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ORIGINAL ARTICLE

Endoscopic surgical simulation using low-fidelity and virtual reality transurethral resection simulators in urology simulation boot camp course: trainees feedback assessment study

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Abstract

Objectives The objective of our study was to study trainees' feedback and rating of models for training transurethral resection of bladder lesions (TURBT) and prostate (TURP) during simulation.

Methods The study was performed during the ''Transurethral resection (TUR) module" at the boot camp held in 2019. Prior to the course, all trainees were required to evaluate their experience in performing TURBT and TURP procedures. Trainees simulated resection on two different models; low-fidelity tissue model (Samed, GmBH, Dresden, Germany) and virtual reality simulator (TURPMentor, 3D Systems, Littleton, US). Following the completion of the module, trainees completed a questionnaire using a 5-point Likert scale to evaluate their assessment of the models for surgical training.

Results In total, 174 simulation assessments were performed by 56 trainees(Samed Bladder–40, Prostate–45, TURPMentor Bladder–51, Prostate–37). All trainees reported that they had performed < 50 TUR procedures. The Samed model median scores were for appearance (4/5), texture (5/5), feel (5/5) and conductibility (5/5). The TURPMentor median score was for appearance (4/5), texture and feel (4/5) and conductibility (4/5). The most common criticism of the Samed model was that it failed to mimic bleeding. In contrast, trainees felt that the TURPMentor haptic feedback was inadequate to allow for close resection and did not calibrate movements accurately.

Conclusions Our results demonstrate that both forms of simulators (low-fidelity and virtual reality) were rated highly by urology trainees and improve their confidence in performing transurethral resection and in fact complement each other in providing lower tract endoscopic resection simulation.

Keywords Urology · Simulation · TURP · TURBT · Virtual reality

Introduction

Currently, approximately 15,000 transurethral prostate resections (England and Wales) and 20,000 transurethral bladder resections (UK) are performed annually to treat benign prostatic disease and bladder tumours [1, 2]. A decline in the exposure to transurethral procedures by trainees has been

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well documented [3, 4]. The ongoing reduced opportunities for training have been attributed to alternative methods of treatment to treat lower urinary symptoms, reduced number of cases, medical therapy and a highly selective approach [5]. To some extent the, simulation-based training in urology has been shown to bridge the gap [6–8]. Transurethral resection of bladder lesions (TURBT) and prostate (TURP) remain major surgical procedures for urology trainees to achieve competence and for certification of completion of training. Simulation-based learning is aimed at providing training opportunities in simulation laboratories to circumvent some of the challenges we face in surgical training. Learning transurethral procedural skills is pivotal in the management of many urological pathologies. Training aids for TURP include synthetic, animal, cadaveric and virtual reality models, and the efficacy of this training model is well-described [6, 9–17]. Important skills necessary for transurethral procedures are handling the resectoscope, hand-eye-foot coordination, resection techniques and bleeding control. There is no single resection model offering all these necessary skills. Trainee assessments and feedback remain crucial for evaluating simulation models in effective simulation-based training.

At the urology simulation boot camp (USBC), we have used a virtual reality model and a synthetically manufactured prostate model for teaching prostate and bladder tumour resection techniques [7]. In this study, we compared the efficacy of both models for the acquisition of resection skills.

Methods

The study was conducted during the 5th urology simulation boot camp (USBC) in 2019. All participants consented for the study. The USBC is a 5-day hands-on simulation-based course consists of 8 modules [18]. Resection skills for the prostate and bladder tumour were taught in one of the modules of the course. Participants were divided into eight groups with six participants in each group. Prior to the course, all trainees were required to evaluate their experience in performing TURBT and TURP procedures. The prostate and bladder resection training session lasted for four hours. The module lead was responsible for content and the uniform high-standard learning experience. In the TURP module, there were 7 stations (1 Samed TURP, 1 Samed TURBT, 1 TURP on TURPMentor, 1TURBT on TURPMentor, 1 station to teach instruments, 1 table to simulated clot evacuation from the bladder, and 1 Urolift simulator. Each participant was allocated a fixed time for each station in a 4-h session. We assigned seven trainees to each session and by delivering the module eight times in four days, all 56 participants managed to complete training. The module was delivered by 6 expert trainers providing 1:1 training, and the session was repeated eight times to provide training to all participants.

The Samed model (Samed, GmBH, Dresden, Germany) provides a realistic haptical experience with anatomy, opportunity to practice with standard resection instruments, use of standard electrosurgery and genuine "resection smell". The virtual reality (TURPMentor, 3D Systems, US) simulator allows multiple attempts, variable pathology, cutting and coagulation and performance data. All participants were supervised by one supervisor who gave answers to questions and guidance as and when required. Participants completed a questionnaire immediately after completing the module. It included questions about participants' demographics and experience level prostate and bladder tumour resection. The opinion of each participant was assessed with seven questions about the simulator. These questions concerned the realism of the simulation and training capacities and were presented on a 5-point Likert scale. Additionally, one statement was added for trainers to assess the simulator role in training (Additional file 1). Each participant completed one form for each procedure on both models. The questionnaire was developed by the experts facilitating the module. A free-text box was also included to increase the richness of responses and allow for unanticipated benefits or limitations of the models.

Results

In total, 174 simulation assessments were performed by 56 trainees (Samed Bladder–40, Samed Prostate–45, TURPMentor Bladder–51, TURPMentor Prostate–37). All trainees reported that they had performed < 50 TUR procedures. The Samed model median scores for appearance were 4/5 (good), texture and feel were 5/5 (excellent) and conductibility was 5/5. The TURPMentor median score for appearance was 4/5, texture and feel were 4/5 and conductibility was 4/5. Trainees reported the overall ability to simulate TUR as 4/5 for each model (Tables 1, 2).

Ninety-seven per cent of trainees' assessments rated their satisfaction with the use of both models as either "Good" or "Very Good" (Fig. 1). A Mann–Whitney U test was applied to the "satisfaction" results producing a non-significant result ($U = 11$, $p = 0.83$). The null hypothesis was therefore accepted that there was no difference in the satisfaction of the trainees when using either the low-fidelity Samed model or the TURPMentor. Ninety-one per cent of trainees "strongly agreed" or "agreed" that the use of both models improved their confidence in performing transurethral resections.

The free text response rate for qualitative feedback was 29.3% ($n = 51/174$). The most common criticism of the Samed model was that it failed to mimic bleeding. In

Table 1 Trainees feedback following transurethral resection of the prostate

	Samed					TURMentor				
	1	2	3	4	5	1	2	3	4	5
Appearance	0.0%	2.2% (1)	13.3% (6)	48.9% (22)	35.6% (16)	0.0%	0.0%	5.4% (2)	59.5% (22)	35.1% (13)
Texture and feeling	0.0%	0.0%	2.2% (1)	37.8% (17)	60.0% (27)	0.0%	8.1% (3)	27.0% (10)	40.5% (15)	24.3% (9)
Conductibility	0.0%	0.0%	2.2% (1)	31.1% (14)	66.7% (30)	0.0%	0.0%	14.3% (5)	51.4% (18)	34.3% (12)
Overall ability	0.0%	0.0%	0.0%	57.8% (26)	42.2% (19)	0.0%	5.4% (2)	13.5% (5)	56.8% (21)	24.3% (9)
Satisfaction	0.0%	0.0%	0.0%	48.9% (22)	51.1% (23)	0.0%	0.0%	8.1% (3)	48.6% (18)	43.2% (16)
Transferable skill	0.0%	0.0%	2.2% (1)	40.0% (18)	57.8% (26)	0.0%	0.0%	8.1% (3)	48.6% (18)	43.2% (16)
Trainee confidence	0.0%	0.0%	4.4% (2)	48.9% (22)	46.7% (21)	0.0%	0.0%	13.9% (5)	52.8% (19)	33.3% (12)
Trainer confidence	0.0%	0.0%	0.0%	47.1% (8)	52.9% (9)	0.0%	0.0%	0.0%	58.3% (7)	41.7% (5)

Table 2 Trainees feedback following transurethral resection of the bladder tumour

	Samed					TURBTMentor™				
	1	2	3	4	5	1	2	3	4	5
Appearance	0.0%	0.0%	7.5% (3)	45.0% (18)	47.5% (19)	0.0%	0.0%	3.8% (2)	49.1% (26)	47.2% (25)
Texture and feeling	0.0%	0.0%	5.0% (2)	42.5% (17)	52.5% (21)	0.0%	3.8% (2)	26.9% (14)	38.5% (20)	30.8% (16)
Conductibility	0.0%	0.0%	5.0% (2)	25.0% (10)	70.0% (28)	0.0%	0.0%	2.0% (1)	47.1% (24)	51.0% (26)
Overall ability	0.0%	0.0%	5.0% (2)	40.0% (16)	55.0% (22)	0.0%	0.0%	7.7% (4)	53.8% (28)	38.5% (20)
Satisfaction	0.0%	2.5% (1)	2.5% (1)	37.5% (15)	57.5% (23)	0.0%	0.0%	1.9% (1)	55.8% (29)	42.3% (22)
Transferable skill	0.0%	0.0%	5.0% (2)	30.0% (12)	65.0% (26)	0.0%	0.0%	1.9% (1)	42.3% (22)	55.8% (29)
Trainee confidence	0.0%	2.5% (1)	5.0% (2)	30.0% (12)	62.5% (25)	0.0%	0.0%	9.6% (5)	42.3% (22)	48.1% (25)
Trainer confidence	0.0%	0.0%	3.4% (1)	37.9% (11)	58.6% (17)	0.0%	0.0%	6.3% (2)	40.6% (13)	53.1% (17)

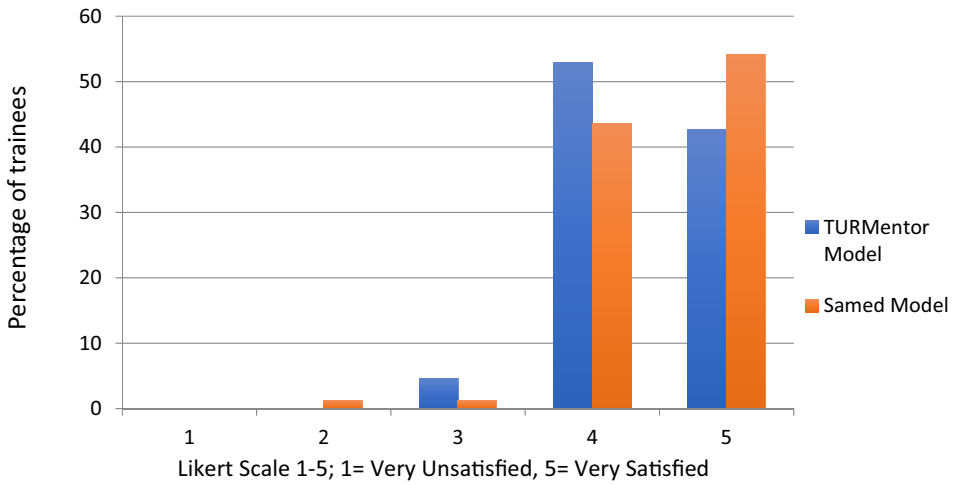

Fig. 1 Overall trainee satisfaction with simulator models: TURMentor and Samed

contrast, trainees felt that the TURPMentor haptic feedback was inadequate to allow for close resection and did not calibrate movements accurately.

Feedback from Trainees included:

"Realistic technology making good real life training. Enjoyed blend of clinical and technology teaching. Interesting to have statistical feedback from computers"

"Simulation was very realistic and the mentor and samed model complemented each other well"

Feedback from Trainers included:

"Excellent models. Some issues with the irrigation fluid drainage, but once sorted were brilliant"
"TURP/TURBT virtual simulators were better than I expected, giving good opportunity to discuss principles because of the recreation of anatomy"

Discussion

Transurethral resection is an important skill for trainee urologists to develop and become confident in performing [4]. With ever increasing pressures on the theatre environment there is an ever increasing need to adapt surgical training to ensure trainees continue to develop. The USBC seeks to provide the skills to urology trainees to allow them to safely and more effectively utilise the theatre.

The simulation models both received positive feedback with trainees perhaps slightly favouring the Samed model, although this was not a statistically significant difference. Through content analysis of free-text feedback the favouring of the Samed model was due to the realistic haptic feedback offered by using standard instruments on simulated tissue. Whilst that haptic feedback was lost with the TURPMentor, the ability to simulate variant anatomy, bleeding and haemostasis is valued by trainees. Combining both training models provides a comprehensive simulated experience of transurethral resection. The training and performance review offered by the TURPMentor, whilst potentially useful for independent training, is not so important with the intensive and experienced feedback offered by course faculty.

Both simulation models have previously been studied for face and content validity and have demonstrated training benefits [6, 9–11, 13]. In a literature review by Khan et al., they described similar pros and cons to the models to those that the trainees in our study highlighted [16]. The benefits of the haptic feel in the low-fidelity models versus the bleeding and anatomical simulation from virtual reality simulators were one of the clear outcomes of their review. The Samed model has been shown to significantly improve resection speed and quality [17]. Studies of the TURPMentor have also demonstrated that it can be used to effectively train with demonstrated improvements in resection speed and fluency [10, 12, 14].

Whilst individually the models are effective there is a need to provide trainees with holistic training to develop the haptic feel but also the techniques required to perform an effective, safe and efficient procedure. By combining the use of both models in the same session, our trainees have had the opportunity to develop all of these skills.

Both models are easy to use by both trainees and trainers. TURPMentor is self-sufficient as an integrated unit, without disposables, and is user friendly. Beyond the initial acquisition costs there is annual maintenance required, and the software has been found to be reliable. The Samed model is effectively operated with the help of a technician, as maintenance of the equipment is needed throughout the session. This includes changing the resection medium, maintaining irrigation and occasional troubleshooting with equipment. The Samed model has various components, and the cost of the workstation is 3.999,00€. The consumable (prostate and balder tumour models) cost can vary, and further information can be gathered from their website (https://samed-dresden.de/).

Conclusion

Our results demonstrate that both forms of simulators (low-fidelity and virtual reality) were rated highly by urology trainees and improve their confidence in performing transurethral resection. The Samed and TURPMentor simulators are different but complimentary to each other when used together to facilitate transurethral resection skills.

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Compliance with ethical standards

conflict of interest None.

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Research involving Human Participants and/or Animals Not applicable.

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