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RESEARCH ARTICLE

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Early postoperative outcomes among patients with delayed surgeries after preoperative positive test for SARS-CoV-2: A case-control study from a single institution

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Abstract

Background: There are limited data on surgical complications for patients that have delayed surgery after severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. We aimed to analyze the surgical outcomes of patients submitted to surgery after recovery from SARS-CoV-2 infection.

Methods: Asymptomatic patients that had surgery delayed after preoperative reverse-transcription polymerase chain reaction (RT-PCR) for SARS-CoV-2 were matched in a 1:2 ratio for age, type of surgery and American Society of Anesthesiologists to patients with negative RT-PCR for SARS-CoV-2.

Results: About 1253 patients underwent surgical procedures and were subjected to screening for SARS-CoV-2. Forty-nine cases with a delayed surgery were included in the coronavirus disease (COVID) recovery (COVID-rec) group and were matched to 98 patients included in the COVID negative (COVID-neg) group. Overall, 22 (15%) patients had 30-days postoperative complications, but there was no statistically difference between groups –16.3% for COVID-rec and 14.3% for COVID-neg, respectively (odds ratio [OR] 1.17:95% confidence interval [CI] 0.45–3.0; $p = .74$). Moreover, we did not find difference regarding grades more than or equal to 3 complication rates – 8.2% for COVID-rec and 6.1% for COVID-neg (OR 1.36:95%CI 0.36-5.0; $p = .64$). There were no pulmonary complications or SARS-CoV-2 related infection and no deaths within the 30-days after surgery.

Conclusions: Our study suggests that patients with delayed elective surgeries due to asymptomatic preoperative positive SARS-CoV-2 test are not at higher risk of postoperative complications.

KEYWORDS
SARS-CoV-2, surgical complications, surgical oncology

1 | INTRODUCTION

The new coronavirus (SARS-CoV-2) pandemic has been impairing the diagnosis and treatment of chronic diseases with major impact on public health, such as cardiovascular disease and cancer. This could be justified by the concern among oncological patients after several reports pointed to the worst outcomes for SARS-CoV-2 disease during cancer treatment.[1,2] However, the delay in diagnosis and treatment of cancer has a negative impact on prognosis. Recently, a model for predicting the effect of coronavirus disease 2019 (COVID-19) on cancer screening and treatment in the United States estimated an increase of almost 10,000 excess deaths to the next decade, including just breast and colorectal cancer.[3]

Moreover, recent data from COVIDSurg collaborative[4] reported a 30-day mortality rate of 23.8% in a series of patients with perioperative SARS-CoV-2 infection, with overall pulmonary complication rates of 51.2%. In addition, a matched cohort study that included 41 cases with SARS-CoV-2 positive patients reinforced a higher 30-day mortality and complication rates for the SARS-CoV-2 positive patients compared with controls.[5]

In this setting, actions for protecting the access to health services have been proposed and are under practice during the pandemic. Despite the weakness of evidence, preoperative screening for SARS-CoV-19 has been proposed for elective cancer surgeries in Europe[6] and North America,[7] and also became a recommendation in Brazil since April 2020.[8] Therefore, we have implemented universal screening for SARS-CoV-2 with reverse-transcription polymerase chain reaction (RT-PCR) nasopharyngeal swabs for all surgical procedures in our institution since late April 2020. Notably, we found a preoperative positivity rate of 7.6% among asymptomatic patients scheduled for elective surgeries.[9] These patients had their surgeries postponed, and the next raised question is about the safer strategy for re-scheduling.

Although it has been suggested a significant increase in morbidity and mortality rates for perioperative SARS-CoV-2 positive patients, it is not clear if these patients still have an increased risk of surgical complications in a delayed surgery after complete recovery from SARS-CoV-2 infection. Our aim was to evaluate the surgical morbidity and mortality among patients with delayed surgery due to asymptomatic positive SARS-CoV-2 at a tertiary comprehensive cancer center.

2 | METHODS

2.1 | Patients

Since April 22, 2020, all patients scheduled for surgical procedures at AC Camargo Cancer Center were subjected to preoperative RT-PCR test for SARS-CoV-2. The preoperative screening protocol included: (1) All patients with scheduled elective surgery were contacted for performing SARS-CoV-2 test, 2–3 days before surgical admission; (2) patients underwent epidemiological survey about flu symptoms or contact with infected relatives 5 days before surgery; (3) patients were tested with RT-PCR for SARS-CoV-2 from nasopharyngeal swabs; (4) before and after surgery, all patients were oriented to remain in social isolation; and (5) patients with positive results had the admission canceled, a new SARS-CoV-2 test was collected after 14 days, and the surgery was re-scheduled only after a negative test. There were no additional costs for the patients with respect to screening and the study had the Institutional Review Board approval (#4.072.209).

From April 22 to July 2, 2020, a total of 1253 patients underwent surgical procedures at AC Camargo Cancer Center and were subjected to screening for SARS-CoV-2 by nasopharyngeal swabs. Eighty-five (6.8%) tests were positive for SARS-CoV-2% and 17.6% (15/85) positive cases had emergency procedures. All elective surgeries with positive SARS-CoV-2 had admission canceled and surgery postponed ($n = 70$). Until the end of July 2, 49 cases have already been operated after a subsequent negative test and were included in the COVID recovery (COVID-rec) group. Figure 1 depicts the patient's flow chart.

Patients with delayed surgery due to SARS-CoV-2 positive (COVID-rec) were matched in a 1:2 ratio to those with primary SARS-CoV-2 negative (COVID-neg) that had the surgery performed according to the first schedule. Patients underwent the surgical procedures by the same surgical teams and during the same period of time. Moreover, patients with SARS-CoV-2 positive test were oriented for social distance and their symptoms development were followed. Oncological surgeries were considered as resections performed with curative intent and nononcological surgeries were those performed in patients without curative intent or related to the oncological management (e.g., ureteral catheter in a pelvic tumor recurrence or hysteroscopy in a patient previously treated for breast cancer).

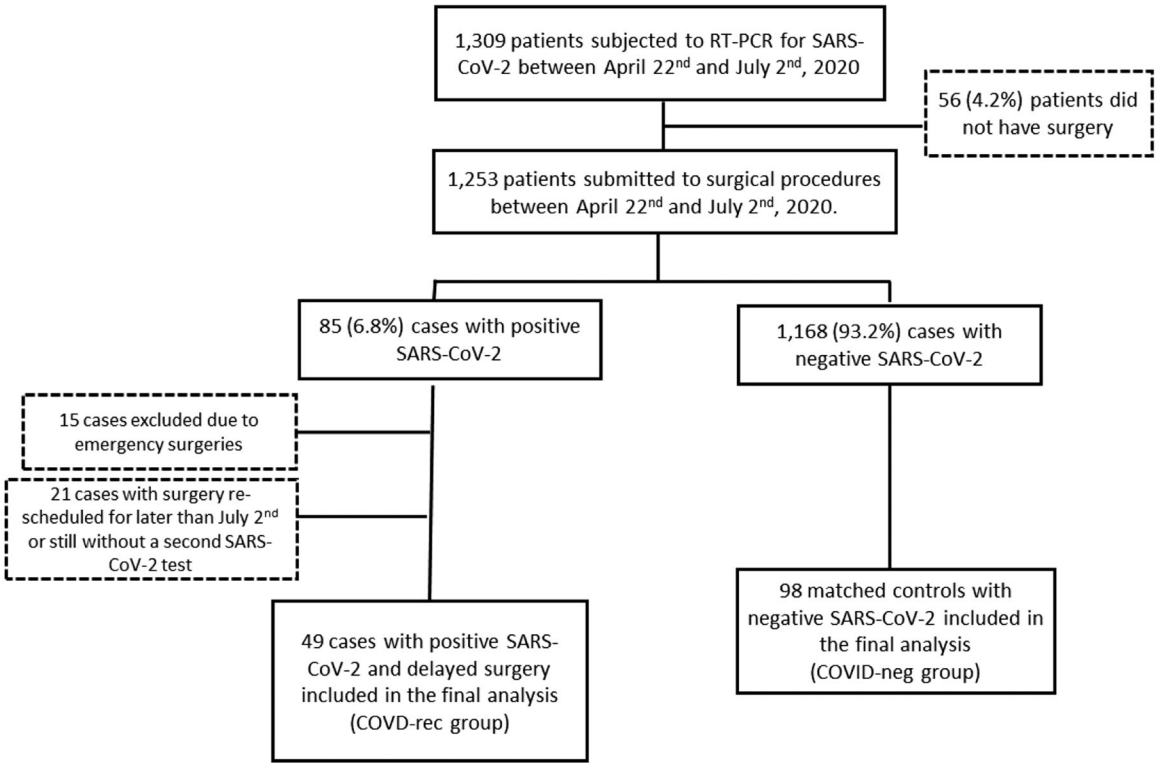

FIGURE 1 Flow-chart of the 147 patients included in the study. COVID, coronavirus disease; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2

For both groups we analyzed demographic and clinical variables such as: age, gender, body mass index, American Society of Anesthesiologists (ASA) Physical Status Classification System,[10] surgical procedure length, intensive care unit (ICU) admission, hospital stay length, type of surgery (oncological surgeries or non-oncological surgeries), and Eastern Cooperative Oncology Group (ECOG) Performance Status.[11] Complications were recorded according to Clavien-Dindo classification.[12]

2.2 | Statistical analysis

The patients in the COVID-rec group ($n = 49$) were matched in a 1:2 ratio for age, type of surgery (oncological surgeries or non-oncological surgeries) and ASA (1 and 2 vs. 3 and 4) to those in the COVID-neg group ($n = 98$). We calculated the propensity score using a logistic regression model including type of surgery, ASA and age to balance these variables between the studied groups. A database was constructed using SPSS, version 20.0 for Mac (SPSS; Inc.). Descriptive statistics were described for both groups. The χ^2, Fisher's exact test were used to analyze the correlations between categorical variables and Mann–Whitney for continuous variables. Odds ratios (ORs) were assessed with logistic regression. For all tests, $p < .05$ was considered to be significant.

3 | RESULTS

Forty-nine cases had elective surgery delayed due to asymptomatic positive RT-PCR for SARS-CoV-2 (COVID-rec) and 98 controls with preoperative negative RT-PCR for SARS-CoV-2 (COVID-neg) were included in the study. The median time between the positive SARS-CoV-2 and definitive surgery was 25 days (range, 12–84). Interestingly, 3 (6.1%) cases had the second positive test, and only had a negative test after 20, 35, and 82 days.

Data on symptoms after positive RT-PCR for SARS-CoV-2 were retrieved from 48 (98%) cases, and notably only 9 (22.9%) cases had symptoms related to SARS-CoV-2 infection. All cases that developed symptoms had a mild presentation such as coryza, myalgia and anosmia, and any patient required hospital admission. Of the three cases with a second positive test, two developed symptoms but any of them had surgical complications.

There were no statistically differences between groups regarding age, body mass index, gender, performance status, surgical time length, and hospital stay length. For the COVID-rec group, 25 (51%) cases had oncological surgeries and 24 (49%) nononcological surgeries. In addition, 2 (4.1%) cases of COVID-rec groups had emergency surgeries due to complications during the delaying period. For COVID-neg group, 6 (6.1%) cases with emergency surgeries were included ($p = .71$). Table 1 describes the surgical procedures.

TABLE 1 Description of the 147 cases included in the study

Case	SARS-CoV-2 status	Age	ASA[a]	ECOG[b]	Oncological surgery	Surgical procedure	Clavien–Dindo[c]
1	Positive	48	2	1	No	Biliary drainage	IIIb
2	Positive	68	3	0	Yes	Pulmonary lobectomy MIS[d]	IIIa
3	Positive	76	2	0	Yes	Skin resection	IIIa
4	Positive	57	3	1	No	Splenic embolization	IIIa
5	Positive	57	2	0	Yes	Cytoreductive surgery	II
6	Positive	48	2	0	No	Implantable venous catheter	II
7	Positive	64	2	0	No	Renal arteriography	I
8	Positive	60	2	0	Yes	Rectosigmoidectomy MIS	I
9	Positive	62	2	1	No	Implantable venous catheter	None
10	Positive	19	2	0	No	Hemangioma embolization	None
11	Positive	49	2	0	Yes	Total thyroidectomy	None
12	Positive	60	2	0	No	Implantable venous catheter	None
13	Positive	51	2	0	Yes	Brain tumor resection	None
14	Positive	46	2	0	No	Oophorectomy	None
15	Positive	72	3	1	No	Ureteral stent implant	None
16	Positive	13	1	0	Yes	Skin resection	None
17	Positive	55	2	0	Yes	Total hysterectomy	None
18	Positive	26	1	0	No	Hysteroscopy	None
19	Positive	55	2	1	No	Celiac plexus block	None
20	Positive	34	2	0	Yes	Axillary lymphadenectomy	None
21	Positive	62	2	0	Yes	Partial breast resection	None
22	Positive	69	3	0	No	Implantable venous catheter	None
23	Positive	31	1	0	Yes	Transurethral bladder resection	None
24	Positive	40	1	0	No	Total hysterectomy	None
25	Positive	38	2	0	Yes	Simple mastectomy	None
26	Positive	56	2	0	No	Skin resection	None
27	Positive	58	2	0	Yes	Total gastrectomy	None
28	Positive	52	2	0	No	Lymph node biopsy	None
29	Positive	38	1	0	No	Cervical conization	None
30	Positive	52	2	0	No	Implantable venous catheter	None
31	Positive	38	2	0	Yes	Simple mastectomy	None
32	Positive	68	2	0	No	Total thyroidectomy	None
33	Positive	59	2	0	Yes	Radical prostatectomy MIS[d]	None
34	Positive	48	2	0	Yes	Skin resection	None
35	Positive	48	2	0	Yes	Skin resection	None
36	Positive	62	2	0	No	Total hysterectomy	None
37	Positive	28	1	0	Yes	Radical orchiectomy	None

TABLE 1 (Continued)

Case	SARS-CoV-2 status	Age	ASA[a]	ECOG[b]	Oncological surgery	Surgical procedure	Clavien–Dindo[c]
38	Positive	51	2	0	Yes	Partial penectomy	None
39	Positive	46	1	0	Yes	Total thyroidectomy	None
40	Positive	53	1	0	Yes	Radical prostatectomy MIS[d]	None
41	Positive	55	2	0	No	Salpingectomy MIS[d]	None
42	Positive	45	1	0	Yes	Skin resection	None
43	Positive	35	1	0	No	Cervical conization	None
44	Positive	39	2	0	Yes	Partial parotidectomy	None
45	Positive	49	2	0	Yes	Axillary lymphadenectomy	None
46	Positive	17	2	0	No	Skin resection	None
47	Positive	81	2	1	No	Implantable venous catheter	None
48	Positive	45	3	1	No	Ureteral stent implant	None
49	Positive	55	2	0	Yes	Simple mastectomy	None
50	Negative	55	3	0	No	Implantable venous catheter	IVb
51	Negative	55	3	0	No	Ileostomy closure	IVa
52	Negative	48	2	0	Yes	Total gastrectomy MIS[d]	IIIb
53	Negative	48	3	1	No	Biliary drainage	IIIa
54	Negative	52	2	0	No	Total hysterectomy MIS[d]	IIIa
55	Negative	49	2	0	Yes	Rectal amputation	IIIa
56	Negative	69	2	1	No	Ureteral stent implant	II
57	Negative	51	3	1	Yes	Simple mastectomy	II
58	Negative	61	2	0	No	Small bowel resection	II
59	Negative	38	2	0	Yes	Radical mastectomy	II
60	Negative	46	2	0	Yes	Simple mastectomy	II
61	Negative	60	2	0	Yes	Axillary lymphadenectomy	II
62	Negative	59	2	1	Yes	Pulmonary lobectomy MIS[d]	II
63	Negative	77	3	0	Yes	Skin resection	I
64	Negative	68	4	1	No	Implantable venous catheter	None
65	Negative	62	2	0	Yes	Skin resection	None
66	Negative	68	2	1	No	Endoscopic gastrostomy	None
67	Negative	68	3	0	Yes	Maxillectomy	None
68	Negative	53	2	0	Yes	Skin resection	None
69	Negative	66	2	0	No	Tracheoplasty	None
70	Negative	45	2	0	Yes	Skin resection	None
71	Negative	49	2	0	Yes	Simple mastectomy	None
72	Negative	48	2	0	Yes	Simple mastectomy	None
73	Negative	72	2	2	No	Ureteral stent implant	None
74	Negative	61	2	0	No	Ureteral stent implant	None
75	Negative	45	2	0	No	Hysteroscopy	None

(Continues)

TABLE 1 (Continued)

Case	SARS-CoV-2 status	Age	ASA[a]	ECOG[b]	Oncological surgery	Surgical procedure	Clavien–Dindo[c]
76	Negative	39	2	0	No	Craniotomy	None
77	Negative	57	2	0	Yes	Skin resection	None
78	Negative	46	2	0	No	Breast plastic	None
79	Negative	55	2	0	Yes	Skin resection	None
80	Negative	55	3	1	No	Bowel bleeding angiography	None
81	Negative	16	2	0	No	Ileostomy closure	None
82	Negative	48	2	0	No	Eye brachytherapy implant	None
83	Negative	57	2	0	No	Cystoscopy	None
84	Negative	39	2	0	Yes	Axillary lymphadenectomy	None
85	Negative	62	3	1	No	Esophageal prosthesis	None
86	Negative	46	2	0	No	Hysteroscopy	None
87	Negative	55	2	0	No	Laryngeal biopsy	None
88	Negative	45	2	0	No	Hysteroscopy	None
89	Negative	52	2	0	No	Total hysterectomy MIS[d]	None
90	Negative	64	3	1	No	Prostate endoscopic resection	None
91	Negative	39	2	0	Yes	Radical mastectomy	None
92	Negative	57	3	1	No	Choledocoplasty	None
93	Negative	55	2	0	Yes	Partial breast resection	None
94	Negative	51	2	0	Yes	Pulmonary resection MIS	None
95	Negative	52	2	0	No	Biliary drainage	None
96	Negative	66	3	1	No	Biliary drainage	None
97	Negative	51	2	0	Yes	Eye enucleation	None
98	Negative	49	2	0	Yes	Radical mastectomy	None
99	Negative	40	2	0	No	Total hysterectomy MIS[d]	None
100	Negative	38	2	0	Yes	Skin resection	None
101	Negative	45	2	0	Yes	Simple mastectomy	None
102	Negative	24	1	0	Yes	Partial parotidectomy	None
103	Negative	38	2	0	Yes	Axillary lymphadenectomy	None
104	Negative	58	2	0	Yes	Liver resection	None
105	Negative	39	1	0	No	Anal fistulectomy	None
106	Negative	25	2	0	No	Oophoroplasty MIS[d]	None
107	Negative	81	4	0	No	Eye brachytherapy implant	None
108	Negative	45	1	0	Yes	Partial breast resection	None
109	Negative	64	2	0	Yes	Paraortic lymphadenectomy	None
110	Negative	59	3	0	Yes	Partial breast resection	None
111	Negative	52	2	0	No	Partial thyroidectomy	None
112	Negative	38	1	0	Yes	Total thyroidectomy	None
113	Negative	51	1	0	Yes	Partial breast resection	None

TABLE 1 (Continued)

Case	SARS-CoV-2 status	Age	ASA[a]	ECOG[b]	Oncological surgery	Surgical procedure	Clavien–Dindo[c]
114	Negative	19	2	0	No	Implantable venous catheter	None
115	Negative	58	2	0	Yes	Skin resection	None
116	Negative	46	2	0	Yes	Simple mastectomy	None
117	Negative	58	2	0	Yes	Axillary lymphadenectomy	None
118	Negative	34	1	0	Yes	Total thyroidectomy	None
119	Negative	48	2	0	Yes	Partial breast resection	None
120	Negative	40	2	0	No	Paravertebral tumor biopsy	None
121	Negative	57	2	0	Yes	Simple mastectomy	None
122	Negative	53	1	0	Yes	Radical prostatectomy MIS[d]	None
123	Negative	25	2	0	No	Cervical conization	None
124	Negative	20	1	0	No	Anal fistulectomy	None
125	Negative	62	2	0	Yes	Skin resection	None
126	Negative	31	1	0	Yes	Total thyroidectomy	None
127	Negative	55	2	0	Yes	Total thyroidectomy	None
128	Negative	26	2	0	No	Cervical conization	None
129	Negative	49	2	0	Yes	Hysteroscopy	None
130	Negative	35	2	0	No	Hepatic angiography	None
131	Negative	31	2	0	Yes	Partial nephrectomy MIS	None
132	Negative	68	2	0	Yes	Radical prostatectomy MIS	None
133	Negative	51	2	0	Yes	Skin resection	None
134	Negative	27	2	0	Yes	Oropharyngeal biopsy	None
135	Negative	72	2	2	No	Eye brachytherapy implant	None
136	Negative	16	2	0	No	Biliary drainage	None
137	Negative	24	1	0	No	Skin resection	None
138	Negative	55	2	0	Yes	Simple mastectomy	None
139	Negative	56	2	0	No	Hysteroscopy	None
140	Negative	34	1	0	Yes	Total thyroidectomy	None
141	Negative	48	2	0	Yes	Radical mastectomy	None
142	Negative	70	2	0	Yes	Transurethral bladder resection	None
143	Negative	75	2	0	Yes	Radical nephrectomy MIS[d]	None
144	Negative	60	3	0	Yes	Partial breast resection	None
145	Negative	60	2	1	No	Hysteroscopy	None
146	Negative	60	3	1	No	Transurethral bladder resection	None
147	Negative	38	1	0	No	Cervical conization	None

[a]ASA: American Society of Anesthesiologists risk classification.[10]

[b]ECOG: Eastern Cooperative Oncology Group Performance Status.

[c]Clavien–Dindo: Clavien–Dindo classification of surgical complications.[11]

[d]MIS: Minimally Invasive Surgery.

Overall, 22 (15%) patients had 30-days postoperative complications, but there was no statistically difference between groups – 16.3% for COVID-rec and 14.3% for COVID-neg, respectively (OR 1.17: 95% confidence interval [CI] 0.45–3.0; $p = .74$). Moreover, we did not find difference regarding Grades ≥ 3 complication rates – 8.2% for COVID-rec and 6.1% for COVID-neg (OR 1.36: 95%CI 0.36–5.0; $p = .64$). Yet, we had no pulmonary complications or SARS-CoV-2 related infection during the hospital stay length or during the 30-days after surgery for both groups. Table 2 summarizes the clinical and demographic data between groups and Table 3 describes the surgical complications of Grades ≥ 3.

For the COVID-rec group, 18.2% of patients that developed symptoms after suspended surgery had any type of complications (Grades ≥ 1) compared with 16.2% for those who did not have any symptom ($p = 1.0$). Moreover, Grades ≥ 3 complications were found in COVID-rec and COVID-neg groups in 9.1% and 8.1% of cases, respectively ($p = 1.0$). Interestingly, delaying time length for surgery, analyzed as a continuous variable, was not related to a higher risk of complications ($p = .18$).

We found no deaths within the 30-days after surgery. However, after a longer follow-up, we observed five deaths. All deaths occurred after 45 days of follow-up: three for the COVID-rec group and two for the COVID-neg. No death occurred directly after SARS-CoV-2 infection. For the COVID-rec group, one patient died after bone marrow transplant and catheter infection; one related to empyema after a pulmonary segmentectomy; and one related to hepatic progression of colon cancer after biliary drainage. For the two COVID-neg group cases, one died due to congestive heart failure and one after ovarian cancer progression.

4 | DISCUSSION

According to the World Health Organization, Brazil is the second country in the number of cases and deaths by COVID-19 disease.[13] After considering the implications in delaying oncologic care, and the availability of ward and ICU beds, our institution opted to resume elective surgeries and implemented the strategy of universal preoperative testing. In our preliminary experience including 540 patients, the positivity rate was 7.6% among asymptomatic preoperative patients, allowing us to perform 84.1% of the surgeries electively scheduled.[9]

Recently, the published data from the COVIDSurg collaborative[4] included 1115 patients with perioperative positive SARS-CoV-2 (835 with emergency surgeries and 280 with elective surgeries). SARS-CoV-2 infection was confirmed preoperatively in 294 (26.1%) patients. The overall 30-day mortality in this study was 23.8%, with all-cause mortality rates of 18.9% in elective patients and 25.6% in emergency patients (hazard ratio [HR] 1.67, 1.06–2.63; $p = .026$). Moreover, the mortality rates for minor and major surgeries were 16.3% and 26·9%, respectively (HR 1.52, 1.01–2.31; $p = .047$); for cancer surgery and benign cases of 27.6% and 22.1%, respectively (HR 1.55, 1.01–2.39; $p = .046$); and for ASA 3-5 and 1-2 were 32.2% and 12.1%, respectively (2.35, 1.57–3.53; $p < .0001$). Mortality in patients with SARS-CoV-2 occurred mainly in those who had postoperative pulmonary complications, which was about 50% of patients.

In addition, Doglietto et al.[5] reported a matched cohort study that included 41 cases with SARS-CoV-2 positive and compared with 82 negative cases. The 30-day mortality (19.5% vs. 2.4%: OR 9.5; 95%CI 1.77–96.5) and any complication rates (85.3% vs. 53.6%: OR 4.98; 95%CI 1.81–16) were significantly higher for the SARS-CoV-2 positive cases. In contrast form our study, only seven cases of elective SARS-CoV-2 positive cases were included and only 13.4% (11/82) controls were treated during the same period of time.

Due to the devastating impact on morbidity and mortality in SARS-CoV-2 positive patients submitted to surgical procedures even for minor procedures, consideration should be given for delaying nonemergency procedures and promoting alternative nonoperative treatments for surgery delay. Extrapolating the data from COVIDSurg Collaborative,[4] for the 272 elective cases, we estimate that up to 53 deaths could have been potentially avoided after applying a preoperative SARS-CoV-2 test and subsequent surgery delay.

Universal preoperative screening is now crucial, mainly in places with a high burden of SARS-CoV-2 positive cases. As stated, robust data suggest a highly unacceptable complication and mortality rates even for elective surgeries in SARS-CoV-2 positive patients, and these surgeries should be delayed. However, to date the only study that addressed the complication rates for patients that had delayed surgeries after a positive SARS-CoV-2 was recently published by COVIDSurg Collaborative.[14] They reported in a series of 112 patients that time from positive SARS-CoV-2 and surgery correlated to pulmonary complications and mortality. The authors found no pulmonary complications or deaths when the surgery was performed after 4 weeks of the positive test, suggesting that a 4-week interval between the positive test and surgery may be a safe parameter.

As far as we know, we present the second series that evaluated this topic and we found no difference in complication rates between patients with previous positive SARS-CoV-2 compared with matched controls. Moreover, all cases were operated only after a negative SARS-CoV-2 test, and no case developed pulmonary disease or SARS-CoV-2 infection during the 30-days after surgery. These findings suggest that it may be safe to postpone and operate patients after a negative control SARS-CoV-2 test. Notably, due to positive SARS-CoV-2, 2 elective surgeries were delayed and after oncological complications these cases had emergency procedures, however, with negative SARS-CoV-2 at this time and no deaths even after emergency procedures.

Our strategy was based on a negative control test, despite the interval between tests. The patients were planned to be re-tested after 2 weeks from the first positive test and surgery were only performed after a negative test. Although our data suggest that this parameter is safe for re-scheduling, we still need to determine if it is safe to operate after 3–4 weeks from the first positive test, even after a second (control) positive test or if a subsequent third test is necessary in an asymptomatic patient.

TABLE 2 Clinical and demographic characteristics of the 147 patients submitted to surgical procedures from April 22 to July 2, 2020

Variable		COVID-neg[a] group *n* = 98 (%)	COVID-rec[b] group *n* = 49 (%)	*p* value	Total 147 (%)
Age, mean; median (range) year		49.8; 51 (16–81)	50.1; 52 (13–81)	.86	49.9; 51 (13–81)
Body mass index, mean; median (range) kg/m^2		26.8; 25.9 (16.9–53.9)	27.6; 27.5 (18.8–43)	.33	27.1; 26.6 (16.9–53.9)
Surgical time length, mean; median (range) (min)		119.0; 100 (10–670)	110.2; 79 (10–362)	.54	116.1; 93 (10–670)
Hospital stay length, mean; median (range) (days)		3.48; 1.0 (0–62)	3.08; 1.0 (0–47)	.28	3.35; 1.0 (0–62)
Gender	Male	40 (40.8)	16 (33.3)	.38	56 (38.4)
	Female	58 (59.2)	32 (66.7)		90 (61.6)
ASA[c]	1 and 2	82 (83.7)	44 (89.8)	.31	126 (85.7)
	3 and 4	16 (16.3)	5 (10.2)		21 (14.3)
ECOG[d]	0 and 1	83 (84.7)	42 (85.7)	.87	125 (85.0)
	2 and 3	15 (15.3)	7 (14.3)		22 (15.0)
Surgical type	Oncological	53 (54.1)	25 (51.0)	.72	78 (53.1)
	Nononcological	45 (45.9)	24 (49.0)		69 (46.9)
Surgical Department	Gastrointestinal	17 (17.3)	10 (20.4)	.73	27 (18.4)
	Gynecology	16 (16.3)	10 (20.4)		26 (17.7)
	Breast	21 (23.5)	5 (14.3)		26 (17.7)
	Skin Cancer	14 (14.3)	5 (10.2)		19 (12.9)
	Urology	12 (12.2)	7 (14.3)		19 (12.9)
	Head and Neck	11 (11.2)	7 (14.3)		18 (12.2)
	Others[e]	8 (8.2)	4 (8.2)		12 (8.2)
Intensive care unit	No	92 (93.9)	41 (85.4)	.12	133 (91.1)
	Yes	6 (6.1)	7 (14.6)		13 (8.9)
Morbidity (Clavien–Dindo[f])	none	84 (85.7)	41 (83.7)	.74	125 (85.0)
	I	1 (1.0)	2 (4.1)		3 (2.0)
	II	7 (7.1)	2 (4.1)		9 (6.1)
	IIIa	3 (3.1)	3 (6.1)		6 (4.1)
	IIIb	1 (1.0)	1 (2.0)		2 (1.4)
	IVa	1 (1.0)	0 (0)		1 (0.7)
	IVb	1 (1.0)	0 (0)		1 (0.7)

[a]COVID-neg: patients that had surgeries after a negative RT-PCR test for SARS-CoV-2.

[b]COVID-rec: asymptomatic patients that had surgeries delayed due to positive RT-PCR test for SARS-CoV-2.

[c]ASA: American Society of Anesthesiologists risk classification.[10]

[d]ECOG: Eastern Cooperative Oncology Group Performance Status.

[e]Others: Vascular surgery, Intervention Radiology, Neurosurgery and Reconstructive Surgery.

[f]Clavien–Dindo: Clavien–Dindo classification of surgical complications.[11]

Although being an institution dedicated to cancer treatment, we expanded the analysis for nononcological surgeries and the COVID-rec cases were matched for cases treated during the same period of time and by the same surgical teams. Despite the relatively low number of patients with SARS-CoV-2 positive with delayed surgeries, it is the first matched control study that evaluated this population, and our findings may contribute with valuable data for literature on this topic. However, we should point out the weaknesses of a retrospective single center study.

In conclusion, patients with delayed elective surgeries due to asymptomatic preoperative positive SARS-CoV-2 test are not at higher risk of postoperative complications after having a negative

TABLE 3 Characteristics of the 10 patients with Clavien–Dindo[a] Grades III and IV submitted to surgical procedures from April 22 to July 2, 2020

Group	Age (year)	ASA[b]	Oncological surgery	Surgical procedure	Clavien–Dindo[a]	Complication type	Treatment	ICU[c]
COVID-rec	57	3	No	Splenic embolization	IIIa	Abdominal abscess	Guide drainage[d]	No
COVID-rec	76	2	Yes	Skin resection	IIIa	SS[e] infection	Local suture	No
COVID-rec	68	3	Yes	Pulmonary lobectomy	IIIa	Pleural effusion	Pleural drainage	No
COVID-rec	61	2	No	Biliary drainage	IIIb	Biliary leakage	Re-drainage	No
COVID-neg	49	2	Yes	Rectal amputation	IIIa	Abdominal abscess	Guide drainage	No
COVID-neg	52	2	No	Hysterectomy	IIIa	Abdominal abscess	Guide drainage	No
COVID-neg	48	3	No	Biliary drainage	IIIa	SS bleeding	Local suture	No
COVID-neg	48	2	Yes	Total gastrectomy	IIIb	Small bowel obstruction	Laparotomy	No
COVID-neg	55	3	No	Ileostomy closure	IVa	Anastomotic leakage	Laparotomy	Yes
COVID-neg	55	3	No	Implantable venous catheter	IVb	Catheter infection	Catheter removal	Yes

[a]Clavien–Dindo: Clavien–Dindo classification of surgical complications.[11]
[b]ASA: American Society of Anesthesiologists risk classification.[10]
[c]ICU: Intensive Care Unit admission after complication.
[d]Guided drainage: Image guided procedure.
[e]SS: Surgical Site.

test before surgery. If ward and ICU beds are available, elective surgeries can be scheduled safely with preoperative screening for SARS-CoV-2 based on systematic RT-PCR SARS-CoV-2 testing.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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