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Surgical Endoscopy and Other Interventional Techniques

Predicting baseline laparoscopic surgery skills

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Abstract
Background: Laparoscopic surgery requires specialized dexterity even beyond that required for open surgery. Decreased tactile feedback, different eye–hand coordination, and translation of a two-dimensional video image into a three-dimensional working area are just some of the obstacles in the performance of laparoscopic surgery. Possession of certain nonsurgical skills may help in overcoming some of these obstacles. Prediction of baseline laparoscopic surgery skills may help further to refine the education of basic laparoscopic surgery skills. This investigation explores whether nonsurgical skills and demographic data can predict baseline laparoscopic surgery tasks.
Methods: First- and second-year students were given a survey regarding nonsurgical dexterity skills. The survey inquired about typing skills, play with computer games, ability to sew, skill with music instruments, use of chopsticks, and experience operating tools. Demographic data were requested as well. All the students underwent four tasks: placing a piece of bowel in a retrieval bag, placing a stapler on the bowel, measuring a piece of bowel, and performing a liver biopsy in a porcine animal model. Both objective (time and error) and subjective evaluation were assessed for all the tasks. Statistical analysis using analysis of variances (ANOVA) Kruskal–Wallis test with post hoc tests, two-tailed unpaired *t*-tests/Mann–Whitney test, and Fischer's exact tests/chi-square tests was performed when appropriate.
Results: There were 68 students in this investigation. Gender, medical student year, ethnicity, desire to enter a surgical field, and age were not associated with increased performance in any of the tasks. Chopstick use was associated with statistically significantly better mean time in placing a piece of bowel in a retrieval bag and measuring a piece of bowel ($p < 0.04$). The other nonsurgical dexterity skills did not statistically increase performance, as indicated by time, errors, or subjective scores, for the four tasks.
Conclusions: It is difficult to predict baseline laparoscopic surgery skills.

Key words: Laparoscopy — Surgery — Technical skill — Education

The advent of complex laparoscopic procedures has required a new set of skills that must be acquired by general surgeons. Laparoscopic surgery mandates specialized dexterity beyond that of open surgery because of certain obstacles including altered tactile feedback, different eye–hand coordination, translation of a two-dimensional video image into a three-dimensional working area, and the fulcrum effect [1, 2, 4]. These unique issues make the training of surgeons in laparoscopic skills more difficult. In addition, unlike open surgery, it can be difficult for laproscopic surgery to allow graduated responsibility for novice surgeons. In open surgery, it is easier to guide a novice surgeon-in-training through a complex procedure safely and efficiently. In laparoscopic surgery, once the surgeon-in-training is given the instruments, he or she is given control of the operation. Thus, training in a basic laparoscopic skill laboratory is important before a surgeon is allowed to perform actual surgical procedures. How vigorous this training needs to be depends on the level at which the trainee starts.

Not all surgeons-in-training start on equal ground. The ability of the trainee can vary even before he or she performs any laparoscopic surgery. Thus, predicting baseline laparoscopic surgery skills may help further refine the education of basic laparoscopic surgery skills. This study tested our hypothesis that certain nonsurgical skills and demographic data can predict performance in baseline laparoscopic surgery tasks.

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Table 1. Objective and subjective scoring of the laparoscopic tasks

1. Placing a piece of bowel in a retrieval bag
Objective scores
Time
Errors of dropped bowel or perforated bowel
Subjective scores (1–100)
Use of both hands
Tissue handling
Overall
2. Placing a stapler on the bowel
Objective scores
Time
Errors of incorrect placement, bowel injury, or inclusion of other tissue in stapler
Subjective scores (1–100)
Use of both hands
Tissue handling
Overall
3. Measuring a piece of bowel
Objective scores
Time
Errors of bowel injury or dropping tape
Subjective scores (1–100)
Use of both hands
Tissue handling
Overall
4. Performing a liver biopsy
Objective scores
Time
Errors of bowel injury or dropping tape
Subjective scores (1–100)
Use of both hands
Tissue handling
Biopsy-site hemostasis
Overall

Table 2. Student responses to nonsurgical skills questions[a]

Dominant hand	Right	67	Left	0
Computer/video games	Yes	49	No	18
	Novice	31	Expert	18
Typing	Yes	66	No	0
	Novice	23	Expert	37
Chopsticks	Yes	50	No	17
	Novice	26	Expert	23
Music instruments	Yes	33	No	33
	Novice	24	Expert	6
Sew	Yes	28	No	39
	Novice	25	Expert	2
Tools	Yes	28	No	39
	Novice	25	Expert	2

[a] Blank responses not computed

Table 3. Overall mean objective and subjective scores by all students[a]

1. Placing a piece of bowel in retrieval bag	
Objective scores	
Time	31 ± 22
Errors	0.0 ± 0.0
Subjective scores	
Use of both hands	86 ± 8
Tissue handling	87 ± 6
Overall	88 ± 6
2. Placing a stapler on the bowel	
Objective scores	
Time	199 ± 100
Errors	0.3 ± 0.5
Subjective scores	
Use of both hands	63 ± 25
Tissue handling	70 ± 12
Overall	67 ± 16
3. Measuring a piece of bowel	
Objective scores	
Time	190 ± 133
Errors	0.2 ± 0.4
Subjective scores	
Use of both hands	80 ± 18
Tissue handling	88 ± 12
Overall	90 ± 12
Performing a liver biopsy	
Objective scores	
Time	267 ± 115
Errors	0.3 ± 0.5
Subjective scores	
Use of both hands	68 ± 13
Tissue handling	69 ± 13
Biopsy-site hemostasis	67 ± 12
Overall	69 ± 10

[a] Time is given as seconds, and data are given as mean ± standard deviation

Methods

This investigation used first- and second-year volunteer students. Our institution's institutional review board exempted this study from formal informed consent. A survey regarding nonsurgical dexterity skills was given to all the students (Appendix). The survey inquired about typing skills, play with computer games, ability to sew, skill with music instruments, use of chopsticks, and experience operating tools. Incomplete responses were not included in the study. Demographic data also were collected.

The students were given a didactic session (30 min) to demonstrate four laparoscopic tasks. All the students engaged in these laparoscopic tasks in a porcine laboratory. The four tasks included placing a piece of bowel in a retrieval bag, placing a stapler on the bowel, measuring a piece of bowel with an umbilical tape, and performing a liver biopsy and hemostasis in a porcine animal model. Both objective (time and error) and subjective evaluation were assessed for all the tasks (Table 1).

All subjective scores were given by one examiner per task. A score of 100 for the subjective evaluation overall meant the student could easily perform the task with no assistance at all. A score of 100 for the subjective assessment of both hands meant the student always used both hands to his or her advantage. A score of 100 on tissue handling meant the student was always careful to ensure that the tissue was not injured or unduly stressed. A score of 100 for the subjective evaluation of biopsy-site hemostasis meant the student controlled hemorrhage and the site was not bleeding at all. Statistical analysis including analysis of variance (ANOVA), Kruskal–Wallis testing with post hoc tests, two-tailed unpaired *t*-tests/Mann–Whitney test, Fisher's exact tests/chi-square tests) was performed as appropriate.

Results

A total of 67 students were enrolled in this study (55% female and 45% male). There were 41 first-year students and 26 second-year students. Their mean age was 29 years. Although 22% had some surgical experience, their experience was limited to animal research or observation. Only 4% of the students had any laparoscopic experience, all of which was limited to observation. Almost half of the students (46%) desired to go into surgery. Other student responses are shown in Table 2.

Table 3 displays the average performance by all the students on each task. Age did not correlate consistently with any scores ($r = -0.26$–0.19). Errors and subjective scores did not show any statistically significant differences by any demographic data or nonsurgical skills. (Table 4) Only the students who used chopsticks dem-

Table 4. Demographic data and nonsurgical skills that were not associated with scores

Gender
Ethnicity
Medical student level
Residency choice of surgery
Typing
Computer video games
Tools
Sewing
Music instruments

Table 5. Time scores (s) by chopstick use

Chopstick use	No	Expert	Novice
Placing a piece of bowel in a retrieval bag	38[a]	25	29
Placing a Stapler on the bowel	200[b]	224	179
Measuring a Piece of bowel	237[a]	165	181
Performing a liver biopsy	272[b]	242	290

[a] $p < 0.04$
[b] p = not significant

onstrated statistically significant better times for the tasks of placing a piece of bowel in retrieval bag and measuring a piece of bowel (Table 5).

Conclusions

This study demonstrated that the use of chopsticks was associated with better performance in baseline laparoscopic skills. No other nonsurgical skill or demographic data were associated with better performance. The significance of this finding is debatable. Our thought is that fine motor movements and understanding of the fulcrum effect are needed for the use of chopsticks, which may translate into better laparoscopic skills.

Our assessment of nonsurgical dexterity skills was admittedly limited. We did not actually test students in performing nonsurgical tasks. Because these tasks were self-reported, may have been some bias in our results.

Risucci et al. performed a study that investigated factors correlated with mean laparoscopic suturing and dexterity drill times [5]. They found that age, years after training, and performance on visual perception standardized tests correlated with laparoscopic skills. We purposely studied medical students so we could find factors in similarly aged and experienced trainees.

Our investigation demonstrated no gender difference in laparoscopic skills. However, one European study suggested that female residents were more likely to take more time for tasks on a virtual reality trainer [3]. They also saw a decrease in errors among residents who played computer games. The discrepancy in their results and ours is most likely multifactorial including sample size, the use of residents in their study, and possibly even cultural differences of residency selection. In addition, the study demonstrated no statistically significant gender difference when multiple regression analysis was performed.

We honestly were surprised that playing video games did not correlate with baseline laparoscopic skills. This may be indicate that our new generation of students all are adapt with computers in general, as demonstrated by the fact all the students knew how to type. Although they may not play video games, many students have been exposed to computers, which may give them some baseline eye–hand coordination, as compared with other generations.

Most nonsurgical skills and demographic data do not predict laparoscopic skills. In fact, this study found only one nonsurgical skill that predicted laparoscopic skills. Further investigations may be helpful to determine what other nonsurgical skills predict laparoscopic skills and whether participating in these nonsurgical skills may help surgeons-in-training become better laparoscopic surgeons.

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Appendix

Appendix continues on page 104.

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Appendix

Name		Date of birth	
Gender		Ethnicity	
Contact information:			
Email		Phone(s)	
Best way to contact:	Email	Phone	
Year started medical school:			
Medical school year:	M1	M2	
Any past surgical experience (if yes, describe)?			
Any past laparoscopic experience (if yes, describe)?			
Which hand is dominant?	Left	Right	Ambidextrous
Do you play computer or video games?			
How many years?			
Consider yourself:	Novice	Expert	
Can you type?			
How many years?			
Estimated words per minute:			
Consider yourself:	Novice	Expert	
Can you use chop sticks?			
How many years?			
Consider yourself:	Novice	Expert	
Do you play any musical instruments?			
Which type and how many years?			
Consider yourself:	Novice	Expert	
Do you sew (clothes etc.)?			
How many years?			
Consider yourself	Novice	Expert	
Do you use tools (to work on house projects or cars etc.)?			
How many years?			
Consider yourself	Novice	Expert	
Residency interest—be specific (If not sure, please write most likely):			