

## Perioperative outcomes of patients undergoing urological elective surgery during the COVID-19 pandemic: a national overview across 28 Italian institutions

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**Introduction** The aim of this study was to assess the safety of elective urological surgery performed during the pandemic by estimating the prevalence of COVID-19-like symptoms in the postoperative period and its correlation with perioperative and clinical factors.

**Material and methods** In this multicenter, observational study we recorded clinical, surgical and postoperative data of consecutive patients undergoing elective urological surgery in 28 different institutions across Italy during initial stage of the COVID-19 pandemic (between February 24 and March 30, 2020, inclusive).

**Results** A total of 1943 patients were enrolled. In 12%, 7.1%, 21.3%, 56.7% and 2.6% of cases an open, laparoscopic, robotic, endoscopic or percutaneous surgical approach was performed, respectively. Overall, 166 (8.5%) postoperative complications were registered, 77 (3.9%) surgical and 89 (4.6%) medical. Twenty-eight (1.4%) patients were readmitted to hospital after discharge and 13 (0.7%) died. In the 30 days following discharge, fever and respiratory symptoms were recorded in 101 (5.2%) and 60 (3.1%) patients. At multivariable analysis, not performing nasopharyngeal swab at hospital admission (HR 2.3; CI 95% 1.01–5.19;  $p = 0.04$ ) was independently associated with risk of developing postoperative medical complications. Number of patients in the facility was confirmed as an independent predictor of experiencing postoperative respiratory symptoms ( $p = 0.047$ , HR:1.12; CI95% 1.00–1.05), while COVID-19-free type of hospitalization facility was a strong independent protective factor ( $p = 0.02$ , HR:0.23, CI95% 0.07–0.79).

**Conclusions** Performing elective surgery during the COVID-19 pandemic does not seem to affect perioperative outcomes as long as proper preventive measures are adopted, including nasopharyngeal swab before hospital admission and hospitalization in dedicated COVID-19-free facilities.

**Key Words:** coronavirus <> COVID-19 <> infection <> outcome <> surgery <> urology

**INTRODUCTION**

A pneumonia of undefined etiology, first detected in Wuhan, China, was reported by the World Health Organization (WHO) Country Office on 31 December 2019 [1]. Soon thereafter a new coronavirus was identified as the causative agent and the International Committee on Taxonomy of Viruses named the virus as ‘acute severe respiratory syndrome coronavirus 2’ (SARS-CoV-2) with the related respiratory corona virus disease (COVID-19) [2].

The COVID-19 pandemic has unequivocally brought unique challenges to the global healthcare community [3, 4, 5]. Public health guidance tried to face the overwhelming impact of the virus using the best available scientific evidence to properly inform and guide decision makers involved in the management of the pandemic [6]. Most eminent international scientific committees released recommendations for prioritizing urgent and time-sensitive surgical procedures, despite having limited and flawed supporting evidence. As a result, surgical departments have thoughtfully reviewed all scheduled procedures to minimize or postpone elective surgery so that the health care centres could eventually support a rapid increase in critical patient care needs [7–10].

We currently acknowledge paucity of data regarding perioperative outcomes of patients undergoing

elective surgery during the COVID-19 pandemic [11, 12]. Indeed, the progressively growing need of assistance for COVID-19 patients will lead to fewer resources and personnel for patients seeking care for other conditions [13, 14]. Moreover, in the hypothesis of a further reduction of elective surgical activity, ethical concerns would be raised especially in the setting of oncological surgery [15–19]. Last but not least, assuming a long-lasting pandemic, we truly need strong evidence to assess safety of performing surgical procedures also for benign pathology [20].

In this light, a better understanding of the real impact of the pandemic on urological surgery and the associated perioperative outcomes represents a key unmet need and could lead towards an in-depth knowledge of the pandemic for a proper rationalization of human and logistic resources. Furthermore, we do believe our findings might eventually be transposed to other surgical specialties.

To address these needs, we retrospectively reviewed our prospectively collected clinical and surgical data of patients undergoing different types of elective urological procedures during the COVID-19 pandemic in 28 different institutions across Italy. The aim of this study was to assess the safety of elective surgery performed during the pandemic by estimating the prevalence of COVID-19-like symptoms in the

postoperative period and its correlation with perioperative and clinical factors.

## MATERIAL AND METHODS

### Patients, dataset and selection

The AGILE group ([www.agilegroup.it](http://www.agilegroup.it)) is a multi-center non-profit consortium with scientific, educational and training purposes, grouping several urologists affiliated to different departments and clinics across Italy. All the centres of the consortium were asked to record and submit clinical, surgical and postoperative data with regards to patients undergoing elective urological procedures at their respective institutions between the 24<sup>th</sup> of February 2020 and the 30<sup>th</sup> of March 2020. Written informed consent was obtained from all patients before surgery. The accrual period was set basing on the first case of laboratory-confirmed COVID-19 in Italy recorded on the 21<sup>st</sup> of February, and lasted approximately one month, in order to have a picture of surgical activity performed before protocols to adequately triage patients were effectively established.

Inclusion criteria at baseline were: 1) age  $\geq$  18 years; 2) patients scheduled for standard open procedures, conventional laparoscopy or robotic surgery, as well as endourological procedures. COVID-19 triage through serology and/or nasopharyngeal swab was progressively introduced during the study period at different times among the various institutions, according to respective regional indications. Such data

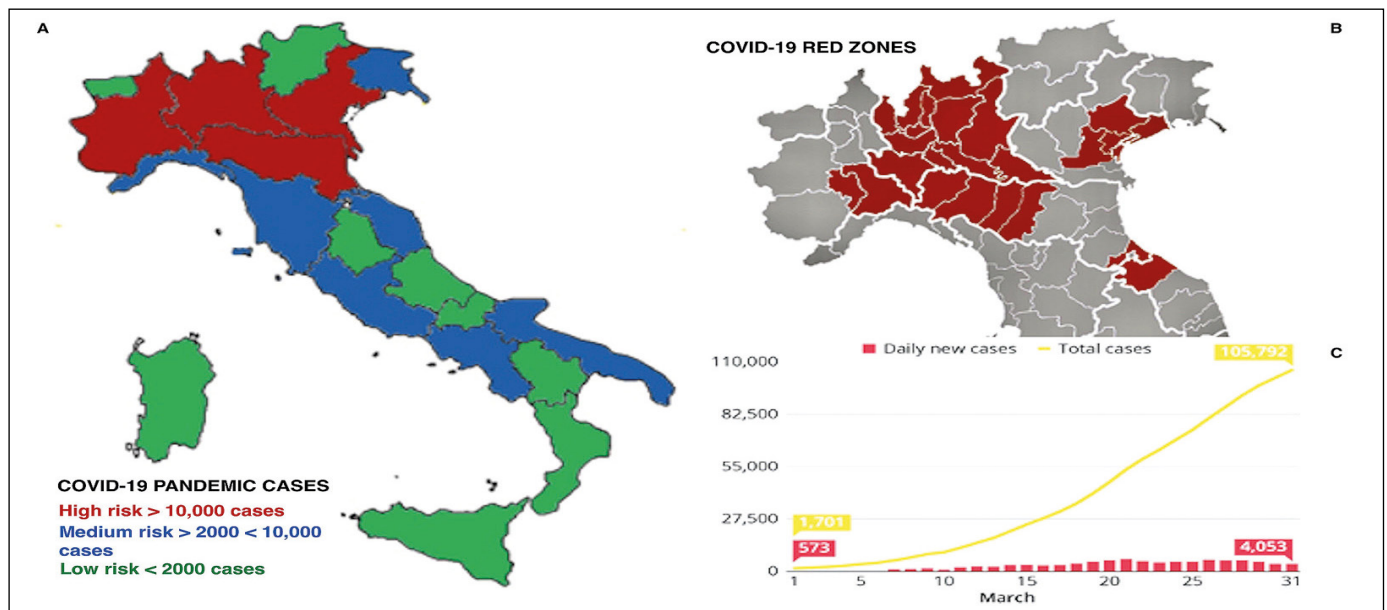
were recorded and considered in the analysis. In addition, COVID-19-like symptoms as dry cough and/or persistent fever ( $>3$  days) within 2 months before hospitalization were investigated. Patients with non-time-sensitive urological conditions and/or laboratory confirmed COVID-19 infection were excluded. Facility was defined as any location of the included centres where healthcare was provided. Risk of contracting COVID-19 was further stratified according to patients' geographical provenance (districts at higher disease prevalence were defined as 'COVID-19 red zones') as well as Italian region where surgical procedure was performed (defined as 'risk hospital areas'). The geographical distribution of risk hospital areas and COVID-19 red zones is provided in Figure 1A and Figure 1B.

### Follow-up

Starting from two weeks after hospital discharge, all patients were contacted by phone to appraise whether they had developed fever and/or respiratory symptoms such as rhinitis, cough, sore throat or pneumonia during the postoperative period. Possible contacts with confirmed positive COVID-19 subjects and eventual execution of nasopharyngeal swab after discharge were also recorded.

### Outcomes

The main outcomes were to estimate the prevalence of respiratory symptoms during postoperative



**Figure 1.** A) Distribution of Italian risk areas for COVID-19 according to pandemic total cases per region in the reference timeframe. B) Distribution of COVID-19 Italian red zones; C) Italian COVID-19 daily new cases and total cases in March 2020.

period of patients undergoing urological elective surgery and its correlation with perioperative, geographical and clinical factors. Patients were thoroughly stratified according to preoperative and surgical features, including age, gender, geographic region, baseline comorbidities and type of surgery. Moreover, we aimed to compare asymptomatic with symptomatic patients during the postoperative period with regards to postoperative complications rate, readmission rate after discharge and mortality. Finally, geographical, clinical and surgical predictors of postoperative medical complications and respiratory symptoms were explored.

### Statistical analysis

Descriptive statistics were obtained reporting medians (and interquartile ranges, IQR) for continuous variables, and frequencies and proportions for categorical variables, as appropriate. Continuous variables were compared by the Student t or the Mann-Whitney U test based on their normal or not-normal distribution, respectively (normality of variables' distribution was tested by the Kolmogorov-Smirnov test). Categorical variables were tested with the Chi-square test. Uni- and multivariable logistic and Cox regression analyses were performed to identify predictors of postoperative respiratory symptoms and postoperative medical complications. All tests were two-sided with a significance set at  $p < 0.05$ . Statistical analyses were performed using SPSS v. 24 (IBM SPSS Statistics for Mac, Armonk, NY, IBM Corp).

## RESULTS

### Patients characteristics and baseline features

Overall, 1943 patients were enrolled. Baseline characteristics of the entire cohort are reported in Table 1. The median age was 67 (IQR 58-74) years, median American Society of Anesthesiologists (ASA) and Charlson Comorbidity Index (CCI) score were 2 (IQR 2-3) and 3 (IQR 1-4), respectively. A urological surgical procedure was carried out due to malignant disease in 65.2% of cases.

Overall, 544 (28%) patients came from 'COVID-19 red zones'. In the two months preceding hospitalization, 54 (2.8%) and 33 (1.7%) patients reported dry cough and persistent fever (>3 days), while COVID-19 specific IgM and IgG screening was performed in 5.1% and 5.7% of cases respectively. In 138 (7.1%) patients, nasopharyngeal swab was performed before hospitalization.

**Table 1.** Preoperative and surgical features of 1943 patients undergoing elective urological procedures in 28 different Italian centres between the 24<sup>th</sup> of February and the 30<sup>th</sup> of March 2020

Preoperative features	
Age, median (IQR)	67 (58–74)
BMI, median (IQR)	25.6 (23.5–27.7)
ASA score, median (IQR)	2 (2–3)
Charlson Comorbidity Index, median (IQR)	3 (1–4)
Barthel Index, median (IQR)	100 (96–100)
Race or ethnicity, n. (%)	
White/Caucasian	1908 (98.2%)
Hispanic	2 (0.1%)
Black/African American	23 (1.2%)
Asian	10 (0.5%)
Provenance from 'COVID-19 red zones', n. (%)	
No	1399 (72%)
Yes	544 (28%)
Risk hospital area, n. (%)	
Low	166 (8.5%)
Medium	891 (45.9%)
High	866 (44.6%)
History of previous neoplasm, n. (%)	
No	638 (32.8%)
Yes	1305 (67.2%)
Dry cough in the 60 days prior to hospitalization, n. (%)	
No	1889 (97.2%)
Yes	54 (2.8%)
Fever for more than 3 days in the 60 days prior to hospitalization, n. (%)	
No	1910 (98.3%)
Yes	33 (1.7%)
IgM testing in the 60 days prior to hospitalization, n. (%)	
No	1844 (94.9%)
Yes	99 (5.1%)
IgG testing in the 60 days prior to hospitalization, n. (%)	
No	1832 (94.3%)
Yes	111 (5.7%)
Nasopharyngeal swab in the 60 days prior to hospitalization, n. (%)	
No	1937 (99.7%)
Yes	6 (0.3%)
Nasopharyngeal swab at hospitalization, n. (%)	
No	1805 (92.9%)
Yes	138 (7.1%)
Preoperative haemoglobin (mg/dL), median (IQR)	13.9 (12.7–15.1)
Preoperative creatinine serum level (mg/dL), median (IQR)	0.96 (0.8–1.16)
Surgical indication, n. (%)	
Benign condition	676 (34.8%)
Malignant condition	1267 (65.2%)

n – number; IQR- interquartile range; BMI – body mass index; ASA – American Society of Anesthesiologists; IgM – immunoglobulin-M; IgG – immunoglobulin-G

### Surgical features and surgical complications

The surgical and postoperative features are shown in Table 2 and Table 3. In 12%, 7.1%, 21.3%, 56.7%



and 2.6% of cases an open, laparoscopic, robotic, endoscopic or percutaneous surgical approach was performed, respectively. The most common surgical procedure performed was transurethral resection of bladder tumour (TURBT) in 29.4% of cases. Intraoperative medical and surgical complications were recorded in 5 (0.3%) and 15 (0.8%) cases, respectively. Overall, 166 (8.5%) postoperative complications were registered, 77 (3.9%) surgical and 89 (4.6%) medical. A laboratory confirmed COVID-19 infection during hospitalization was recorded in 10 (0.5%) patients.

### Follow-up

Overall, 28 (1.4%) patients were readmitted to hospital after discharge and 13 (0.7%) died. Median time to rehospitalization was 11 (IQR 6-19) days. In the

30 days following discharge, fever and respiratory symptoms were recorded in 101 (5.2%) and 60 (3.1%) patients, while 68 (3.5%) and 21 (1.1%) declared contact with people presenting respiratory symptoms or infected with COVID-19, respectively. Nasopharyngeal swab after discharge was performed in 55 (2.8%) patients, being positive in 6 of them. An insight into patients experiencing hospital readmission and death is provided in Table 5 and Table 6. A significant correlation was found between experiencing fever as well as respiratory symptoms at discharge and readmission ( $p = 0.01$ ) and mortality ( $p = 0.001$ ) rates.

### Stratification by risk hospital areas

Overall, 166 (8.5%), 891 (45.9%) and 866 (44.6%) patients were treated in a low, medium and high-

**Table 2.** Intraoperative features of 1943 patients undergoing elective urological procedures in 28 different Italian centres between the 24<sup>th</sup> of February and the 30<sup>th</sup> of March 2020

Perioperative features	
Surgical approach, n (%)	
Open	234 (12%)
Laparoscopic	137 (7.1%)
Robotic	414 (21.3%)
Endoscopic	1107 (56.7%)
Percutaneous	51 (2.6%)
Surgical procedure, n (%)	
Radical prostatectomy	121 (6.2%)
Radical prostatectomy and lymph node dissection	179 (9.2%)
Radical nephrectomy	90 (4.6%)
Partial nephrectomy	123 (6.3%)
Cytoreductive nephrectomy	4 (0.2%)
Complex radical nephrectomy (i.e. plus lymph node dissection, venous neoplastic thrombosis, etc.)	16 (0.8%)
Pyeloplasty	19 (1%)
Partial ureterectomy and/or ureteral reimplantation	12 (0.6%)
Radical cystectomy	78 (4%)
Orchifuniculectomy	22 (1.1%)
Retroperitoneal lymph node dissection	2 (0.1%)
TURBT	570 (29.4%)
TURP	96 (5%)
Ureteroscopy + lithotripsy	166 (8.6%)
Diagnostic ureteroscopy	31 (1.6%)
Ureteral stenting	61 (3.2%)
Nephrostomy placement	16 (0.8%)
PCNL	35 (1.8%)
Other	302 (15.5%)
EBL (cc), median (IQR)*	200 (100-300)
Intraoperative medical complications, n. (%)	
No	1938 (99.7%)
Yes	5 (0.3%)
Intraoperative surgical complications, n. (%)	
No	1935 (99.2%)
Yes	15 (0.8%)

n – number; TURBT – transurethral resection of bladder tumor; TURP – transurethral resection of the prostate; PCNL – percutaneous nephrolithotomy; EBL – estimated blood loss

\*EBL was calculated only for open, laparoscopic and robotic procedures

**Table 3.** Postoperative features of 1943 patients undergoing elective urological procedures in 28 different Italian centres between the 24<sup>th</sup> of February 2020 and the 30<sup>th</sup> of March 2020

Postoperative features	
Postoperative complications, n. (%)	166 (8.5%)
Surgical complications, n. (%)	77 (3.9%)
Clavien 1 surgical complications, n.	26
Clavien 2 surgical complications, n.	32
Clavien 3 surgical complications, n.	18
Clavien 4 surgical complications, n.	0
Clavien 5 surgical complications, n.	1
Medical complications, n. (%)	89 (4.6%)
Fever, n.	26
UTI, n.	12
Laboratory confirmed COVID-19 infections	10
Acute renal failure, n.	9
Respiratory complications, n.	8
Vascular complications, n.	7
Gastrointestinal disorders, n.	6
Cardiologic complications, n.	6
Metabolic disorders	3
Delirium, n.	2
Length of stay (days), median (IQR)	3 (1-5)
Follow-up	
Rehospitalization, n (%)	28 (1.4%)
Time to rehospitalization (days), median (IQR)	11 (IQR 6–19)
Fever in the 30 days following discharge, n (%)	101 (5.2%)
Respiratory symptoms in the 30 days following discharge, n (%)	60 (3.1%)
Confirmed contact with people presenting respiratory symptoms	68 (3.5%)
Confirmed contact with people infected with COVID-19	21 (1.1%)
Nasopharyngeal swab in the 30 days following discharge, n (%)	
Not performed	1888 (97.2%)
Negative	49 (2.5%)
Positive	6 (0.3%)
Overall mortality, n (%)	13 (0.7%)

n – number; UTI – urinary tract infection; IQR – interquartile range

**Table 4.** Multivariable analysis investigating clinical and geographical predictors of postoperative medical complications and postoperative respiratory symptoms

Covariates	Postoperative medical complications			Postoperative respiratory symptoms		
	HR	95% CI	p value	HR	95% CI	p value
Age at surgery	0.99	0.96–1.04	0.85	1.02	0.97–1.08	0.12
Gender						
Male	3.94	0.52–12.16	0.38	2.14	0.72–5.69	0.15
Female	ref	ref	ref	ref	ref	ref
BMI	1.01	0.95–1.08	0.77	–	–	–
Charlson Comorbidity Index	1.14	1.01–1.12	0.02	1.06	1.01–1.23	0.01
Risk hospital area						
High	2.87	1.94–4.27	0.03	3.82	0.97–4.14	0.14
Medium	1.83	0.98–2.64	0.10	2.22	1.16–5.57	0.29
Low	ref	ref	ref	ref	ref	ref
Patients' geographic provenance from 'COVID-19 red zones'						
Yes	1.43	1.18–6.22	0.42	0.76	0.10–6.34	0.80
No	ref	ref	ref	ref	ref	ref
COVID-19-free facility						
Yes	0.74	0.22–1.23	0.21	0.23	0.07–0.79	0.02
No	ref	ref	ref	ref	ref	ref
Number of patients hospitalized in the same facility	1.65	0.67–4.01	0.28	1.12	1.00–1.05	0.047
Nasopharyngeal swab before admission						
No	2.30	1.01–5.19	0.04	–	–	–
Yes	ref	ref	ref	–	–	–
Type of pathology treated						
Neoplastic	1.16	0.19–7.09	0.22	0.90	0.27–2.98	0.87
Benign	ref	ref	ref	ref	ref	ref

CI – confidence interval; BMI – body mass index

hospital risk area, respectively. Among them, 65.3%, 90.9% and 54.3% were hospitalized in a COVID-free facility ( $p < 0.001$ ), while 0%, 2.2% and 53.2% came from 'COVID-19 red zones' ( $p < 0.001$ ), and 72.7%, 68% and 61.1% were hospitalized due to malignant disease ( $p = 0.001$ ), respectively. A significantly lower median number of patients hospitalized in the same facility was found in low-risk areas, as compared to median and high-risk (70 vs 100 vs 120;  $p < 0.001$ ).

### Predictors of postoperative medical complications

A significantly higher rate of perioperative medical complications was found in patients who had not performed nasopharyngeal swab at hospital admission ( $p = 0.003$ ) and those treated in high-risk areas (6.3% vs 5.4% vs 3.6%;  $p = 0.01$ ). No association was found between type of surgery and perioperative surgical or medical complications. At multivariable analysis after adjusting for age, gender, body mass index (BMI), comorbidity burden, type of pathology (benign vs. neoplastic), number of patients hospitalized in the same facility, patients' geographical provenance and risk hospital area, not performing nasopharyngeal swab at hospital admission was independently associated to risk of developing post-

operative medical complications (HR 2.3; CI 95% 1.01–5.19;  $p = 0.04$ ) (Table 4).

### Predictors of postoperative respiratory symptoms

Univariable analysis showed a statistically significant association between respiratory symptoms and coming from 'COVID-19 red zones' ( $p = 0.016$ ), setting of hospitalization ( $p = 0.03$ ), number of patients in the facility ( $p < 0.001$ ), and longer length of stay ( $p = 0.01$ ). At multivariable analysis, number of patients in the facility was confirmed as an independent predictor of experiencing postoperative respiratory symptoms ( $p = 0.047$ , HR:1.12; CI95% 1.00–1.05), while hospitalization in a COVID-19 free facility was a strong independent protective factor ( $p = 0.02$ , HR:0.23, CI95% 0.07–0.79) (Table 4).

## DISCUSSION

The current COVID-19 pandemic has critically underlined the importance of a mindful employment of financial and human resources. Indeed, after the outbreak of the novel coronavirus in China, Europe and the USA soon thereafter were hit with the highest vehemence, emphasizing the shortage of avail-

**Table 5.** A deep insight exploring correlation with geographical, clinical features in patients experiencing hospital readmission and death

	Readmission (n = 28)	p value	Mortality (n = 13)	p value
Provenance from 'COVID-19 red zones', n. (%)				
No	25 (89.3%)	0.02	4 (30.8%)	0.001
Yes	3 (10.7%)		9 (69.2%)	
Risk hospital area				
Low	3 (10.7%)	0.41	0 (0%)	0.02
Medium	12 (42.9%)		3 (23.1%)	
High	13 (46.4%)		10 (76.9%)	
Admission to COVID-19-free facility, n. (%)				
No	18 (64.2%)	0.36	7 (53.8%)	0.20
Yes	10 (35.8%)		6 (46.2%)	
Nasopharyngeal swab at hospitalization, n. (%)				
No	24 (85.7%)	0.01	12 (92.3%)	0.01
Yes	4 (14.3%)		1 (7.7%)	
Postoperative surgical complications, n. (%)				
No	21 (75%)	0.001	11 (84.6%)	0.03
Yes	7 (25%)		2 (15.4%)	
Postoperative medical complications, n. (%)				
No	19 (67.9%)	0.01	8 (61.5%)	0.01
Yes	9 (32.1%)		5 (38.5%)	
Fever in the 30 days following discharge, n (%)				
No	17 (60.7%)	0.001	9 (69.2%)	0.001
Yes	11 (39.3%)		4 (30.8%)	
Respiratory symptoms in the 30 days following discharge, n (%)				
No	23 (82.1%)	0.01	8 (61.5%)	0.001
Yes	5 (17.9%)		5 (38.5%)	

n – number

able qualified professionals and assistance facilities. If on one hand preserving resources and manpower is paramount in healthcare, likewise on the other it is pivotal to ensure the ability of surgeons and specialized professionals to keep providing the highest assistance through the pandemic [21, 22, 23]. Several opinion leaders worldwide have proposed recommendations for the triage of elective urologic surgeries [24–29]. However, we must point out that many 'elective' procedures are not truly elective but only scheduled and not only medically necessary, are time-sensitive. Furthermore, in the hypothesis of a long-lasting pandemic, we acknowledge a lack of non-biased evidence to support the feasibility and safety of resuming elective surgery also for benign disorders. The exact burden of COVID-19 on perioperative outcomes after different urological procedures is still poorly investigated. In our opinion, the exact assessment of COVID-19 impact and its correlation with perioperative and clinical factors represents the first step towards a more comprehensive appraisal of the trustworthiness of recent recommendations and how those may affect every day urologic practice. To fill this gap, herein we provided a real-life overview of the Italian situation during the COVID-19 pandemic.

The first key finding of our study is that performing elective surgery during the COVID-19 pandemic is safe as long as proper preventive measures are adopted. This is a paramount finding, since high complication rates and risks have been hypothesized for surgical procedures performed during the pandemic. In this regard, in line with our findings, Soytaş et al. [10] recently reported that urological procedures applied with appropriate infrastructure and protocols during the pandemic can be safely performed. Indeed, setting of hospitalization now more than ever can meaningfully affect postoperative outcomes [30]. In our experience, the number of patients hospitalized and the non-COVID-19-free type of facility were independently associated with the onset of postoperative respiratory symptoms. Considering the unfeasibility of performing a control swab to every subject developing respiratory symptoms after discharge, we could not ascertain the COVID-19 origin of symptoms. However, we could speculate that patients developing postoperative respiratory symptoms might have been unintentionally scheduled for surgery during their incubation period or have contracted the infection during their hospital stay. This result strongly underlines the need to set specific

**Table 6.** Geographical, clinical and surgical details of patients experiencing postoperative death

Age	Risk region	COVID-19-free facility	Nasopharyngeal swab before admission	Surgical procedure	Surgical approach	Cause of death	Postoperative nasopharyngeal swab
70	High	Yes	No	URS	Endoscopic	AMI	Positive
69	Medium	Yes	Yes	Cytoreductive nephrectomy	Open	Pneumonia	Not performed
89	Medium	No	No	TURBT	Endoscopic	Unknown	Not performed
70	Medium	Yes	No	Radical cystectomy	Open	Sepsis	Negative
75	High	No	No	Radical nephrectomy	Laparoscopic	Sarcoma end stage	Not performed
43	High	No	No	Percutaneous nephrostomy	Percutaneous	Malignant mammary tumor	Not performed
81	High	No	No	TURBT	Endoscopic	Pneumonia	Positive
82	High	No	No	Double J ureteral stenting	Endoscopic	Pneumonia	Positive
82	High	No	No	TURBT	Endoscopic	Pneumonia	Not performed
79	High	No	No	Radical nephrectomy	Open	Peritonitis and MOF secondary to duodenal lesion	Not performed
85	High	Yes	No	Double J ureteral stenting	Endoscopic	Unknown	Not performed
79	High	Yes	No	Radical nephrectomy	Laparoscopic	Gastrointestinal bleeding	Positive
73	High	Yes	No	Radical cystectomy	Robotic	Pneumonia	Positive

AMI – acute myocardial infarction; MOF: – multiorgan failure, TURBT – transurethral resection of bladder tumor; URS – ureterorenoscopy

areas for the management of patients not affected by COVID-19, by identifying facilities capable of providing higher assistance in compliance with the safety for both patients and health care providers.

A second key point of our study is that not performing nasopharyngeal swab at hospital admission was confirmed as an independent predictor of developing postoperative medical complications. Indeed, nowadays an indispensable condition for the patient to be candidate for surgical treatment is being tested with nasopharyngeal swab for COVID-19 before entering the facility. However, how and how long before admission is meaningfully changeable, being extremely depending on the internal logistics of the hospital and the time needed to obtain the result of the swab. We truly believe that such precautionary measures nowadays represent the mainstay for disease control and should be thoroughly pursued whenever any kind of elective surgery is performed.

Third, it is reasonable to assume that COVID-19 might have influenced peri- and postoperative outcomes. Lei et al. suggested that surgical stress can exacerbate disease progression and severity in patients recently undergoing surgery [11, 31]. Since less than 10% of our cohort was tested with nasopharyngeal

swab before admission, we cannot precisely establish the percentage of patients in their incubation period at the time of surgery and those who have contracted the infection during hospital stay. However, most importantly, herein we provided a comparison between asymptomatic patients and those developing postoperative respiratory symptoms after surgery, showing a significant correlation between experiencing fever and respiratory symptoms at discharge and readmission and mortality rates.

The current study was not devoid of several limitations. Only a limited percentage of patients underwent the specific COVID-19 confirmation test before surgery, due to the limited understanding of the pandemic situation and the shortage of laboratory kits during the study period. Similarly, a non-negligible rate of patients experiencing respiratory symptoms after discharge did not perform nasopharyngeal swab to confirm COVID-19 infection. Of course, we should consider also an undefined percentage of patients who have contracted COVID-19 during their hospital stay, but were completely asymptomatic and, thus, hardly detectable. All these issues may have introduced statistical bias, undermining trustworthiness of reported results.



Acknowledging these limitations, the current study represents the largest series thus far exploring safety of urologic elective surgery during the COVID-19 pandemic. Restructuring of the medical system represents only the first step to keep providing the highest level of care to all patients. Indeed, assuming a possible worsening of the global situation and, thus, in theory a further reduction of elective surgical activity, additional concerns would be raised, also from an ethical perspective, especially in the setting of oncologic surgery [32, 33]. Certainly, our findings could pave the way to unexplored scenarios, where resuming elective surgery does represent a feasible option also in the setting of benign pathology, as long as proper, precautionary measures are observed.

## CONCLUSIONS

In our experience, performing elective surgery during the COVID-19 pandemic was safe and showed no detrimental impact on perioperative outcomes, as long as adequate, preventive measures were pursued.

We hope these data might be of value for healthcare professionals and decision makers involved in the management of the COVID-19 pandemic. In the meantime, under elective conditions, we should pursue the concept of prioritizing the most urgent surgical cases and, after careful evaluation of each individual case, provide adequate preventive measures for both patients and health care providers.

## CONFLICT OF INTEREST STATEMENT

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

## STATEMENT OF ETHICS

Informed consent was obtained from all individual participants included in the study. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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