Original Article

Are urologists in trouble with SARS-CoV-2? Reflections and recommendations for specific interventions

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Objective

To assess the risk of viral infection during urological surgeries due to the possible hazards in tissue, blood, urine and aerosolised particles generated during surgery, and thus to understand the risks and make recommendations for clinical practice.

Patients and Methods

We reviewed the available literature on urological and other surgical procedures in patients with virus infections, such as human papillomavirus, human immunodeficiency virus and hepatitis B, and current publications on coronavirus disease 2019 (COVID-19).

Results

Several possible pathways for viral transmission appear in the literature. Recently, groups have detected severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in the urine and faeces, even after negative pharyngeal swabs. In addition, viral RNA can be detected in the blood and several tissues. During surgery, viral particles are released, aerosol-borne and present a certain risk of transmission and infection. However, there is currently no evidence on the exact risk of infection from the agents mentioned above. It remains unclear whether or not viral particles in the urine, blood or faeces are infectious.

Conclusions

Whether SARS-CoV-2 can be transmitted by aerosols remains controversial. Irrespective of this, standard surgical masks offer inadequate protection from SARS-CoV-2. Full personal protective equipment, including at least filtering facepiece-2 masks and safety goggles should be used. Aerosolised particles might remain for a long time in the operating theatre and contaminate other surfaces, e.g. floors or computer input devices. Therefore, scrupulous hygiene and disinfection of surfaces must be carried out. To prevent aerosolisation during laparoscopic interventions, the pneumoperitoneum should be evacuated with suction devices. The use of virus-proof high-efficiency particulate air filters is recommended. Local separation of anaesthesia/intubation and the operating theatre can reduce the danger of viral transmission. Lumbar anaesthesia should be considered especially in endourology. Based on current knowledge, COVID-19 is not a contraindication for acute urological surgery. However, if possible, as European guideline committees recommend, non-emergency urological interventions should be postponed until negative SARS-CoV-2 tests become available.

Keywords

SARS-CoV-2, COVID-19, urology, guideline, surgery, laparoscopy, recommendations, coronavirus, endourology, #uroonc, #Urology

Recommendations

In general:

- Basic infection prevention measures (hand hygiene, respiratory etiquette, physical distancing) should be promoted universally.
- Limitation of inpatient and outpatient occurrence in the hospital to reduce virus spreading to a minimum for patients and health workers.
- Prioritise patients according to major guidelines or in accordance to local specific requirements.
- Suspension of all non-urgent elective surgeries by increasing the critical care capacity.
- If possible, test suspected patients with quantitative reverse transcriptase-PCR before surgery.
- If medically reasonable, treatment should be delayed in case of suspected COVID-19.
- Consider increased interventions with use of local anaesthesia and lumbar anaesthesia.
- Local separation of anaesthesia/intubation and operation room.
- Utilise increased personal protective equipment (PPE) including at least filtering facepiece (FFP)-2 masks and safety goggles if suspected or confirmed patients with COVID-19 are treated.
- Delay successive operations in the same room.
- Separate COVID-19 operating theatres.
- Systematic hygiene and disinfection (confined virucide) of surfaces.
- Adjustments of surgical techniques, e.g. lowering electrocautery power settings and reduced time, use of bipolar electrocautery or ultra-scission, increased use of sutures and clips.
- Utilise high-efficiency particulate air (HEPA) filters and check the functionality and specific requirements.

In laparoscopy:

- Use lowest pressure possible to reduce aerosolisation.
- Carefully evacuate the pneumoperitoneum with suction devices.
- Carefully salvage tissue without causing bursting

Introduction

In December 2019, a novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was identified, which causes coronavirus disease 2019 (COVID-19). The WHO first described COVID-19 as a public health emergency of international concern on 30 January 2020 and then on 11 March 2020 as a pandemic. COVID-19 has been spreading rapidly worldwide, posing a major threat to people and severely burdening healthcare systems and workers [1,2]. COVID-19 is a contagious pulmonary infectious disease with respiratory symptoms similar to those seen in the previously reported SARS epidemic in 2003 and Middle East respiratory syndrome (MERS) in 2012 [3]. Similar to other viruses with pandemic potential including the H1N1, H5N1 and H5N7 influenza viruses, and similar to the SARS or MERS in the past, the primary transmission of human coronaviruses is believed to occur principally through direct contact transmission (independent of surface contamination), respiratory droplets from coughing and sneezing, and airborne routes [4]. This infection risk may significantly increase in the case of elevated aerosol contaminations in closed spaces. The possibility of COVID-19 infection from virus spread from inanimate surfaces, where SARS-CoV-2 can survive for many days [4,5]; by air samples from the Intensive Care Unit (ICU), operating theatre or general COVID-19 wards; as well by the use of surgical equipment, needs to be further evaluated.

Even though the urological patient caseload has diminished during the crisis [6], a significant number of patient presentations persist. While elective urological procedures can be postponed for days or weeks, probably without any real risk to patients, emergency and oncological operations need to be carried out without any delay. Standard measures for the safety of emergency personnel and anaesthetists are always in place, but due to possible exposure to SARS-CoV-2 contaminated aerosols, surgeons too might need personal protection equipment (PPE). To avoid any SARS-CoV-2 infection, all healthcare workers during urological surgeries need to be appropriately protected. This poses the question of whether urological surgery is safe and acceptable under such conditions in 2020 and beyond? Acute surgical interventions will continue to be necessary to prevent danger to patient health. We reviewed recent studies to contextualise and offer guidance to clinicians in this specific field.

The main types of urological surgery comprises open surgery, laparoscopy (with or without robotic assistance) and endourological surgery. In the absence of recommendations in the guidelines of urological societies, we focus here on the infection risk arising from urological surgeries such as laparoscopy and endoscopy.

Laparoscopic surgery, a minimally invasive approach, offers some advantages in the urological field and is a well-established technique for many indications. It reduces hospitalisation time, resources and occupation of ICUs; any personnel- and resource-sparing options are generally considered crucial during the ongoing COVID-19 pandemic. Furthermore, surgical complications are reportedly less common in laparoscopy compared to classic open surgical

interventions [7,8]. Despite that, some concerns about possible infection via aerosols originating from the pneumoperitoneum have been raised recently, especially in gynaecology [9–11]

SARS-CoV-2

Around the globe, as of today roughly 5.4 million people are infected with the SARS-CoV-2 with an estimated fatality of >324 000 cases, and 169 000 deaths registered in Europe alone. The daily number of confirmed infected and fatal cases is increasing and the peak has yet to be reached. An unknown number of asymptomatic people represent a possible source for spread of infection. Indeed, a substantial number of cases are underdiagnosed. The incubation period for COVID-19 is between 5 and 14 days [12]. Therefore, virus transmission from a pre-symptomatic case can occur before symptom onset. This must be considered as a risk during surgery. According to WHO data, asymptomatic infections in the European Union are between 1% and 3%, whereas some researchers estimate it to be ~30% [12]. Among Japanese patients evacuated from Wuhan, the centre of the COVID-19 outbreak, 30.8% were asymptomatic but in close contact with SARS-CoV-2 infected people (95% CI 7.7%, 53.8%) [13]

SARS-CoV-2 can be diagnosed by a combination of clinical evaluation and imaging procedures: a chest CT scan shows typical abnormalities with ground-glass opacity and bilateral patchy shadowing in >80% of cases. The chest CT scan usually has superior detection rates compared to radiography, which detects ~59% of abnormalities [14]. The WHO recommends collecting specimens from the upper respiratory tract (naso- and oropharyngeal samples) or the lower respiratory tract (e.g. expectorated sputum or endotracheal aspirates), suitable for genomic reverse transcriptase-PCR (RT-PCR) analysis. The infectiousness (basic case reproduction rate) varies between 1.9 to 6.47 new infections per patient [15–19]

In a selected, but representative random sample population of 1544 persons tested between 1 and 6 April in Austria, 0.33 % of the subjects tested positive for SARS-CoV-2 by RT-PCR measurements, thus allowing an estimation of a nationwide total of acute, in terms of RT-PCR positive tested persons of between 10 200 and 67 400 [20]. Due to the study protocol, the analysis addressed only the acute infection rate and not any recent or past contact with SARS-CoV-2. Therefore, in another study, 2822 persons from two 'hot spot' regions in Tyrol, (Ischgl and St. Anton, Austria) were investigated. The analysis showed a higher prevalence of COVID-19 immunopositivity of between 13% and 19%, respectively [21].

The high number of diagnosed or suspected cases together with the high infectiousness of SARS-CoV-2 underscores the need for clinicians to carefully plan all their treatment modalities for ordinary diseases in their specialty.

Endourology

One of the major domains in urological surgery is endourological procedures, such as electro-resection of the bladder and prostate. Furthermore, removal of ureter and kidney stones remains a common part of urgent urological treatment. Recently, groups have suggested a transmission path for SARS-CoV-2 via the urine as an unsuspected infection risk. Ling et al. [22] tested 66 women and men, who had survived COVID-19 in China. In 6.9% of cases (four out of 58 patients), viral nucleic acid could be found additionally in the urine. The urine samples remained positive even after negative results in the pharyngeal swab in three patients, thus making the patients potential vectors and posing a threat to transurethral surgeons and health workers. In another study, contamination with viral nucleic acid in the urine was shown in four out of 53 patients (7.5 %) [23]. Congruently, a recent study by Liang Peng [24]showed a positive finding in the urine by quantitative RT-PCR in 11.1% and the author concluded that SARS-CoV-2 can invade the urinary system. These findings are in concordance with findings on other diseases associated with beta-coronavirus. Indeed, earlier studies with related viral diseases like the SARS-CoV epidemic in 2002/2003, which affected 8098 persons and caused 774 deaths, and MERS-CoV in 2012 offer supporting data on viral RNA in the urine [25]. Indeed, in one study 296 urine samples from 415 patients were tested and 4.7% showed positive results by RT-PCR. Notably, for COVID-19, the viral shedding peak in urine appears to occur even later, namely at weeks 3–4; however, the urine specimen RT-PCR still remained positive for many weeks after infections [26]. In a large study by Hung et al. 2004 [27], the detection rate of SARS positive urine findings was 28.8% (32 of 111 patients). Similarly, viral RNA was detected in 31 of 74 urine samples (42%) collected at a mean of 15.2 (1.7) days after onset of symptoms [28]. Again, urine specimens (n = 133) from 101 patients with SARS-CoV were collected yielding a positive rate by RT-PCR measurements of 25% and remarkable, until the 45th day after infection [25,29]

On the other hand, Lescure et al. [30], in a very small cohort of only five patients with SARS-CoV-2 showed no viral load in the urine. Another recent publication failed to find SARS-CoV-2 RNA in any of the 42 tested patients.

All these findings are crucial for all endourological interventions and personal safety of surgeons and healthcare workers involved. Therefore, minimising the risk of urine-borne infection is advised. Usually closed pumping systems for urine and irrigation fluid are commonly used in endourology. In patients with confirmed SARS-CoV-2 infections, a systematic use of these systems is definitely

recommended [31]. Monitor-equipped systems allowing some distance to the surgical field are used nowadays. Closed continuous-flow irrigation systems probably cause a certain dilution effect of the virus load in the urine as well as of the excised tissue. While a certain threat seems to be present, we consider endourological procedures as safe in terms of COVID-19. The viral load in the urine is at a maximum <10%. A review of the current literature showed no data for any kind of viral disease transmission via aerosols or droplets during transurethral resection of bladder (TURP). Therefore, in our opinion, the risk of aerosol generation by electrosurgical devices in TURB and TURP is negligible. Nevertheless, secure PPE and filtering facepiece (FFP)-2 masks should be used for any SARS-CoV-2 suspected patient, especially if anaesthesia with tracheal intubation is performed in the same operating room. Lumbar anaesthesia is a valid alternative in many cases to reduce the risk of aerosol generation, thus eliminating the largest risk factor for contracting SARS-CoV-2 [32]

Laparoscopy

Generally, laparoscopy poses a significantly higher risk of generating aerosols by the establishment and maintenance of an artificial pneumoperitoneum. During laparoscopy, there is a large so-called 'surgical smoke' formation in the pneumoperitoneum due to the use of harmonic or ultrasonic scalpels, lasers, and other electrosurgical equipment. In electrosurgery, heat by diathermy causes cell membranes to rupture and generates a plume of smoke containing mostly water vapour (95%) and ~5% cellular debris of different sizes (0.007–0.31 μm) in the pneumoperitoneum. Thus, surgical smoke contains blood and tissue particles, bacteria or viruses (or at least part of it), and represents a potential risk for surgeons and all other personnel in the operating theatre. It is not the surgical smoke itself that is critical as long as it remains in the 'closed' body cavity, but rather any uncontrolled decompression of the pneumoperitoneum: this can occur at the end of the surgery or during tissue extraction, or by any leaky system of the insufflation/deflating system with gas expulsion via ports or trocars. Herein exists the risk of release of pneumoperitoneum-associated aerosolisation of the smallest particles of <5 μm in to the surgical room. Compared with droplets, which are heftier and thought to travel only short distances after someone coughs or sneezes before falling to the floor or onto other surfaces, aerosols can linger in the air longer and have a larger spreading radius. SARS-CoV-2 can survive for several hours in aerosols and droplets, and because of gravity and airflow, most droplets sink to the ground or on to other surfaces in the operating theatre. Investigation of detectable viable SARS-CoV-2 viruses in a 3-h experiment showed that the infectious titre dropped from $10^{3.5}$ to $10^{2.7}$ $TCID_{50}$ (50% tissue-culture infectious dose) per litre of air. The half-life of the virus in

aerosol was around 1.1–1.2 h [33]. Nevertheless, it must be emphasised that to our best knowledge, there are no data linking risk of being infected with SARS-CoV-2 and exposure of the operating room team during surgical procedures. However, virus load was detected in such surgical smoke in cases of patients with hepatitis, HIV or human papillomavirus (HPV) [34,35]. The risk of occupational HPV transmission from patients to medical personnel during laser vaporisation or laparoscopic interventions was studied intensively but remains controversial [36]. Although the possibility of disease transmission through surgical smoke exists, documented cases of pathogen transmission by aerosols are rare. Indeed, in contrast to the viral load in the blood or stools of infected patients, there has not been any increased risk of transmission from the surgical plume or laparoscopic pneumoperitoneum documented in recent decades.

Standard surgical masks offer less protection from contamination by aerosols compared to droplets. Therefore, it definitely seems reasonable to use FFP-2 or -3 masks in cases of suspected COVID-19. Viral diseases are not in themselves a contraindication to surgery [37]. For example, patients with HIV or hepatitis commonly undergo surgery with certain precautionary measures in place.

However, whether SARS-CoV-2 can be transmitted by aerosols remains controversial, and the exposure risk for close contacts has not been systematically evaluated. Compared to droplet-borne infection, transmission via aerosol generated in the operating theatre seems to be more likely [11]. It must be kept in mind that aerosol formation might remain for a longer time in the surgery room and contaminate other surfaces, floors or computer input devices etc.

Despite earlier pandemics, no useful information exists for healthcare worker infection during laparoscopic surgery with comparable diseases such as SARS-CoV, MERS-CoV or influenza. However, some data suggest faecal–oral transmitted infection of SARS-CoV-2. This is not surprising, as aside from the typical respiratory symptoms [fever (47%), dry or productive cough (25%), sore throat (16%), and general weakness (6%)], diarrhoea, nausea, vomiting, and abdominal discomfort has been described. These clinical findings can be correlated to direct viral detection in biopsy specimens or stool examinations. Interestingly, viral RNA in the faeces persists even after symptom resolution and negative nasal RT-PCR. Cai et al. [38] found a high frequency (83.3%) of SARS-CoV-2 RNA detection in faeces in mildly affected paediatric patients and prolonged virus RNA shedding in faeces for at least 2 weeks and even >1 month

This is primarily a concern for abdominal surgeons, but also affects urologist in complex oncological procedures such as cystectomy with simultaneous orthotopic neobladder formation. Viral RNA was extracted with rectal swabs and stool samples in >60% of patients testing positive for

COVID-19, as well as many days after a negative oropharyngeal swab [39]. All stool-related aerosol contamination and infection risk has to be investigated in detail. Urine-borne contamination is, as stated earlier, a rare situation. Although viral shedding in blood is common (even in lower concentrations) [40], there is currently no known case of infection via blood according to the European Centre for Disease Prevention and Control (ECDC, www.ecdc.e uropa.eu) [41]. It should be noted that detection of viral RNA by PCR does not equate with infectivity. This is based on the experience that as of today there are no cases of transfusion-associated infections for SARS-CoV-2, or for other SARS- or MERS-coronavirus. What remains is primarily a theoretical risk of transmission of coronaviruses through the blood contaminated plumes.

All these aspects suggest that low-pressure laparoscopy should be used [42]. The use of a closed system with careful smoke evacuation together with specific filters is to be recommended. Additionally, the pneumoperitoneum may be cleared directly by closed-suction devices. PPE, in addition to the already fluid-resistant clothing in use, should be used. Specifically FFP-2 or -3 masks, protective glasses and single shoe covering are mandatory.

However, laparoscopy appears generally to be less of a threat than any intubation intervention before surgery. Therefore, intubation outside the operating room is advised whenever possible.

Laparoscopic Kidney Surgery

Laparoscopic kidney surgery takes a special role in this context, as kidney tissue can be infected with SARS-CoV-2 [43]. Immunohistochemistry has shown that SARS-CoV-2 nucleoprotein (NP) antigen accumulates in kidney tubules, and virions and virus-like particles in kidney cells were detected by transmission electron microscopy. Haematoxylin and eosin staining of renal tissue identified that SARS-CoV-2 infection mainly induces severe acute tubular necrosis and lymphocyte infiltration leading to acute renal failure in around 25–30% of patients [44]. This is not surprising, as SARS-CoV-2 having passed through the mucous membranes, especially nasal and pharyngeal mucosa, enters the lungs through the respiratory tract. Here a viraemia is observed and the virus attacks targeting organs that express angiotensin-converting enzyme 2 receptors, e.g. the kidney [31]. As stated above, electrosurgical or ultrasonic devices create aerosols when used. This is the case in most procedures of partial tumour nephrectomies; thus, special precautions need to be taken. The aerosols generated while cutting kidney tissue could be infectious. In contrast, such risks have to be weighed against laparotomy, where direct exposure of the medical staff to the aerosols generated can be assumed. Thus, extraction units can be used for direct suction, but need to be very

potent assuring continuous inflow capacity. Laparoscopy in most cases is already equipped with good suction devices and might, therefore, be preferred. Besides, as kidney surgery is often done retroperitoneally, the risk of exposure seems less in comparison to abdominal laparoscopic surgery. The potential contact with urine, especially in kidney-sparing surgery can be neglected, as SARS-CoV-2 RNA has not been reported in many urine samples.

Laparoscopic Cystectomy

In laparoscopic cystectomy, a higher probability of viral transmission is suspected, as the lancing of the intestines is necessary. As stated before, stools represent a hazard in terms of COVID-19. Besides, the procedure is done transperitoneally and possible contamination of the urine adds minimally to the general risk.

Prostate Biopsy

Prostate biopsy is an essential part of the urological routine. The main risk factors for COVID-19 transmission during this procedure are the possible contamination with blood and faeces, as well as to a lesser extent, urine. As described before, SARS-CoV-2 can be detected in all three cases, although the exact hazard is still unknown [22–26,28–30,39,41]. The specimen itself can be processed normally, as to date; a contamination of prostate tissue has not been detected [45]. In our experience, the putative risk of contamination might be highest whilst extracting the needle in order to process the specimen. In this case, face shields in particular seem promising, and FFP-2 or -3 masks, as well as PPE, will be necessary. As an alternative, perineal biopsy can be discussed. However, as there are no firm data on faecal virus transmission, transrectal biopsy is considered reasonable within the common indications.

Surgeries in Patients with COVID-19 under Haemodilution

Even though a lot of the pathogenesis of SARS-CoV-2 infection in humans remains unclear, some researchers have found that there are many pathological findings in patients with COVID-19. Among alterations in several cytokines, coagulation parameters such as D-dimer increase is often observed (D-dimer value is four-times higher than the normal upper limit). Inflammation, infection and other factors can lead to excessive activation of coagulation. This is clinically seen by the increased development of disseminated intravascular coagulation in patients with COVID-19, mainly of severe types [46,47]. Therefore, some clinicians are recommending anticoagulation therapy with a dose of low-molecular-weight heparin by subcutaneous injection of 100 IU/kg body weight twice a day in the first week. However, such flanking anticoagulation therapy is

accompanied by higher risk of bleeding, especially during urological surgeries, requiring more careful intraoperative coagulation [48]

Some Specific Concerns In Urological Surgeries

The SARS-CoV-2 virus is part of the *Coronaviridae* family and has now been completely sequenced, with the GeneBank entry MN908947 [49]. The entry describes an RNA virus with an RNA sequence of 29033 bases. It was discovered that this new virus had around 80% and 50% genomic similarity to SARS-CoV and MERS, respectively. The SARS-CoV-2 is a large-sized virus ~120 nm in diameter (diameters vary from ~60 to 140 nm) [50]. This might be considered for the infection's way of transmission by respiratory droplets due to coughing and sneezing from patients with COVID-19, as well for the aerosol formation. It was calculated that the virus spread of droplets of <10 μm can range 1.5 m by exhalation (breathing v_0 = 1m/s), but 2 m for coughing (calculated velocity v_0 10 m/s) and up to 6 m for sneezing (v_0 = 50 m/s) [51,52]. With this knowledge at hand, investigators studied the virus load in different areas in contact with patients with COVID-19. They investigated the virus load on floors, computer mice, trash cans, sickbed handrails, patient masks, PPE, and air outlets. The floor swab samples in ICUs showed a higher contamination rate of >40% compared to the general COVID-19 ward (GW) with 7.9%. One explanation from the authors was that gravity and airflow cause most virus droplets to sink to the ground. To our best knowledge, no operating theatres have been investigated to date. Half of the samples taken from the soles of shoe of the ICU medical staff tested positive, and therefore, these shoes might function as carriers. Furthermore, according to this study, there was an unexpectedly high rate of positivity for the surface of objects that were frequently touched by medical staff or patients. The highest rates were for computer mice (ICU six of eight; GW one of five), followed by trash cans (ICU three of five; GW none of eight), sickbed handrails (ICU six of 14; GW none of 12), and doorknobs (GW one of 12) [53]. Contamination, therefore, can be expected also in the operating theatre when there is uncontrolled virus shedding due to aerosol formation during or after urological surgeries.

Thus, the air conditioning in the operating theatre has to be specifically controlled and monitored. Air purifiers with high-efficiency particulate air (HEPA) filtration efficiently capture particles the size of viruses like the SARS-CoV-2, namely 0.01 μm (10 nm) and above. But as described in a National Aeronautics and Space Administration (NASA) technical manuscript by Perry et al. [54], not only the porous diameter in the HEPA fibre is relevant, but other flow-related capturing mechanisms known as the inertial impaction, interception, and diffusion mechanisms are even more relevant. Scientists have found other additional physical aspects that need to be considered such as straining and electrostatic attraction, concluding that under certain circumstances, even with well-determined airflow and pressure rates. Therefore, it is not only the particle sequestration determined in respect to the net virus size by the HEPA filters that is relevant, because several other additional features must be considered.

Is SARS-CoV-2 a Problem for Onco-testicular Sperm Extraction (TESE)?

SARS-CoV-2 has already been detected in many human fluids. A recent Chinese study group showed evidence for viral contamination of seminal fluid. Of the 38 tested patients, 15.8% had positive results [55]. Although there are no reported cases of COVID-19 transmission via sperm, this possible pathway needs to be considered. Urologists are affected when performing Onco-TESE during semicastration and as testicular tumours are considered high risk in prioritisation, semen acquisition can hardly be postponed. However, regarding the little evidence, cryoconservation should still be performed. Further investigations will show whether the specimens can be used for *in vitro* fertilisation or intracytoplasmic sperm injection later on.

What do the Guidelines Say?

Starting in March and April 2020, European and American societies offered evidence-based Guidelines for urologists. Starting with the prioritisation of surgical procedures, the European Association of Urology (EAU) [56] and expert groups [31,57,58] offered detailed information on how to triage patients during the COVID-19 pandemic. While low-risk patients (clinical harm unexpected, if postponed for 6 months) should not be treated during the peak of the pandemic, emergency and high-risk patients, e.g. trauma patients or patients with metastatic diseases, need to receive therapy despite the risk of COVID-19. While the EAU recommends treatment of intermediate-risk patients, given free capacity, the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) [59] advises therapy on malignancies and emergencies alone. With both societies aiming to reduce resource expenditure and patient accumulation in the clinic as well as the ambulant setting, while offering space in ICUs. This is supported by AUA, offering comparable advice for patient triage [60]. To ensure safety for medical personnel, preoperative COVID-19 testing is recommended if an infection is suspected. Suspects might include patients with respiratory symptoms and fever, as well as contact with patients with confirmed COVID-19 or arrival from endemic areas. Preoperative testing in general is only advised if enough resources are at hand [59] and should be

done in an outpatient setting [56]. Citing the WHO, all major societies are in agreement, that any patients with suspected COVID-19 need to be seen as confirmed positive until proven negative. In case of suspected or confirmed COVID-19, virus-proof masks (e.g. FFP-2 or higher), PPE including safety goggles and gloves are essential during any surgery [56,59,61,62]. In accordance with the findings above, separate COVID-19 operating theatres using an autonomous ventilation system in a low-pressure environment should be installed. Physical separation of anaesthesia/intubation and surgery in order to reduce aerosolisation is commonly accepted [56,59]

If specific procedures cannot be postponed and conservative treatment is not available or equivalent, experienced surgeons should perform the surgery with minimal personnel. Electric cauterisation, with mono- or bipolar devices might be reduced to a minimum intensity. Expert societies in laparoscopy, like SAGES and EAU Robotic Urology Section (ERUS) recommend closed suction devices, low-pressure pneumoperitoneum and closed pumping systems in both laparoscopy and endourology [56,63]

Conclusion

SARS-CoV-2 poses a new threat in surgery. The risk of infection is well known and should be taken into account in every department. Over the years, laparoscopy and endourology have proved to be safe and effective surgical procedures. Existing data suggest a possible hazard in terms of aerosol generation and droplet infection. Nevertheless, laparoscopic surgery has not been abandoned and is not regarded as a substantial danger to medical staff in cases of HPV, hepatitis B, and HIV. There is currently no evidence that SARS-CoV-2 infections occur in conjunction with laparoscopic surgery. Still, in accordance with urological societies around the world, it seems rational to systematically use high-quality PPE including at least FFP-2 masks and safety goggles. The deployment of proper suction devices in laparotomy and closed systems with smoke evacuation are recommended. Experienced surgeons should perform operations to reduce the risk of bleeding in haemodiluted patients, while simultaneously decreasing the amount of plume and surgical smoke. Continuous-flow procedures might be the safest approach in endourology. Overall, to relieve wards and ICUs, shorter occupation time after surgery appears to be an important argument.

Conflicts of Interest

None declared.

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Abbreviations: COVID-19, coronavirus disease 2019; EAU, European Association of Urology; FFP, filtering facepiece; GW, general COVID-19 ward; HEPA, high-efficiency particulate air; HPV, human papillomavirus; ICU, Intensive Care Unit; MERS, Middle East respiratory syndrome; PPE, personal protective equipment; RT-PCR, reverse transcriptase-PCR; SAGES, Society of American Gastrointestinal and Endoscopic Surgeons; SARS-CoV-2, severe acute respiratory syndrome coronavirus-2; TESE, testicular sperm extraction; TURB, transurethral resection of bladder.

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