Preventing Bloodstream Infections in Hemodialysis Patients

By Michele H. Mokrzycki

In 2017, approximately 459,000 patients in the United States received in-center hemodialysis (HD), and more than 108,000 new patients began renal replacement with HD (1). HD catheters were the most common form of vascular access in new patients, accounting for 80% of all accesses. Therefore, more than 86,000 new HD patients began treatment with a catheter in 2017 (1). Among prevalent HD patients, catheter use was lower: approximately 20%. Unfortunately, catheter use in patients receiving both incident and prevalent HD has remained unchanged over the past 6 years.

Patients receiving in-center HD are a unique patient population and are at risk for infections because of the shared treatment setting and frequent accessing of the bloodstream. Catheter-dependent patients are particularly vulnerable because of the potential for direct entry of skin bacteria from the catheter entrance site into the tunnel and bloodstream, and during catheter connection and disconnection. In fact, the rate of bloodstream infection is nine times higher for catheter-dependent HD patients than in those using arteriovenous fistulas (2).

Core interventions for preventing infections in HD

A recently published review, “Prevention of bloodstream infections in patients undergoing hemodialysis” by Fisher et al. (3), in the January 2020 issue of CJASN examines both established and novel strategies available for the prevention of bloodstream infections in patients receiving HD (Figure 1).

The CJASN review highlights the Centers for Disease Control and Prevention’s core interventions for preventing HD catheter infections, which are also available on the CDC’s website. The CDC’s core interventions were initially published in 2013 and were last updated in 2016 (4). An important recent additional recommendation to the updated 2016 CDC core interventions was on the preferred use of chlorhexidine as a skin antiseptic agent for care of the catheter exit site.

Chlorhexidine-alcohol antiseptic solution has been shown to be significantly superior to povidone iodine–alcohol in preventing catheter infections in the intensive care unit. In a 2015 study, patients randomized to the chlorhexidine-alcohol arm experienced an 80% lower rate of catheter-related bloodstream infections than did those in the povidone iodine–alcohol arm (5). The CDC also recommends the use of a topical antimicrobial ointment as an important part of routine care of the HD catheter exit site. Triple antibiotic ointment and povidone-iodine ointment are the recommended antimicrobial agents, and both are associated with marked reductions in bloodstream infections of approximately 75% to 93%. The application of mupirocin to the catheter exit site, although effective, may have the potential for microbial resistance with long-term use, and its routine use is not recommended.

New chlorhexidine-containing products

Chlorhexidine-based products are now widely used in the HD setting. They include chlorhexidine-impregnated sponges (Biopatch CHG, Johnson and Johnson, Inc.) and dressings (Tegaderm CHG, 3M), which may be alternatives to antimicrobial ointments for routine catheter exit site care. More recently, a novel catheter hub device (ClearGuard HD Antimicrobial Barrier Cap, Pursuit Vascular, Inc.) has been shown to reduce central catheter–associated bloodstream infections in HD patients and was approved by the US Food and Drug Administration in 2018 (6–9). It is designed with a chlorhexidine-coated rod, which provides antiseptic delivery directly into the HD catheter lumen between HD sessions (6–9). Although the upfront costs of these novel products are higher, the long-term projected savings attributable to lower rates of bloodstream infections and hospitalizations may be substantial.

Progress in catheter lock research

Antibiotic catheter locking solutions have been used for prevention of bloodstream infections and are highly effective, achieving a reduction of 50% to 100% in infections. Gentamicin is the most frequently prescribed antibiotic catheter lock; however, a report of gentamicin resistance in one series, which used a relatively high concentration of gentamicin (4 mg/mL) has warranted caution about its routine use (10). More recent studies of gentamicin lock, using lower concentrations (0.32 mg/mL), reported either no change or a decline in gentamicin resistance during long-term follow-up and without loss of efficacy (11, 12).

To avoid the risk of selection for antibiotic-resistant microorganisms, recent efforts have focused on the development of novel nonantibiotic catheter locking agents, including tissue plasminogen activator, taurodilin, ethanol, and sodium bicarbonate. The instillation of tissue plasminogen activator into the catheter lumen as a lock once weekly, in addition to heparin lock twice weekly, has been shown to significantly reduce bloodstream infection rates; however, the immediate costs are a concern and have hindered its routine use (13). Taurodilin, which has a low potential for resistance, is widely used as a catheter locking agent in the European Union and is effective for prevention of HD catheter–related bloodstream infections, but it has not yet been approved for use in the United States. A phase 3 trial, the Lock-It 100 study of taurodilin-heparin-citrate lock (Neutrolin, CovMedix, Inc.) in the United States, reported a significantly lower rate of catheter-associated bloodstream infec-
Developing an electronic catheter checklist

Implementing the CDC’s core interventions to clinical practice in the HD setting has been shown to reduce the bloodstream infection rate associated with vascular access by 58% (Figure 2) (18). Partnerships between the CDC and the dialysis community (Making Dialysis Safer for Patients Coalition), and more recently with the American Society of Nephrology (Nephrologists Transforming Dialysis Safety, NTDS) have increased awareness about the evidence-based tools available to reduce preventable infections in HD, but there is still a need for improvement to achieve the NTDS’s goal to “target zero infections.”

One of the components of the CDC’s core interventions is the recommendation that observations of vascular access care and catheter accessing by the HD staff be performed quarterly. Catheter checklists are available on the CDC’s website to assess staff adherence to recommended aseptic technique when connecting catheters, when disconnecting catheters, and during dressing changes. The NTDS’s Vascular Access Workgroup and the CDC have developed the *Electronic Chairside Catheter Checklist* (Figure 3). This is an electronic web-based version of the CDC’s checklists available on a handheld tablet, and it is currently being evaluated as a pilot in seven outpatient HD units in the United States.

The *Electronic Chairside Catheter Checklist* also includes resources for patients in a video format, which address another one of the CDC’s core interventions: providing patient education and increasing patient engagement (Figure 4). The embedded videos include the following topics: 1) the importance of hand hygiene, 2) catheter-associated bloodstream infections, 3) proper technique to prevent infection, and 4) the clean hands count campaign for dialysis. The pilot will run from January through April 2020 to determine the feasibility of its use in the busy outpatient HD setting, and feedback will be collected from staff members and patients about the tool. We hope to make the results of this pilot available in the latter half of 2020.

Conclusion

Bloodstream infection is potentially preventable in the HD population. A significant percentage of such infection is related to vascular access. Interventions to reduce infections in the HD setting include new tools to improve compliance with the CDC’s existing core interventions for catheter care, improving patient involvement and staff education, and the development of novel products and devices for preventing catheter-associated infections.

Acknowledgment: Kerry Leigh, RN, project specialist, NTDS, for the images of *Electronic Chairside Catheter Checklist*.

Michele H. Mokrzycki, MD, EASN, is chair of the vascular access committee, Nephrologists Transforming Dialysis Safety Initiative of the American Society of Nephrology, and a professor of medicine at the Montefiore Einstein College of Medicine.

---

**Figure 2. Access-related bloodstream infection rates before and after intervention in 17 hemodialysis facilities participating in the CDC Dialysis Bloodstream Infection Prevention Collaborative**

Reprinted from Patel et al. (18).

**Figure 3. Example of the Electronic Chairside Checklist 2020, which is in development by the Nephrologists Transforming Dialysis Safety (NTDS) Vascular Access Workgroup of the American Society of Nephrology and the Centers for Disease Control and Prevention**

---

**References**


Community-Acquired Acute Kidney Injury in Asia

By Vivek Kumar and Vivekanand Jha

Asia is synonymous with diversity, which is reflected in the epidemiology of kidney diseases, especially acute kidney injury (AKI). In contrast to people in the industrialized developed countries, most Asian people, especially those living in rural areas with limited access to healthcare, continue to bear a large burden of AKI. This condition develops in their communities secondary to locally prevalent health issues of public health importance.

The 0by25 Global Snapshot study by the International Society of Nephrology showed that 80% of the burden of AKI in low- and middle-income countries of Asia is community acquired. Community-acquired AKI (CA-AKI) predominately affects young, previously healthy individuals who often work outdoors in rural areas and are exposed to a variety of occupational, environmental, or sociocultural risk factors that predispose or lead to the development of AKI. These factors are often the culmination of a complex interplay between geographic, ecologic, social, and economic conditions prevalent in those regions. They include exposure to tropical infections like malaria, leptospirosis, dengue, or acute diarrheal illnesses; toxic envenomation after animal or insect bites; use of unproven traditional or local systems of medicine that frequently include nephrotoxic compounds; delays in seeking appropriate care; and lack of hygiene, sanitation, or an adequate supportive healthcare infrastructure.

This pattern of development for CA-AKI is in striking contrast to that for hospital-acquired AKI, which is seen in developed regions and high-income countries. The usual prototype of a patient at risk of AKI in such regions is an individual with preexisting comorbidities like chronic kidney disease, diabetes, or hypertension who is admitted to the hospital for complications related to chronic disease, or in whom AKI develops after a healthcare intervention like major surgery. The fact that mortality in children with AKI is 55 times higher in low- and middle-income countries than in high-income countries reflects the public health importance of addressing AKI in such settings.

Infections are the leading cause of CA-AKI in Asia. The tropical Asian climate favors the persistence and growth of microbes and disease vectors. Although most countries have undertaken community-based measures to control and prevent tropical infections through national programs and international collaborative efforts, the absolute burden still remains very high. At one end, Sri Lanka and the Maldives have recently declared malaria free, whereas at the other end, southeast Asia still reports the second highest number of malaria cases after Africa.

The epidemiology of infectious diseases has changed in Asia over recent decades, reflecting the changing host-pathogen interactions resulting from habitat destruction, industrialization, climate change, and indiscriminate use of drugs. Examples include the recognition of human Plasmodium knowlesi malaria, previously seen in Old World monkeys in countries like Malaysia, Cambodia, and Indonesia; the identification of semi-domestic farm animals as main-tenance or accidental hosts for leptospirosis in Sri Lanka; the dramatic increases in dengue viral infections; and the reemergence of ricinoid diseases like scrub typhus across India and China. All of these infections can cause AKI.

Other important risks for CA-AKI are animal or insect bites—occupational hazards for those living in rural areas and working outdoors for their livelihood. South Asia and southeast Asia report the highest number of snakebite-related envenomation and deaths in the world. AKI is common in vasculotonic viper bites. Stinging insects like wasps, hornets, and bees can also cause AKI, especially when a swarm attacks an individual and injects large doses of venom.

Finally, AKI after the consumption of exotic tropical plants continues to be encountered in Asia. The development of acute oxalate nephropathy leading to AKI after star fruit juice consumption is a classic example. Other plants whose consumption has been reported to lead to AKI include Glossoxia superba and Cleistanthus collinus. The unregulated and easy availability of chemicals, insecticides, and pesticides allows their abuse for homicidal or suicidal intent. AKI can develop after the ingestion of copper sulfate, parapat, or aluminum phosphate. A lack of healthcare facilities, and reliance on unproven traditional or indigenous medicines owing to social or cultural beliefs, frequently expose underprivileged people to local drugs that contain nephrotoxic compounds and heavy metals.

AKI in obstetric patients in the setting of puerperal sepsis, unsupervised pregnancies, unsafe deliveries, or illegal abortions by untrained personnel is still common among young women from poor socioeconomic groups. Acute cortical necrosis is a dreaded complication especially associated with obstetric AKI, which portends poor renal recovery.

Despite the nonmodifiable nature of a few risk factors (e.g., geographic and ecologic factors), a vast majority of CA-AKI cases in Asia are potentially preventable. Concreted efforts over three decades in Bangladesh have almost eliminated a mortality rate of 27% that was previously seen with AKI and acute diarrheal illnesses during floods. Such successes underline the need to adopt public health approaches to the elimination of preventable mortality due to AKI—the mission behind the 0by25 initiative of the International Society of Nephrology. Awareness among the general public, focused social groups, administrative stakeholders, and various healthcare professionals, and collaborative efforts to implement measures for preventing CA-AKI by early identification in the community and timely referral to appropriate healthcare facilities, are keys to improving outcomes.

Vivek Kumar, MD, DM, is assistant professor, Department of Nephrology, PGIMER, Chandigarh, India. Vivekanand Jha, MD DM FRCPC FAMS, is executive director, The George Institute for Global Health, India, professor of nephrology and James Martin Fellow, University of Oxford, conjoint professor of medicine, University of New South Wales, Sydney, and president, International Society of Nephrology.