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Differential Impact of Central Venous Catheters versus Arteriovenous Fistulae on Quality of Life among Irish Haemodialysis Patients

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Key Points

- The study compares the effect of vascular access (arteriovenous fistula versus central venous catheter) on health-related quality of life.
- Arteriovenous fistula users were more satisfied with their access but dissatisfied with physical complications of access type, including bruising, bleeding, and pain.
- Central venous catheter users were more dissatisfied with social aspects of access care such as showering and bathing.

Abstract

Background Arteriovenous fistulae (AVF) have superior clinical outcomes compared with central venous catheters (CVC) among patients undergoing hemodialysis (HD). Yet, there is increasing recognition that health-related quality of life (HRQoL) may be more important to patients than survival and that differences may exist between AVF and CVCs in this regard. This study compared HRQoL between AVF and CVC in an Irish cohort.

Methods We conducted a cross-sectional survey among prevalent patients undergoing hemodialysis ($N=119$) dialyzing with either an AVF or CVC at a regional program. The Short Form 36 (SF-36) and a validated Vascular Access Questionnaire (SF-VAQ) compared QoL between AVF and CVC in domains of physical functioning, social functioning, and dialysis complications. Multivariable logistic regression compared differences between groups for outcomes of physical functioning, social functioning, and dialysis complications expressed as adjusted odds ratios and 95% CI.

Results Mean age was 66.6 years; 52% were using an AVF and 48% had a CVC. Patients dialyzing with an AVF were more satisfied with their access when asked directly (6.2 versus 5.0; $P<0.01$). Physical functioning scores for bleeding, swelling, and bruising were significantly higher for AVF than CVC ($P=0.001$, $P=0.001$, and $P<0.001$, respectively). In contrast, patients with a CVC reported greater difficulties in bathing and showering than those using an AVF (4.4 versus 2.0; $P<0.001$), whereas patients with an AVF expressed greater concerns with physical appearances. Compared with AVF, CVC users were less likely to report difficulties in physical functioning (OR=0.35; 95% CI, 0.12 to 0.94; $P=0.04$) but more likely to report dialysis complications (OR=1.94; 95% CI, 0.69 to 5.87; $P=0.22$).

Conclusions Vascular access contributes to HRQoL in hemodialysis. CVCs are associated with fewer difficulties from bleeding and bruising but greater negative effect on social activities, including bathing and showering. Overall, patients with a CVC had lower dissatisfaction scores than patients with an AVF when all three domains were added. Innovation in vascular access design and engineering may confer benefits and improve patient comfort on HD.

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Introduction

A diagnosis of ESKD is associated with a shortened life span and reduced quality of life (QoL) (1–3). Hemodialysis (HD) remains the principal modality for most patients who reach ESKD and require treatment and is delivered through either an arteriovenous fistula (AVF) or a central venous catheter (CVC) (4). National and international guidelines recommend the

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use of AVF whenever possible because the risk of infections and other complications is highest among patients using CVCs (5–10). This is in part due to a mounting body of evidence that suggests that the AVF confers a survival advantage over CVC, and that the risk of several major complications such as infection, thrombosis, loss of patency, and hospitalization are more common with CVCs than with AVF. Nevertheless, despite these dangers, CVC use remains the principal form of access for the majority of incident patients undergoing HD (11,12). However, controversy exists as to whether the AVF is the preferred approach for all patients who approach ESKD and require treatment. Increasingly, new evidence suggests that the use of AVF as primary vascular access in certain subgroups of patients undergoing HD such as the elderly and those with substantial multimorbidity has been found to be less beneficial (13,14). This is further reflected in the Kidney Disease Outcomes Quality Initiative (KDOQI) where the "Fistula First" is recommended only after clinical judgment and consideration of a holistic approach to the patient. The 2019 update to the KDOQI Clinical Practice Guideline for Vascular Access seeks to move away from a primary AVF focus to a more patient-centered approach known as the ESRD Life-Plan Strategy (15).

Beyond patient survival, there is increasing emphasis on patient-reported outcomes and health-related QoL (HRQoL) among patients who develop ESKD and require HD (3,16). QoL is an indicator of effectiveness of the medical care provided to patients receiving dialysis, and mounting evidence has shown that all key domains of QoL are strongly associated with patient survival (17–19). Given the challenges and burden of care required for the planning, placement, and monitoring of vascular access in dialysis, it would seem appropriate that vascular access recommendations consider a patient's personal preferences, life goals, and HRQoL. A report in *The Journal of Vascular Access* in 2020 highlights the need to examine the HRQoL outcomes relating specifically to vascular access to facilitate the initiation of quality improvement programs for this population (16). The benefits extend not only to service provision and planning but also to the support of patient choice and care.

CVC is the predominant form of vascular access for incident patients undergoing HD in Ireland. A recent study found that up to 77% of new patients depend on CVC as their primary vascular access (20,21). Although several factors may account for this observation, it is very clear that CVCs continue to be the dominant form of vascular access for a large proportion of patients to support HD (22). To our knowledge, information is scarce on whether HRQoL is better for patients who have a CVC rather than an AVF. Furthermore, it is unclear whether patients perceive the AVF as a superior vascular access strategy over CVC. Clarifying the symptom burden associated with each vascular access is an essential first step for strategic planning of a patient-centric vascular access service and embedded quality improvement program.

The primary goals of this study were to assess patient satisfaction relating to vascular access using a validated vascular access questionnaire (Short Form Vascular Access Questionnaire [SF-VAQ]) and to determine whether differences exist in symptom burden across the domains of physical and social functioning, and dialysis complications (23,24).

Materials and Methods

Study Design

We conducted a cross-sectional survey to determine HRQoL among patients undergoing HD at a regional program in the Mid-West Region of Ireland. Adult patients (≥18 years of age) were recruited from dialysis units at University Hospital Limerick, Ireland, and its contracted satellite unit. Data were collected on demographic characteristics, cause of ESKD, laboratory values, comorbid conditions, and medication during a screening visit. All patients provided written informed consent. Patients were excluded if they had dementia or were under the influence of

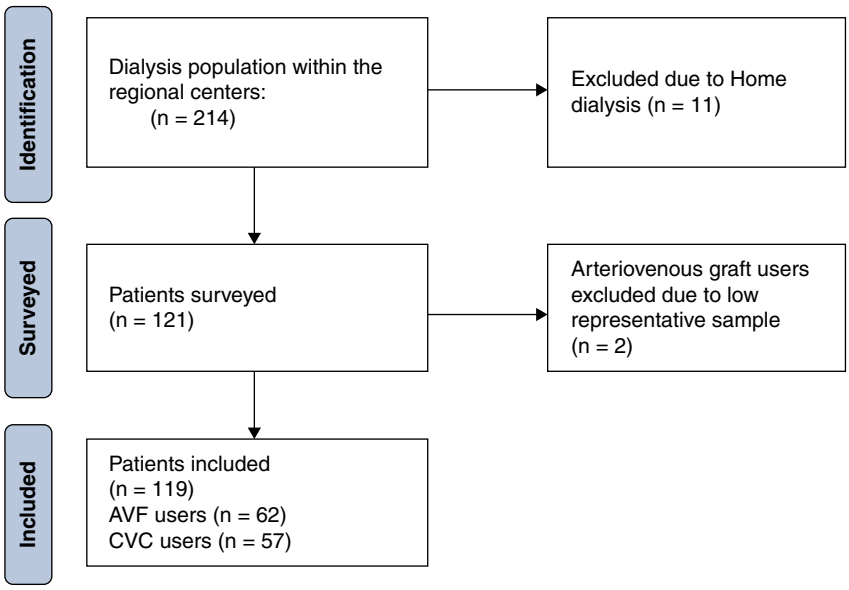

Figure 1. | **Flow diagram of included/excluded patients.**

substances that may have interfered with their ability to cooperate. Patients were also excluded from this study if utilizing a arteriovenous graft as dialysis access due to low representative numbers. Figure 1 details the patient cohort included in the study.

Assessment of HRQoL

The Short Form 36 (SF-36) was used to assess the general health status and QoL score for each patient (22). This questionnaire included 36 questions that captured patients' perception of their health across eight domains of daily life: physical functioning, physical health, social functioning, vitality, bodily pain, role of emotional limitations, mental health, and general health. Response questions within a dimension were combined to generate a score from 0 to 100, where 100 indicated good health and optimal functioning in that domain. For bodily pain, a high score indicated freedom from pain. These eight subscales can be summarized according to two primary dimensions of functioning: a physical component summary score (PCS) and a mental component summary score (MCS). The eight scales of the SF-36 were standardized using a z score transformation, with the mean and SD obtained from an Irish general population (22).

Assessment of Patient Satisfaction with Access Type

The SF-VAQ was used to measure patient satisfaction with their vascular access (24). This validated 13-item form assessed level of patient satisfaction across four domains: overall satisfaction, physical symptoms, social functioning, and dialysis complications. Response to each item within a domain was measured using a seven-point Likert scale with a neutral middle. In the domain assessing overall satisfaction, a Likert value of 1 indicated low satisfaction and a score of 7 indicated high satisfaction. For the other three domains, lower scores of 1–3 indicated no or low problems for that item, and higher scores of 5–7 indicated serious issues.

Statistical Analyses

Descriptive characteristics are reported as means±SDs or as number of cases and percentages. Baseline characteristics were compared using the chi-squared test for categorical data and the Kruskal–Wallis test for continuous data. The one-sample t test was used to compare mean scores with Irish normative values for general health, bodily pain, mental health, and vitality dimensions. Comparisons of HRQoL scores were compared by access type using the Kruskal–Wallis test. For each domain of the SF-VAQ, separate logistic regression models were calculated to estimate the odds ratio (OR) and 95% confidence intervals (CIs) of scoring in the highest quartile of each HRQoL domain by vascular access type. $P<0.05$ was accepted as statistically significant. All statistical analyses were performed using R v4.0 (The R Foundation for Statistical Computing, Vienna, Austria).

Ethical Approval

The study was approved by the Ethics Committee at University Hospital Limerick.

Results

Baseline Characteristics of the Study Population

The study included 119 patients: 62 with a documented AVF and 57 with a CVC. The baseline characteristics for the study population are shown in Table 1. The mean age was 66.6 years; 60% were men, and the majority were White Irish (79%). Diabetes was the primary cause of ESKD, and the distribution of comorbid conditions was generally similar between groups.

HRQoL

Table 2 summarizes survey responses from the SF-36 by vascular access type. Overall, summary scores for the entire study population for the two primary dimensions of functioning (PCS and MCS) were low at 33.6 and 48.3, respectively, and similar to studies from previous HD cohorts (17). General health perception was significantly better for patients with a CVC than for patients with an AVF (48.4 versus 40; $P<0.05$). Patients with a CVC reported greater freedom from bodily pain than patients with an AVF did (62.6 versus 52.6; $P<0.05$). Both groups were generally comparable in their perception of HRQoL across the other subscales in relation to physical functioning, role limitations caused by physical problems, vitality, social functioning, role limitations caused by emotional problems, and mental health.

Vascular Access Satisfaction

Table 3 summarizes the outputs from the SF-VAQ, with the results presented as mean Likert scores. Where patients indicated their level of agreement with the statement "I am satisfied with my vascular access" (where 1 is "strongly disagree" and 7 is "strongly agree"), patients with an AVF initially reported greater overall satisfaction with their access compared with patients with a CVC (6.2 versus 5, respectively; $P=0.008$).

Physical Functioning

Likert scores were significantly higher for AVF users than CVC users, indicating more problems with pain related to their vascular access (3.3 versus 2.5; $P=0.04$), bleeding (3 versus 1.7; $P=0.001$), swelling (3.1 versus 1.8; $P=0.001$), and bruising (3.7 versus 2; $P<0.001$). In general, Likert scores for both types of vascular access were <4 in the domain of physical functioning, suggesting that although differences existed, overall, patients had high levels of satisfaction with their vascular access. The mean summative scores out of a possible 28 points across the physical domain were 8 and 13 for catheters and fistulae, respectively, indicating higher levels of dissatisfaction for those with fistulae ($P<0.05$).

Social Functioning

Patients with an AVF reported greater interference with daily activities of living (3.5 versus 2.8; $P<0.05$) and physical appearance (3.3 versus 2.1; $P<0.01$) than those with a CVC. In contrast, CVC users reported significantly greater difficulties in showering and bathing than AVF users (4.4 versus 2; $P<0.001$), whereas there were no reported differences in sleep disturbance between groups. The mean summative scores for dissatisfaction across the four items

Table 1. Baseline characteristics of study population according to vascular access type

Variable	*N*	Overall	Fistula	Central Venous Catheters	*P* Value
Observations, *n* (%)		119 (100)	57 (48)	62 (52)	0.4
Age at baseline, mean±SD	119	66.6±13.1	65.5±13.3	67.7±12.9	
Sex, *n* (%)					
Women		48 (40)	17 (30)	31 (50)	0.04
Men		71 (60)	40 (70)	31 (50)	
Race and ethnicity, *n* (%)					
White Irish		94 (79)	47 (82)	47 (76)	0.65
White British		2 (2)	—	2 (3)	
Black British		1 (1)	—	1 (2)	
White other		2 (2)	1 (2)	1 (2)	
Other		8 (7)	3 (5)	5 (8)	
Missing		12 (10)	6 (11)	6 (10)	
Primary cause of ESKD, *n* (%)					
Diabetes		20 (17)	12 (21)	8 (13)	0.49
Glomerulonephritis		19 (16)	11 (19)	8 (13)	
Hypertension		11 (9)	4 (7)	7 (11)	
Autosomal dominant polycystic disease		11 (9)	6 (11)	5 (8)	
Hereditary kidney disease		1 (1)	NA	1 (2)	
Other		33 (28)	12 (21)	21 (34)	
Unknown		24 (20)	12 (21)	12 (19)	
Comorbid conditions, *n* (%)					
Hypertension		96 (81)	44 (77)	52 (84)	0.49
Diabetes		37 (31)	18 (32)	19 (31)	1
Cancer		37 (31)	18 (32)	19 (31)	1
Heart failure		49 (41)	24 (42)	25 (40)	0.99
Thyroid disease		15 (13)	9 (16)	6 (10)	0.47
History of stroke/TIA		6 (5)	5 (9)	1 (2)	0.17
COPD		5 (4)	1 (2)	4 (6)	0.41
Peripheral vascular disease		13 (11)	4 (7)	9 (15)	0.31
Coronary artery disease		38 (32)	22 (39)	16 (26)	0.19
Obesity		9 (8)	3 (5)	6 (10)	0.57
Gout		22 (18)	14 (25)	8 (13)	0.16
Hypercholesterolemia		28 (24)	13 (23)	15 (24)	1
Depression		8 (7)	4 (7)	4 (6)	1
Arthritis		22 (18)	14 (25)	8 (13)	0.16
Osteoporosis		5 (4)	2 (4)	3 (5)	1
Current or ex-smoker		11 (9)	4 (7)	7 (11)	0.63
Anthropometric data, mean±SD					
Height, cm	118	166.94±11.54	169.05±11.32	165.03±11.5	0.04
Weight, kg	113	70.32±16.23	70.3±14.2	70.34±18.08	0.81
BMI, kg/m^2	112	25.77±6.86	25.18±6.78	26.32±6.95	0.2
Laboratory measures, mean±SD					
Hemoglobin, g/dl	118	10.56±1.61	10.55±1.85	10.58±1.35	0.61
Serum albumin, g/L	119	32.58±4.28	33.07±3.53	32.13±4.85	0.21
Serum calcium, mmol/L	119	2.24±0.19	2.28±0.17	2.2±0.19	0.05
PTH, pg/ml	85	289.46±194.26	306.85±234.35	274±151.15	0.97
Serum phosphate, mmol/L	119	1.55±0.58	1.58±0.68	1.53±0.47	0.87
Urea reduction rate, %	119	74.67±9.71	74.23±11.84	75.06±7.3	0.95
CRP, mg/L	27	31.22±62.87	40.83±92.81	23.53±20.76	0.18

Percentages may not total 100 due to rounding. TIA, transient ischemic attack; COPD, chronic obstructive pulmonary disease; BMI, body mass index; PTH, parathyroid hormone; CRP, C-reactive protein. $P<0.05$ was accepted as statistically significant.

in the social functioning domain were 10 for catheters and 10.4 for fistulae out of a possible 28 points ($P=0.91$).

Dialysis Complications

The dialysis complications domain explored differences between access type in the areas of vascular access care, hospitalization, and concerns about vascular access longevity. Patients with a CVC reported greater difficulties in caring for the access than those with an AVF (2.6 versus 1.6; $P=0.005$). There were no reported differences between groups in concerns for access longevity and hospitalization. The mean summative scores for dissatisfaction across the four items out of a possible 28 points in the dialysis complications domain were 9.3 and 8.12 for catheters and fistulae, respectively ($P=0.36$).

When the scores were summed across the physical, social functioning, and dialysis complications domain, the mean

Table 2. Summary of results from the SF-36 health-related quality of life survey in dialysis patients using arteriovenous fistula versus central venous catheter

Domains	Variable	Overall	Arteriovenous Fistula	Central Venous Catheter	*P* Value
Physical functioning	118	44.9±28.2	47.8±27.3	42.2±29	0.35
Role of physical limitations	105	32.2±40.1	30±37.8	34.2±42.3	0.96
Bodily pain[a]	117	57.7±29.8	52.6±28.8	62.6±30.2	0.05
General health perception	114	44.3±21.4	40±19.4	48.4±22.5	0.04
Vitality	115	43±20.8	40.1±19.2	45.7±22.1	0.08
Social functioning	119	61±29.6	57.9±29.5	63.9±29.6	0.3
Role of emotional limitations	99	57.7±45.1	61.2±43.2	54.3±47	0.51
Mental health	115	72.8±19.6	72.2±21	73.4±18.5	0.98
Physical component score[b]	98	33.6±10.1	32.05±9.4	35.2±10.6	0.13
Mental component score[b]	98	48.3±11.6	47.95±10.97	48.74±12.3	0.59

Values are expressed as mean±SD. Each subscale was scored on a range of 0–100; the higher the score, the better the health-related quality of life.
[a]The pain subscale was scored so that a high score indicates freedom from pain.
[b]Mental and physical component scores based on normative data from an Irish population (22).

sum scores were 36.2 and 30.3 and median sum scores were 33 and 28 for fistulae and catheters, respectively, out of a possible 84 points (12 questions multiplied by seven points of the Likert scale). Thus, patients using an AVF reported the highest levels of dissatisfaction overall, but these were not significantly different from their CVC counterparts ($P=0.07$).

Multivariate Analysis of SF-VAQ Domain-specific Scores in CVC versus AVF Users

Figure 2 illustrates the ORs and 95% CIs for achieving a score in the highest quartile (versus lower quartiles) in each SF-VAQ specific domain (physical functioning, social functioning, and dialysis complications) by vascular access type. Patients with CVCs had fewer difficulties relating to physical functioning compared with their counterparts with an AVF. This finding persisted after adjustment for age sex and comorbidities (OR=0.35; 95% CI, 0.12 to 0.94; $P=0.04$). Although CVC patients had increased likelihood of dissatisfaction in terms of social functioning and dialysis complications, these did not reach statistical significance.

Discussion

In this regional survey of prevalent patients undergoing HD, we found significant differences in HRQoL between patients dialyzed with an AVF compared with a CVC. Findings from the SF-VAQ revealed that patients using an AVF reported significantly more physical problems than patients who were dependent on a CVC. Problems with bleeding, swelling, and bruising were the dominant concerns for AVF users and led to higher dissatisfaction scores

Table 3. Mean Likert scores of SF-VAQ in dialysis patients by vascular access type

Variable	*N*	Overall	AVF	CVC	*P* Value
Overall satisfaction with vascular access					
Satisfaction with vascular access (3)	102	5.6±1.9	6.17±1.38	5±2.18	0.008
Physical functioning					
Pain (4)	106	2.88±2.22	3.28±2.28	2.47±2.11	0.04
Bleeding (5)	107	2.35±2.01	2.98±2.26	1.72±1.51	0.001
Swelling (6)	108	2.42±1.97	3.06±2.16	1.8±1.56	0.001
Bruising (7)	107	2.84±2.18	3.7±2.12	2±1.9	<0.001
Social functioning					
Daily activities (8)	108	3.13±2.26	3.5±2.25	2.76±2.23	0.04
Appearance (9)	108	2.71±2.23	3.32±2.38	2.13±1.92	0.005
Sleep (10)	106	2.24±1.87	2.35±1.93	2.13±1.82	0.38
Bathing and showering (11)	107	3.21±2.4	1.96±1.71	4.44±2.34	<0.001
Dialysis complications problem					
Complications (12)	106	2.35±2.04	2.04±1.73	2.66±2.29	0.34
Access care (13)	106	2.08±1.68	1.58±1.26	2.56±1.89	0.005
Hospitalization (14)	105	2.03 (1.75)	1.85±1.68	2.21±1.81	0.36
Worry about access longevity (15)	106	3.35 (2.26)	3.4±2.29	3.3±2.25	0.92

Results are presented as mean±SD. Kruskal–Wallis test assessed different Likert score distributions by vascular access type. For question 3 on satisfaction with vascular access, a higher score indicated greater satisfaction. For questions 4–15 and domains, if a patient indicated 1–3, they agreed there was low or no problems for that item; if they indicated 4, they were neutral; if they indicated 5–7, they agreed there was serious problems for that item. $P<0.05$ was accepted as statistically significant. SF-VAQ, Short Form Vascular Access Questionnaire; AVF, arteriovenous fistula; CVC, central venous catheter.

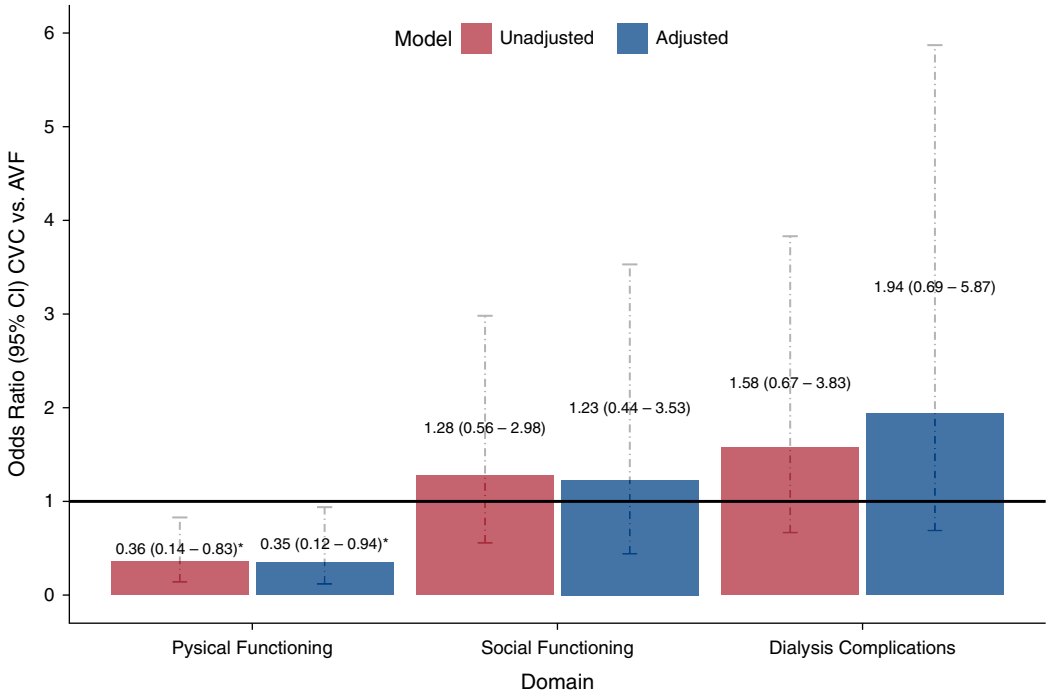

Figure 2. | **Unadjusted and adjusted odds ratios (OR) of the summative quality of life score above the third quartile for each Short Form Vascular Access Questionnaire domain by access type (physical functioning >15.5, social functioning >15.5, dialysis complications >13).** If OR<1, central venous catheters were less likely to have domain-specific complications. If OR>1, central venous catheters were more likely to have domain-specific complications compared with arteriovenous fistula patients. Adjustments include age, sex, and comorbidities. *P<0.05. For the adjusted physical functioning, social functioning, and dialysis complications model, R^2=0.21, 0.17, and 0.20, respectively.

in the physical functioning domain. Moreover, when we accounted for differences in baseline characteristics, CVC users were less likely to report difficulties in physical functioning than AVF users. In contrast, concerns with showering and bathing were far more common concerns for CVC users than for AVF users. These findings suggest that vascular access adversely affects QoL, with a differential effect on specific health-related dimensions. Such findings should serve to fuel innovation in dialysis access design in in order to improve QoL across the physical, social, and functional domains.

It is intriguing that despite the greater discomfort from bleeding, bruising, swelling, and appearance, our survey revealed that Irish patients reported overall greater satisfaction with fistulae than with catheters (6.2 versus 5; P<0.008). This observation is concordant with findings observed by Quin *et al*. in a Canadian cohort (24). One may have surmised that physical symptoms associated with repeated fistula use (*i.e.*, pain, bleeding, bruising, and appearance) would have negatively influenced overall satisfaction rates for fistulae in preference for catheters. However, this appears not to be the case. When asked directly, patients with an AVF reported being more satisfied with their access. However, when summative scores were compared across domains, AVF users reported more difficulty, particularly in the physical domain. It is possible that perceived limitations attributed to catheters outweighed those attributed to fistulae. Two key observations from this study are worthy of mention. First, vascular access care was significantly more bothersome for patients with catheters than for those with fistulae. Second, catheter users reported significantly more difficulties in bathing and showering than fistula users. Collectively, these items may have conferred a greater effect on QoL for patients than symptoms attributed to the physical dimension alone.

The assessor of QoL has moved away from a physician-led assessment to a patient-led assessment. Patient-perceived QoL gives a valuable insight into the factors that affect QoL for the patients and their interaction with health systems. A growing body of evidence suggests that for many patients, QoL supersedes mortality benefit in many chronic disease states (17–19). Vascular access is a contributing factor to HRQoL in patients undergoing HD (25). Although several studies have comprehensively addressed the quantitative effect of vascular access type on major clinical outcomes, including infection, morbidity, and mortality, there has been far less focus on the qualitative aspects of vascular access and consequently a lack of knowledge on patient perceptions and patient-reported outcomes (16). In an attempt to address these concerns, the Kidney Disease Quality of Life Questionnaire Short Form (KDQoL-SF) was developed to assess HRQoL in dialysis using a validated questionnaire that focuses on QoL and disease burden relating to kidney disease (23). However, given the limitations of the KDQoL-SF because it was not specifically designed for assessment of HRQoL relating to vascular access, a more specific survey instrument was required. By utilizing the SF-VAQ for this study, we gained valuable

insights from a validated 13-item questionnaire that explored and quantified QoL concerns as they related to the primary vascular access (26).

Vascular access provision remains a key concern for both patients and health care organizations throughout the patient journey (7,8,15,16). A better understanding of the attitudes and perceptions of patients on type of vascular access is critical for the design, planning, and delivery of sustainable vascular access programs and quality improvement initiatives (16–19,24,26). Despite huge efforts at improving predialysis care and access planning, tunneled dialysis catheters account for a large proportion of vascular access among incident and prevalent patients (11,12,26). Our analysis supports the findings from previous studies that dialysis catheters negatively influence HRQoL from a social dimension by interfering disproportionately with daily activities of living, including showering and bathing. Equally important, patients reported greater dissatisfaction in the care of tunneled catheters: "During the past 4 weeks, my vascular access was difficult to care for (*i.e.*, dressings, trying to keep access clean and protected)." These findings suggest that the current management practices for catheters fail to support the most basic needs of patients in maintaining cleanliness through regular showering and supporting easier mechanisms for exit site care. The vascular access policy for CVC care at our program advises patients to keep the exit site dry, although the methods used to achieve this vary widely from shower avoidance to self-funded catheter covers. A more specific standardized policy for exit site maintenance might improve HRQoL scores within this domain. The Hemodialysis Infection Prevention Protocols Ontario—Shower Technique (HIPPO-ST) group have published a pilot randomized control trial with favorable initial results, which is encouraging and perhaps will lead to more standardized protocols being available for patient and clinician use (25).

The current study has some limitations. The survey was center based, and thus the results may not be generalizable to other dialysis programs. The survey questionnaire was based on self-report, and thus there is the possibility of recall bias with regard to some of the survey items. The instrument used to characterize vascular access–related QoL, although verified, may be an imperfect tool. There are current efforts to development a more specific HRQoL tool for vascular access on HD, which may be more reflective of key drivers of HRQoL for patients undergoing HD relating to their QoL (27). The use of arteriovenous grafts is a relatively uncommon form of vascular access within the region examined. However, the limitations are counterbalanced by several strengths. The study included many patients who were dialyzing with a fistula and tunneled catheter, and the baseline characteristics of the study population were broadly similar to those of the prevalent HD population in Ireland (11). The vascular access survey chosen is a validated instrument with strong internal validity (24,27). It has been used to measure patient satisfaction with vascular access in several countries (16,28,29).In conclusion, HRQoL is directly affected by vascular access among Irish patients undergoing HD. Although patients in general expressed satisfaction with their vascular access, there were important differences between groups. Patients with an AVF reported greater satisfaction than patients with a CVC on direct questioning. However, AVF users experienced greater difficulty with physical issues relating to pain, bleeding, and bruising. When scores from the three domains of physical, social, and dialysis functioning were added together, AVF users paradoxically reported higher dissatisfaction scores. This study sheds further light on the importance of showering and bathing and general access care for patients undergoing HD with a CVC. Minimizing the effect of vascular access on HRQoL should remain a key priority for all stakeholders involved in vascular access design and quality improvement programs in order to improve QoL.

Disclosures

M. Dawood reports an advisory or leadership role for OCFP FMS Planning Committee. A.G. Stack reports consultancy for AstraZeneca and Vifor Pharma; research funding from Educational Grant Vifor Pharma; honoraria from AstraZeneca and Vifor; being on the editorial board for *BMC Nephrology*; and participating in a speakers' bureau for Vifor. E. White reports patents or royalties from the University of Limerick. All remaining authors have nothing to disclose.

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Author Contributions

L.D. Browne was responsible for software; L.D. Browne, F. Leahy, I.C. Maguire, and M.C. Ryan were responsible for data curation; L.D. Browne and I.C. Maguire were responsible for formal analysis; L.D. Browne, I.C. Maguire, and A.G. Stack reviewed and edited the manuscript; M. Dawood, I.C. Maguire, and A.G. Stack were responsible for conceptualization; I.C. Maguire wrote the original draft of the manuscript; I.C. Maguire, A. O'Sullivan, L. O'Sullivan, and E. White were responsible for resources; I.C. Maguire and A.G. Stack were responsible for project administration; and A.G. Stack was responsible for funding acquisition, supervision, and validation.

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