How many cases do instructor class pediatric surgeons need to experience to be an independent operator in performing advanced endoscopic surgery? - A nationwide survey to establish an ideal curriculum for pediatric endoscopic surgery in Japan

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Abstract

Purpose: To ensure the safe spread of pediatric endoscopic surgery, it is essential to build a training curriculum, and a survey of the current situation in Japan is necessary. The present study assessed an efficient training curriculum by clarifying instructor class pediatric surgeons' experiences, including autonomy when performing advanced endoscopic surgeries.

Methods: An online nationwide questionnaire survey was conducted among pediatric surgeons who had Endoscopic Surgical Skill Qualification (ESSQ) and board-certified instructors who had skills comparable to ESSQ. We assessed participants' training experience, opinions concerning the ideal training curriculum and the correlation between surgical experience and the level of autonomy. The Zwisch scale was used to assess autonomy.

Results: Fifty-two participants responded to the survey (response rate: 86.7%). Only 57.7% of the respondents felt that they had received sufficient endoscopic surgery training. Most respondents considered an educational curriculum for endoscopic surgery including off-the-job training essential during the training period. Autonomy had been acquired after experiencing two to three cases for most advanced endoscopic surgeries.

Conclusion: This first nationwide survey in Japan showed that instructor class pediatric surgeons acquired autonomy after experiencing two to three for most advanced endoscopic surgeries. Our findings suggest that training, especially off-the-job training, has been insufficient.

(Present: 200/ Max. 200 words)

Introduction

Endoscopic surgery is becoming widespread even in the field of pediatric surgery. Advanced procedures, such as laparoscopic surgery for choledochal cyst or thoracoscopic repair for esophageal atresia, have been performed in many institutions. Pediatric endoscopic surgery requires extremely advanced surgical skills because of the small working space, few ports, small scope and fragility of tissues in pediatric patients [1]. Furthermore, a variety of operative procedures need to be performed in this field. However, pediatric surgeons have limited opportunities to perform endoscopic surgery due to the small number of cases requiring such procedures and therefore have difficulty keeping up their training.

The current Japanese qualification systems for board-certified pediatric surgeons and board-certified instructors of pediatric surgery do not include experience with endoscopic surgery. In 2008, the Endoscopic Surgical Skill Qualification system (ESSQS) was introduced for pediatric surgery to reduce the rate of complications of endoscopic surgery by certifying applicants as having sufficient skills to perform such surgery safely in Japan Society of Endoscopic Surgery (JSES). However, Japan lacks a common established curriculum for training in pediatric endoscopic surgery, and it is still depending on each institution. In addition, paradoxically, it is also reported that the incidence of intra/postoperative

complications in institutions with ESSQS-qualified pediatric surgeons is significantly higher than in institutes without ESSQS-qualified pediatric surgeons in Japan, suggesting that advanced pediatric endoscopic surgeries tended to be aggressively performed at institutions with ESSQS-qualified pediatric surgeons [2].

Thus, to ensure the safe spread of pediatric endoscopic surgery, it is essential to establish a training curriculum that includes even advanced pediatric endoscopic surgeries.

The present study explored the bases of an efficient training curriculum by clarifying instructor class pediatric surgeons' training experiences, including autonomy for performing each procedure of advanced pediatric endoscopic surgeries, based on a survey among instructor class pediatric surgeons in Japan.

Methods

Ethical issues

The study design was approved by the institutional review board of Kagoshima University (220067). The study was also approved by the scientific sub-committee of the JSES. All participants received an explanation about the objective of this study, and informed consent was obtained from them during the study. The survey and data collected were anonymous, maintaining the privacy of the participants. The participants had the right to retract their responses at any time.

Study participants

The participants of this survey were the instructor class surgeons of pediatric endoscopic surgery in Japan, who were qualified surgeons according to the ESSQS and board-certified instructors in pediatric surgery who were also council members of the JSES as having competence equivalent to that of the ESSQS.

Survey questionnaire

The questionnaire content was devised by researchers at Kagoshima University and the Surgical Education research group at Hokkaido University and evaluated and checked by the scientific sub-committee of the JSES. Questions inquired about participants' backgrounds, their experience with endoscopic surgical training, their concerning the ideal training curriculum for pediatric endoscopic surgery, their experienced case numbers of advanced pediatric endoscopic surgery and a self-evaluation of their autonomy in advanced pediatric endoscopic surgery. The evaluated procedures of advanced pediatric endoscopic surgery were as follows: laparoscopic fundoplication, laparoscopic splenectomy, thoracoscopic repair of esophageal atresia, thoracoscopic lung resection, laparoscopic choledochal cyst excision and reconstruction, laparoscopic portoenterostomy for biliary atresia (Kasai procedure), laparoscopy-assisted pull-through for Hirschsprung's disease and laparoscopy-assisted anorectoplasty for imperforate anus.

The Zwisch scale self-evaluation

The Zwisch scale [3, 4, 5] was used for participants' self-evaluation of their operative autonomy for performing advanced pediatric endoscopic surgical procedures. This is a simple scale that rates the competency in performing the procedure according to four levels, as follows:

1. "Show and Tell", where the attending surgeon performs most of the portion while explaining each step to the trainee.

2. "Active Help", where the attending surgeon actively guides the trainee through critical portions of the procedure.

3. "Passive Help", where the trainee performs critical portions of the operation independently while the attending surgeon passively provides skilled assistance and intervenes only when necessary to make an important teaching point or to optimize patient safety.

4. "Supervision Only", where an attending surgeon's presence is necessary only to guarantee patient safety.

The average respondent Zwisch scores for each advanced pediatric endoscopic surgery were separated by case number. A Zwisch score of 3 or 4 indicated that the surgeon was able to perform the surgery with passive help from their supervisor or with supervision only and no help. We investigated how much experience (in case numbers) was required to exceed a Zwisch score of 3, which represents an operator with autonomy in a certain procedure. The primary endpoint of the survey was the identification of the number of cases needed for each advanced pediatric endoscopic surgery to achieve a Zwisch model score of $\geq$3 points.

Survey procedures

An anonymous online survey was created on www.surveymonkey.com (Survey Monkey, Portland, OR, USA). The survey was distributed by e-mail with a link to the online survey from the JSES in June 2022. The survey was open for two months, and one e-mail reminder was sent during this period.

Statistical analyses

Data were analyzed using the Microsoft Excel 2019 software program. The average value and standard deviation (SD) of the respondent Zwisch model score were calculated in each group, defined by the number of endoscopic surgical procedures performed.

Results

Participants' background characteristics

Participants' background characteristics are shown in Table 1. There were 54 ESSQS qualified pediatric surgeons and 6 board-certified instructors in pediatric surgery who were also council members of the JSES. A total of 60 pediatric surgeons were eligible for this study, and 55 responded to the online survey. Three participants who did not complete the survey were excluded from the analysis. The final response rate was 86.7% (52 out of 60). There were 48 (92.3%) males and 4 (7.7%) females. The mean years of experience as a medical doctor were 23.2.

Of the 52 participants, 88.5% (n=46) were ESSQS qualified pediatric surgeons, and 76.9% (n=40) were board-certified instructors in pediatric surgery. Of the 52 participants, 90.4% (n=47) had experienced over 100 cases of basic pediatric endoscopic surgery, and 63.5% (n=33) had experienced over 50 cases of advanced pediatric endoscopic surgery (Table 1).

Past experiences in endoscopic surgical training

Participants' experience with endoscopic surgical training is shown in Table 2. Most participants (75.0%, n=39) had a training facility for endoscopic surgery at their hospitals and had trained in basic endoscopic surgical skills. Only a few had pediatric disease-specific simulators (25.0%, n=13) or regular educational off-the-job programs (25.0%, n=13) in their hospitals. Among those who reported having access to regular educational off-the-job programs, basic skill training with a dry box (84.6%, n=11) and training with an animal model (92.3%, n=12) were the most common contents of the program. Of the 52 respondents, 69.2% (n=36) had trained in general surgery (Table 2).

Participants' opinions concerning past endoscopic surgical training

Participants' opinions concerning their endoscopic surgical training are shown in Table 3. Approximately only half of the respondents (strongly agree: 15.4%, somewhat agree: 42.3%) felt that they had received sufficient pediatric endoscopic surgery training. Andmore, a majority of respondents (strongly agree: 15.4%, somewhat agree: 50.0%) felt a lack of training when encountering difficult-to-manage situations during endoscopic surgery. Approximately half of respondents (42.6%, n=23) said that on-the-job training had contributed most to their acquisition of endoscopic surgical skills and improvement in their technique. Almost 30% of respondents said that off-the-job skill training had contributed most to their acquisition of endoscopic surgical skills and improvement in their technique (dry box: 11.1%, disease-specific simulator: 7.4%, animal model: 11.1%).

Participants' opinions concerning the ideal training curriculum for pediatric endoscopic surgery

Participants' opinions concerning the ideal training curriculum of pediatric endoscopic surgery are shown in Table 4. Most respondents (strongly agree: 51.9%, somewhat agree: 42.3%) felt that training experience in general surgery was necessary to acquire pediatric endoscopic surgical skills. The required levels were as follows: laparoscopic appendectomy/ cholecystectomy/inguinal hernia repair: 34.7%, laparoscopic colectomy: 36.7%, laparoscopic gastrectomy: 24.5%, laparoscopic liver/ pancreatic resection: 4.1%. Most respondents (strongly agree: 48.1%, somewhat agree: 38.5%) felt that pediatric surgical departments in

institutions should provide equipment for off-the-job endoscopic surgical training. In addition, most respondents (strongly agree: 48.1%, somewhat agree: 42.3%) felt that an educational curriculum for pediatric endoscopic surgery was necessary during the training period for pediatric surgery. The contents of an educational curriculum considered necessary were on-the-job training (83.0%), off-the-job skill training (dry box: 80.9%, disease-specific simulator: 66.0%, animal model: 70.2%, cadaver: 21.3%), reviewing videos of procedures (78.7%), observing surgery at a centralized institution (57.4%), viewing surgical video sites (51.1%) and viewing lectures on endoscopic surgery (46.8%).

The correlation between the number of experienced cases and autonomy in performing advanced endoscopic surgery in instructor class pediatric surgeons

The correlation between the number of experienced cases and autonomy when performing advanced endoscopic surgery in instructor class pediatric surgeons is shown in Table 5. Most respondents had a Zwisch model score ≥3 points for laparoscopic fundoplication (100%), laparoscopic splenectomy (94.2%), laparoscopic-assisted pull-through for Hirschsprung's disease (92.3%) and laparoscopic-assisted anorectoplasty for imperforate anus (86.5%). Of the 52 respondents, 73.1% had a Zwisch model score ≥3 points for laparoscopic choledochal cyst excision and reconstruction. In contrast, fewer participants had a Zwisch model score ≥3 points for thoracoscopic repair of esophageal atresia (55.8%), thoracoscopic lung resection (51.9%) and laparoscopic portoenterostomy for biliary atresia (40.4%) than with the above procedures.

Regarding laparoscopic fundoplication or laparoscopic splenectomy, all groups of case number were above a Zwisch score of 3 (Fig. 1a, b). To exceed a Zwisch score of 3, respondents needed to perform two to three cases of thoracoscopic repair of esophageal atresia, laparoscopic portoenterostomy for biliary atresia, laparoscopic-assisted pull-through for Hirschsprung's disease and laparoscopic-assisted anorectoplasty for imperforate anus (Fig. 1c, f, g, h). In contrast, four to five cases of laparoscopic choledochal cyst excision and reconstruction needed to be performed before a respondent felt autonomous (Fig. 1e), and it took 11-20 procedures to exceed a Zwisch score of 3 in thoracoscopic lung resection (Fig. 1d).

Discussion

This is the first nationwide survey to investigate the training history and level of autonomy among the instructor class of pediatric endoscopic surgery performing advanced pediatric endoscopic surgery in Japan. We also assessed their opinions concerning the ideal training curriculum to facilitate the safe spread of pediatric endoscopic surgery. The results of this study are expected to aid in the establishment of an effective curriculum and training system for young pediatric surgeons in pediatric endoscopic surgery.

Japan has universal health care insurance system, and its ideal philosophy is to give patients equal and easy access of the same quality of medical care at outlying hospital throughout the country. Therefore, in

Japan, pediatric surgeons are spread over a relatively large number of institutions (191 institutions), and the number of cases experienced per institution is limited. However, the operative outcomes of advanced pediatric endoscopic surgery are reportedly comparable to high-volume centers in Europe, the United States, and Asia [6, 7, 8, 9]. Nevertheless, there is a marked disparity between institutions in the application of advanced endoscopic surgery in Japan. Even in the United States, where patient centralization is relatively advanced unlike Japan, the mean numbers of most major pediatric surgery cases per surgeon per year are less than 2.0 (anorectal malformation 2.2 ± 2.8, lung resection 1.9 ± 2.5, Hirschsprung's disease 1.7 ± 2.7, esophageal atresia 1.5 ± 1.7, biliary atresia/choledochal cyst 0.9 ± 1.7) [10]. A nationwide survey in the United States reported that only 15.6% of patients with esophageal atresia underwent initial thoracoscopic repair, and 53% of them were converted to open surgery [11]. In a retrospective cohort study of 11 children's hospitals in the United States, 61.7% of infants with congenital lung malformation underwent initial thoracoscopic lobectomies, and 17.6% of them were converted to open surgery [12]. Thus, case exposure can be very limited in pediatric surgery worldwide, and advanced pediatric endoscopic surgery remains challenging. Therefore, not only in Japan but also in the global concern, we thought it would be important to reveal the correlation between surgical experience and the level of autonomy in performing advanced endoscopic surgery is important.

Only a few previous reports have examined the case number and competency of limited endoscopic surgical procedures [13, 14]. Kurashima et al. indicated the number of cases required for young general surgeons to acquire autonomy in performing laparoscopic surgery using the Zwisch model score and mentioned that this information would be valuable for considering the development of a practical and appropriate training curriculum [15]. However, in the field of pediatric surgery, the number of cases pediatric surgeons need to perform in order to be capable of performing advanced pediatric endoscopic surgery independently is poorly defined at present.

In our study, we investigated the correlation between surgical experience and the level of autonomy in instructor class pediatric surgeons. Our findings indicated that autonomy was acquired after performing two to three cases for laparoscopic fundoplication, laparoscopic splenectomy, thoracoscopic repair of esophageal atresia, laparoscopic portoenterostomy for biliary atresia, laparoscopic-assisted pull-through for Hirschsprung's disease and laparoscopic-assisted anorectoplasty for imperforate anus. However, with biliary atresia, 39 respondents (75.0%) had no surgical experience with the laparoscopic procedure, and only 40.4% had a Zwisch model score ≥ 3 points. Even in Japan, because of the relatively strict institutional requirements for laparoscopic portoenterostomy for biliary atresia, there are only a few institutions (3 institutions) where perform this procedure, which may reflect the small number of experienced surgeons. For thoracoscopic repair of esophageal atresia, only 55.8% of respondents had acquired autonomy, reflecting the small number of such cases and the difficulty of the procedure. Regarding laparoscopic choledochal cyst excision and reconstruction, 73.1% had a Zwisch model score ≥ 3 points, but it took 4–5 cases to acquire autonomy, which was thought to reflect the difficulty of hepaticoenterostomy. In the present study, lung resection was the most difficult procedure to master, requiring 11–20 cases to obtain autonomy, which was thought to reflect the fact that thoracic surgery is less common for pediatric surgeons than others, leaving them unfamiliar with the thoracic and lung

hilum anatomy. Overall, it was indicated that the instructor class of pediatric endoscopic surgeons was able to acquire autonomy after experiencing two to three cases in most advanced pediatric endoscopic surgeries.

In Japan, the board certification system for pediatric surgeons consists of a written examination and experience completing 300 cases of surgery, including neonatal surgery. However, there are no requirements for experience with endoscopic surgery. Pediatric surgeons must train to perform not only endoscopic surgery but also open surgery in a small number of cases. In 1904, Halsted introduced the apprenticeship model of, “See one, do one, teach one,” which has been the backbone of surgical education worldwide for more than a century [16]. In Japan, most surgical training has been conducted as “on-the-job training” without a structured curriculum for a long while [17]. However, while the field of surgical education has undergone a remarkable evidence-based transformation in the last few decades through the incorporation of simulation training, objective evaluation of residents and inclusion of feedback, especially in North America, surgical education in Japan remains in its infancy and has not caught up with these changes [18].

In the present study, only 25% of respondents had educational programs in their hospitals, and almost half of respondents said on-the-job training had contributed most to their acquisitions of endoscopic surgical skills. Only approximately half of respondents felt that they had received sufficient pediatric endoscopic surgical training, and a majority of respondents reported feeling a lack of training when encountering difficult-to-manage situations during endoscopic surgery. These findings therefore suggest that training, especially off-the-job training, has been insufficient in Japan.

Off-the-job training is very important in pediatric surgery to compensate for the lack of experience due to the small number of cases. In pediatric endoscopic surgery, simulation-based training (SBT) is a highly effective educational modality [19]. Most instructor class pediatric endoscopic surgeons in our study felt that the pediatric surgical departments of their institutions should provide equipment for off-the-job endoscopic surgical training and that an integrated educational curriculum for endoscopic surgery was necessary during the training period for pediatric surgery. As for the content of the curriculum, off-the-job training using dry boxes, disease-specific simulators, and animal models, as well as on-the-job training, are desired. Effective training programs including SBT should be developed. Furthermore, more than half of respondents thought that reviewing videos, observing procedures at centralized institutions and viewing surgical video sites were also necessary. It would be useful to establish a video library and visiting program for institutions performing advanced surgery under the initiative of the association of pediatric surgery. Regarding on-the-job training, nearly 70% of the instructor class of pediatric endoscopic surgeons had training experience performing general surgery, and more than 90% of them indicated that training in general surgery was necessary, suggesting that training in general surgery would be useful to compensate for the small number of cases in the field of pediatric surgery. Overall, it is necessary to develop off-the-job programs to compensate for the small number of cases, and we feel it practical to set a goal of performing three cases of each advanced pediatric endoscopic surgery for young pediatric surgeons.

Limitations

Several limitations associated with the present study warrant mention. It is possible that bias among the pediatric surgeons who responded may have influenced the results; however, the relatively high response rate suggests that there was minimal bias. Since we only investigated respondents' autonomy via self-assessment, which may not reflect their actual objective autonomy, our results may also be biased. The experienced surgeons who responded had already experienced open procedures before performing endoscopic surgery, so they understood the local anatomy and operative procedure itself. These are significant differences in relation to the experience of young pediatric surgeons. The results of this study concerning the correlation between the acquisition of autonomy in advanced pediatric endoscopic surgery and the number of cases may not be directly applicable to young pediatric surgeons in training, so we should conduct a similar survey among young pediatric surgeons, including concerning basic pediatric endoscopic surgery in addition to advanced pediatric endoscopic surgery, in the near future.

Conclusion

This first nationwide survey showed that the instructor class of pediatric endoscopic surgeons acquired autonomy after experiencing two to three cases of most advanced pediatric endoscopic surgical procedures. Furthermore, training in Japan, especially off-the-job training, appeared to be insufficient at present. The results of this study are expected to aid in the establishment of an effective curriculum and system for training young pediatric surgeons to perform pediatric endoscopic surgery.

Declarations

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Conflict of interest:

The authors declare no conflicts of interest in association with the present study.

References

1. Iwanaka T, Uchida H, Kawashima H, Nishi A, Kudou S, Satake R (2004) Complications of laparoscopic surgery in neonates and small infants. J Pediatr Surg. 39: 1838–1841.

https://doi.org/10.1016/j.jpedsurg.2004.08.011

2. Saka R, Tazuke Y, Ueno T, et al (2020) Does the "Endoscopic Surgical Skill Qualification System" Reduce Serious Intraoperative Complications in the Field of Pediatric Surgery? J Laparoendosc Adv Surg Tech A. 30: 1282–1285. https://doi.org/10.1089/lap.2020.0309
3. George BC, Teitelbaum EN, Meyerson SL, et al (2014) Reliability, validity, and feasibility of the Zwisch scale for the assessment of intraoperative performance. J Surg Educ. 71: 90–96. https://doi.org/10.1016/j.jsurg.2014.06.018
4. DaRosa DA, Zwischenberger JB, Meyerson SL, et al (2013) A theory-based model for teaching and assessing residents in the operating room. J Surg Educ. 70: 24–30. https://doi.org/10.1016/j.jsurg.2012.07.007
5. George BC, Teitelbaum EN, Darosa DA, et al (2013) Duration of faculty training needed to ensure reliable or performance ratings. J Surg Educ. 70: 703–708. https://doi.org/10.1016/j.jsurg.2013.06.015
6. Tainaka T, Shirota C, Hinoki A, et al (2022) Laparoscopic definitive surgery for congenital biliary dilatation with aggressive hilar bile ductoplasty and complete resection of the intrapancreatic bile duct in pediatric patients is safe and effective, comparable to open surgery. Surg Endosc. 36: 7352–7359. https://doi.org/10.1007/s00464-022-09132-x
7. Murase N, Hinoki A, Shirota C, et al (2019) Multicenter, retrospective, comparative study of laparoscopic and open Kasai portoenterostomy in children with biliary atresia from Japanese high-volume centers. J Hepatobiliary Pancreat Sci. 26: 43–50. https://doi.org/10.1002/jhbp.594
8. Koga H, Miyake Y, Yazaki Y, et al (2022) Long-term outcomes of male imperforate anus with recto-urethral fistula: laparoscopy-assisted anorectoplasty versus posterior sagittal anorectoplasty. Pediatr Surg Int. 38: 761–768. https://doi.org/10.1007/s00383-022-05106-1
9. Miyano G, Masuko T, Ohashi K, et al (2021) Recovery of bowel function after transperitoneal or retroperitoneal laparoscopic pyeloplasty. A multi-center study. Pediatr Surg Int. 37: 1791–1795. https://doi.org/10.1007/s00383-021-04990-3
10. Abdullah F, Salazar JH, Gause CD, et al (2016) Understanding the Operative Experience of the Practicing Pediatric Surgeon: Implications for Training and Maintaining Competency. JAMA Surg. 151: 735–741. https://doi.org/10.1001/jamasurg.2016.0261
11. Etchill EW, Giuliano KA, Boss EF, Rhee DS, Kunisaki SM (2021) Association of operative approach with outcomes in neonates with esophageal atresia and tracheoesophageal fistula. J Pediatr Surg. 56: 2172–2179. https://doi.org/10.1016/j.jpedsurg.2021.04.006
12. Weller JH, Peter SDS, Fallat ME, et al (2021) Thoracoscopic versus open lobectomy in infants with congenital lung malformations: A multi-institutional propensity score analysis. J Pediatr Surg. 56: 2148–2156. https://doi.org/10.1016/j.jpedsurg.2021.04.013
13. Palter VN, de Montbrun SL (2020) Implementing new surgical technology: a national perspective on case volume requirement for proficiency in transanal total mesorectal excision. Can J Surg. 63: 21–26. https://doi.org/10.1503/cjs.001119

14. Stein S, Stulberg J, Champagne B (2012) Learning laparoscopic colectomy during colorectal residency: what does it take and how are we doing? Surg Endosc. 26: 488–492. https://doi.org/10.1007/s00464-011-1906-8
15. Kurashima Y, Hirano S, Yamaguchi S (2021) Can general surgeons perform laparoscopic surgery independently within 10 years of training? A nationwide survey on laparoscopic surgery training in Japan. Surg Today. 51:1328–1334. https://doi.org/10.1007/s00595-020-02218-w
16. Kerr B, O'Leary JP (1999) The training of the surgeon: Dr. Halsted's greatest legacy. Am Surg. 65:1101–1102.
17. Kurashima Y, Watanabe Y, Ebihara Y, Murakami S, Shichinohe T, Hirano S (2016) Where do we start? The first survey of surgical residency education in Japan. Am J Surg. 211: 405–410. https://doi.org/10.1016/j.amjsurg.2015.09.004
18. Poudel S, Hirano S, Kurashima Y, et al (2019) A snapshot of surgical resident training in Japan: results of a national-level needs assessment survey. Surg Today. 49: 870–876. https://doi.org/10.1007/s00595-019-01819-4
19. Yokoyama S, Mizunuma K, Kurashima Y, et al (2019) Evaluation methods and impact of simulation-based training in pediatric surgery: a systematic review. Pediatr Surg Int. 35: 1085–1094. https://doi.org/10.1007/s00383-019-04539-5

Tables

Table 1. Participants' background characteristics

	Number of respondents (%)
Experienced years of medical doctor, mean (SD)	23.2 (8.1)
Gender	
Male	48 (92.3)
Female	4 (7.7)
Others	0 (0.0)
Board-certified instructor in pediatric surgeon	40 (76.9)
Qualified surgeons of ESSQS	46 (88.5)
Experienced case number of pediatric endoscopic surgery	
<u>Basic procedures</u>	
0-49	1 (1.9)
50-99	4 (7.7)
100-199	16 (30.8)
200-299	8 (15.4)
300-	23 (44.2)
<u>Advanced procedures</u>	
0-9	0 (0)
10-19	2 (3.9)
20-49	17 (32.7)
50-99	18 (34.6)
100-	15 (28.8)

ESSQS: endoscopic surgical skill qualification system in Japan, SD: standard deviation

Table 2. Past endoscopic surgical training

	Number of respondents (%)
Were there simulation training facilities in the hospitals?	
Yes	39 (75.0)
No	13 (25.0)
If "Yes" (n=39)	
Have you ever practiced basic endoscopic surgical skills?	
Yes	39 (100.0)
No	0 (0)
If "Yes" (n=39)	
Total practice time (hours)	
1-49	0 (0)
50-99	12 (42.9)
100-	16 (57.1)
Were there pediatric disease-specific simulators in the hospitals?	
Yes	13 (25.0)
No	39 (75.0)
Were there regular educational off-the-job programs in the hospitals?	
Yes	13 (25.0)
No	39 (75.0)
If "Yes" (n=13)	
How often (times/year)? Mean (SD)	7.0 (9.8)
What were the contents of the programs?	
Lecture about endoscopic surgery	6 (46.2)
Basic skill training in a dry box	11 (84.6)
Training with a disease-specific simulator	4 (30.8)
Training with an animal model	12 (92.3)
Training with a cadaver	1 (7.7)

Reviewing videos of procedures	4 (30.8)
Others	1 (7.7)
Have you ever trained in general surgery?	
Yes	36 (69.2)
No	16 (30.8)

SD: standard deviation

Table 3. Participants' opinions concerning past endoscopic surgical training

	Number of respondents (%)
Have you received enough pediatric endoscopic surgery training?	
Strongly agree	8 (15.4)
Somewhat agree	22 (42.3)
Somewhat disagree	19 (36.5)
Strongly disagree	3 (5.8)
Have you ever felt a lack of training when faced with a difficult-to-manage situation during endoscopic surgery?	
Strongly agree	8 (15.4)
Somewhat agree	26 (50.0)
Somewhat disagree	14 (26.9)
Strongly disagree	4 (7.7)
What has contributed most to your acquisition of endoscopic surgical skills and improvement in your technique?	
Lecture about endoscopic surgery	2 (3.7)
Basic skill training in dry box	6 (11.1)
Training with a disease-specific simulator	4 (7.4)
Training with an animal model	6 (11.1)
Training with a cadaver	0 (0)
Reviewing videos of procedures	3 (5.6)
Observation of surgery at a centralized facility	1 (1.9)
Viewing surgical video sites	5 (9.3)
On-the-job training	23 (42.6)
Others	4 (7.4)

Table 4. Participants' opinions concerning idealized training curricula of pediatric endoscopic surgery

	Number of respondents (%)
Do you think training in general surgery is necessary to acquire pediatric endoscopic surgical skills?	
Strongly agree	27 (51.9)
Somewhat agree	22 (42.3)
Somewhat disagree	3 (5.8)
Strongly disagree	0 (0)
If "Strongly agree" or "Somewhat agree" (n=49)	
What level of surgical training do you think is necessary?	
Laparoscopic appendectomy/ cholecystectomy/ inguinal hernia repair	17 (34.7)
Laparoscopic colectomy	18 (36.7)
Laparoscopic gastrectomy	12 (24.5)
Laparoscopic liver/pancreatic resection	2 (4.1)
Do you think that pediatric surgical training facilities need equipment for off-the-job endoscopic surgical training (dry boxes, disease-specific simulators, etc.)?	
Strongly agree	25 (48.1)
Somewhat agree	20 (38.5)
Somewhat disagree	6 (11.5)
Strongly disagree	1 (1.9)
Do you think an educational curriculum for endoscopic surgery is necessary during the training period for pediatric surgery?	
Strongly agree	25 (48.1)
Somewhat agree	22 (42.3)
Somewhat disagree	5 (9.6)
Strongly disagree	0 (0)
If "Strongly agree" or "Somewhat agree" (n=47)	
What kind of contents do you think are needed within the educational curriculum?	
(Multiple selection possible)	
Lecture about endoscopic surgery	22 (46.8)

Basic skill training in dry box	38 (80.9)
Training in disease-specific simulator	31 (66.0)
Training in animal model	33 (70.2)
Training in cadaver	10 (21.3)
Reviewing videos of procedures	37 (78.7)
Observation of surgery at a centralized facility	27 (57.4)
Viewing surgical video sites	24 (51.1)
On-the-job training	39 (83.0)
Others	5 (10.6)

Table 5. The number of participants with a Zwisch model score ≥3 points for each advanced pediatric endoscopic procedure

Zwisch score ≥ 3	Number of respondents (%)
Laparoscopic fundoplication	52 (100.0%)
Laparoscopic splenectomy	49 (94.2%)
Thoracoscopic repair of esophageal atresia	29 (55.8%)
Thoracoscopic lung resection	27 (51.9%)
Laparoscopic choledochal cyst excision and reconstruction	38 (73.1%)
Laparoscopic portoenterostomy for biliary atresia	21 (40.4%)
Laparoscopic-assisted pull-through for Hirschsprung's disease	48 (92.3%)
Laparoscopic-assisted anorectoplasty for imperforate anus	45 (86.5%)

Figures

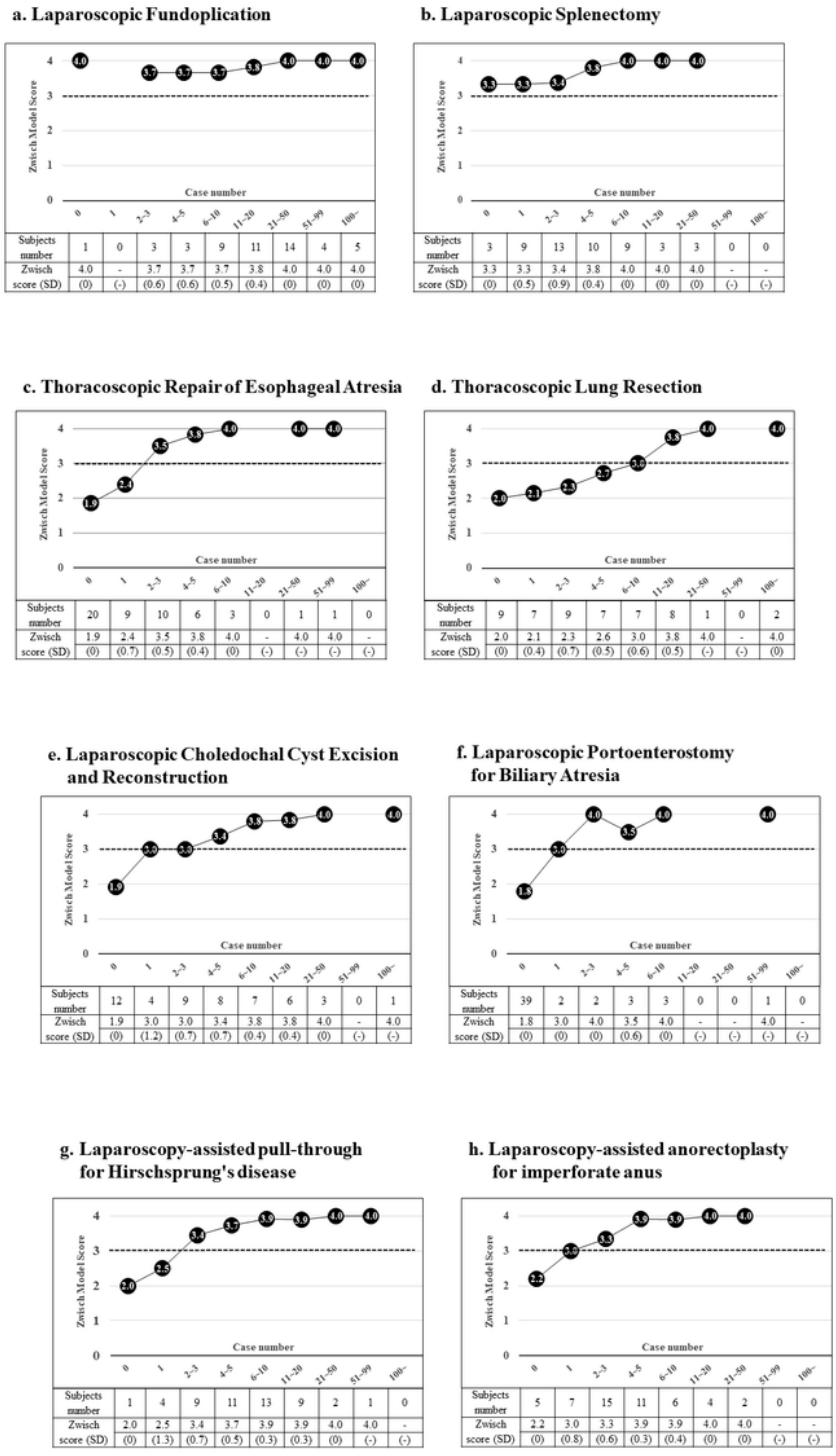

Figure 1

Zwisch score.

(a) Laparoscopic fundoplication

All groups of case number were above a Zwisch score of 3.

(b) Laparoscopic splenectomy

All groups of case number were above a Zwisch score of 3.

(c) Thoracoscopic repair of esophageal atresia

To exceed a Zwisch score of 3, respondents needed to perform two to three cases.

(d) Thoracoscopic lung resection

To exceed a Zwisch score of 3, respondents needed to perform 11-20 cases.

(e) Laparoscopic choledochal cyst excision and reconstruction

To exceed a Zwisch score of 3, respondents needed to perform four to five cases.

(f) Laparoscopic portoenterostomy for biliary atresia

To exceed a Zwisch score of 3, respondents needed to perform two to three cases.

(g) Laparoscopic-assisted pull-through for Hirschsprung's disease

To exceed a Zwisch score of 3, respondents needed to perform two to three cases.

(h) Laparoscopic-assisted anorectoplasty for imperforate anus

To exceed a Zwisch score of 3, respondents needed to perform two to three cases.