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Usefulness of Detailed Analysis with Operative Procedure of Total Laparoscopic Hysterectomy (TLH) Done a Single Surgeon, to Master the Surgical Technique of TLH and Gain Higher Proficiency

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Abstract

Objective: To analyze the relationship between the numbers of cases experienced and the operation time for a single surgeon aiming to master the TLH surgical technique. Material and Methods: Retrospective data analysis of women who underwent TLH for benign diseases between April, 2014 and March, 2016 was conducted by a single surgeon in a single hospital (Showa University of Fujigaoka Hospital). We divided the main procedures of the TLH operation into five sections, and measured the time required for each section. These cases were divided into three groups, group 1, 2, and 3. Results: There were 54 cases of TLH over two years for a single surgeon, and 21 cases that included essential operative procedures were divided into three groups of seven cases each. The average duration of the surgery (min.) was 178.3 ± 48.2 in the group 1, 128.3 ± 15.6 in the group 2, and 111.3 ± 15.9 in the group 3. A significant reduction in the required time was observed between group 1, 2, and 3 groups. As the number of cases increased, the operation time became statistically significantly shorter for every section except B and D. The skill growth rate was different at each section. Conclusion: For a single surgeon, as the number of surgical cases increased, we recognized the increased skill with the procedure in every section and the rate of skill growth differed for different sections. The difference of growth rate for each section implied that the number of operative cases required for a surgeon in each section was different.

Keywords

Total Laparoscopic Hysterectomy, on the Job Training, Learning Curve, Surgical Technique of TLH

1. Introduction

TLH is a less invasive surgery and widespread operative method used worldwide [1]; however, since it requires complicated procedures, mastering the surgical techniques of TLH is difficult [2]. Some previous studies have reported that for some surgeons, as the number of operations experienced increases, the operation time will shorten and the rate of complications will decrease [3] [4]. However, there has been no detailed analysis of the operative procedure of TLH for a single surgeon; therefore, it was unclear how a surgeon masters the surgical technique of TLH to gain higher proficiency. To clarify whether the number of cases experienced affects the proficiency of acquiring the skills for TLH by a single surgeon, we divided the main procedures of TLH operations into five sections. We analyzed the relationship between the number of cases experienced and the operation time for a single surgeon aiming to master the TLH surgical technique and performed a detailed analysis of the operative procedure of TLH.

2. Material and Methods

2.1. Study Design

We collected all patients who underwent TLH due to benign uterine diseases and were treated by a single surgeon April 1, 2014 - March 31, 2016 at Showa University Fujigaoka Hospital. In our hospital, patients are consent about use of medical reports for scientific purpose for hospitalization. This study was approved by institutional ethical review board.

We divided the main procedures of the TLH operation into five sections. The first section is the incision of the peritorium of the vesco-uterine pouch, identification of the ureters, and ligation and transection of the uterine arteries. The second is incision of the uteroovarian pedicles and retroperitoneal membranes. The third is ligation and transection of the vessels of the cardinal ligaments. The fourth is incising the vagina below the cervix. The fifth is suturing the vaginal cuff. Patients were excluded from the analysis if they had a lot of adhesions, excessive bleeding, or were missing essential procedures during their operation. We analyzed every case that consisted of the same procedures (containing all five sections) without using advanced bipolars or harmonic devices, and arranged the cases in chronological order [5]. We measured the time required for each section in an operation where an expert completed TLH in about an hour. These cases were divided into three groups, 1, 2, and 3, and the operation time was measured in each section.

2.2. Terminology

An expert was defined as a person who could complete TLH in about one hour.

The skill growth rate was defined as the gradient of the ratio of each section's surgery time divided by the expert's surgery time divided.

2.3. TLH Procedure

Under general anesthesia, uterine manipulator was placed. In each case, four trocars were placed in a standard "diamond" configuration: three 5-mm trocars and a 12-mm trocar. All ligaments attached with uterus were incised, and uterus was pushed by manipulator and a circumferential incision of vagina separated the uterus from vagina. After delivery of uterus from vagina, vaginal cuff was closed.

2.4. Statistical Analysis

The data were analyzed with EZR version 1.54 for windows (Jichi medical Univ., Saitama, Japan). In each case of these groups, we used ANOVA and Tukey tests to compare the operation time and skill growth rate and compared the expert's operation duration over time. Data were shown as mean ± standard deviation, and nominal data were expressed as number of cases. A P value less than 0.05 was considered statistically significant.

3. Results

There were 54 cases of TLH over two years for a single surgeon, and 21 cases that included essential operative procedures were divided into three groups of seven cases each. 13 cases were excluded because of using advanced bipolars or harmonic devices, and 7 cases were excluded because of missing essential procedures. 9 cases were excluded because of having a lot of adhesion, and 4 cases were excluded because of excessive bleeding. The average duration of the surgery (min.) was 178.3 ± 48.2 in the group 1, 128.3 ± 15.6 in the group 2, and 111.3 ± 15.9 in the group 3 (**Figure 1**). A significant reduction in the required time was observed between the group 1, group 2, and group 3. At section A, the average duration of the surgery (min.) was 46.5 ± 22.3 in the group 127.2 ± 7.4 in the group 2, and 24.5 ± 3.9 in the group 3. The operation time became statistically significantly shorter between group 1 and 2, group 1 and 3. At section B, the average duration of the surgery was 17.6 ± 1.7 in the group 1, 12.7 ± 1.5 in the group 2, and 14.7 ± 2.5 in the group 3. At section C, the average duration of the surgery was 24.4 ± 3.6 in the group 1, 23.2 ± 3.6 in the group 2, and 16.6 ± 6.1 in the group 3. The operation time became statistically significantly shorter between group 2 and 3. At section D, the average duration of the surgery was 7.6 ± 3.6 in the group 16.9 ± 3.5 in the group 2, and 4.3 ± 1.9 in the group 3. At section E, the average duration of the surgery was 14.6 ± 3.1 in the group 1, 12.4 ± 4.2 in the group 2, and 8.1 ± 2.8 in the group 3. The operation time became statistically significantly shorter between group 2 and 3. As the number of cases

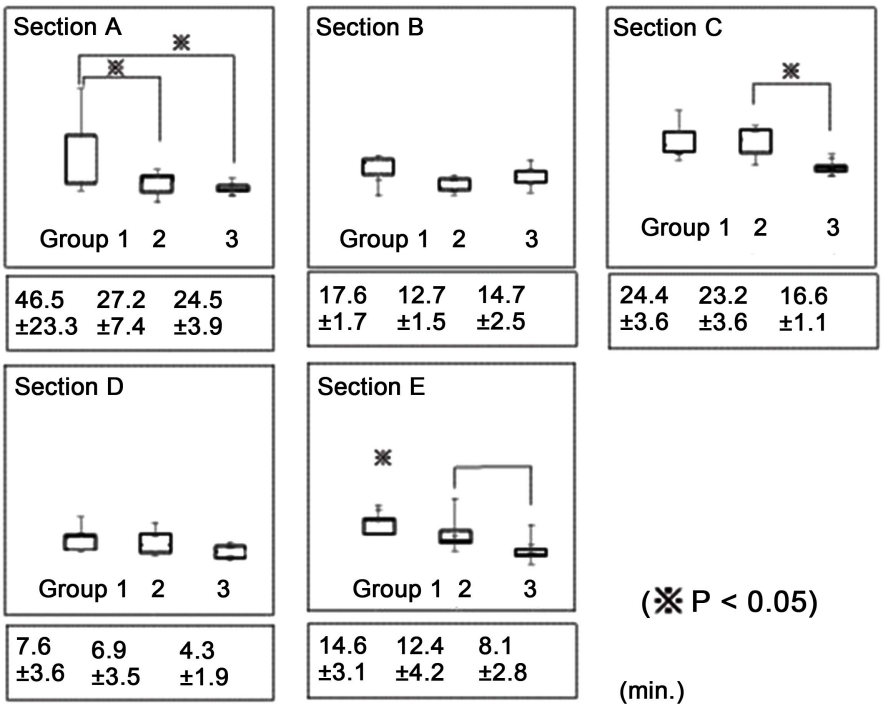

Figure 1. The average duration of the surgery

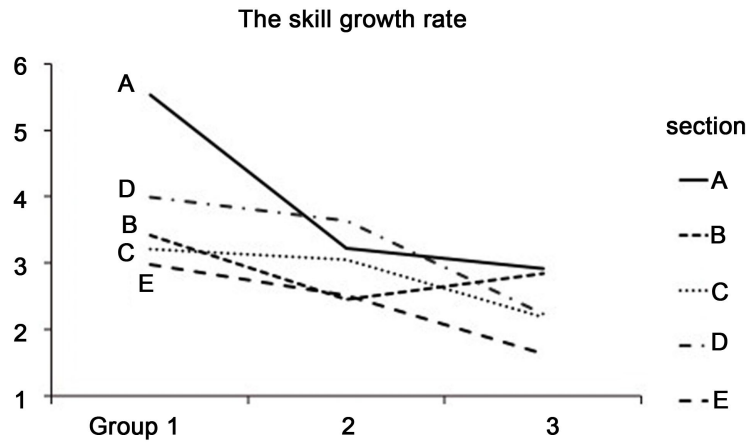

Figure 2. The skill growth rate.

increased, the operation time became statistically significantly shorter for every section except section B and D.

The skill growth rate became significant at section A in the early phase, at section C in the late phase, and at section E gradually. At sections A, D, and E, the skill growth rate approximately doubled in the late phase. Proficiency in section E was improved 1.6 times in the late phase; it gained a higher level than sections A and C (**Figure 2**).

4. Discussion

Since TLH includes various procedures, it is expected that the relationship be-

tween the increase in the number of experienced cases and the shortening of the required time will differ for each procedure. With respect to the number of cases experienced and the surgical time required for TLH, it has been reported that the overall time required for surgery is shortened with an increased number of cases experienced, but there is no detailed analysis of each procedure performed during TLH. TLH can be divided into a several sections for each procedure that can be analyzed as independent items. It is useful for the same surgeon to divide the TLH into sections and analyze the required time to understand the tasks and assist the surgeon in mastering the procedure and to examine effective practice methods.

In this study, the average time required for the entire operation tended to decrease as the number of cases experienced increased, and the time required for activities other than the procedure also tended to decrease. Laparoscopic training requires a combination of off-the-job training (Off JT) such as dry boxes and simulators and on-the-job training (On JT) in actual surgery. In the proficiency of TLH sections, the ratio of Off JT and On JT differs for each section.

The tasks for each section in this surgery were examined separately. In Section A, the understanding of pelvic anatomy by Off JT and suturing training with a dry box reached a certain level but experience in On JT is required to gain an anatomical understanding of the ureteral and uterine arteries [6] [7] [8]. Since the forceps operation and manipulator operation of the assistant also greatly affect the operation time, it is important to cooperate with the assistant in On JT. The main procedures in Section B are hemostasis and incision, which are not difficult, and the surgeon can reach a certain skill level by mastering hand-eye coordination in Off JT. It is difficult to learn the procedure in Off JT to operate the energy device and it is necessary to stop the bleeding because it requires being careful and performing hemostasis precisely, or unexpected bleeding occurs. It is difficult to judge the degree of proper sealing and it is necessary to familiarize oneself with this via On JT. Section C is the collective ligation and hemostasis operation of the basal ligament blood vessels, and although needle ligation can be mastered by suturing practice in Off JT, [6] the basal ligament detachment operation is also required and inexperienced surgeons tend to be cautious. Coordination with assistants is also important in visual field development, and it is important to practice efficiently in Off JT in simulations to improve proficiency in a limited number of cases. In Section D, it is important for the assistant to develop the surgical field, and thus cooperation with the assistant is necessary. In addition, since it includes the operation of the energy device by the operator, it is difficult to practice in Off JT, it is difficult to standardize the procedure, and the skill necessary for the procedure takes time to acquire. In section E, suturing is the main procedure, and practicing in Off JT is effective, [7] but since the suture position of the vaginal stump is different from the normal practice position, it is necessary to acquire mastery.

In this study, we found that the time was shortened by practicing suturing with Off JT, [9] while being conscious of the anatomical position, making the

best use of the experience gained in actual surgery and in Off JT. There is a limit to the practice with Off JT in the sections where there is a lot of cooperation with the assistant, [10] but there is a limit to the number of cases that can be experienced with On JT alone. This can be complemented by incorporating Off JT that enhances cooperation with assistants. It is important for the surgeon to manage the surgery themselves to reduce the overall time required. To reduce the time not directly related to the surgical procedure, it is also necessary to cooperate with assistants and staff such as by handing over instruments and cleaning the camera. It is not sufficient to compare the total time required for surgery as an index to objectively evaluate the degree of TLH proficiency. In this study, it was possible to evaluate the proficiency level of each section at a time by comparing it with the requirements of each section for the expert. The degree of proficiency can be improved by evaluating the degree of proficiency for each section and intensively practicing the sections with low proficiency in Off JT and On JT.

The main restrictions of this study are that its retrospective design prevents patient allocation and small sample size. Its size meant that it was not possible to evaluate the results until the skill level had reached an equilibrium state. Therefore, the relationship between the number of experienced cases and the equilibrium state needs to be reexamined by accumulating cases in the future by the same surgeon. The second limitation of this study is that this analysis is a tendency analysis of proficiency level for a single surgeon. However, it is useful for analyzing the process of individual technique acquisition and examining better training methods, but it is difficult to generalize as a tendency of TLH technique acquisition. It is necessary to increase the number of subjects for analysis. The third limitation of this study is that the division of procedures of TLH might be arbitrary. The procedures of TLH are kind of series of procedures, and thus it seems to be hard to divide their procedures definitely, however, if a section contains some procedures, the result of study is influenced by arbitrary division. Thus, we divided section contains one important procedure of each section.

5. Conclusion

For a single surgeon, as the number of surgical cases increased, we recognized the increased skill with the procedure in every section and the rate of skill growth differed for different sections. The existence of a difference in the skill growth rate for each section implied that the number of operative cases required for a surgeon in each section was different. Dividing the TLH procedure into several sections and analyzing them in detail, allowed us to evaluate the surgeon's acquisition of the operative technique objectively and precisely. Therefore, with detailed analysis, we could suggest an effective training method for mastering the TLH surgical technique and gaining higher proficiency with it.

Author's Contribution

Tsutomu Muramoto—making concept, analysis and interpretation of data, article draft, corresponding author.

Shin Takenaka—making concept, acquisition of data, advice of making discussion.

Ryo Koike—analysis of data.

Megumi Sano and Kyosuke Kamijo—advice of making study design and discussion.

Author's Statement

There is no conflict of interests which occurs when the authors remain in a financial or personal relationship which unjustly affects his actions associated with the publication of the manuscript.

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