A comparative study on the effect of laparoscopic simulation on skill training in laparoscopic surgery

Mohamed Lotfy, Mohamed I. Abdelhamid, Hazem N. Ashri

Department of General and Laparoscopic Surgery, Faculty of Medicine, Zagazig University, Zagzig, Egypt

Correspondence to Mohamed Lotfy Ali, MD, Department of General and Laparoscopic Surgery, Zagazig University, Zagazig, 44629, Egypt; Tel: + 20 106 014 0862; e-mail: lotfymira@yahoo.com

Received 4 March 2017
Accepted 26 March 2017

The Egyptian Journal of Surgery
2017, 36:336–339

Context
This study examined the effect of using laparoscopic simulation on the enhancement of psychomotor capabilities linked to performing laparoscopic appendectomy.
Participants and methods
Thirty surgical trainees carried out a laparoscopic appendectomy in the operating room (OR). The participants were then randomized to have a training course of six sessions (1 h each) on our simple simulator (MED-SIMU) or no training. Subsequently, all participants performed a further laparoscopic appendectomy in the OR. Both operations of each participant were recorded on video tapes, and assessed by two blinded laparoscopic senior surgeons using the predefined objective criteria such as time to complete the operation and the error counting.
Results
No differences in baseline variables were found between the two groups. Surgeons who received simulator training carried out laparoscopic appendectomy significantly faster than those in the control group (P=0.0006) and showed a greater improvement in error (P=0.0001).
Conclusion
Surgeons who had simulator training showed a greater enhancement in performance in the OR than those in the control group. Our simple surgical simulator is, therefore, a suitable tool for the training of laparoscopic motor skills and could be included in surgical training programs.

Keywords:
laparoscopy, simulator, training

Egyptian J Surgery 36:336–339

1110-1121

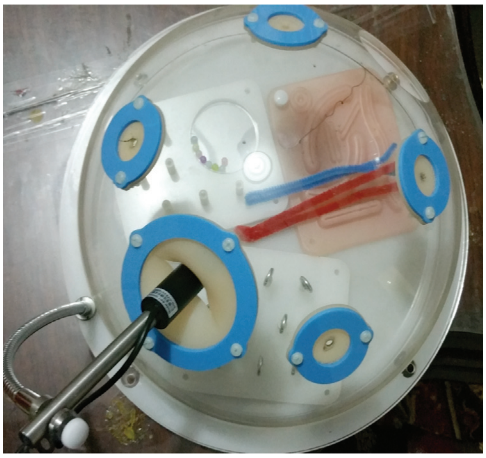
Introduction

Laparoscopy has grown to be the standard progress for many conditions in almost all surgical specialties [1–3]. It is obvious, however, that during the learning curve of the surgeons, laparoscopy is accompanied with a longer operation time and a superior rate of surgical complications. [4–8]. The possibility of beating these problems throughout the learning curve by appropriate training and ensuring that surgeons carry out enough number of cases are also been known [9]. The first obstacles in learning laparoscopy are psychomotor and perceptual. Focusing on patients' safety and rights and concern over costs of operating theater time are factors that confront the conventional surgical approach and give an increasing need for new methods in the training of laparoscopic surgeons [10]. Although simulation comes with important advantages in the spot of training for novel capabilities and procedures, proof of the shift of skills from the fake environment to the operating room is still inadequate [11,12].

Participants and methods

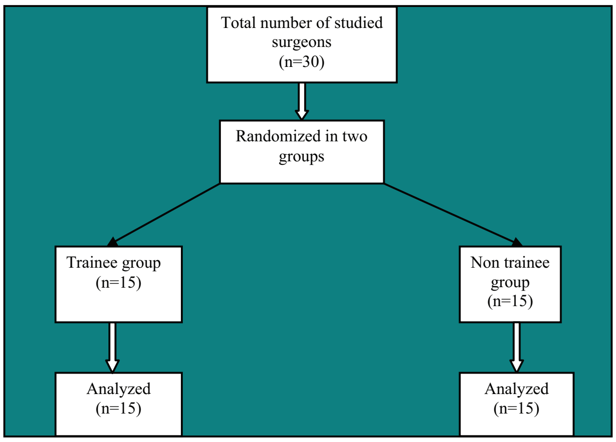
This study was carried out in the Emergency Department in Zagazig University Hospitals during February 2017. Participants were employed between March 2014 and March 2016. Thirty surgeons with limited practice in laparoscopic surgery (two to five laparoscopic appendectomies) participated in the study. All participants did a laparoscopic appendectomy, supervised by an experienced laparoscopic surgeon. The participants were then randomized to either a group that received training on our simple simulator (MED-SIMU, lyd917, China) (Fig. 1) or a control group that did not receive training. Randomization was done using closed envelopes. Training included six sessions (1 h each) in 3 weeks. Six tasks were of increasing difficulty and were designed to imitate the techniques used during the laparoscopic appendectomy. Task 1, the participant was asked to hold a sphere and place it in a small box. In task 2, the sphere was held, transferred between instruments, and then put in the box. Task 3 consisted of holding alternately the parts of a pipe. Task 4 required the participant to hold the sphere, touch it with the tip of the other instrument, remove and re-enter this instrument, and once more touch the sphere. Task 5 involved putting a thread through a sequence of holes. Task 6 involved making an intracorporeal knot. Within 3 weeks after the initial operation, all participants carried out another laparoscopic appendectomy, supervised by an expert laparoscopic surgeon who was blinded to the training status. The operations carried out by the participants were documented on video tapes and assessed by two senior surgeons highly skilled in laparoscopic surgery. We compared the time required to carry out the two operations for each surgeon and calculated the number of errors mentioned by the reviewers in the two operations for each surgeon. Errors were related to the psychomotor skills only and not related to the technical knowledge and anatomy. Cases presented with complications or discovered as complicated during surgery were excluded and the participant submitted to operate another case. The only assessed component of the operation was starting from the point at which dissection the mesoappendix took place and control of the base and removing the specimen outside the abdominal cavity. All cases were operated via three ports (supraumbilical, left iliac fossa, and suprapubic). The video tapes reviewers were blinded to the training category of the participants and performed the evaluation independently. The statistical analysis was done using data from the 30 surgeons.

Figure 1



The used simulator (MED-SIMU).

Figure 2



Flow of the participants through the study.

Results

We statistically analyzed 30 participants (15 in each group) whose operative procedures were documented on video tapes; their flow is demonstrated in Fig. 2. The demographic data of the participants are shown in Table 1. There was a fair agreement in the assessment scores provided by the two reviewers related to changes in the time taken to complete the operation, and error counted between the first and the second laparoscopic appendectomies, as shown in Table 2. Participants who received simulator training performed laparoscopic appendectomy significantly faster than did individuals in the control group (P=0.0006, t-test). Furthermore, the simulator-trained group showed considerably greater progress in their error (P=0.0001, t-test).

Discussion

Enormous types of simulators exist for laparoscopic training in general surgery with different degrees of validity and dependability. They differ widely in their platforms (physical or virtual reality) [13]. Physical simulators contain a box trainer and real instruments (as used in the laparoscopic theater). The equipment used in those simulators can offer texture and behavior like real tissues. The measurement method can be scored by a trained viewer [14–17]. Mammal's models have also been used to advance laparoscopic skills [18–21]. The conversion from the 'dry lab' to the 'wet lab' should be a necessary part of the exercise procedure of a laparoscopic surgeon. Animal training models offer an extensive variety of training applications, but

Table 1 Demographic data of the participants

	Trained group	Nontrained group
Sex ratio (male : female)	13 : 2	14 : 1
Age (years)	31.92 (28–32)	32 (29–33)
Time since graduation (years)	5.14 (5–7)	6.12 (5–7)
Number of laparoscopic appendectomy performed	3.2 (2–5)	2.95 (2–5)

Table 2 Time of the procedure and errors difference between the two groups

	First operation		Second operation	
	Trained group	Nontrained group	Trained group	Nontrained group
Duration of the procedure (min) [range (mean)]	45–75 (60)	55–70 (65.3)	40–60 (49.9)	45–75 (60.2)
P value	0.015		0.0006	
Number of calculated errors	5–7 (6)	5–9 (7.2)	2–5 (3.47)	4–8 (6)
P value	0.007		0.0001	

although this is important, it is also costly and we do not have an animal lab in our hospital.

Most training devices such as pelvic trainers or VR simulators provide training abilities with a spotlight on eye-hand harmonization, targeting the skill of suturing and knotting techniques. The low cost of pelvic trainers has paved the way for their widespread use [22]. We have adopted the use of a simple simulator (MED-SIMU) consisting of a box with four lateral ports for a needle holder and forceps, while a camera and PC monitor are used to simulate a two-dimensional laparoscopic field. Similar equipment for laparoscopic training had been described by Beatty [22].

In our study, training schedule was for 6 h for each trainee (2 h weekly) and this was double the training hours in a similar study conducted by Ahlberg *et al.* [23], who denoted no improvement in skills after training with a VR simulator. However, the participants in that study were trained for 3 h, and may not have reached the area of stability in their learning curves. A previous study established that the learning curve for junior surgeons reached an area of stability after eight repetitions of the whole six tasks, a course that may need more than 3 h of training [23]. This study discovered that there was a significant reduction in the time of the second operation in the trained group, more than that in the nontrained group; this was in agreement with Grantcharov *et al.* [24] in a similar study.Our study revealed that there was a significant reduction in the number of psychomotor errors in the trained group, more than that in the nontrained group; this was in agreement with Grantcharov *et al.* [24]. In our study, we used a MED-SIMU simulator that costs around 500 US dollars including the shipping, which is much cheaper than the virtual simulator fees, and provided a thorough training of our junior staff.

Conclusion

Laparoscopic surgery has a significant component in the field of surgical therapy and includes procedures with variant levels of complexity. Therefore, laparoscopy should be an important component of the training for junior surgical staff. In this study, surgeons who had simulator training showed a considerably greater advance in performance in the operating room than did those in the control group. MED-SIMU laparoscopy trainer represents a promising economic tool for training in laparoscopic surgery.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Bruhat M, Pouly J. Endoscopic treatment of ectopic pregnancies. Curr Opin Obstet Gynecol 1993; 5:260–266.
2 Keus F, Broeders I, van Laarhoven C. Gallstone disease: surgical aspects of symptomatic cholecystolithiasis and acute cholecystitis. Best Pract Res Clin Gastroenterol 2006; 20:1031–1051.
3 Rosenmuller M, Haapamaki M, Nordin P, Stenlund H, Nilsson E. Cholecystectomy in Sweden 2000–2003: a nationwide study on procedures, patient characteristics, and mortality. BMC Gastroenterol 2007; 7:35.
4 Karvonen J, Gullichsen R, Laine S, Salminen P, Gronroos J. Bile duct injuries during laparoscopic cholecystectomy: primary and long-term results from a single institution. Surg Endosc 2007; 21:1069–1073.
5 Avital S, Hermon H, Greenberg R, Karin E, Skornick Y. Learning curve in laparoscopic colorectal surgery: our first 100 patients. Isr Med Assoc J 2006; 8:683–686.
6 Kumar U, Gill I. Learning curve in human laparoscopic surgery. Curr Urol Rep 2006; 7:120–124.
7 Eto M, Harano M, Koga H, Tanaka M, Naito S. Clinical outcomes and learning curve of a laparoscopic adrenalectomy in 103 consecutive cases at a single institute. Int J Urol 2006; 13:671–676.
8 Adibe O, Nichol P, Flake A, Mattei P. Comparison of outcomes after laparoscopic and open pyloromyotomy at a high-volume pediatric teaching hospital. J Pediatr Surg 2006; 41:1676–1678.
9 Fleisch M, Newton J, Steinmetz I, Whitehair J, Hallum A, Hatch K. Learning and teaching advanced laparoscopic procedures: do alternating trainees impair a laparoscopic surgeon's learning curve? J Minim Invasive Gynecol 2007; 14:293–299.
10 Carlsson S, Nilsson A, Wiklund P. Postoperative urinary continence after robot-assisted laparoscopic radical prostatectomy. Scand J Urol Nephrol 2006; 40:103–107.
11 Issenberg S, McGaghie W, Petrusa E, Lee G, Scalese R. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. Med Teach 2005; 27:10–28.
12 Sutherland L, Middleton P, Anthony A, Hamdorf J, Cregan P, Scott D, *et al.* Surgical simulation: a systematic review. Ann Surg 2006; 243: 291–300.
13 Feldman L, Sherman V, Fried G. Using simulators to assess laparoscopic competence: ready for widespread use? Surgery 2004; 135:28–42.
14 Keyser E, Derossis A, Antoniuk M, Sigman H, Fried G. A simplified simulator for the training and evaluation of laparoscopic skills. Surg Endosc 2000; 14:149–153.

15 Risucci D, Geiss A, Gellman L, Pinard B, Rosser J. Surgeon specific factors in the acquisition of laparoscopic surgical skills. Am J Surg 2001; 181:289–293.

16 Rosser J, Rosser L, Savalgi R. Objective evaluation of a laparoscopic surgical skill program for residents and senior surgeons. Arch Surg 1998; 133:657–661.

17 Scott D, Young W, Tesfay S, Frawley W, Rege R, Jones D. Laparoscopic skills training. Am J Surg 2001; 182:137–142.

18 Katz R, Nadu A, Olsson L. A simplified 5-step model for training laparoscopic urethrovesical anastomosis. J Urol 2003; 169: 2041–2044.

19 Nadu A, Olsson L, Abbou C. Simple model for training in the laparoscopic vesicourethral running anastomosis. J Endourol 2003; 17:481–484.

20 Traxer O, Gettman M, Napper C. The impact of intense laparoscopic skills training on the operative performance of urology residents. J Urol 2001; 166:1658–1661.

21 Van Velthoven R, Hoffmann P. Methods for laparoscopic training using animal models. Curr Urol Rep 2006; 7:114–119.

22 Beatty J. How to build an inexpensive laparoscopic webcam-based trainer. BJU Int 2005; 96:679–682.

23 Ahlberg G, Heikkinen T, Iselius L, Leijonmarck C, Rutqvist J, Arvidsson D. Does training in a virtual reality simulator improve surgical performance? Surg Endosc 2002; 16:126–129.

24 Grantcharov T, Kristiansen V, Bendix J, Bardram L, Rosenberg J, Funch-Jensen P. Randomized clinical trial of virtual reality simulation for laparoscopic skills training. Br J Surg 2004; 91:146–150.