Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Best Practice & Research Clinical Anaesthesiology 34 (2020) 345–351

Contents lists available at ScienceDirect

Best Practice & Research Clinical Anaesthesiology

journal homepage: www.elsevier.com/locate/bean

16

Telemedicine for preoperative assessment during a COVID-19 pandemic: Recommendations for clinical care

Maks Mihalj, Resident Surgeon [a],
Thierry Carrel, Consultant Surgeon [a],
Igor D. Gregoric, Consultant Surgeon [b],
Lukas Andereggen, Consultant Surgeon [c],
Pascal O. Zinn, Consultant Surgeon [d],
Dietrich Doll, Consultant Surgeon [e],
Frank Stueber, Consultant Anaesthetist [f],
Rodney A. Gabriel, Consultant Anaesthetist [g],
Richard D. Urman, Consultant Anaesthetist [h],
Markus M. Luedi, Consultant Anaesthetist [f, *]

[a] *Department of Cardiovascular Surgery, Inselspital, Bern University Hospital, University of Bern, Freiburgstrasse, CH-3010, Bern, Switzerland*
[b] *Center for Advanced Heart Failure, Cardiopulmonary Support and Transplantation Program, Memorial Hermann Heart & Vascular Institute, Texas Medical Center, and University of Texas McGovern Medical School, 6400 Fannin St., Suite 2350, Houston 77030, TX, USA*
[c] *Department of Neurosurgery, Kantonsspital Aarau, Tellstrasse 25, 5001, Aarau, Switzerland*
[d] *Department of Neurosurgery, University of Pittsburgh School of Medicine, 200 Lothrop Street, Pittsburgh, PA, 15213, USA*
[e] *Department of Colorectal Surgery, St. Marien-Krankenhaus, Marienstraße 6–8, 49377, Vechta, Germany*
[f] *Department of Anaesthesiology and Pain Medicine, Inselspital, Bern University Hospital, University of Bern, Freiburgstrasse, CH-3010, Bern, Switzerland*
[g] *Department of Anesthesiology, University of California San Diego, 9300 Campus Point Dr, 92037, La Jolla, CA, USA*
[h] *Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, Harvard Medical School, 75 Francis Street, 02115, Boston, MA, USA*

* Corresponding author. Department of Anaesthesiology and Pain Medicine, Inselspital, Bern University Hospital, University of Bern, Freiburgstrasse, 3010, Bern, Switzerland.
E-mail addresses: maks.mihalj@insel.ch (M. Mihalj), Thierry.carrel@insel.ch (T. Carrel), Igor.D.Gregoric@uth.tmc.edu (I.D. Gregoric), lukas.andereggen@gmail.com (L. Andereggen), zinnpo@upmc.edu (P.O. Zinn), ddoll@gmx.de (D. Doll), frank.stueber@insel.ch (F. Stueber), ragabriel@health.ucsd.edu (R.A. Gabriel), rurman@bwh.harvard.edu (R.D. Urman), markus.luedi2@insel.ch (M.M. Luedi).

https://doi.org/10.1016/j.bpa.2020.05.001

Keywords:
COVID-19
telemedicine
telehealth
preoperative assessment
surgery
management

Limiting the spread of the disease is key to controlling the COVID-19 pandemic. This includes identifying people who have been exposed to COVID-19, minimizing patient contact, and enforcing strict hygiene measures. To prevent healthcare systems from becoming overburdened, elective and non-urgent medical procedures and treatments have been postponed, and primary health care has broadened to include virtual appointments via telemedicine. Although telemedicine precludes the physical examination of a patient, it allows collection of a range of information prior to a patient's admission, and may therefore be used in preoperative assessment. This new tool can be used to evaluate the severity and progression of the main disease, other comorbidities, and the urgency of the surgical treatment as well as preferencing anesthetic procedures. It can also be used for effective screening and triaging of patients with suspected or established COVID-19, thereby protecting other patients, clinicians and communities alike.

Introduction

Since the emergence of the coronavirus disease (COVID-19) at the end of 2019, the healthcare world has been struggling to address the resulting pandemic. It is the third zoonotic infection of the animal coronavirus documented in humans within the past 17 years. Major efforts are directed at containing the spread of the disease in the global population [1–3]. As a retroviral disease transmitted via airborne droplets of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), it is highly contagious, and patients may be infectious even before they develop symptoms [2–5]. Epidemiologically, the disease has reached a pandemic stage at which the surge of COVID-19 patients requiring complex medical treatment has placed many health care systems on the brink of collapse. In many places, access to healthcare, diagnostic tools, and a healthy work force is limited, as are the local, regional, and global availabilities of hospital and intensive care unit (ICU) beds, personal protective equipment (PPE), and advanced critical care technologies such as renal replacement therapy, ventilators, and extracorporeal membrane oxygenation (ECMO) [6–8]. Efforts to limit the spread of the disease and flatten the coronavirus' epidemiological peak surge have included enforcement of local, regional, or national lockdowns and movement restrictions population-wide, as well as strict hygiene measures [6–8]. Healthcare systems around the world have undertaken extensive measures to reallocate and reorganize the available resources [9], including limiting or completely eliminating in-person preoperative evaluation visits. Telemedicine, using novel and existing virtual heath care technologies, allows continuation of patient care, specifically in the perioperative arena, while limiting the spread of COVID-19.

Among the measures used are postponing elective and non-emergency medical treatments, minimizing contact both with and between patients, and enforcing strict hygiene measures [10]. The key to controlling the current situation is to identify people with COVID-19 before they transmit the disease to others. Novel technologies such as telemedicine may be useful in identifying such patients while also enforcing social distancing, leading to effective screening for infectious disease. This protects not only patients, but also health care providers (doctors, nurses, others) and communities.

What is telemedicine?

Telemedicine is a technology that provides remote diagnosis and treatment of patients and can be used for long-distance clinical care, administrative tasks, as well as patient education [11]. It enables around-the-clock communication between the healthcare provider and the patient through services

such as secured phone or video calls, telephone text messages (SMS), and e-mail, as well as through interactive mobile health applications, remote patient monitoring, home laboratory testing kits, and online physician selection and appointment scheduling [12,13].

There are two types of telemedicine – synchronous and asynchronous or delayed. Synchronous telemedicine allows real–time interaction between the clinician and patient, for example through a secured video call, whereas asynchronous telemedicine provides information transferred between the two parties with a delay, such as through data transfer, images and videos via e-mails or secure text messaging applications. This form of communication enables reciprocal communication without direct risk of disease transmission, thus maintaining the continuity of patient care.

A Cochrane systematic review published in 2015 found similar outcomes for patients treated with telemedicine and patients who met with clinicians face-to-face for chronic conditions including diabetes, congestive heart failure, respiratory conditions, mental health or substance abuse, comorbidities, and urogenital conditions, as well as for neurological conditions, gastrointestinal disorders, solid organ transplantation, and cancer [12].

Telemedicine helps assess the primary disease progression and treatment urgency

In situations in which health care systems are at risk of being overwhelmed by a surge in patients, as in the COVID-19 pandemic, most elective surgical procedures are postponed [8,14–18]. Telemedicine is an important option for the preoperative identification of patients who do not urgently require an otherwise essential procedure [19–23]. It can provide information on the progression of the symptoms of the primary disease, thus helping identify those patients in need of a timely surgery [14–18,24,25].

The definition of essential surgery varies, but, at its minimum, it is an operative procedure that is considered necessary in a predetermined timeline. Postponement of such cases may lead to death, significant comorbidity, or impairment. The decision to postpone a surgical procedure is primarily based on the nature of the primary disease (e.g., cancer with curative intention) as well as the disease progression and symptom severity (e.g., class III angina in coronary artery disease). While telemedicine cannot always replace in-person visits, such as a physical examination, it can help identify patients at risk and provide a great deal of information to complete the preoperative assessment. Involving all relevant clinicians involved in the patient's care – and the patient himself – in decision-making is an important component, and a way to maintain primary patient care [4,12–18,24–27].

Using telemedicine to triage patients for COVID-19 before hospital admission

Triaging patients in the time of COVID-19 is one of the key strategies to limit the spread of the disease, protecting patients and communities alike [4,8,17]. It can be especially beneficial for patients with known risk factors for COVID-19, such as cardiovascular and pulmonary disease, diabetes, immunocompromise, cancer, and those over the age of 65 [2–4,8,28–30].

Patients with symptoms of COVID-19 and those who have been exposed to someone who was COVID-19-positive in the past 14 days should be evaluated for screening for the disease before hospital admission. Telemedicine can help obtain a detailed medical history focusing on the primary condition, as well as help evaluate the presence of symptoms associated with COVID-19 [2–4]. Through close visual observation, the patient's general appearance and well-being can be evaluated, e.g., use of accessory respiratory muscles, presence of chills, confusion, and bluish lips or face [2,3,13,24]. The aim of these measures is to prevent further spread of COVID-19 by isolating those patients who have tested positive before disease transmission can occur [3,4,8,17,31]. Gathering this information early on via telemedicine allows clinicians to strategically decide when such essential surgeries should be scheduled, thereby reducing rates of exposure and same-day cancellations. A high level of empathy amongst the employees involved appears to be beneficial for both patients and clinicians alike given the otherwise very technical setup [32–35].

Some patients are at higher risk for COVID-19, such as patients with preexisting cardiac disorders and those undergoing cardiac surgery procedures [4,8,27–30]. There is currently a discrepancy in the recommendations of experts around the world, for example in terms of testing asymptomatic patients. During the COVID-19 pandemic, the European Society of Cardiology, recommends prophylactic

screening for SARS-CoV-2, with a nasal swab and a CT scan of the chest in all patients undergoing cardiac surgery [4]. Currently there is no recommendation on prophylactic screening for SARS-CoV-2 in asymptomatic patients undergoing non-cardiac surgery. In symptomatic and hospitalized patients, a diagnostic nasal swab is recommended, with mixed recommendations on the added value of a CT scan of the chest [4,36,37]. If COVID-19 is suspected, the patient should be tested and isolated at latest upon hospital admission, bypassing all departments and being processed directly in the respective isolation ward. Furthermore, the invasive diagnostics and non-urgent surgical procedures should be postponed in all confirmed cases with ongoing COVID-19, until the patient has fully recovered [4,8].

Telemedicine helps in preoperative assessment

When an operative procedure is scheduled, preoperative assessment is crucial to obtaining an optimal surgical outcome [26]. With good patient collaboration and compliance, this preoperative evaluation may be extended to a patient-directed assessment, such as self-assessment of temperature, blood pressure and pulse rate. Diseases and symptoms with clearly visible disorders of the skin, for example, may be evaluated through image transfer or a video conference. Remote monitoring of blood sugar, blood pressure, electrocardiogram (ECG), and even a heart murmur through an electronic stethoscope is also possible. With this information, recommendations can be made for medications, lifestyle changes, as well as the time point of the next check-up or intervention [4,13,15,17,18,24,25,38]. However, the majority of diagnostic tests for preoperative assessment require the physical presence of the patient at a diagnostic center. Recent radiographic imaging, echocardiography, ultrasound, and laboratory tests are often recommended as part of the preoperative assessment, depending on the surgical procedure and comorbidities [26]. In the wake of the ongoing COVID-19 pandemic, however, surgical procedures which are not-essential may be postponed, and thus non-invasive preoperative diagnostics may also be postponed to limit the burden on the inpatient and outpatient healthcare system [4,5,8,14,17,27]. For patients undergoing a surgical procedure that cannot be postponed, preoperative diagnostic tests should be performed in an outpatient setting prior to the hospital admission, either at a healthcare center in proximity to the patient's home, or at the institution where the surgical procedure is to take place.

Efforts should be made to minimize the number of visits required to obtain all tests, thus reducing the potential exposure of the patient and other members of the community [4]. Furthermore, timing is important in the scheduling of a telemedicine appointment. Screening for COVID-19 should ideally not be performed too early, as exposure to the virus may occur any time after this appointment and prior to surgery. Thus, preoperative telemedicine appointments aimed at screening for COVID-19 should be performed closer to surgery. However, the purpose of a preoperative assessment is also to ensure medical optimization, and this may be difficult within 24 h of surgery. Thus, in certain circumstances, patients may require additional telemedicine appointments for preoperative assessment – one to assess disease severity and comorbidity optimization and another for COVID-19 screening.

Telemedicine can be helpful in informing patients timely about upcoming anesthetic and surgical procedures and in obtaining informed consent which can be confirmed later on by the patient's signature at the start of the in-hospital stay.

Factors determining use of telemedicine

Four factors need to be addressed for rapid implementation of telemedicine in preoperative assessment of COVID-19:

- First, technological requirements must be ensured, including a broadband connection and technology for both the healthcare providers and patients.
- Second, the facility needs to ensure that it is running the telemedicine platform using secured software conforming to the standards of the Health Insurance Portability and Accountability Act (HIPPAA), or according to the standards of the respective national agency.

- Third, healthcare providers need to be trained in the use of the platform.
- Fourth, patients need to be educated on the safety, privacy, efficacy and personal benefit of using individualized telemedicine, which brings healthcare specialists from the hospitals into the patients' homes. Instructional materials to ensure that patients can communicate with their providers must be provided [15,24,25].
- Fifth, cognitive and hearing impairments, which are relatively common in the elderly, need to be addressed and circumvented.

A recent telehealth consumer study in the US observed that while up to 66% of patients were willing to use telemedicine in 2019, only 8% had used it previously [24]. The authors postulated that the main reasons were the lack of patient familiarity with the new technology and hesitance to trust a consulting specialist clinician whom they have never encountered in person. The majority would prefer to consult their personal healthcare provider over telemedicine instead. However, while the efficacy and patient safety of telemedicine in previous settings have been observed [12], the rapid implementation of these technologies in the general population in the broader healthcare sectors, including in the preoperative assessment of surgical patients, is unknown. In addition, telehealth reimbursement rules are constantly evolving, and remain an obstacle for across-the-board implementation.

Conclusion

Since the emergence of COVID-19 in December 2019, health care systems globally have been embracing new ways to limit the spread of the disease by limiting non-essential inpatient contacts such as treatments and consultations, while continuing to provide routine patient care. While telemedicine has been evolving continuously due to advances in telecommunications as well as in virtual and video-based technology, the current COVID-19 pandemic is forcing clinicians and health care systems around the globe to embrace flexibility in the provision of health care. Telemedicine allows the continued provision of individualized health care to patients in their homes without the need for physical contact, using virtual technologies. This minimizes the exposure of the patient, the healthcare provider, as well as entire communities to COVID-19. It furthermore helps conserve scarce health care resources on a global scale. In patients who need to undergo a non-emergent surgical procedure in the era of COVID-19, preoperative assessment may be partially performed with telemedicine. The focus is on identifying primary disease progression and severity, determining the urgency of the surgical procedure, as well as triaging patients prior to hospital admission for suspicion of COVID-19.

However, no real data exist on the effectiveness of such preoperative assessments. Telemedicine needs to be implemented with caution and on an individualized basis, weighing the potential risks and benefits. Furthermore, healthcare data security during these conferences must be guaranteed. While the COVID-19 crisis is ongoing however, scaling up the use of telemedicine to minimize non-essential physician-to-patient contact is crucial, and will likely remain so until health-care capacity can be expanded.

Practice points

- Telemedicine secures continuation of primary health care, but may also be beneficial in preoperative assessment
- Preoperative assessment in times of COVID-19 pandemic should include assessment of the primary disease progression and treatment urgency using telemedicine
- Triaging each patient for COVID-19 using telemedicine prior to hospital admission may limit the spread of COVID-19
- Informing and educating both patients and clinicians in the use of telemedicine and its potential is important

Research agenda

- Patient assessment and diagnostics can be expanded using telemedicine
- Further developments in end-user technology for telemedicine can be expected
- Telemedicine may be able to help reduce some of the financial impact of COVID-19 on health care systems
- How telemedicine can be applied after COVID-19 is a topic for future research

Contributions

Maks Mihalj, Thierry Carrel, Igor D. Gregoric, Lukas Andereggen, Pascal O. Zinn, Dietrich Doll, Frank Stueber, Rodney A. Gabriel, Richard D. Urman, and Markus M. Luedi helped write the article.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

None.

References

[1] Gates B. Responding to covid-19 — a once-in-a-century pandemic? New Engl J Med 2020 Apr 30;382(18):1677–9.
[2] Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in wuhan, China. J Am Med Assoc 2020;323(11):1061–9.
[3] Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395(10223):497–506.
*[4] ESC. ESC guidance for the diagnosis and management of CV disease during the COVID-19 pandemic European society of Cardiology. 2020 [updated April 20, 2020; cited 2020 April 22]. Guidance Document for the Diagnosis and Management of CV Disease during COVID-19 Pandemic]. Available from: https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance.
*[5] United States Center for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19), US center for disease control and prevention.: center for disease control and prevention, national center for immunization and respiratory diseases (NCIRD), division of viral diseases. U.S. Department of Health & Human Services; 2020 [updated March 20, 2020 cited 2020 April 20]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/index.html.
[6] Grasselli G, Zangrillo A, Zanella A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the lombardy region, Italy. JAMA 2020 [Epub ahead of print].
*[7] Lau H, Khosrawipour V, Kocbach P, et al. The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China. J Trav Med 2020 [Epub ahead of print].
[8] Katz JN, Sinha SS, Alviar CL, et al. Disruptive modifications to cardiac critical care delivery during the covid-19 pandemic: an international perspective. J Am Coll Cardiol 2020 [Epub ahead of print].
*[9] Mascha EJ, Schober P, Schefold JC, et al. Staffing with disease-based epidemiologic indices may reduce shortage of intensive care unit staff during the COVID-19 pandemic. Anesthesia and analgesia; 2020.
*[10] Herman JA, Urits I, Kaye AD, et al. COVID-19: general anesthesia precautions. J Clin Anesth 2020:109840.
[11] Bashshur RL, Shannon GW, Krupinski EA, et al. National telemedicine initiatives: essential to healthcare reform. Telemed J e-health : official J Am Telemed Assoc 2009;15(6):600–10.
*[12] Flodgren G, Rachas A, Farmer AJ, et al. Interactive telemedicine: effects on professional practice and health care outcomes. Cochrane database Syst Rev 2015;2015(9):Cd002098.
[13] Elliott T, Yopes MC. Direct-to-Consumer telemedicine. J Allergy Clin Immunol Pract 2019;7(8):2546–52.
[14] Ablin JN, Berman M, Aloush V, et al. Effect of fibromyalgia symptoms on outcome of spinal surgery. Pain Med (Malden, Mass) 2017;18(4):773–80.
[15] Webster P. Virtual health care in the era of COVID-19. Lancet 2020;395(10231):1180–1.
[16] Lurie N, Carr BG. The role of telehealth in the medical response to disasters. JAMA Internal Medicine 2018;178(6):745–6.
[17] Chauhan V, Galwankar S, Arquilla B, et al. Novel coronavirus (COVID-19): leveraging telemedicine to optimize care while minimizing exposures and viral transmission. J Emergencies, Trauma, Shock 2020;13(1):20–4.
*[18] Hollander JE, Carr BG. Virtually perfect? Telemedicine for covid-19. New Engl J Med 2020 Apr 30;382(18):1679–81.

[19] Allin O, Urman RD, Edwards AF, et al. Using time-driven activity-based costing to demonstrate value in perioperative care: recommendations and review from the society for perioperative assessment and quality improvement (SPAQI). J Med Syst 2019;44(1):25.
[20] Alvarez-Nebreda ML, Bentov N, Urman RD, et al. Recommendations for preoperative management of frailty from the society for perioperative assessment and quality improvement (SPAQI). J Clin Anesth 2018;47:33–42.
[21] Arias F, Wiggins M, Urman RD, et al. Rapid in-person cognitive screening in the preoperative setting: test considerations and recommendations from the society for perioperative assessment and quality improvement (SPAQI). J Clin Anesth 2020;62:109724.
[22] Arias F, Wiggins M, Urman RD, et al. Rapid in-person cognitive screening in the preoperative setting: test considerations and recommendations from the society for perioperative assessment and quality improvement (SPAQI). Perioper Care Oper Room Manag 2020;19.
[23] Wong J, An D, Urman RD, et al. Society for perioperative assessment and quality improvement (SPAQI) consensus statement on perioperative smoking cessation. Anesthesia and analgesia; 2019.
[24] Portnoy J, Waller M, Elliott T. Telemedicine in the era of COVID-19. J Allergy Clin Immunol Pract 2020 May;8(5):1489–91.
[25] Loeb AE, Rao SS, Ficke JR, et al. Departmental experience and lessons learned with accelerated introduction of telemedicine during the COVID-19 crisis. The J Am Acad Orthopaedic Surgeons 2020 [Epub ahead of print].
[26] Mihalj M, Carrel T, Urman RD, et al. Recommendations for preoperative assessment and shared decision-making in cardiac surgery. Current Anesthesiology Reports 2020 [Epub ahead of print].
[27] Maron DJ, Hochman JS, Reynolds HR, et al. Initial invasive or conservative strategy for stable coronary disease. New Engl J Med 2020;382(15):1395–407.
[28] Guo T, Fan Y, Chen M, et al. Cardiovascular implications of fatal outcomes of patients with coronavirus disease 2019 (COVID-19). JAMA Cardiology 2020 [Epub ahead of print].
[29] Zheng Y-Y, Ma Y-T, Zhang J-Y, et al. COVID-19 and the cardiovascular system. Nat Rev Cardiol 2020;17(5):259–60.
[30] Li B, Yang J, Zhao F, et al. Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. Clin Res Cardiol 2020 [Epub ahead of print].
[31] Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. Can J Anaesth = J canadien d'anesthesie 2020;67(5):568–76.
[32] Boggs SD, Luedi MM. Nonoperating room anesthesia education: preparing our residents for the future. Curr Opin Anaesthesiol 2019;32(4):490–7.
[33] Luedi MM, Boggs SD, Doll D, et al. On patient safety, teams and psychologically disturbed pilots. Eur J Anaesthesiol 2016; 33(3):226–7.
*[34] Luedi MM, Doll D, Boggs SD, et al. Successful personalities in anesthesiology and Acute care medicine: are we selecting, training, and supporting the best? Anesth analgesia 2017;124(1):359–61.
[35] Milenovic MS, Matejic BR, Simic DM, et al. Burnout in anesthesiology providers: shedding light on a global problem. Anesth analgesia 2020;130(2):307–9.
[36] Ai T, Yang Z, Hou H, et al. Correlation of chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases. Radiology 2020:200642.
[37] American College of Radiology. ACR recommendations for the use of chest radiography and computed tomography (CT) for suspected COVID-19 infection. American College of Radiology; 2020 [updated March 22, 2020; cited 2020 April 20]. Available from: https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection.
[38] American College of Surgeons. American college of surgeons: COVID-19 and surgery: clinical issues and guidance. American College of Surgeons; 2020 [cited 2020 April 20]. §:[Available from: https://www.facs.org/covid-19/clinical-guidance.