Introduction

Over past two decades, with the increasingly widespread performance of laparoscopic surgery for colorectal cancer patients, the non-inferiority of laparoscopic surgery to open surgery has largely been established and accepted in terms of the short- and long-term outcomes for benign and malignant diseases\(^1\text{-}^5\). In particular, in cases of bariatric surgery and gastric cancer surgery, it was reported that the surgical technical performance was key in determining the outcomes of laparoscopy\(^6\text{-}^7\).

The assessment of technical skill remains an important component of education programs and prediction of complications. However, it is difficult to assess the surgical technical performance. The Global Operative Assessment of Laparoscopic Skills scale, Objective Structured Assessment of Technical Skill (OSATS) and its modifications were established in order to assess surgeons’ technical skills. However, while the OSATS has been used for many kinds of surgical procedures, it is not appropriate for evaluating the procedure-specific points in specialized procedures, like laparoscopic colorectal surgery (LCS)\(^8\text{-}^9\), although tools for assessing surgeons’ skills have been developed for specific laparoscopic surgical techniques, such as inguinal hernia repair and laparoscopic gastric bypass surgery\(^10\text{-}^12\).

In the present study, we explored new rating scales focusing on the assessment of surgeons’ skills in laparoscopic right-hemicolecotony and sigmoidecotony. These new scales may be able to be used in future clinical studies evaluating surgical skills for LCS or for predicting the efficacy of surgical education.

Methods

Study design

The present study includes two parts; a cognitive task...
analysis (CTA) and the Delphi method. The Delphi method, which was developed by the RAND Corporation in 1948\(^{13-15}\), is used to achieve a consensus among elected experts in order to identify the essential procedures of the laparoscopic sigmoidectomy and laparoscopic right hemicolectomy. Approval for this study was obtained from the institutional review board at Southern Tohoku General Hospital. Informed consent was obtained from all participants of the survey.

**Selection of experts**

The experts included in this study were all opinion leaders in the field of LCS and members of the Japan Society for Endoscopic Surgery or other surgical societies. They were also currently practicing surgeons who were involved in training LCS both at the resident and continuing professional development level, and they supervised trainees. In addition, all experts had been certified as “Endoscopic surgical skill qualification system provided by Japan Society for Endoscopic Surgery: qualified surgeon” established by the Japan Society for Endoscopic Surgery (Endoscopic Surgical Skill Qualification System in Japan). The members of expert panel were also the qualified surgeon.

The Delphi method does not indicate the number of experts required to achieve consensus. We therefore planned to invite 10 experts from at least 9 different institutions.

**CTA**

The CTA was conducted in three steps as follows:

1. **Document analysis**: Referring to textbooks, the Japanese Society for Cancer of the Colon and Rectum guidelines 2016 for the treatment of colorectal cancer, videos and literature, we determined the key elements of LCS and developed a draft assessment tool.

2. **Operation video analysis and observations**: By analyzing the experts’ techniques and videos, we created the subtasks.

3. **Semi-structured interview**: After interviewing experts, staff surgeons and trainees about to draft items, we made revisions and completed our draft.

**Surveillance using the Delphi method**

Surveillance using the Delphi method was conducted in two steps, as follows:

1. **First round**
   
   Each expert who agreed to participate was sent an e-mail containing a link with the first round of an anonymous online questionnaire. In round 1 of the survey, we listed the subtasks required to complete laparoscopic right hemicolectomy and laparoscopic sigmoidectomy. The experts were then asked to rate the subtasks they considered important for performing the two procedures based on the following question: “Do you think this subtask should be included in an assessment tool to be used for the education of trainees learning to perform LCS?”. The responses were obtained via Likert scale ratings from 1 to 5 (1: strongly disagree, 2: disagree, 3: undecided, 4: agree, 5: strongly agree). Experts were free to include comments if they felt the subtask was not appropriate by selecting a response of 6 (“other”) in each subtask.

   The experts were asked to provide responses while imagining a typical, uncomplicated case with multi-port surgery. We set the questionnaire response time at four weeks, and a reminder e-mail was sent once to the experts two weeks before the deadline.

2. **Second round**
   
   After the round 1 survey, subtasks were revised or added based on the respondents’ comments. After analyzing all experts’ rating of the round 1 survey, the results were made to known to the experts. In the round 2 survey, the experts were requested to rate the new subtasks. We set the same response time and sent a reminder at the same timing as in round 1.

**Statistical analyses**

Descriptive statistics was evaluated. The means and 95% confidence intervals (CIs) were calculated for all subtasks. Cronbach’s alpha was calculated for internal consistency among the experts. STATA version 15.1 (STATA Corporation, College Station, TX, USA) was used for the statistical analyses.

**Definition of consensus**

The consensus was defined in advance using Cronbach’s alpha ≥0.8 according to a global Delphi consensus study on defining and measuring the quality of surgical training\(^{16}\). Subtasks that 70% of experts ranked as ≥4 (agree or strongly agree) were included in the new tool.

**Discussion**

We planned the scale development to evaluate the technique of laparoscopic surgery for colorectal cancer. Our challenge is to evaluate technical skill of surgeons more detail than previous scale. Using this new scale, we will able to measure the surgeon’s skill focusing on laparoscopic colorectal surgery. In addition, we would apply as the outcome of clinical study or the indication of surgeon’s education. The reliability and validation of this scale will be proved from psychometrical perspective in next study.
Trial registration: UMIN000035174 (registration date: 07/12/2018)

Conflict of interest: The authors have no conflict of interest

References