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Original Article

Simulator based teaching of Trans-Urethral Resection of Prostate (TURP) skills in urology.

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Abstract

Background: After the introduction of simulators in urology, urology education has evolved significantly. The development of Transurethral Resection of Prostate (TURP) skills has shifted to simulator-based learning from being directly on patients. We evaluated the outcome of simulation-based teaching of TURP procedural skills on virtual reality simulator and objectively assessed the operative skills on the Global Rating Scale (GRS).

Methodology: In this prospective comparative study, high fidelity (VirtaMed | UroSim™) simulator was used. A total of 17 participants were enrolled in this study, 4 were urology faculty members, and 13 were post-graduate urology trainees. All participants performed five attempts of real-time TURP complete procedure and were allowed to resect the maximum possible prostate tissue (goal ≥ 85%). Skills were assessed in terms of resection, bleeding control and safety parameters. Objective assessment of simulative operative skills was done on GRS score sheets by faculty, based on the Global Rating Index for Technical Skills (GRITS) and OSATS. The data from the 1st and 5th attempts of all participants was analyzed on SPSS version 22.0.

Results: There was statistically significant difference in the mean resection score at 1st attempt between faculty and trainees i.e. 112±8.6 and 86.69±9.95, respectively ($p<0.01$), while the scores were comparative by the 5th attempt. All the enrolled members resected >80% of prostate volume (40 score points). Similarly, for the parameters associated with bleeding control, there was a significant difference in the bleeding control, lost blood and remaining bleeders between trainees and faculty members ($p<0.01$) at 1st attempt while on 5th attempt, the outcomes were comparative in both groups. The objective assessment of operative skills of the trainee's displayed improvement in all 5 parameters including tissue injury, movement and time, instrument application, surgical process and surgical details.

Conclusion: Simulation-based TURP teaching significantly improves simulative operative skills in resection, bleeding control and safety parameters. GRS is an effective tool in assessing simulative operative skills and may evaluate endo-urological procedural training in urology trainees periodically.

Keywords

Transurethral Resection of Prostate, Simulative Education, Global Rating Scale, Endourology Training, Uro-simulator.

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Introduction

The simulation is the fundamental component for learning almost all skills[1,2]. The concept of simulative teaching in urology has evolved the post-graduate urology training. Currently, available simulators cover almost all range of endo-urological procedures along with laparoscopic and robotic urology procedures[2]. Transurethral Resection of the prostate (TURP) is the most common endoscopic urological procedure performed worldwide. Traditionally, trainees learn this procedure by observing and gradually assisting and performing the real-time procedure on the patient in operative rooms. Studies have shown steep learning curve for TURP.

Furuya et al reported that mean 81 ± 17.0 number of operations were needed before the surgeon's skill reached a plateau in performing TURP[3]. With the introduction of high fidelity, validated TURP simulators[4], the TURP teaching became safer, task-oriented and less time consuming[1]. The data from the residency program directors at accredited urology training institutes - USA reports that, almost 60% of institutes have incorporated simulation into their curriculum. More than 70% directors agreed that simulator training improve operative room performance and in addition author concluded that cost was a limiting factor and agreed that there was an increased need for simulator education within work-hour limitations and reduction in patient risks and complications[5].

After incorporating validated virtual reality simulators (VirtaMed | UroSim™) in the urology department, we rationalized/ intended to study the effectiveness of simulator-based teaching and the development of TURP skills in post-graduate urology trainees. For an objective assessment of operative skills, we used the already published Global Rating Scale (GRS) system with the kind permission of the Zhang et al[6]. It encompasses 5 parameters, and each parameter scaled from 1 to 5 score with a total score of 25. A higher GRS score indicates a higher level of knowledge and skills related to the TURP procedure.

Methodology

In this prospective comparative study, high fidelity (VirtaMed | UroSim™) simulator was used. A total of 17 participants were enrolled in this study, 4 were urology faculty members, and 13 were post-graduate urology trainees. All participants were involved in the simulative mode of teaching and learning and asked to perform basic TURP tasks on high fidelity simulator including skill modules of visualization, bleeding control, resection and partial TURP. Once accustomed to handling a simulator, all participants were given the task of TURP full procedure (Easy 1 mode) and five attempts of real-time TURP under the direct supervision of trained faculty.

Participants were asked to resect the maximum possible prostate tissue (goal ≥ 85%) with effective bleeding control and safety profile. Skills were assessed in terms of resection (procedure time, prostate volume and capsule), Bleeding control (average visibility, lost blood and remaining bleeders) and safety parameters.

Objective assessment of simulative operative skills was done on GRS score sheets by faculty, based on the Global Rating Index for Technical Skills (GRITS) and OSATS. GRS evaluation system comprises 5 assessment points on basic, surgical and procedural knowledge related to TURP. And each parameter scaled from 1 to 5 score points. To minimize the biasness, 2 faculty members were assigned for supervision and observation of the score on the GRS sheet.

We analyzed the data from the results of the 1st and 5th attempts of all the participants. The simulator data was generated at the end of each attempt. To ensure the reliability, data from both simulator and GRS sheets were analyzed using independent sample T test and chi-square test on SPSS version 22.0. The p-value <0.05 was considered statistically significant.

Results

The total achievable score of the simulative TURP procedure on the simulator is 300, which includes

visualization score (30), resection score (120), bleeding score (70) and safety score (80). All candidates performed the visualization section completely and achieved 30 out of 30 scores.

The set goal of capsular resection was <25% (score 40). The capsular resection decreased from 26.75% to 18.5% in faculty. Similarly, operative time also decreased. In contrast, post-graduate trainees had a statistically significant improvement in their capsular resection and operative time.

Table 1: Comparative findings of Simulative TURP – Resection among urology faculty & trainees.

Parameters		Study Groups		p-value
		Faculty	Trainees	
Resection	1st Attempt	112±8.6	86.69±9.95	<0.01*
	5th Attempt	120±0.55	119±0.55	0.30
Prostate amount (%)**	1st Attempt	>80	>80	#
	5th Attempt	>80	>80	#
Capsule amount (%)	1st Attempt	26.75±9.1	39.92±6.6	<0.01*
	5th Attempt	18.50±4.4	22.54±2.72	0.10
Procedure time (sec)	1st Attempt	282±40.0	646±151	<0.01 *
	5th Attempt	222±37.4	345±79	0.01*

Values are given as mean±SD. # p-value can't be assessed. *p<0.01 is considered significant.
**All members resected >80% of prostate volume (40 score points).

Table 2 illustrates simulator data of bleeding control parameters. All participants had procedure visibility of >90% and scored 40. Experienced faculty had 100% bleeding control and left no bleeders in the 1st and 5th attempts. In contrast, post-graduate trainees had poor bleeding control and left bleeders in 1st attempt, which shows statistically significant improvement in the 5th attempt.

Table 2: Comparative findings of Simulative TURP-Bleeding Control among urology faculty & trainees.

Parameters		Study Groups		p-value
		Faculty	Trainees	
Bleeding Control	1st Attempt	70±0.0	57±10.2	<0.01*
	5th Attempt	70±0.0	69±0.7	0.10
Lost blood (ml)	1st Attempt	35.0±11.9	127±112	0.01*
	5th Attempt	19.0±2.9	27.54±9.8	0.01*
Remaining bleeders	1st Attempt	--	1.23±0.83	0.01*
	5th Attempt	--	0.15±0.37	0.10

Values are given as mean±SD. *p<0.01 is considered significant.
**All candidates had average visibility of > 90%/ 40 score.

Safety parameters from simulator data are presented in table 3. Overall, it was shown that the faculty remained safe in the 1st and 5th attempts of simulative TURP. While, post-graduate trainees were unsafe in 1st attempt, but gradually their scores showed statistically significant improvement and they developed safety practices by the 5th attempt.

Table 3: Comparative findings of Simulative TURP- Safety among urology faculty & trainees.

Parameters		Study Groups		p-value
		Faculty	Trainees	
Safety	1st Attempt	70±14.14	48.46±14.0	0.01*
	5th Attempt	80±3.5	77.69±4.3	0.30
Cutting while viewing obscure	1st Attempt	0.25±0.5	1.38±2.59	0.10
	5th Attempt	--	0.23±0.59	0.10
Tool active when pushing	1st Attempt	0.25±0.5	0.38±0.5	0.60
	5th Attempt	--	--	#
Cuts into sphincter	1st Attempt	--	0.69±0.7	<0.01*
	5th Attempt	--	--	#
Cuts into Verumontanum	1st Attempt	--	1.54±0.87	<0.01*
	5th Attempt	--	0.8±0.27	0.30
Undermining bladder neck	1st Attempt	0.5±0.57	2.08±1.00	<0.01*
	5th Attempt	0.1±0.0	0.15±0.37	0.10

Values are given as mean±SD. *p<0.01 is considered significant.
**None of the participants injured the ureteral orifice.

Trainee's achieved statistically comparable operative skill scores by the end of the study. Regarding GRS scores, the initial mean total score (1st attempt) of post-graduate trainees was 12.0±2.97, which increased to 19.15±3.10 (p<0.01) by the end of the study (5th attempt). Post-graduate trainees showed improvement in all 5 parameters, which include Tissue injury, Movement and Time, Instrument Application, Surgical process and Surgical Details (Table 4).

Table 4: TURP full procedure (Easy – 1), subjective assessment of trainees through GRS evaluation system.

Parameters (Score)	Attempt 1	Attempt 5	p-value
Tissue Injury	2.08±0.76	3.54±0.51	<0.01*
Movement and Time	2.08±0.76	3.62±0.65	<0.01*
Instrument Application	2.38±0.76	3.77±1.01	<0.01*
Surgical Process	2.54±0.77	3.77±0.72	<0.01*
Surgical Details	2.92±0.49	4.46±0.77	<0.01*
Total GRS	12.00±2.97	19.15±3.10	<0.01*

Values are given as mean±SD. *p<0.01 is considered significant.

Discussion

Up till now, a variety of TURP simulators have been introduced and incorporated into institutional training programs. Almost all of them are focused on the development of safe procedural skills, focusing the concept of optimal training in a safe environment for the patient and the trainee[12].

The concept of simulative training is based on cognitive training[13]. Many theories postulated that training focused on developing cognitive skills will yield improvement in motor and physical performance[14,15]. Simulation-based training in surgical education has complemented the cognitive training approach and playing an important role in the current era[16]. In urology, simulative technology is evolving and many studies conclude that urology trainees should spend more and more time in high fidelity simulative training environments to improve the surgical skills before embarking on real patients in the operative room[17].

We enrolled all our urology trainees in the TURP simulator program. They had previous 'hands-on experience' of cystoscopy and observed real-time TURP procedure multiple times. In this study, participants were allowed to resect at least 80% of the prostate, considering bleeding control and safety parameters. Our results indicated that the trainees had significant improvement in reduced prostate capsule damage, decreased procedure time, improved bleeding control, and safety parameters from 1st to 5th attempt. A study conducted by Zhang et al. concluded a significant improvement with TURP simulator program[2].

Findings of simulator differentiating between novice and trained person, and gradual improvement of operative skills in repeated attempts also indirectly reconfirms the Construct Validity (Type A and B) of high fidelity TURP simulator (VirtaMed | UroSim™) significantly improves the resection volume per minute and decrease in loop active time while not resecting[18], which is consistent to the present study findings.

Apart from the simulation-based assessment, objective assessment of proficiency is a well-recognized parameter for the promotion of trainee's[1]. Global assessment methods that have been widely used in urology as assessment tools include OSATS[19] and GEARS[20]. In our opinion, GRS is easy to implement, and parameters are more procedure-specific, also pointed out by Kamran et al. in a cross-sectional survey[10]. We measured the GRS scores of trainees with each simulative attempt of TURP, and the scores significantly increased with each attempt. The data showed statistically significant impact of training duration on simulative skills. By the end of the study (5th attempt), the simulation scores of trainees were comparable with the final scores of faculty.

To our knowledge Liaquat University of Medical & Health Sciences (LUMHS) is the only public sector institution in Pakistan, having state of the art endo-urology simulator. The incorporation of simulative training in urology is an important step towards raising the standard of education and training of operative skills. The current study from Pakistan will further add to the significant knowledge of simulative learning in surgical training.

Conclusion

Simulation-based TURP teaching significantly improves simulative operative skills in resection, bleeding control and safety parameters. GRS might be an effective tool for assessing simulative operative skills and evaluating endo-urological procedural training in urology trainees periodically in future.

Conflicts of Interest

The authors have declared that no competing interests exist.

Disclosure

The abstract of this article was presented as moderated poster in the 35th world congress of Endourology in 2017. The abstract was published in an indexed supplement of the journal of Endourology (The Journal of Endourology; Vol 31: Issue S2, Sep 2017. Abstract Publication).

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