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Author(s)	Poudel, Saseem
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学位論文（要約）

Summary of the PhD Thesis

Development of safe and efficient training system for
laparoscopic inguinal hernia repair surgery

(安全かつ効率的な腹腔鏡下鼠径ヘルニア修復術の
トレーニングシステムの構築)

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北海道大学

サシーム パウデル

Saseem Poudel

Introduction:

The basis of surgical education around the world has basically been the apprenticeship model “See one, do one, teach one” introduced by W.S. Halsted in 1904. However, especially in North America, for the past few decades, this field has been undergoing a significant evidence-based transformation through the incorporation of simulation training, objective evaluation of the resident and feedback. One of the main reasons behind this paradigm shift is the introduction of laparoscopic surgery and the focus on medical errors. These have led surgical educators and researchers to look into the alternative to Halsted model.

Laparoscopic inguinal hernia repair (LIHR) has been gaining popularity recently due to its better postoperative course however, it is hampered by the technical difficulty of the procedure. The procedure reportedly has a long learning curve. Few training systems using simulators has been developed for this procedure however, these systems are not feasible in the setting where residents are distributed over a wider variety of the hospitals. For novices, assessment of their performance and providing them with formative feedback plays a vital role in development of their skills. The objective of my research project was to develop a novel education system based on assessment and feedback.

I divided the project into three phases

Phase 1: Development and validation of the Assessment tool

Objective: To develop an assessment tool to assess the performance of LIHR, transabdominal preperitoneal (TAPP) procedure and demonstrate its validity using the video recordings of the surgical performance.

Method:

Several rounds of discussion within an expert panel consisting of TAPP experts, hernia experts and expert in surgical education, was used to develop the TAPP checklist. This assessment tool was developed as a tool that can be used to assess the performance of TAPP repair with the procedure video and to give appropriate feedback to the surgeon. Checklist consisted of list of twenty-four important steps of TAPP procedure and details of what was expected in each step. Thirty unedited TAPP videos of various levels surgeons were collected from eleven institutes. Three blinded hernia experts rated these videos using newly developed TAPP checklist. Inter-rater reliability, construct and concurrent validity were evaluated.

Results:

The Inter-rater reliability between 3 raters was 0.75 (95%CI 0.60-0.86). The median total score of experienced (>50 TAPP operator experience) group was 23.2 (22.7-24.0), intermediate group (TAPP operator experience $10 \leq < 50$) was 22.0 (19.7-23.0) and novice group (TAPP operator experience <10) was 18.7 (15.3-20.3) ($p < 0.001$). TAPP checklist score showed high co-relation with the GOALS-GH score ($r_s = 0.94$, $p < 0.001$).

Conclusion: TAPP checklist is a valid tool for the assessment of the surgical skill of TAPP procedure using surgical video.

Phase 2: Development of the Educational system

Objective: To develop an educational system using for TAPP procedure.

Method: We developed a TAPP educational video explaining each item of the TAPP checklist and basic knowledge of the procedure. A training manual was developed for the instructors that would help them to educate, evaluate and give feedback to the trainees using the TAPP checklist. We set up the operators criteria for the novices. We integrated a training tool with the evaluation and feedback in the operation theater and by third party using video raters. These were integrated as TAPP education system which was used to train novices the TAPP procedure.

Phase 3: Validation of the new educational system

Objective: To evaluate the educational impact of the TAPP education system on novice surgeons.

Method: Residents and surgeons from participating hospitals, who had performed 0 or 1 TAPP procedure were recruited for this study. The participants were randomly assigned to Intervention Group (IG) who trained under the educational system developed in phase 2 and Control Group (CG) who trained using the conventional education system present in that institute. They were required to send the surgical videos of their TAPP cases until 4th case. These videos were rated by blinded raters. All the participants performed their first case before randomization as control. The participants scoring more than 20 (full marks 24) in their first case were excluded from the study. IG then received the educational tools and both ratings and feedback from their first surgery. They were not allowed to perform further cases until they met the predetermined operator criteria. The CG were allowed to continue performing TAPP procedures until 4th case after which they were also provided with the educational tools. The improvement of the TAPP checklist scores in each group from case 1 to 3, and the 3rd case score between 2 groups were compared. Score in different aspects of the procedure was also compared between 2 groups.

Result: The eighteen participants from 9 institutes were recruited for this study. Four participants were excluded, as they met the exclusion criteria and 2 participants dropped out of the study due to their personal reasons. Seven participants in IG and 5 participants in CG completed the study and were included in the final analysis. There was no difference between the backgrounds of the participants. From their first case to third case, the participants in IG significantly improved their scores from 12.4(SD3.7) to 21.3 (SD2.0) ($p=0.008$). On the other hand, the scores of the participants of CG did not change significantly from their first case 15.4 (SD2.6) to third case 16.4 (SD4.7) ($p=0.52$). The IG score of 3rd case was also significantly higher than that of CG ($p=0.04$). While there was no significant difference between the scores of both the groups in Trochar placement ($p=1.0$), Suturing ($p=1.0$) and Overall performance ($p=0.54$) section of the procedure, there was significant improvement in performance of IG and in important aspects of TAPP procedure Dissection ($p=0.021$), Extent of Dissection ($p=0.003$), Mesh Deployment ($p=0.049$). The score of IG in these aspects were also significantly better than that of CG in their third case ($p=0.006$ for Dissection, $p=0.027$ for extent of dissection and $p=0.06$ for mesh deployment).

Conclusion: The newly developed TAPP educational system was effective in improving the TAPP performance of novice surgeons.

Discussion: Assessment and feedback is very important for the training of novices. It helps them identify the portions that they need to work on and helps in deliberate practice, leading to the improvement in their performance. One of the advantages of video assessment system is to get performance evaluation and feedback by the external experts. Other validated educational system for LIHR are mainly simulation based training, making it suitable only for large teaching hospitals. Our educational tool has been able to drastically improve the performance of novice trainees mainly by using the systematic approach to the education and utilizing video assessment and feedback system and tools

that were readily available in each individual hospital. The positive impact of this tool was noted on the novices scattered over variety of hospitals.

The TAPP checklist uses several subjective terms, however, these terms have been avoided at the critical aspects of the procedure. The RCT didn't show the significant difference in the patient outcome as it was also not our main objective. Also as these studies were done in the controlled environment, the instructors took over the case to avoid patient complications.

Overall conclusion:

This newly developed education tool based on the assessment and feedback has the potential to reduce the learning curve of the novices for TAPP procedure. It may also be able to improve the patient outcome by enhancing the quality of the surgery performed by the trainees during the early stages of their learning curve and improving their understanding of the procedure. The educational tool is simple and cost effective enough to be implemented at almost any institute in the world.