18-22Fr Malecot tail stent or a 16Fr nephrostomy was placed in the nephrostomy track. Statistical analysis: Statistical significance of differences between various proportions was tested using the indicated "N-1" Chi-squared test (4, 5).

Results

Effect of the course on the ability of urologist to establish their own access. Prior to the course 12.5% (n = 8) of attending physicians were using a radiologist to establish the access of their cases while none employed radiologist assistance after the course ($p < 0.01$).

Effect of the course on track dilation technique: Prior to the course, 41.9% of surgeons used Alken dilators, 24.2% balloon dilation, 30.6% Amplatz dilation and 3.2% other dilation options (eg mini PCNL instrumentation). After the course, the majority of surgeons are using the Amplatz dilators (54.1%) followed by Alken (26.2%), balloon dilation (16.4%) and others (3.3%).

Effect of course on track establishment time and overall operation time: A significant change in the pre and post course track establishment times and overall operation times was evident. In the demonstrated technique, mean access establishment time (from skin puncture to initiation of lithotripsy) last regularly less than 10 minutes. Prior to the course this was the case for only 15.9% of surgeons while it increased to 47.5% after the course ($p < 0.001$). In addition, the rate of surgeons requiring more than 20 min to obtain access dropped from 28.6% prior to the course to zero after the course ($p<0.001$) (Figure 1A). Similarly, mean overall operative time (from skin puncture to nephrostomy tube placement) in our department is regularly less than an hour (2). Prior to the course this was the case for only 12.7% of attending surgeons while rate increased to 36.5% after the course ($p < 0.05$) and the rate of surgeons reporting more than 1.5 hours for a regular case dropped from 38.1% to 4.8% after the course ($p < 0.001$) (Figure 1B).

According to the literature on the learning curve of PCNL, operative times reach a plateau after 40-60 cases (6-8). Given that ongoing growing of surgical experience after the course might also contribute to the noted reduction in puncture and operational times to attending surgeons, we separately analyzed time reduction in surgeons reporting good experience (defined as > 50 cases) prior to the course (n = 26). Reduction of puncture and operating times in this subgroup of already proficient surgeons was even more prominent than the whole cohort. Prior to the course only 30.7% of them could accomplish puncture and dilation in less than 10 min while after the course this rate raised to 65.4% ($p < 0.05$). Similarly, prior to the course 23% required < 1 hour for a regular PCNL case while this rate raised to 50% after the course and 19.2% reported mean operation lasting more than 1.5 hours prior to the course while none reported such times after our training ($p < 0.05$ and $p < 0.01$ accordingly).

Adaptation of tips and tricks: Indirect indications of the educational value of this event can be extracted by the adaptation of several technical aspects that were stressed during our training. Our department is one of the few

Figure 1.
*Gross estimation of mean access (A) and overall operation times (B) before and after the course. h = hours; * = p < 0.001.*

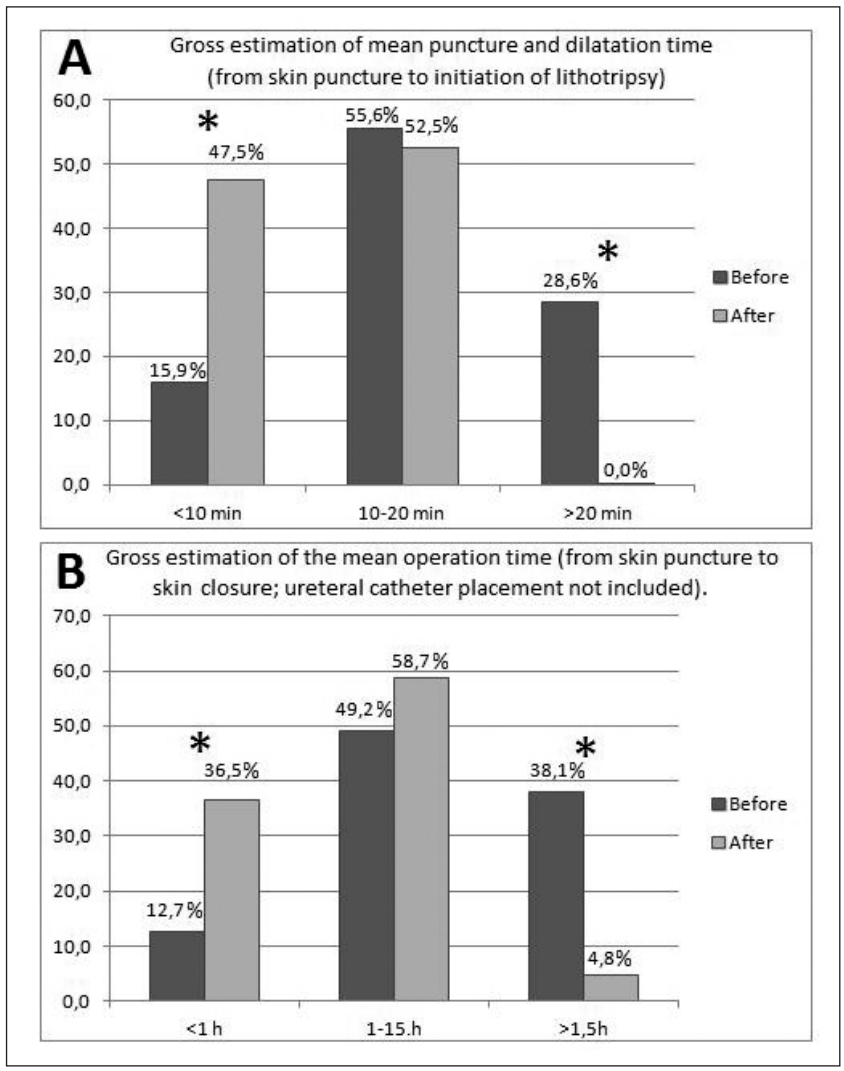
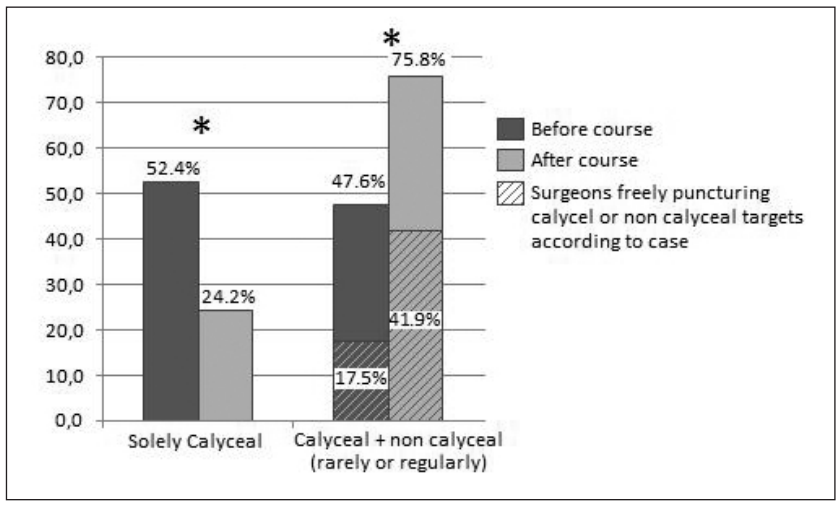


Figure 2.
*Puncture site selection preferences before and after the course. Please notice that a subgroup of surgeons in calyceal plus non calyceal puncture group feel free to puncture in every aspect of the kidney based on the given case. * = p < 0.01.*



centers worldwide practicing central (non calyceal) punctures in almost all PCNL cases. The safety of the approach has been previously documented (2, 3). The adaptation of this policy by the attending physicians after the course was notable. Prior to the course only 17.5% of attending surgeons were feeling free to exercise non calyceal punctures and 52.4% were performing solely calyceal punctures according to the established gold standard puncture technique.

After the course, 75.8% of attending surgeons are practicing non calyceal punctures either rarely (33.9%) or regularly (41.9%) (Figure 2).

Another indirect sign of the educational value of our course was that in the demonstrated technique a guidewire should pass down the ureter in almost every case as a safety measure and orientation tool inside the system. Prior to the course 50% of attending physicians had a guidewire down the ureter regularly (defined as > 75% of their cases) which increased to 73% after the course ($p < 0.01$) (Figure 3).

Overall impressions on the course: 41.3% of attending surgeons considered that the course had a major impact to their daily surgical practice and 55.6% that they gained some tips and tricks to modify their existed technique. Only 3.2% (n = 2) reported no impact to their practice. Examining what parameters did course change in the established surgical practice of each surgeon, 79.4% responded that it increased the safety of their procedure, 73% that it reduced operating times, 39.7% that increased their stone free rates, 23.8% that reduced their complications and 23.8% that induced to change their instrumentation respect to that they were using in the past (Figure 4). Interestingly, the impact of the course was not only significant for novice or intermediate skilled surgeons but was similar for experienced surgeons with 46.1% of the 26 experienced surgeons considering that the course had a major impact in their practice.

Discussion

Despite the wide applicability of PCNL worldwide, there is a notable lack of data on the evaluation of percutaneous surgery training (9). The vast majority of relevant literature focuses on docu-

Figure 3.
*Percent of cases that a safety guidewire is passed down the ureter before and after the course. * = p < 0.01.*

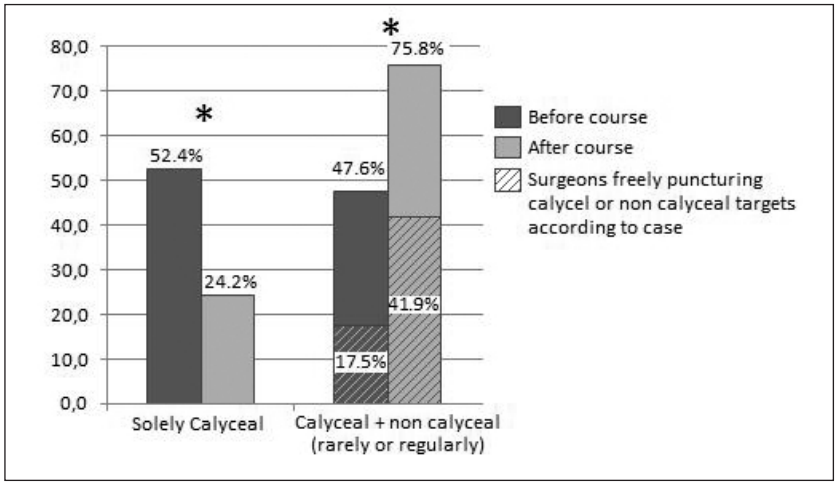
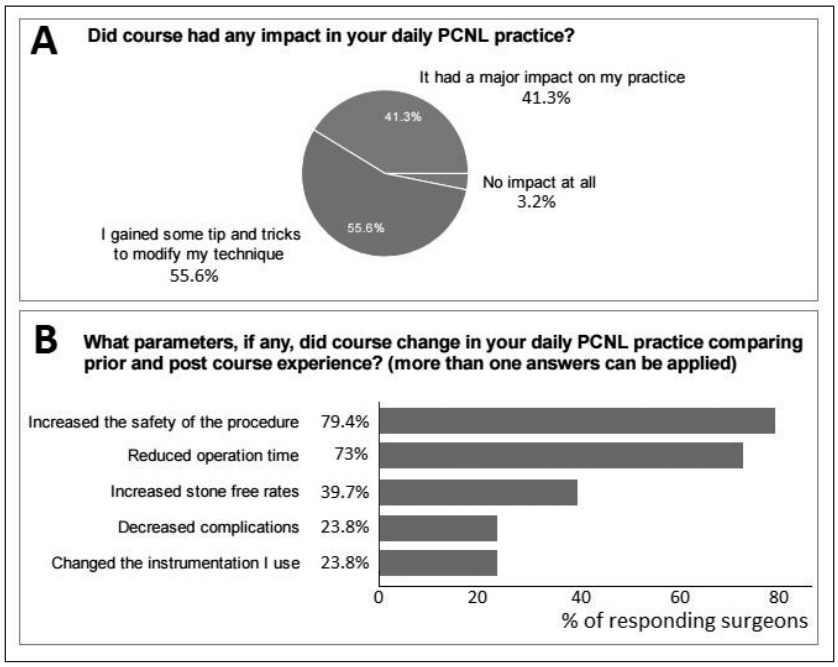


Figure 4.
Overall impression (A) and particular effects of the course to clinical practice (B) of participating surgeons.



menting the learning curve of individual surgeons, the validation of different PCNL simulators and the description of particular modular training programs (6-12). *Aslam et al.* reported global tendencies in endourology training, comparing a significant number of different national systems.

They concluded that huge heterogeneity exists in quality of urological training between different countries and continents, underlining the importance of introducing standardization in training worldwide (13).

Procedure specific courses is a very common tool of surgical training and hands on PCNL courses are widely available in the setting of congresses or expert center initiatives. Still their effectiveness in inducing real changes in the clinical practice of attending physicians remain completely undocumented until now. This is the first study reporting the effect of a short intensive hands-on PCNL course on attending surgeons with 96.8% of participants considering to have a direct impact in their practice.

Basic limitations of the study include the self reporting and retrospective nature of data acquisition and the lack of surrogate markers of outcome improvement (eg. specific operation and fluoroscopy times, blood loss, hospitalization, stone free status and complications for each of their cases). Moreover, accumulated experience after the course in addition to other educational activities that trainees potentially followed after this event might have also contributed to their improved outcomes and as a result the examined PCNL course itself cannot be solely responsible for the documented practice changes. Another limitation of this current study was, that not all participants responded to our mail. It is thus possible, that non-responders could not be interested to reply because they were less satisfied of the course. Finally, this survey has inherited selection bias. Some, if not all of participating physicians opted to follow a PCNL course aiming to address limitations faced in their previous practice and as a result they might have been prone and ready to change their technique. Still, the large number of responders, the uniform nature of responses documenting a positive impact in various aspects of their surgery and improvements in their operational times and the subgroup analysis demonstrating similar benefits even for those surgeons that had theoretically overpassed PCNL learning curve prior to the course reinforce the conclusions of this study.

Conclusions

Literature on the educational value of hands-on PCNL training courses is lacking. In the proper setting, a 2-day intensive hands on PCNL training course can have a significant impact to attending physicians and participation to such events even for experienced surgeons should be encouraged.

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Correspondence

Iason Kyriazis, MD, MSc, PhD, FEBU (Corresponding Author)
jkyriazis@gmail.com

Theodoros Spinos, MD
thspinos@otenet.gr

Panagiotis Kallidonis, MD, MSc, PhD, FEBU
pkallidonis@yahoo.com

Evangelos Liatsikos, MD, PhD
liatsikos@yahoo.com

Department of Urology, University of Patras, Greece
Rion, Patras 26504

Eleni Kyrkopoulou
kyrkopel@aueb.gr

Department of Economics, Athens University of Economics and Business, Greece