

Hemodialysis vascular access care during the COVID-19 pandemic

Chih-Yu Yang^{a,b,c,d,e}, Yi-Fang Wang^b, Yang Ho^b, Cheng-Hsueh Wu^{c,f}, Chiu-Yang Lee^{c,g}, Der-Cherng Tarn^{a,b,c,e,h,*}

^aInstitute of Clinical Medicine, School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC; ^bDivision of Nephrology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; ^cFaculty of Medicine, School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC; ^dStem Cell Research Center, National Yang-Ming University, Taipei, Taiwan, ROC; ^eCenter for Intelligent Drug Systems and Smart Bio-devices (IDS²B), Taiwan, ROC; ^fDivision of Cardiology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; ^gPeripheral Vascular Treatment and Research Center and Division of Cardiovascular Surgery, Department of Surgery, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; ^hDepartment and Institute of Physiology, School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC

Abstract: Dialysis patients are more vulnerable and susceptible to the severe coronavirus disease 2019 (COVID-19) infection due to multiple comorbidities. Since Taiwan has the highest incidence and prevalence of treated end-stage kidney disease worldwide, it is crucial to act in advance to prevent a potential disaster. In the face of the COVID-19 pandemic, we implement proactive infection control measures to prevent it from spreading without sacrificing the dialysis care quality. In this article, we focused on hemodialysis vascular access (HVA) care in particular. As a life-line of hemodialysis (HD) patients, HVA care has a profound impact on the patient's quality of dialysis and life. Specifically, in our facility, the working and office areas of the HD units are separated to reduce cross-infection. All elective procedures for HVA are postponed, and operating rooms equipped with a negative-pressure anteroom are used for the suspected or confirmed COVID-19 patients. Herein, we share how we modified our HVA care policy not only to prevent our patients from COVID-19 infection but also to maintain the quality of HVA care.

Keywords: COVID-19; Hemodialysis vascular access; Infection control; Severe acute respiratory syndrome coronavirus 2

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) struck China first in late 2019 and then spread worldwide in an enormous way in early 2020. Taiwan, being geographically 80 miles nearby China, was predicted to have the second-highest number of cases worldwide.¹ On the contrary, this prediction did not become a reality, and Taiwan earned recognition as a successful example against this crisis.² The low COVID-19 rate in Taiwan has partly attributed to the government's immigration and screening policies, spontaneous mask-wearing by the general public (either cloth or surgical masks), and the proactive infection control measures implemented at the hospital level.

Many COVID-19-infected patients were detected at the airport in Taiwan; however, there are still some civilians who got infected with an unidentified infection source.³ Taiwan has the highest incidence and prevalence of treated end-stage kidney disease worldwide.⁴ Since dialysis patients are more vulnerable and susceptible to severe COVID-19 infection due to old age

and multiple comorbidities,⁵ we, therefore, have to implement proactive infection control measures to prevent a potential disaster.⁶ As a life-line of hemodialysis (HD) patients, hemodialysis vascular access (HVA) care has a profound impact on the patient's dialysis and quality of life. Our HVA Care Unit belongs to the HD center in Taipei Veterans General Hospital, which is a national tertiary-care referral hospital with 2,947 beds in total, including 187 intensive care unit beds, 90 HD beds, 82 regular isolation beds, and 16 negative-pressure isolation rooms.⁷ As a nation-run hospital, we are responsible for taking care of suspected and confirmed patients of COVID-19 in the special ward.

Our facility provides multidisciplinary and interdepartmental HVA care for HD patients, with 6,965 HD sessions per month. Our HVA care team comprises 10 nephrology physicians, three vascular interventionists, two vascular surgeons, three case managers, and one medical radiological technician. HVA services that we provide include routine HVA care, active and overall surveillance of intradialytic access flow quarterly for every patient using a Transonic HD03 monitor (Transonic, Ithaca, NY, USA); Doppler ultrasound of HVA for patients with abnormal access flow; angiographic examination and percutaneous intervention for HVA complications; and surgical intervention for HVA build-up and complication management. In this article, we share our experiences in the infection control measures implemented in our daily care for HVA.

2. GENERAL INFECTION CONTROL MEASURES

The entrance and exit numbers of our hospital are reduced for effective access control. For each building, only one entrance and one exit are open, and the rest are closed. Before entering

*Address correspondence. Dr. Der-Cherng Tarn, Division of Nephrology, Department of Medicine, Taipei Veterans General Hospital, 201, Section 2, Shi-Pai Road, Taipei 112, Taiwan, ROC. E-mail address: dcartarn@vghtpe.gov.tw (D.-C. Tarn).

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the building, wearing a mask is obligatory for every employee and visitor to reduce respiratory droplet transmission. Every open entrance was installed a thermal camera scanner with the automatic alarm function (Table 1). After temperature checks, the people flow separates into an express lane for hospital staffs with ID and an access control lane for visitors. For the access control lane, there is visitor number limit (i.e., one companion maximum for one outpatient; one visitor maximum for one inpatient), and documentation of the Travel/Occupation/Contact/Clustering (TOCC) history at the register counter is mandatory for every visitor.⁸ Besides, another measure to limit the people flow is to restrict the inpatient visiting hours, which is limited to 6:00 to 7:00 p.m. unless the inpatient encounters a medical emergency.

As shown in the Figure, the TOCC history declaration for COVID-19 is registered for every visitor at the hospital entrance, and the questionnaire is as follows: (1) Have you traveled abroad in the last 14 days? (2) Have you had a fever, respiratory symptoms such as cough, runny nose, sore throat, breathing asthma/dyspnea, and so on in the last 14 days? (3) What is your occupation? (4) Have you contacted and entered the following places in the past 14 days? (5) Your group history in the past month. When the visitor finishes the registry, a certificate sticker (valid for 1 day) is placed on the visitor's ID card for recognition.

For patients/visitors who were screened positive, a special team wearing full personal protective equipment will transfer him/her to a specific zone where SARS-CoV2 will be tested. Confirmed and suspected cases will be quarantined at a COVID-19 special ward. Given the fact that an estimated 25% of patients infected with SARS-CoV2 are asymptomatic and can still transmit the virus,⁹⁻¹¹ our facility requests patients/visitors to wear the mask at all times, a measure that may effectively reduce respiratory droplet transmission.^{12,13} However, most countries have a shortage of surgical masks. Although randomized controlled trial evidence is lacking, some data suggest that in terms of blocking droplet transmission, cloth masks may be only marginally (15%) less effective than surgical masks and fivefold more effective than not wearing masks.¹⁴ Therefore, face mask-wearing by the general public (either cloth or surgical masks) could have a substantial impact on transmission with a relatively small impact on social and economic life.¹⁵⁻¹⁷ Herein, we would like to emphasize that the cloth mask is simple yet potentially effective in blocking the emission of particles.

Table 1
Patient and companion flow before HDU arrival

Site	Infection control measure
Hospital entrance	Obligatory mask-wearing at all times in all in-hospital areas (no mask no entry)
	Thermal camera scanner with the automated alarm function
	Express lane for hospital staffs with ID
	Visitor number limit (one companion maximum for one outpatient; one visitor maximum for one inpatient)
	Inpatient visiting hours restriction (6:00-7:00 p.m. unless the inpatient encounters a medical emergency)
	TOCC history declaration for every visitor at the register counter
HDU entrance	Place a certificate sticker (valid for 1 day) on the visitor' ID card
	Thermal camera scanner with the automated alarm function
	ID registry for every visitor
	Body temperature measurement and record for every visitor
	People flow restriction (only open at the beginning/end of HD)
	Prohibition of food and drink in all HDU areas
Every HD patient is provided with two surgical masks per HD session by the government	

HD = hemodialysis; HDU = hemodialysis unit; TOCC= Travel/Occupation/Contact/Clustering.

3. INFECTION CONTROL MEASURES FOR HEMODIALYSIS UNIT AREAS

Our dialysis facility comprises of an office area, an outpatient hemodialysis unit (HDU) area, and an inpatient HDU area. Each area of the dialysis facility is connected through doors, which are temporarily closed to avoid cross-infection. These three major zones are separated, and checkpoints are set at each entrance. At each HDU checkpoint, we installed a thermal camera scanner, which alarms if the body temperature is higher than normal. Besides, our staffs take shifts to stay at each HDU checkpoint to record the body temperature for each visitor using a forehead thermometer. Because the ear thermometer is time-consuming for the probe cover replacement, we use an infrared forehead thermometer instead, but the fever threshold is 0.5°C lower (fever criteria: $\geq 37.5^{\circ}\text{C}$ for a forehead thermometer; $\geq 38.0^{\circ}\text{C}$ for an ear thermometer). Meanwhile, the ID registry for patients and their companions (one companion maximum for one patient) is mandatory at every checkpoint. On the other hand, in the office area checkpoint, the body temperature is measured and recorded by the staff themselves on a daily basis.

As the COVID-19 pandemic is a devastating threat to dialysis patients, we made every effort to prevent our patients from getting infected. Food and drink are prohibited in all HDU areas to reduce droplet transmission. We would like to emphasize that the purpose of obligatory mask-wearing at all times is to reduce respiratory droplet transmission.^{12,13} Taiwan government boosts the production of surgical masks since January 2020 and disperses two surgical masks per HD session to every HD patient.¹⁸ Meanwhile, because contact transmission can be effectively prevented by hand washing,¹⁹ chlorhexidine (0.5%) dispensers are available at all checkpoints, all doors (both sides), all rooms, and all beds throughout the hospital for consistent hand hygiene. All hospital staff, patients, and visitors are encouraged to use chlorhexidine dispensers. In addition, chairs in the public area are marked to be seated separately for social distancing. With the measures conducted above, we continue the quarterly intradialytic access flow monitoring and the Doppler ultrasound of HVA to ensure that every HD patient is under the proper surveillance of HVA health.

4. INFECTION CONTROL MEASURES FOR ANGIOGRAPHIC AND OPERATING ROOMS

As listed in Table 2, we postpone all elective angiography and surgery for HVA, as guidelines suggested.²⁰⁻²² For urgent angiography or surgery for HVA, the aforementioned general infection control measures have complied. However, when there is a suspected or confirmed COVID-19 patient who requires an immediate angiography or surgery for his/her HVA complication, an operating room with a negative-pressure anteroom is used. When the postoperative care and observation are needed, the patient is transferred to a negative-pressure recovery room after the surgery. Because the angiographic rooms in our hospital are not equipped with a negative-pressure anteroom, any suspected or confirmed COVID-19 patient who needs an urgent angiography is managed in the operating room instead.

5. HD FOR SUSPECTED OR CONFIRMED COVID-19 PATIENTS

Once there is a suspected or confirmed COVID-19-infected patient who requires renal replacement therapy. Intermittent HD is performed as appropriate in the isolation room of the COVID-19 special ward, which is equipped with reverse osmosis

Taipei Veterans General Hospital Health Declaration and Affidavit

In view of the **COVID-19** epidemic situation and maintaining everyone's health, please fill in the following information:

Date: 2020/____(M)/____(D)
Purpose of arrival : (Please tick)
 Outpatient consultation Accompany the patient
 Blood/urine test, examination, treatment rehabilitation or Health examination
 Visit patient Doctor explanation patient condition business Other_____

1. Have you traveled abroad in the last 14 days?
 No Yes

2. Have you had fever, respiratory symptoms such as cough, runny nose, sore throat, breathing asthma / dyspnea etc. in the last 14 days? ?
 No Yes

3. What is your occupation?
 Healthcare Workers Transportation Tourism industry Hotel industry
 Aviation Services Other_____

4. Have you contacted and entered the following places in the past 14 days?
 No Have contacted travel abroad people who have fever, respiratory tract symptoms.
 Have visited a hospital or clinic.
 Traveled to and from airports, tourist attractions, and other places that frequently contact foreigners.
 Participated in public gathering, such as religious / political / academic / artistic/cultural activities.
 Participated in crowd activities such as school opening / graduation ceremony, weddings and funerals, sports events, etc.
 Contact with wild animals, avian.
 Other_____

5. Your group history in the past month.
 None Family members are (home quarantine Self-Health Management)
 family friends colleagues , have fever or respiratory symptoms

I guarantee that the information provided is true, and if there is any concealment that is willing to accept the prosecution of laws and regulations such as the Prevention and Control of Infectious Diseases, there will be no objection.

Name : _____ Telephone/Mobile No. : _____
 Resident Certificate No./ Passport No. : _____
 Address : _____

Fig. The TOCC (Travel/Occupation/Contact/Clustering) history declaration and ID registry for every visitor at the hospital entrance.

water supply. In Table 3, we summarize current HVA-related recommendations or comments on the COVID-19 pandemic.

In conclusion, HD patients are more comorbid and at risk of severe COVID-19 pneumonia once they get infected. In this article, we present the primary infection prevention measures for COVID-19 in an HVA care unit of the tertiary-care referral hospital, including obligatory mask-wearing at all times, body

temperature measurement, visitor number limit, inpatient visiting hours restriction, and visitor's TOCC history registry. We would like to highlight two easy yet effective measures, obligatory mask-wearing and consistent hand hygiene, to reduce respiratory droplet and contact transmission risks. Although in most parts of the world where stocks of surgical masks are quite limited for now, evidence suggests that cloth masks may be only

Table 2**COVID-19 infection control measures for HVA care****General infection control measures**

Obligatory mask-wearing at all times
 Body temperature measurement and record
 Visitor number limit
 Inpatient visiting hours restriction
 TOCC history declaration and ID registry for every visitor
 Chlorhexidine (0.5%) dispensers for hand hygiene are available at all checkpoints, all doors (both sides), all rooms, and all beds throughout the hospital
 Chairs in the public area are marked to be seated separately for social distancing

HVA care item**Specific infection control measure**

a. Overall surveillance for intradialytic access flow quarterly using a Transonic HD03 monitor	Prohibition of food and drink in all HDU areas
b. Doppler ultrasound for HVA with abnormal flow	Postpone elective ultrasound follow-ups
c. Angiographic examination for HVA complications	Postpone elective angiographic examination for HVA
d. Surgery for HVA build-up and complications	Postpone elective surgery for HVA build-up Use an operating room with a negative-pressure anteroom and a negative-pressure recovery room for the suspected or confirmed COVID-19 case who requires an urgent angiography or surgery for his/her HVA complication

HVA = hemodialysis vascular access; TOCC = Travel/Occupation/Contact/Clustering; HDU = hemodialysis unit.

Table 3**Current HVA-related Recommendations or Comments on the COVID-19 Pandemic (May 3, 2020, Date Last Accessed)**

Recommendation/Comment	Reference
a. Elective surgery or procedures should be postponed.	20-22
b. Surgical masks should be used during connection of the HD tubing to the arteriovenous fistula, loop graft, or tunneled central line. Patients are asked not to remove the surgical masks during the HD procedure, and to keep their masks for transport to and from the HDU.	23
c. The isolation gowns should be worn over laboratory coats or scrub suits. If gowns are in short supply, they should be prioritized for initiating and terminating HD, manipulating access needles and catheters, assisting patients to and from the HD station, and cleaning and disinfecting the HD station.	24
d. HD patients should be recommended to wash their hands and fistula arm before starting HD and to thoroughly disinfect the puncture areas as a general hygiene measure.	25, 26
e. The HDU is a setting at high risk for infectious outbreaks; the HD procedure is time-consuming, and the extracorporeal circuit is a risk element; the management of the arteriovenous fistula is likewise critical.	26
f. Patients who need vascular access surgery should be screened for COVID-19. Operations on patients with confirmed or suspected COVID-19 infection must be carried out in a designated room with the necessary protection for medical staff.	27
g. Some HD organizations suggest facilitating home HD for as many patients with kidney failure as possible with timely placement of peritoneal catheters and vascular access.	28

HD = hemodialysis; HDU = hemodialysis unit; HVA = hemodialysis vascular access.

marginally less effective than surgical masks and fivefold more effective than not wearing masks in blocking droplet transmission. Therefore, the cloth mask for hospital visitors is likely to be a good alternative in areas having a shortage of surgical masks and is better than wearing no mask at all.

In our facility, the working and office areas of the HD units are separated to reduce cross-infection. With the implementation of proactive infection control measures, we continue the quarterly intradialytic access flow monitoring and the Doppler ultrasound of HVA to ensure that every HD patient is under the proper surveillance of HVA health. All elective procedures for HVA are postponed, and operating rooms equipped with a negative-pressure anteroom are used for the suspected or confirmed COVID-19 patients. By modifying our HVA care policy, we not only prevent our patients from getting infected with COVID-19 till now but also maintain HVA care quality.

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