Modular training in percutaneous nephrolithotripsy

Stepwise training and close mentoring offer benefits to endourological trainees

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Percutaneous nephrolithotripsy (PNL) represents the gold standard for the management of the renal stones larger than 2 cm. The complication rate is low in experienced hands[1,2] and the combination of efficacy and low morbidity render the technique as a mainstay of urological practice in the years to come[3].

PNL is associated with a steep learning curve and training in the technique requires significant commitment as well as structured methods in order to ensure patient safety[3]. Several investigators have proposed methods for PNL training[4-11]. When endourological training in PNL is critically reviewed, several issues such as who performs the access or how the learning curve is defined influence the efficacy of the training schemes[3]. In fact, structured training programmes with technical skills acquisition, cognitive skills enhancement and clinical training with high safety for the patient are currently lacking[8].

Structured training programmes, including modular training, have been proposed in laparoscopic literature and have proven to be efficient for the trainee and safe for patients[12,13]. Modular training is based on the division of the procedure in steps and the performance of each step by the trainee under continuous mentoring. When the trainee masters the step, he/she is allowed to progress to the next. This stepwise training allows the performance of the procedure with efficacy while ensuring the safety of the patients[13].

Modular training scheme

Based on the above concept, we recently proposed a modular training scheme in PNL. The concept of modular training is not enough for the establishment of a standardised programme for training in PNL. Thus, two main axes were set in order to achieve a reproducible and safe environment for PNL training.

The first axis was the stepwise training of a well standardised technique under constant mentoring (Figure 1). A standardised technique and constant mentoring are important for the acquisition of cognitive skills in surgical and minimally invasive techniques[7]. Thus, the PNL technique is simply described and is performed with the same manner every time. A ureteral catheter is inserted for the injection of contrast during the puncture. The puncture is performed by the operating urologist under fluoroscopic guidance with the patient in prone position. The orientation of the puncture takes place in 0° and 30° perpendicularly to the long axis of the patient. Dilation of the tract is performed with the use of Amplatz dilators. The insertion of the nephroscope, fragmentation and extractions of stones follows. A Malecot catheter is left in place after the end of the procedure.

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The second axis of the training structure is based on the objective evaluation of the candidates in the acquisition of skills as they progress. The lack of proper evaluation of the trainees could result in significant difficulty to correct any deficiencies[8]. In an attempt to achieve an objective measurement of the progress of the trainees, an objective assessment tool (Global Rating Scale) of PNL training was adapted[7].

The modular training PNL scheme is divided into five modules. Initially, an animal lab course takes place for basic skill acquisition (Module 1). At this course, the participant learns and practices the basic puncturing, dilation and intra-renal orientation with the nephroscope. The remaining four modules are based in the sequence of the steps of PNL procedure and include the performance of puncture, tract dilation, single stone and large stone management. When the trainees are qualified for the clinical training, they perform the puncture which is the first clinical module (Module 2). Then, the remaining steps of the procedure are performed by the mentor with the trainee as assistant. The decision for progression of the trainee to the next level is based on the GRS which represent an objective evaluation of the trainee by the mentor. When the trainee advances to the next module, he/she performs all previous modules and the new module for each procedure. Eventually, the trainee performs all modules independently. After the successful completion of the modular training scheme, the trainee performs a series of PNL procedures independently.

Performance results

The evaluation of the above training programme took place at our institution with the participation of a resident and a fellow in endourology. None of the above participants had previous experience in PNL and both had assisted in a number of PNL procedures. The results showed that each of the above-mentioned trainees required no more than two pigs and 22 cases for the successful completion of the modular training scheme. After the modular training, each trainee performed 60 procedures independently. These procedures were divided in segments of 15 cases in an attempt to estimate the learning curve of the procedure. The mentor also performed 25 cases of PNL as a control series.

Operative and fluoroscopy times were initially longer for the trainees in comparison to the mentor. Nevertheless, after 30 cases the trainees reached a plateau in terms of operative and fluoroscopy time and they required similar time to the mentor (Fig. 2). During the performance of the 60 cases, the stone-free rate, complication rate and drop of haemoglobin were similar among the trainees and the mentor. These results showed that the trainees were able to perform safe and efficient PNL procedures immediately after finishing the modular training programme. Further experience only improved operative time efficiency rather than results.

Some points are interesting for the design of the above-mentioned successful training programme. Module 1 is based on the live porcine model as the latter closely replicates the human kidney and simulates realistically the performance of PNL under both fluoroscopic and ultrasound guidance[8,14]. In fact, it is considered to provide results that are similar to those obtained with human anatomy and, moreover, the "tissue feeling" is superior to any other biological model[8,9]. The evaluation of the modular training scheme shows that Module 1 sufficiently prepares the trainees for the clinical segment of the modular training.

Basic skills

The basic cognitive skills could be acquired after using a very limited number of animal models. Moreover, our data show that the performance of trainees during the clinical modules is associated with a low number of errors. The latter observation probably supports the aforementioned efficient skill acquisition. It should be noted that the animal lab allows the mastering of puncture, which is probably the most important step in the PNL technique as it defines the success of the whole procedure[4]. In addition, the clinical steps of the modular scheme provide clinical training on the technique with constant mentoring, and the smooth transition from the animal lab training to the independent clinical cases is possible.

In conclusion, the modular training scheme in PNL provides a basic skill acquisition course which is followed by a stepwise clinical training course under controlled conditions and mentoring. This scheme facilitates the faster advancement of trainees into levels of efficiency similar to that of their mentor during the independent experience acquisition. The modular training scheme could be considered by all instructors who are involved in endourological training since it is easily replicated and highly reproducible due to the use of standardised methods.

Fig. 1: Continuous mentoring is very important for surgical training. The very specialised field of endourology requires the development of skills which are not developed in conventional surgery and which also requires precise knowledge of technique, available material and equipment. Thus, the mentoring by an expert endourologist cannot be substituted by any other learning process. During the modular training the candidate is always under the mentor's supervision and guidance and every evaluation is based on objective parameters.

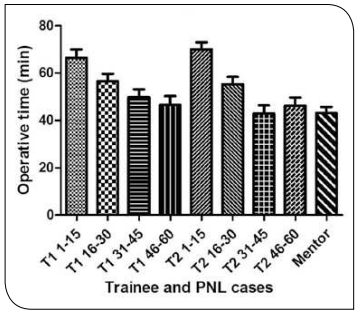

Fig. 2: Operative time in relation to the cases performed by the trainees and mentor. T1 and T2 represent cases of the trainees. The operative time achieves a plateau for both trainees after the performance of 30 procedures.

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