COVID-19 and Acute Kidney Injury: Point-of-care Ultrasound in the Assessment of Volume Status

To the Editor,
A high incidence of acute kidney injury (AKI) has been reported in the novel coronavirus disease (COVID-19). Patients with ongoing maintenance hemodialysis (MHD) as well as those with AKI may require dialysis in COVID-19 units. Along with hypoxemia, the pathology of COVID-19 includes a hypercoagulable state with intravascular micro emboli and frequent pulmonary embolism. Most practitioners had advocated a fluid-sparse management regimen because of concerns associated with worsening hypoxemia in these patients, echoing the interim recommendations of the World Health Organization. However, in our experience, most patients with COVID-19 admitted to our unit presented with features of intravascular dehydration.

Point-of-care echocardiography and lung ultrasound in the initial 10 patients admitted to our intensive care unit revealed predominantly normal biventricular function along with low inferior vena cava diameter and high inferior vena cava collapsibility (cIVC) in most, indicating intravascular volume depletion [Figure 1]. Most patients had the presence of B-lines on lung ultrasonography [Table 1]. This indicates that the pulmonary pathology is not correlated with fluid overload as already hypothesized.

Interestingly, three of these ten patients had stage five chronic kidney disease (CKD) and were on regular hemodialysis, which was interrupted because of the lockdown, for periods of 15, 8, and 12 days, respectively. They had presented with dyspnea and altered sensorium and were diagnosed with COVID-19. Concerns of CKD as well as COVID-19 led to conservative fluid management. However, two of these patients had highly collapsible inferior vena cava, which indicated intravascular volume depletion. Both these patients required fluid boluses to maintain hemodynamic stability during dialysis.

The role of fluid-sparse management along with fever and inadequate prehospital resuscitation leading to prerenal AKI in COVID-19 has already been hypothesized. Initial investigations also have found higher urine-specific gravity and urine sodium levels, possibly hinting a prerenal etiology. In the context of hypercoagulability, intravascular volume depletion may increase micro embolism and prerenal AKI. Hypovolemia may also cause precipitation of acute-on-chronic kidney disease in CKD patients.

Hence, we suggest that fluid therapy in COVID-19 should be individualized. It should be guided by objective parameters like point-of-care echocardiography along with the assessment of weight trends in CKD patients. Fluid resuscitation should not be held back in hypovolemic patients, and fluid restriction as per various guidelines about CKD or acute respiratory distress syndrome (ARDS) should only be instituted once the patient is fluid replete. An analysis of the patterns of fluid management in presenting patients along with larger prospective studies of volume status in COVID-19 may elucidate the pathophysiology more.

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Conflicts of interest
There are no conflicts of interest.

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Table 1: Demographics, presenting characteristics and echocardiographic features, in the patients (n=10)

| Parameter | Values | Range |
|-----------|--------|-------|
| Age (years), median (IQR) | 50 (42.3-58) | 30-67 |
| Gender (male), n (%) | 6 (60%) | |
| Comorbidities, n (%) | | |
| Hypertension | 8 (80%) | |
| DM | 4 (40%) | |
| CKD | 3 (30%) | |
| Morbid obesity | 1 (10%) | |
| Presenting symptoms, n (%) | | |
| Fever | 6 (60%) | |
| Shortness of breath | 7 (70%) | |
| Cough | 7 (70%) | |
| Asymptomatic | 3 (30%) | |
| Echocardiographic findings | | |
| LVEF (%), median (IQR) | 50 (40-55) | 35-60 |
| Presence of diastolic dysfunction, n (%) | 5 (50%) | |
| TAPSE (mm), median (IQR) | 25 (22-27) | 18-28 |
| PAAT (msec), median (IQR) | 110 (100-131) | 70-135 |
| Inferior vena cava diameter (mm), median (IQR) | 11 (7-14) | 3-22 |
| cIVC, median (IQR) | 75 (30-85) | 9-100 |
| Presence of B-lines in more than four zones on lung USG, n (%) | 9 (90%) | |

IQR = Interquartile range, DM = Diabetes mellitus, CKD = Chronic kidney disease, LVEF = Left ventricular ejection fraction, TAPSE = Tricuspid annular plane systolic excursion, PAAT = Pulmonary artery acceleration time, cIVC = Inferior vena cava collapsibility, USG = Ultrasonography

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