



Identifying the needs for teaching fundamental knowledge of laparoscopic surgery: a cross-sectional study in Japan

Shinichiro Yokoyama¹ · Yusuke Watanabe^{1,2,12} · Yo Kurashima^{1,3} · Akihiko Oshita^{4,5} · Yuji Nishizawa⁶ · Takeshi Naitoh⁷ · Fumitaka Nakamura² · Satoru Kikuchi⁸ · Kazuhiro Noma⁸ · Saseem Poudel^{1,9} · Akihiro Suzuki¹⁰ · Yuichi Nishihara¹¹ · Masaaki Ito⁶ · Satoshi Hirano¹

Received: 25 July 2018 / Accepted: 11 October 2018 / Published online: 22 October 2018
© Springer Science+Business Media, LLC, part of Springer Nature 2018

Abstract

Background Recently, laparoscopic surgery (LS) has become a more common procedure than traditional open surgery. Although LS-related adverse events have been reported, there is no formal, standardized curriculum to teach the fundamentals of LS in Japan. Understanding surgeons' knowledge regarding LS is crucial for developing an educational curriculum. The purpose of this study was to determine the baseline knowledge on LS of surgeons and surgical trainees in Japan.

Methods Participants completed 24 multiple-choice questions testing basic cognitive knowledge of LS and a questionnaire regarding the status of laparoscopic education. The examination was developed according to the 13 content domains of the Fundamentals of Laparoscopic Surgery (FLS) program. Scores were compared between post-graduate year (PGY) > 5 and PGY 1–5 participants. Data are expressed as median scores and interquartile ranges. Wilcoxon signed-rank test was used for statistical analysis.

Results A total of 195 surgeons and surgical trainees from 10 teaching hospitals (PGY1–5: 66, PGY > 5: 129) across Japan completed the examination. The median score in the entire cohort was 75 [67; 83] %, with significantly higher scores in the PGY > 5 group compared to the PGY 1–5 group (79 [75; 83] % vs. 67 [58; 75] %, $p < 0.001$). The differences in performance were due to better scores for PGY > 5 group on the sections “equipment,” “patient considerations,” “abdominal access,” “tissue handling,” “hemorrhage and hemostasis,” “tissue approximation,” and “exiting the abdomen.” Overall, the median scores in the “energy sources” and “establishment and physiology of the pneumoperitoneum” subsections were lower than in other domains. All participants agreed on the need for fundamental knowledge and a formal educational curriculum.

Conclusions Compared to experienced surgeons, surgical trainees had lesser knowledge about performing LS. Regardless of the years of experience, there are crucial knowledge gaps in specific areas regarding safe LS that should be addressed by implementing an educational curriculum.

Keywords Patient safety · Competence · Surgical education · Continuing medical education · Evaluation · Laparoscopic surgery

Laparoscopic surgery (LS) has become a part of the routine surgical practice and has led to the advancement of surgery by its increasing role in patient outcomes, such as decreasing surgical site infection rates, and education [1, 2]. LS is a surgical operation that is performed in specific circumstances and involves the use of new devices and the creation of a physiological pneumoperitoneum. In LS, complications that are not typically experienced in open surgery can occur.

Although intraoperative adverse events are rare, problems related to LS have been reported [3, 4]. Application of fundamental cognitive and psychomotor training will ensure a minimal standard of care for all patients undergoing LS. In this regard, the Fundamentals of Laparoscopic Surgery™ (FLS) program was developed with a definite goal in 2004 by the Society of American Gastrointestinal Endoscopic Surgery as a validated standard training model [5]. Successful completion of the FLS exam has become a requirement for board certification by the American Board of Surgery due to its educational role and reliability [6, 7].

✉ Yusuke Watanabe
ywatanabe328@gmail.com

Extended author information available on the last page of the article

LS has advanced from basic procedures to more complex procedures. As such, the safety demands of LS have increased. LS-related adverse events have been reported in Japan and these were significant but preventable social problems [8, 9]. Currently, the Japan Surgical Society, which is the body for board certification, requires the performance of ten cases of LS as a requirement for board certification; however, there are no further requirements of skills, including cognitive and psychomotor skills [10]. The endoscopic surgical skill qualification system, which is an advanced LS-certified system developed by the Japan Society for Endoscopic Surgery, assesses operative performance but not cognitive focus [11]. A standard curriculum to teach and assess basic knowledge for safe LS is lacking.

There have been no investigations on the degree of knowledge required for safe LS, and no studies that explore the need for an educational training module to teach and assess knowledge of LS in Japan. To understand the requirements for fundamental LS knowledge and to survey which areas need to be focused on when designing the educational curriculum, elucidating the knowledge levels of surgeons and surgical trainees regarding safe LS is crucial. The purpose of this study was to determine the baseline knowledge of the surgeons and surgical trainees who were performing LS and to identify the educational needs for a cognitive-focused LS curriculum in Japan.

Materials and methods

Participants were recruited from all levels of the surgical profession to complete a web-based examination assessing knowledge of LS over a 3-month time frame. They completed questionnaires about the need for learning the basics of LS and a formal educational curriculum. The local investigators were recruited on a volunteer basis directly at the 2016 Surgical Education Summit, the Japanese Association for Surgical Education (JASE) and through email [12]. The assessment questionnaires were circulated to all surgeons and surgical trainees at each institution using departmental announcements and personal communications. Surgeons and surgical trainees had at least one laparoscopic case experience as either a primary surgeon or an assistant in the 2015 academic year. This study was approved by the institutional review board of Hokkaido University (# 016–026) and consent was obtained from all participating institutes except for three institutions where the institutional ethics approval was waived for this study. All participants provided written informed consent before study enrolment. Participants were categorized according to years of experience after medical school [post-graduate years (PGY)].

Assessment instruments

A 24-question multiple-choice examination was used. The assessment for essential knowledge of LS was developed based on the 13-content domains of the FLS program [13]. The number of questions for each objective was modified from the weighting reported for the FLS certification examination blueprints in order to better reflect the clinical practice in Japan. Anesthesia and biopsy technique objectives were excluded because of differing practice patterns in Japan. Our research team adjusted the weight of the content area and finalized the questions based on the modified weight. The final domains of the FLS program are shown in Table 1. The survey questionnaire used a 4-point Likert scale for the four categories of strongly agree, agree, disagree, and strongly disagree. The questionnaire investigated the need for learning the fundamentals of laparoscopy, providing a formal educational curriculum, and assessing fundamental laparoscopic knowledge at the point of preliminary examination of board certification or endoscopic surgical skill qualification. The assessment was developed by two surgeons (Y.W. and Y.K.) who had FLS program certification and the members of the surgical education research team at Hokkaido University.

Data analysis

Total score was calculated as percentage correct answers of the 24 items. Scores were compared between PGY > 5 and PGY 1–5 participants. PGY 6 was used as a cutoff to segregate levels of experience as trainees are eligible to be board-certified surgeons at the end of PGY 6 of training in Japan. The PGY > 5 group was further divided into PGY 6–15 and PGY > 15 categories based on teaching responsibilities and surgical experience. Results are expressed as median and interquartile range unless otherwise stated. Wilcoxon signed-rank test was used to analyze differences between the groups. All analyses were performed using JMP version 12.2.0 (SAS Institute Inc., Cary, NC, USA). $p < 0.05$ was considered statistically significant.

Results

Participants

Of the 220 candidates from 10 teaching institutions, 195 surgeons and surgical trainees completed the assessment (response rate 89%). Participant characteristics, including board certification, self-reported experience, and prior

Table 1 Eleven major content areas conformed to the weighting reported for the FLS certification examination blueprints

Subject area	FLS original weight (%)	Modified weight in this study (%)
1 Equipment: tools of the trade	11	13
2 Energy sources: electrosurgery, ultrasound, and laser	7	8
3 Patient considerations: patient selection, contraindications, and preparation	11	13
4 Anesthesia: types and complications	4	NA ^a
5 Patient positioning	7	4
6 Establishment and physiology of the pneumoperitoneum	11	17
7 Abdominal access and trocar placement	11	8
8 Tissue handling, exposure, and examination of the abdomen and pelvis	11	8
9 Biopsy techniques	5	NA ^a
10 Hemorrhage and hemostasis	7	13
11 Tissue approximation: indication and techniques	4	8
12 Exiting the abdomen: drains, site closure	4	4
13 Postoperative care	4	4

FLS Fundamentals of Laparoscopic Surgery, NA not applicable

^a“Anesthesia” and “biopsy techniques” were excluded due to different practice situations in Japan

Table 2 Participant characteristics ($n = 195$)

	PGY 1–5 group ($n = 66$)	PGY > 5 group ($n = 129$)
Age in years	27 [26–29]	38 [33–43]
Male sex: no. (%)	53 (76)	122 (89)
Board Certified Surgeon: no. (%)	0 (0)	116 (84)
Endoscopic surgical skill qualification system: no. (%)	0 (0)	28 (20)
Experience as leading assistant: no. (%)	9 (14)	91 (71)
Self-reported prior training in laparoscopic surgery ^a : no. (%)		
Self-learning (text books)	21 (50)	83 (71)
Informal teaching by a surgeon or colleague	34 (81)	101 (86)
Industry-sponsored course or lecture	4 (10)	62 (53)
CME course or lecture	0 (0)	53 (45)
Total laparoscopic surgical cases: no. (%)		
0–100	51 (77)	16 (12)
101–500	15 (23)	65 (50)
501–	0 (0)	48 (37)

Results are presented as median [interquartile range]

PGY post-graduate year

^aThe results included some overlapping

training in LS are shown in Table 2 (median age, 34; 85% male).

Assessment

The median score of the entire cohort was 75 ([67; 83] % range = 38–96%), with significantly higher scores in the PGY > 5 group compared to that in the PGY1–5 group (79 [75; 83] vs. 67 [58; 75], $p < 0.01$) (Fig. 1A). For all

participants, the median scores in each domain subsection are shown in Table 3. Content areas with suboptimal understanding included “energy sources,” “tissue handling, exposure, and examination,” and “tissue approximation.” In PGY < 5 group, the participants with more operative experience had higher scores compared to those with less surgical experience (≤ 100 cases 67 [58; 71] vs. 101–500 cases 79 [63; 83], $p = 0.01$), although the difference in the rate of self-reported laparoscopic study was not significant. In

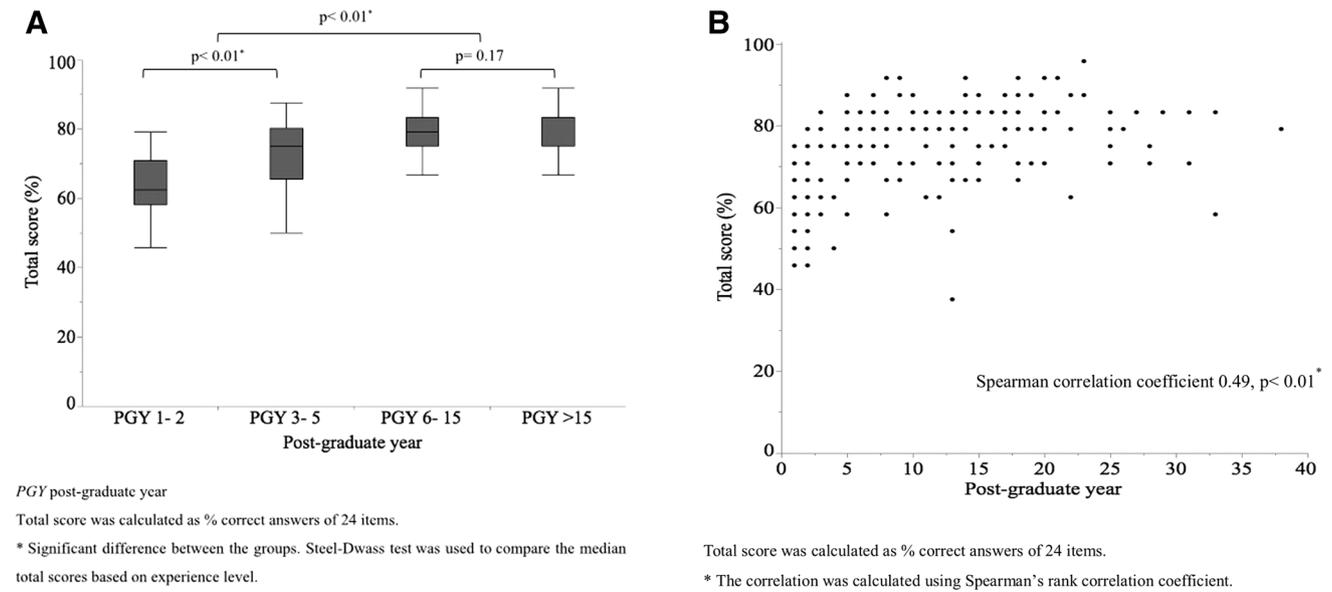


Fig. 1 **A** Assessment total scores for each group. **B** Correlation between assessment total scores and experience levels

Table 3 Scores for each participant group ($n = 195$)

	Total participants ($n = 195$)	PGY 1–5 group ($n = 66$)	PGY > 5 group ($n = 129$)	p value
Total score	75 [67; 83]	67 [58; 75]	79 [75; 83]	< 0.01*
Subsection score: no. (%)				
Equipment: tools of the trade	100 [67; 100]	67 [67; 100]	100 [67; 100]	< 0.01*
Energy sources; electrosurgery, ultrasound, and laser	50 [50; 100]	50 [50; 100]	50 [50; 100]	0.08
Patient considerations: patient selection, contraindications, and preparation	67 [67; 100]	67 [67; 67]	67 [67; 100]	0.03*
Patient positioning	100 [100; 100]	100 [100; 100]	100 [100; 100]	0.72
Establishment and physiology of the pneumoperitoneum	75 [50; 75]	75 [50; 75]	50 [50; 75]	0.18
Abdominal access and trocar placement	100 [50; 100]	50 [50; 100]	100 [100; 100]	< 0.01*
Tissue handling, exposure and examination of the abdomen and pelvis	50 [50; 100]	50 [50; 100]	50 [50; 100]	< 0.01*
Hemorrhage and hemostasis	100 [100; 100]	100 [100; 100]	100 [100; 100]	< 0.01*
Tissue approximation: indication and techniques	50 [50; 100]	50 [50; 50]	100 [50; 100]	< 0.01*
Exiting abdomen: drains, site closure	100 [0; 100]	0 [0; 100]	100 [50; 100]	< 0.01*
Postoperative care	100 [0; 100]	100 [0; 100]	100 [100; 100]	0.13

Results are presented as median [interquartile range]

PGY post-graduate year

*Significant difference between the groups

the PGY > 5 group, there was no difference in both overall scores and scores for each domain regardless of whether the participants were qualified surgeons or not (79 [76; 83] vs. 79 [75; 83], $p = 1.00$) and endoscopic surgical skill qualified surgeons or not (81 [75; 83] vs. 79 [75; 83], $p = 0.41$). Beyond 5-year experience, a higher level of experience did not necessarily correlate with fundamental knowledge

(6–15 years vs. >15 years of experience after graduation from medical school: 79 [75; 83] vs. 83 [75; 83], $p = 0.17$) (Fig. 1). There were no differences in any of the scores across institutions.

Of the study participants, 30% did not know the physiological changes in gas embolism and its management; 63% were unfamiliar with the features of residual heat of energy

devices (e.g., monopolar, ultrasonic device, and vessel sealing); 27% did not know how long the postoperative shoulder pain secondary to diaphragmatic irritation persisted; and 43% could not prioritize the steps of managing a reduced laparoscopic view of the operative field. Of the trainees, 50% had poor understanding of the best area for alternate trocar insertion relative to the midline incision (vs. 90% of surgeons with PGY > 5). Of the PGY > 5 group, 40% of surgeons did not know the ideal suture length for extracorporeal knot tying. The scores for patient positioning, hemorrhage, and hemostasis were over 90% in both groups.

Questionnaire

According to the survey questionnaire, 99% (194 of 195) of the participants strongly agreed or agreed with the need for basic knowledge and an educational curriculum on LS. Regardless of training levels, 94% (184 of 195) of the participants agreed that surgeons should be assessed for the basic knowledge of LS until board certification.

Discussion

This study specifies some of the insufficiencies in the fundamental knowledge required for safe LS among surgeons with varying levels of experience in various institutions. While the trainees had suboptimal knowledge, the experienced surgeons were more knowledgeable, but still had several deficiencies in knowledge of particular content areas, suggesting an educational need that has to be strategically addressed in Japan. There were also considerable gaps in the knowledge of physiological changes that occur in pneumoperitoneum and gas embolism, the effect of energy devices, and postoperative care regardless of level of experience. Most participants agreed that surgeons should acquire and be assessed for fundamental knowledge to perform safe LS. The significance of the results demonstrates a universal need for formal educational interventions regardless of clinical experience and highlights the pertinence of acquiring fundamental knowledge of LS.

This is the first multicenter study to examine the fundamental knowledge for safe LS across varying levels of experience in Japan. Numerous studies, of both cross-sectional as well as interventional design, focusing on the technical skills in LS have reported the effectiveness of educational interventions. Since studies focused on cognitive knowledge are limited, implementing the FLS program and its examination widely [14, 15], and collecting the baseline data of cognitive knowledge can be challenging. Although the results of studies focused on cognitive knowledge are limited, there were multi-institutional investigations which showed the baseline data of cognitive knowledge fundamental to safe LS in North

America presented similar to our trends [16]. The results of our study are significant for further promoting educational interventions such as FLS.

Assessment of the total scores of surgeons with different levels of experience suggested that clinical experience did not necessarily correlate with a better knowledge of basic LS, especially beyond the initial experience of 5 years, suggesting that the proportion of knowledge acquired from clinical experience may be limited. Knowledge gaps were observed in several content areas including “energy sources,” “tissue handling, exposure, and examination,” and “tissue approximation.” With regard to energy devices, there were many surgeons who knew how to actually use them without knowing the underlying mechanism. This knowledge gap has been emphasized in previous research [17]. In this study, we found similar findings to those previously reported, which highlight the potential risks of adverse events. Suboptimal knowledge was also found in particular content areas that were unlikely to be acquired from clinical experience due to infrequently encountered situations or commonly overlooked changes. The published reports of complications such as intraoperative hypercapnia and acidosis with pneumoperitoneum and vessel damage associated with trocar insertion indicated the possibility of causing complications because of lack of knowledge [3, 4]. These results emphasize the need to rectify the gaps in knowledge systematically. A standardized curriculum will be critical for ensuring a fundamental knowledge base that includes rare but important complications.

In the questionnaire results, almost all the participants felt the need for fundamental laparoscopic knowledge and 94% of the participants answered that fundamental laparoscopic knowledge was assessed in the written certifying examination which is conducted by the Board Committee of Japan Surgical Society. Currently, the minimum requirement to be certified for LS is case experience, with at least ten cases of any endoscopic surgery being required regardless of knowledge on LS [10]. LS has become a part of routine surgical practice and its role and importance are growing with respect to better patient outcomes, decreasing surgical site infection rates, and educational parts. Thus, acquiring the required skills and knowledge in the LS procedure is becoming increasingly important for surgeons. However, the study results point to a mismatch between the requirements of the surgeons and the current situation. With the insight gained from this study, improvements in the existing system can be made.

There are several limitations of the current study. The multicenter design, including both academic and community teaching institutions, and various geographic locations with a high response rate allowed us to minimize sampling bias and to increase the generalizability of the results. Nonetheless, there was some degree of sampling bias which limits

generalizing the data. Second, all the participants were either surgeons or trainees in general surgery, and surgeons from other specialties including pediatric surgeons, cardiovascular surgeons, obstetricians, and gynecologists were not included in this study. Ideally, all surgeons and trainees who perform or assist in LS should be assessed to ensure patient safety. If other surgical specialists were assessed, the results may have differed, because the operation frequency of LS would be different. Indeed, the spread of LS varies from field to field; LS is more important in obstetrics, gynecology, pediatric surgery, and general surgery than in cardiovascular surgery. Nonetheless, LS has become a routine practice for various surgical specialties. It is thus necessary to discuss the minimal requirements to perform LS. Although there are limitations to the generalizability of the findings, we believe that our results reveal a need for an education curriculum to teach fundamental knowledge contributing to safe LS. It remains unclear to what degree knowledge is associated with the clinical risk of adverse events related to LS. It would, therefore, be ideal to establish a correlation between the clinical rates of LS-related adverse events and knowledge of the surgeon.

In conclusion, in the absence of a formal educational curriculum for LS in Japan, several knowledge gaps have been identified between surgeons and trainees regarding safe LS. All surgeons and trainees were cognizant of the necessity of fundamental knowledge of LS. We stress the need for a formal educational curriculum in order to close the knowledge gaps and ensure safe LS.

Acknowledgements The authors would like to thank Manabu Yamamoto, Tomoko Mizota, JASE members, and local residency program directors of teaching hospitals, surgeons, and trainees for their participation in this study. We could not have completed the survey study without their support.

Compliance with ethical standards

Disclosures Drs. Shinichiro Yokoyama, Yusuke Watanabe, Yo Kurashima, Akihiko Oshita, Yuji Nishizawa, Takeshi Naitoh, Fumitaka Nakamura, Satoru Kikuchi, Kazuhiro Noma, Saseem Poudel, Akihiro Suzuki, Yuichi Nishihara, Masaaki Ito, and Satoshi Hirano have no conflicts of interest or financial ties to disclose associated with this manuscript.

References

1. Yu MC, Feng Y, Wang W, Fan W, Cheng H, Xu J (2017) Is laparoscopic appendectomy feasible for complicated appendicitis? A systematic review and meta-analysis. *Int J Surg* 40:187–197. <https://doi.org/10.1016/j.ijsu.2017.03.022>
2. Arkenbosch J, Miyagaki H, Kumara HMCS, Yan X, Cecik V, Whelan RL (2015) Efficacy of laparoscopic-assisted approach for reversal of Hartmann's procedure: results from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. *Surg Endosc* 29:2109–2114. <https://doi.org/10.1007/s00464-014-3926-7>
3. Bishay M, Giacomello L, Retrosi G, Thyoka M, Garriboli M, Brierley J, Harding L, Scuplak S, Cross KM, Curry JI, Kiely EM, Coppi PD, Eaton S, Pierro A (2013) Hypercapnia and acidosis during open and thoracoscopic repair of congenital diaphragmatic hernia and esophageal atresia. *Ann Surg* 258:895–900. <https://doi.org/10.1097/SLA.0b013e31828fab55>
4. Alkatout I (2017) Complications of laparoscopy in connection with entry techniques. *J Gynecol Surg* 33:81–91. <https://doi.org/10.1089/gyn.2016.0111>
5. Brunt LM (2014) FLS: celebrating a decade of innovation in surgical education. <http://bulletin.facs.org/2014/11/fls-celebrating-a-decade-of-innovation-in-surgical-education/#.Wr7zVWbAOnc>. Accessed 18 July 2018
6. Derevianko AY, Schwaitzberg SD, Tsuda S, Barrios L, Brooks DC, Callery MP, Fobert D, Irias N, Rattner DW, Jones DB (2010) Malpractice carrier underwrites Fundamentals of Laparoscopic Surgery training and testing: a benchmark for patient safety. *Surg Endosc* 24:616–623. <https://doi.org/10.1007/s00464-009-0617-x>
7. Hafford ML, Van Sickle KR, Willis RE, Wilson TD, Gugliuzza K, Brown KM, Scott DJ (2013) Ensuring competency: are Fundamentals of Laparoscopic Surgery training and certification necessary for practicing surgeons and operating room personnel? *Surg Endosc* 27:118–126. <https://doi.org/10.1007/s00464-012-2437-7>
8. Survey finds high death rate after complex liver surgery. *The Japan Times*. <https://www.japantimes.co.jp/news/2015/03/24/national/science-health/survey-finds-high-death-rate-after-complex-liver-surgery/#.Wr4W5GbAOgw>. Accessed 18 July 2018
9. Appalling surgical negligence. *The Japan Times*. https://www.japantimes.co.jp/opinion/2015/03/21/editorials/appalling-surgical-negligence/#.WwVyZi_AOvM. Accessed 18 July 2018
10. Japan Surgical Society Website. Training curriculum to be a Board-certified surgeon. <https://www.jssoc.or.jp/procedure/specialist/curriculum-1.pdf>. Accessed 18 July 2018
11. Japan Society for Endoscopic Surgery Website. <http://www.jses.or.jp/en/index.html>. Accessed 18 July 2018
12. Japanese Association for Surgical Education Website. <http://www.surgicaleducation.jp>. Accessed 18 July 2018
13. Peters JH, Fried GM, Swanstrom LL, Soper NJ, Sillan LF, Schirmer B, Hoffman, the SAGES FLS Committee (2004) Development and validation of a comprehensive program of education and assessment of the Fundamentals of Laparoscopic Surgery. *Surgery* 135:21–27. <https://doi.org/10.1016/S0039>
14. Okraïnec A, Soper NJ, Swanström LL, Fried GM (2010) Trends and results of the first 5 years of Fundamentals of Laparoscopic Surgery (FLS) certification testing. *Surg Endosc* 25:1192–1198. <https://doi.org/10.1007/s00464-010-1343-0>
15. Bilgic E, Kaneva P, Okraïnec A, Ritter EM, Schwaitzberg SD, Vassiliou MC (2017) Trends in the Fundamentals of Laparoscopic Surgery® (FLS) certification exam over the past 9 years. *Surg Endosc* <https://doi.org/10.1007/s00464-017-5907-0>
16. Swanstrom LL, Fried GM, Hoffman KI, Soper NJ (2006) Beta test results of a new system assessing competence in laparoscopic surgery. *J Am Coll Surg* 202:62–69. <https://doi.org/10.1016/j.jamcollsurg.2005.09.024>
17. Watanabe Y, Kurashima Y, Madani A, Feldman LS, Ishida M, Oshita A, Naitoh T, Noma K, Yasumasa K, Nagata H, Nakamura F, Ono K, Suzuki Y, Matsuhashi N, Shichinohe T, Hirano S (2015) Surgeons have knowledge gaps in the safe use of energy devices: a multicenter cross-sectional study. *Surg Endosc* 30:588–592. <https://doi.org/10.1007/s00464-015-4243-5>

Affiliations

Shinichiro Yokoyama¹ · Yusuke Watanabe^{1,2,12} · Yo Kurashima^{1,3} · Akihiko Oshita^{4,5} · Yuji Nishizawa⁶ · Takeshi Naitoh⁷ · Fumitaka Nakamura² · Satoru Kikuchi⁸ · Kazuhiro Noma⁸ · Saseem Poudel^{1,9} · Akihiro Suzuki¹⁰ · Yuichi Nishihara¹¹ · Masaaki Ito⁶ · Satoshi Hirano¹

- ¹ Department of Gastroenterological Surgery II, Hokkaido University Graduate School of Medicine, Sapporo, Japan
- ² Department of Surgery, Teine Keijinkai Hospital, Sapporo, Japan
- ³ Clinical Simulation Center, Hokkaido University, Sapporo, Japan
- ⁴ Department of Gastroenterological Surgery, Hiroshima Prefectural Hospital, Hiroshima, Japan
- ⁵ Department of Gastroenterological and Transplant Surgery, Applied Life Science, Institute of Biomedical and Health Science, Hiroshima University, Hiroshima, Japan
- ⁶ Department of Colorectal Surgery, National Cancer Center Hospital East, Kashiwa, Japan
- ⁷ Department of Surgery, Tohoku University Graduate School of Medicine, Sendai, Japan

- ⁸ Department of Gastroenterological Surgery, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Science, Okayama, Japan
- ⁹ Department of General Surgery, Steel Memorial Muroran Hospital, Muroran, Japan
- ¹⁰ Department of Gastrointestinal Surgery, St. Luke's International Hospital, Tokyo, Japan
- ¹¹ Department of Surgery, National Hospital Organization, Tokyo Medical Center, Tokyo, Japan
- ¹² Department of Gastroenterological Surgery II, Faculty of Medicine, Hokkaido University, Kita 15, Nishi 7, Kita-ku, Sapporo 060-8638, Japan