

## Operation Cancellation at Chang Gung Memorial Hospital

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**Background:** Roughly 60,000 operations are performed at our medical center every year, so making efficient use of operating rooms (OR) is an important issue. Decreasing the cancellation rate of surgery is one method that could increase efficiency. We reviewed all OR cancellations in 2007 to survey the cancellation rates and causes.

**Methods:** The present study was retrospective. Data were collected from the Department of Anesthesiology Quality Assurance Database of Chang Gung Memorial Hospital. We analyzed medical records for cancellations from January 1 to December 31, 2007. Data were analyzed using SPSS 16.0, employing descriptive measures and logistic regression.

**Results:** There were 61855 operations scheduled during this period; 229 were cancelled (0.37%). The mean age of patients in the cancelled group was significantly higher than that in the non-cancelled group. We found a positive correlation between the cancellation rate and American Society of Anesthesiologists physical status. Cancellations for outpatient surgery were most frequent, as were those in the ophthalmology department. Forty-seven cases were cancelled because of cardiovascular problems; 136 operations were done later after the original cancellation issues were addressed while 11 were done under local anesthesia.

**Conclusions:** Of all causes of cancellation of surgery, 54.1% were avoidable. Medical teams must communicate better with patients and relatives, identify and treat relevant comorbidities, and make adequate preparations for surgery.  
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**Key words:** case cancellation, postpone, operation cancellation, cancelled, surgery, operation room

Operating room (OR) cancellation rates vary between institutions. Cancellation rates at Stanford Medical Center and the University of Chicago Hospital were 13% and 5.3%, respectively.<sup>(1,2)</sup> Reported rates at specific institutions in Canada, Australia, England and Pakistan were 10%, 11.9%, 14% and 25%, respectively.<sup>(3-6)</sup> At Stanford,

OR turnover time was 31 minutes. However, for unexpected cancellations, it took 1 hour and 37 min to prepare for the next patient.<sup>(7)</sup> In America, OR costs are estimated to be \$10.00/min US dollars (USD).<sup>(8)</sup> Lost revenues from cancellations average \$1430-\$1700 USD per OR hour.<sup>(9)</sup> Postponement of an operation increases costs, prolongs hospital stays

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and distresses patients and relatives.<sup>(10,11)</sup> One study of pediatric surgery cancellations showed that 45% of parents and 16% of children were disappointed by cancellations; 16% of parents were frustrated and 3.3% became angry.<sup>(12)</sup>

Roughly 60,000 operations are performed annually at the Chang Gung Memorial Hospital Linkou, Taipei and Taoyuan branches, making OR efficiency a key issue. The present study analyzed reasons for OR cancellations and outcomes, and proposed strategies to reduce cancellation rates in the OR.

## METHODS

The present study was retrospective. After obtaining approval from the Chang Gung Memorial Hospital institutional research ethics review board, we analyzed all cancellations listed in our quality assurance database for the anesthesia department, from January 1 to December 31, 2007. About 95% of patients were referred to our pre-anesthetic evaluation clinic after evaluation by a surgeon and were scheduled for surgery in a surgical clinic. Patients arrived at our clinic with their medical records, including their current surgical history, physical exam results and an operation consent form. On arrival, patients filled out a self-assessment before the anesthesiologist's evaluation. Pre-anesthetic assessments were performed by an anesthesiologist, who explained the anesthesia method and risks, and gave written preoperative instructions to patients. At the same time, consultations with other clinical departments were done for high-risk patients who had a disease history. Inpatients were admitted to the ward on the day before surgery. Upon hospital admission, these patients underwent regular exams, including chest radiographs, electrocardiograms (EKG) and laboratory (lab) tests. If patients had abnormal data, the surgeon consulted a physician in the relevant field and an anesthesiologist and then arranged a specific examination.

All patients were assessed by the anesthesiologist again when they arrived in the surgical waiting room. If the risks of anesthesia and surgery were accepted by patients and their families, they were sent to the OR for anesthesia. All patients who reached the waiting room during the study period had their data solicited for this study. Patients who received local anesthesia were excluded. A patient

was classified as an OR cancellation if the patient arrived in the waiting room but the surgery was not completed. Operations cancelled in the ward or emergency department were also excluded. Collected data included the total number, sex, age, source, American Society of Anesthesiologists (ASA) physical status, surgical specialty and cancellation reason. All decisions concerning OR cancellation were agreed upon by surgeons, anesthesiologists, patients and their relatives.

Data were analyzed using SPSS 16.0 (SPSS Inc., Chicago, IL, U.S.A.). An independent samples T-test was used to compare differences in age between the OR cancellation group (DC) group and OR non-cancellation group (non-DC) group. Pearson's chi-squared test was used to compare differences in sex, source, ASA physical status and surgical specialty, between the two groups, individually. Binary logistic regression was used to determine the significance and odds ratios for all parameters between the two groups. Reasons for cancellation and data for surgeries that were later completed, after postponement, were analyzed using descriptive measures.

## RESULTS

A total of 61,855 patients were sent to the waiting room for surgery from January 1 to December 31, 2007; 229 of these surgeries (0.37%) were cancelled. The mean age of the DC group was 47.9 years, while that in the non-DC group was 43.9 years. The difference between these groups proved significant ( $p = 0.02$ ; 95% confidence interval [CI], 0.64- 7.26). Sex was not a significant factor in the cancellation rate ( $p = 0.09$ , Table 1).

The overall cancellation rate for inpatient surgery was 0.34%. The cancellation rate for emergency surgery (0.16%) was the lowest while the rate for outpatient surgery (0.59%) was the highest ( $p < 0.001$ , Table 1). After adjustment, the odds ratios for outpatient and emergency surgery were 2.79 (95% CI: 1.97-3.95) and 0.42 (95% CI: 0.21-0.82, Table 1), respectively. As shown in Table 1, ASA class I had the lowest cancellation rate (0.18%) while class V had the highest (2.56%,  $p < 0.001$ , odds ratio: 60.86, 95% CI: 7.76-477.26). Compared with other departments, ophthalmology had the highest cancellation rate (0.93%, Table 2). After adjustment, the

**Table 1.** Baseline and Clinical Data in DC and Non-DC Groups

	Cancellation rate (%)	DC group		Non - DC group		<i>p</i>	Odds ratio	95% CI	
		No.	%	No.	%			Lower	Upper
Sex		229		61626		0.09			
Male	0.41	119	52.0	28577	46.4				
Female	0.33	110	48.0	33049	53.6				
Source		229		61626		< 0.001			
Inpatient	0.34	150	65.5	43915	71.3				
Outpatient	0.59	69	30.1	11580	18.8		2.79	1.97	3.95
Emergency	0.16	10	4.4	6131	9.9		0.42	0.21	0.82
ASA physical status		229		61626		< 0.001			
I	0.18	29	12.7	15874	25.8				
II	0.22	71	31.0	32486	52.7		1.64	1.05	2.55
III	0.98	121	52.8	12286	19.9		12.96	7.98	21.07
IV	0.74	7	3.1	942	1.5		14.53	5.91	35.76
V	2.56	1	0.4	38	0.1		60.86	7.76	477.26

**Abbreviations:** DC group: Cancellation group; Non-DC group: Non-cancellation group; CI: Confidence interval; ASA: American Society of Anesthesiologists.

**Table 2.** Surgical Specialty in DC and Non-DC Groups

	Cancellation rate (%)	DC group		Non - DC group		<i>p</i>	Odds ratio	95% CI	
		No.	%	No.	%			Lower	Upper
Surgical specialty		229		61626		< 0.001			
GYN*	0.35	48	21.0	13644	22.1				
GS	0.11	5	2.2	4720	7.7		0.19	0.07	0.49
Urology	0.52	31	13.5	5930	9.6		0.93	0.58	1.49
Orthopedics	0.44	30	13.1	6820	11.1		0.70	0.42	1.17
Trauma <sup>†</sup>	0.24	20	8.7	8479	13.8		0.58	0.33	1.03
CVS <sup>‡</sup>	0.59	14	6.1	2339	3.8		0.52	0.27	1.00
Neurosurgery	0.23	11	4.8	4750	7.7		0.30	0.15	0.60
Plastic surgery	0.16	4	1.8	2503	4.1		0.28	0.10	0.78
Proctology	0.18	6	2.6	3261	5.3		0.36	0.1	0.85
ENT	0.49	21	9.2	4237	6.9		1.07	0.63	1.83
Pediatrics	0.75	16	7.0	2114	3.4		1.92	1.00	3.67
Ophthalmology	0.93	17	7.4	1818	2.9		2.14	1.21	3.80
Dental	0.89	5	2.2	555	0.9		2.09	0.81	5.41
Others <sup>§</sup>	0.22	1	0.4	456	0.7		0.26	0.04	1.91

**Abbreviations:** DC group: Cancellation group; Non-DC group: Non-cancellation group; CI: Confidence interval; ASA: American Society of Anesthesiologists; GYN: Gynecology; GS: General surgery; CVS: Cardiovascular surgery; ENT: Ear, nose and throat surgery; \*: Gynecology (GYN) included the obstetrics and gynecology department; †: Trauma included trauma general surgery (GS), trauma plastic surgery and trauma orthopedic surgery; ‡: Cardiovascular surgery (CVS) included cardiovascular and chest surgery; §: Others included radiological surgery (e.g: angiography, radiotherapy, radiofrequency abrasion, percutaneous nephrolithotomy), electroconversion therapy and dermatological surgery.

odds ratio was 2.14 ( $p = 0.009$ , 95% CI: 1.21-3.80).

Reasons for cancellation were grouped into 9 categories (Table 3) and classified as potentially avoidable and non-avoidable. Changes in the patient's clinical condition was the most common cause (77 cases; 33.6%). Fever (24 cases), upper respiratory tract infection (URI) (12 cases) and asthma (11 cases) led to the most cancellations in this group. The second ranking reason for cancellation was cardiovascular problems (47 cases; 20.5%). Among these cases, severe hypertension with systolic/diastolic  $\geq 210/120$  mmHg (21 cases) and an abnormal EKG (18 cases) were the most common reasons. Congestive heart failure resulted in 4 and chest pain in 3 cancellations. Recent myocardial infarction (MI) contributed to one cancellation case. Inadequate preparation and surgical factors led to 39 (17.0%) and 34 (14.8%) cancellations, respectively. Diagnosis and treatment course changes (18 cases)

and inadequate communication with the patient or relatives (13 cases) were the most important surgical factors. There were 12 cancellations by the patient or family (5.2%), while 20 cases (8.8%) had miscellaneous reasons. Details are shown in Table 3. Potentially avoidable causes (124 cases, 54.1%) included inadequate fasting, cardiovascular problems (severe hypertension and abnormal EKG), surgical factors, lack of a post-operative bed and inadequate preparation.

Non-avoidable causes (105 cases, 45.9%) included changes in clinical conditions, cardiovascular problems (congestive heart failure, chest pain and recent MI), airway problems, cancellation by the patient or family and others. OR cancellation cases were followed for 3 months, because this duration is enough to correct problems that induce case cancellations. Initial cancellations in which surgery proceeded later, within this period, were defined as the postponed operation group (PO). Patients whose surgeries had not been done within the study period were deemed the non-operation group (NOP). A total of 147 patients were in the PO group (64.2%); 136 proceeded with the same operation while 11 cases were shifted to local anesthesia on the same day. Although all the patients cancelled by inadequate fasting received operations eventually, others cancelled either by infeasible bed or patient/family decision were under 50% (Table 3). Thirty-one (66.0%) of the patients who cancelled surgery for cardiovascular problems had surgery within 3 months, after consultation with a cardiologist (Table 3). The obstetrics and gynecology department had the most OR cancellations (48 cases, 21.0%); 64.6% of these patients had surgery later (Table 4). In the urology, dental and "other" departments 41.9%, 40% and 0% of patients, respectively, had operations later.

**Table 3.** Reasons for Cancellation of Operation in the Postponed Operation Group and Non-operation Group

Reasons for case cancellation	Cancellation cases (%)	NOP (%)*	PO (%)*
Inadequate fasting	7 (3.1)	0 (0)	7 (100)
Change in clinical condition	77 (33.6)	22 (28.6)	55 (71.4)
Cardiovascular problem	47 (20.5)	16 (34.0)	31 (66.0)
Airway problem <sup>‡</sup>	4 (1.8)	2 (50.0)	2 (50.0)
Surgical factors	34 (14.8)	17 (50.0)	17 (50.0)
Cancelled by patient or family	12 (5.2)	7 (58.3)	5 (41.7)
Lack of post-operative bed	5 (2.2)	3 (60.0)	2 (40.0)
Inadequate preparation <sup>§</sup>	39 (17.0)	13 (33.3)	26 (66.7)
Others <sup>  </sup>	4 (1.8)	2 (50.0)	2 (50.0)
Total	229 (100.0)	82 (35.8)	147 (64.2)

**Abbreviations:** NOP: Non operation group; PO: postponed operation group; \*: % within cancellation reason; †: This group included patients shifted to local anesthesia; ‡: Airway problems included difficult intubation (1 case), neck mass and tracheal deviation (2 cases) and interference with intubation due to unexpected laryngeal cyst (1 case); §: Inadequate preparation included abnormal laboratory data (23 cases), inadequate pre-op examination, preparation or consultation (9 cases), anticoagulation not stopped (5 cases), and equipment failure (2 cases); ||: Others included no one accompanying the patient (2 cases), difficulty in posing the patient (severe Ankylosing Spondylosis) (1 case), use of incorrect identification card (ID) (1 case).

## DISCUSSION

The OR cancellation rate for CGMH was 0.37%, which seems extremely low when compared with other medical centers (5.3-25%).<sup>(1-6)</sup> However, comparisons with other studies may be problematic. The present study included patients who arrived in the waiting room; cancellations in the ward or emergency department were excluded. Other studies may not have made these distinctions. In addition, our database involved elective and emergency surgeries.

**Table 4.** Postponed Operations and Non-operations according to Surgical Specialty

Surgical specialty	Cancellation cases (%)	NOP (%)*	PO (%)*
GYN‡	48 (21.0)	17 (35.4)	31 (64.6)
GS	5 (2.2)	1 (20.0)	4 (80.0)
Urology	31 (13.5)	18 (58.1)	13 (41.9)
Orthopedics	30 (13.1)	11 (36.7)	19 (63.3)
Trauma§	20 (8.7)	6 (30.0)	14 (70.0)
CVS <sup>¶</sup>	14 (6.1)	4 (28.6)	10 (71.4)
Neurosurgery	11 (4.8)	2 (18.2)	9 (81.8)
Plastic surgery	4 (1.8)	0 (0.0)	4 (100)
Proctology	6 (2.6)	3 (50.0)	3 (50.0)
ENT	21 (9.2)	9 (42.9)	12 (57.1)
Pediatrics	16 (7.0)	2 (12.5)	14 (87.5)
Ophthalmology	17 (7.4)	5 (29.4)	12 (70.6)
Dental	5 (2.2)	3 (60.0)	2 (40.0)
Others <sup>¶</sup>	1 (0.4)	1 (100)	0 (0.0)
Total	229 (100)	82 (35.8)	147 (64.2)

**Abbreviations:** NOP: Non-operation group; PO: Postponed operation group; GYN: Gynecology; GS: General surgery; CVS: Cardiovascular surgery; ENT: Ear, nose and throat surgery; \*: % within cancellation reason; †: This group included patients shifted to receive local anesthesia; ‡: Gynecology (GYN) included the obstetrics and gynecology department; §: Trauma included trauma general surgery (GS), trauma plastic surgery and trauma orthopedic surgery; ¶: Cardiovascular surgery (CVS) included cardiovascular and chest surgery; ¶: Others included radiological surgery (e.g. angiography, radiotherapy, radiofrequency abrasion, percutaneous nephrolithotomy), electroconversion therapy and dermatological surgery.

Other studies involved elective surgery only.

The mean age of the DC group was significantly higher than in the non-DC group ( $p = 0.02$ ). Older patients tend to have more comorbidities and complications that could lead to cancellation.

In our hospital, outpatient surgeries are scheduled by the surgical clinic. Patients visit the pre-operative evaluation clinic immediately after the surgical clinic. Anesthesiologists usually had insufficient information (chest radiograph, EKG, lab data) to

assess patients. If exams show abnormal or life-threatening conditions on the day of surgery, outpatient surgeries may be cancelled. However, most surgeons can evaluate medical problems for inpatients and have enough time to correct those problems, making the DC rate for outpatient surgeries higher. Emergency surgeries had the lowest DC rate, as would not cancel these cases unless the operations were not really urgent. Our results are in line with a study by Pollard et al. that compared DC rates for outpatient (26%) and inpatient surgery (21%).<sup>(13)</sup> However, a study by Hand et al. showed a higher DC rate for inpatient (17%) than outpatient (13%) surgery.<sup>(14)</sup> The DC rate for patients scheduled for admission on the same day was lowest (9%). Differences between studies may occur because of varied preoperative evaluation procedures.

In the present study, a positive correlation was noted between the ASA status and the cancellation rate. This is in line with a study by Ferschl et al. that ASA status correlated with the cancellation rate and delay.<sup>(2)</sup> The DC rate for ophthalmology was the highest in this study. In a U.K. study, Sanjay et al. showed the cancellation percentages for ear, nose and throat surgery (ENT) and general surgery (GS) to be highest.<sup>(5)</sup> Disease incidence varies by region and race and different medical centers specialize in different surgeries, so cancellation percentages by surgical specialty vary.

Severe hypertension was the most common cardiovascular reason for cancellation in the current study. Most anesthesiologists suggest postponing surgery when the diastolic blood pressure (DBP) is above 110 mmHg because of the increased risk of perioperative dysrhythmia, myocardial ischemia and stroke. Previous studies recommended optimizing preoperative treatment for hypertension to reduce the risks of anesthesia.<sup>(15)</sup> In CGMH, we suggest taking oral hypertension medication in the morning on the day of surgery. One operation was cancelled due to a recent MI. American College of Cardiology/American Heart Association guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery suggest waiting at least 4-6 weeks after a myocardial infarction before performing elective surgery.<sup>(16)</sup>

In our hospital, the percentage of potentially avoidable causes was 54.1%. In Australia, it was 60%.<sup>(4)</sup> Lacqua et al. concluded that lack of medical

clearance is responsible for most OR cancellations.<sup>(11)</sup> Previous studies have demonstrated that visits to preoperative evaluation clinics can reduce OR cancellation rates, total hospital stays, and the number of consultations and lab tests, and increase patient satisfaction and efficient utilization of OR resources.<sup>(2,7,17-22)</sup> Hariharan et al. also demonstrated a 52% greater chance of cancellation if the patient does not visit a preoperative evaluation clinic.<sup>(23)</sup> Pollard et al. found no significant differences in cancellation rates between those who completed a preanesthesia interview within 24 hours of surgery (standard group) and those who interviewed 2-30 days (early group) before surgery.<sup>(1)</sup> However, the ASA suggests a preanesthesia evaluation before the day of surgery, done by the anesthesiology staff.<sup>(24)</sup> In our hospital, patients visited the preoperative evaluation clinic immediately after visiting the surgical clinic. Anesthesiologists usually had insufficient information to assess the patients at that time. A delay in the completion of preoperative evaluations until basic examinations are finished may be preferable. Twelve of 229 surgeries were cancelled by patients or relatives. Basson et al. concluded that patients who do not comply with hospital visits for pre-surgical procedures probably will not comply with surgical appointments.<sup>(25)</sup> Basson suggested that surgeries for noncomplying patients should be booked at the end of the OR daily schedule. In the present study, we found inadequate communication between medical teams, patients and relatives to be responsible for 13 cancellations. However, this can be improved.

Inadequate fasting was deemed a temporal factor and all patients with this factor eventually had surgery. The rate of surgery for those that originally had no post-operative bed was lowest. Insufficient ward or intensive care unit space is common, especially at Chang Gung Memorial Hospital, the largest medical center in Taiwan. Only 5 of the 12 patients who cancelled because of their own or a relative's decision, had surgery later. For those with surgical factors, most diagnosis changes and treatment course changes were because of passage of stones from the ureter or bladder. Most pediatric surgeries were cancelled because of fever, URI or asthma attack. Those factors are temporal and treatable; 14/16 (87.5%) surgeries were performed after symptoms subsided. In the preoperative clinic, anesthesiologists inform parents about the risks of fever, URI and asthma, but

it can be difficult to keep children constantly healthy.

There were some limitations to this study. First, our database only included patients with operations cancelled in the OR or waiting room. Those with surgeries cancelled in the ward or emergency department were excluded. Second, surgeries with local anesthesia were excluded. Our database only included operations in which anesthesiologists took part. If our study included those data, our results would be more objective and comparable to other studies. Third, our study did not evaluate the relationship between the DC rate and rate of visiting the preoperative clinic, as we did not have sufficient data to calculate interview rates.

In conclusion, 54.1% of cancellations are potentially avoidable, as long as the medical team can communicate better with patients and relatives, identify and treat important medical problems in a timely fashion, adequately prepare for surgery and control blood pressure, and delay the completion of the preoperative evaluation until basic examinations are finished. This decreases DC rates and hospital costs. Operations for noncompliant patients should be booked at the end of the day to decrease the influence of cancellation on the daily workload of the OR.

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# 長庚醫院手術取消案件分析

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**背景：** 每年大約有 60,000 台手術在我們的醫學中心進行，因此，能有效的運用開刀房就是一個很重要的課題。減少手術取消率將能增加開刀房利用率。因此，我們回顧 2007 年開刀房個案取消案件來檢視當年度手術取消率及其原因。

**方法：** 這是一個回溯性的研究。所有的資料都是來自長庚紀念醫院麻醉部醫療品質小組資料庫。我們分析 2007 年 1 月 1 日到 12 月 31 日所有的手術取消個案。並且使用 SPSS 16.0 軟體來做描述性統計及回歸分析。

**結果：** 研究期間一共有 61,855 台手術，其中 229 台手術取消，取消率約 0.37%。個案取消組的平均年齡明顯大於非取消組。個案取消率和美國麻醉醫學會麻醉風險度分級有正相關。門診手術和眼科病人的取消率最高。因心血管問題而取消的病人有 47 人；有 136 台手術在追蹤期間內復行手術，有 11 台手術轉而接受局部麻醉。

**結論：** 54.1% 的手術取消原因是可以避免的。醫療團隊必須加強與病人及家屬的溝通，及早發現及治療嚴重的疾病，做好手術前的準備工作。

(長庚醫誌 2010;33:568-75)

**關鍵詞：** 個案取消，延後，手術取消，取消，手術，開刀房

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