



COVID-19 crisis and minimally invasive surgery: a narrative review on intraoperative aerosol viral transmission and their impact on guidelines and clinical practice in Austria

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Purpose of review

The purpose of this review is to evaluate the risk of intraoperative aerosol viral transmission and the impact of updated COVID-19 guidelines on minimally invasive surgery (MIS) in Austria.

Recent findings

The current literature does not support the risk of intraoperative viral transmission nor does it suggest a harm of minimally invasive procedures in the context of the COVID-19 pandemic. However, medical societies mostly adopted a precautionary approach with a focus on protective measures. Austrian surgeons considered MIS safe during the pandemic and Austria managed to keep the initial outbreak in control. Yet, MIS programs were still affected due to the postponements of elective procedures and switches to other methods by some surgeons.

Summary

The postponement and cancellation of MIS caused complexities in health-care delivery in Austria, whilst the evidence to substantiate this precautionary approach is missing. It must be noted, both the guidelines and our review are limited by the scarcity of evidence. In further consequence, regional factors should be considered while taking precautions. Specific studies on the severe acute respiratory syndrome coronavirus type 2 transmission risk during MIS are urgently needed.

Keywords

Austria, COVID-19, intraoperative viral transmission, minimally invasive surgery, surgical smoke

INTRODUCTION

The COVID-19 outbreak drastically changed health-care delivery worldwide. Prioritization and reduction of surgical activity were necessary to shift resources to the urgent care of SARS-CoV-2 patients. However, this transformation also had an impact on the use of minimally invasive surgery (MIS), which originated from concerns of increased risk of SARS-CoV-2 transmission via pneumoperitoneum for operating theater staff [1]. Surgical smoke and aerosol were already regarded as biohazards before the pandemic [2,3]. The reason for the emerging concern about COVID-19 transmission through MIS stems from the proven presence of several other pathogens in surgical smoke, such as the Human Papilloma Virus (HPV) [4], Hepatitis B Virus (HBV) [5]. Furthermore, a recent study by Wang *et al.* [6] demonstrated that

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KEY POINTS

- To date, there is no solid evidence for intraoperative aerosol viral transmission.
- Deviations from approved guideline methodology should be evaluated rigorously to ensure patient safety.
- Austrian specialists considered minimally invasive surgery safe, yet a switch to open surgery took place frequently.

SARS-CoV-2 can spread via aerosol, similarly to SARS-CoV-1 [7], MERS-CoV [8], H1N1 [9].

Current evidence does suggest the presence of SARS-CoV-2 in various tissues such as gastrointestinal mucosa [10]. Nevertheless, there exists no solid evidence for intraoperative SARS-CoV-2 transmission yet. But due to the uncertainty arising from weak data and lack of experience, many medical societies embraced the precautionary approach, including the European Association of Urology (EAU) [11[■]], American College of Surgeons (ACS) [12[■]], and Royal College of Surgeons [13[■]] that recommended rather avoiding laparoscopic or robotic surgery right at the beginning of the pandemic. In contrast, the joint statement of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and European Association for Endoscopic Surgery and other Interventional Techniques (EAES) [14[■]] emphasize the proven benefits of MIS and state that there is no evidence for aerosolization of COVID-19 specifically in MIS procedures [4]. All guidelines cite the work of Zheng *et al.* [15[■]], which suggests operational adjustments to minimize the exposure, preoperative testing, along with some organizational measures.

Governmental public health measures successfully curbed the transmission of the novel coronavirus in Austria [16[■]]. As of March 24, 2021, Austria had 520.050 cases of COVID-19 with 9.121 fatalities [17]. The case fatality rate (CFR) is below the European and the world average [18], thanks to the healthcare system in which virtually all individuals receive publicly funded care [19].

Our aim was to evaluate the risk of intraoperative aerosol viral transmission and to determine the adherence of Austrian surgeons to updated COVID-19 guidelines and the impact of COVID-19 on surgical activity in Austria.

EVIDENCE ACQUISITION

We conducted a nonsystematic search in September 2020 using MEDLINE/PubMed database with a focus on articles published to evaluate the risk of

intraoperative aerosol viral transmission and COVID-19 guideline recommendations for MIS. We used the following string terms in combination or isolation: 'COVID-19', 'surgical smoke', 'aerosol', 'surgery', 'virus', 'viral', 'guidelines'. Based on eligibility, we selected articles published in the English language and extracted additional relevant publications from authors' bibliography. Furthermore, to analyze the COVID-19's effect on MIS in Austria, a 15-item, cross-sectional web-based survey was constructed in English using Google Forms. Its structure is based on the Checklist for Reporting Results of Internet E-Surveys [20]. The survey was sent to operators in Austria on April 13, 2020 via E-Mail. Specialists from the fields of general surgery, gynecology, and urology were included. The course of the COVID-19 outbreak in Austria was also summarized.

EVIDENCE SYNTHESIS

Guidelines

The EAU [11[■]] graded the urologic interventions according to their priority in the context of the COVID-19 pandemic (in 4 grades) and recommends postponement for lower grade operations. According to the EAU, prioritization of the operations should base on the local situation, because the health system capacities and the severity of the pandemic may differ between countries/cities. They suggested that laparoscopic or robotic surgery should only be performed, when it is a necessity, because the released surgical smoke may contain viral particles. The ACS [12[■]] also took a similar pathway. They recommended against laparoscopy because of the higher aerosolization and increased droplet transmission hazard [2,3]. In the UK, the main surgical associations released the joint guideline 'Intercollegiate General Surgery Guidance on COVID-19' [13[■]]. Although they initially suggested avoiding laparoscopy completely on March 25, 2020, after a week they modified this suggestion into considering laparoscopy only when the clinical benefit to the specific patient markedly exceeded the risk of potential viral transmission in that situation. As of July 11, 2020, the joint guideline recommended using laparoscopy, whereas highlighting the importance of precautionary measures [13[■]].

However, not all medical associations adopted a precautionary approach in the earlier phases of the pandemic. The SAGES and the EAES released a joint recommendation [14[■]] on March 30, 2020, which stated that there is no evidence for aerosolization of COVID-19 specifically in MIS procedures. They emphasized the proven benefits of MIS such as reduced length of stay and fewer complications,

whereas recommending the use of devices to filter released CO₂ for aerosolized particles during laparoscopy. As of August 8, 2020, this joint statement of SAGES und EAES was subject to change and update [14[¶]]. Similarly, the Joint Statement on Minimally Invasive Gynecologic Surgery During the COVID-19 Pandemic [21] recommended laparoscopy, but they described a detailed surgical approach with several precautions in laparoscopic procedures. This joint statement was also updated several times, but as of July 20, 2020, no essential change has been made.

Although most guidelines mentioned that circumstances might differ among regions/countries, none of them provided a detailed approach that described how the geographic nature of the pandemic should influence the clinical decision-making process.

Intraoperative viral transmission risk

Currently, there is no evidence on the specific subject of 'SARS-CoV-2 transmission during MIS'. WHO mentioned contact, droplet, airborne, fomite, fecal-oral, bloodborne, mother-to-child, and animal-to-human transmission in a scientific brief, yet the intraoperative transmission risk was not mentioned [22]. In Basel, a clinical trial [23] is registered with the primary objective to investigate the contamination of surgical smoke and aerosols with SARS-COV-2 virus particles during laparoscopic and open abdominal emergency procedures.

Several reports suggest the presence of viruses in the surgical smoke, such as HBV [5], HPV [24], or

human immunodeficiency virus (HIV) [25], but the infectivity of these pathogens remains unclear [26].

HPV is the only virus, of which an infection via surgical smoke is suspected [2]. Gloster Jr. *et al.* [27] reported a higher prevalence of nasopharyngeal warts in laser surgeons, whereas acknowledging the limitations of their study; such as potential selection bias among the surgeons that responded to the survey, recall bias, or opinion bias by the surgeons. On the other hand, a recent review of Fox-Lewis *et al.* claims the current recommended precautions to be effective, while also suggesting treating surgical smoke as potentially infectious and underlining the importance of the preventive measures [28].

There are no studies reporting an HBV or HIV transmission via surgical smoke. Likewise, no studies are reporting the transmission of any other coronavirus via surgical smoke either.

COVID-19 pandemic in Austria

The first COVID-19 cases in Austria were reported on February 25, 2020 [29]. After the World Health organization characterized COVID-19 as pandemic on March 11, 2020 [30], the Austrian Federal government imposed several restrictions on social life on 16th March 2020 [29]. With the fast reaction of the authorities and the compliance of the citizens, Austria managed to keep the COVID-19 casualties at a relatively low level. As of March 24, 2021, there were 520.050 cases and 9.151 fatalities in Austria [17]. The CFR and mortality of COVID-19 in Austria are clearly below the EU average [18], which is shown in Fig. 1.

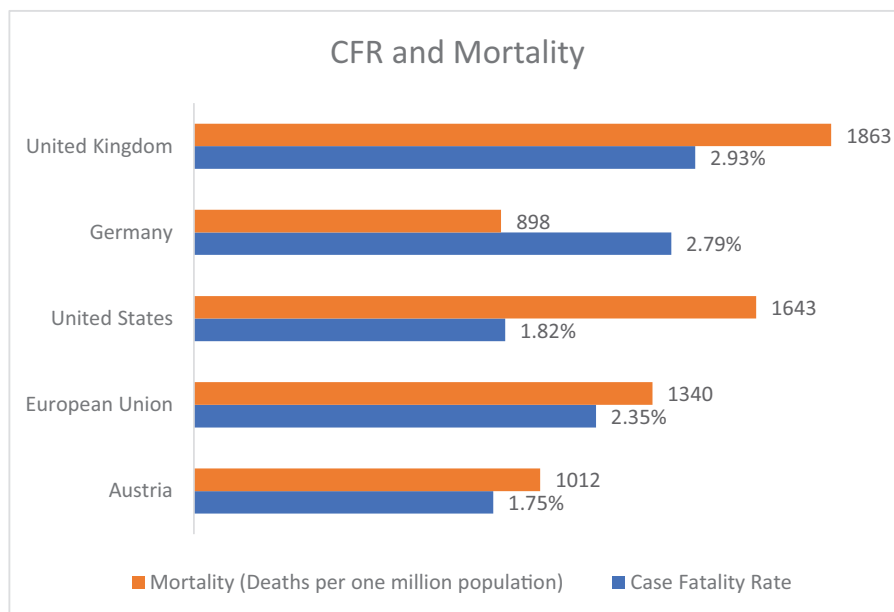


FIGURE 1. Comparison of Case Fatality Rates in Austria, Germany, European Union, United Kingdom, and the United States. Comparison of Mortality Rates in Austria, Germany, European Union, United Kingdom, and the United States.

Due to the principle of statutory health insurance, 99% of the Austrian population is insured [31]. SARS-CoV-2 testing and treatment were conducted without additional costs for the patients [32]. The bed or ventilator capacities in COVID-19 stations were not in shortage. During the pandemic, there were some critics [33,34] about the scope of testing, since the ‘share of COVID-19 tests that are positive’ hit 20% mark on multiple days by the end of March 2020 in Austria [18]. Austria then managed to reduce this number, which has been between 2 and 6% in the past 60 days with a declining trend. As of March 24, 2021, the COVID-19 situation in Austria is far from over, especially 33.521 active cases and the increasing new infections are considered [17].

Survey

Our survey was submitted to participants on April 13, 2020 and was completed by 84 specialists. Table 1 displays the characteristics of the respondents. Apart from few exceptions, the study participants were urologists, who work in Austria. In total, 26% of

Table 1. Characteristics of survey respondents (n = 84).

Position, n (%)	
Faculty	22 (26%)
Resident	62 (74%)
Hospital n (%)	
Private	6 (7%)
Public	78 (93%)
Treating COVID-19 patients in hospital, n (%)	
No	23 (27%)
Yes	61 (73%)
Systematic screening for COVID-19 prior to surgery, n (%)	
No	26 (31%)
Yes	58 (69%)

participants are faculty doctors and 93% are working in the public sector. By the time of the survey, 72% of the responders were treating COVID-19 patients in their hospital, whereas only 68% of participants were conducting preoperative screening for SARS-CoV-2.

Overall, 98% of the respondents stated that COVID-19 affected their surgical program (Fig. 2).

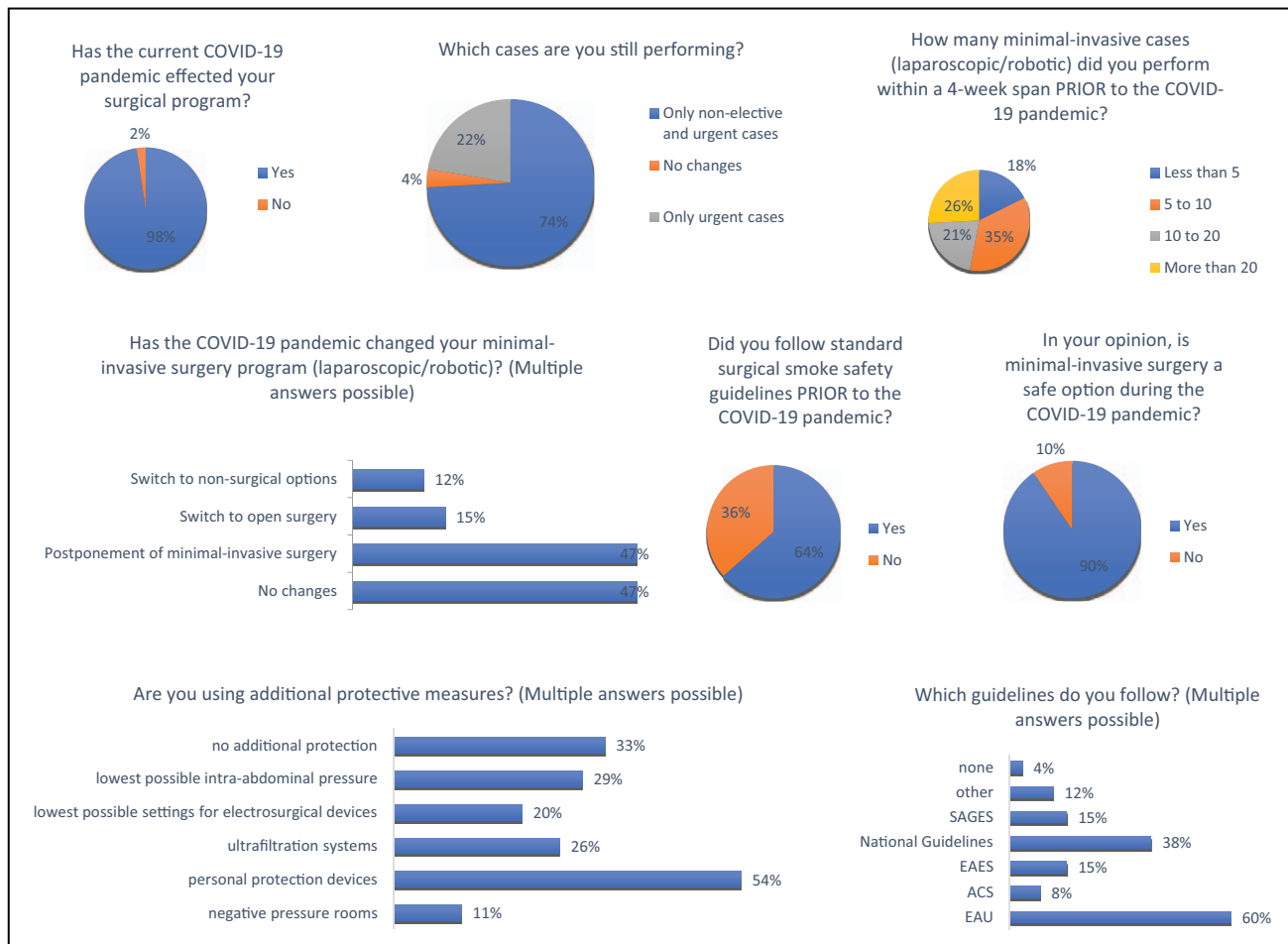


FIGURE 2. Survey results.

In total, 90% of the respondents believe that MIS is a safe option during the pandemic (Fig. 2), although 22% were operating only urgent cases and 74% were operating nonelective and urgent cases (Fig. 2). Minimally invasive operations were postponed by 47% of the surgeons, 15% switched to open surgery and around 12% decided to treat the patients with non-surgical options (Fig. 2).

In total, 47% of the respondents stated that the COVID-19 pandemic did not change their surgery program (Fig. 2) and 33% of the respondents choose to work without any additional protective measures during the outbreak (Fig. 2). The additional protective measures used by participants were lowest possible intra-abdominal pressure (29%), lowest possible settings for electrosurgical devices (20%), ultrafiltration systems (26%), personal protection devices (54%), and negative pressure rooms (11%) (Fig. 2).

Austria does not have specific guidelines on the subject of 'MIS during the COVID-19 pandemic'. In total, 64% of Austrian doctors were following standard surgical smoke guidelines before the pandemic (Fig. 2). The EAU Guidelines are followed by 60% of Austrian operators, thus it is the leading recommendation on the subject in Austria (Fig. 2).

DISCUSSION

The present empirical data on the intraoperative aerosol viral transmission is quite poor. The scarcity of information might be due to the complexity of evidence acquisition on the subject. There is not enough data even on the HIV transmission risk during MIS, although AIDS has been a major threat to human health in the last 40 years [35]. Multiple experts underline the weak availability of data for intraoperative transmission risk and emphasize the benefits of MIS for patients [36,37]. However, they also highlight the value of precautionary measures.

The purpose of medical guidelines is to support doctors in light of the latest scientific data. As mentioned above, several leading medical societies released guidelines on MIS during the COVID-19 pandemic. Yet, there is no broad consensus on the recommendations because SARS-CoV-2 is a novel virus, and the pathogen transmission during MIS is not a subject with comprehensive data on it. Many guidelines have adopted a precautionary approach, emphasizing the severity of the pandemic. However, due to various regional factors, the protection strategies cannot be incorporated in the same manner across different countries. Especially when the relatively stable situation of the COVID-19 outbreak in Austria is considered, the lacking compliance of Austrian doctors to the guidelines becomes more

understandable. Our critical view is, it is best to stick to the standards until we have clear data, as hasty alterations may pose a serious risk for the patients.

Our survey findings illustrate COVID-19's remarkable effect on minimally invasive operations in Austria, as well as the differences between recommendations and practitioners' choices. EAU has the most followed guideline in Austria, which suggests the postponement of MIS procedures according to their prioritizations. In contrast, 90% of Austrian doctors think that MIS is a safe option during the COVID-19 pandemic, whereby 47% did not change their MIS programs.

Guideline development is a scientific gradual process of evaluating the best current evidence. The unexpected breakout of the COVID-19 pandemic made a systematic development impossible. There was no time for a comprehensive benefit-risk analysis, wherefore guidelines had to be updated several times.

CONCLUSION

As things stand, the COVID-19 pandemic is far from over in the world, and in Austria. Precautionary measures in our social lives and healthcare seem mandatory. However, the extent of this precautionary approach in medical guidelines must be carefully evaluated, since it affects healthcare delivery directly. In our opinion, the recommendations of medical societies were given too hastily, given the fact that pathogen transmission during MIS is a disputed subject. It must also be noted; no guideline has provided a methodology that describes how the regional severity of the pandemic should affect clinical decision making.

The next obstacle for the Austrian and global medical professionals is to find a way to optimize surgical operations during COVID-19 times. Concrete studies on the SARS-CoV-2 transmission risk during MIS are needed. Austrian medical chambers must assess the risk of minimally invasive procedures during the COVID-19 pandemic so that the interventions can continue with the maximum benefit for all parties.

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Conflicts of interest

There are no conflicts of interest.

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- of special interest
- of outstanding interest

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