13 Geriatric Patients and COVID-19

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13.1 Introduction

The CDC reports that, as of July 26, 2020, there are over 16.3 million cases of the novel coronavirus in the United States and that the death toll is nearly 645,000 [1]. Although information regarding risk factors, pathophysiology, treatments, and protective measures remains controversial, analysis of patient demographics suggests that older patients are particularly vulnerable to COVID-19: in China, where the disease first emerged, coronavirus deaths in those aged 60 and older constituted 80% of the total number of deaths [2]; in Italy, the median age of death due to COVID-19 is reported as 78.5 [3, 4]; an examination of COVID-19 cases in the United States between February 12 and March 16 reports that adverse outcomes most frequently occur in adults aged over 85 years [2]. The correlation between adverse outcomes and advanced age demonstrates the need to develop efficient guidelines to provide palliative care for older and vulnerable populations while protecting healthcare workers.

13.1.1 Background

To develop these guidelines in a targeted and specific manner, it is necessary to consider the nuances in the pathophysiology and clinical manifestations of COVID-19 in the context of geriatric patients. Current literature suggests that the incubation period of COVID-19 is 2–14 days [5] with a median of 5.1 days [6], and
the most common symptoms include fever, cough, shortness of breath, and fatigue [7]. In older adults, because the fever response is attenuated and because other symptoms are concurrent with age-related disorders, diagnosis can be more challenging [6]. Moreover, age-related disorders may directly contribute to the vulnerability of geriatric patients to COVID-19. Cases of COVID-19 in older adults are also unique because healthcare providers must consider the impact of medications for age-related disorders upon pathogenicity and virulence [6]. Special precautions must be taken for older patients residing in nursing facilities to prevent rapid transmission to other residents who may be at high risk of severe outcomes [8]. Finally, differential clinical features of COVID-19 in older patients warrant the development of treatment guidelines specific to geriatric patients [9]. By considering the unique aspects of COVID-19 in older patients, in this subsection we outline the clinical and anesthetic considerations, potential complications, and critical care management of geriatric patients.

### 13.2 Clinical Considerations

#### 13.2.1 Diagnosis and Clinical Presentation

Several clinical features indicate coronavirus infection in the older adult. Although fever is one of the most common symptoms of COVID-19, the definition of fever must be modified to account for the attenuated fever response in older adults. High et al. proposed that for residents of long-term care facilities, a single oral temperature >100 °F, multiple oral temperatures >99 °F, and a >2 °F increase in temperature compared to baseline are suitable definitions of fever [6, 10]. In addition to typical symptoms such as cough and dyspnea, atypical symptoms such as confusion, sore throat, chills, and rhinorrhea may also occur. Godaert et al. suggest, based on experience in a short-stay geriatric unit for suspected COVID-19 cases, that some atypical symptoms may present more frequently in older adults [11]. Both typical and atypical symptoms reportedly take longer to present in older patients [12]. In consideration of clinical presentation and duration of incubation period, a low threshold for suspicion and frequent testing should be employed [6]. Management of these typical and atypical symptoms is summarized in the Sect. 13.2.4 of this chapter. Older individuals are more likely to present with higher pneumonia severity index, more acute respiratory distress syndrome, and acute organ dysfunction [9]. Furthermore, lung lesions appear particularly severe in older patients. Tomographic findings show a more extensive bilateral ground-glass pattern of lung involvement, peripheric ground-glass opacity and consolidation, and interlobular septal, subpleural line, and pleural thickening. Alveolar and interstitial involvement are twice more intense than in younger adults [13]. Laboratory findings in older patients indicate lower lymphocyte ratios and lower C-reactive protein levels compared with younger patients [9]. A summary of differential clinical features of COVID-19 between older and younger patients is provided below in Table 13.1.
13.2.2 Frailty and COVID-19 Outcomes

The COPE study, COVID-19 in Older People, in *The Lancet* assessed the effect of frailty on outcomes in people of all ages with COVID-19. Frailty increases mortality, earlier death, and longer hospital stays in hospital-admitted patients affected with COVID-19. The importance of this study is that frailty assessment rather than age is important in determining admission, triage, and resource allocation [14]. Age-related physiological changes may contribute to the frailty of older patients; these physiological changes are provided in Table 13.2.

13.2.3 Anesthetic Considerations

13.2.3.1 Perioperative Anesthesiologic Evaluation

Protecting hospital personnel and patients during perioperative anesthesiologic evaluation is imperative, and a general protocol is provided in Table 13.3.

In a scientific brief published on July 9, 2020, the World Health Organization implicates airborne transmission as one possible modality by which COVID-19 spreads—particularly in the context of aerosol-generating medical procedures (AGMPs) [16]. Provided below is a list of anesthesiologic procedures considered AGMPs:

- Manual mask ventilation [17]
- Endotracheal intubation [17]
- Extubation [17]
- Non-invasive ventilation such as BiPAP or CPAP [17]
- Bronchoscopy [17]
- Open airway suctioning [17]
- Processes which induce coughing and sputum generation [17]
- Tracheostomy [17]
- Cardiopulmonary resuscitation [17]
| Clinical findings                                                                                   |
|---------------------------------------------------------------------------------------------------|
| **Cardiopulmonary system**                                                                      |
| Systolic hypertension                                                                            |
| Increased afterload                                                                               |
| Left ventricular hypertrophy                                                                      |
| Decreased cardiac output                                                                         |
| Diastolic dysfunction                                                                             |
| Depressed baroreceptor function                                                                   |
| Decreased heart rate                                                                             |
| Increased incidence of arrhythmia, particularly atrial fibrillation                              |
| Compromised small airway patency                                                                  |
| Increased closing capacity                                                                        |
| Chronic airway obstruction                                                                       |
| Increased shunting and dead space                                                                |
| Micro-aspiration and concomitant chronic pulmonary inflammation                                  |
| Decreased ventilatory response to hypoxemia and hypercarbia                                      |
| Presence of pulmonary diseases such as COPD, pneumonia, and sleep apnea                           |
| **Renal system**                                                                                  |
| Decline (50%) of functioning nephrons by age 80                                                   |
| Glomerular filtration rate reduces by 1–1.5% per year                                              |
| Reduced creatinine clearance                                                                      |
| Impaired electrolyte handling and ability to dilute/concentrate urine                             |
| Increased risk of dehydration and sodium depletion                                                |
| Increased retention of drugs and drug metabolites                                                 |
| **Hepatic system**                                                                                |
| Decreased liver mass and hepatic blood flow decreases (10% per decade)                            |
| Decreased hepatic metabolism of drugs especially phase 1 reactions                               |
| Altered pharmacokinetics of drugs                                                                 |
| Increased plasma concentration of water-soluble drugs                                             |
| Decreased plasma concentration of lipid-soluble drugs                                             |
| Cognitive, sensory, motor, and autonomic function impairments                                      |
| **Nervous system**                                                                                |
| Reduction in brain mass and neuronal size                                                         |
| Decreased dendritic tree complexity and decreased number of synapses                              |
| Decreased production of neurotransmitters, neurotransmitter receptors                             |
| Impaired autonomic nervous system function                                                        |
| Impaired thermoregulation                                                                         |
| Decreased baroreceptor sensitivity                                                                |
| Increased susceptibility to dehydration                                                          |
| Increased prevalence of central nervous system disorders in older patients such as cerebral atherosclerosis, Parkinson’s disease, Alzheimer’s disease, dementia, and depression |
| Increased risk of delirium                                                                        |
| **Endocrine system**                                                                             |
| Potential for hormonal deficiency (insulin, thyroxine, growth hormone, aldosterone, testosterone) |
| Potential for endocrine disorders such as diabetes, hypothyroidism, osteoporosis, impotence, and impaired electrolyte homeostasis |
The list above is not extensive and new information may identify additional AGMPs germane to anesthesia. In addition, surgical societies cite procedures that are potentially aerosol-generating, including oral and upper airway procedures and surgeries, upper GI endoscopies including ERCP (endoscopic retrograde cholangio-pancreatography), and laparoscopies. It is uncertain whether aerosols generated from some procedures may be infectious, such as nebulizer administration and high-flow O₂ delivery.

### 13.2.3.2 General Anesthesia

While conclusive evidence indicating the use of particular airway techniques is not available, heuristics and clinical experience can be utilized to intuit the risk
associated with anesthetic choices. For instance, at low pressures, LMA seals the airway, thus protecting healthcare personnel; however, at high pressures, a complete seal may not be maintained, and a resultant leak may allow for the generation of aerosols. Another suggestion is that, in general, fiber-optic intubation is not advised. If difficult airway or cannot ventilate situation is anticipated, video laryngoscope, LMA for cannot intubate, and difficult airway cart and algorithm should be ready.

COVID-19 Airway Management and Anesthesia Recommendations

- **RSI** (rapid sequence induction) or a modified version of RSI with small tidal volumes must be used during induction [18].
- **Video laryngoscope should be used for intubation** and a high-quality heat- and moisture-exchanging filter (>99.97% rejection of airborne particles >0.3 μm) placed in between the facemask and breathing circuit or between the facemask and reservoir bag [18].
- **Monitored anesthesia care** cases with low fresh gas flow rate and spontaneous ventilation are permissible; note, during jaw lift and positive pressure administration, the likelihood of coronavirus transmission to the anesthesiologist increases. Risk is further increased to healthcare personnel if AGMPs (such as upper endoscopy and bronchoscopy) are conducted; accordingly, appropriate PPE must be donned for these procedures [17]. It is also important to recognize that transition from MAC to tracheal intubation augments risk to the anesthesiologist which could be why local experts report the use of endotracheal anesthetics instead of MAC when there is high prevalence of COVID-19 cases in the community [17].

### 13.2.3.3 Regional Anesthesia

To circumvent the risk associated with AGMPs, Uppal et al. provide a comprehensive review on the guidelines for providing regional anesthesia for suspected or confirmed COVID-19 patients [19]. Uppal et al. first recommend decreasing clinical load and testing and triaging patients adequately prior to anesthesia to ensure optimal allocation of hospital resources. Next, neuraxial anesthesia and peripheral nerve blocks should be encouraged for hospital procedures; however, because intraoperative conversion to general anesthesia is undesirable, anesthetic considerations and options should be thoroughly investigated and planned. Once anesthetic considerations are evaluated, regional anesthesia should be conducted in an operating room or isolation room to prevent the spread of disease to other healthcare providers and patients. To prevent fomite-based transmission of COVID-19, all non-essential items should be removed from the patient’s room. Since neuraxial anesthesia and peripheral nerve blocks are considered non-aerosol-generating procedures, contact and droplet precautions can be used; however, evidence suggests that the use of airborne precautions for spinal anesthesia reduces risk of transmission. Importantly,
the anesthesiologist must be prepared with the appropriate PPE in case there is an emergent need to convert to general anesthesia. Modulating the flow rate of oxygen delivery and considering an appropriate oxygen delivery device can reduce risk of disease transmission while ensuring oxygen saturation. Considerations for neuraxial anesthesia include testing for the presence of thrombocytopenia, adequate dosing, and post-dural puncture headache; these considerations are enumerated, delineated, and discussed by Uppal et al. Considerations for peripheral nerve blocks include utilizing appropriate PPE (blocks performed in the head and neck area may indicate airborne precautions) and minimizing systemic toxicity; these factors are discussed in detail by Uppal et al. Patient monitoring must be thorough to eliminate the need for intra-operative conversion to general anesthesia; the use of a viral filter for the monitoring of gas samples is recommended [19]. The article by Uppal et al. utilized for our discussion of regional anesthesia is provided below and should be read for a more detailed review of these key points.

### 13.2.4 Treatment

Triaging patients is one of the first key steps in treatment; appropriate triage can allocate resources efficiently and provide targeted care. Triage of older patients is predicated on the presence of comorbidities, frailty of patients, and resource availability. Triage of older patients residing in congregate senior living facilities also involves isolating the patient from other residents or transporting the patient to an appropriate facility [20]. Mantha et al. propose a modified 6-min walk test for triaging but do not recommend its use for patients aged over 70 years old as they may already qualify for emergent care [21]. The recent NICE guideline of frailty assessment of older adults upon admission to hospital, irrespective of age and COVID-19 status, is recommended to efficiently utilize available resources [22].

Because of reports of asymptomatic and pre-symptomatic disease transmission, patients admitted to the hospital for non-COVID-19-related surgical procedures must also be triaged; essentially, all surgical procedures must be planned and approached systematically to protect OR personnel. The general protective procedures for conducting surgeries during this pandemic are provided in Fig. 13.1.

As no anti-viral therapeutics against COVID-19 have been conclusively established, treatment is primarily supportive. Several pharmacological agents and treatments are utilized to ameliorate symptoms of COVID-19, such as paracetamol for fever, codeine for cough, and ventilation for respiratory distress [3]. For older patients presenting with atypical symptoms, drugs such as haloperidol and metoclopramide can be used to treat delirium/confusion and nausea, respectively [3]. Another important consideration for geriatric patients is appropriate dosing of
Fig. 13.1 Flowsheet demonstrating the protocol for surgery patients during the COVID-19 pandemic. (Modified from Zhao et al. [23])
medications; typically, potentially due to age-related changes in renal and hepatic metabolism, older patients are more sensitive to analgesics such as midazolam [3, 24, 25]. Information regarding treatment of common symptoms is summarized in Table 13.4.

### 13.2.5 Recent Advances in the Treatment of Coronavirus

Several candidate pharmacological treatments to attenuate the severity of COVID-19 are currently being investigated. As severe outcomes following COVID-19 are more frequently reported in older patients, this developing research should be continuously reviewed by healthcare providers treating geriatric COVID-19 patients.

Zhang and Yap reported in 2004 that a combination of lopinavir and ritonavir, which is used to treat HIV (human immunodeficiency virus), demonstrates weak in vitro activity against severe acute respiratory syndrome-associated coronavirus (SARS-CoV) [26]. Accordingly, Cao et al. explicate the efficacy of lopinavir/ritonavir combination in patients (median age, 58 years; IQR, 49–68 years) with COVID-19 was not significantly different from standard care in terms of time to clinical improvement in critically ill patients, mortality in critically ill patients, and viral load and detectability [27]. Cao et al. explain that their results do not necessarily indicate that lopinavir/ritonavir is ineffective. Dalerba et al., Kunz, and Havlichek suggest that experimental parameters, such as delayed administration of lopinavir/
ritonavir and primary outcome measures may obfuscate the efficacy of lopinavir/ritonavir [28]. In another study, COVID-19 patients (median age, 52 years; IQR, 42–62 years) treated with lopinavir/ritonavir along with ribavirin and interferon beta-1b displayed significantly decreased time from onset of infection to negative nasopharyngeal swab and improved secondary clinical outcomes such as sequential organ failure assessment score [29]. These data suggest that more studies to assess the efficacy and clinical use of lopinavir/ritonavir combination for COVID-19 in elderly patients are required.

The non-selective cyclooxygenase inhibitor, indomethacin [30], was shown by Xu et al. to possess anti-viral properties against SARS-CoV-2 pseudovirus in vitro and canine coronavirus [31]. More testing is needed to confirm the utility of indomethacin for COVID-19, keeping in mind that advanced age may contraindicate indomethacin due to harmful side effects [30, 32].

Remdesivir, an anti-viral RNA-dependent RNA polymerase inhibitor, is postulated by Cao et al. to be a putative treatment for COVID-19; the severity of illness in animal models of SARS-CoV and Middle East respiratory syndrome-related coronavirus was attenuated through treatment with remdesivir [33]. In a randomized control trial, COVID-19 patients (median age, 65 years; IQR, 56–71 years) treated with remdesivir displayed numerically shorter time to clinical improvement compared with the placebo group; however, the difference between the treatment and placebo group was not statistically significant [34]. Similar results are reported for 28-day mortality, duration of mechanical ventilation, and viral load [34].

A more recent randomized control trial by Biegel et al. reports that the remdesivir group had shorter time to recovery and numerically lower mortality (not statistically significant) compared with the placebo group; in this study, the mean patient age is 58.9 ± 15 years [35].

Dexamethasone is the latest candidate treatment for COVID-19 and is reported to decrease the mortality of COVID-19 patients on ventilators by one-third [36]. Additional studies regarding the efficacy of dexamethasone as a pharmacotherapy will certainly be published; it is important to consider the most recent and accurate literature regarding its usage for COVID-19. Moreover, data on age of COVID-19 patients treated with dexamethasone must be examined in determining its utility in geriatric patients.

A summary of promising treatments for COVID-19 is provided in Table 13.5.

### 13.2.6 Outcomes

Adverse outcomes refer to death due to COVID-19 and complications such as acute kidney injury, acute respiratory distress syndrome, and secondary infection. Several
Table 13.5 Candidate pharmacotherapies for COVID-19 along with their biological effects, reported clinical outcomes, advantages, and disadvantages

| Therapy         | Biological effects                             | Reported clinical outcomes                                                                 | Advantages                                                                                                   | Disadvantages                                      | References     |
|-----------------|------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------|
| Lopinavir/ritonavir | Type 1 aspartate protease inhibitor            | Similar to placebo in one study but improved outcomes in another when administered with interferon beta-1b and ribavirin | Some results demonstrating improved outcomes                                                                | Inconsistent outcomes reported                   | [25, 28]       |
| Indomethacin     | Cyclooxygenase inhibitor                       | NA                                                                                          | In vitro and in vivo evidence suggests a potential use for COVID-19                                         | Lack of randomized clinical trials Side effects including gastritis, renal dysfunction, and platelet dysfunction which could be deleterious to geriatric COVID-19 patients | [30–32]        |
| Remdesivir       | RNA-dependent RNA polymerase inhibitor         | Reports suggest numerically or statistically significant shorter time to recovery; numerically reduced mortality rate | May potentially reduce mortality and time to clinical recovery—more evidence is needed                        | In short supply                                   | [34–36]        |
| Dexamethasone    | Anti-inflammatory corticosteroid               | NA                                                                                          | Widely available and inexpensive                                                                          | Lack of randomized clinical trials               | [36]           |
factors contribute to the selective vulnerability of older patients to COVID-19. Age-dependent comorbidities, such as cerebrovascular disease, COPD, and cardiovascular disease, disrupt cardiopulmonary function and impose physiological stresses that may therefore lead to more severe outcomes following COVID-19 [37]. Additionally, medications used to treat comorbidities may also exacerbate SARS-CoV-2 infections. The most controversial of these are the use of ACE inhibitors (ACEIs) and aldosterone receptor blockers (ARBs) for diabetes and hypertension; reports differ on whether the role of ACEIs/ARBs in the renin-angiotensin-aldosterone system (RAAS) is beneficial or detrimental in COVID-19 [38]. A schematic of RAAS is provided in Fig. 13.2. The controversial role of ACEIs/ARBs in COVID-19 is portrayed in Fig. 13.3.

In the absence of conclusive evidence, as of March 17, 2020, the American Heart Association, the Heart Failure Society of America, and the American College of Cardiology recommend the continued use of ACEIs and ARBs for patients with prescriptions unless otherwise stated by personal physicians [39]. More research is needed to conclusively state the effects of ACEIs/ARBs and drugs, such as corticosteroids, for other age-related disorders. Age-related immunological changes such as decreased production of naïve T and B cells, attenuated lymphocyte proliferation and activity, and ultimately a blunted immune response further contribute to the vulnerability of geriatric patients to COVID-19 [6].

![Schematic depiction of RAAS](image-url)

**Fig. 13.2** Schematic depiction of RAAS [38]
Fig. 13.3  Contrasting hypotheses suggest both beneficial and detrimental effects of ACEI and ARBs in COVID-19 [38]
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