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REVIEW ARTICLE

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Review of the present features and the infection control challenges of COVID-19 pandemic in dialysis facilities

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Abstract

The COVID-19 has swept the world causing suffering, death, loss, and massive economy damage. The dialysis population is vulnerable and the dialysis facility is critical in maintaining operations and avoiding disease transmission. The present information regarding the clinical features of COVID-19 infection in the dialysis population was collected, and the useful measures of COVID-19 infection prevention and infection control in the dialysis facilities were summarized. Leadership, education, preparedness, management, and recovery phase were determined to be the critical procedures. It is hoped this updated interim review might provide information for medical professionals to take proactive action to best prepare and mitigate damage when facing the COVID-19 pandemic challenge.

KEYWORDS

COVID-19, hemodialysis, infection control

1 | INTRODUCTION

The world is now in the middle of the COVID-19 pandemic. Since a cluster of severe pneumonia cases was first noted in Wuhan, Hubei province, China in December 2019, this novel infection has spread rapidly and lethally and was declared pandemic by the World Health Organization on 11 March 2020. Principles of infection prevention and infection control are universal; however, critical measures and challenges vary at different medical settings and in different disease populations. Patients with regular dialysis treatment are usually older in age, have multiple comorbid diseases, and are relatively immune-compromised. Triweekly visits, lengthy duration of each treatment, proximity to medical staff, and shared space with a group of people together risk the dialysis facilities becoming a vector in COVID-19 transmission.[1,2]

Today, on 28 April 2020, there were 3 004 956 COVID-19-infected cases globally, causing 205 901 deaths, and affecting 184 countries. Taiwan has 429 COVID-19 confirmed cases with clinical presentation including 298 (69.6%) cases of mild disease, 95 (22.2%) cases of pneumonia, 35 (8.2%) cases of acute respiratory distress syndrome, and six deaths (1.4%).[3] The first mortality case in Taiwan was a case of end-stage renal disease (ESRD) with peritoneal dialysis. The first two mortality cases in the United States were ESRD cases under regular hemodialysis (HD).[4] A recent article and news also suggested increasing dialysis indication in severe COVID-19 patients.[4–6] At this moment, physicians and scientists continue fighting at the front lines, swiftly collecting data, studying, and constantly learning about this novel contagious disease. Accordingly, this interim summary is not a comprehensive review but aims to update present clinical information and

infection control strategies currently focusing on COVID-19 control in dialysis facilities.

2 | THE PRESENT FEATURES OF COVID-19 INFECTION IN THE DIALYSIS POPULATION

At the beginning of the COVID-19 outbreak in China, one case series from a dialysis facility in Wuhan recorded the occurrence of 37 cases in 230 HD patients (16.1%) and four cases in 33 staff members (12.1%) during the 33-day period of time.[7] Most of the cases had mild to no obvious symptoms (27/37, 72%), while bilateral multiple ground-glass opacity was prevalent in chest-computed tomography (CT) (23/37, 62%); however, one COVID-19-negative and six COVID-19-positive cases died during this period. The immune profile showed lower inflammatory cytokines of the HD COVID-19 case in comparison with non-HD cases.[7]

Another case series from a different hospital in Wuhan, China reported five COVID-19-positive cases in a cohort of 201 HD patients. The overall outcome of these five cases was favorable with no death or intubation while all cases had ground-glass opacity at the chest CT examination. Another remarkable point was that four of the five cases had symptoms of diarrhea.[8] This symptom was in-line with one reported case of ESRD with regular HD in the United States presenting with gastroenteritis symptoms and later developing severe pulmonary involvement.[9]

Till mid-April, most of the other published articles have not focused on dialysis populations, and only some related information can therefore be highlighted. In the first case series reported in the United States, in the presentation and outcome of 21 critically ill patients, the majority was linked to exposure at a skilled nursing facility. Fifteen of the 21 cases (71%) needed mechanical ventilation, 11 deaths occurred (52.4%), and eight cases (38.1%) remained critically ill with ventilator support at the time of reporting. Among the patients, two (9.5%) cases had baseline ESRD and four cases developed acute kidney injury (AKI) (19.2%).[10] Moreover, seven cases (33.3%) showed cardiomyopathy and one case developed seizure. Whether these acute multiple organ injuries reflected a direct organ complication induced by the virus or resulted from overwhelming critical illness remains to be determined.[10]

One large, retrospective case series of 1591 COVID-19-positive cases who were admitted to the intensive care unit (ICU) in the Lombardy Region of Italy showed similar presentation and patient outcomes.[11] In total, 1300 of the 1591 cases needed respiratory support, and among these, 1150 (88%) needed invasive mechanical ventilation, and five cases needed extracorporeal membrane oxygenation (ECMO) support, with 405 (26%) dying in the ICU and 920 (58%) still in ICU care at the time of report. The most common comorbidity was hypertension (509, 49%) and the second was cardiovascular disease (223, 21%). Thirty-six cases (3%) were identified as having chronic kidney disease (CKD).[11]

An early case series of critically ill COVID-19 patients of the Seattle region included 24 cases from nine hospitals.[12] Sixteen cases (67%) came from home and six (25%) cases were from skilled nursing homes, with a mean age of 64 years; five cases (21%) had history of CKD, but there were no ESRD cases; 18 cases needed invasive mechanical ventilation (75%), no case needed ECMO; and 12 cases (50%) died in the hospital.[12]

On the other hand, reports from China showed more diverse information. One large case series including 1099 cases from China had the median age of 47 years, where 261 cases (23.7%) had coexisting disease including 81 (7.4%) with diabetes mellitus, 165 (15%) with hypertension, and only eight cases (0.7%) had CKD. Six cases (0.5%) developed AKI during the course. Twenty-five (2.3%) cases needed invasive mechanical ventilation, five cases (0.5%) needed ECMO, and 15 deaths (1.4%) occurred.[13] In another 191 adult inpatient with COVID-19 infection case series from Wuhan, China had a mean age of 56 years. Two of the 191 cases (1%) had CKD, and during the treatment course, 32 cases (17%) needed invasive mechanical ventilation, three cases needed ECMO (2%), and 10 cases (5%) needed renal replacement therapy. Acute cardiac injury occurred in 33 cases (17%), and AKI occurred in 28 cases (15%).[14]

From the above literature review, we could only tell that the appearance and level of COVID-19-infected HD patients is not uncommon. High mortality around 25% to 50% was observed in severe COVID-19 cases. However, it is still too early to obtain an accurate incidence or a detailed clinical course of COVID-19-infected HD patients. More complete and comprehensive studies focusing on COVID-19-infected HD cases are required for better understanding and caring for this vulnerable population.

3 | THE PRINCIPLES AND THE CRITICAL MEASURES FOR COVID-19 INFECTION CONTROL IN DIALYSIS FACILITIES

In the era of this pandemic, all dialysis facilities should be well prepared for providing dialysis to COVID-19-positive patients and to keep other patients and staff members healthy. Measures for infection prevention and control are based on science with the highest standards of care. Most importantly, when coming to dialysis, patient safety and health should be assured for all outpatients.[1,15–17] Here, we summarize measures of COVID-19 infection control in dialysis facilities from present guidelines of different professional bodies (Table 1).[1,15–20]

3.1 | Leadership

Leadership is critical. Singular effort is required in communication with local health authorities and health departments as is coordination between departments and multiple disciplines to form a reactive working procedure. Assurance, transparency, communication, support for patients, dialysis, and medical staff are the important components of successful leadership.[17,20]

TABLE 1 Important measures of COVID-19 infection control in dialysis facilities

Leadership
Coordination
Communication
Assurance, transparency, and support
Education
Transmitted route: handwashing, respiratory hygiene, and coughing etiquette
Regional epidemic status
Clinical presentation
Adequate usage of personal protective equipment
Preparedness
Triaging strategy: waiting area with signs and hand sanitizers, appropriate space with at least 6 ft in between
Traffic control bundle and checkpoint hands hygiene: design the patient zone, intermediate zone, clean zone, and control the patients flow
Divided work group and fixed caring team
Full-time facemask usage: expand the inventory of PPE
Management
Screening and triage: travel, occupation, contact, and cluster
Patient allocation and PPE
No infection, no TOCC risk: regular dialysis at the clean zone; dialysis standard percussion, full-time mask for all
No infection, with TOCC risk: exposure history, infectious status to be determined: the intermediate zone; high level PPE
COVID-19 confirmed case: isolation in the patient zone; alternatively, cohorting care in a confined section; highest level PPE
Environment disinfect
Good indoor air ventilation
Surface cleaning and disinfection
Terminal station disinfection
Recovery phase
Step-down plan: step-by-step
New normal life: source control with masking, keep social distance, stringent environment disinfect, hands hygiene
Promising therapies
Herd immunity

Abbreviations: PPE, personal protective equipment; TOCC, travel, occupation, contact, and clustering.

3.2 | Education

Professor Ikizler has emphasized the importance of patient and health care worker education.[1] As the knowledge and evidence about COVID-19 is rapidly evolving and updating, this education should be on an ongoing basis. Knowledge concerning the transmission routes and characteristics of this RNA virus could enhance the compliance of people in infection prevention measures. Handwashing, respiratory hygiene, coughing etiquette, and adequate usage of personal protective equipment (PPE) are the key components.[1] Information about the regional epidemic status and the identified clinical presentation of COVID-19 might also increase alertness.

3.3 | Preparedness

Professor Ikizler has also highlighted the importance of preparedness for the surge of patients focusing on waiting areas with signs and hand sanitizers, appropriate spacing with at least 6 ft in between individuals, and a triage plan.[1] In Taiwan, we follow the government's policies and the guidelines of the Taiwan Centers for Disease Control and Prevention (CDC). The Taiwan Society of Nephrology (TSN) has issued the "guidance of COVID-19 infection prevention in dialysis facilities" and published an article adding import proactive measures, including detail of the screening and triage strategy, traffic control bundle and checkpoint hands hygiene, a preplan divided work group and fixed caring team, and a full-time facemask usage policy.[18,21]

The traffic control bundle includes designating the patient zone, the intermediate zone, and the clean zone to control the patient flow and to prevent nosocomial transmission, while a planned divided working group and a fixed caring team decrease staff-patient exposure.[22] This fixed, cohort-actualized caring mode could minimize the infection risk in situations of high community transmission.[21] Taking proactive action to design the patient allocation, controlling the patient flow, establishing a fixed caring team, and expanding the inventory of PPE are crucial components of preparedness during this pandemic era.

3.4 | Management

3.4.1 | Screening and triage

Professor Ikizler has also suggested advising patients to call ahead and report any fever or respiratory symptoms.[1] In general, early recognition of symptomatic patient signs including fever, cough, upper airway involvement, or conjunctivitis and avoiding entrance to the waiting and treatment area is suggested.[16] In Taiwan, all clinics and hospitals perform at-the-gate body temperature measurement and infectious risk assessment recording any recent travel, occupation, contact, and clustering (TOCC) history.[15,18] The TOCC at present concerns every traveler from abroad who must abide by home quarantine for 14 days, health-care workers and staff related to transportation or travel business, those ever attending large-scale public or private activities, and recent health problems simultaneously occurring in family members, friends, or coworkers, while also considering any alerting symptoms including fever, respiratory symptoms, newly noticed loss of taste and smell, and diarrhea. Any symptomatic patient will be triaged and examined for COVID-19 at a separate area.[23]

3.4.2 | Patient allocation and PPE

We allocate patients according to their COVID-19 infection status and the risk status.[15–17,21]

Symptom-free, TOCC free

Patients with no symptoms and no exposure history or cluster history receive regular dialysis at the clean zone. Caring medical staff comply with dialysis standard precautions, while the patient and health-care workers wear facemasks in the treatment area.[19] In the updated CDC guidelines, to address asymptomatic and presymptomatic transmission, implementation of source control for everyone entering the health facilities is suggested.[19]

Symptom-free, with TOCC risk

Patients having history of exposure are closely monitored for their health condition for 14 days after exposure. They may dialyze in the transition zone and the caring team is equipped with higher-level PPE, including shields or goggles for eye protection, N95 masks, waterproof isolation gowns, hair caps, and gloves.[16,17,21]

The confirmed case

Patients are allocated to the patient zone, ideally, the negative pressure isolation room. If the medical capacity is exceeded, the COVID-19-infected patient with mild to moderate symptoms may dialyze in the outpatient area. Stringent compliance to the designated area, time, patient flow, checkpoint hygiene, and a fixed caring staff or necessary cohort mode (more than one patient) should be carried out. The caring team is equipped with the highest level of PPE including barrel suits if available.[17,18,21]

3.4.3 | Environment disinfection

The air conditioner should be operated full-time to maintain good indoor ventilation, while stringent cleaning and disinfecting of surfaces of the environment and equipment are mandatory as is the terminal station. The cleaning worker should be equipped with adequate PPE.[17,23]

3.5 | Recovery phase

Before the herd immunity and promising therapies available in the longer future, we may plan for a step-down strategy step-by-step. Source control with adequate masking, keeping social distance, cleaning, and disinfecting surfaces of the regular environment, and hand hygiene could become a normal part of life.

4 | THE CHALLENGES AND THE CHANCES

The early report from China showed that COVID-19 was not associated with AKI or had relatively low incidence around 3% to 9% of AKI.[24,25] Updated and accumulated data have now shown the incidence of AKI is higher, up to 15% of the severe COVID-19 cases and is associated with high mortality.[26] The increased medical need for renal replacement therapy, hypercoagulation status, easy clotted filters, and the mandatory infection control setting are challenges for the medical system.[4,6] Furthermore, 34% to 65% of COVID-19-infected cases show occurring albuminuria and proteinuria.[15] Whether the renal injury and the hypercoagulation status are related to the cytokine storm or a direct cytopathic effect will need further investigation.[4,27–29]

On the bright side, the intervention study of 53 severe COVID-19 hospitalized cases treated with compassionate use of remdesivir showed promising results.[30] The baseline oxygen saturation was 94% or less, 30 (57%) cases were under mechanical ventilation, and four (8%) cases needed ECMO. In a median follow-up of 18 days, 36 of 53 patients (68%) showed clinical improvement in the oxygen-support class; 17 of the 30 (57%) intubated cases were weaned from the ventilator; 25 (47%) cases were discharged from hospital; and seven patients (13%) expired.[30] In addition, remdesivir showed efficacy against severe acute respiratory syndrome (SARS)-CoV in a mouse model. Remdesivir also had prophylactic and therapeutic effects in a nonhuman primate model of Middle East respiratory syndrome (MERS)-CoV infection.[31,32] Sulfobutylether β-cyclodextrin sodium, an inactive ingredient of remdesivir, is renally cleared.[33] The inclusion criteria of the present remdesivir study required a creatinine clearance above 30 mL per minute, while the mean creatinine in the study was 0.89 mg/dL.[30] Ergo, the renal disease population will need further evidence and clinical trials in treating COVID-19-infected cases.

5 | CONCLUSIONS

Today on 28 April 2020, 184 countries have been infected by COVID-19 and many countries and areas are in lockdown or in a shelter-in-place situation. Taiwan is doing well so far through attribution to effective and transparent leadership, proactive border control, and timely case identification and setting strategies and risk level of quarantine.[34] Updated information is important at this critical time for the world to battle the infection. Before more solid evidence and validation is available, this study is an interim brief based on the current accumulated information.

COVID-19 infecting dialysis patients are not uncommon and might be associated with poor prognosis. The dialysis facilities as an interface of hospital and community could be a center of vortex in infection transmission. Nephrologists should take proactive actions and work hard for COVID-19 infection prevention and infection control through the prevention, containment, mitigation, and recovery stages (Table 1).

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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