福岡大医紀（*Med. Bull. Fukuoka Univ.*）：46(1)，55–61，2019

Predictors of a Prolonged Operation Duration When Using General Anesthesia in a Teaching Hospital

Toshitaka YAMANOKUCHI [1),2)], Tomoko NAKAGAWA [3)], Ken YAMAURA [4)], Chikara YOSHIMURA [1)], Toshiki MAEDA [1)], Masayoshi TSUJI [1)], Miki KAWAZOE [1)], Atsushi SATO [1)], Hisatomi ARIMA [1)]

1) *Department of Preventive Medicine and Public Health, Faculty of Medicine, Fukuoka University*
2) *Office of Institutional Research, Kyushu University*
3) *Department of nursing, Fukuoka University Hospital*
4) *Department of Anesthesiology, Faculty of Medicine, Fukuoka University*

Abstract

Aim: To investigate the predictors of a prolonged operation duration when using general anesthesia in a teaching hospital.

Methods: From 2012 to 2013, a total of 11,942 operations were performed at Fukuoka University Hospital. After the exclusion of operations without general anesthesia and those with planned operative duration <60 minutes or actual operative duration <30 minutes, a total of 10,623 operations were included in the present analysis. Predictors of a prolonged operation duration（defined as actual operation duration >30% of the planned duration）were assessed using logistic regression, hierarchical and mixed models with adjusting for random operator effects.

Results: The mean age of participants was 52.1 years, and 51.1% were female. The types of performed operations were cranial（5.5%）, thoracic（7.2%）, abdominal（9.9%）, thoracoscopic（3.9%）, laparoscopic（6.5%）, endoscopic（1.1%）, endovascular（2.0%）, eye（8.0%）, orthopedic（22.9%）, skin（6.1%）, obstetric（3.2%）, gynecologic（7.0%）, male genital（1.2%）, otorhinolaryngological（6.8%）, breast（1.6%）and others（7.1%）. There were 1649 cases（13.8%）with a prolonged operation duration. In the multivariable analysis, significant predictors of a prolonged operation duration were female gender（odds ratio［OR］1.19, 95% confidence interval［95% CI］1.01-1.30）, obesity（defined as a body mass index ≥25 kg/m^2; OR 1.19, 95% CI 1.05-1.36）, history of heart disease（OR 1.38, 95% CI 1.14-1.67）, laparoscopic surgery（OR 1.79 vs. abdominal surgery, 95% CI 1.34-2.38）, endoscopic surgery（OR 2.50 vs. abdominal surgery, 95% CI 1.24-5.07）, eye surgery（OR 2.31 vs. abdominal surgery, 95% CI 1.43-3.72）and intraoperative bleeding ≥200 mL（OR 2.95, 95% CI 2.51-3.46）.

Conclusions: Female gender, obesity, a history of heart disease, several types of operation and increased intraoperative bleeding were associated with a prolonged operation duration.

Key words: prolonged operation duration, general anesthesia, predictors, observational study

Introduction

A prolonged operation duration has been shown to be associated with adverse events, such as a fever, anorexia and infection after operation.[1),2)] It may also increase the working hours of medical staff and result in a worse financial situation at hospitals. Effective management of the operation room requires a strategy based on recognizing predictors of a prolonged operation duration.

A number of observational studies have suggested that the skill of surgeons, characteristics of patients and size of the hospital may predict a prolonged operation

Corresponding to: Prof. Hisatomi Arima, Department of Preventive Medicine and Public Health Faculty of Medicine, Fukuoka University, 7-45-1 Nanakuma, Jonan-ku, Fukuoka 814-0180 Japan
TEL: +81-92-801-1011（ext. 3315） E-mail: harima@fukuoka-u.ac.jp

duration.[3)-6)] However, current evidence is mainly derived from Western populations, and it is unclear to what extent these findings apply to Japanese populations.

The aim of the present analysis was to investigate the predictors of a prolonged operation duration for various types of surgeries using a large-scale database from a teaching hospital in Japan.

Materials and Methods

Study design and participants

This is a cross-sectional study of patients who underwent surgery at Fukuoka University Hospital. From January 2012 to December 2013, a total of 11,942 operations were performed in the hospital. After excluding operations without general anesthesia (n=508) and those with a planned operative duration <60 minutes (n=427) or actual operative duration <30 minutes (n=384), a total of 10,623 operations were included in the present analysis. This study was approved by the Medical Ethics Review Board of the Fukuoka University (No 15-130).

Predictors

We collected information on gender, age, body mass index (BMI), type of surgeries (cranial, thoracic, abdominal, thoracoscopic, laparoscopic, endoscopic, endovascular, eye, orthopedic, skin, obstetric, gynecologic, male genital, otorhinolaryngological, breast or others; and emergency [operation not scheduled but required to be conducted as soon as possible] or elective), and intraoperative bleeding volume from hospital electronic medical record database, including operation records. Histories of diabetes, hypertension, and heart disease were estimated from medical histories, medications and insurance names of disease listed in the hospital's electronic medical record database.

Outcomes

The outcome was >30% prolongation of the scheduled operative duration, which was decided by the surgeon and listed on the application form of each operation.

Statistical analyses

Predictors of a prolonged operation duration were assessed using logistic regression, hierarchical and mixed models with adjusting for random operator effects. Effects of predictors are shown as odds ratio (ORs) with 95% confidence intervals (95% CIs). The SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) software program was used for the statistical analyses, and P <0.05 was considered statistically significant.

Results

The mean age of the participants was 52.1 years, and 51.1% were female. Types of performed operations were cranial (5.5%), thoracic (7.2%), abdominal (9.9%), thoracoscopic (3.9%), laparoscopic (6.5%), endoscopic (1.1%), endovascular (2.0%), eye (8.0%), orthopedic (22.9%), skin (6.1%), obstetric (3.2%), gynecologic (7.0%), male genital (1.2%), otorhinolaryngological (6.8%), breast (1.6%) and others (7.1%) (Table 1).

The scheduled and observed operative durations according to the type of surgery are shown in Table 2. The average observed operative duration was longer than the average scheduled operative duration for thoracic surgery, laparoscopic surgery and endoscopic surgery (Table 2). Regarding emergency surgery, the average observed operative duration was longer than the average scheduled operative duration for laparoscopic surgery and gynecologic surgery.

There were 1649 cases (13.8%) with a prolonged operation duration. In the crude analysis, significant predictors of a prolonged operation duration were female gender (OR 1.19, 95% CI 1.06-1.35), obesity (defined as BMI ≥25 kg/m^2; OR 1.23, 95% CI 1.08-1.40), history of heart disease (OR 1.38, 95% CI 1.15-1.64) and intraoperative bleeding ≥200 mL (OR 2.60, 95% CI 2.24-3.01). Thoracoscopic surgery (OR 0.47, 95% CI 0.30-0.74), endovascular surgery (OR 0.42, 95% CI 0.23-0.78) and obstetric surgery (OR 0.41, 95% CI 0.23-0.74) were associated with a reduced risk of a prolonged operation duration, while laparoscopic surgery (OR 1.31, 95% CI 1.00-1.71), endoscopic surgery (OR 1.85, 95% CI 0.96-3.53) and eye surgery (OR 1.55, 95% CI 0.99-2.42) were marginally associated with increased risks of prolongation (Table 3).

In the multivariate analysis, female gender (OR 1.14, 95% CI 1.01-1.30), obesity (OR 1.19, 95% CI 1.05-1.36), history of heart disease (OR 1.38, 95% CI 1.14-1.67), laparoscopic surgery (OR 1.79, 95% CI 1.34-2.38), endoscopic surgery (OR 2.50, 95% CI 1.24-5.07), eye surgery (OR 2.31, 95% CI 1.43-3.72) and intraoperative bleeding ≥200 mL (OR 2.95, 95% CI 2.51-3.46) remained statistically significant. Endovascular surgery (OR 0.50, 95% CI 0.26-0.97) and obstetric surgery (OR 0.24, 95% CI

Table 1 Characteristics and clinical features of participants

	Participants
Female	5424 (51.1%)
Age (years)	52.1±23.5
Body mass index (kg/m^2)	22.4±4.4
Diabetes	1397 (13.2%)
Hypertension	2552 (24.0%)
Heart disease	1086 (10.2%)
Type of surgery	
Cranial surgery	581 (5.5%)
Thoracic surgery	762 (7.2%)
Abdominal surgery	1048 (9.9%)
Thoracoscopic surgery	411 (3.9%)
Laparoscopic surgery	692 (6.5%)
Endoscopic surgery	119 (1.1%)
Endovascular surgery	217 (2.0%)
Eye surgery	847 (8.0%)
Orthopedic surgery	2434 (22.9%)
Skin surgery	653 (6.1%)
Obstetric surgery	335 (3.2%)
Gynecologic surgery	739 (7.0%)
Male genital surgery	129 (1.2%)
Otorhinolaryngological surgery	727 (6.8%)
Breast surgery	171 (1.6%)
Other surgery	758 (7.1%)
Emergency surgery	1916 (18.0%)
Intraoperative bleeding (mL)	203.3±546.7

Values are the mean ± standard deviation for continuous variables and N (%) for categorical variables. Emergency surgery was defined as operations that were not scheduled but were required to be conducted as soon as possible.

0.13-0.47) were also significantly associated with reduced risks of prolongation (Table 3).

Discussion

In the present analysis using a large-scale database from a teaching hospital in Japan, female gender, obesity, history of heart disease, several types of operation (thoracoscopic, endoscopic and eye surgery) and increased intraoperative bleeding were significantly associated with a prolonged operation duration.

Obese patients have been shown to have increased risks of a prolonged operation duration in orthopedic or laparoscopic surgery.[7)-12)] We confirmed the findings of the previous studies and demonstrated that obesity was clearly associated with a prolonged operation duration for various types of surgeries in a large-scale observational study of Japanese patients. Strategies to reduce the body weight before operation (e.g. a pre-operative weight reduction program) may be useful for reducing the risk of prolongation.

In the present analysis, we investigated the effects of diabetes, hypertension and heart disease on a prolonged operation duration but did not collect information on histories of diseases in the lung, kidney or liver, or smoking habits, which is a limitation to this study. As a result, the history of heart disease was associated with increased risks of prolongation of the planned operative duration. Very few studies have investigated the association between a history of heart disease and a prolonged operation duration, but an observational study of 17,412 operations (mean patient age 55.8 years) conducted from 1993 to 2005 in a hospital in the Netherlands reported that a history of neither heart failure nor coronary artery disease was associated with an increased risk of prolongation.[9)] Such conflicts in findings may be attributable to differences in hospital settings and characteristics of patients (e.g. ethnicity and age).

Table 2 The scheduled and observed operative duration according to type of surgery

	Scheduled operative duration (min)	Observed operative duration (min)	Difference (min)
Any surgery	172.1±127.8	162.4±138.1	-9.7±73.1
Elective (n=8707)	176.5±132.9	167.5±144.2	-9.0±74.4
Emergency (n=1916)	151.8±99.2	139.4±102.6	-12.4±67.2
Cranial surgery	248.3±146.1	223.2±147.8	-25.1±84.5
Elective (n=308)	284.7±154.3	258.1±154.0	-26.5±92.9
Emergency (n=273)	207.2±124.4	183.7±129.8	-23.6±73.9
Thoracic surgery	313.0±137.5	313.2±172.9	0.2±112.9
Elective (n=578)	323.7±128.9	335.2±173.2	11.4±113.5
Emergency (n=184)	279.4±157.2	244.1±152.9	-35.3±103.4
Abdominal surgery	225.5±181.5	214.0±191.0	-11.5±96.6
Elective (n=744)	259.6±202.9	244.1±215.1	-15.5±106.7
Emergency (n=304)	142.3±55.9	140.5±69.9	-1.8±64.6
Thoracoscopic surgery	161.8±65.6	144.3±88.0	-17.5±67.5
Elective (n=284)	189.2±58.1	165.2±86.8	-24.0±66.9
Emergency (n=127)	100.4±30.1	97.5±71.1	-2.9±66.8
Laparoscopic surgery	196.3±102.5	202.3±113.7	6.0±69.3
Elective (n=588)	209.5±104.3	213.9±116.0	4.5±71.6
Emergency (n=104)	121.7±43.5	136.5±70.1	14.8±53.6
Endoscopic surgery	169.4±56.5	177.6±88.7	8.2±76.3
Elective (n=113)	167.0±51.9	175.7±88.7	8.7±77.9
Emergency (n=6)	215.0±111.3	212.3±89.0	-2.7±38.6
Endovascular surgery	200.3±81.7	141.4±75.6	-58.9±78.0
Elective (n=154)	211.4±75.6	147.6±72.4	-63.7±74.9
Emergency (n=63)	173.3±89.9	126.3±81.6	-47.1±84.8
Eye surgery	88.5±30.3	85.2±44.0	-3.3±36.3
Elective (n=634)	83.4±27.4	79.8±41.5	-3.6±36.4
Emergency (n=213)	103.5±33.5	101.2±47.4	-2.3±36.1
Orthopedic surgery	112.5±52.8	109.2±60.2	-3.3±46.5
Elective (n=2273)	111.1±51.1	108.4±59.4	-2.8±46.1
Emergency (n=161)	131.5±69.8	120.9±69.6	-10.6±50.9
Skin surgery	199.4±204.2	192.6±223.1	-6.8±106.2
Elective (n=587)	206.2±212.7	198.9±230.7	-7.3±109.0
Emergency (n=66)	139.1±77.8	136.9±126.8	-2.2±76.9
Obstetric surgery	97.9±38.8	81.8±24.6	-16.1±42.3
Elective (n=117)	98.2±41.1	92.9±27.0	-5.3±39.3
Emergency (n=218)	97.8±37.6	75.9±21.0	-21.9±42.9
Gynecologic surgery	148.1±73.2	142.2±93.4	-5.9±57.1
Elective (n=675)	149.6±74.4	142.9±94.9	-6.7±56.1
Emergency (n=64)	132.7±57.8	134.9±77.1	2.2±67.1
Male genital surgery	160.9±102.1	131.7±80.7	-29.2±58.2
Elective (n=120)	164.3±104.7	134.9±81.7	-29.4±60.0
Emergency (n=9)	116.7±38.1	89.7±51.6	-27.0±23.6
Otorhinolaryngological surgery	176.3±110.2	152.6±110.6	-23.7±67.5
Elective (n=703)	177.0±111.1	153.5±111.5	-23.5±68.0
Emergency (n=24)	156.3±75.6	126.9±74.3	-29.4±51.6
Breast surgery	202.8±144.0	171.1±153.6	-31.7±54.2
Elective (n=170)	203.1±144.4	171.5±153.9	-31.6±54.3
Emergency (n=1)	150.0	110.0	-40.0
Other surgery	181.9±107.7	169.1±128.5	-12.8±69.5
Elective (n=659)	186.8±110.6	172.8±130.6	-13.9±70.2
Emergency (n=99)	149.7±78.7	144.2±111.3	-5.5±64.4

Values are the mean ± standard deviation.

Table 3 Predictors of a prolonged operation duration among 10623 participants

	N (%)		Crude analysis		Multivariable analysis	
	1st listed	2nd listed	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Female vs. male	753 (13.9%)	896 (17.2%)	1.19 (1.06 - 1.35)	0.003	1.14 (1.01 - 1.30)	0.035
Age ≥65 vs. <65 years	631 (15.6%)	1018 (15.5%)	1.02 (0.90 - 1.15)	0.778	0.94 (0.82 - 1.07)	0.333
Body mass index ≥25 vs. <25 kg/m^2	436 (17.1%)	1154 (14.9%)	1.23 (1.08 - 1.40)	0.001	1.19 (1.05 - 1.36)	0.008
Diabetes vs. no diabetes	230 (16.5%)	1419 (15.4%)	1.09 (0.93 - 1.28)	0.288	0.99 (0.83 - 1.18)	0.917
Hypertension vs. no hypertension	402 (15.8%)	1247 (15.5%)	1.05 (0.92 - 1.20)	0.454	0.98 (0.84 - 1.13)	0.749
Heart disease vs. no heart disease	199 (18.3%)	1450 (15.2%)	1.38 (1.15 - 1.64)	<0.001	1.38 (1.14 - 1.67)	0.001
Type of surgery						
Cranial vs. abdominal surgery	57 (9.8%)	193 (18.4%)	0.66 (0.42 - 1.04)	0.075	0.74 (0.46 - 1.19)	0.216
Thoracic vs. abdominal surgery	116 (15.2%)	193 (18.4%)	0.85 (0.59 - 1.22)	0.380	0.62 (0.41 - 0.92)	0.018
Thoracoscopic vs. abdominal surgery	48 (11.7%)	193 (18.4%)	0.47 (0.30 - 0.74)	0.001	0.63 (0.39 - 1.03)	0.066
Laparoscopic vs. abdominal surgery	152 (22.0%)	193 (18.4%)	1.31 (1.00 - 1.71)	0.051	1.79 (1.34 - 2.38)	<0.001
Endoscopic vs. abdominal surgery	34 (28.6%)	193 (18.4%)	1.85 (0.96 - 3.53)	0.065	2.50 (1.24 - 5.07)	0.011
Endovascular vs. abdominal surgery	16 (7.4%)	193 (18.4%)	0.42 (0.23 - 0.78)	0.006	0.50 (0.26 - 0.97)	0.039
Eye vs. abdominal surgery	152 (17.9%)	193 (18.4%)	1.55 (0.99 - 2.42)	0.054	2.31 (1.43 - 3.72)	<0.001
Orthopedic vs. abdominal surgery	394 (16.2%)	193 (18.4%)	0.75 (0.54 - 1.05)	0.091	0.98 (0.69 - 1.40)	0.923
Skin vs. abdominal surgery	119 (18.2%)	193 (18.4%)	0.95 (0.67 - 1.35)	0.770	1.13 (0.77 - 1.65)	0.532
Obstetric vs. abdominal surgery	27 (8.1%)	193 (18.4%)	0.41 (0.23 - 0.74)	0.003	0.24 (0.13 - 0.47)	<0.001
Gynecologic vs. abdominal surgery	110 (14.9%)	193 (18.4%)	0.71 (0.46 - 1.11)	0.138	0.64 (0.39 - 1.05)	0.076
Male genital vs. abdominal surgery	16 (12.4%)	193 (18.4%)	0.84 (0.46 - 1.55)	0.581	1.02 (0.53 - 1.98)	0.944
Otorhinolaryngological vs. abdominal surgery	84 (11.6%)	193 (18.4%)	0.54 (0.37 - 0.79)	0.002	0.77 (0.51 - 1.16)	0.211
Breast vs. abdominal surgery	9 (5.3%)	193 (18.4%)	0.35 (0.14 - 0.89)	0.027	0.55 (0.21 - 1.44)	0.224
Other vs. abdominal surgery	122 (16.1%)	193 (18.4%)	0.89 (0.65 - 1.23)	0.493	1.22 (0.87 - 1.71)	0.260
Emergency vs. elective surgery	296 (15.4%)	1353 (15.5%)	1.00 (0.86 - 1.17)	0.988	1.06 (0.90 - 1.25)	0.503
Intraoperative bleeding ≥200 vs. <200 mL	476 (22.0%)	1166 (13.8%)	2.60 (2.24 - 3.01)	<0.001	2.95 (2.51 - 3.46)	<0.001

CI, confidence interval.

1st listed indicates female for gender, ≥65 years for age, body mass index ≥25 kg/m^2 for obesity, diabetes, hypertension, heart disease, each type of surgery, emergency surgery and ≥200 mL for intraoperative bleeding; and 2nd listed indicates male for gender, <65 years for age, body mass index <25 for obesity, no diabetes, no hypertension, no heart disease, abdominal surgery, elective surgery and <200 mL for intraoperative bleeding.

A number of studies have investigated the effects of gender on the operation duration. Some studies have reported increased risks of prolongation among female patients,[5),13)] while others reported opposite findings.[14),15)] In the present analysis, a female gender was associated with an increased risk of prolongation. Such conflicts in findings may be attributable to differences in the study design or characteristics of participants, surgeons and hospitals.

Limited evidence is available regarding the influence of the type of surgery on a prolonged operation duration. An observational study reported that the ratio of the actual vs. planned operative duration was larger in neurosurgery, eye surgery and otorhinolaryngological surgery than general surgery.[17)] However, the sample size of the study (160 patients) was somewhat small, and findings of laparoscopic and endoscopic surgery were not reported. The present analysis of 11,942 operations confirmed that eye surgery was associated with higher risks of a prolonged operation duration than abdominal surgery. In contrast, cranial and otorhinolaryngological surgeries were not associated with a prolonged operation duration. Further large-scale studies are required to establish the influence of the surgery type on the prolongation of the planned operative duration.

In the present analysis, increased intraoperative bleeding was a very strong risk factor of a prolonged operation duration. These findings are comparable with those from previous studies that reported clear associations between intraoperative bleeding and the prolongation of surgeries.[10),16)] In order to reduce the risk of a prolonged operation duration, it is important to minimize intraoperative bleeding.

To our knowledge, this is one of the largest studies to investigate predictors of a prolonged operation duration for various types of surgeries among Japanese. One limitation is the possible selection bias due to the single-center design of this study. Another limitation is the lack of detailed information on the reasons for the prolongation. A third limitation is that this study was set in a teaching hospital. Because the operative duration in teaching hospitals has been shown to be longer than that in non-teaching hospitals[18)], our findings may not be applicable to general hospitals. A fourth limitation is that the scheduled operative duration might have varied due to a lack of standardized procedures for deciding on the scheduled operative duration for each type of surgery.

In conclusion, female gender, obesity, a history of heart disease, several types of operation and increased intraoperative bleeding were associated with a prolonged operation duration in a large-scale observational study in a teaching hospital in Japan. High-risk strategies focusing on these predictors (pre-operation weight reduction, reduction in intraoperative bleeding, recognition of high-risk patients beforehand) may aid in the effective management of the operation room in hospitals.

References

1) Rambachan A, Mioton L M, Saha S, Fine N, Kim: The impact of surgical duration on plastic surgery outcomes, *Eur. J Plast Surg*, *36*(11): 707–714, 2013.

2) Willis-Owen CA, Konyves A,Martin DK: Factors affecting the incidence of infection in hip and knee replacement, *J. Bone Joint Surg Br*, 92-B(8): 1128-1133, 2010.

3) Strum DP, Sampson AR, May JH, Vargas LG: Surgeon and type of anesthesia predict variability in surgical procedure times, Anestheslology, 92(5):1454-1466, 2000.

4) Patoir A, Payet C, Peix JL, Colin C, Pascal L, Kraimps JL, Maneguax F, Pattou F, Sebag F, Touzet S, Bourdy S, Lifante JC, Duclos A: Determinants of operative duration in thyroid surgery: a prospective multicenter study of 3454 thyroidectomies, *PLoS One*, 12: 1–11, 2017.

5) Wu A, Rinewalt DE, Lekowski RW, Urman RD: Use of historical surgical times to predict duration of primary aortic valve replacement, J Cardiothorac. Vasc. Anesth., 31: 810–815, 2017.

6) Girotto JA, Koltz PF, Drugas G: Optimizing your operating room: or, why large, traditional hospitals don't work, *Int J Surg*, 8: 359–367, 2010.

7) Bradley BM, Griffiths SN, Stewart KJ, Higgins GA, Hockings M, David L: The effect of obesity and increasing age on operative duration and length of stay in primary hip and knee arthroplasty, *J Arthroplasty*, 29: 1906–1910, 2014.

8) Sato N, Yabuki K, Shibao K, Mori Y, Tamura T, Higure A, Yamaguchi K: Risk factors for a prolonged operative timbasee in a single-incision laparoscopic cholecystectomy, *Int HPB Asso*, *16*(2), 177–182, 2014.

9) Eijkemans MJ, Houdenhoven M, Nguyen T, Boersma E, Steyerberg EW, Kazemier G: Predicting the unpredictable: a new prediction model for operating room times using individual characteristics and the

surgeon's estimate, *Anesthesiology*, 112: 41–49, 2010.
10) Ballantyne GH, Ewing D, Capella RF, Capella JF, Davis D, Schmidt HJ, Wasielewski A, Davies RJ: The learning curve measured by operating times for laparoscopic and open gastric bypass: roles of surgeon's experience, institutional experience, body mass index and fellowship training, *Obes Surg*, 15: 172–182, 2005.
11) Kato JM, Iuamoto LR, Suguita FY, Essu FF, Meyer A, Andraus W: Impact of obesity and surgical skills in laparoscopic totally extraperitoneal hernioplasty, *ABCD Arq Bras Cir Dig*, 30: 169-172, 2017.
12) Schwartz ML, Drew RL, Chazin-Caldie M: Laparoscopic Roux-en-Y Gastric Bypass: Preoperative Determinants of A prolonged operation durations, Conversion to Open Gastric Bypasses, and Postoperative Complications, Obes Surg, 13: 734-738, 2003.
13) Subhas G, Gupta A, Bhullar J, Dubay L, Ferguson L, Goriel Y, Mittal, VK: Prolonged（longer than 3 hours）laparoscopic cholecystectomy: Reasons and results. *Am Surg*, *77*（8）: 981–984, 2011.
14) Ambe PC, Kohler L: Is the Male Gender an Independent Risk Factor for Complication in Patients Undergoing Laparoscopic Cholecystectomy for Acute Cholecystitis?, Int Surg, 100: 854-859, 2015.
15) Marty Z, Yasser B, Gunnar B, Derek Z, Tobias M, Alfred K: Impact of risk factors for a prolonged operation duration in laparoscopic cholecystectomy, Eur J Gastroenterol Hepatol, 24: 1033-1038, 2012.
16) Kobayashi K, Ando K, Ito K, Tsushima M, Morozumi M, Tanaka S, Machino M, Ota K, Ishiguro N, Imanaga S: Factors associated with extension of the scheduled time for spine surgery, Clin Neurol Neurosurg, 169: 128-132, 2018.
17) Gillespie BM, Chaboyer W, Fairweather: Factors that influence the expected length of operation: results of a prospective study, BMJ Qual Saf, 21,（1）: 3-12, 2012.
18) Vinden C, Malthaner R, McGee R, McClure JA, Winick-Ng J, K Liu, M Math KL, Nash Dm, Welk B, Dubois L: Teaching surgery takes time: the impact of surgical education on time in the operating room, *Can. J. Surg*, 59（2）: 87-92, 2016.

（平成 30. 9. 3 受付，平成 30. 10. 3 受理）
「The authors declere no conflict of interest.」