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.

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Review Article

Post-Acute COVID-19 Syndrome for Anesthesiologists: A Narrative Review and a Pragmatic Approach to Clinical Care

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ABSTRACT

Post-acute coronavirus disease 2019 (COVID-19) syndrome is a novel, poorly understood clinical entity with life-impacting ramifications. Patients with this syndrome, also known as "COVID-19 long-haulers," often present with nonspecific ailments involving more than one body system. The most common complaints include dyspnea, fatigue, brain fog, and chest pain. There currently is no single agreed-upon definition for post-acute COVID-19 syndrome, but most agree that criterion for this syndrome is the persistence of mental and physical health consequences after initial infection. Given the millions of acute infections in the United States over the course of the pandemic, perioperative providers will encounter these patients in clinical practice in growing numbers. Symptoms of the COVID-19 long-haulers should not be minimized, as these patients are at higher risk for postoperative respiratory complications and perioperative mortality for up to seven weeks after initial illness. Instead, a cautious multidisciplinary preoperative evaluation should be performed. Perioperative care should be viewed through the prism of best practices already in use, such as avoidance of benzodiazepines in patients with cognitive impairment and use of lung-protective ventilation. Recommendations especially relevant to the COVID-19 long-haulers include assessment of critical care myopathies and neuropathies to determine suitable neuromuscular blocking agents and reversal, preoperative workup of insidious cardiac or pulmonary pathologies in previously healthy patients, and, thorough medication review, particularly of anticoagulation regimens and chronic steroid use. In this article, the authors define the syndrome, synthesize the available scientific evidence, and make pragmatic suggestions regarding the perioperative clinical care of COVID-19 long-haulers.

Key Words: post-acute COVID-19 syndrome; long COVID; post-viral syndrome; perioperative considerations

Introduction

As the rate of new respiratory syndrome coronavirus 2 (SARS-CoV-2) infections continues to increase with the dominance of the delta variant, there are a growing number of reports describing a post-acute coronavirus disease 2019 (COVID-19) syndrome.[1] Patients with this syndrome, colloquially known as "COVID-19 long-haulers," present with a constellation of nonspecific symptoms of mild-to-life-threatening consequences.[2] Given the millions of acute infections with SARS-CoV-2 around the globe, clinicians will encounter COVID-19 long-haulers in practice in the aftermath of the pandemic. There are no current recommendations that would aid anesthesiologists when caring for these patients because of the novelty and the current fragmentary understanding of post-acute COVID-19 syndrome (PACS). Thus, the authors gathered available data on PACS and applied it to the perioperative setting to define the syndrome, describe the available scientific

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evidence, and make pragmatic recommendations regarding approaches to clinical care of the COVID-19 long-haulers.

Methods

A literature review of the US National Library of Medicine Database and Excerpta Medica Database was performed from November 1, 2019 through July 31, 2021 for the medical subject headings and key words related to long-COVID-19, chronic COVID-19 syndrome, COVID-19 long-haulers, post-acute COVID-19 syndrome, and post-COVID-19 syndrome. The reference lists of all included citations were hand-searched to identify any additional relevant studies. Abstracts were screened for clinical studies and case reports reporting on adult patients (aged ≥18 years) at least 28 days after acute COVID-19 infection.

Summary of Study Characteristics

After the removal of duplicate citations, the literature search yielded a total of 2,414 unique citations. Of the potentially eligible abstracts identified, 2,327 did not satisfy the inclusion criteria based on title and abstract alone. The remaining 87 abstracts had their full-text citations retrieved for review. Five additional citations were identified after hand-searching the reference list of the included studies; therefore, the review ultimately encompassed the findings of 92 full-text citations. Specifically, these included 60 prospective studies,[3-62] 18 case reports,[63-80] 12 retrospective studies,[81-92] and two bidirectional studies.[93,94] There were no randomized controlled trials identified. A full-flow diagram for study inclusion can be seen in Figure 1; 40 publications reported on PACS prevalence, symptomatology, risk factors, and outcomes.[3-21,23-26,28-35,63,81-86,93,94] The remaining 52 articles addressed organ-specific sequelae of PACS, including 17 neuropsychiatric studies,[36-44,64-69,92] 16 cardiovascular studies,[45-54,70-74,87] ten pulmonary studies,[55-60,75-77,88] three hematologic studies,[62,80,91] three gastrointestinal studies,[78,79,89] and three endocrine studies.[27,61,90] The populations studied were heterogeneous, including patients who did not require hospitalization, those hospitalized for more severe illness, and those who required admission to the intensive care unit (ICU). Additionally, most studies evaluated patients one-six months after acute disease, with only two articles[19,25] having study periods of 12 months.

Definition of Post-Acute COVID-19 Syndrome

Although there are no established criteria for PACS, most publications agree on a basic premise: the persistence of mental and physical health consequences after initial infection.[95] However, the exact temporal course of long COVID currently is undetermined, and no single definition is universally employed. According to the Centers for Disease Control and Prevention, the criteria for PACS are met if symptoms persist for >four weeks.[1] Meanwhile, the National Institute for Health and Care Excellence requires a 12-week period to make the diagnosis.[96] At this time, studies that directly investigate the temporal course of PACS are missing. Moreover, while very sensitive, these definitions encompass a heterogeneous patient population of those recovered from asymptomatic or mild infection in addition to those who were severely ill.[1] Notably, long-term consequences of a critical illness, also known as "postintensive care syndrome" (PICS), are now being considered as part of PACS.[97] Given this ambiguity, subgroup analyses concentrating on severity of illness are needed, and as more data emerges, definitions are likely to evolve. For example, expanding PACS to include the subcategory of PICS for patients who required intensive care would add clarity to current terminology. Nevertheless, for the purpose of this article, the broad definition of PACS established by the Centers for Disease Control and Prevention is used, with a goal of making pragmatic suggestions regarding the perioperative clinical care of all patients with chronic sequelae of COVID-19.

Epidemiology

The reported prevalence of PACS among the collected reports ranged from roughly 20%[61] to 95%.[10] Fatigue and dyspnea were the most common symptoms, usually occurring in more than half of the studied population.[3-21,23-26,28-35,63,81-86,93,94] Other frequently reported complaints included smell and taste disturbances, cough, myalgias and arthralgias, sleep disturbances, anxiety, depression, post-traumatic stress disorder (PTSD), and cognitive impairment.[2] Lastly, limited numbers of individuals reported palpitations, hair loss, diarrhea, and rashes.[2]

The authors found four studies that evaluated long-term mortality.[19,31,85,86] An analysis of the US Veterans Affairs' data estimated mortality at six months to be about eight per 1,000 nonhospitalized persons, and 29 per 1,000 hospitalized persons.[85] Meanwhile, data from the UK's National Health Service found a significantly higher mortality rate among previously hospitalized patients—12.3% at an average follow-up period of 140 days.[86] This National Health Service data also showed a readmission rate of 29.4%, which was comparable to the 19.9% readmission rate at 60 days reported by a separate VA study.[31] Additional studies validating these findings are needed to risk-stratify these patients more accurately.

Several reports revealed potential risk factors for developing chronic disease.[7,98] Severity of acute illness is associated most strongly with long-term sequelae; thus, ICU survivors have the highest risk.[6] Other factors that were associated with long-term sequelae included higher body mass index, preexisting respiratory disease, older age, female sex, and Black/Asian/minority ethnicities.[33] Abnormal radiologic findings, reduced quality-of-life scores, and decreased pulmonary function on spirometry found on follow-up examination after acute disease also corresponded to an increased risk of developing PACS.[16] Anesthesiologists should be vigilant when caring for patients with these risk factors and consider further preoperative workup when encountering patients with symptoms consistent with PACS.

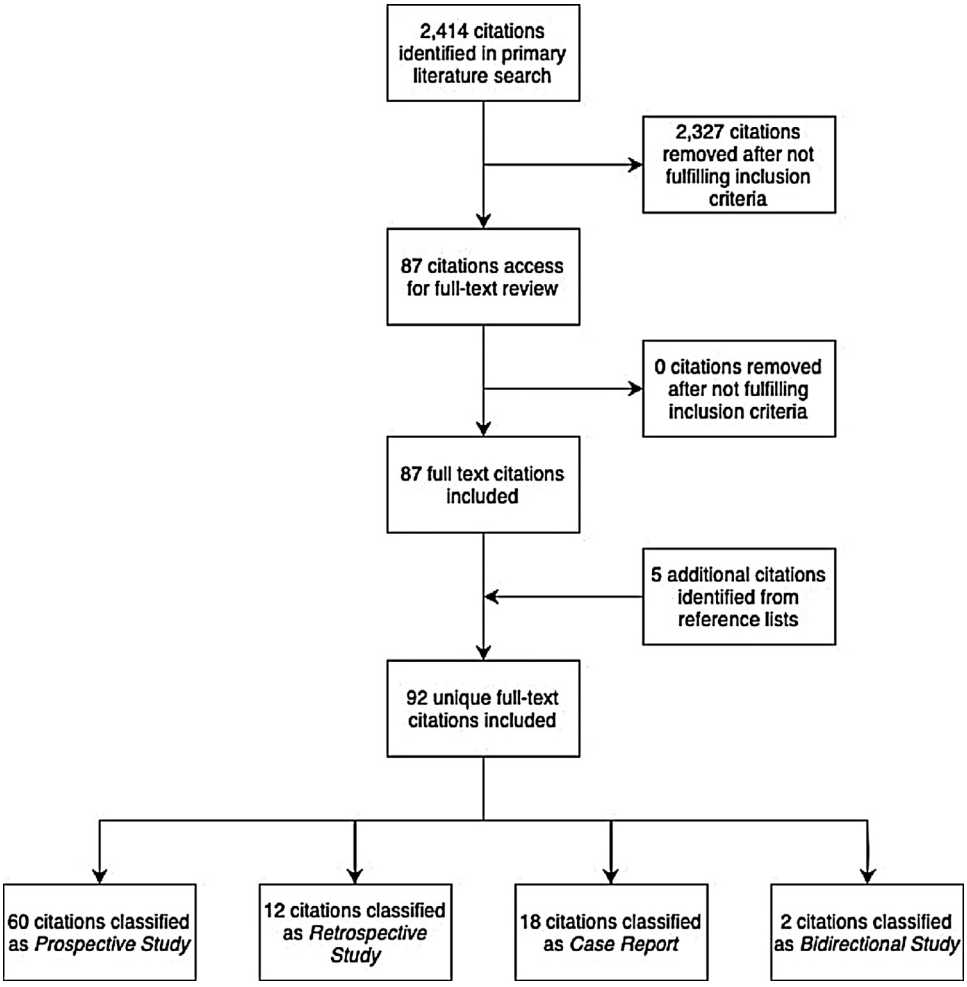

Fig 1. Study selection diagram.

Review of PACS and Its Perioperative Implications

Current reports suggest that COVID-19 long-haulers experience sequelae in multiple body systems, though the mechanisms of organ-specific dysfunction are unclear. Possible causes include virus-specific tissue damage,[99] dysregulated immune and inflammatory response to the initial insult,[100] and PICS.[101] Although not elucidated fully, these have significant consequences on anesthetic care.

Given the novelty and scientific uncertainty, the overall approach to perioperative management should be pragmatic, with strict adherence to previously established standards of care. Preoperatively, symptoms should not be minimized but addressed in a multidisciplinary fashion. Deferring evaluation to the day of surgery should be strongly discouraged, except for urgent or emergent situations. As such, institutions need to develop preoperative evaluation and risk-assessment protocols for patients who previously had COVID-19.[102] Until more specific scientific evidence emerges, care of COVID-19 long-haulers should be viewed through the prism of best practices already in use. Such practices are discussed below, categorizing them by organ systems. A summary of symptoms can be viewed in Figure 2, and this review's key recommendations in Figure 3.

Neuropsychiatric

Several neuropsychiatric sequelae of PACS that are relevant to anesthesiologists have been described in the emerging literature. These include cognitive dysfunction, anxiety, depression, PTSD, chronic pain, and complications of acute structural lesions. Dysfunction in reasoning, spatial planning, problem solving, and verbal fluency have been found to be the basis of what is commonly referred to as "brain fog."[103] Numerous reports of residual cognitive dysfunction have been published, estimating significant cognitive deficits in about one-third of recovered individuals who did not require hospitalization, and in as high as two-thirds of recovered individuals who required hospitalization for acute infection.[39-42,64] Although severity of initial disease was found to be a risk factor for cognitive problems, even patients with mild disease were more likely to develop cognitive deficits compared with matched controls.[39] Among other psychiatric sequelae of PACS, anxiety and depression were reported to occur in 12%-to- 47% of patients, with higher rates in individuals requiring hospitalization.[36] Symptoms consistent with PTSD also have been reported in roughly 10% of recovered patients, regardless of whether they were hospitalized or not.[37,38] Additionally, recent articles also commented on chronic pain experienced by

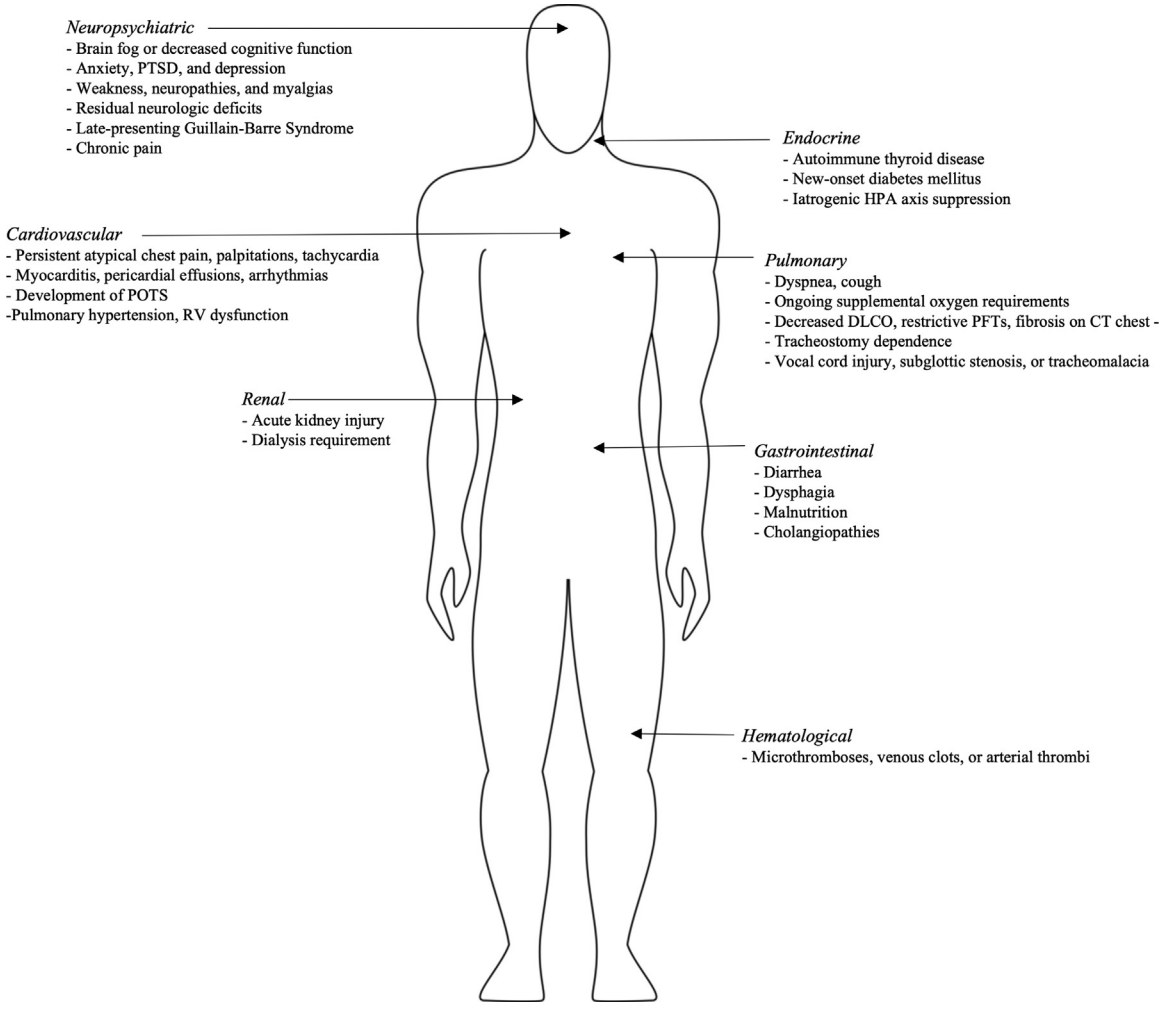

Fig 2. Summary of common PACS symptoms.

COVID-19 long-haulers.[6,20,44,92] Myalgias, arthralgias, and headaches are among the most common complaints with quality-of-life implications, and 1 study noting the associated use of pain medications (including non-opioids).[44] and quality-of-life implications of moderate-to-severe pain. Finally, many severely ill individuals suffered structural damage from ischemic or hemorrhagic strokes, anoxic brain injury, or seizures.[104-106] Other serious neurologic sequelae stemmed from immune-mediated reactions, such as acute disseminated myelitis, encephalitis, vestibular neuritis, and late-presenting Guillain-Barré Syndrome.[67-69] A follow-up study of patients developing neurologic manifestations during acute infection found that about nine in ten patients reported persisting deficits at six months, reflecting the pervasive and significant neurologic disability encountered in clinical practice.[39]

Neuropsychiatric sequelae of PACS have important implications on perioperative care. First, initial evaluation should consist of focused history and physical examination; noting baseline deficits, palsies, and asymmetries is especially important.[107,108] Patients with anxiety/depression should have their therapies continued and offered preoperative premedication.[109] However, due to an increased risk of postoperative delirium and cognitive dysfunction, benzodiazepine use is generally discouraged in individuals older than 65 and in patients experiencing cognitive dysfunction.[110] Additionally, although low doses of ketamine are being used now as a therapy for PTSD, long-haulers with PTSD may not benefit from its use for sedation due to the risk of traumatic hallucinations with anesthetic doses.[111] Moreover, the functionality of cerebral autoregulation is unknown, especially in individuals with anoxic brain injury, strokes, or dysautonomia, making cerebral perfusion pressure potentially more dependent on adequate blood pressure.[112] Until more data are available, maintaining mean arterial pressure close to baseline is encouraged. Furthermore, neuromuscular blocking strategies should take into consideration risk factors for hyperkalemic response in individuals with history of strokes, immobility, and denervated muscles.[113] Patients with critical illness neuropathy especially may benefit from quantitative monitoring of neuromuscular blockade depth, like acceleromyography, and reversal with sugammadex.[114] Finally, for patients experiencing chronic pain, multimodal analgesia is paramount, with specific concentration on neuropathic modalities in individuals suffering from critical-illness neuropathy.[115] Risk of opioid dependence in COVID-19 long-haulers has not been evaluated; however, individuals with PICS have been shown to be at increased risk

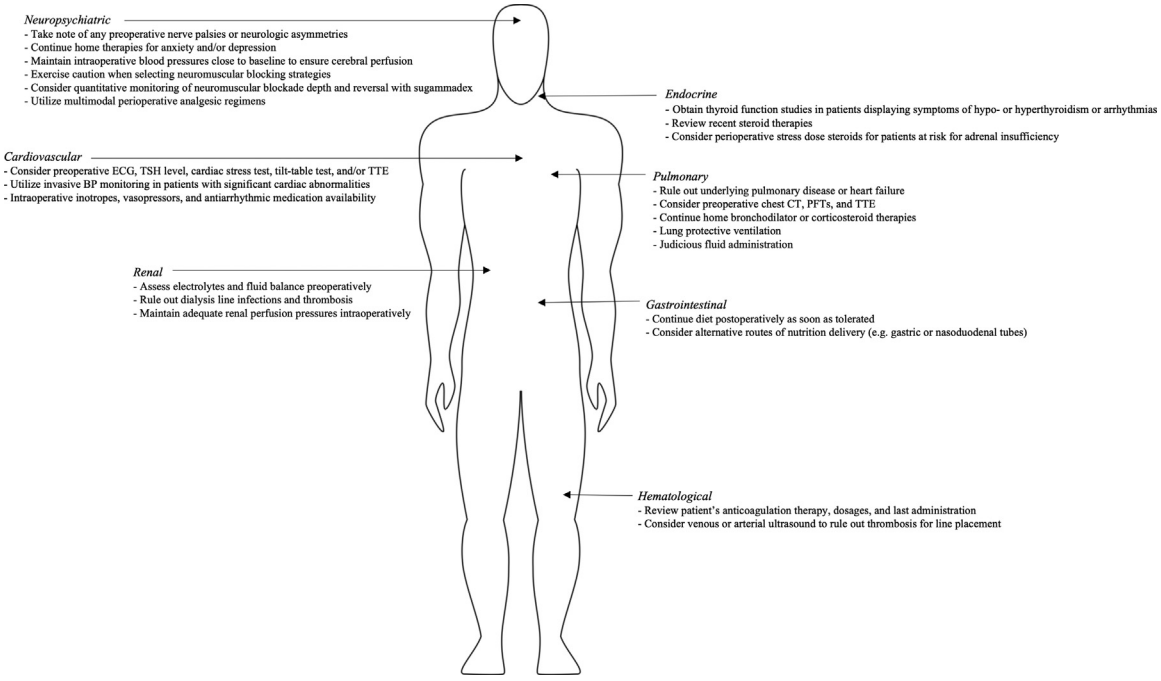

Fig 3. Summary of pragmatic perioperative recommendations. Abbreviations: PTSD, posttraumatic stress disorder; POTS, postural orthostatic tachycardia syndrome; RV, right ventricle; ECG, electrocardiogram; TSH, thyroid-stimulating hormone; TTE, transesophageal echocardiogram; CT, computed tomography; DLCO, diffusing capacity of carbon monoxide; PFTs, pulmonary function tests; HPA, hypothalamic-pituitary-adrenal.

and should be planned for accordingly.[116] For this reason, these patients may be good candidates for regional or neuraxial anesthesia; nevertheless, individuals suffering from acquired peripheral or inflammatory neuropathies, such as critical-illness neuropathy or Guillain-Barré Syndrome, require particular caution and discussion with their anesthesiologist. The limited safety data on regional or neuraxial techniques in patients with neuropathies currently are equivocal. As such, the American Society of Regional Anesthesia recommends careful discussion of risks and benefits on a case-by-case basis.[117]

Cardiovascular

Anesthesiologists especially should be aware of the substantial cardiovascular disease experienced by COVID-19 survivors. Chest pain and palpitations are the most common subjective findings.[2] Objectively, individuals recovering from acute infection have been found to be at risk for lasting vascular,[45,70] pericardial,[71] and myocardial inflammation.[46] In studies of COVID-19 survivors evaluated with cardiac magnetic resonance, ongoing cardiac inflammation was present in anywhere from 0%-to-60% of participants.[46-49] These findings suggest that long-term sequelae, such as arrhythmias and heart failure, are possible even in seemingly healthy patients. This was substantiated recently by evaluations of resting heart rates after acute illness.[50,51] In one of these studies, COVID-19-positive individuals experienced prolonged relative tachycardia that lasted on average 79 days after symptom onset; 13.7% of patients did not return to resting heart rate baseline until after 133 days.[50] Those previously hospitalized appear to be at risk for even more severe sequelae. For example, a 140-day follow-up study in the United Kingdom found the risk of heart failure, arrhythmias, myocardial infarction, and stroke to be three times that of matched controls.[72] Other complications have been reported as well. For instance, development of postural orthostatic tachycardia syndrome (POTS) and orthostatic intolerance without hemodynamic effects have been described in the literature.[73,74,87] Finally, right ventricular dysfunction in response to fibrotic lung damage, pulmonary hypertension, and/or clot burden in people recovering from severe disease also recently has been reported.[52-54] These studies consistently demonstrated an incidence of diastolic dysfunction of roughly 32%-to-55%, and an incidence of pulmonary hypertension of roughly 10%-to-35% after up to 12 weeks following acute disease.[52-54]

Given the significance of cardiac burden from COVID-19, perioperative cardiovascular challenges also should be anticipated. The most common symptoms of chest pain and palpitations could have a significant underlying cause. Given that myocardial damage, such as inflammation and fibrosis, have been found in these patients, palpitations can be a potential symptom of conduction abnormalities or ventricular dysfunction.[118] Chest pain, although likely atypical in nature and related to respiratory sequelae, should not be minimized and should be investigated with focused history and physical examination for heart failure, coronary artery disease, and arrhythmias; obtaining an electrocardiogram, thyroid-stimulating hormone level, and transthoracic echocardiogram may be prudent, especially when other worrisome symptoms are present.[119] Intraoperatively, patients with significant cardiac abnormalities require invasive monitoring and preparation of vasopressors, inotropes, and antiarrhythmic medications, depending on underlying pathology.[120] A constellation of palpitations, chest pain, fatigue, and postural dizziness may be

indicative of POTS.[121] Patients with these symptoms should be evaluated further, preferably with a tilt-table test, or by a specialist in an autonomic specialty clinic. Due to adrenergic receptor hypersensitivity, patients with POTS can exhibit labile hemodynamics intraoperatively due to overcorrections of blood pressure and heart rate in response to reductions in blood pressure. Volume administration and careful titration of phenylephrine have been suggested as therapies of choice for hypotension.[122] Lastly, right ventricular dysfunction should be of particular concern in individuals who had severe disease and continue to have respiratory dysfunction with other symptoms associated with heart failure.[123] Echocardiographic evaluation is prudent, and intraoperative availability of invasive monitoring and inotropic support are paramount.[124]

Pulmonary

Respiratory sequelae are the second most common ailments reported by COVID long-haulers, with shortness of breath and cough being the most frequent. Numerically, shortness of breath has been noted in 8%-to-98% of patients, and cough in 10%-to-75%, with lower prevalence in patients with mild initial disease.[2] Patients with severe dyspnea tended to exhibit abnormal performance on six-minute walk tests.[55] These complaints and functional limitations have their basis in underlying lung pathology.[56] Radiographically, multiple reports noted abnormal chest x-rays and computed tomography (CT) scans on three-sixmonth follow-ups, with ground-glass opacities and architectural distortion being the most common.[54,57,75,76] These findings on CT scan also are correlated with abnormal pulmonary function test results. Functional evaluation of lung disease commonly revealed reduced diffusion capacity for carbon monoxide (DLCO), with a range between 21% and 50% of patients.[57,58,88] Moreover, female sex and an ICU admission were found to be risk factors for DLCO <60% of predicted at four months.[58] Other notable spirometry findings included restrictive flow patterns and impaired alveolar volume on spirometry.[55,88] A study evaluating the incidence of interstitial lung disease after hospitalization found that 4.8% of patients developed interstitial lung disease,[59] with an organizing pneumonia-like pattern similar to that seen in patients of another case series.[77] Additionally, patients who required hospitalization for acute COVID-19 also experienced ongoing oxygen requirements, tracheostomy dependence, respiratory muscle weakness, fibrotic changes, and transplantation necessity.[58] Unlike the cardiac toll of COVID-19, the severity of acute disease appears to be the main risk factor for development of these pulmonary complications.[60]

The perioperative pulmonary sequelae of COVID-19 should be addressed. Although COVID-19 survivors are at increased risk of developing postoperative respiratory failure, this risk decreases substantially ≥seven weeks after recovery from acute infection.[125] Nevertheless, multidisciplinary preoperative optimization is of particular importance, as some patients will require a complete workup, including a CT scan of the chest, pulmonary function testing, or echocardiography.[126] On the day of surgery, patients previously hospitalized may be using inhaled bronchodilators and corticosteroids, both of which should be continued.[127] Intraoperatively, airway manipulation may be challenging in individuals previously tracheostomized, or intubated for extended periods.[128] Vocal cord injuries, subglottic stenosis, and tracheomalacia all have been described.[129-132] Depending on the severity of respiratory/airway sequelae and type of surgery, use of supraglottic airway devices should be considered and offered to individuals on case-by-cases basis. Furthermore, given reports of significant fibrosis and bullae, lung-protective ventilation is encouraged strongly, with tidal volumes 4-to-8 mL/kg of predicted body weight and driving pressures <15 cm H_2O.[133,134] Additionally, judicious use of intravenous fluids should be a priority to limit expansion of extravascular lung water.[135,136] Finally, given reports of diminished respiratory muscle strength; again, reversal of neuromuscular blockade with sugammadex should be considered.[137]

Hematologic

Intensivists quickly recognized thromboembolic disease as a frequent complication of acute COVID-19 disease. Microthrombosis, venous clots, and arterial thrombi frequently have been reported.[138] The pulmonary vasculature appears to be especially prone to microthrombi, and while pulmonary embolism (PE) has been reported, the rate of PE varies widely in the literature.[139] A meta-analysis of 102 studies stated a prevalence of deep vein thrombosis (DVT) and PE as roughly 15% and 8%, respectively, with higher rates in the critically ill population during acute infection.[140] Long-term effects also have been described in a case series of four previously healthy, young individuals who developed arterial thromboses.[80] However, the incidence of hematologic complications appeared to decrease with time after recovery. For example, at 30 days, the cumulative incidence of overall thrombosis and bleeding were only 2.5% and 3.7%, respectively.[91] Likewise, an analysis of 146 previously hospitalized patients in Belgium, many of whom were on thromboprophylaxis, only revealed a single incidence of symptomatic DVT and PE at six weeks, and none at six months.[62]

Many of those who survived severe disease may be on oral anticoagulation therapy when they present for elective surgery, and this will require perioperative planning.[141] Cessation of therapy should be addressed preoperatively to consider the risks and benefits; however, postoperatively, held medications promptly should be restarted.[142] For acute warfarin reversal, prothrombin complex concentrates can be considered if intravascular volume is of concern;[143] rivaroxaban and apixaban now can be reversed acutely with andexanet alpha;[144] and dabigatran can be reversed with idarucizumab.[145] For patients not on anticoagulation therapy, a preoperative D-dimer measurement and/or venous ultrasound for thrombosis should be considered.[103] A D-dimer only has clinical utility if there is low suspicion for inflammation or malignancy, so prudent patient selection is necessary.[146] If a deep-vein thrombosis is identified on ultrasound, anticoagulants such as heparin can be administered in addition to prophylactic compression

stockings.[146] As an additional consideration, ICU survivors may have thrombosed or injured arteries that were cannulated previously for monitoring, therefore intraoperative ultrasonographic examination before new instrumentation is advised.[147]

Renal

There is currently a scarcity of literature regarding the long-term consequences of PACS on kidney function; however, some inferences can be drawn from data following early recovery from COVID-19. Acute kidney disease was prevalent in hospitalized patients with acute COVID-19 infection, with 35% not recovering to their baseline renal function upon discharge.[148] Moreover, one study found a greater rate of decline in glomerular filtration rate per year among recovered COVID-19 patients compared with a non-COVID-19 cohort.[149] Electrolyte imbalances, volume status issues, dialysis line infections, and thrombosis all can be encountered and require attention.[2] Intraoperatively, mean arterial pressure should target values ≥65 mmHg to ensure adequate renal perfusion.[150]

Gastrointestinal

From a gastrointestinal standpoint, 5%-to-10% of patients developed diarrhea after resolution of acute disease.[5,93] However, newer data suggest that gastrointestinal sequelae may be more serious in some patients. For example, two case reports described four patients developing cholangiopathies in the months following acute disease infection, necessitating liver transplantation in one of these patients.[78,79] Even among the noncritically ill, malnutrition in hospitalized patients is also a serious concern. For example, a report from Italy described nearly 50% of patients in a rehabilitation unit as malnourished after acute disease and 90% as having some degree of dysphagia.[89] As such, patients recovering from severe acute disease who present for surgery may be malnourished, dysphagic, or in need of alternate mode of nutrition delivery, such as gastric or nasoduodenal tubes.[151] Care should be taken to continue feeding as close to surgery as possible, especially when postpyloric tubes are present.[152]

Endocrine

The effect of COVID-19 on endocrine systems has not been investigated thoroughly; however, case reports of new-onset Hashimoto's,[153] Graves' disease,[154] and diabetes mellitus[155] are emerging. A follow-up study of hospitalized patients noted a rate of new diabetes diagnosis of 29 per 1,000 on average at 140 days.[90] Additionally, two studies evaluated long-term thyroid function after acute disease.[27,61] Most patients who had abnormal thyroid function during acute hospitalization had normalized function on follow-up; however, 3%-to-5% developed antithyroid peroxidase antibodies, and <2 % developed subclinical thyrotoxicosis and hypothyroidism.[61] It also is crucial to consider the iatrogenic effects of dexamethasone therapy on the hypothalamic-pituitary-adrenal axis.[156] During the preoperative endocrinology workup, patients with symptoms worrisome for arrhythmias should have their thyroid function evaluated.[157] Also, recent steroid therapy should be investigated, and perioperative stress doses administered in patients at risk for functional adrenal insufficiency.[158]

Timing of Surgery and Type of Anesthesia

Although the data are limited on when it is safe to schedule an elective surgery after acute infection, patients recovering from COVID-19 are at increased risk of a 30-day adjusted mortality when undergoing elective or emergent surgery.[125] The latest international, multicenter, prospective cohort study found that risk of mortality returned to baseline ≥seven weeks after recovery from COVID-19 infection; however, patients with persisting symptoms continued to have increased mortality even after seven weeks.[125] Patients at highest risk were those undergoing emergency surgery and those with an American Society of Anesthesiologists physical status of III-to-V presenting for surgery within six weeks of initial illness. In concert with these findings, the ASA and the Anesthesia Patient Safety Foundation recommend at least a 12-week delay before undergoing elective surgery for patients who experienced a critical illness, ten weeks for patients with diabetes/hospitalized patients/immunocompromised patients, six weeks for symptomatic patients not requiring hospitalization, and four weeks for asymptomatic individuals or those with mild, nonrespiratory symptoms.[159] Nevertheless, the decision of when to proceed with a surgery must be reached by discussing the increased perioperative hazards with the potential health risks of delaying the procedure. Currently, no data exist regarding differences in outcomes between monitored anesthesia care versus general or neuraxial anesthesia in the COVID-19 long-hauler population. Therefore, until further analysis emerges, practitioners should exercise clinical prudence when devising an anesthetic plan for these patients.

Conclusion

Studies on PACS are just beginning to materialize. With time, bedside practitioners will possess more data in their armamentarium to make evidence-based decisions. Currently, it is of paramount importance to approach COVID-19 long-haulers in a multidisciplinary fashion. Symptoms should not be minimized, as life-threatening entities like pulmonary artery hypertension, severe lung fibrosis, and ventricular failure may be present. In the perioperative setting, practitioners should exemplify a pragmatic approach and use best practices from similar disease states to guide perioperative care.

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Conflict of Interest

None of the authors has any conflicts of interest to report.

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