DOI: 10.1111/sdi.12670

WILEY Seminars in Dialysis

DIALYSIS EDUCATION:
ISSUES, INNOVATIONS AND IMPACT

Guest Editors: Bernard G. Jaar and Michael J. Choi

Dialysis access procedure training for the nephrologist

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Abstract

Historically, the placement and maintenance of dialysis access has been an integral part of nephrology training. However, in recent years, a big debate has ensued regarding whether this should be limited to trainees' understanding and counseling the patients regarding indications, alternatives, risks and possible complications of these procedures or should it actually involve more of a hands-on experience for the trainees. Some of the barriers in making these procedures a requirement across the board are the lack of standardization of procedural training across various training programs and the absence of consensus on what achieving competency in these procedures looks like. However, in the era of declining interest in nephrology, giving up "ownership" of nephrology procedures and increasing reliance on other sub specialties might be a deterrent in attracting residents to this field; we have to make a concerted effort to increase the exposure and opportunities for the trainees to perform these procedures. Moreover, we need to emphasize the implementation of a curriculum for nephrology fellows to evaluate access properly in order to decrease the burden of access related complications. Lastly, we need to continue working towards a more structured curriculum for a dedicated interventional nephrology fellowship for trainees who want to focus on procedures for their long-term career goals.

1 | INTRODUCTION

Hemodialysis is a critical component of nephrology fellowship education. Given that hemodialysis cannot be performed without a reliable access to the circulation, it follows that placement and maintenance of vascular access for dialysis should be an integral part of a nephrology fellowship curriculum, both in theory and practice. The past several years have witnessed a marked decline in nephrology fellowship applications and, as a result, many successful programs are finding themselves scrambling to fill fellowship spots.[1] At the same time, many Nephrology training programs have either diminished or even entirely removed their fellows' procedural training requirements.[2] There is a temporal association between these two phenomena, to be sure, but which one is cause and which is effect? Or are these two phenomena entirely unrelated—the conclusion that they are causal being simply a mistake of *post hoc, ergo propter hoc*?

Initially, hemodialysis was performed exclusively in the setting of acute kidney injury. Chronic hemodialysis became possible after the development of the first permanent vascular access—the Scribner shunt.[3] At this nascent stage of chronic dialytic therapy, nephrologists placed the access, maintained it, dealt with its complications, and performed hemodialysis. As our specialty evolved, however, the role of nephrologists changed from a full service specialty to one focusing exclusively on the delivery of dialysis, deferring care of the vascular access to other specialties such as surgery for placement and interventional radiology for maintenance.[4] This trend persists in the present day education of fellows; there are many training programs around the country that defer vascular access care to other specialties. The goal of this review is to describe the issues, limitations, and opportunities for nephrology education in dialysis access interventions, both acute and chronic.

2 | ACUTE DIALYSIS ACCESS-THE GENERAL NEPHROLOGY EXPERIENCE

Non-tunneled hemodialysis catheters (NTHDC) are often the access of choice for patients starting dialysis in the acute setting and the insertion of NTHDCs is one of the core competencies for nephrology trainees in the United States.[5] Currently, there is no standardized approach for nephrology fellows to be trained in NTHDC insertions and procedural competence is not routinely assessed.[6] In addition, the practicality and utility of training all nephrology fellows in NTHDC insertion has also come under fire.[7]

The debate over whether fellowship programs should continue to train fellows to place NTHDC is largely opinion based in the absence of robust data. The most compelling reason for retaining this requirement is to reduce the reliance of nephrologists on other specialties to deliver urgent dialysis-a lifesaving therapy.[7,8] Second, it can be argued that if the nephrologists themselves are placing NTHDC then they are in a better position to discuss the risks and benefits of performing this procedure. Moreover, given that the interest of internal medicine residents in procedural fields like cardiology and gastroenterology has increased over time,[9] giving up ownership of our procedures might hurt our efforts to attract procedurally minded residents to nephrology. Last, employers may require the nephrologists to place NTHDC and job opportunities for the graduating fellows can be limited by lack of competency in line placement.

On the other hand, the need to prioritize educational goals can be a deterrent for all programs to train fellows in NTHDC placement as the time required to successfully place a NTHDC might encroach on more educational undertakings.[7] Moreover, since majority of practices do not require nephrologists to place NTHDC,[10] the likelihood of losing proficiency over time in NTHDC insertion is high.[11-13] Despite some of the disadvantages mentioned, we believe that NTHDC placement is an important skill for nephrology practice and training programs should strive to train fellows to achieve this procedural skill.

This raises the important question of examining what the competence level of current nephrologists in placing NTHDCs is and how can this be improved? According to one study, about one-third of nephrologists do not feel competent in placing NTHDC in the internal jugular vein.[14] Similarly, Sachdeva et al. have recently shown in a survey that approximately 20%-25% of the graduating fellows have not placed a NTHDC despite the ACGME requirement and only 34%-42% have placed more than 10 NTHDCs.[2] Potential reasons for this low rate might include that more NTHDCs are being placed by intensivists and interventional radiologists and attending nephrologists themselves are uncomfortable with their procedural skills. This was shown in one study where only 11% of attending nephrologists achieved a minimal passing score on a 28 item checklist for NTHDC insertion.[15] One possible explanation for this might be that attending nephrologists are mostly supervising and not personally performing the procedure.[12,15] To achieve procedural competence for our fellows, attending nephrologists need to enlist the help of intensivists and interventional radiologists or to consider periodic retraining for the nephrology faculty.[2]

The lack of standardization across different training programs is also a barrier. A survey by Berns et al. showed that 41% of the programs have no minimum requirement for NTHDC placement.[6] The argument for having a minimum number of procedure requirements is based on studies that show improvement in procedural skills with repeated line placement.[16] However, it is unclear what the optimal number of NTHDC performed should be before someone can be certified to be "competent" as the learning curve for each individual is different. Moving towards a more competency-based system would be better where learners practice until they reach a predetermined achievement standard regardless of how many attempts it takes to get these results.[17]

Since standardizing the procedural experience for all learners in the patient care setting can be challenging, simulation offers an attractive alternative to provide opportunities for deliberate and safe practice, adherence to best practice guidelines and development of clinical skills.[13,15] Studies have shown that skills obtained in the simulated setting translate to a lower rate of complications.[18] Barsuk et al. demonstrated improvement in NTHDC placement skills in a study, where 12 of 18 fellows underwent a 2-hour simulation session.[13] Only one of the twelve first year fellows reached the minimal passing score on a 27-item checklist prior to the simulation session and eleven out of twelve (92%) were able to reach that score after a 2-hour session.[13] Therefore, efforts should be made to incorporate simulation, whenever possible in nephrology training programs for clinicians who insert NTHDC.

A structured curriculum for NTHDC placement with deliberate practice and feedback from individuals who can competently perform the procedure themselves is superior to the traditional method of "see one, do one and teach one".[13,15]

3 | CHRONIC DIALYSIS ACCESS-THE GENERAL NEPHROLOGY EXPERIENCE

Equally important to the procedural requirements of the general nephrologist is the ability to perform a satisfactory assessment of the vascular access to help assure hemodialysis can continue uninterrupted and to minimize the burden of access complications.[19,20] Firstly, we must educate our trainees on the critical distinction between "monitoring" and "surveillance," two words that are often used interchangeably, but which have completely different meanings.[21] Although there are various techniques and technology used for surveillance of access dysfunction, there is no consensus on the most effective method. It remains largely unclear if surveillance is helpful at all in the care of vascular access. On the other hand, vascular access monitoring, consisting of physical examination and clinical evaluation, remain the mainstay in detecting dysfunction.[22,23]

The ACGME has recognized this need and vascular access evaluation remains a requirement for all fellows to receive instructional training.[5] However, in this area as well there is a lack of standard

education programs available for fellows in nephrology.[24] It has been shown that training can be effectively provided, even to non-medical learners, to develop accurate assessments.[25] Using this model, appropriate instruction from an experienced teacher, along with dedicated practice has shown improvement in the accuracy of assessments if the practice is continued over time.[26] While the cited article used a robust amount of dedicated time, there are less intense iterations of this curriculum being developed and tested for effectiveness. While vascular access assessment is a requirement in fellowship training, there is a lack of standardized approach to this topic. Dedicated instruction from an experienced clinician, along with hands-on practice over a period of time can provide instruction that has proven to be effective.[25] While the ACGME has not formally recommended that fellows needs to demonstrate competence in the vascular access examination, it seems that this would be a place where an objective structured clinical examination (OSCE) would be an easy assessment. (Table 1).

4 | CHRONIC DIALYSIS ACCESS-THE INTERVENTIONAL NEPHROLOGY EXPERIENCE

Dialysis access care remains an important concern for patients with chronic kidney disease stages 4, 5 and 5D. In the 1990s, access care had been fragmented and divided among radiologists and surgeons, with nephrologists playing only a limited role.[4] The resurgence of the importance of the procedural aspect of nephrology to optimize patient care led to the creation of the specialty of Interventional Nephrology (IN) about 15 years ago. Partly as a result of this renewed interest in chronic dialysis procedures, access care has evolved from being a chaotic, uncontrolled, and unsupervised discipline to an effective multidisciplinary team approach coordinated by nephrologists.[4] The paradigm shift in dialysis access care was initially embraced by nephrologists in the private sector, but is now spreading to academic medical centers across the United States.[4]

Despite the improvement in vascular access care delivery described above, dialysis access education remains challenging. First, while many academic centers have robust clinical IN programs, the vast majority of current practitioners of IN received their education in the private sector. As a result, the education of most IN practitioners tends to be unstructured and variable. This conundrum was judiciously articulated by Ted Saad in 2002.[27] The specific learning goals, however, were not articulated for the academic IN community until 2012.[24] Roy-Chaudhury and colleagues first described educational goals that would focus around the following core concepts: an understanding of the pros and cons associated with the different access choices, learning how to develop a life plan that is individualized for each patient and optimally uses all the different types of vascular access and also peritoneal dialysis (PD), and learning how to do the access physical exam with an emphasis not just on the technique but also the rationale, the interpretation, and the follow-up actions that are needed.[24] The authors posited that these goals could be achieved through a dialysis access (both hemodialysis and PD) lecture series, a rotation with an interventionalist (radiologist/interventional nephrologist/surgeon) to observe endovascular procedures and PD catheter placement, and to learn the basics of physical examination, which they believed to be absolutely fundamental to nephrology training. Finally, the authors stipulated that there should be a rotation with a surgeon for an understanding of the issues involved in the placement of arteriovenous fistulae, polytetrafluoroethylene grafts, and PD catheters.[24] This emphasis on PD catheter placement training should be highlighted as studies have shown that training nephrologists to place PD catheters can lead to growth of

TABLE 1 Dialysis related procedure requirements for general nephrology fellows

Dialysis related procedure requirements		
General nephrology training		
ACGME requirement	**Comment**	**Recommendation**
Demonstrate knowledge		
Principles of dialysis access including indications, techniques and complications	Can be done with didactic instruction	Knowledge test
Demonstrate competence		
Placement of temporary vascular access	No location or number of placements recommended	10 independent placements per location
Formal instruction		
Maintenance of chronic vascular access patency	Training led by experienced clinician	Demonstrate competency through hands on OSCE (not required)
Balloon angioplasty	Experience to understand for future patient education	Observe to understand how physical examination correlated with findings
Radiology of vascular access	Include venogram, arteriogram and doppler assessment	Involve fellows in the work up of placing vascular access
Management of peritoneal catheters		Done during home dialysis experience but fellows should watch one placement

ACGME program requirements for graduate medical education in Nephrology. July 1, 2016.

TABLE 2 Training milestones for interventional nephrology fellowship

One month
Can properly perform physical exam of dialysis vascular access
Can obtain informed consent for procedures
Has identified a research project and mentor
Understands basic operation of the vascular access center
Understands basic radiation physics
Understands how radiation exposure is monitored
Can list the most common methods of radiation protection their principles, and practical applications
Can operate the fluoroscopy machine
Can operate the ultrasound machine
Can navigate the vascular access database
Can define the regulation of patient safety
Has completed research training, HIPAA, CIDA and conflict of interest training
Three months
Can successfully cannulate a vein/vascular access using ultrasound guidance
Understands the basic procedure for all interventional procedures
Can competently perform a native and transplant kidney biopsy
Can define the roles of each staff member on the vascular access team
Has obtained IRB approval and has begun data collection
Has prepared animal or IRB protocol relevant to experiments and/or sample collection
Becomes familiar with statistical methods
Has developed and presented at Renal Grand Rounds
Has led a journal article discussion
Competently can store images into the medical record
Can recognize vascular access abnormalities using surveillance techniques
Can recognize and manage allergic reactions to intravenous contrast dye
Can administer and maintain effective conscious sedation for patient comfort during and after the procedure
Six months
Can independently place a PD catheter
Can competently perform an ultrasound of the native and transplant kidney
Understands and participated in the center QA project
Recognizes and can treat procedure related complications during and after the procedure including but not limited to contrast/anaphylactic reaction, over sedation pain, nausea/vomiting, arrhythmia, decreased oxygen saturation, sepsis, hypertensive urgency, emergency, low blood pressure, hyper/hypoglycemia, or bleeding/hematoma
Provide appropriate patient follow-up in the inpatient and outpatient settings
Nine months
Preliminary research abstract written
Is analyzing research data, continues data collection
Has written the introduction and materials/methods section for publication
Can properly interpret an ultrasound of a native and transplant kidney
Understands the proper billing and coding of procedures
Understands the principles of office management
Has developed and presented a second presentation at Renal Grand Rounds
Has lead a second journal article discussion
Twelve months
All research data collected, analyzed, and first draft of manuscript written
Successfully, independently performs all endovascular procedures and can manage complications
Successfully, independently performs PD catheter placement and can manage complications
Successfully, independently performs ultrasound and biopsy of native and transplant kidney
Has obtained knowledge necessary to independently manage and operate a vascular access center

ASN-Sponsored Interventional Education Guidelines., in 7th Annual Scientific Meeting, ASDIN. 2011.

PD as a dialysis modality—something that is desperately needed in the United States.[28]

These broad educational objectives provided the skeleton upon which IN education was based, but the skeleton was not fleshed out until the publication of a curriculum by the American Society of Nephrology. This was put together by the Interventional Nephrology Advisory Group (INAG) whose mission was to define a comprehensive curriculum for academic-based interventional nephrology training programs.[29] The purpose of this curriculum was to define an ideal, comprehensive curriculum based on the six core competencies (patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems based practice) espoused by the ACGME. Each specific skill set (eg venous angioplasty, peritoneal dialysis catheter placement) was to be measured according to the six core competencies described above. Perhaps more importantly, several temporal training milestones were published to allow program directors to evaluate their specific educational achievements (Table 2).[29]

Interventional Nephrology Advisory Group made theoretical progress, but practical application of these principles to IN education continued to prove elusive due to several barriers. Firstly, education of IN practitioners occurs predominantly in the private practice setting, where academic curricula may be viewed as impractical. Secondly, while the INAG curriculum defined a 1-year roadmap, most IN practitioners become "fully trained" over the span of 3 months. Third, the number of existing practitioners of IN remains too low to allow the ABIM to designate IN as a subspecialty of Nephrology, with its own test and MOC requirements that would move the discipline towards a single curriculum.

5 | CONCLUSION

In summary, procedural nephrology can be challenging and rewarding, and should be promoted for young nephrologists who might thrive with procedures as a central part of their practice. The past two decades have witnessed great strides in the procedural training of general nephrology and IN fellows. Nevertheless, many barriers to achieving comprehensive procedural training remain. Chief among these barriers seems to be a crisis of identity for our discipline—are nephrologists procedural specialists or are they not?

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How to cite this article: Waheed S, Maursetter L, Yevzlin A. Dialysis access procedure training for the nephrologist. *Semin Dial*. 2018;31:149–153. https://doi.org/10.1111/sdi.12670