Effect of a Short Preclinical Laparoscopy Course for Interns in Surgery: A Randomized Controlled Trial

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OBJECTIVES: Surgical interns are often not well prepared and have high anxiety about the execution of basic technical skills. This study investigates whether a short preclinical course focusing on laparoscopic camera-navigating skills is useful in the preparation for internship.

DESIGN: Through randomization, an experimental group who attended a short laparoscopic training session and a control group were created. Students' interest for this training and their confidence for laparoscopic exposure during surgical internship were inquired. During internship, camera-navigating skills were assessed by the operating surgeons (using a validated global rating scale) as well as by the students themselves (using a 10-points Likert scale).

SETTING: All research was performed in the Center for Surgical Technologies, Leuven, Belgium.

PARTICIPANTS: A total of 205 fifth-year medical students at the University of Leuven, Belgium.

RESULTS: Of the control group students, 80% were interested in attending the training session. There was no difference in confidence between experimental and control group. According to the surgeons and students, there was a significant improvement in clinical performance from the first (scores on global rating and Likert scales ±50%) to the last procedure (scores ±70%) for both groups. However, there was no difference in performance between groups.

CONCLUSIONS: Students are very interested in attending a preclinical laparoscopic training session. However, trained students did not display higher confidence or better clinical performance during internship. Even without previous training, students are fast to acquire the necessary skills during surgical internship. (J Surg 71:187-192. © 2014 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: preclinical, laparoscopy, internship, camera navigation, confidence, training

COMPETENCY: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement

INTRODUCTION

Changing environments in surgical departments, such as time limitations or legal pressure, have created the need for acquisition of technical skills outside the operating room (OR).[1] Although much attention is focused on teaching surgical skills during residency now, few efforts are made to prepare medical students for the technical skills necessary to be an intern.[2] Surgical interns often have high anxiety about the execution of basic technical skills.[2,3] It has been proven that elaborate structured technical skills curricula held before internship significantly improved their overall confidence in performing these skills.[2,4-6]

As laparoscopy and other minimally invasive techniques have gained a very important role in almost every surgical discipline, interns would have to attend and sometimes participate in these procedures, mostly to navigate the camera. When they perform poorly in the use of the laparoscopic camera with failure to achieve the optimal view (errors in horizontal axis, centering, or zooming), the performance of the surgeon may be hampered.[7]

During internship, medical students are supposed to practice basic technical skills and apply the theoretical

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knowledge gathered through the years. During operations, interns can refresh their anatomical knowledge and learn about the different surgical procedures and techniques. However, it is known that human beings have a limited attentional capacity. When these attentional resources are only used to acquire technical skills and spatial judgment (e.g. during camera navigation), there is little left to learn anything about anatomy or operative decision making.[8]

Therefore, it seems useful to include a preclinical training session in laparoscopy and camera navigation to ensure an optimal learning environment for the intern. There is evidence that preclinical training courses are useful in improving camera-navigating skills in a laboratory setting,[7,9,10] but this study investigates whether it can also improve performance in real clinical practice. The second outcome parameter focused on the effect of the laparoscopic training session (focused on camera navigation) on the confidence of students for this specific technical skill.

MATERIALS AND METHODS

This study was performed on students who were in the fifth year of medical training at the University of Leuven, Belgium. Medical students in Belgium start internship after 5 years of theoretical courses. For an entire year, they attend clinical activities in hospitals, among which 4 months of surgery is included. Thus at the time of the study, students had no clinical experience and all were in the prospect of attending 4 months of internship in the OR.

All students in the fifth year of medical training were randomly divided into 2 groups (taking into consideration the different time schedules of students): an experimental group ($n = 104$) who had the possibility to attend a short laparoscopic training session during their fifth year of medicine and a control group ($n = 101$) who did not receive this training. At the beginning of the sixth year, a short questionnaire concerning this preclinical training and confidence for laparoscopic exposure during surgical internship was given to all students. Finally, during their surgical internship (sixth year of medicine), camera-navigating skills were assessed by the supervising surgeons as well as by the students themselves. Informed consent was obtained from all participants.

Training lasted 3 hours and started with a theoretical introduction about the video installation and instruments used in laparoscopy. Students were instructed to connect endoscope, camera, light source, and monitor in a correct way. After that, students attended the hands-on part of the training. The exercises were performed on a Laparoscopic Skills Testing and Training model (Fig. 1)[11] in a Szabo trainer box (Karl Storz, Tutlingen, Germany) with a conventional laparoscopic tower (Karl Storz, Tutlingen, Germany). The first exercise focused on the use of the 30° angled laparoscope. The Laparoscopic Skills Testing and Training

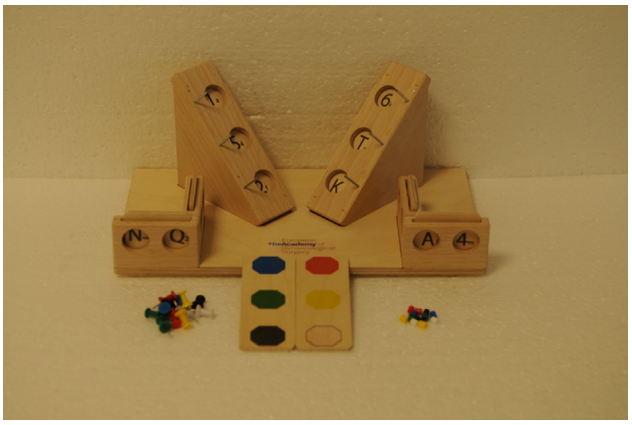

FIGURE 1. The LASTT model.[11]

model was mounted with 14 targets at the different modules in such a way that they could only be identified by moving the scope in all directions (rotation, lateral, and zoom-in/zoom-out movements). A second exercise focused on the interaction between the camera navigator and the surgeon. One student navigated the 0° laparoscope while the other student grasped an object, transferred it from the dominant to the nondominant hand, and introduced it into its target. The last exercise focused on hand-eye coordination. The student grasped an object with a Kelly forceps and positioned it onto its target while manipulating the camera with the nondominant hand. Construct validity for all exercises was shown by Molinas et al.[11] After the video demonstration of the different exercises, students performed them independently (2 students per box trainer). Training was supervised with continuous expert feedback by a research fellow. A cystoscopy task in a cadaver porcine bladder (retrieval of an object from the bladder) was added to provide a real life application.

The questionnaire that was administered in the beginning of the sixth year of medicine gathered information concerning gender, dexterity, and experience with laparoscopic simulators and video games. It also included a complex visual-spatial test, the Schlauch figures test, requiring mental visualization and manipulation of objects in 3 dimensions.[12] Control group students were asked whether (before randomization) they had been interested in attending the training session (yes/no). The experimental group was asked how useful they thought the training had been on a Likert scale (1 = not useful at all and 6= extremely useful) and whether they would recommend it to their successors (yes/no). Furthermore, all students had to indicate on a 6-point Likert scale how prepared they felt for laparoscopic exposure during surgical internship (1 = totally not prepared and 6 = very well prepared) and how nervous were they for their role as camera navigator during laparoscopic procedures (1 = not nervous at all and 6 = very nervous).

Assessment during surgical internship (4 months in the sixth year of medicine) was performed by the operating

surgeons as well as by the students themselves. The first 5 consecutive laparoscopic procedures where the intern assisted in camera navigation were evaluated. The operating surgeons used a Global Rating Scale (GRS) with the same template as described by Reznick etal.[13] This GRS assessed several dimensions of camera navigation: anticipation of the student to movements of the surgeon, adjustment of the horizontal axis, preservation of the image in the center of the scope, zooming function (in/out), use of the angled laparoscope, depth perception when assisting with a grasper, amount of verbal and manual corrections by the surgeon, amount of unnecessary movements, and overall performance. These different dimensions were based on previously validated assessment tools for camera navigation.[7,9] Each dimension was graded on a 5-point scale with the middle and extreme points anchored by explicit descriptions. The final score on the GRS, sum of all dimensions, was converted to a scale on 100 (%). The intern was asked to evaluate the procedure as well by filling in a Likert score from 1 (unprepared, insecure, and incapable) to 10 (easy, full control, and the surgeon did not have to correct). Surgeons were asked to keep the amount and content of instructions identical as before the study and identical for both groups. Interns were asked not to reveal their training status, but real blinding of the surgeons could not be guaranteed.

Ordinal data are shown as box plots [median ± interquartile range (IQR)] and compared using the Mann-Whitney test. To obtain a comparison between groups in a multivariate setting (repeated measures owing to multiple procedures), a repeated measures analysis of variance was used for the clinical evaluations with group and procedure as factors (mean ± standard deviation); $p < 0.05$ is considered significant.

RESULTS

Twelve students in the experimental group refused to participate and were excluded from the study. For the remaining students in the experimental group ($n = 92$), questionnaires were available in 90 cases, surgeons' clinical evaluation in 34 cases, and personal clinical evaluation in 38 cases; whereas in the control group ($n = 101$), data were available in 99, 33, and 36 cases, respectively. These low response rates on clinical evaluations were owing to the fact that interns were not always allowed assisting in laparoscopic procedures, especially when this function was entrusted to nurses or residents that were more experienced. Experimental and control groups were comparable concerning gender, dexterity, previous experience with laparoscopic simulators and video games, and scores on visual-spatial testing.

In the experimental group, students quoted the usefulness of the training session with a median of 5 (IQR; 1) on a 6-point Likert scale. All of them indicated that they would recommend the training to their successors. They indicated feeling prepared for laparoscopic exposure during surgical internship with a median of 2 (IQR; 2.75) and being nervous for their job as a camera navigator with a median of 4 (IQR; 2) on the 6-point Likert scale (Fig. 2). In the control group, although 79 students (80%) regretted not being able to participate, 20 students (20%) were not interested in attending a sortlike training. They indicated feeling prepared for laparoscopic exposure during surgical internship with a median of 2 (IQR; 2) and being nervous for their job as camera navigator with a median of 3 (IQR; 2) on the 6-point Likert scale. There was no difference between the experimental and control group concerning feeling prepared ($p = 0.190$) or nervous ($p = 0.723$) for laparoscopic exposure during surgical internship (Fig. 2).

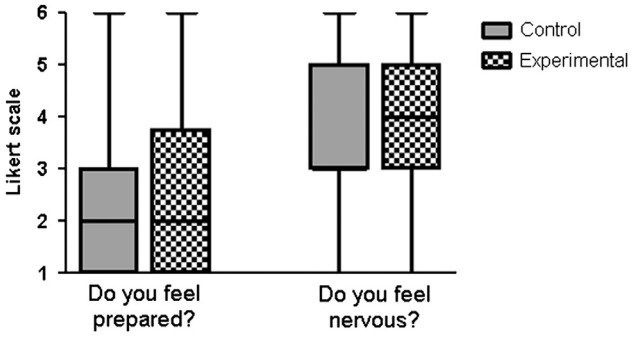

FIGURE 2. Box plots for the 6-point Likert scales of confidence on the levels of feeling prepared (1 = totally not prepared and 6 = very well prepared) or being nervous (1 = not nervous at all and 6 = very nervous) for laparoscopic exposure during surgical internship.

During surgical internship, sometimes less than 5 procedures were assessed. So only the information gathered about the available procedures was used. Scores on items concerning the use of the angled endoscope and the assistance with grasper were missing in a large amount of cases, so these 2 items were removed from the final GRS score, therefore consisting of the sum of 8 dimensions (value 1-5) converted to a scale on 100 (%). Figure 3 shows the assessment of the surgeons, using the GRS, and students, using the 10-point Likert scale, of the first 5 procedures that the students assisted in camera navigation. According to the surgeons, both experimental and control group improved significantly ($p < 0.001$) from the first [47 (±17) % and 51 (±19) %] to the last procedure (69 (±18) % and 73 (±17) %). A repeated measures analysis of variance did not show a difference between groups on any procedure ($p = 0.347$) nor for the learning curve ($p = 0.873$). According to the students themselves, performance improved significantly ($p < 0.001$) from the first to the last procedure [4.7 (±1.8) and 4.6 (±1.8) to 7.4 (±1.3) and 7.2 (±1.6)] for both experimental and control group. Again there was no

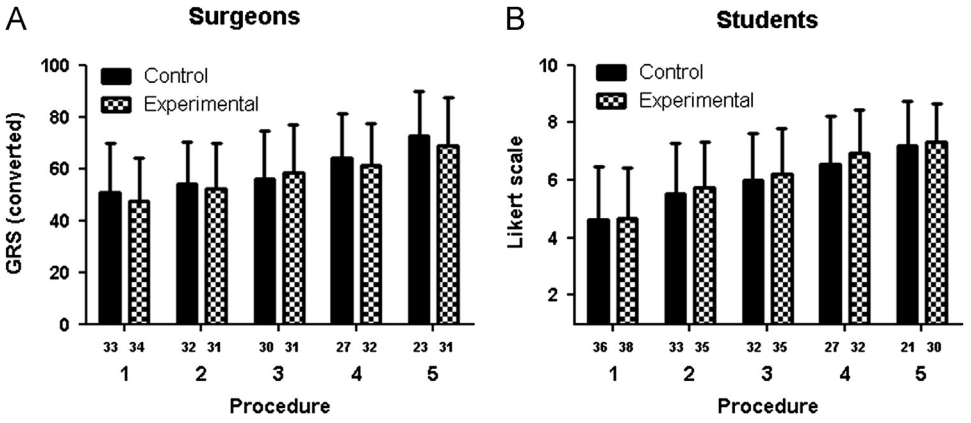

FIGURE 3. Evaluation of performance by (A) surgeons and (B) students (mean ± standard deviation). The amount of available assessment forms is indicated at the base of each column.

difference between groups on any procedure ($p = 0.303$) nor for the learning curve ($p = 0.982$).

DISCUSSION

Changing environments in surgical departments have created the need for acquisition of technical skills outside the OR. Although much attention is focused on training during residency now, few efforts are made to prepare medical students for the technical skills necessary to be an intern. This study investigates whether a short preclinical course in laparoscopy (focused on camera navigation) is useful in preparing students for laparoscopic exposure during surgical internship.

According to our data, fifth-year medical students show high interest for preclinical training in laparoscopy. Eighty percent of students who did not get the opportunity to participate in the training session regretted this. Students who did attend the training session perceived it as very useful, and all would recommend it to their successors. This was surprising because probably only a minority of these students is interested in entering a surgical discipline. Kozar et al.[14] reported that only 33% of first-year medical students show interest in pursuing a surgical career. Moreover, before entering the sixth year of medicine (internship), a significant portion of medical students probably did not make their final career choice. We believe this high interest among medical students for the training basically originates from a general need of a more practical approach of medical education where technical skills are taught parallel to theoretical lessons. Students are keen to participate in a training session that increases insights in surgical procedures and techniques.[3] Furthermore, students can be aware that training in laparoscopic skills is not only useful for future surgeons but for all disciplines that are using endoscopy such as gynecology and internal medicine (gastroenterology and pneumology).[15] In our study, we did not investigate the influence of the training on the students career choice, but previously, some authors suggested preclinical laparoscopy courses might increase interest in surgery.[16-18]

Although they perceived the training as useful, this did not seem to influence their confidence because both groups indicated to feel rather unprepared and nervous for laparoscopic exposure during surgical internship. Furthermore, the training did not influence OR performance (camera navigation) either, because there was no difference between groups, as assessed by the surgeons or the students. This is in contradiction to previous findings[2,4-6,19] where skills training during medical school did improve confidence and perceived readiness before internship. Those studies, however, focused on general surgical skills instead of pure laparoscopic skills and included more elaborate training schedules. Similarly, previous research did prove a beneficial effect of preclinical training in camera-navigating skills[7,9,10,19,20] in a laboratory setting. However, this study investigated the effect on real OR performance.

The question remains why we could not detect any benefit for the experimental group in this study. First, the training session could have been insufficient to significantly improve their laparoscopic and camera-navigating skills. Other research groups developed more elaborate training programs with multiple sessions during several weeks[9] or used proficiency criteria to ensure equal performance of all trainees.[7,10] However, even a short 3-hour training session should allow reasonable skill acquisition, as shown in a recent study by Korndorffer that a mean time of only 107 minutes was required to achieve proficiency in camera-navigating skills.[10] Furthermore, our ultimate goal was to provide a training session for all fifth-year medical students ($n = \pm 200$), which makes the organization of a more elaborate or proficiency-based training rather difficult. A second possible drawback of this training session was the low-fidelity box trainer model that was used. Although similar box trainer exercises have been proven useful in

improving camera-navigating skills during a porcine Nissen procedure,[10] this model lacks similarity with the actual task and might therefore not influence students' confidence for laparoscopic procedures on real patients. It has been previously suggested that interaction with a real live organism should be a part of preclinical surgical courses.[5]

Suppose the students did acquire the necessary camera-navigating skills during the training session, several factors might have concealed the existing differences between the experimental and control group (type II error). Response rate for clinical evaluations was less than 40%, implying a risk of selection bias. Furthermore, interns were evaluated by different possibly nonblinded surgeons who might have evaluated their general appreciation of the student rather than their camera-navigating skills (assessment bias). Next, we could not control for the anatomical and procedural knowledge of students nor for the type of procedure they attended, which has a large effect on camera-navigating skills in the OR. Although we attempted to prevent these problems by using structured GRSs and these interindividual differences should have equal effect in both groups owing to randomization, it nevertheless creates additional noise and thereby increases the risk of a type II error. Last, students were evaluated on some camera-navigating skills but not on angled endoscope use or other aspects of the training like hand-eye coordination. All these issues indicate the logistic difficulties that are encountered when trying to demonstrate the only important result of training namely clinical benefit, in comparison with the frequently used outcome parameter of laboratory-measured benefit. In future studies, a setup with small number of participants could include video-based blinded assessment to overcome some of these drawbacks.

Independent of training status, the self-perceived performance as well as the assessment by the supervising surgeons shows significant improvement in score between the first and consecutive procedures. According to the operating surgeons, students achieved reasonable results ($\pm$ 70%) after 5 procedures, which might indicate that irrespective of previous training, the learning curve of camera-navigating skills in the OR is acceptable. Most research compared navigation training vs a control group without training.[7,9,10] The results of this study show the importance of including control groups that receive conventional clinical training in the OR. Recently, Franzeck et al.[21] showed equal significance in camera-navigating performance after simulation-based vs OR-based training. Bennett et al.[22] demonstrated that novice medical students are able to gain laparoscopic camera skills from "hands-on" experience, with no added benefit of preclinical camera simulator training. So, although students are in favor of preclinical training, one should not underestimate the efficiency and importance of conventional training, especially for a relatively simple skill such as camera navigation.

CONCLUSIONS

Our results suggest that preclinical skills training in laparoscopy (focused on camera navigation) does not result in a higher confidence or better clinical performance during laparoscopic procedures in internship. Even without previous training, students are quick to acquire the necessary skills during surgical internship. On the contrary, students are very interested in following a sortlike training session.

REFERENCES

1. Bradley P, Bligh J. One year's experience with a clinical skills resource centre. *Med Educ*. 1999;33(2):114-120.
2. Peyre SE, Peyre CG, Sullivan ME, Towfigh S. A surgical skills elective can improve student confidence prior to internship. *J Surg Res*. 2006;133(1):11-15.
3. Wu EH, D. Elnicki DM, Alper EJ, et al. Procedural and interpretive skills of medical students: experiences and attitudes of third-year students. *Acad Med*. 2006;81(suppl 10):S48-S51.
4. Esterl RM Jr, Henzi DL, Cohn SM. Senior medical student "Boot Camp": can result in increased self-confidence before starting surgery internships. *Curr Surg*. 2006;63(4):264-268.
5. Riboh J, Curet M, Krummel T. Innovative introduction to surgery in the preclinical years. *Am J Surg*. 2007;194(2):227-230.
6. Sammann A, Tendick F, Ward D, Zaid H, O'Sullivan P, Ascher N. A surgical skills elective to expose preclinical medical students to surgery. *J Surg Res*. 2007;142(2):287-294.
7. Ganai S, Donroe JA St, Louis MR, Lewis GM, Seymour NE. Virtual-reality training improves angled telescope skills in novice laparoscopists. *Am J Surg*. 2007;193:260-265.
8. Gallagher AG, Ritter EM, Champion H, et al. Virtual reality simulation for the operating room: proficiency-based training as a paradigm shift in surgical skills training. *Ann Surg*. 2005;241(2):364-372.
9. Hyltander A, Liljegren E, Rhodin PH, Lönroth H. The transfer of basic skills learned in a laparoscopic simulator to the operating room. *Surg Endosc*. 2002;16(9):1324-1328.
10. Korndorffer JR Jr, Hayes DJ, Dunne JB, et al. Development and transferability of a cost-effective

laparoscopic camera navigation simulator. *Surg Endosc*. 2005;19(2):161-167.

11. Molinas CR, De Win G, Ritter O, Keckstein J, Miserez M, Campo R. Feasibility and construct validity of a novel Laparoscopic Skills Testing and Training (LASTT) model. *Gynecol Surg*. 2008;5(4):281-290.

12. Stumpf H, Fay E, Hogrefe CJ. Schlauchfiguren: Ein Test Zur Beurteilung Des Räumlichen Vorstellungsvermögens. Göttingen: Verlag für Psychologie; 1983.

13. Reznick R, Regehr G, MacRae H, Martin J, McCulloch W. Testing technical skill via an innovative "bench station" examination. *Am J Surg*. 1997;173(3):226-230.

14. Kozar RA, Lucci A, Miller CC, et al. Brief intervention by surgeons can influence students toward a career in surgery. *J Surg Res*. 2003;111(1):166-169.

15. Adamsen S, Funch-Jensen PM, Drewes AM, Rosenberg J, Grantcharov TP. A comparative study of skills in virtual laparoscopy and endoscopy. *Surg Endosc*. 2005;19(2):229-234.

16. Madan AK, Frantzides CT, Quiros R, Dujovny N, Tebbit C. Effects of a laparoscopic course on student interest in surgical residency. *JSLS*. 2005;9(2):134-137.

17. Glasgow SC, Tiemann D, Frisella MM, Conroy G, Klingensmith ME. Laparoscopy as an educational and recruiting tool. *Am J Surg*. 2006;191(4):542-544.

18. Zaid H, Ward D, Sammann A, Tendick F, Topp KS, Maa J. Integrating surgical skills education into the anatomy laboratory. *J Surg Res*. 2010;158(1):36-42.

19. Naylor RA, Hollett LA, Castvellvi A, Valentine RJ, Scott DJ. Preparing medical students to enter surgery residencies. *Am J Surg*. 2010;199(1):105-109.

20. Yee KA, Karmali S, Sherman V. Validation of a simple camera navigation trainer. *J Am Coll Surg*. 2009;209:753-757.

21. Franzeck FM, Rosenthal R, Muller MK, et al. Prospective randomized controlled trial of simulator-based versus traditional in-surgery laparoscopic camera navigation training. *Surg Endosc*. 2012;26:235-241.

22. Bennett A, Birch DW, Menzes C, Vizhul A, Karmali S. Assessment of medical student laparoscopic camera skills and the impact of formal camera training. *Am J Surg*. 2011;201:655-659.