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Simulation Training in Endo-urology: a New Opportunity for Training in Senegal

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Abstract

Purpose of Review Teaching of surgery has long relied on live practice. The advent of endo-urology and laparoscopy have favored the development of simulation. The purpose of this study was to evaluate the role of simulation in the development of a center of excellence center in Senegal.

Recent Findings Simulation has become the standard for surgical training students in Europe and the USA, allowing for a better and faster learning. The routine practice of minimally invasive surgery in urology along with a high number of residents should favor the use of simulation in this setting.

Summary The experts achieved a higher percentage of prostate tissue resection within the allotted time for this procedure. The quality of the control of hemostasis evaluated on a basic procedure and during a resection is significantly better in the expert group. The satisfaction survey was conducted at the end of the seminar.

Keywords Simulation · TURP · Urology training · Senegal

Introduction

The teaching of surgery has long relied on the companionship in the operating room, pedagogical method best suited to the learning of open surgery. The advent of endo-urology, laparoscopy, and robotics along with the constraints imposed by the operating rules of our operating theaters have favored the development of new training methods including simulation learning. Specialized training centers providing animal learning and pelvi-trainer and validating university degrees have opened a new training path that can be integrated into university programs. More recently, the advent of simulation in virtual reality brings a new educational dimension, representing for some an initial stage of training residents. It can also find its place in the context of continuing education. It is needed in different countries with the creation of expert training centers by simulation including these learning techniques in their university programs.

Despite the proliferation of minimally invasive alternatives for the treatment of benign prostatic hypertrophy, transurethral resection of prostate remains a reference technique. The three stages of training from theoretical learning to the autonomous practice of the act through the supervised acquisition of the technique by companionship in the operating room have evolved. The acquisition of this surgical technique is difficult

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to justify the completion of many procedures before obtaining sufficient expertise. It may be useful to include an initial simulation stage in the resident training curriculum, with most intraoperative complications occurring during the acquisition phase of the technique, often to the detriment of the patient. Simulators currently can reduce the learning curve for complex procedures by creating different reproducible acquisition steps in a suitable program. They reduce and better manage complications when they occur in the operating room.

Methods

Forty-three residents and experienced urologists participated in this study during a training seminar organized with the support of STORZ. These included 14 young residents without endoscopic resection experience, 16 senior residents and young urologists with limited resection experience, 10 experienced urologists, and three experts with more than 200 procedures. The simulator included a monitor, a resector with its handle, and a resection pedal. Handling of the loop allowed resection and coagulation to be reproduced with gestures like those performed during endoscopic resection. The software was able to record the performance of each user at the end of the procedure.

The Urotrainer simulator used (UroSim, VirtaMed AG, Zurich, Switzerland) allows different types of procedures to be carried out. Eight modules corresponding to the basic procedures made it possible to become familiar with the urethro-vesico-prostatic anatomy, with the use of a resection loop as well as with achieving hemostasis. Eight modules of endoscopic prostate resection of increasing difficulty were also proposed. HoLEP laser technique and transurethral resection of bladder were also the subject of different training modules.

All participants performed three basic procedures including recognition of anatomical landmarks, resection of a nodule similar to a median lobe, and hemostasis. Twenty-seven of the participants also performed the resection of low volume prostatic hypertrophy.

Results

The resection of a prostatic nodule as presented in step 5 of the basic modules had to be performed in less than 5 min. This procedure made it possible to evaluate the resected volume, the percentage of capsular break-ins, and the time during which the loop was active without contact with the tissue to be resected. There was no significant difference in the percentage of resected tissue between the different groups and with the experts knowing that this step corresponds to a simple resection without associated complications such as bleeding. The novices have resected on average 84.2% of this nodule (range: 50–97%), the second part of the curriculum 87.3% (range: 66–100%), confirmed urologists 88.3% (range: 73–95%), and the experts 95% (range: 93–97%). The average time during which the loop was active without contact with the tissue was close regardless of the groups of participants involved (respectively for each group: 6.6 s, 6.3 s, 5.1 s, and 6.6 s). The percentage of capsular break-in being respectively on average for each group of 7.5%, 6.5%, 8% and 8.5%.

The level of bleeding control (Fig. 1) was evaluated from module 3 of the pedagogical stages of the learning phase. The objective was to achieve at least 17 hemostasis in a predetermined time with blood losses of less than 50 ml. In the group of 14 novice residents in first and second year of residency without resection experience, the number of hemostasis performed ranged from 2 to 15 with average of 6 hemostasis, the average blood loss being 52 ml (maximum: 63 ml). The 16 residents in the second part of their training corresponding to the intermediate group performed between 0 and 18 hemostasis (average: 12) with blood loss ranging from 18 to 76 ml (average: 41 ml). Among the urologists, one of them performed only four hemostasis, but an average of 14 hemostasis was performed with average blood loss of 35 ml. The three experts performed 18 hemostasis with a mean blood loss of 19 ml.

The resection of a small volume prostatic hypertrophy corresponding to the module 1 of the learning phase was carried out by 27 participants including 16 urologists in training (group 1), 8 confirmed urologists (group 2), and the three experts. The percentage of resected tissue and capsular break-in were also considered, and the amount of blood loss during this procedure limited to 5 min. There was no significant difference in the percentage of resected tissue between the first two groups (mean 76% for group 1 and 75% for group 2), but it existed with the experts who resected on average 95% of the prostate volume in the allotted time. We noted a significant difference between the 1st group and the other two in achieving hemostasis with average blood loss of 223 ml for group 1, 62 ml for the 2nd group, and 32 ml for the experts.

Discussion

Teaching methods are based more on companionship than on the traditional “Halsteadian” model, “see one, do one, teach one,” which have evolved in recent years in Europe and the Anglo-Saxon countries. European standards for training students in line with the need to optimize the use of operating theaters are largely responsible for reducing the time spent on learning in the operating theater. At the same time, as early as 2007, Sweet et al. underline the significance of a 50% reduction in the practice of endoscopic prostate resections compared to the 1990s on the learning capabilities of the technique, thus justifying the development of simulation in the training programs of American universities [1].

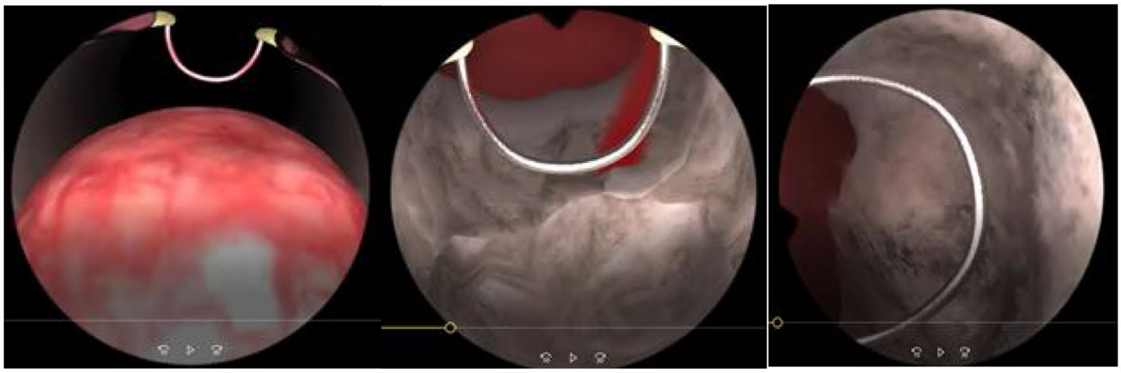

Fig. 1 Simulation view of the cutting loop approaching the bleeder for hemostasis during TURP

It is currently also necessary to consider the development, in the treatment of benign prostatic hypertrophy, of minimally invasive therapeutic alternatives, in particular with the laser, resulting in a reduction in the practice of endoscopic resection as shown by the Canadian study by Ben-Zvi et al. [2•].

In West Africa, there are also difficulties related to the high number of students in training services limiting the custom acquisition capabilities of endoscopic techniques. Senegal is indeed a reference point for Sub-Saharan Africa ensuring not only the training of its future Senegalese urologists but also that of residents from neighboring countries (Comoros, Benin, Guinea, Djibouti, Ivory Coast, Tunisia, Morocco, etc.) with access to urological surgery residency.

These transformations have challenged the traditional ways of learning, leading different universities to look at the position that simulation could take in a training course as inspired by the military and aviation for which it has been emphasized by Coxon et al., an indispensable step before exposure to the realities of these trades [3]. This is even more justified because medical errors are no longer accepted in a context of mediatization and ubiquitous judicialization.

The fundamental principle for a young surgeon never to perform an intervention first on a patient explains this recourse more and more frequent simulation. While this is important for learning laparoscopic and robotic surgery, its use for the endo-urology of the lower device remains undeveloped. For many university experts, be they Europeans or Anglo-Saxons, its integration into training programs in endoscopic procedures is nonetheless inevitable. Arora et al. argue for the use of simulators for young residents during the acquisition of basic procedures, but also later for the surgical technique, including an introduction to the management of complications [4]. He noted, however, that despite its advantages for endo-urology of the lower urinary tract, simulation is not yet sufficiently developed in this field. Le et al. in 2007 during a US survey of 119 program managers revealed that access to simulation for endoscopic resection is estimated at 8%, while it is 76% for laparoscopy [5]. Likewise, a study in 2013 by Fiard et al. for the French Association of Urologists in Training (AFUF) with 125 residents showed a low use of endoscopic surgery simulators [6]. Only 0.5% (7 out of 125) had access. If the expectations of residents encourage its integration into the urological curriculum whether for initial training or for the improvement of practices, the evaluation of this teaching method is rarely the subject of a formal university supervision. Aydin et al. of the Royal College of Surgeons confirmed his interest in learning surgical techniques in urology during a survey conducted in 2015 with 91 residents and 172 specialists [7••]. Twenty-five percent of the specialists and 44% of the residents had, during this survey, a simulation experience for performing endoscopic resection of prostate. Brewin et al. suggested an immersion in an environment comparable to that of an operating theater [8]. They validated this concept from an evaluation of the Bristol TURP simulator (Limbs and Things ®, UK) on 20 participants confirming its interest in learning technical and non-technical gestures. Ahmed et al. nevertheless drew attention to the need for perfect mastery of this new teaching method [9]. They suggested the creation of centralized sites of expertise to include simulation in educational training programs for urologists. de Vries et al. also validate the value of its integration into the residents' training course based on a survey of 20 hospitals in the Netherlands [10•].

Ballaro and Kumar have laid the foundations of these new teaching methods for the endo-urology of the lower apparatus, giving a prime role to learning by simulation [11, 12]. Although the first simulator presented by Ballaro in Great Britain in 1999 did not meet the criteria for commercialization enough, various models have since been evaluated, particularly in the USA, where simulation is integrated into student training programs. Mc Dougall et al. have defined various criteria for validating the simulators [13]. The opinion of experts (content validity) and the ability to compare different levels of experience (construct validity) and to compare different models (criterion validity) represent the parameters selected by the author.

Different simulators, meeting these criteria, are currently offered by manufacturers, some universities having acquired them and integrated them into their training programs. The PelvicVision simulator (Melerit Medical AB, Sweden) is evaluated from a study conducted by Källström et al. at the University Hospital Linköping [14]. Twenty-four residents, at a training seminar on endoscopic prostate resection, performed two simulator procedures integrated into a 5-day seminar including theoretical training and the performance of three prostate resections supervised by experts subjected to a video recording. The analysis of the results shows an increase of their autonomy with an optimization of the time devoted to the resection as well as an improvement of the hemostasis. The proportion of residents able to perform a resection procedure autonomously increased from 10% at the beginning of the seminar to about 75% at the end of it with a recognized benefit of the simulation sessions in this progression.

The TURP trainer version 1 (Simulab, Seattle, Washington) was evaluated by Rashid et al. in a study involving 136 participants from three levels of mastering the technique of resection from novice without experience to experts [15]. The virtual resection was performed over a period of 5 min and allowed the analysis of the following parameters: total volume resected, weight of each resected chip, amount of irrigation liquid used, and blood loss. In the group of novices, there is a correlation between resected volume and blood loss. This study done in 2002 at the AAU conference is certainly not the reflection of an evaluation in a university context. Nevertheless, it encourages its inclusion in training programs. Note that the best performance of novices was with mastery of video games that we also saw in our experience.

The Surgical SIM® Simulator TURP Simulator from the University of Washington was analyzed by Hudak et al. for a group of 35 participants from different levels of resection experience [16•]. The evaluation was done on two sessions of prostate resection. Depending on the experience of the participants, there was a significant difference in the resected volume.

The Urotrainer simulator (Karl Storz GmbH, Tuttlingen, Germany) is initially evaluated for the management of endovascular proliferation by Reich et al. in 2006 [17]. Thirty-six participants including 24 novices performed various technical steps during two 1-h simulation sessions to judge the educational effectiveness of the system. The percentage of resected tumor (49 versus 65%) and bleeding management were improved for the novice during the 2nd session. This preliminary study constituted, for the team, the first step of the integration of the virtual reality in the learning of the endoscopy of the lower urinary system. Schout et al. reported the results of a more nuanced study concerning this same simulator [18]. One hundred four participants of different levels of expertise performed a virtual resection of prostate and/or bladder. The validity criteria of the evaluated model did not allow for the authors to validate it justifying the necessity of new studies. It should be noted that contrary to the definition used in the literature, the novices who participated in this study already had less than 50 procedures for resection.

The Urotrainer simulator currently marketed by Storz as the Simbionix simulator (TURP Mentor) using the same VirtaMed software was evaluated in the context of Mc Dougall criteria pedagogical protocols by different teams. Bright et al. chose to evaluate the Simbionix simulator for learning single resection of a median lobe by comparing the results of 11 novices without any resection experience and 8 experts already having a retraction of more than 200 resections [19]. There was a significant difference between the two groups (novice versus expert) for the percentage of resected tissue (median: 30.8 versus 59.05) and the time during which the resection loop appeared to be active without tissue contact (1.41 versus 0.19). The benefit of this learning appeared clearly after 5 sessions with a volume resected by the novices comparable to that of the experts.

Tjiam et al. conducted in the Netherlands a more complete analysis of TURPsim (Simbionix/VirtaMed, Beit Goal, Israel) aimed at evaluating the role of this simulator in the various stages of learning endoscopic resection of prostate [20]. This study included 66 participants divided between novices without resection experience, intermediates, and experts with experience of more than 50 interventions. The resection time was significantly shorter with less blood loss in the intermediate and expert groups compared to the novices. This simulator responded according to the authors to the criteria of reference and can be integrated in the training programs of the residents.

Conclusion

The implementation of surgical training programs incorporating simulation techniques during the learning and acquisition phase of technical procedures is now becoming a reality for some universities. The performance of simulators in virtual reality and their ability to analyze the different stages of a resident's training make them an essential teaching tool. Without a substitute for operating room learning, simulation facilitates the initial training phase for residents. It requires the implementation of real educational programs controlled in expert centers ensuring the quality and proper use of this training tool. The preliminary study conducted during this seminar showed the need to use this educational tool to reinforce the quality of training in the endo-urology of urologists performing their curriculum in Senegal. The creation of an expert center may eventually be an objective for the University of Dakar.

Compliance with Ethical Standards

Conflict of Interest Lamine Niang, Mohamed Jalloh, Alain Houlgatte, Medina Ndoye, Abdourahmane Diallo, Issa Labou, Ibrahima Louis Mane, and Serigne M. Gueye declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent Not applicable.

References

Papers of particular interest, published recently, have been highlighted as:
• Of importance
•• Of major importance

1. Sweet RM. Review of trainers for transurethral resection of the prostate skills. J Endo Urol. 2007;21:280–4.
2.• Ben-Zvi T, Hueber PA, Valdivieso R, et al. Urological resident exposure to transurethral surgical options for BPH management in 2012–2013: a pan-Canadian survey. Can Urol Assoc J. 2014;8:54–60 **Comprehensive evaluation of the techniques for BPH management.**
3. Coxon JP, Pattison SH, Parks JW, Stevenson PK, Kirby RS. Reducing human error in urology: lessons from aviation. BJU Int. 2003;91:1–3.
4. Arora S, Lamb B, Undre S, Kneebonne R, Darzi A, Sevdalis N. Framework for incorporating simulation into urology training. BJU Int. 2010;107:806–10.
5. Le CQ, Lightner DJ, VanderLei L, Segura JW, Gettman MT. The current role of medical simulation in American urological residency training programs: an assessment by program directors. J Urol. 2007;177:288–91.
6. Fiard G, Capon G, Rizk J, Maurin C, Dariane C, Audenet F, et al. The place of simulation in the curriculum of French urologists in training : a study by the French Association of Urologists in training (AFUF). Prog Urol. 2014;24:390–6.
7.•• Aydin A, Ahmed K, Shafi AM, Khan MS, Dasgupta P. The role of simulation in urological training- a quantitative study of practice and opinions. Surgeon. 2016;14:301–7 **Evaluation of both trainees and trainers focused of both technical and non-technical skills showing the efficacy of the approach.**
8. Brewin J, Tang J, Dasgupta P, Khan MS, Ahmed K, Bello F, et al. Full immersion simulation: validation of a distributed simulation environment for technical and non-technical skills training in urology. BJU Int. 2015;116:156–62.
9. Ahmed K, Amer T, Challacombe B, Jaye P, Dasgupta P, Khan MS. How to develop a simulation programme in urology. BJU Int. 2011;108:1698–702.
10.• De Vries AH, et al. High educational impact of a national simulation-based urological curriculum including technical and non-technical skills. Surg Endosc. 2017;31:928–36 **Simulation has a great educational value.**
11. Ballaro A, Briggs T, Garcia-Montes F, McDonald D, Emberton M, Mundy AR. A computer generated interactive transurethral prostatic resection simulator. J Urol. 1999;162:1633–5.
12. Kumar PV, Gomes MP, Davies BL, Timoney AG. A computer assisted surgical trainer for transurethral resection of the prostate. J Urol. 2002;168:2111–4.
13. Mc Dougall EM. Validation of surgical simulators. J Endourol. 2007;21:244–7.
14. Källström R, Hjertberg H, Svanvik J. Impact of virtual reality-simulated training on urology residents' performance of transurethral resection of the prostate. J Endourol. 2010;24:1521–8.
15. Rashid HH, Kowallewski T, Oppenheimer P, Ooms A, Krieger JN, Sweet RM. The virtual reality transurethral prostatic resection trainer: evaluation of discriminate validity. J Urol. 2007;177:2283–6.
16.• Hudak SJ, Landt CL, Hernandez J, Soderdahl DW. External validation of a virtual reality transurethral resection of the prostate simulator. J Urol. 2010;184:2018–22.
17. Reich O, Noll M, Gratzke C, Bachmann A, Waidelich R, Seitz M, et al. High level virtual reality simulator for endourologic procedures of lower urinary tract. Urology. 2006;67:1144–8.
18. Schout BM, Bemelmans BL, Martens EJ, Scherpbier AJ, Hendrikx AJ. How useful and realistic is the UroTrainer for training transurethral prostate and bladder tumor resection procedures? J Urol. 2009;181:1297–303.
19. Bright E, Vine S, Wilson MR, Masters RS, McGrath JS. Face validity, construct validity and training benefits of a virtual reality TURP simulator. Int J Surg. 2012;10:163–6.
20. Tjiam IM, Berkers CH, Schout BM, Brinkman WM, Witjes JA, Scherpbier AJ, et al. Evaluation of the educational value of a virtual reality TURP simulator according to a curriculum-based approach. Simul Healthc. 2014;9:288–94.