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Who should be referred for a fistula? A survey of nephrologists

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Abstract

Background. There is marked variation in the use of the arteriovenous fistula (AVF) across programmes, regions and countries not explained by differences in patient demographics or comorbidities. The lack of clear criteria of who should or should not get a fistula may contribute to this, as well as barriers to creating AVFs.

Methods. We conducted a survey of Canadian and American nephrologists to assess the patient variables considered to determine the timing and type of access requested. Perceived barriers and absolute contraindications to access were also collected.

Results. An immediate referral for a fistula was more highly preferred when patients are <65 years old, have minimal comorbidities or have no history of failed accesses. In older patients, and in those with increased comorbidities or a previously failed fistula, US nephrologists selected arteriovenous grafts as an alternative to the fistula, while Canadian nephrologists selected primarily catheters. Referral for vascular mapping was more common in the USA than in Canada. Gender did not influence the timing or the type of access. Perceived barriers to establishing a mature fistula included patient refusal for creation (77%) or cannulation (58%), delay in decision regarding dialysis modality (71%), wait time for surgical creation (55%) and high failure-to-mature rate (52%). We found that 27% of Canadian and 43% of American nephrologists indicated no absolute contraindications for permanent vascular access.

Conclusions. This study demonstrated marked variability in timing and criteria used to select patients for referral for a vascular access between nephrologists practicing within Canada and the USA. Establishing minimal eligibility criteria for fistulae is an important area of future research.

Keywords: arteriovenous fistula; central venous catheter; haemodialysis; vascular access

Introduction

The establishment and maintenance of vascular access in patients present major challenges in haemodialysis (HD) for the management of end-stage renal failure. Current practice guidelines recommend an arteriovenous fistula (AVF) as the preferred access for lower mortality and complication rates compared to central venous catheters (CVCs) and arteriovenous grafts, and that patients be referred for an AVF if their estimated glomerular filtration rate (eGFR) is <15 mL/min and progressive [1,2]. The Fistula First initiative promulgated these vascular access guidelines, resulting in a marked decline in grafts and an increase in both catheters and AVF in the USA [3]. However, studies within Australia, Canada and Europe have shown a trend towards increased CVC use, which is not fully explained by patient demographics or comorbidities [4–6].

Table 1. Characteristics of the two patient scenarios presented in the survey

	Patient A	Patient B
Similarities	Caucasian Progressive stage 5 (eGFR 15 ml/min) CKD Not eligible for peritoneal dialysis Medications: 4 antihypertensive agents, phosphate binders, vitamin D and a diuretic Palpable radial and ulnar pulse	
Differences	CKD secondary to polycystic kidney disease No history of diabetes, coronary artery disease, peripheral vascular disease Functions independently No additional medications	CKD secondary to diabetes History of coronary artery disease, peripheral vascular disease Functions with help of family Additional medications: erythropoietin (EPO), acetylsalicylic acid (ASA) and a statin

Recent studies have highlighted the high rate of failure in fistulae and several studies have identified patient criteria associated with fistula use [4,7,8], yet there are no specific standard patient eligibility criteria for a fistula. The clinician and vascular access team must evaluate the patient, weighing major issues including time to anticipated dialysis, referral timeline, potential failure of the access and patient characteristics and comorbidities. The variability in both incident and prevalent fistula use within and between countries may in part be related to nephrologists' preference based on patient characteristics.

We conducted a survey of nephrologists across Canada and the USA to document the patient characteristics used in determining both the timing of referral for a vascular access and the type of vascular access. Also, we identified nephrologists' perceived barriers and contraindications to permanent vascular access creation.

Materials and methods

Participants

Nephrologists from Canada and the USA who treat adult patients with chronic kidney disease (CKD) were eligible to complete the survey. Canadian nephrologists were recruited through the Canadian Organ Replacement Registry directory of dialysis centres. US nephrologists were

recruited through members of the North American Vascular Access Consortium. A fore-contact system was used to maximize response rates. One nephrologist, usually the chair or vascular access specialist, within each dialysis centre was sent an e-mail describing the study. This nephrologist recruited the other nephrologists in the centre and their e-mail addresses were provided for the study. A survey was then sent to the individual nephrologists and repeated two times if a reply was not received. Nephrologists attending vascular access-related workshops at the National Kidney Foundation meeting held in March 2009 were asked to complete a paper-based survey. Only participants from Canada and the USA were included.

Survey construction

We developed the survey based on two different clinical patient cases to differentiate the role age, sex and comorbidities played in determining timing and type of vascular access (VA). The patient descriptions are listed in Table 1. Both patients were Caucasian, and variation in race was not surveyed to avoid participant fatigue. The timing of referral for VA, use of VA mapping and choice of first and second vascular accesses were determined by varying the age, gender and history of a failed VA in each of the two patients. Choices for referral timeline are indicated in Figure 1. Access types included the AV fistula, graft or a CVC. A list of patient and healthcare system factors were used to determine what nephrologists considered as barriers and absolute contraindications to AVF creation. Participants were also asked which members of their patient care team are involved in VA referral.

We performed pre-testing of the survey questions on nephrologists within a single centre to ensure clarity and reduce ambiguity of the survey. We conducted the survey securely online using the website Survey Mon-

Fig. 1. Timing of referral for a permanent vascular access in Patient A and Patient B at an eGFR of 15 mL/min, with increasing patient age, by nephrologists' country of practice.

Table 2. Demographics of nephrologists completing the survey

Nephrologists' characteristics	Percent % (N = 148)
Country of origin	
Canada	50
USA	50
Age (years)	
<35	20
35–65	73
>65	3
Not available	4
Hospital affiliation	
University-affiliated hospital	68
Metropolitan (community-based hospital)	14
Regional/rural (hospital)	10
Private hospital	3
Years in practice	
<6	32
6–10	20
11–20	26
>20	22

key. Data were collected, summarized and analysed using Survey Monkey, Excel and Prism 5.0.

This study was approved by the University of Western Ontario Research Ethics Board at the London Health Sciences Center (15313E).

Results

A total of 148 nephrologists completed the survey, 62% using the online survey and the remainder at the National Kidney Foundation Meeting, Vascular Access Workshop 2008. The overall response rate for the online survey was 54%. The demographics of participants as well as their academic affiliation are shown in Table 2.

Vascular access referral in the patient with minimal comorbidities

Figure 1A illustrates the timing of referrals for a permanent vascular access, by age category and country, in a patient with progressive stage 5 CKD secondary to polycystic kidney disease and minimal comorbidities (Patient A).

In Patient A, the timing of referral was similar in Canada and the USA across all age groups, with delay of referral until dialysis initiation or use of a CVC primarily reserved for those patients ≥ 85 years old. There was a marked difference in the use of VA mapping between countries. In the USA the majority of patients would be referred for VA mapping regardless of age, while in Canada VA mapping was reserved for those ≥ 75 years old.

The fistula was the preferred access in Patient A; however, increasing age was associated with decreased referral for a fistula (Figure 2A). Grafts were requested more commonly as the alternative access for those ≥ 85 years old among American nephrologists compared to Canadian nephrologists (26 vs 5%), while Canadian nephrologists selected the catheter more in this age group (23 vs 11%, Figure 2A).

If Patient A had one failed fistula, nephrologists followed a similar trend for fistula referral but with slightly fewer referrals within all age groups, ranging from 44 to 96% among Canadian and American nephrologists (Figure 3A). Canadian nephrologists considered grafts more often after a failed fistula in the 75 and 85 age groups (23 and 19% with one failed access vs 0 and 5% with no previous failure), with catheters also used at a higher rate. American nephrologists also used grafts more often in the 75 and 85 age groups (37 and 43% with one failed access vs 10 and 26% with no previous failure), with catheters used for 85-year-old patients at a similar rate as those with no failed permanent accesses (12 vs 11%).

Vascular access referral in the patient with multiple comorbidities

Figure 1B illustrates the timing of referrals for a permanent vascular access, by age category and country and use of vascular mapping in a patient with progressive stage 5 CKD secondary to diabetes with multiple comorbidities (Patient B). Referral for a permanent VA decreased with increasing age, with no referral for a permanent VA in those ≥ 75 or ≥ 85 years old in 18 and 44% of patients, respectively, among Canadian nephrologists and 10 and

Fig. 2. Type of vascular access requested in Patient A and Patient B at an eGFR of 15 mL/min, with increasing patient age, by nephrologists' country of practice.

Fig. 3. Type of access referred for after one failed forearm fistula in Patient A and Patient B with increasing age by nephrologists' country of practice.

19%, respectively, among US nephrologists (Figure 1B). Canadian nephrologists would increase their use of vascular mapping in this population but it remained less than that in the USA.

Figure 2B depicts the nephrologists' choice for type of access, varying by country of practice and patient age. Age deterred fistula referral to a greater extent when considering the patient with multiple comorbidities, with catheters selected more frequently as the alternative in Canada and grafts more frequently in the USA. In the patient with one failed permanent access, fistula

referral as a second access declined to a greater extent than in Patient A. Again, grafts were the preferred second access in the USA with more Canadian nephrologists selecting a catheter, particularly in the older age group (Figure 3B).

Gender did not influence either the timing of referral nor type of VA requested in either Patient A or B or by age category (data not shown). Patient comorbidities had less influence on the timing of referral and type of access among US nephrologists compared to Canadian nephrologists. The nephrologists' years in practice did not influence

Fig. 4. Perceived barriers to establishing a mature fistula by Canadian ($n = 69$) and American ($n = 54$) nephrologists. Percentages are indicated immediately to the right of bars.

Fig. 5. Absolute contraindications for referral for a permanent vascular access (fistula or graft) as selected by Canadian ($n = 74$) and American ($n = 54$) nephrologists. Percentages are indicated immediately to the right of bars. PD, peritoneal dialysis; HD, haemodialysis; CKD, chronic kidney disease.

timing or choice of VA. However, those with more years of practice referred more frequently for VA mapping before access referral.

Perceived barriers and contraindications

The perceived barriers for use of a fistula for haemodialysis are depicted in Figure 4. Interestingly, access to a CKD clinic was not a significant barrier, particularly in Canada (4%), yet delay in decision making in choosing peritoneal or haemodialysis (75%), patient refusal for fistula creation (80%) and refusal to cannulate a fistula (60%) were significant barriers. The delay in surgical consultation was a greater barrier in the USA than in Canada (50 vs. 38%).

Figure 5 depicts factors considered to be absolute contraindications to fistula creation by Canadian and American nephrologists. Interestingly, 27% of Canadian and 43% of American nephrologists indicated that there were no absolute contraindications towards referral for permanent vascular access.

Table 3. Healthcare practitioners who participate in the decision of patient referral for vascular access as reported by the nephrologist (reported as percentage)

Practitioner	Canadian nephrologists percent % ($N = 74$)	US nephrologists percent % ($N = 74$)
Nephrologist	88%	97%
Surgeon	8%	0%
Multidisciplinary team	57%	14%
Vascular access coordinator/RN	32%	8%

Both Canadian and American survey participants indicated that they are likely involved in referral for permanent vascular access creation, and Canadian nephrologists are more likely to have a surgeon, vascular access coordinator and a multidisciplinary team involved in the referral (Table 3).

Discussion

Our study identified that, among both Canadian and American nephrologists, there is considerable variability in the timing of referral and the type of VA requested varying by patient age, comorbidities, previous permanent access history, but not gender. Perceived barriers and absolute contraindications to fistula creation also varied between Canadian and American nephrologists.

Though there is strong evidence that initiating haemodialysis with a fistula is associated with a decrease in mortality compared with catheter access [6,7,9–11], we have seen marked variation in the use of fistulae, either as the initial access or subsequent access across regions and countries, that is not explained solely by patient characteristics [5,6,10]. Our study indicates that nephrologists do not deem every patient eligible for a fistula, and the factors influencing that decision vary across nephrologists, dialysis facility, patient age, comorbidities and past access history.

The Dialysis Outcomes and Practice Patterns Study (DOPPS) has provided significant insight into the practice patterns for VA use. Recently, Pisoni *et al.* identified that the dialysis facility is independently associated with the type of VA used, suggesting it is a practice pattern of the

facility [10]. As there was great variation among facilities, it does suggest that there is opportunity to improve VA outcomes if we can influence practice patterns [10,12]. DOPPS data have also shown that the VA preferences of nurse managers and medical directors influence the type of VA in a facility; however, more frequent use of grafts or catheters did not improve outcomes [12]. In Canada, increased use of catheters has not resulted in improved outcomes, and catheters remain strongly associated with increased mortality [6].

Older age has been associated with lower fistula use [4,7,8,13], which is partially attributable to a decrease in referral for fistulae as well as increased rates of failure to mature (FTM) among those who do get a fistula [14]. National guidelines do not indicate selection criteria for a fistula nor do they select by age but rather state that the fistula is the access of choice and patients should be referred when their eGFR is <15 mL/min and progressive. This may not be the most rational nor economical approach and certainly, based on our survey, is not how nephrologists are practicing. O'Hare *et al.* [13] showed that patients aged 85–100 were more likely to die at a 2-year follow-up (41%) than to start dialysis (17%), with the remainder of the patients likely to survive without requiring dialysis. Within this age group, there is relatively minimal benefit for the creation of a fistula, and if they were created, many would not be used [13–15]. This age-dependent effect deserves closer scrutiny as the fastest rate of growth in HD is in the age group >75 [16]. Among those >75 and 85, there was a greater selection of grafts among US nephrologists and a greater preference toward catheters in the Canadian nephrologists. The literature provides little guidance as to patient outcomes comparing these two VA types in the elderly in either observational studies or randomized controlled trials.

The presence of comorbidities including diabetes, coronary artery disease and peripheral vascular disease deterred some nephrologists from permanent access creation within the older patient population or patients who have a history of failed AVFs. Type 2 diabetes has been shown to be predictive of not having an AVF for dialysis [8,17]. Potential reasons are vascular steal syndrome in diabetics, in which only the brachial artery can be used, and an increased risk of AVF calcification, which increases mortality [18,19]. Grafts were selected by American nephrologists in a majority of comorbid patients aged 75 and 85. Our study also found that a history of a failed permanent access will lead nephrologists to refer for grafts and catheters at a higher rate, in concordance with literature associating failed accesses with increasing catheter use [4]. With individuals at high risk for FTM among fistulae [20], particularly in the elderly [14], not using an AVF may be a more rational approach. The risk of FTM would be exceedingly high in these patients using a published, validated equation to predict risk of FTM [14].

Interestingly, given the same physical findings, gender did not play a role within the referral pattern for vascular access. Despite women being underrepresented within the AVF group, the pattern is likely explained by the tendency for women to have smaller vascular diameters and higher

primary failure rates, though gender is not an independent predictor of primary failure [14,21,22].

Vascular mapping was requested for the majority of patients by American nephrologists with little influence from age or comorbidity, whereas mapping was used by Canadian nephrologists in those with increased age and comorbidities. Preoperative ultrasound before VA placement can result in a change in surgical management, with increased numbers of fistulae placed and improved likelihood of selecting the most functional vessels preoperatively [23,24]. These studies influenced the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (K-DOQI) VA guidelines and it is now recommended to do VA mapping in all patients [2]. However, other national guidelines have not recommended VA mapping as a routine procedure [1], and recent studies have not demonstrated an improvement in fistula FTM rates with routine VA mapping in all patients [25,26]. The decreased use of VA mapping in Canada may reflect a problem with access to resources as well as a selection based on need.

Earlier and more frequent nephrology visits have been associated with improved first-year mortality on dialysis as well as increased use of fistulae [27–30]. In our survey, the majority of nephrologists indicate referral for a VA when the eGFR is 15 mL/min with a progressive decline as per the K-DOQI guidelines, except for the very elderly and those with multiple comorbidities. As identified in other studies, the creatinine decline does not always predict when a patient will start dialysis, making it challenging to time the VA referral [31].

Patient access to CKD clinics and education was cited to be a barrier by American nephrologists but not with Canadian nephrologists, which reflects on previous research suggesting the benefit of integrated CKD clinics with access to multidisciplinary teams that are established in Canada but not in the USA [32]. In spite of having reasonable access to CKD clinics, particularly in Canada, the majority of nephrologists felt delay in deciding dialysis modality, and refusal of creation and cannulation of a fistula were major barriers. This highlights the need to not only deliver information in the CKD clinic but ensure it is adequately transferred to the patient. A recent study indicated that those patients scoring in the top 25th percentile in an exam testing their CKD knowledge had a greater use of fistulae [33]. Understanding patient preference, beliefs, values and reasons for refusal will be necessary to appropriately address eligible patients who simply refuse a permanent VA. Patients desire a VA that is easy to cannulate, has minimal effect on their appearance, provides quick haemostasis after dialysis and enables arm comfort during dialysis [34,35]. Currently, VA may not meet all of these requirements. Also, we need to understand the decision-making process presented to patients regarding modality type and other aspects of dialysis preparation. While delay in deciding dialysis modality (peritoneal dialysis or HD) was an identified barrier, challenges to research in this area include the heterogeneous patient population [15].

In terms of surgical creation, wait times from referral to fistula creation in countries with higher prevalent fistula

rates, Italy, Germany and Japan, ranged from 5 to 6 days while it was 40–43 days in the UK and Canada, where fistula prevalence is lower [4]. Although the delay in surgical creation is much shorter in the USA than in Canada (7 vs 25 days), more American nephrologists indicated surgical consultation delay to be a barrier (50 vs 38%).

We have little understanding as to why patients refuse a permanent access or even refuse to cannulate a viable fistula. Potential reasons could be related to quality of life and the possibility of undergoing unnecessary surgery [13,35,36]. Our group is currently researching this area to address these barriers to using a fistula.

A significant percentage of American nephrologists felt there were no absolute contraindications to fistula creation, with a smaller echo from the Canadians. This identifies a gap in the literature and in our knowledge. In a procedure that has a significant failure rate and potential for harm, we should be establishing a description of the appropriate patient for fistula creation. Within the past 40 years, the primary failure rate has grown from 11 to 39% [4]. A higher rate of primary fistula failure, up to 50–65%, has been cited within the USA [20,37]. This high failure rate may be partially attributed to a lack of appropriate selection of patients.

Limitations within our study include the use of a self-report survey to assess referral patterns, which can factor in the clinician's inherent bias. There may also be differences between survey responses and the clinician's actual practices. The survey may not have been sensitive enough to reveal the clinician's reasoning process for patient referral and access choice. Because of the fore-contact system used to improve response rates, the dialysis sites for which no initial contact could be established were excluded. The opinions of respondents could potentially differ from non-respondents. The two cases were summarized to include factors influencing prevalence of vascular access use found within the literature, but the patients were generic in nature and may not have painted the full clinical picture for the sake of brevity. It was assumed that the nephrologists clearly understood the cases as we performed pre-testing of the survey on a select population within a single centre.

In summary, the timing of access referral and type of access requested varies by patient age, comorbidity and previous access failure. Establishment of patient eligibility criteria for a fistula as well as recommendations for an appropriate second access is needed. Future research should be focused on this as well as understanding the process of patient decision making regarding modality and access type.

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Conflict of interest statement. None declared.

Supplementary data

Supplementary Data is available at <http://ndt.oxfordjournals.org>.

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Bismuth coating of non-tunneled haemodialysis catheters reduces bacterial colonization: a randomized controlled trial

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Abstract

Background. Haemodialysis (HD) catheter-related blood stream infections are a major cause of morbidity and mortality in patients with acute and chronic renal failure.

Methods. We conducted a randomized, prospective, double-blinded trial investigating the clinical value of bismuth-coated non-tunneled HD catheters in patients in need of temporary short-term vascular access. A standard catheter (SC) was compared to a surface-modified, bismuth-film-coated catheter (FCC). After removal of the catheter for any reason, both arterial and venous lumina were rinsed and the fluid cultured for detection of bacterial colony-forming units (CFU). The catheter tip was placed in a tube containing sterile saline, sonicated and shortly centrifuged to remove debris (3 min at 1000 g). The supernatant was cultured and assayed for DNA content.

Results. Seventy-seven patients in three HD units were randomized. Thirteen patients suffered from acute renal failure, 60 patients from chronic renal failure, and four patients without renal insufficiency were treated with plasma exchange. The time to catheter removal was not significantly different between groups, with a mean of 18.5 ± 2 days for SC and 15.1 ± 2 days for FCC. In most cases, the reasons for catheter removal were related to no further need for extracorporeal therapy or establishment of a permanent vascular access. Six catheters for SC and four catheters for FCC were removed because of presumed infection. Bacterial colonization was significantly lower for coated catheters compared to standard catheters, both for cultured catheter tips as well as for CFU in rinse fluids ($P < 0.05$).

Conclusions. Surface modification with bismuth film reduces bacterial colonization of temporary non-tunneled