Preoperative assessment clinics and case cancellations: a prospective study from a large medical center in China

Shiwen Liu[#], Xu Lu[#], Ming Jiang, Weishan Li, Ailun Li, Fang Fang, Jing Cang

Department of Anesthesiology, Zhongshan Hospital, Fudan University, Shanghai, China

Contributions: (I) Conception and design: J Cang, F Fang; (II) Administrative support: J Cang; (III) Provision of study materials or patients: X Lu, M Jiang, W Li; (IV) Collection and assembly of data: S Liu, A Li; (V) Data analysis and interpretation: S Liu, F Fang; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Fang Fang; Jing Cang. Department of Anesthesiology, Zhongshan Hospital, Fudan University, Shanghai, China. Email: jerryfang81@hotmail.com; cangjing_zs@sina.com.

Background: Preoperative assessment clinics have great benefits in reducing surgical cancellations, saving hospital resources and improving patient satisfaction. However, previous studies did not focus on patients with comorbidities. With advancements in medicine and aging population, the number of elderly patients with multiple comorbidities is increasing. This study was designed to assess the effectiveness of a preoperative assessment clinic for patients with multiple comorbidities.

Methods: This prospective, observational study enrolled patients with multiple comorbidities from Nov 1, 2019 to Oct 31, 2020 in a tertiary teaching hospital in China. Patients either visited the preoperative assessment clinic before admission or received an anesthesia consultation after admission. The impact of clinic visits on operating room cancellations, length of hospital stay before surgery, length of hospital stay after surgery, major postoperative complications, incidence of postoperative intensive care unit (ICU) admission, readmission to any hospital within 30 days after surgeries and total in-hospital costs were analyzed.

Results: A total of 326 eligible cases were included. Eighty-seven of 108 cases who visited the clinic before admission were scheduled for selective surgeries. In all, 218 patients received an anesthesia consultation after admission. The cancellation rate in the inpatient group was 7.80%, while no surgeries were cancelled in preclinic group (P=0.016). A preoperative assessment clinic visit statistically decreased the length of in-hospital stays before surgery from 93.02 to 76.11 h (P=0.010). After propensity score matching, significant differences in operating room cancellations (0 *vs.* 6.48%; P=0.015) and length of stay before surgery (76.11 *vs.* 92.22 h; P=0.038) persisted between two groups. No significant differences between the two groups were found in terms of prognosis, including major postoperative complications, incidence of postoperative ICU admissions, and readmissions to any hospital within 30 days (P>0.05).

Conclusions: Among patients with comorbidities undergoing major surgeries, a preoperative assessment clinic visit was more efficient than an anesthesia consultation after admission. These findings may provide impetus for the opening of preoperative assessment clinics for critical patients in China.

Keywords: Preoperative assessment clinic; cancellation; anesthesia consultation; length of stay; efficiency

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Introduction

In China, traditionally, patients with comorbidities have consultations with anesthesiologists after admission. After consultations, patients either continue onto surgery or face delays, if not cancellations, of surgeries. Cancellations of scheduled surgical procedures are a major problem in perioperative medicine and have negative effects on operating room (OR) economics (1,2). For patients scheduled for selective surgeries, case cancellation might lead to unnecessary hospital stays, additional costs, and organizational problems for surgeons and anesthesiologists (3,4). In addition, delays or cancellations of planned procedures can result in significant emotional distress, repeated preoperative fasting, and extra expenses for patients (5,6).

At the end of 2017, the National Health Commission of People's Republic of China issued a policy to encourage the opening of an anesthesia clinic in the context of perioperative medicine (7). In response to the policy, our tertiary teaching hospital started preoperative assessment clinics (PACs) for major surgeries on Nov 1, 2019.

Most medical reasons for cancellations are inappropriate medications (warfarin, aspirin, clopidogrel), abnormal pre-operative investigations (requiring further assessment prior to surgery), untreated or investigated medical condition (hypertension, bradycardia) (8). Preoperative assessment clinics are designed to optimize patients' medical conditions as well as hospital resource utilization before selective surgery and anesthesia (9). In the clinic, anesthesiologists lead the clinic and assess the physical condition of patients, adjusting medications, treating comorbidities, functional training, identifying those who are at high risk for anesthesia and those requiring extensive management before surgery thus reducing cancellations for these patients (3,10). Surgeons assess patients who need to visit PAC and do not participate in the medical activities in the clinic. If the patient does not meet the criteria for surgery, both anesthesiologists and surgeons decide whether the case should be cancelled (3,10). The anesthesiologist-led preoperative clinics have been shown to have many advantages, such as identifying undiagnosed medical problems, improving the management of operating room resources, reducing surgical cancellations, and improving patient safety and satisfaction (11-13).

Previous studies showed that preoperative assessment clinic significantly reduced operation room cancellations (2,3,8). However, these studies compared the outcome of PAC patients with non-consultation patients. Fewer studies focused on critically ill patients scheduled for selective surgeries with multiple comorbidities. A multicenter study showed that a higher case cancellation rate in university hospitals, which might be due to the complexity of patients' medical conditions, meaning that PACs are more indispensable for patients with multiple comorbidities (14).

We therefore set out this prospective study to assess the benefits of a PAC in a tertiary teaching hospital in China. We hypothesized that a preoperative clinic visit would decrease cancellations, unnecessary admissions, and medical expenses in patients with multiple comorbidities. We present the following article in accordance with the STROBE reporting checklist (available at https://dx.doi.org/10.21037/atm-21-4665).

Methods

Study design

This single center prospective cohort study enrolled patients from Nov 1, 2019 to Oct 31, 2020 in Zhongshan Hospital, Fudan University, Shanghai, China. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by ethics board of clinical trial (No.: NCT03665987) and informed consent was taken from all the patients.

Patients with multiple comorbidities, who were not receiving proper treatment were included. Patients under 18 years, who were undergoing emergency surgeries and had no comorbidities [i.e., American Society of Anesthesiologists (ASA) I] were excluded from the study.

After considering surgeries in surgical clinics, those with multiple comorbidities, who were not receiving proper treatments, were assigned by the surgeon to visit or not visit the PAC.

In the PAC, the anesthesiologist assessed the physical conditions of the patient, adjusting medications (warfarin, clopidogrel), treating investigated comorbidities (hypertension, bradycardia), functional training, referring assessment by medical team (cardiologist, respiratory physician). If both the surgeon and the anesthesiologist believed that the case was not ready for surgery, the case would not be scheduled for surgery. If patient went through PAC, the patient was scheduled for the surgery and admitted to hospital. On the day before surgery, the anesthesiologist and surgeon would perform the preoperative assessment. If they believed that the patient did not meet the criteria for surgery, the case would be cancelled.

For patients who bypassed PAC and were admitted to

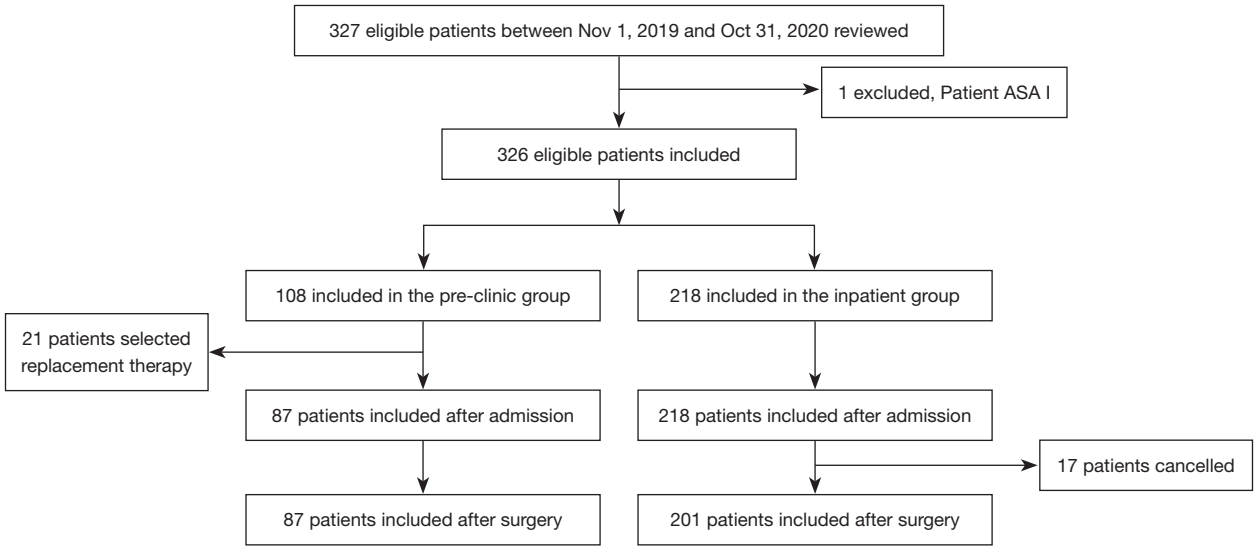

Figure 1 Cohort structure and missing data for patients with preclinic visits *vs*. anesthesia consultations after admission.

hospital, the anesthesia consultation was conducted at least 12 hours before the scheduled surgery. If the case was not ready for surgery, the surgery would be cancelled by the surgeon and anesthesia team.

The two groups did not receive any additional interventions following selective surgery.

Major surgeries in this study included surgeries graded III or IV.

Outcomes

The primary outcome was operating room cancellations of the surgeries.

The secondary outcomes were major complications, the incidence of postoperative intensive care unit (ICU) admissions and readmissions to any hospital within 30 days of the patients who eventually completed the surgery. In addition, length of hospital stay before surgery, length of hospital stay after surgery and hospitalization expenses were analyzed as secondary outcomes.

Preoperative comorbidities and major complications were defined by the International Classification of Diseases Tenth Revision (ICD-10) diagnostic codes. Major complications were defined as those diagnosed for the first time postoperatively or aggravated after surgery.

Statistical analysis

Statistical analyses were performed using the Statistical Product and Service Solutions 22 (SPSS Inc., Chicago, IL, USA) statistical software. Continuous variables were compared using analysis of variance or the Kruskal-Wallis test, while proportions were compared using the chi-square or Fisher's exact test. The Pearson chi-square test was used to analyze the rates of cancellation. Binary logistic regression analysis was performed to determine prognostic factors associated with preclinic visits. Multiple logistic regression analysis was used to examine the effect of preclinic visits on cancellation rates after adjusting for major complications, the incidence of postoperative ICU admissions and readmissions to any hospital within 30 days.

Patients in the two groups were likely to differ systematically due to the small number of cases included in the sample. In particular, gender bias might exist in this type of research. Therefore, propensity scores were estimated using multivariable logistic regression with receipt of a visit to preclinic as the dependent variable and covariates decided upon a priori as independent variables (sex, age, and ASA states).

All statistical analyses were performed separately for each operative site. A P value of 0.05 or less was considered as indicating statistical significance.

Results

Preoperative and intraoperative status

This study enrolled 327 patients from Nov 1, 2019 to Oct 31, 2020 (*Figure 1*). One patient was excluded

Table 1 Baseline characteristics of the patients

	Observed data (n=326)			Propensity score matched data (n=216)		
	Preclinic group (n=108)	Inpatient group (n=218)	P value	Preclinic group (n=108)	Inpatient group (n=108)	P value
Women, n (%)	52 (48.15)	78 (35.78)	0.032	52 (48.15)	42 (38.89)	0.371
Age, mean ± SD, years	67.59±12.597	69.09±10.966	0.270	67.59±12.597	67.73±12.428	0.913
ASA physical status, n (%)			<0.01			0.721
II	72 (66.67)	185 (84.86)		72 (66.67)	76 (70.37)	
III	36 (33.33)	33 (15.14)		36 (33.33)	32 (29.63)	
Age-adjusted Charlson comorbidity index, mean ± SD	6.06±1.521	5.99±1.577	0.724	6.06±1.521	5.91±1.673	0.241
No. of comorbidities, n (%)						
1	32 (29.63)	78 (35.78)	0.635	32 (29.63)	41 (37.96)	0.213
2	45 (41.67)	90 (41.28)	0.947	45 (41.67)	40 (37.04)	0.600
3	24 (22.22)	36 (16.51)	0.211	24 (22.22)	21 (19.44)	0.263
≥4	7 (6.48)	14 (6.42)	0.984	7 (6.48)	6 (5.56)	0.622
Hypertension, n (%)	57 (52.78)	107 (49.08)	0.556	57 (52.78)	46 (42.59)	0.215
Coronary artery disease, n (%)	24 (22.22)	58 (26.61)	0.391	24 (22.22)	27 (25.00)	0.433
Arrhythmia, n (%)	11 (10.19)	43 (19.72)	0.029	11 (10.19)	21 (19.44)	0.053
Congestive heart failure, n (%)	15 (13.89)	22 (10.09)	0.309	15 (13.89)	13 (12.04)	0.845
Peripheral vascular disease, n (%)	3 (2.78)	11 (5.05)	0.509	3 (2.78)	2 (1.85)	0.535
Diabetes, n (%)	29 (26.85)	41 (18.81)	0.096	29 (26.85)	19 (17.59)	0.078
Previous stroke or transient ischemic attack, n (%)	17 (15.74)	44 (20.18)	0.333	17 (15.74)	19 (17.59)	0.668
Chronic liver disease, n (%)	2 (1.85)	2 (0.92)	0.404	2 (1.85)	1 (0.93)	0.528
Chronic kidney disease, n (%)	6 (5.56)	15 (6.88)	0.646	6 (5.56)	12 (11.11)	0.101
Chronic obstructive pulmonary disease, n (%)	7 (6.48)	29 (13.30)	0.064	7 (6.48)	12 (11.11)	0.265

SD, standard deviation; ASA, American Society of Anesthesiologists.

since she was ASA I and visited the PAC by herself. A total of 326 patients were included in this prospective study (108 in the preclinic group, 218 in the inpatient group). Age, preoperative complications, ASA states, age-adjusted Charlson comorbidity index (aCCI) scores and preoperative laboratory examination showed no statistical differences between groups (P>0.05; *Tables 1*,*2*). Patients in the inpatient group received more IV grade surgeries and abdominal surgeries than those in the preclinic group (P=0.038; P=0.004; *Table 3*). No statistical differences were observed in operation time, intraoperative blood loss, and fluid transfusion between the two groups (P>0.05; *Table 3*).

Primary outcomes

In the preclinic group, 21 patients (19.44%) selected replacement therapy due to severe comorbidities and, therefore, were not suitable for surgery and anesthesia. All the patients admitted after attending the PAC completed the scheduled surgeries without delay or cancellation. Seventeen patients (7.80%) in the inpatient group cancelled the surgery after admission. The number of operating cancellations in the inpatient group (7.80%) was significantly higher than that in the preclinic group (0%) [risk ratio (RR), 1.056; 95% confidence interval (CI), 1.032–

Table 2 Preoperative laboratory examination for surgical cases

	Observed data (n=288)			Propensity score matched data (n=188)		
	Preclinic group (n=87)	Inpatient group (n=201)	P value	Preclinic group (n=87)	Inpatient group (n=101)	P value
Hb, g/L	120.885±24.4870	122.144±22.4438	0.671	120.885±24.4870	118.933±24.4454	0.494
ALT, U/L	17.996±11.4987	17.577±10.2120	0.776	17.996±11.4987	17.827±9.1677	0.996
AST, U/L	20.310±7.0699	20.284±8.0302	0.979	20.310±7.0699	20.702±7.8492	0.616
TBil, μmol/mL	11.125±5.2570	12.365±13.1899	0.398	11.125±5.2570	11.378±5.4079	0.597
ALB, g/L	42.517±5.6480	40.995±5.1396	0.026	42.517±5.6480	40.981±6.2566	0.099
Cr, μmol/mL	89.908±64.8463	102.378±99.3884	0.284	89.908±64.8463	116.029±142.0791	0.103
cTnT, ng/mL	0.0156±0.01342	0.0164±0.01959	0.750	0.0156±0.01342	0.0203±0.03540	0.267
CK-MB, ng/mL	1.9290±1.83170	2.3768±4.63359	0.442	1.9290±1.83170	2.9483±6.16291	0.175

Data are shown as mean ± standard deviation. Hb, Hemoglobin; ALT, aminoleucine transferase; AST, aspartate aminotransferase; Tbil, total bilirubin: ALB, albumin; Cr, creatinine; cTnT, cardiac troponin T; CK-MB, creatine kinase-MB.

Table 3 Operative conditions

	Observed data (n=288)			Propensity score matched data (n=188)		
	Preclinic group (n=87)	Inpatient group (n=201)	P value	Preclinic group (n=87)	Inpatient group (n=101)	P value
Duration of surgery, mean ± SD, h	2.155±0.9128	2.193±1.0915	0.777	2.155±0.9128	2.248±0.9966	0.533
Intraoperative blood loss, mean ± SD, mL	71.32±109.688	68.19±130.208	0.845	71.32±109.688	67.03±141.247	0.818
Fluid transfusion, mean ± SD, mL	1,206.90±503.197	1,184.65±606.361	0.764	1,206.90±503.197	1,225.74±603.267	0.818
Surgical grade, n (%)			0.434			0.038
III	18 (20.69)	34 (16.92)		18 (20.69)	10 (9.90)	
IV	69 (79.31)	167 (83.08)		69 (79.31)	91 (90.10)	
Type of surgery, n (%)			0.607			0.004
Abdominal surgery	60 (68.97)	154 (76.62)		60 (68.97)	92 (91.09)	
Thoracic surgery	5 (5.75)	10 (4.98)		5 (5.75)	2 (1.98)	
Urologic surgery	9 (10.34)	12 (5.97)		9 (10.34)	2 (1.98)	
Gynecological surgery	9 (10.34)	19 (9.45)		9 (10.34)	3 (2.97)	
Neurosurgery	4 (4.60)	6 (2.99)		4 (4.60)	2 (1.98)	

SD, standard deviation.

1.223; P=0.016; *Table 4*].

After propensity score matching, the number of operating cancellations in the inpatient group (6.48%) was still significantly higher than that in the preclinic group (0%) (RR, 1.070; 95% CI, 1.017–1.124; P=0015; *Table 4*).

In cases who selected replacement therapy, the medical status in the preclinc group was comparable to those who in the inpatient group (P>0.05; *Table 5*). The cancelled cases in the inpatient group cost 13,057.74 RMB [standard deviation (SD), 10,125.03 RMB] during hospitalization, which is equivalent to one third of per capita disposable income (32,189 RMB) in China in 2020 (15).

Secondary outcomes

Major complications, incidence of postoperative ICU admissions

Table 4 Primary outcome in the study cohort

	Observed data (n=305)						Propensity score matched data (n=195)					
	Preclinic group (n=87)	Inpatient group (n=218)	Unadjusted values		Adjusted values		Preclinic group (n=87)	Inpatient group (n=108)	Unadjusted values		Adjusted values	
			RR (95% CI)	P value	RR (95% CI)	P value			RR (95% CI)	P value	RR (95% CI)	P value
Operating room cancellation	0 (0)	17 (7.80%)	1.085 (1.044–1.127)	0.007	1.056 (1.032–1.223)	0.016	0 (0)	7 (6.48%)	1.038 (1.001–1.078)	0.016	1.070 (1.017–1.124)	0.015

RR, risk ratio; CI, confidence interval.

Table 5 Baseline characteristics of the cancellation cases

	Preclinic group (n=21)	Inpatient group (n=17)	P value
Age, mean ± SD, years	69.24±14.142	71.12±10.295	0.641
ASA physical status, n (%)			0.217
II	12 (57.14)	13 (76.47)	
III	9 (42.86)	4 (23.53)	
Age-adjusted Charlson comorbidity index, mean ± SD	6.43±1.690	6.65±1.455	0.667
No. of conditions, n (%)			
1	9 (42.86)	2 (11.76)	0.048
2	7 (33.33)	8 (47.06)	0.391
3	5 (23.81)	4 (23.53)	0.984
≥4	0 (0)	3 (17.65)	0.081
Hypertension, n (%)	11 (52.38)	12 (70.59)	0.257
Coronary artery disease, n (%)	5 (23.81)	6 (35.29)	0.440
Arrhythmia, n (%)	2 (9.52)	4 (23.53)	0.253
Congestive heart failure, n (%)	4 (19.05)	2 (11.76)	0.544
Peripheral vascular disease, n (%)	0 (0)	2 (11.76)	0.193
Diabetes, n (%)	3 (14.29)	6 (35.29)	0.140
Previous stroke or transient ischemic attack, n (%)	2 (9.52)	4 (23.53)	0.253
Chronic kidney disease, n (%)	0 (0)	1 (5.88)	0.477
Chronic obstructive pulmonary disease, n (%)	2 (9.52)	3 (17.65)	0.468

SD, standard deviation; ASA, American Society of Anesthesiologists.

and hospital readmissions within 30 days showed no statistical differences between the two groups (P>0.05, *Table 6*).

Analysis showed that a PAC visit was significantly associated with a decrease in the length of hospital stay before surgery (76.11 *vs.* 93.02 h; P=0.010; *Table 6*). Propensity score matched data also showed a significant difference in the length of hospital stay before surgery (76.11 *vs.* 92.22 h, P=0.038; *Table 6*).

There were no statistical differences between the two groups in the length of hospital stays after surgery, hospitalization expenses, and hospitalization expenses without surgical costs (P>0.05; *Table 6*). The follow-up data on postoperative laboratory examinations showed no statistical differences between the two groups (P>0.05; *Table*

Table 6 Secondary outcomes in the study cohort

	Observed data (n=288)						Propensity score matched data (n=188)					
	Preclinic group (n=87)	Inpatient group (n=201)	Unadjusted values		Adjusted values		Preclinic clinic group (n=87)	Inpatient group (n=101)	Unadjusted values		Adjusted values	
			RR (95% CI)	P value	RR (95% CI)	P value			RR (95% CI)	P value	RR (95% CI)	P value
Major complications within 30 d, n (%)	13 (14.94)	24 (11.94)	0.768 (0.371–1.588)	0.476	0.490 (0.110–2.180)	0.349	13 (14.94)	14 (13.86)	0.927 (0.410–2.096)	0.855	0.580 (0.108–3.125)	0.527
Non-surgical related major complications within 30 d, n (%)	8 (9.20)	17 (8.46)	0.907 (0.376–2.189)	0.829	0.549 (0.111–2.725)	0.463	8 (9.20)	9 (8.91)	0.977 (0.360–2.652)	0.963	1.645 (0.269–10.101)	0.589
Incident of Clavien-Dindo index, n (%)			0.893 (0.651–1.224)	0.481	0.706 (0.245–2.033)	0.519			0.608 (0.099–3.371)	0.790	0.343 (0.076–1.546)	0.734
I	4 (4.60)	4 (1.99)					4 (4.60)	4 (3.96)				
II	4 (4.60)	13 (6.47)					4 (4.60)	8 (7.92)				
III	4 (4.60)	7 (3.48)					4 (4.60)	2 (1.98)				
IV	1 (1.15)	0 (0)					1 (1.15)	0 (0)				
Intensive care unit admission, n (%)	3 (3.45)	3 (1.49)	0.422 (0.083–2.132)	0.297	0.374 (0.045–3.079)	0.360	3 (3.45)	1 (0.99)	0.280 (0.029–2.740)	0.274	0.291 (0.025–3.413)	0.326
Readmission within 30 d, n (%)	4 (4.60)	10 (4.98)	1.081 (0.330–3.545)	0.898	1.820 (0.401–8.254)	0.438	4 (4.60)	9 (8.91)	2.028 (0.602–6.849)	0.253	2.915 (0.647–13.158)	0.164
Length of stay before surgery, mean ± SD, h	76.11±46.627	93.02±53.746		0.011		0.010	76.11±46.627	92.22±58.883		0.040		0.038
Length of stay after surgery, mean ± SD, h	153.97±134.465	162.62±213.317		0.729		0.287	153.97±134.465	151.77±75.431		0.889		0.862
Hospitalization expenses, mean ± SD, RMB	60,225.18±43,370.504	61,299.83±44,023.467		0.645		0.728	60,225.18±43,370.504	63,624.48±29,263.447		0.518		0.369
Hospitalization expenses without surgical costs, mean ± SD, RMB	34,676.24±33,147.258	35,296.31±38,982.132		0.917		0.914	34,676.24±33,147.258	34,437.24±33,147.256		0.953		0.748

SD, standard deviation; RR, risk ratio; CI, confidence interval.

7).

Discussion

This is the first study on PACs in a tertiary teaching hospital in China. In this prospective observational study, we found that a visit to a PAC significantly reduced operation room cancellations of selective surgeries and decreased length of stays before surgery in patients with comorbidties. Meanwhile, the prognosis of those who underwent surgeries was similar in both groups, which indicates identical effectiveness of the PAC and an anesthesia consultation on patients' outcomes.

Under the condition of ambulatory and same-day surgery, PACs showed benefits in terms of reducing surgical cancellations, improving patient prognosis, saving hospital resources, reducing costs, and improving patient satisfaction (8,16). The physical status of these patients could be optimized through preoperative management including comprehensive preoperative examination, medication adjustment and functional training to decrease postoperative complications (17). Preoperative assessment clinics were therefore set up to meet these functions as well as reduce cancellations and improve prognosis (18).

A prospective multicenter study showed a higher case cancellation rate in university hospitals, which might be due to the complexity of patients' medical conditions, with cancellations being costly and resulting in lost revenue as well as disrupting the throughput of cases in the operating room suit (14). Considering the above, our study was set up to focus on patients with multiple comorbidities, who were not receiving proper treatment, where the majority of cancellations and postoperative complications occurred, and who might benefit more from visits to PACs in a tertiary teaching hospital setting in China.

Most previous studies compared patients who visited PACs with those who neither visited the clinics nor received in-hospital consultations from anesthesiologists (3,8,10). Our study focused on the timing of consultations. Unlike in western countries, traditionally in China surgical patients with multiple comorbidities who are not receiving proper treatment receive an anesthesia consultation after admission. With the opening of the PAC, the timing of consultations is earlier. In our study, the earlier timing of consultations as a result of the PACs visits led to a significant decrease in surgical cancellations. The cancellation rate after consultation in the inpatient group was 7.8%, while all the patients admitted after visiting the PAC completed their selective surgeries. Although the previous reported incidence of cancellations varies from 2% to 27% with studies suggesting that a <5% cancellation rate is achievable at the best-performing centers, the cancellations in our study only indicated the cancelled cases in patients with multiple comorbidities who were not receiving proper treatment (19,20). Furthermore, PACs visits resulted in a shorter length of stay before surgery in our study. This may be due to the focused and detailed examination in the clinic, such that patients admitted for surgeries received full examinations (21).

In our study, unnecessary costs for admission were significantly reduced in the preclinic condition, which is consistent with previous studies (22). The cancelled cases in the preclinic group could select alternative treatments, thus reducing unnecessary costs for admissions to the surgery ward (23). Although a retrospective study on preoperative clinic visits showed reduced operating room cancellations and delays especially in older patients and patients with more medical comorbidities, it did not show reduced medical expenses (24). In this study, the average cost of any canceled case in the inpatient group was 13,057.74 RMB during hospitalization, which is about one third of per capita disposable income (32,189 RMB) in China in 2020 (15).

Previous studies showed a visit to a PAC reduced postoperative complications (25,26). In our study, the similar prognosis of patients in both groups who completed the surgeries might indicate comparable effects of both PACs and in-hospital consultations from anesthesiologists on medical outcomes. At the same time, the medical status of the cancelled patients in the inpatient group was comparable to that of those who did not go through the PACs. This indicates that the same criteria were used in the PACs and in-hospital consultations.

This study showed advantages of preoperative assessment clinics for patients with multiple comorbidities as reducing operation room cancellations, length of stay before surgery as well as unnecessary costs. The anesthesiologist-led PAC still leaves much to be improved (27). Firstly, multidisciplinary cooperation with other relevant medical teams should be invited since most patients in the PAC are with multidisciplinary problems. Secondary, anesthesiologist should participate more in the medical activities after operation. Patients should be recommended to visit PAC after hospital discharge for the purposes of further medical activities and follow-up.

This study has several limitations. First, the sample size was limited, because the PAC had only just been started in our center. Second, bias may exist since a visit or not visit

Table 7 Follow-up data of laboratory examination in the study cohort

	Observed data (n=288)			Propensity score matched data (n=188)		
	Preclinic group (n=87)	Inpatient group (n=201)	P value	Preclinic group (n=87)	Inpatient group (n=101)	P value
Hb, mean ± SD, g/L						
Preoperative	120.885±24.4870	122.144±22.4438	0.671	120.885±24.4870	118.933±24.4454	0.494
Postoperative day 1	111.828±19.7208	113.401±20.6150	0.547	111.828±19.7208	110.792±22.2326	0.738
Postoperative day 3	110.775±20.1576	111.492±19.6258	0.788	110.775±20.1576	110.389±20.8088	0.902
Postoperative day 14	113.047±20.8832	114.547±20.2526	0.624	113.047±20.8832	114.773±20.5559	0.612
Postoperative day 28	116.064±19.7312	115.923±19.4773	0.967	116.064±19.7312	116.513±19.0023	0.899
ALT, mean ± SD, U/L						
Preoperative	17.996±11.4987	17.577±10.2120	0.776	17.996±11.4987	17.827±9.1677	0.996
Postoperative day 1	21.839±12.3692	23.277±19.9657	0.534	21.839±12.3692	22.188±18.1812	0.880
Postoperative day 3	25.338±22.3913	19.906±21.9833	0.456	25.338±22.3913	16.147±16.4181	0.342
Postoperative day 14	23.547±25.7620	21.253±23.0803	0.521	23.547±25.7620	18.182±10.0694	0.191
Postoperative day 28	30.574±23.7318	24.026±16.0996	0.162	30.574±23.7318	23.863±13.6203	0.125
AST, mean ± SD, U/L						
Preoperative	20.310±7.0699	20.284±8.0302	0.979	20.310±7.0699	20.702±7.8492	0.616
Postoperative day 1	21.138±7.4399	25.351±31.3240	0.217	21.138±7.4399	22.901±26.4059	0.548
Postoperative day 3	29.562±36.1210	24.304±22.0538	0.524	29.562±36.1210	21.126±18.0709	0.447
Postoperative day 14	37.973±23.8339	24.727±22.4143	0.250	37.973±23.8339	22.011±10.0327	0.230
Postoperative day 28	28.957±23.8828	27.547±15.1131	0.651	28.957±23.8828	27.750±13.5745	0.717
TBil, mean ± SD, μmol/mL						
Preoperative	11.125±5.2570	12.365±13.1899	0.398	11.125±5.2570	11.378±5.4079	0.597
Postoperative day 1	13.410±6.4011	14.696±13.0122	0.382	13.410±6.4011	13.519±7.1060	0.913
Postoperative day 3	15.415±10.6849	15.796±12.8404	0.817	15.415±10.6849	15.149±8.2202	0.853
Postoperative day 14	13.345±9.8515	12.575±11.7578	0.647	13.345±9.8515	11.090±5.3347	0.072
Postoperative day 28	14.209±9.8657	11.481±6.2829	0.036	14.209±9.8657	10.941±4.6976	0.013
ALB, mean ± SD, g/L						
Preoperative	42.517±5.6480	40.995±5.1396	0.026	42.517±5.6480	40.981±6.2566	0.099
Postoperative day 1	36.287±5.0392	36.025±5.0534	0.685	36.287±5.0392	35.634±5.2014	0.385
Postoperative day 3	37.731±3.8193	37.680±5.5200	0.955	37.731±3.8193	37.726±4.4660	0.983
Postoperative day 14	41.953±6.6199	42.053±5.3140	0.907	41.953±6.6199	42.705±4.7613	0.417
Postoperative day 28	44.340±6.8850	43.368±5.9199	0.366	44.340±6.8850	44.200±6.4029	0.908
Cr, mean ± SD, μmol/mL						
Preoperative	89.908±64.8463	102.378±99.3884	0.284	89.908±64.8463	116.029±142.0791	0.103
Postoperative day 1	89.149±82.7828	100.851±106.6365	0.363	89.149±82.7828	105.653±118.0925	0.276
Postoperative day 3	89.025±86.5813	96.923±90.4982	0.511	89.025±86.5813	103.084±110.2644	0.356
Postoperative day 14	89.391±79.0494	98.007±74.1941	0.447	89.391±79.0494	99.727±73.9850	0.410
Postoperative day 28	78.745±27.1473	84.198±36.8735	0.360	78.745±27.1473	86.225±41.8690	0.275

SD, standard deviation; Hb, hemoglobin; ALT, aminoleucine transferase; AST, aspartate aminotransferase; Tbil, total bilirubin; ALB, albumin; Cr, creatinine.

to the PAC was recommended by surgeons who did not fully recognize the function of a PAC. Finally, the detailed reasons for cancellation for each cancelled case were not documented.

For patients with multiple comorbidities, a visit to a PAC compared with an anesthesia consultation after admission could reduce operating room cancellations as well as unnecessary admissions and additional medical expenses. This means that PACs are more benefit for patients with multiple comorbidities. These findings may support the development of PACs in China and lead to further advances in the perioperative setting.

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Footnote

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References

1. Hepner DL, Bader AM, Hurwitz S, et al. Patient satisfaction with preoperative assessment in a preoperative assessment testing clinic. Anesth Analg 2004;98:1099-105.
2. Parker BM, Tetzlaff JE, Litaker DL, et al. Redefining the preoperative evaluation process and the role of the anesthesiologist. J Clin Anesth 2000;12:350-6.
3. van Klei WA, Moons KG, Rutten CL, et al. The effect of outpatient preoperative evaluation of hospital inpatients on cancellation of surgery and length of hospital stay. Anesth Analg 2002;94:644-9.
4. Miller-Hoehl DA. Patient satisfaction and quality care. Caring 1992;11:34-7.
5. Tait AR, Voepel-Lewis T, Munro HM, et al. Cancellation of pediatric outpatient surgery: economic and emotional implications for patients and their families. J Clin Anesth 1997;9:213-9.
6. Ljungqvist O, Søreide E. Preoperative fasting. Br J Surg 2003;90:400-6.
7. Available online: http://www.nhc.gov.cn/yzygj/s3593/201712/251fb61008bc487797ed18a3a15c1337.shtml
8. Knox M, Myers E, Hurley M. The impact of pre-operative assessment clinics on elective surgical case cancellations. Surgeon 2009;7:76-8.
9. Kopp VJ. Preoperative preparation. Value, perspective, and practice in patient care. Anesthesiol Clin North Am 2000;18:551-74.
10. Ferschl MB, Tung A, Sweitzer B, et al. Preoperative clinic visits reduce operating room cancellations and delays. Anesthesiology 2005;103:855-9.
11. Correll DJ, Bader AM, Hull MW, et al. Value of preoperative clinic visits in identifying issues with potential impact on operating room efficiency. Anesthesiology 2006;105:1254-9; discussion 6A.
12. Harnett MJ, Correll DJ, Hurwitz S, et al. Improving efficiency and patient satisfaction in a tertiary teaching hospital preoperative clinic. Anesthesiology 2010;112:66-72.
13. Halaszynski TM, Juda R, Silverman DG. Optimizing postoperative outcomes with efficient preoperative assessment and management. Crit Care Med

2004;32:S76-86.
14. Schuster M, Neumann C, Neumann K, et al. The effect of hospital size and surgical service on case cancellation in elective surgery: results from a prospective multicenter study. Anesth Analg 2011;113:578-85.
15. Available online: http://www.stats.gov.cn/ztjc/zthd/lhfw/2021/lh_hgjj/202103/t20210301_1814216.html
16. Yen C, Tsai M, Macario A. Preoperative evaluation clinics. Curr Opin Anaesthesiol 2010;23:167-72.
17. Sweitzer BJ. Preoperative screening, evaluation, and optimization of the patient's medical status before outpatient surgery. Curr Opin Anaesthesiol 2008;21:711-8.
18. Koris J, Hopkins C. Improving the quality of the surgical preoperative assessment in a district general hospital. BMJ Qual Improv Rep 2015;4:u205381.w3406.
19. Morris AJ, McAvoy J, Dweik D, et al. Cancellation of Elective Cases in a Recently Opened, Tertiary/Quaternary-Level Hospital in the Middle East. Anesth Analg 2017;125:268-71.
20. Macario A. Are your hospital operating rooms "efficient"? A scoring system with eight performance indicators. Anesthesiology 2006;105:237-40.
21. Kluger MT, Tham EJ, Coleman NA, et al. Inadequate pre-operative evaluation and preparation: a review of 197 reports from the Australian incident monitoring study. Anaesthesia 2000;55:1173-8.
22. Pinzur MS, Gurza E, Kristopaitis T, et al. Hospitalist-orthopedic co-management of high-risk patients undergoing lower extremity reconstruction surgery. Orthopedics 2009;32:495.
23. Edwards AF, Slawski B. Preoperative Clinics. Anesthesiol Clin 2016;34:1-15.
24. Vazirani S, Lankarani-Fard A, Liang LJ, et al. Perioperative processes and outcomes after implementation of a hospitalist-run preoperative clinic. J Hosp Med 2012;7:697-701.
25. Wijeysundera DN. Preoperative consultations by anesthesiologists. Curr Opin Anaesthesiol 2011;24:326-30.
26. Blitz JD, Kendale SM, Jain SK, et al. Preoperative Evaluation Clinic Visit Is Associated with Decreased Risk of In-hospital Postoperative Mortality. Anesthesiology 2016;125:280-94.
27. Tariq H, Ahmed R, Kulkarni S, et al. Development, Functioning, and Effectiveness of a Preoperative Risk Assessment Clinic. Health Serv Insights 2016;9:1-7.

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