

Supplementary material

Perioperative SARS-CoV-2 infection and postoperative complications: a retrospective cohort study

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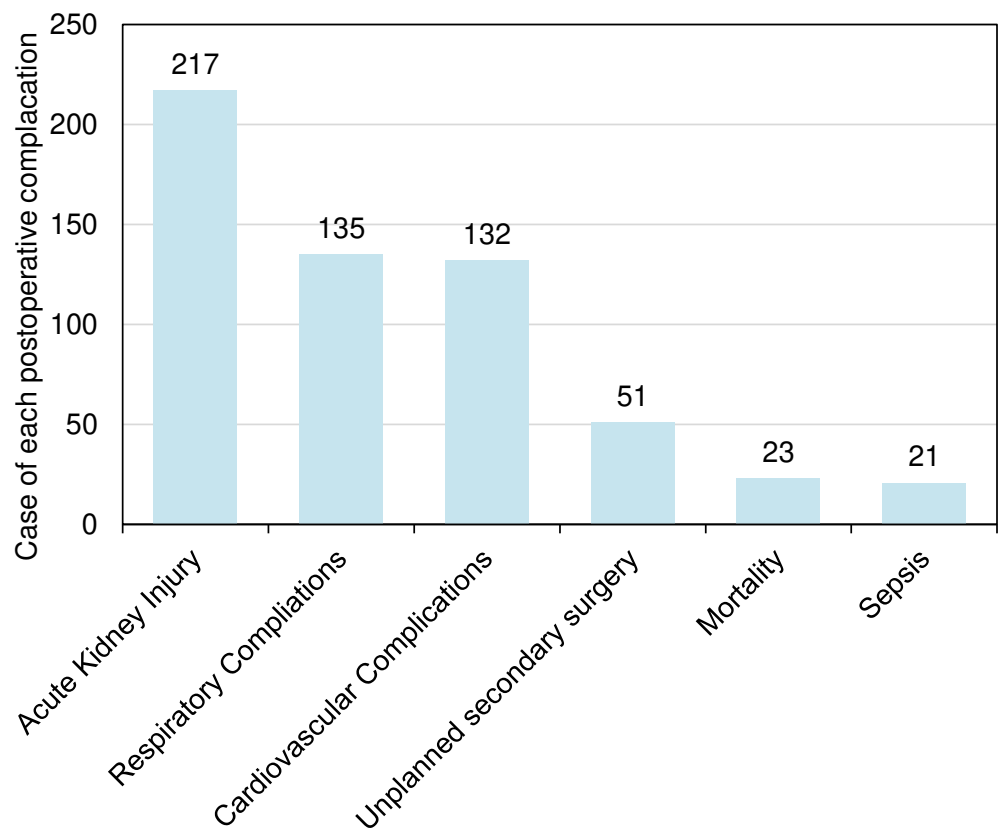
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**Supplementary Figure 1.** Distribution of composites of postoperative complications

Data were presented as the number of cases. It should be noted that multiple postoperative complications may occur in a single patient.

Supplementary Table 1. WHO clinical progression scale of COVID-19

Patient State	Descriptor	Score
Uninfected	Uninfected; no viral RNA detected	0
Ambulatory mild disease	Asymptomatic; viral RNA detected	1
	Symptomatic; independent	2
	Symptomatic; assistance needed	3
Hospitalised: moderate disease	Hospitalised; no oxygen therapy	4
	Hospitalised; oxygen by mask or nasal prongs	5
Hospitalised: severe diseases	Hospitalised; oxygen by NIV or high flow	6
	Intubation and mechanical ventilation, pO2/FiO2 ≥150 or SpO2/FiO2 ≥200	7
	Mechanical ventilation pO2/FiO2 <150 (SpO2/FiO2 <200) or vasopressors	8
	Mechanical ventilation pO2/FiO2 <150 and vasopressors, dialysis, or ECMO	9
Dead	Dead	10

**Supplementary Table 2.** Postoperative complications: details and corresponding ICD-10 codes

Postoperative complications	Details	ICD-10 Codes
Respiratory complications	Pneumonia	J12, J13, J14, J15, J16, J17, J18, J80, J85.802, J96, I26
	Respiratory failure	
	Pulmonary embolism	
Cardiovascular complications	Deep vein thrombosis	I82, I74, R09.2, I21, I49, I50, I60, I61, I62, I63, I64
	Limb artery thrombosis	
	Splenic infarction	
	Hepatic infarction	
	Cerebral hemorrhage	
	Cerebral infarction	
	Hypoxic-ischemic encephalopathy	
	Arrhythmia	
	Myocardial infarction	
	Acute heart failure	
	Acute ischemic heart disease	
	Cardiac arrest	
	Cardiogenic shock	
Acute kidney injury		N17
Sepsis		A41
Unplanned secondary surgery		
Mortality		

**Supplementary Table 3.** Preoperative comorbidities: details and corresponding ICD-10 codes

Preoperative comorbidities	ICD-10 Codes
Diabetes	E10, E11, E13, E14
Chronic obstructive pulmonary disease	J44
Diffuse emphysema	J43
Bronchiectasis	J47
Asthma	J45
Pulmonary fibrosis	J84
Lung transplantation status	Z94
Respiratory failure	J96
Hypertension	I10, I15
Chronic heart failure	I50
Coronary artery disease	I25
Cardiomyopathy	I42
Ventricular aneurysm	I25
Pericardial disease	I30, I31
Cerebrovascular disease	I63, I65, I66, I67, I68, I69
Chronic kidney disease	N18

**Supplementary Table 4.** Definition of American Society of Anaesthesiologists (ASA) Physical Status Classification

ASA Classification*	Details
ASA 1	A normal healthy patient.
ASA 2	A patient with mild systemic disease.
ASA 3	A patient with a severe systemic disease that is not life-threatening.
ASA 4	A patient with a severe systemic disease that is a constant threat to life.
ASA 5	A moribund patient who is not expected to survive without the operation. The patient is not expected to survive beyond the next 24 hours without surgery.
ASA 6	A brain-dead patient whose organs are being removed with the intention of transplanting them into another patient.

\*Statement on ASA Physical Status Classification System. December 13, 2020. <https://www.asahq.org/standards-and-practice-parameters/statement-on-asa-physical-status-classification-system> (accessed January 24, 2024).

**Supplementary Table 5.** Details of grade of surgery

Surgery	Minor	Major
Thoracic surgery	Endoscopic thoracic;  Sympathectomy;  Chest-wall procedures;  Biopsy;  Removal of the thoracic internal fixator.	Lung resection;  Lung transplant;  Esophagectomy;  Mediastinal procedures;  Chondrosternoplasty;  Correction of pectus carinatum.
Head and neck surgery	Reduction of nasal bone;  Electrocoagulation of epistaxis;  Laryngoscopy;  Biopsy;  Tracheotomy.	Neck dissection;  Thyroidectomy;  Parathyroidectomy and transplant;  Sinusotomy;  Cochlear implant reconstruction;  Ossicular chain reconstruction;  Stapes implantation;  Laryngectomy and reconstruction;  Myringoplasty;  Parotidectomy;  Tympanoplasty;  Mastoidectomy;  Adenoidectomy;  Tonsillectomy;  Palatopharyngoplasty;  Branchial fistula resection;

		Deviated septum surgery;  Septoplasty;  Nasal polypectomy;  Excision of turbinates.
Cardio-vascular surgery		Valve procedures;  Coronary artery bypass graft;  Coronary artery transplant;  Artificial vessel replacement;  Atrial tumor resection;  Aortic aneurysm procedures;  Left ventricular outflow tract dredging;  Carotid endarterectomy;  Auricular or/and ventricular septal defect repair.
Digestive surgery	Gastroscopy (diagnostic or biopsy);  Stoma closure procedures; Appendicectomy;  Biopsy;  Anal fistula procedures;  Procedure for prolapse and hemorrhoids.	Gastroscopy (therapy);  Enterostomy;  Gastrectomy;  Small intestine resection;  Hemicolectomy or colectomy;  Cholecystectomy;  Pancreaticoduodenectomy;  Hepatectomy;  Liver transplant;  Biliary procedures;  Oesophagectomy;



		Splenectomy;  Radiofrequency ablation of liver or pancreatic.
Breast surgery	Biopsy;  Removal of breast implants;  Mammoplasty;  Quadrantectomy of the breast.	Mastectomy
Gynaecology and obstetrics surgery	Hysteroscopy (diagnostic);  Repair of obstetric lacerations;  Colposcopic procedures.	Hysterectomy;  Salpingo-oophorectomy;  Hysteroscopy (therapeutic);  Caesarean section.
Orthopaedics surgery	Amputation of toe or finger;  Tendon procedures;  Arthroscopy (diagnostic);  Removal of fracture; fixation;  Biopsy;  Debridement.	Amputation of limb;  Spinal procedures;  Arthroscopy (therapeutic);  Knee replacement;  Hip replacement;  Revision of hip or knee replacement;  Shoulder replacement;  Reduction of the fracture.
Other surgeries	Ureteroscopic procedures;  Cystoscopy (diagnostic);  Biopsy;  Ureteric stent insertion;  Orchiopexy;  Resection of hydrocele of testis;	Nephrectomy;  Adrenalectomy;  Prostatectomy;  Partial penectomy;  Pyeloureteroplasty;  Ureterocystostomy;  Nephrectomy;

	Posthectomy;  Scrotal procedures;  Ureteral stenting;  Excision of skin lesion;  Great saphenous vein procedures;  Hernia repair.	Cystectomy;  Transurethral resection of bladder tumour;  Kidney transplant;  Cystoscopic (therapeutic);  Procedures for kidney stones;  Renal cyst procedures;  Hypophysectomy;  Aneurysm procedures;  Spinal cord procedures;  Intracranial procedure.
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**Supplementary Table 6.** Details of urgency of surgery

Category	Details
Elective surgery	whose indication and scheduling have been conjointly decided by the patient and the surgeon, then followed by a consultation with an anaesthesiologist occurring at least 48h prior to the date of surgery, and then definitively scheduled in the operating theatre programme.
Emergency surgery	unplanned urgent interventions performed in the 48 hours after the surgical indication has been set (“relative emergency”), or in the four hours after the surgical indication has been set “absolute emergency”).

**Supplementary Table 7.** Patient characteristics based on absence or presence of postoperative complications

	Overall (n=3571)	Absence of postoperative complications (n=3151)	Presence of postoperative complications (n=420)
Men, n (%)	1622 (45.42)	1401 (44.46)	221 (52.62)
Age, years, IQR	52.00 [40.00, 63.00]	51.00 [39.00, 61.00]	59.00 [50.00, 69.00]
BMI, kg/m <sup>2</sup> , IQR	23.15 [20.93, 25.19]	23.12 [20.93, 25.20]	23.21 [20.87, 25.04]
Smoking, n (%)	440 (12.32)	369 (11.71)	71 (16.90)
Diagnosis of COVID-19, n (%)			
No COVID-19	959 (26.86)	856 (27.17)	103 (24.52)
Preoperative COVID-19	1871 (52.39)	1657 (52.59)	214 (50.95)
Postoperative COVID-19	741 (20.75)	638 (20.25)	103 (24.52)
COVID-19 vaccination status, n (%)	3318 (92.92)	2943 (93.40)	375 (89.29)
Severity of COVID-19, n (%)			
Mild	2461 (94.22)	2200 (95.86)	261 (82.33)

Moderate/Severe	151 (5.78)	95 (4.14)	56 (17.67)
Number of comorbidities*, n (%)			
0	2323 (65.05)	2221 (70.49)	102 (24.29)
1	112 (3.14)	97 (3.08)	15 (3.57)
2	519 (14.53)	414 (13.14)	105 (25.00)
3	364 (10.19)	260 (8.25)	104 (24.76)
≥4	253 (7.08)	159 (5.05)	94 (22.38)
History of cancer, n (%)	1296 (36.29)	1200 (38.08)	96 (22.86)
ASA classification, n (%)			
Grade 1-2	3048 (85.35)	2843 (90.23)	205 (48.81)
Grade 3-5	523 (14.65)	308 (9.77)	215 (51.19)
Grade of surgery, n (%)			
Minor	1349 (37.78)	1250 (39.67)	99 (23.57)
Major	2222 (62.22)	1901 (60.33)	321 (76.43)
Urgent of surgery, n (%)			

Elective	3339 (93.50)	2979 (94.54)	360 (85.71)
Emergency	232 (6.50)	172 (5.46)	60 (14.29)
Duration of surgery, n (%)			
≤240 minutes	3060 (85.69)	2800 (88.86)	260 (61.90)
>240 minutes	511 (14.31)	351 (11.14)	160 (38.10)
General anesthesia, n (%)	3402 (95.27)	2998 (95.14)	404 (96.19)
Type of surgery, n (%)			
Thoracic	821 (22.99)	762 (24.18)	59 (14.05)
Head and Neck	518 (14.51)	496 (15.74)	22 (5.24)
Cardio-vascular	336 (9.41)	172 (5.46)	164 (39.05)
Digestive	444 (12.43)	385 (12.22)	59 (14.05)
Breast	371 (10.39)	366 (11.62)	5 (1.19)
Gynaecologic and Obstetrics	317 (8.88)	305 (9.68)	12 (2.86)
Orthopadic	276 (7.73)	256 (8.12)	20 (4.76)
Other surgeries‡	488 (13.67)	409 (12.98)	79 (18.81)

Continuous variables are described as median (Interquartile Range, IQR), and categorical variables are described as number (percent).

\*Comorbidities included diabetes, chronic obstructive pulmonary disease, diffuse emphysema, bronchiectasis, asthma, pulmonary fibrosis, lung transplantation status, respiratory failure, hypertension, coronary artery disease, chronic heart failure, cardiomyopathy, ventricular aneurysm, pericardial disease, cerebrovascular disease, and chronic kidney disease.

‡Other surgeries included urologic surgery, interventional surgery, plastic surgery, hernia surgery, and neurosurgery.

ASA Classification = American Society of Anaesthesiologists Physical Status Classification. COVID-19=Coronavirus disease 2019. BMI = body mass index.

**Supplementary Table 8.** Sensitivity analysis of association between preoperative and postoperative COVID-19 and risk of postoperative complications in patients undergoing elective surgery

		Postoperative complications					
		Model 1		Model 2		Model 3	
		OR (95%CI)	p value	OR (95%CI)	p value	OR (95%CI)	p value
Preoperative COVID-19 vs No COVID-19							
Time from surgery to diagnosis of COVID-19							
No COVID-19	88/903 (9.75)	Ref.		Ref.		Ref.	
Pre-1w	17/100 (17.00)	2.11 (1.19, 3.75)	0.011	2.22 (1.20, 4.12)	0.012	2.84 (1.48, 5.46)	0.002
Pre-2w	22/122 (18.03)	2.25 (1.34, 3.78)	0.002	2.67 (1.53, 4.69)	0.001	2.62 (1.43, 4.77)	0.002
Pre-3w	15/137 (10.95)	1.26 (0.70, 2.27)	0.43	1.28 (0.69, 2.37)	0.43	1.39 (0.73, 2.66)	0.32
Pre-4w or more	132/1382 (9.55)	1.06 (0.80, 1.42)	0.68	1.13 (0.84, 1.53)	0.41	1.23 (0.89, 1.69)	0.20
Postoperative COVID-19 vs No COVID-19							
Time from surgery to diagnosis of COVID-19							
No COVID-19	88/903 (9.75)	Ref.		Ref.		Ref.	



Post-1w	24/157 (15.29)	1.90 (1.15, 3.12)	0.012	1.73 (1.00, 2.99)	0.048	1.95 (1.09, 3.50)	0.026
Post-2w	21/162 (12.96)	1.54 (0.92, 2.59)	0.10	1.65 (0.94, 2.92)	0.08	2.02 (1.11, 3.67)	0.021
Post-3w	21/170 (12.35)	1.63 (0.97, 2.74)	0.07	2.19 (1.24, 3.85)	0.007	2.51 (1.37, 4.59)	0.003
Post-4w or more	20/206 (9.71)	1.11 (0.66, 1.87)	0.69	1.19 (0.68, 2.09)	0.55	1.19 (0.65, 2.18)	0.57

Model 1: Adjusted for age (continuous) and sex (men or women).

Model 2: Additionally adjusted for BMI (continuous), smoking (yes or no), COVID-19 vaccination status (yes or no), number of comorbidities (0, 1, 2, 3, and ≥4), and history of cancer (yes or no).

Model 3: Further adjusted for ASA classification (grade 1-2 or grade 3-5), grade of surgery (minor or major), urgency of surgery (elective or emergency), duration of surgery (≤240 minutes or >240 minutes), general anesthetic (yes or no) and type of surgery (Thoracic, Head and neck, Cardio-vascular, Digestive, Breast, Gynaecologic and obstetrics, Orthopadic, and Other surgeries).

**Supplementary Table 9.** Sensitivity analysis of association between preoperative and postoperative COVID-19 and risk of postoperative complications excluding imputed data

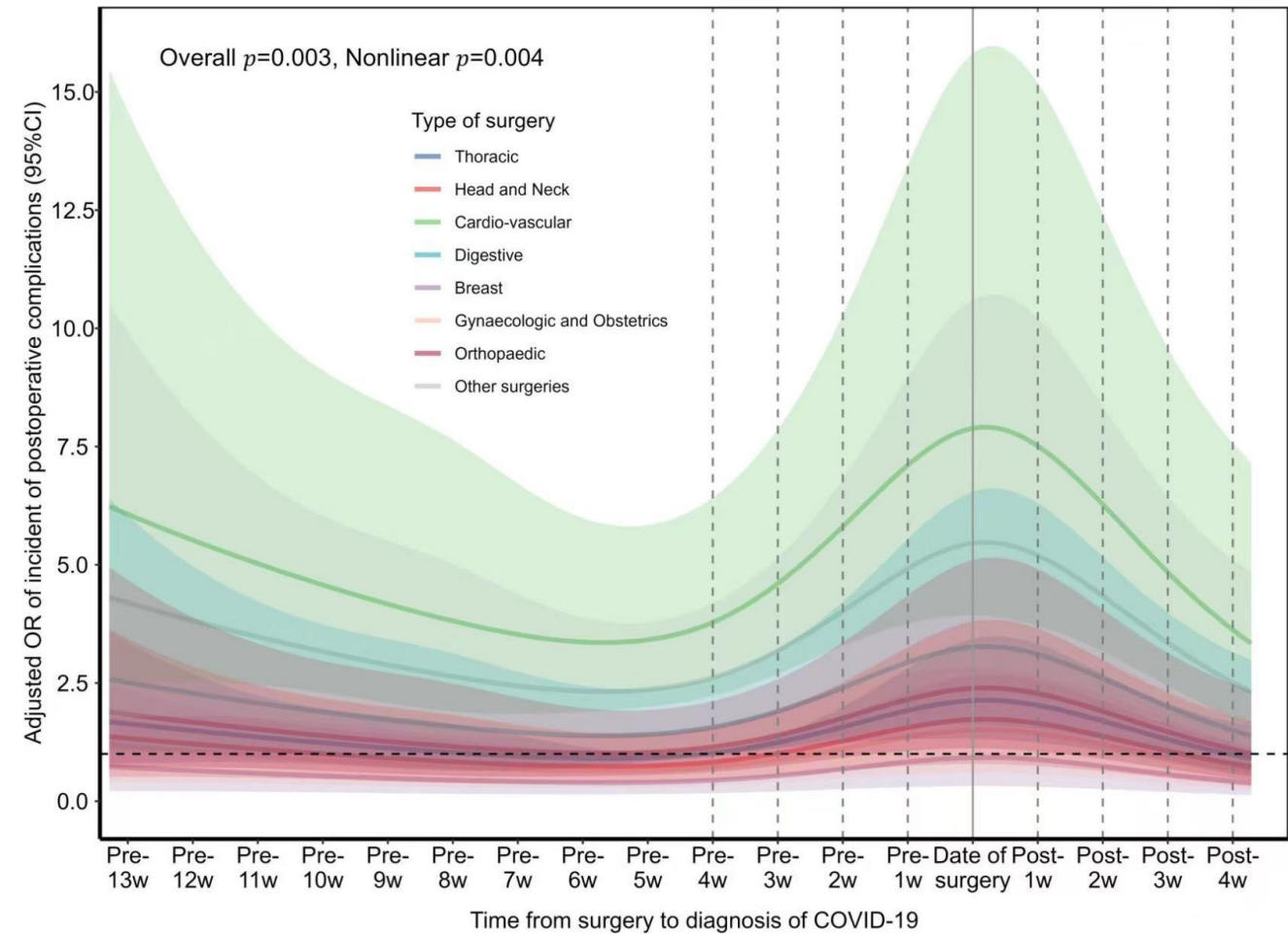
		Postoperative complications					
		Model 1		Model 2		Model 3	
		OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Preoperative COVID-19 vs No COVID-19							
Time from surgery to diagnosis of COVID-19							
No-COVID-19	82/815 (10.06)	Ref.		Ref.		Ref.	
Pre-1w	13/82 (15.85)	1.84 (0.97, 3.51)	0.06	2.15 (1.07, 4.31)	0.031	2.54 (1.22, 5.25)	0.012
Pre-2w	14/97 (14.43)	1.69 (0.91, 3.14)	0.10	2.08 (1.07, 4.03)	0.030	2.40 (1.20, 4.79)	0.013
Pre-3w	11/114 (9.65)	1.01 (0.52, 1.97)	0.98	1.03 (0.51, 2.07)	0.94	1.17 (0.57, 2.40)	0.67
Pre-4w or more	121/1226 (9.87)	1.05 (0.78, 1.42)	0.74	1.13 (0.82, 1.54)	0.46	1.25 (0.90, 1.75)	0.19
Postoperative COVID-19 vs No COVID-19							
Time from surgery to diagnosis of COVID-19							
No COVID-19	82/815 (10.06)	Ref.		Ref.		Ref.	

Post-1w	20/131 (15.27)	1.77 (1.04, 3.04)	0.037	1.84 (1.03, 3.30)	0.041	1.93 (1.04, 3.58)	0.036
Post-2w	16/142 (11.27)	1.26 (0.71, 2.25)	0.42	1.42 (0.76, 2.66)	0.27	1.58 (0.82, 3.05)	0.17
Post-3w	16/156 (10.26)	1.22 (0.69, 2.16)	0.50	1.69 (0.91, 3.12)	0.10	1.89 (0.99, 3.59)	0.05
Post-4w or more	21/189 (11.11)	1.25 (0.75, 2.10)	0.40	1.29 (0.74, 2.27)	0.37	1.17 (0.64, 2.15)	0.60

Model 1: Adjusted for age (continuous) and sex (men or women).

Model 2: Additionally adjusted for BMI (continuous), smoking (yes or no), COVID-19 vaccination status (yes or no), number of comorbidities (0, 1, 2, 3, and ≥4), and history of cancer (yes or no).

Model 3: Further adjusted for ASA classification (grade 1-2 or grade 3-5), grade of surgery (minor or major), urgency of surgery (elective or emergency), duration of surgery (≤240 minutes or >240 minutes), general anesthetic (yes or no) and type of surgery (Thoracic, Head and neck, Cardio-vascular, Digestive, Breast, Gynaecologic and obstetrics, Orthopadic, and Other surgeries).



**Supplementary Figure 2.** Relationship between time from surgery to diagnosis of COVID-19 and adjusted OR for incident of postoperative complications with different surgical types.

Included 2612 patients with perioperative COVID-19. On the X-axis, Pre means patients with Preoperative COVID-19, and Post means patients with Postoperative COVID-19.