K/DOQI Guidelines: What Should an Interventionalist Know?

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ABSTRACT

The Kidney Disease Outcomes Quality Initiative (K/DOQI) is an evolving, literature-based set of practice guidelines designed to improve measurably the quality of life for dialysis patients. As is characteristic of guidelines, they do not change as rapidly as the literature. The K/DOQI guidelines are not meant as the definitive document and should be not treated as such. Although the guidelines are not perfect, everyone caring for chronic renal patients should be very familiar with the guidelines. It is perfectly acceptable to adopt approaches that differ from the guidelines as long as they are supported by literature. An attempt is made in this article to review the aspects of the guidelines most pertinent to the interventionalist and outline deviations from the guidelines that are supported by literature.

KEYWORDS: K/DOQI, vascular access, dialysis access, complications, AV grafts, AV fistula, venous preservation

Objectives: Upon completion of this article, the reader should be able to (1) summarize the main objectives of K/DOQI (2) summarize the importance of the guidelines, and (3) obtain a basic understanding of appropriate management of vascular access for dialysis patients.

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In the United States, ~300,000 patients suffer from end-stage renal disease (ESRD) and receive dialysis as renal replacement therapy. Although dialysis technology has improved over the years, opportunities still exist for further refinement.¹ Maintaining vascular access patency is a key component in the care of patients with ESRD who are dependent on hemodialysis.² Ideally, a venous access for dialysis has the following characteristics: (1) indefinite life, (2) high flow rate, and (3) no associated complications (such as infection, thrombosis,

stenosis, aneurysm formation, or limb ischemia). Obviously, no presently available access can fulfill these criteria. However, it seems that from the currently available options, the native arteriovenous (AV) fistula is the best choice. When compared with other dialysis access types, native AV fistulae have the best patency rates, require the fewest interventions, and have the best results following interventions.²⁻⁴ Despite this published evidence, in the United States, polytetrafluoroethylene grafts outnumber native AV fistulae almost two to one.²

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Because accesses created using synthetic grafts require more interventions to maintain patency, they are partly responsible for continued increases in dialysis patient care costs.^{2,5} Suboptimal planning for permanent dialysis access has resulted in a large number of hospitalizations for initiation of hemodialysis. Earlier planning might help decrease this.² A major cause of morbidity for dialysis patients is hemodialysis access malfunction. Many ESRD patient hospitalizations are due to complications related to vascular access (especially hemodialysis access failure and infection).^{2,6} It is also evident that an aggressive policy for monitoring AV graft patency reduces access replacement rates and graft thrombosis.^{2,7}

In 1995, the National Kidney Foundation (NKF) established the Dialysis Outcomes Quality Initiative (DOQI), the first literature-based effort to develop practice guidelines that could measurably improve the quality of life for dialysis patients.^{1,8} To achieve this objective, four work groups (Peritoneal Dialysis Adequacy, Anemia Management, Hemodialysis Adequacy, and Vascular Access) were created. They reviewed the available literature and met periodically to compile comprehensive guidelines. On the basis of the available evidence, the Vascular Access work group believed that by striving for the following targets, among others, quality of life and outcomes for dialysis patients might be significantly improved. The goals are (1) to detect access dysfunction prior to thrombosis, (2) to increase creation of native AV fistulae, and (3) to discourage catheter use.^{2,8} When evidence was not available, the guidelines were based on the expert opinion of the work group members. After a thorough three-stage review process, including review by various professional organizations and subsequent revisions, these practice guidelines were published in 1997 in the *American Journal of Kidney Diseases*.^{1,8-10} At the core of these guidelines are venous preservation, detection of the vascular access at risk, and implementation of procedures to maximize access longevity. It requires a combined, coordinated effort from patients, nephrologists, interventionalists, access surgeons, and nephrology nurses to achieve these objectives.²

As with any set of guidelines, review and revisions are essential as more evidence becomes available. After the initial publication, the guidelines were updated in 2000 and were broadened to encompass the spectrum of chronic kidney disease before the need for dialysis arises. The expansion was made to prevent or delay the need for dialysis with early intervention and prevention measures. To reflect this, the "Dialysis" in DOQI was changed to "Disease" and the initiative was renamed the Kidney Disease Outcomes Quality Initiative (K/DOQI).¹

In the overall management of patients with chronic renal disease, interventional radiologists play a

critical and ever-increasing role. From the set of guidelines published under K/DOQI, the Vascular Access section should be of most interest to interventionalists. Another section that is currently under development, Cardiovascular Disease in Dialysis Patients, will be of interest to interventionalists. The Vascular Access section is a document with broad coverage intended for interventionalists, access surgeons, and nephrologists. In this review, we try to summarize the most important information that every interventionalist who cares for patients with renal disease should know.

K/DOQI SUMMARY

The vascular access section of the K/DOQI guidelines (<http://www.kidney.org/professionals/kdoqi>) includes 38 guidelines divided into the following six main parts: (1) Patient Evaluation Prior to Access Placement, (2) Monitoring, Surveillance, and Diagnostic Testing, (3) Prevention of Complications: Infection, (4) Management of Complications: When to Intervene, (5) Management of Complications: Optimal Approaches for Treating Complications, and (6) Potential Quality of Care Standards.^{11,12} Although familiarity with all of these guidelines is critical for anyone caring for patients undergoing hemodialysis, some are of more interest to the interventionalist than others. Although the guidelines are very comprehensive and evidence based where possible, they are meant as practice guidelines and not as the definitive word on vascular access management for hemodialysis patients. In fact, some of the recommendations are becoming outdated and we believe current practice should deviate from some of the guidelines. In addition, there are other evidence-based guidelines as well, including those published by Australian, British, and Canadian organizations. For example, the Caring for Australians with Renal Impairment (CARI) guidelines (<http://www.kidney.org.au/cari/drafts/bvascular.html>),¹³ published by the Australian Kidney Foundation, provide their recommendations and comparison with the other guidelines. A critical review of these guidelines is beyond the scope of this article.

The K/DOQI guidelines have had and will continue to have a significant impact on dialysis access management. For example, Medicare policy has already been altered as a result of some of the guidelines.¹¹ Furthermore, the prevalence of native fistulae in the United States has increased measurably since the 1997 publication of the DOQI.¹⁴ Areas of specific interest are summarized and their importance is outlined.

Patient Evaluation

Patient evaluation is essential prior to placement of a permanent dialysis access. Although interventionalists are not directly involved in vascular access creation other

than catheter placement, we do manage access sites after creation. To determine the most suitable type of access, a history and physical examination of the vascular system is essential, helping guide further diagnostic evaluation. We argue that this is a key component of patient care prior to performing *any* procedure on a dialysis patient. Patient history including prior central venous catheter, pacemakers, prior peripheral arterial or venous catheter, vascular access failures, coagulation disorder, or heart valve disease is important for various reasons. For example, ~40 to 64% of the time, prior subclavian catheters or pacemakers are associated with venous stenosis.^{15–19} For physical examination, extremity edema, differential extremity size, collateral veins, and evidence or prior venous catheterization should be considered. (For a comprehensive history and physical examination table, and their relevance, see the K/DOQI document.)¹² Extremity edema, differential extremity size, and collateral veins are signs of venous obstruction and therefore warrant a venogram. Similarly, a history of prior subclavian vein access and pacemakers might lead to central vein occlusion or stenosis, and multiple prior venous accesses might exhaust all suitable veins. Venography helps find suitable veins and exclude unsuitable veins for access placement.

For those patients with residual renal function, alternative contrast agents such as carbon dioxide and gadolinium may be used.¹² We presently prefer contrast-enhanced magnetic resonance venography for comprehensive evaluation of the central veins. These simple steps taken prior to access placement will help avoid many of the complications, access or treatment failures, and ultimately, morbidity to patients. For example, a history of pacemaker along with chest wall collaterals or arm swelling (on physical examination) might be indicative of subclavian or innominate vein stenosis or occlusion. This might prompt the interventionalist or the surgeon to perform a venographic evaluation, to change the side of access placement, and/or to treat the existing stenosis prior to catheter placement or AV fistula/graft placement.

Dialysis Catheter Placement and Management

Hemodialysis catheters have an appropriate place in the management of hemodialysis patients. The guidelines state that fluoroscopic guidance for placement of all catheters is essential to achieve ideal tip position and maximize blood flow.¹² We believe that to reduce puncture-related complications, real time ultrasound guidance should be mandatory for all dialysis catheter placements.^{12,20,21} The time might soon come when low-cost ultrasound units will make this a reality. We use it 100% of the time in our practice for central venous catheterization.

The K/DOQI recommends that tunneled dialysis catheters are the best choice when the access is needed for longer than 3 weeks (as temporary access or as permanent access for patients who have no alternative access options). However, it is acceptable to use them for shorter periods.¹² We believe that tunneled catheters, which have lower infection rates and higher flow rates than nontunneled catheters, should be placed in all patients who need dialysis for more than 1 week (provided no contraindication exists) because this might be more sound economically. The K-DOQI guidelines state that the right internal jugular vein is preferred for tunneled catheter access. The guidelines list alternate sites in the following order: right external jugular, left internal jugular, left external jugular, subclavian veins, femoral veins, and translumbar inferior vena cava access. We believe the order of site choice for tunneled catheters should be right internal jugular vein, left internal jugular vein, external jugular veins, other collateral veins (or recanalization of the other veins), translumbar access to inferior vena cava, femoral veins, and subclavian veins. This order is slightly at odds with the K/DOQI recommendations but we believe it is more consistent with the doctrine of venous preservation. Although some interventionalists prefer femoral tunneled dialysis catheters before resorting to the translumbar approach, transfemoral catheters are associated with high deep venous thrombosis and infection rates, the latter three times that of translumbar catheters.^{22–24} Furthermore, loss of a femoral venous site to deep vein thrombosis precludes use of that site for future access grafts or fistulae, whereas caval occlusion resulting from translumbar catheters rarely precludes femoral permanent access. Finally, femoral lines can sometimes cause caval thrombosis as the femoral lines are made longer and longer, thereby rendering the inferior vena cava unusable for translumbar access. According to the guidelines, if possible, tunneled catheters should not be placed on the same side as a maturing AV access, but evidence does not support this as a problem.²⁵ The catheter tip should be positioned in the right atrium, guided by fluoroscopy.

Nontunneled catheters should be inserted only when needed for immediate use and should not be inserted in anticipation of dialysis. For internal jugular vein catheter insertion, ultrasound guidance should be used. Confirmation with a chest x-ray of the catheter tip at caval atrial junction or superior vena cava and exclusion of pneumothorax or hemothorax is mandatory; when such catheters are placed in interventional radiology, this is an integral part of the procedure. Furthermore, these complications are virtually nonexistent with imaging-guided placement of catheters. Femoral nontunneled catheters should be long enough to reach the inferior vena cava and should not be left in place longer than 5 days. In our practice, we use the longest catheter

available to us, 24 cm. The catheter should be left in place only in bed-bound patients.¹²

It is imperative that the doctrine of vein preservation be applied not only to the interventional radiology practice, but also to all those caring for patients with renal disease. All patients receiving or expected to require hemodialysis (patients with ESRD or progressive kidney disease [creatinine > 3.0 mg/dL]) should be taught to protect the arms from venipuncture or intravenous catheters, including peripherally inserted central catheters (PICCs), given that PICCs cause thrombosis in up to 50% of all peripheral veins.^{12,26} It is obvious that subclavian vein access should be avoided for access because of the high rates of stenosis associated with central line placement in this location. If venipuncture is necessary in a patient with chronic kidney disease, the dorsum of the hand is preferred. If arm vein puncture is absolutely necessary, puncture sites should be rotated. Preservation of these veins is necessary to allow future construction of primary AV fistulae. Every individual involved in the care of hemodialysis patients (including the patient) needs to support this principle to help achieve the goal of increasing the number of native fistulae and ultimately improve the quality of life of the patient.¹²

Management of Catheter-Related Problems

Because an ideal catheter does not exist, tunneled or nontunneled catheters will encounter problems after they are implanted. If sufficient extracorporeal blood flow to perform hemodialysis is not achieved or maintained, the catheter is defined to be dysfunctional. Although currently, 300 mL/min is considered sufficient, there are some indications that during the next revision, this criterion might be increased to 350 mL/min (T. Vesely, personal communication, 2004). Modern hemodialysis catheters can readily deliver flows greater than 350 mL/min.²⁷ Once confirmed that the catheter tip is at the caval atrial junction (for nontunneled catheters) or in the right atrium (for tunneled catheters), a dysfunctional catheter can be managed in the hemodialysis unit. Although a protocol for urokinase administration is provided in the guidelines, other lytics can also be used.^{12,28} If this fails, a central venogram with contrast injection through the catheter might help evaluate for a fibrin sheath. If the catheter is malpositioned or of inappropriate length, a catheter exchange over a guidewire should be performed. In the event of a fibrin sheath, the guidelines offer several possible courses of action. On the basis of currently available evidence, much of it available since the publication of the second guidelines, over-wire exchange with sheath disruption or lytic infusion²⁹⁻³¹ is probably the best option. To date, no comparison of these two methods has been published, although we are presently studying this. Again, on the

basis of published evidence,³¹ we do not believe there is any role for transfemoral fibrin sheath stripping, with the possible exception of ports that fail infusion.

The treatment of tunneled catheter infection (leading to catheter removal and significant morbidity in dialysis patients) should be based on the nature of the infection. If blood cultures are negative and no systemic symptoms are noted, catheter exit site infection (redness, crusting, and exudate at the exit site) should be treated with topical antibiotics and local care. Antistaphylococcal and antistreptococcal parenteral antibiotics (eventually guided by site cultures) and local care are adequate if there is tunnel drainage. In either case, the catheter should not be removed unless the infection does not respond to therapy. If these therapies do not work, the catheter should be removed (over a wire) to preserve venous access and a new tunnel should be created.¹²

Any catheter-related bacteremia should be treated with parenteral antibiotics appropriate for cultured organism, with catheter removal managed in the following manner. Catheter-related bacteremia in a clinically unstable patient (due to sepsis) should prompt catheter removal. If the patient is clinically stable, the catheter should only be removed if the patient remains symptomatic (i.e., fever; however, the guidelines do not list specific symptoms) after 36 hours of treatment. Some new evidence confirms prior preliminary evidence that in patients without involvement of exit site or tunnel, catheter change over a guide wire (after a bactericidal level of antibiotic is in the blood) and a minimum of 3 weeks of systemic antibiotic therapy is effective.^{32,33} In our practice, we perform catheter change over a wire for all stable patients with bacteremia. This might conflict directly with what the infectious disease team recommends during the course of patient care. However, attempts should be made, with literature support, to reconcile these differences, particularly because this practice is essential for venous preservation.

AV Grafts and Fistulae

If AV grafts are appropriately surveyed for significant stenosis and treated when needed, grafts remain functional longer and clot less frequently. Recent studies have challenged this conclusion.³⁴ With appropriate management, the ultimate goal remains, however, to preserve vascular access. Organizing and participating in multidisciplinary vascular access conferences facilitate a team approach to the management of vascular access complications. Venous outflow stenosis might account for more than 85% of graft thrombosis. Return of clinical or physiological parameters to within acceptable range and residual stenosis of less than 30% is considered adequate treatment.¹² For thrombosed AV grafts or significant venous stenosis, no one treatment is recommended over another (i.e., thrombolysis/percutaneous

transluminal angioplasty or surgical thrombectomy/revision). One of the most important factors in that decision is the locally available expertise. The work group agreed that intervention should be performed in a time period that does not necessitate more than one (but ideally none) femoral vein catheter placement for temporary hemodialysis access. In our practice, this translates into same-day availability Monday through Friday. It is reasonable to ask why percutaneous interventions were not explicitly recommended. To date, no prospective randomized trials are available to support such a recommendation.^{11,12}

The guidelines recognize that the treatment of a thrombosed native AV fistula is difficult and recommend that each institution should determine which is the best the technique that is available at that institution.¹² There is growing evidence that shows that AV fistulae might be managed well percutaneously, not only for access thrombosis but also for failure to mature.^{35,36} This will be a topic of discussion in the next revision of the K/DOQI. The areas of interest are the role of mechanical thrombectomy devices and pharmacological thrombolysis in the management of thrombosed AV fistulae (T. Vesely, personal communication, 2004).

Because the alternative treatments are more invasive, PTA is explicitly recommended for treatment of central vein stenosis. In our practice, we treat central vein lesions only if there is arm swelling or repeated thrombosis of the access without any other explanation for the thrombosis. K/DOQI guidelines conclude that if there is effective PTA (without recoil), stent/PTA grants no advantage over PTA alone. When there is elastic central vein stenosis, which does not respond to larger balloon or prolonged PTA, or if stenosis recurs in 3 months, stent with PTA placement is appropriate. If PTA fails in a surgically inaccessible lesion, stents might be appropriate.¹²

Surgical intervention is mandatory for an infected graft.¹² Although not an explicit recommendation, we believe that a clotted graft with clinical signs of infection should not be declotted percutaneously because of increased risk of septic emboli, sepsis (even death), and treatment failure.

Potential Quality-of-Care Standards

For patients undergoing hemodialysis, vascular access complications lead to a high rate of hospitalization, making them a major cause of morbidity. To minimize this, dialysis centers should have monitoring programs to determine vascular accesses at risk, follow outcomes and complication rate trends, and develop ways to increase access longevity. Access durability can be extended by periodically monitoring accesses to detect and treat hemodynamically significant stenosis prior to thrombosis.¹²

Catheters for Chronic Dialysis

Overall, catheter used as chronic dialysis access should be minimized because of its high rate of infection and malfunction rate. The K/DOQI goal is to have less than 10% of hemodialysis patients with catheters as their permanent chronic dialysis access (defined as use of dialysis catheter for more than 3 months without maturing permanent access). In addition, we argue that with use of real-time ultrasound for venous access, fluoroscopic guidance, and meticulous technique, the insertion complication associated with placement of tunneled catheters can be lowered easily to less than 0.5%.¹²

In conclusion, every individual participating in the management of hemodialysis patients should read and be intimately familiar with the K/DOQI criteria. The updated 2000 version is posted on the National Kidney Foundation Web site. As illustrated in this review, the K/DOQI document is meant only as a guideline. As more evidence becomes available, the practice should be based on both the new evidence and the available guidelines. Other evidence-based guidelines should not be neglected and might supply an alternate viewpoint.

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