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Review Article

Anesthesia for GI endoscopy in the era of COVID-19

ABSTRACT


As a result of COVID-19, the last few weeks have necessitated a reevaluation of the sedation paradigm for gastrointestinal (GI) endoscopic procedures. Routine screening and some surveillance procedures have taken a backseat and likely to remain so until a vaccine or effective treatment becomes available. Anesthesia providers and endoscopists are required to adapt to this new reality rapidly. The general aim of sedation remains the same-patient comfort, reduced hypoxia, prevention of aspiration along with rapid recovery, and discharge. The present review focuses on necessary modification to reduce the risk of virus contagion for both patients (from health-care providers) and vice versa. A preprocedure evaluation and consenting should be modified and provided remotely. Unsedated GI endoscopy, sedation with minimal respiratory depression, and modification of general anesthesia are explored. Challenges with supplemental oxygen administration and monitoring are addressed. Guidelines for appropriate use of personal protective equipment are discussed. Measures for limiting aerosolization are deliberated.

Key words: Aerosolization; COVID-19; dexmedetomidine; ketamine; monitoring; propofol; sedation

Providing sedation to patients undergoing gastrointestinal (GI) endoscopy is considerably challenging in normal times. However, arrival of coronavirus disease 19 (COVID-19) has increased the complexity on many fronts. There is a need to make rapid changes in our approach without unduly compromising the safety and comfort of patients and health-care workers (HCWs). Adaptation is required on the part of endoscopists, nurses, anesthesia providers, hospital administrators, health insurance agencies, and patients. The issues involve preprocedure evaluation, consenting, administration of sedation, and recovery. The goals are avoidance of close proximity (social distancing), minimizing the need for airway intervention, avoidance of potential aerosolization, and safe, but quick discharge. The risk of

contagion to HCWs is both from patients and other HCWs. More importantly, patients are exposed to potentially infected HCWs, possibly asymptomatic. For those of us who lived and worked as anesthesia providers in 1980s and early 1990s, the situation is akin to human immunodeficiency disease, although we have very little knowledge of COVID-19 itself.

Many hospitals across the world are screening patients for COVID-19. Some hospitals are screening their staff as well. However, it is not practical to screen asymptomatic (HCWs) on a regular basis. The prevalence of asymptomatic COVID-19 among HCWs is variable. At Stanford Medicine where more than 11,000 of 14,000 employees were tested, only 0.3% were positive.^[1] However, in another study in London, 400

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participants were tested for SARS-CoV-2 on consecutive weeks from March 23, 2020. Twenty eight (7.1%; 95% CI 4.9–10.0) of 396 HCWs tested positive in week 1, 14 (4.9%; 3.0–8.1) of 284 HCWs in week 2, 4 (1.5%; 0.6–3.8) of 263 HCWs in week 3, 4 (1.5%; 0.6–3.8) of 267 HCWs in week 4, and 3 (1.1%, 0.4–3.2) of 269 HCWs in week 5.^[2] In addition, 50 HCWs (not necessarily those who were SARS-CoV-2 positive) self-isolated for symptoms. Moreover, of the 44 HCWs who tested positive, 12 (27%) had no symptoms in the week before or after positivity.

As a result, appropriate measures need to be employed to minimize these risks. We aim to discuss some of these issues, their implications, and suggest possible solutions.

Preprocedure Evaluation and Consenting

Evaluation of patients undergoing endoscopic procedures requires specific focus on airway assessment and exploration of aspiration risk. Increasing availability and utilization of electronic medical record can easily enable and expedite such process. The providers can take advantage of telemedicine video consultation. Such consultations are common practice in other branches of medicine.^[3] Webcam-enabled computers are widely used and smart phones allow similar experience. Many health systems in the USA such as Jefferson Health, Mount Sinai, Kaiser Permanente, Cleveland Clinic, and Providence have such facilities that allow patients to consult their doctors from the comforts of their own location.^[4]

Although not ideal, sufficient airway evaluation information can be obtained. Focused questioning regarding aspiration risk factors is possible. Many patients presenting for advanced endoscopic procedures are likely to have undergone cardiorespiratory evaluations. Such information can be extracted from electronic medical records. An extensive explanation of the anesthesia procedure can be provided without fear of infection to either parties. Considering the number of patients who require evaluation and consenting can be significant, appropriate time management is important. It is important to involve the information technology department to create secure link on the hospital online portals of individual patients. Clearly such an effort requires more anesthesia workforce who need to be compensated for additional time and work. It is quite likely that some patients might find the experience less stressful. The fear of contacting COVID-19 from health-care providers is a real concern among many patients. Often preprocedure evaluations are hurried and taxing to patients. With the looming threat of COVID-19, it is likely that any prolonged preprocedure evaluation will be stressful for all the parties concerned. As a result, a truly informed consent is difficult to obtain. Such hurried in-person

evaluations will be insufficient and inadequate explanations may also invite potential litigation. Tele-evaluation and consenting may increase patient satisfaction and provide a happier experience.

Another advantage of tele-preprocedure evaluation is the ability to deploy anesthesia providers who have symptoms suggestive of COVID-19, but not incapacitated or mildly incapacitated. In one study, only one in seven self-isolating HCWs were found to have the virus.^[5,6] It is unlikely that all HCWs with symptoms suggestive of COVID-19 can be tested in time. These symptoms are varied and include loss of taste and smell, diarrhea, respiratory symptoms, sore throat, etc. Many such symptoms are common in any population and many hospitals advised their employees to stay at home in the event of any such symptoms. In addition, asymptomatic COVID-19-positive patients can potentially continue to be productive. The prevalence of asymptomatic infection is high from 5% to 80%.^[2,7,8]

Immediate Preprocedure Examination

It is highly recommended that every patient presenting for endoscopic procedures should undergo tests that detect the virus itself (viral ribonucleic acid [RNA]) usually using a polymerase chain reaction (PCR). As per the center for disease control, the incubation period for COVID-19 is thought to extend to 14 days, with a median time of 4–5 days from exposure to symptoms onset.^[9] Testing twice at 72 h and 24 h can reduce false-negatives. If patients show positive result in the PCR test, they are isolated, the national COVID-19 public health protocols are followed (including protocols for exposed staff), and the surgery is postponed.^[10] Yet, the testing cannot eliminate false-negatives completely. As a result, auscultation and any other physical examination should be avoided, unless deemed essential, and a documentation is made to the effect. Ingenious use of certain existing tools might allow to hear auscultatory sounds without being too physically close by. Digital cordless stethoscopes connected to microphones that can be sanitized can be given to the patients to self-auscultate, while a physician can listen at a safe distance.^[11] Similarly, cordless pulse oximeter probes are available.^[12,13] Single-use thermometers are available.^[14] These measures help to reassure the patients as much as HCWs and alleviate the anxiety. Airway evaluation, if deemed essential should be performed from a safe distance of at least 6ft and should be brief.

Sedation Techniques

It is important to avoid aerosolization. To this end, limiting the use of mask ventilation, appropriate use of endotracheal intubation, avoidance high-flow nasal cannula, and all types

of unnecessary airway intervention is valuable. There are instances of patients who were tested negative for COVID-19 on multiple occasions for samples from various sites such as throat and nose and whose bronchial lavage turned out to be positive (one of the authors personal experience). Ideally, procedures such as screening colonoscopies should be delayed until either a vaccine or effective treatment is available. Alternative screening options such as cologuard (described as a noninvasive colon cancer-screening test for adults 45+ at average risk for colon cancer) are available and are encouraged. However, many endoscopic procedures such as diagnostic/therapeutic colonoscopy, endoscopic ultrasound, therapeutic upper GI endoscopy, and endoscopic retrograde cholangiopancreatography (ERCP) are needed to be performed in a time-sensitive manner. The following modifications in sedation techniques are appropriate. This applies to suspected or definite COVID-19 patients. It would be proper to apply these sedation principles in all cases until definitive answers are available in the prevention and management of COVID-19.

Unsedated GI endoscopy

Both upper GI endoscopy and colonoscopy may be performed with either no sedation or with topical anesthesia and mild sedation. While it is a common practice in many developing and some developed countries, the practice is uncommon in the USA. From the point of both patients and HCWs, this can be considered. Many patients might prefer to have minimum staff interaction. Unsedated endoscopy potentially facilitates such patient's preference.

Unsedated upper GI endoscopy is a common practice in the developing and some developed countries. al-Atrakchi reported 2000 upper diagnostic GI endoscopies that were performed without any sedation in a period of 4 years between 1982 and 1986.^[15] While 81.2% were calm, 94.4% had an easy introduction of the gastroscope. In their experience, complications were rare with only four failed complications. The duration for examination was about half of sedated endoscopy and patients can be discharged without need of an escort. With limitations to visitors enforced in many hospitals, unsedated endoscopy can enable such necessities. The incidence of cardiorespiratory complication associated with sedated gastroscopies can be avoided.^[16] Use of sedation is infrequent in Japan, India, and other Asian countries. Often it is the reluctance on the part of patients that has contributed to a low acceptance of unsedated endoscopy. In the era of COVID-19, many reluctant patients might be willing to accept unsedated endoscopy.

Upper GI endoscopy without sedation can cause gagging, a common reason for failure. Use of topical anesthesia can suppress the pharyngeal reflex. Local anesthetic solutions

used for this purpose are cocaine (4%), tetracaine (1%), benzocaine (20%), and most commonly lidocaine (1–10%).^[17] Both lidocaine spray and viscous lidocaine solution are equally effective with regards to ease of procedure, patients' tolerance, and patients' satisfaction in the performance of unsedated gastroscopy.^[18]

Colonoscopy was in fact started as an unsedated procedure.^[19] It has been suggested that cecal intubation rates and polyp detection rates are better with sedation. However, it has been demonstrated that colonoscopy without sedation can be completed successfully in select patients without compromising comfort or polyp detection rates.^[20] It was found to be safe in those for whom anesthesia is high risk. In a retrospective study from a community-based private practice gastroenterology group, colonoscopy without sedation was found to be fairly safe, patient driven, successful, and satisfactory to the patients.^[21] In addition, it is suggested that warm water irrigation or carbon dioxide insufflation can allow a high-quality and well-tolerated examination.^[22] In patients who are concerned about additional exposure to COVID-19, unsedated colonoscopy minimizes interaction with multiple HCWs, decreases duration of stay in the post-procedure area, and avoids the need for an escort to go home.

Sedation techniques with minimal respiratory depression

Propofol-based sedation techniques are most popular in GI endoscopy, at least in the USA. These techniques need modification to decrease the risk of exposure of HCWs to COVID-19. There is no perfect answer. In general, sedation should aim to decrease the risk of hypoxia, airway obstruction, and aspiration.

Oxygen administration may be accomplished either with nasal cannula or non-rebreathing mask. A face mask or a face shield should be applied over the face to limit aerosolization.

Regarding the choice of drugs, smaller doses of short-acting opioids, ketamine, and dexmedetomidine in combination with propofol are useful.^[23]

Suggested dose of fentanyl is 10–25 mg in increments with an aim to suppress coughing without risking apnea. Similarly, remifentanyl should be used extremely cautiously. We have used it along with propofol as a mixture (typically 500 µg of remifentanyl added to 100 ml of 1% propofol).^[24] The stability of the mixture might concern some as it unapproved. However, it is likely to remain stable for at least 30 min.^[25] The context-sensitive half-time is significantly longer for propofol compared to remifentanyl; however, it is of little concern as the endoscopic procedures are shorter and usually

completed in less than 30 min. The mixture is infused at a rate of 60–100 µg/kg/min (as if one is infusing only propofol ignoring the remifentanil component). It is important to avoid injecting the mixture as a bolus due to the risk of apnea and use propofol only for this purpose. The dose of remifentanil in the concentration suggested is very unlikely to cause apnea and will effectively suppress coughing.

Ketamine is unlikely to be sufficient as a single agent for endoscopy sedation. It is useful for intramuscular use in an uncooperative patient to obtain intravenous access. For the purposes of GI endoscopy, it needs to be used via intravenous route along with midazolam. Administration of an anticholinergic such as glycopyrrolate is necessary to suppress salivary secretions that can stimulate coughing and potentially precipitate laryngospasm. Ketamine along with diazepam has been used for advanced endoscopic procedures such as ERCP and EUS along with meperidine with a fair degree of success.^[26] Some anesthesia providers are fond of using ketamine and propofol mixture (“ketofol”), while others administer small-titrated intermittent doses of ketamine in the background of a propofol infusion along with propofol bolus. The aim is to preserve spontaneous ventilation, while suppressing coughing and facilitate procedure. When used as a mixture, the ratio of propofol to ketamine is variable (1:1, 2:1, 3:1, and 4:1), with lower ketamine concentration such as 4:1 respiratory depression and post-procedural drowsiness will be lower.^[23,27] As a result of its analgesic properties, there is decreased need for opiates such as fentanyl.

Dexmedetomidine is another sedative-analgesic similar to ketamine, without the drawbacks of ketamine such as increased salivary secretions, emergence hallucinations, or laryngospasm. It has been used in combination with propofol in both routine and advanced endoscopic procedures. In patients undergoing ERCP, use of dexmedetomidine is likely to be associated with decreased incidence of oxygen desaturation.^[28] Hypotension and bradycardia are the unwanted effects of dexmedetomidine and they are easily treatable. The main benefits are lower incidence of coughing and apnea. It can also be used along with propofol, thereby decreasing the need for propofol. Anesthesia providers can use titrated doses of propofol as a bolus and start dexmedetomidine (loading dose over 10 min, followed by 0.4 µg/kg/h) at the same time. After about 10 min, for many procedures including advanced endoscopic procedures, propofol infusion can be stopped or eliminated altogether.

General anesthesia with endotracheal intubation

Although traditional general anesthesia with endotracheal intubation might be acceptable in COVID-19-negative

patients, existence of false-negative and asymptomatic untested patients should be taken into account when planning general anesthesia. Patients who are traditionally performed under deep sedation with various backup salvage airway techniques or oxygenation techniques that preempt emergency endotracheal intubation such as morbidly obese should be performed with endotracheal intubation. Aerosolization results from such techniques that have been described by us in many other publications.^[29] Many such oxygenation techniques rely on high oxygen flows (15–60 l/min) and are best avoided. Coronavirus causing COVID-19 can stay in the air for significant period of time, and anesthesia providers, technicians, nurses, and gastroenterologists are exposed for extended period of time. A direct relationship between the risk of getting infection and duration of exposure is established. Relation is also established between the dose of virus exposure and severity of infection. As a result, it is imperative to minimize both degree and duration of aerosolization.

On a practical note, in the absence of any specific contraindication, a rapid sequence induction and intubation approach should be employed. This includes preoxygenation with a nonbreathing face mask for 2–3 min followed by administration of appropriate intravenous induction agents and succinylcholine. There is no need to apply cricoid pressure unless there is a specific indication. This should be followed by endotracheal intubation by the most competent anesthesia provider in the room followed by quick connection to a heat moisture exchanger with high efficiency viral filter. It is advisable to use a video laryngoscope for all intubations to ascertain the entry of endotracheal tube into the trachea. After connecting to the filter (heat moisture exchanger), the breathing system should be connected to the ventilator while avoiding any manual ventilation. Some filters are capable of preventing any coronavirus crossing over to the breathing system side as evidenced by examination of surfaces on either side of these filters. While PCR from the surface facing the patient was positive for coronavirus, they were negative on the breathing system side. It is mandatory to have a functioning scavenging system.

Maintenance of anesthesia can be archived with either intravenous agents or inhalational agents. A remifentanil–propofol infusion has the advantage of reduced risk of extubation-related coughing.

Similarly, extubation should be smooth with minimal coughing. A nonbreathing face mask should be applied immediately after extubation to provide supplemental oxygen. Instillation of lidocaine (1–2%, 4–5 cm³) into the endotracheal

tube to topicalize the tracheobronchial tree will suppress coughing. Use of a remifentanyl-based total intravenous anesthesia is known to minimize postoperative coughing. However, careful consideration should be given to the timing of extubation to minimize the risk of postextubation breath holding, laryngospasm, and risk of reintubation. Patients should be allowed to stay on ventilator as long as intrinsic respiratory efforts are insufficient without recouring to any measures that can hasten extubation such as allowing build-up of carbon dioxide, undue patient stimulation, pushing the endotracheal tube towards carina, etc., An experienced clinician will be able to recognize the appropriate time for extubation when patients are awake, responsive, and able to self-ventilate and maintain the airway with minimal coughing.

In the past, we have discouraged use of general endotracheal anesthesia and preferred deep sedation for patients undergoing endoscopy.^[24,29-32] However, in patients with any degree of suspicion of COVID-19, it is preferable to use general endotracheal anesthesia.

Monitoring

The EtCO₂ monitors aspirate expired air (side stream monitors) from patients end for infrared-based analysis. Unfortunately, the aspirated air cannot be filtered and could be contaminated with viral particles. At the end of the procedure, the CO₂ sample line along with trap should be replaced.

Alternatively, the anesthesia provider can use acoustic respiratory monitor and impedance pneumogram.^[33] Unfortunately, the impedance pneumogram cannot detect if the patient is breathing against a closed glottis. Acoustic respiratory monitor does not have such a drawback and the sensors are disposable. In COVID-19 era, both are useful alternatives.

Personal Protection of Anesthesia Providers

Protection of HCWs is crucial. Although practices are varied between individual hospitals depending on the availability of resources, at the Hospital of the University of Pennsylvania, the following is the current practice. We understand that they will change as new evidence accumulates.

- Masks and face shields are used at all times for all patient care in the Operating Rooms, Critical Care Units, and wards regardless of COVID status
- Furthermore, N95 or powered air-purifying respirators (PAPR) are used for all COVID + or Persons under Investigation including unknown status for the entire case
- N95 or PAPR are used for all intubations/extubations for anyone within 6 ft of the airway.

The risk to the personnel in the procedure room is also from the fecal matter aerosolization. In 73 hospitalized patients infected with SARS-CoV-2, Xiao *et al.* found that 39 (53.42%) tested positive for SARS-CoV-2 RNA in stool.^[34] Prolonged viral shedding is demonstrated in feces of pediatric patients with COVID-19.^[35] Patients have remained positive for viral RNA in the feces after the pharyngeal swabs turned negative for variable length of time (6–10 days), notwithstanding COVID-19 severity.^[36] As a result, anesthesia providers sedating patients for colonoscopy should consider using personal protection. The duration of viral shedding in the feces is unknown; consequently, one should use these precautions in patients with past history of COVID-19 (both symptomatic and asymptomatic) or who have tested positive for antibodies. Considering the incidence of asymptomatic COVID-19 infection rates is extremely high (5% and 80%), these precautions are better employed in all cases.^[8] In addition, the anesthesia providers are encouraged to stay away from the rectal end of the patients to avoid such risks.

Conclusions

In the absence of extensive experience and evidence, we have discussed various challenges that face the anesthesia providers caring for patients undergoing GI endoscopy in COVID-19 era. We have used our past experience in the field of GI endoscopy, research, and publications in the area to explore the best and safe options that can be considered. We hope to provide more evidence-based recommendations in the future as knowledge accumulates.

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Conflicts of interest

There are no conflicts of interest.

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