Journal of Medical Systems (2022) 46:95
https://doi.org/10.1007/s10916-022-01883-3

ORIGINAL PAPER

Effects of the Multidisciplinary Preoperative Clinic on the Incidence of Elective Surgery Cancellation

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Received: 16 September 2022 / Accepted: 25 October 2022 / Published online: 14 November 2022

Abstract

To evaluate effects of the multidisciplinary preoperative clinic (POC) consisting of anesthesiologists, dentists, pharmacists, and nurses on elective surgery cancellation, we retrospectively investigated patients who underwent elective non-cardiac, non-obstetric surgeries between October, 2018 and March, 2019 (before the POC establishment: Group 1) and between October, 2019 and March, 2020 (after the POC establishment: Group 2). Among reasons for surgery cancellation allocated into eight categories, three reasons for cancellation (related to consent authorization, medication, and significant comorbidities) were considered preventable. We compared incidences of overall and preventable cancellations of surgeries between 4,198 patients in Group 1 and 4,664 patients in Group 2, who had significantly different clinical backgrounds, including the ASA-PS class. There was no significant difference in the incidence of overall cancellation between Group 1 and Group 2 (4.1% vs. 4.1%, $p=0.96$). However, the incidence of preventable cancellation was significantly lower in Group 2 than in Group 1 (0.4% vs. 0.7%, $p=0.045$). In addition, the incidence of overall cancellation was significantly lower in 3,741 Group 2 patients visiting the POC than in 5,121 patients not visiting the POC in both Groups (3.2% vs. 4.7%, $p<0.001$). Further, in 3,423 pairs of patients with comparable clinical backgrounds created from both Groups using propensity score matching, incidences of overall cancellation (2.2% vs. 3.1%) and preventable cancellation (0.1% vs. 0.6%) were significantly lower in Group 2 than in Group 1 ($p=0.036$ and 0.008, respectively). In conclusion, the multidisciplinary POC was effective in reducing elective surgery cancellation.

Keywords Cancellation of surgery · Multidisciplinary team · Operational efficiency · Preoperative clinic

Introduction

Elective surgeries are not always performed as scheduled, and can be canceled or postponed. While a strategy to reduce surgery cancellations is challenging [1], it is necessary because cancellation not only delays treatment of patients but also interferes with operating room functions in terms of effective management of human resources and surgical supplies [2]. While reasons for surgery cancellation may be various, some cancellation may be preventable via early assessment and management of surgical patients prior to hospitalization. For example, surgeries that are canceled because of medications not stopped appropriately or insufficient evaluation and/or treatment of comorbidities identified after hospitalization may be prevented. Focusing on such preventable reasons seems crucial to reduce cancellation.

A preoperative outpatient-based preoperative clinic (POC) at our institute has a multidisciplinary team consisting of anesthesiologists, pharmacists, dentists or dental hygienists, and nurses, all of which, in collaboration, evaluate patients scheduled for surgery before hospitalization. Preoperative evaluations of patients previously performed by the four professions separately after hospitalization are now systematically organized into the multidisciplinary POC practice. The presence of such a POC may reduce surgery cancellation, compared with its absence. Although several studies explored the impact of the POC on surgery cancellation, most of them focused on the work of anesthesiologists alone [3, 4], and research on the effects of a

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multidisciplinary POC remains limited only to a specific surgical area [5].

The present study was performed to examine whether our multidisciplinary POC could reduce the incidence of elective surgery cancellation.

Methods

The study was approved by the Institutional Review Board of Juntendo University Hospital (No. H20-0082, 2020) with a waiver of informed consent. We retrospectively investigated patients who were scheduled to undergo surgery at our institute, in keeping with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [6].

Outline of the POC at our institute

Patients scheduled to undergo surgery at Juntendo University Hospital are requested to visit the POC before hospitalization. Appointments are required because the POC accommodates 36 patients a day on weekdays and 18 patients a day on Saturdays at maximum. POC medical questionnaires completed by patients in advance are submitted to the POC staff on the day of the POC visit to be reviewed by each POC staff member. Each patient has consultations and/or interviews with a pharmacist, dentist or dental hygienist, anesthesiologist, and nurse at the POC, in principle, in this order. Average length of patients' stay at the POC is approximately 75 min.

Each patient has an interview with a pharmacist on both prescribed and over-the-counter medications, such as antithrombotic drugs, contraceptive drugs, and supplements. The pharmacists may instruct the patient when to stop medications requiring preoperative withdrawal, after discussion with anesthesiologists, attending doctors, and/or specialists, as required. Then, the patient receives dental screening to detect any oral problems, such as loose teeth, periodontal infection, and limited mouth opening. A dental staff may advise the patient to have oral care, such as oral cleaning, mouth guard preparation, and dental treatment including tooth removal. An anesthesiologist provides the patient with information on scheduled anesthesia methods and anesthesia-related risks. Additionally, the patient is asked to watch a short original movie showing scheduled anesthesia procedures during the waiting time. The anesthesiologist may order additional examinations required to evaluate the patient's comorbidities, and may consult with specialists for expert advice to optimize preoperative management of comorbidities. A nurse is the last POC staff member to interact with the patient so that the nurse can confirm completion of required documentations, explain an in-hospital perioperative flow of care, and help the patient better understand information on anesthesia and surgery by answering any open questions. The nurse may also share information on the patient's specific problems, such as morbid obesity, limited joint motions, and sensitive skin, with the operating room staff.

Patient inclusion and data collection

The POC at Juntendo University Hospital was established on May 7, 2019. To evaluate the effects of the POC on elective surgery cancellation, we retrospectively studied patients who were scheduled to undergo surgery under anesthesia managed by anesthesiologists during periods both before and after the POC establishment. Patients visiting the POC during a transitional period between May and September 2019, when the number of patients visiting the POC gradually increased right after the POC establishment, were not included. Patients whose surgeries were scheduled in April, 2020 and later were not included either, as the number of surgeries was restricted due to the SARS-CoV-2 pandemic. Further, to minimize seasonal factors such as influenza epidemics, we intended to compare patients scheduled for surgery during the same seasons. Therefore, we investigated patients scheduled to undergo surgery between October 1, 2018 and March 31, 2019 (before the POC establishment: Group 1) and between October 1, 2019 and March 31, 2020 (after the POC establishment: Group 2). Patients who were scheduled to undergo cardiac surgery and obstetric surgery were not included because almost none of cardiac patients visited the POC during the study period, although currently, they usually visit the POC, and preoperative evaluations of all obstetric patients have been performed by our specific obstetric anesthesia team.

Demographic, surgical, and anesthetic data were collected from the medical and anesthesia records. Data collected included age, gender, American Society of Anesthesiologists physical status (ASA-PS) classes, surgical departments, scheduled surgical procedures, whether surgery was elective or emergency, whether Group 2 patients visited the POC or not, how many days before the scheduled date of surgery visitors in Group 2 visited the POC, and whether the scheduled surgery was performed or canceled. Because patients ranged widely and heterogeneously from neonates to the super-elderly, they were categorized by three age groups, including pediatric patients (0–17 years old), adult patients (18–64 years old), and geriatric patients (65 years and older). In case of surgery cancellation, we examined how many days before the scheduled date of surgery the surgery was canceled. Further, two researchers (SI and OK) independently collected data on reasons for surgery cancellation from medical records by allocating the reasons into eight categories, as shown in Table 1. When the two researchers

Table 1 Reasons for elective surgery cancellation allocated into the eight categories

Reasons	Description
1. Acute illness	Surgery may be postponed when patients' health condition is temporarily worsened due to, for example, acute upper airway inflammation, independent of diseases indicated for surgery and co-existing diseases.
2. Changes in treatment plans	Surgery may become unnecessary even after surgery is scheduled, for example, when computed tomography taken before surgery revealed spontaneous regression of tumor.
3. Consent authorization	Patients' informed consent may be retracted, for example, according to other physicians' second opinion that surgery is unnecessary, and due to patients' unwillingness to undergo surgery from over-anxiety.
4. Medication	Surgery may be canceled if some medications, such as antiplatelet drugs, anticoagulant drugs, and contraceptive drugs, have not been withheld appropriately until surgery.
5. Significant comorbidities	Surgery may be canceled when sufficient examinations for, and/or appropriate management of, high-risk comorbidities have not been achieved until surgery.
6. Patient/family decisions	Surgery may be rescheduled if the scheduled surgery date becomes inconvenient for patients and/or their families for personal reasons, for example, when they get more important things to do, such as attending the funeral of a close relative.
7. Unknown	Reasons for surgery cancellation may not be specified from the medical records.
8. Other	Surgeries may be canceled for reasons other than those listed above.

had different opinions, they drew the final conclusion after discussion.

Study endpoints

The primary endpoint of the study was to compare the incidence of overall cancellation of elective surgeries between Group 1 and Group 2. The secondary endpoint was to compare the incidence of cancellations for three preventable reasons, including (3) cancellation related to consent authorization, (4) cancellation related to medication, and (5) cancellation related to significant comorbidities (Table 1), since cancellation for these three reasons could have been reduced after the POC establishment, as described below. First, visiting the POC might reduce the number of patients retracting their consent immediately before surgery e.g., from anxiety, since it would facilitate earlier explanations of anesthetic and surgical procedures, thereby allowing patients to have sufficient time for acceptance of, and self-preparation for, scheduled procedures. Second, visiting the POC might reduce cancellation related to medication through appropriate medication management instructed by the POC pharmacists. Third, visiting the POC might reduce cancellation related to significant comorbidities, as the POC anesthesiologists would order additional examinations required for evaluation of comorbidities and/or consult with specialists for expert advice to optimize their management before hospitalization. The tertiary endpoint of the study was to compare incidences of cancellations based on the eight reasons between the Groups (Table 1). Additionally, as the quaternary endpoint, we compared overall cancellation between patients visiting and not visiting the POC irrespective of the Groups.

Sample size estimation

The overall surgery cancellation rate was 4% in our pilot study investigating 100 surgical patients before the POC establishment. Thus, we estimated that a sample size of 3,580 patients in each group would be required to provide 80% power with a two sided alpha level of 0.05 in detecting a 30% difference in the overall cancellation rate. Because approximately 10,000 patients a year undergo surgeries under anesthesia managed by anesthesiologists at out institute, above-mentioned six-month observational period in each Group was considered sufficient.

Statistical analysis

Variables are summarized as Median (Interquartile Range (IQR)) or Number (Percentage), and were compared between two groups using the Mann–Whitney *U* test or the chi-square test. Because the patients' clinical backgrounds differed between Groups 1 and 2, the two Groups were compared also after the nearest neighbor propensity score (PS) matching in 1:1 ratio with a 0.002 caliper was applied to create PS-matched pairs of patients by adjusting differences in age, surgical departments, and ASA-PS classes. All tests were two-sided, and a p value < 0.05 was considered statistically significant.

All statistical analyses were conducted using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R foundation for Statistical Computing, Vienna, Austria) [7].

Results

In total, 5,566 patients scheduled for surgery between October 1, 2018 and March 31, 2019, and 5,772 patients scheduled for surgery between October 1, 2019 and March 31, 2020 were identified for this study. After excluding patients scheduled for cardiac, obstetric, or emergency surgeries, 4,198 patients in Group 1 and 4,664 patients in Group 2 were included in the final analysis (Fig. 1).

Patients were older and the ASA-PS class was higher in Group 2 than in Group 1. Surgical departments differed between the Groups, whereas age groups or gender did not differ between the Groups (Table 2). There were 171 and 191 cancellations in Group 1 and Group 2, respectively. Surgery was canceled 1 (1–2) and 1 (1–3) days (in Median (IQR)) before the scheduled date of surgery in Group 1 and 2, respectively, which did not differ between the Groups ($p = 0.49$). There were no significant differences in the incidence of overall surgery cancellation nor in incidences of cancellations for eight categorized reasons between the Groups (Table 2). Regarding three preventable reasons, the incidence of cancellation related to significant comorbidities tended to be lower in Group 2 than in Group 1 ($p = 0.086$), while the incidence of cancellation related to consent authorization or medication did not differ between the Groups ($p = 0.18$, and $p = 0.87$, respectively). Combined together, however, the incidence of cancellation for these three preventable reasons was significantly lower in Group 2 than in Group 1 ($p = 0.045$) (Table 2).

Drugs that caused medication-related cancellation in both Groups included antiplatelet drugs (n = 6), eicosapentaenoic acid (EPA)/docosahexaenoic acid (DHA)-containing drugs (n = 3), and a contraceptive drug (n = 1). Surgeries were canceled for the medication-related reason in five Group 2 patients. Although two of them had been instructed to stop medications by the POC pharmacists, they failed to follow the instructions.

Even after the POC establishment, 923 patients (19.8%) in Group 2 did not visit the POC (Table 3). Visitors in Group 2 visited the POC 15 (8–24) days (in Median (IQR)) before the scheduled date of surgery. Within Group 2, non-visitors were associated with higher proportions of pediatric patients ($p < 0.001$), geriatric patients ($p < 0.001$), and females ($p < 0.001$), and higher ASA-PS classes ($p < 0.001$) (Table 3). Surgical departments also differed between visitors and non-visitors ($p < 0.001$) (Table 3). The incidence of overall cancellation was significantly higher in non-visitors than in visitors ($p < 0.001$) (Table 3). When 923 non-visitors in Group 2 were combined with 4,198 Group 1 patients, the incidence of overall cancellation was significantly lower in visitors in Group 2 than in non-visitors in both Groups (119/3,741 [3.2%] vs. 243/5,121 [4.7%], $p < 0.001$) (see Tables 2 and 3). Thus, visiting the POC was associated with a 33% reduction in overall cancellation.

By applying PS matching, 3,423 pairs of patients with comparable clinical backgrounds were created from Group 1 and Group 2 (Table 4). After PS matching, incidence of overall cancellation, cancellation for preventable reasons, and cancellation related to significant comorbidities were significantly lower in Group 2 than in Group 1 ($p = 0.036$, $p = 0.008$, and $p = 0.003$, respectively) (Table 4).

Throughout the study period, there was no significant change in the hospital environment surrounding surgery,

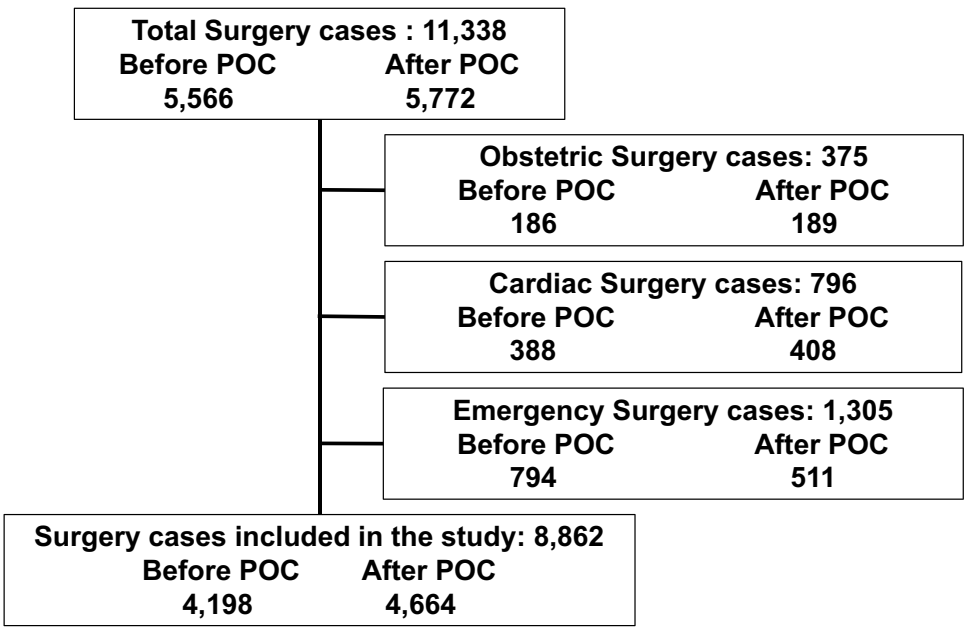

Fig. 1 Flow chart outlining the inclusion and exclusion criteria used in the study. From 11,338 patients who visited POC in the study period, 2,476 patients were excluded leaving 8,862 patients included in the final analysis

Table 2 Comparisons of patients' characteristics and incidences of cancellation between Group 1 and Group 2 before propensity score matching

	Group 1 (n = 4,198)	Group 2 (n = 4,664)	p values
Age	53 (31 - 69)	54 (34 - 70)	0.049
Age groups			0.12
Pediatrics [0 - 17 years, n (%)]	742 (17.7)	749 (16.1)	
Adults [18 - 64 years, n (%)]	2,016 (48.0)	2,289 (49.1)	
Geriatrics [65 - years, n (%)]	1,440 (34.3)	1,626 (34.8)	
Females, n (%)	2,156 (51.4)	2,389 (51.2)	0.92
Surgical departments			< 0.001
Orthopedic, n (%)	592 (14.1)	656 (14.1)	
Gastroenterological, n (%)	559 (13.3)	663 (14.2)	
Gynecological, n (%)	456 (10.9)	518 (11.1)	
Pediatric, n (%)	447 (10.7)	458 (9.8)	
Urological, n (%)	411 (9.8)	432 (9.3)	
Neurosurgical, n (%)	328 (7.8)	433 (9.3)	
General thoracic, n (%)	351 (8.4)	374 (8.0)	
Otorhinolaryngological, n (%)	361 (8.6)	357 (7.7)	
Breast oncologic, n (%)	257 (6.1)	281 (6.0)	
Plastic & reconstructive, n (%)	256 (6.1)	221 (4.7)	
Ophthalmological, n (%)	144 (3.4)	168 (3.6)	
Other, n (%)	36 (0.9)	103 (2.2)	
ASA-PS*, n (%)			< 0.001
1	1,680 (40.3)	1,545 (33.1)	
2	2,314 (55.5)	2,720 (58.3)	
3	169 (4.1)	394 (8.5)	
4	4 (0.1)	4 (0.1)	
5	0 (0.0)	0 (0.0)	
Overall surgery cancellation, n (%)	171 (4.1)	191 (4.1)	0.96
Preventable cancellation**, n (%)	28 (0.7)	17 (0.4)	0.045
Reasons for surgery cancellation			
Acute illness, n (%)	62 (1.5)	76 (1.6)	0.56
Changes in treatment plans, n (%)	25 (0.6)	39 (0.8)	0.18
Consent authorization, n (%)	8 (0.2)	4 (0.1)	0.18
Medication, n (%)	5 (0.1)	5 (0.1)	0.87
Significant comorbidities, n (%)	15 (0.4)	8 (0.2)	0.086
Patient/family decisions, n (%)	18 (0.4)	20 (0.4)	1
Unknown, n (%)	17 (0.4)	18 (0.4)	0.89
Other, n (%)	21 (0.5)	21 (0.5)	0.73

Data are shown as Median (Interquartile Range) or Number (Percentage)

* Thirty-one patients in Group 1 and one patient in Group 2 were excluded due to lacking data on American Society of Anesthesiologists physical status (ASA-PS) classes; ** Preventable cancellation included cancellation related to consent authorization, medication, and significant comorbidities

Table 3 Comparisons of patients' characteristics and incidences of cancellation between patients visiting the preoperative clinic (POC) (Visitors) and those not visiting the POC (Non-visitors) in Group 2

	Visitors (n = 3,741)	Non-visitors (n = 923)	p values
Age	53 (35 - 70)	56 (26 - 72)	0.39
Age groups			< 0.001
Pediatrics [0 - 17 years, n (%)]	558 (14.9)	191 (20.7)	
Adults [18 - 64 years, n (%)]	1,926 (51.5)	363 (39.3)	
Geriatrics [65 - years, n (%)]	1,257 (33.6)	369 (40.0)	
Females, n (%)	1,764 (47.2)	511 (55.4)	< 0.001
Surgical departments			< 0.001
Orthopedic, n (%)	542 (14.5)	114 (12.4)	
Gastroenterological, n (%)	576 (15.4)	87 (9.4)	
Gynecological, n (%)	474 (12.7)	44 (4.8)	
Pediatric, n (%)	325 (8.7)	133 (14.4)	
Urological, n (%)	363 (9.7)	69 (7.5)	
Neurosurgical, n (%)	242 (6.5)	191 (20.7)	
General thoracic, n (%)	322 (8.6)	52 (5.6)	
Otorhinolaryngological, n (%)	273 (7.3)	84 (9.1)	
Breast oncological, n (%)	263 (7.0)	18 (2.0)	
Plastic & reconstructive, n (%)	182 (4.9)	39 (4.2)	
Ophthalmological, n (%)	149 (4.0)	19 (2.1)	
Other, n (%)	30 (0.8)	73 (7.9)	
ASA-PS*, n (%)			< 0.001
1	1,310 (35.0)	235 (23.5)	
2	2,210 (59.1)	510 (55.3)	
3	220 (5.9)	174 (18.9)	
4	1 (0.0)	3 (0.3)	
5	0 (0.0)	0 (0.0)	
Overall surgery cancellation, n (%)	119 (3.2)	72 (7.8)	< 0.001
Preventable cancellation**, n (%)	14 (0.4)	3 (0.3)	0.82
Reasons for surgery cancellation			
Acute illness, n (%)	50 (1.3)	26 (2.8)	0.001
Changes in treatment plans, n (%)	17 (0.5)	22 (2.4)	< 0.001
Consent authorization, n (%)	3 (0.1)	1 (0.1)	0.79
Medication, n (%)	4 (0.1)	1 (0.1)	0.99
Significant comorbidities, n (%)	7 (0.2)	1 (0.1)	0.6
Patient/family decisions, n (%)	14 (0.4)	6 (0.7)	0.25
Unknown, n (%)	11 (0.3)	7 (0.8)	0.042
Other, n (%)	13 (0.4)	8 (0.9)	0.035

Data are shown as Median (Interquartile Range) or Number (Percentage)

* One patient in Non-visitors was excluded due to lacking data on American Society of Anesthesiologists physical status (ASA-PS) classes; ** Preventable cancellation included cancellation related to consent authorization, medication, and significant comorbidities

including hospital policies. However, some changes in surgical patient population occurred, such as a decreased proportion of plastic surgery patients ($p < 0.01$) and increased proportions of neurosurgery patients ($p < 0.05$) and patients scheduled for transcatheter aortic valve implantation (included in "other") ($p < 0.001$) in Group 2, compared with Group 1 (Table 2).

Table 4 Comparisons of patients' characteristics and incidences of cancellation between Group 1 and Group 2 after propensity score matching

	Group 1 (n = 3,423)	Group 2 (n = 3,423)	p values
Age	54 (33 - 69)	53 (33 - 70)	0.66
Age groups			0.69
Pediatrics [0 - 17 years, n (%)]	561 (16.4)	573 (16.7)	
Adults [18 - 64 years, n (%)]	1,699 (49.6)	1,720 (49.1)	
Geriatrics [65 - years, n (%)]	1,163 (34.0)	1,130 (33.0)	
Females, n (%)	1,807 (52.8)	1,758 (51.4)	0.25
Surgical departments			0.11
Orthopedic, n (%)	484 (14.1)	468 (13.7)	
Gastroenterological, n (%)	445 (13.0)	482 (14.1)	
Gynecological, n (%)	417 (12.2)	411 (12.0)	
Pediatric, n (%)	354 (10.3)	365 (10.7)	
Urological, n (%)	333 (9.7)	325 (9.5)	
Neurosurgical, n (%)	261 (7.6)	274 (8.0)	
General thoracic, n (%)	279 (8.2)	291 (8.5)	
Otorhinolaryngological, n (%)	287 (8.4)	273 (8.0)	
Breast oncological, n (%)	239 (7.0)	217 (6.3)	
Plastic & reconstructive, n (%)	193 (5.6)	151 (4.4)	
Ophthalmological, n (%)	107 (3.1)	120 (3.5)	
Other, n (%)	24 (0.7)	46 (1.3)	
ASA-PS, n (%)			1
1	1,304 (38.1)	1,304 (38.1)	
2	2,000 (58.4)	2,000 (58.4)	
3	119 (3.5)	119 (3.5)	
4	0 (0.0)	0 (0.0)	
5	0 (0.0)	0 (0.0)	
Overall surgery cancellation, n (%)	106 (3.1)	77 (2.2)	0.036
Preventable cancellation*, n (%)	19 (0.6)	5 (0.1)	0.008
Reasons for surgery cancellation			
Acute illness, n (%)	40 (1.2)	32 (0.9)	0.41
Changes in treatment plans, n (%)	11 (0.3)	8 (0.2)	0.65
Consent authorization, n (%)	2 (0.1)	3 (0.1)	1
Medication, n (%)	4 (0.1)	1 (0.0)	0.37
Significant comorbidities, n (%)	13 (0.4)	1 (0.0)	0.003
Patient/family decisions, n (%)	8 (0.2)	10 (0.3)	0.81
Unknown, n (%)	12 (0.4)	10 (0.3)	0.83
Other, n (%)	16 (0.5)	12 (0.4)	0.57

Data are shown as Median (Interquartile Range) or Number (Percentage)

ASA-PS American Society of Anesthesiologists physical status

* Preventable cancellation included cancellation related to consent authorization, medication, and significant comorbidities

Discussion

In the present study, we assessed the effects of the POC establishment on the incidence of cancellation of elective non-cardiac, non-obstetric surgeries. In the total cohort before PS matching, the POC establishment tended to decrease cancellation related to significant comorbidities, and significantly decreased preventable cancellation. Although the POC establishment did not decrease overall cancellation, visiting the POC, as compared to not visiting the POC, was associated with a 33% reduction of overall cancellation. Further, after PS matching, the POC establishment significantly decreased overall cancellation, preventable cancellation, and cancellation related to significant comorbidities.

Previously, preoperative patient evaluation by anesthesiologists was performed after hospitalization. In such situations, anesthesiologists might detect, typically on the day before surgery, significant comorbidities requiring further examinations and/or treatment, and medications not stopped appropriately, which could result in surgery cancellation. The potential to reduce such cancellation is one of the essential roles of the POC, along with enhancing patient satisfaction [8], optimizing preoperative tests [9], shortening the hospital stay [5], reducing medical costs [10, 11], and improving postoperative outcomes [12].

It remains controversial whether a POC system can reduce elective surgery cancellation; studies reported that the POC system was effective [3], ineffective [11], and partially effective [10, 13] in reducing cancellation. Such discrepancies might result from differences in target patients, surgeries, POC systems, and reasons for cancellation. Our results seemed in line with the study by van Klei et al. [13], who investigated cancellation in approximately 25,000 adult patients divided into pre- and post-POC establishment groups, and concluded that the POC establishment did not decrease overall cancellation, but decreased cancellation for medical reasons. Although these authors included inadequate examinations, patient illness, fever, and inappropriate medication management in their "medical reasons" [13], we did not include acute illness in "preventable reasons", as this was deemed unpreventable.

In this study, the POC establishment did not decrease overall cancellation. Approximately 20% of patients not visiting the POC in the post-POC establishment group might contribute to the incidence of overall cancellation not differing between pre- and post-POC establishment groups, as within the post-POC establishment group, overall cancellation was more frequent in patients not visiting than visiting the POC. Indeed, when patients were divided into those visiting and not visiting the POC regardless of pre- and post-POC establishment groups, the incidence of overall cancellation was significantly lower by 33% in visitors than non-visitors. The reasons why approximately 20% of Group 2 patients did not visit the POC were not clear but they did not visit the POC e.g., because they could not secure convenient POC appointment slots or could not visit hospital repeatedly due to their significant comorbidities, residences far from the hospital, and/or other inconveniences.

In addition to the effect of non-visitors in the post-POC establishment group, significant differences in clinical backgrounds, including age, ASA-PS classes, and surgical departments, between pre- and post-POC establishment groups also might hampered us from detecting a significant difference in overall cancellation between the groups. Actually, after all uncontrolled covariates were adjusted with PS matching, comparisons between PS-matched pre- and post-POC establishment groups with comparable clinical backgrounds revealed that the POC establishment significantly decreased overall cancellation, preventable cancellation, and cancellation related to significant comorbidities. These results indicated that the establishment of our multidisciplinary POC was effective in reducing elective surgery cancellation.

Both before and after PS matching, the POC establishment significantly decreased preventable cancellation. Among the three components of preventable reasons, however, the POC establishment did not decrease cancellation related to consent authorization or medication. Possibly, very small numbers of patients in both pre- and post-POC establishment groups, whose surgeries were canceled for reasons related to consent authorization (n = 8 and n = 4, respectively) and medication (n = 5 and n = 5, respectively), might explain why significant differences could not be detected in cancellation for these two reasons. On the other hand, the POC establishment tended to decrease cancellation related to significant comorbidities before PS matching, and significantly decreased this after PS matching. Although data on interventions provided at the POC were not sampled in this study, it seemed plausible that POC effectively reduced cancellation related to significant comorbidities through early recognition of comorbidities and optimization of their management before hospitalization. However, such interventions alone might not explain the reduction in the incidence of overall cancellation demonstrated in patients visiting the POC, and also in the post-POC establishment group after PS matching. Further research is needed to determine the potential role of the multidisciplinary POC team and interventions provided at the POC in reducing elective surgery cancellation.

There are some limitations of this study. First, as an observational research at a single institute, extrapolation of our results might be limited to institutes with their profiles similar to our own. Second, our study did not include patients scheduled for cardiac or obstetric surgeries for afore-mentioned reasons. Third, the possibility cannot be excluded that some environmental changes that occurred simultaneously with the opening of the POC might have affected the present results.

In conclusion, the establishment of the multidisciplinary POC did not reduce overall cancellation of elective surgery, but tended to reduce cancellation related to significant comorbidities, and significantly reduced cancellation for preventable reasons. Meanwhile, visiting the POC by itself was associated with a 33% reduction in overall cancellation. Further, group comparisons after PS matching revealed that the POC establishment significantly reduced overall cancellation, cancellation for preventable reasons, and especially, cancellation related to significant comorbidities. These results indicated that the multidisciplinary POC was effective in reducing elective surgery cancellation.

Authors' contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Yuki Umeno, Seiji Ishikawa, and Osamu Kudo. Statistical analyses were performed by Seiji Ishikawa and Masakazu Hayashida. The manuscript was written by Yuki Umeno, and edited by Seiji Ishikawa and Masakazu Hayashida. These works were supervised by Masakazu Hayashida. All authors read and approved the final manuscript.

Funding This work was funded by the Department of Anesthesiology and Pain Medicine, Juntendo University School of Medicine.

Declarations

Ethical approval The study was approved by the Institutional Review Board of Juntendo University Hospital (No. H20-0082, 2020) with a waiver of informed consent. We retrospectively investigated patients who were scheduled to undergo surgery at our institute, in keeping with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Competing interests The authors declare no conflict of interest associated with this study.

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