Chapter 7
The Relationship between the type of Vascular Access used and Survival in UK RRT Patients in 2006

Clare Castledine, Dirk van Schalkwyk, Terry Feest

UK Renal Registry, Bristol, UK

Key Words
Arterio-venous fistula · Arterio-venous graft · End stage renal disease · End stage renal failure · Haemodialysis · Survival · Tunnelled haemodialysis catheter

Summary

- 1 year mean centre level survival was 86.4% (95% CI: 82.2–90.9) in 2006.
- Definitive access (AVF or AVG) was used by a mean of 69.8% of patients in included centres in 2005.
- The type of access in use was able to explain only 6% of the variation in centre level survival.

Introduction

The type of vascular access used for chronic haemodialysis has been postulated as one of the predictors of patient survival [1] mainly thought to be due to higher rates of infection and septicaemia in patients dialysing using cuffed, tunnelled dialysis catheters compared with arterio-venous fistulae (AVF) and arterio-venous grafts (AVG) [2, 3]. Early studies in incident patients in the USA found that those starting dialysis with a catheter had higher rates of late presentation to a nephrologist, greater burdens of comorbidity, lower serum albumin and creatinine [1] and were more likely to be underweight [2]. Whilst these studies attempted to adjust for these recognised differences between patient groups there is the possibility that bias by indication remains. One of the aims of the DOPPS 1 and 2 studies was to examine the effect of vascular access type on outcomes at a dialysis centre level to try and minimise this bias by indication [4]. The majority of patients enrolled in studies comparing survival using different types of dialysis access were not from the UK but from the USA [1–3], US/Europe/Japan/Australia and New Zealand combined [4, 5] and Australia/New Zealand [6]. The results may not apply to the UK where the rate of late presentation, diabetes and Black ethnicity, all of which affect survival, are much lower [7].

The above studies largely apply to incident dialysis patients in whom the confounding factors of the reason for use of venous catheter, such as late presentation, are particularly important. Conclusions from incident patients may not be applicable to well-established prevalent patients on haemodialysis who for a number of reasons may elect for, or be recommended to continue to use venous dialysis catheters. Some renal centres maintain that excellent long-term results can be obtained with appropriate choice of patient, catheter type and catheter care [8] and challenge the published recommendations on long-term use of catheters.

This is an observational UK centre level study reporting on the relationship between the percentage of established prevalent patients using definitive access and the subsequent 1 year survival.

Methods

The UK Renal Registry (UKRR) collects clinical and biochemical data for all patients receiving RRT in the UK from day 0; the data collection methods have been described in detail elsewhere [9]. In brief, renal information technology systems operating in English, Welsh and Northern Irish renal centres with appropriate software links to the UKRR database are able to export quarterly data files electronically to the UKRR on a predefined dataset including demographic data, primary renal diagnosis, postcode of residence at initiation of RRT and RRT modality. Data from renal centres in Scotland are submitted electronically via the Scottish Renal Registry. Data on vascular access are not routinely collected.

Data from a vascular access audit, performed by the Renal Association, in March 2005 were used. The percentage of haemodialysis patients using an AVF or AVG on dialysis on the 31st March 2005 in the main centres and satellite units was obtained and 1 year survival calculated until 31st March 2006. Patients receiving less than 3 months of dialysis at this date were excluded from the survival analyses.

Regression analysis was used to assess the amount of variation in 1 year survival that could be explained by the percentage of patients using an AVF or AVG in a centre. The results were weighted based on the number of patients in each centre. Survival was adjusted to age 60 and then by the percentage of patients with diabetes and who were non-White in each centre.

Results

There were vascular access audit data on 17,409 patients from 54 renal centres of which 16,984 (97.6%) patients also dialysed in centres which reported to the UKRR in 2005. This represented 74.8% of the patients known to the UKRR in 2005 which at that time represented 65 of the 72 renal centres in the UK.

15,418 patients survived for 1 year and 1,566 patients died or were lost to follow up in this time period. The mean centre level 1 year survival was 86.4% (95% CI: 82.2–90.9) and was 86.9% (95% CI: 82.8–91.2) after censoring for transplantation (table 7.1). The mean percentage of haemodialysis patients using definitive access (AVF or AVG) in a centre was 69.8% (SD 10.4) patients (table 7.2).

In the analyses adjusted for age alone a small positive association was found between the percentage of HD patients using an AVG or AVF in a centre and 1 year uncensored survival ($\beta = 0.06$, $p = 0.04$). The type of access in use was able to explain 6% of the variation in centre level survival (figure 7.1).

Adjusting this analysis for the percentage of non-White and diabetic patients in each centre did not change the association found ($\beta = 0.06$, $p = 0.04$).

Table 7.1. One year survival of patients on dialysis on the 31st March 2005, uncensored and censored for transplantation

		1 year survival uncensored			1 year survival censored		
Centre	N	%	LCL	UCL	%	LCL	UCL
Abrdn	211	87.7	83.5	92.1	87.3	83.1	91.8
Airdrie	182	83.3	78.2	88.8	82.7	77.5	88.4
Bangor	90	86.2	79.8	93.1	86.7	80.5	93.4
Barts	468	84.8	81.9	87.8	85.4	82.7	88.3
Basildon	167	90.9	86.3	95.7	90.3	85.5	95.2
Belfast	311	86.8	83.4	90.3	86.3	82.8	90.0
Bheart	350	87.0	83.7	90.5	87.6	84.5	90.9
BQEH	699	88.3	86.2	90.5	88.9	86.9	91.0
Bradfd	195	85.4	80.7	90.4	86.3	81.8	91.0
Brightn	317	83.8	80.4	87.4	84.4	81.0	87.8
Bristol	480	86.5	83.7	89.4	87.4	84.8	90.1
Camb	181	86.2	82.7	89.9	87.5	84.2	90.9
Carlis	96	85.7	79.0	92.9	85.8	79.3	93.0
Chelms	126	81.9	75.7	88.6	82.6	76.6	89.0
Clwyd	192	80.2	71.2	90.4	83.4	75.0	92.8
Covnt	274	88.9	85.7	92.3	89.5	86.4	92.7
D&Gall	81	91.5	85.7	97.7	91.0	84.9	97.5
Derby	293	87.4	83.5	91.4	88.1	84.5	91.9
Dundee	344	88.3	84.2	92.6	87.8	83.6	92.3
Dunfn	140	91.2	86.6	96.1	90.9	86.1	95.9
Edinb	271	86.6	82.8	90.5	86.1	82.2	90.1
GlasRI	385	88.0	84.9	91.3	87.4	84.1	90.8
GlasWI	362	88.3	85.0	91.6	87.8	84.4	91.3
Glouc	197	88.3	84.0	92.9	88.4	84.1	93.0
Guys	421	89.1	86.3	91.9	89.5	86.8	92.2
Hull	324	83.8	80.0	87.8	84.5	80.9	88.4
Inverns	112	87.6	82.3	93.3	87.2	81.7	93.1
Ipswi	253	84.1	78.6	90.0	84.8	79.8	90.2
Kings	374	86.3	82.7	90.1	86.7	83.2	90.4
Klmarnk	129	85.2	79.7	91.1	84.7	79.0	90.8
Leeds	257	88.3	85.8	91.0	88.9	86.4	91.4
Leic	627	86.3	83.8	88.9	87.3	85.0	89.7
Livrpl	545	84.4	81.3	87.6	85.1	82.1	88.3
ManWst	321	82.9	78.9	87.1	83.5	79.7	87.6
Middlbr	383	85.1	81.0	89.4	85.9	82.0	90.0
Newc	312	86.1	82.1	90.3	87.3	83.5	91.2
Norwch	287	86.1	82.1	90.4	87.1	83.3	91.1
Nottm	398	84.5	81.2	87.9	85.3	82.1	88.5
Oxford	423	87.4	84.7	90.1	87.8	85.2	90.4
Plymth	139	86.3	81.4	91.5	87.3	82.7	92.2
Prestn	353	84.9	81.5	88.4	85.7	82.4	89.0
Redng	236	85.3	80.8	90.1	86.3	82.1	90.8
Sheff	564	86.6	84.1	89.2	87.0	84.5	89.5
Stevng	360	88.5	85.8	91.3	88.8	86.2	91.6
Sthend	165	86.5	81.7	91.6	87.5	83.1	92.1
Swanse	339	89.2	86.1	92.4	89.7	86.7	92.7
Truro	213	85.6	81.4	90.1	85.7	81.5	90.1
Tyrone	109	89.1	83.9	94.6	88.7	83.3	94.4
Ulster	91	87.0	78.7	96.3	86.6	78.0	96.1
Wirral	214	88.3	83.8	93.1	89.0	84.6	93.5
Wolve	294	86.9	83.2	90.8	87.6	84.1	91.3
Wrexm	113	82.9	76.8	89.5	84.5	78.9	90.5
York	174	86.8	81.3	92.7	88.1	82.9	93.5

Table 7.2. Access type and dialysis modality for prevalent patients on the 31st March 2005

Centre	Number of patients							% PD	% HD	% HD patients with definitive access
	PD	HD	AVF	AVG	Tunnel	Temp	Other			
Abrdn	43	168	139	19	6	4	0	20.4	79.6	94.1
Airdrie	43	139	85	0	53	1	0	20.6	79.4	61.2
Bangor	23	67	56	2	7	2	0	25.6	74.4	86.6
Barts	13	455	218	58	144	35	0	32.0	68.0	60.7
Basildon	45	122	84	0	36	2	0	19.7	80.3	68.9
Belfast	49	262	122	6	119	15	0	24.7	75.3	48.9
Bheart	42	308	213	15	80	0	0	8.6	91.4	74.0
BQEH	25	674	475	17	178	4	0	17.2	82.8	73.0
Bradfd	38	157	109	0	48	0	0	23.8	76.2	69.4
Brightn	28	289	147	28	112	2	0	23.9	76.1	60.6
Bristol	98	382	272	53	51	6	0	15.5	84.5	85.1
Camb	34	147	123	0	24	0	0	33.8	66.2	83.7
Carlis	22	74	47	0	30	0	0	16.3	83.7	61.0
Chelms	29	97	58	7	30	2	0	28.1	71.9	67.0
Clwyd	132	60	40	0	20	0	0	17.8	82.2	66.7
Covnt	31	243	185	2	54	2	0	21.1	78.9	77.0
D & Gall	11	70	34	2	34	0	0	17.6	82.4	51.4
Derby	95	198	147	1	49	1	0	22.7	77.3	74.8
Dundee	214	130	84	1	43	2	0	25.7	74.3	65.4
Dunfn	54	86	51	1	34	0	0	19.6	80.4	60.5
Edinb	49	222	155	5	58	4	0	18.7	81.3	72.1
GlasRI	99	286	223	5	47	11	0	9.8	90.2	79.7
GlasWI	85	277	196	8	68	4	1	20.9	79.1	73.7
Glouc	70	127	101	7	19	0	0	21.1	78.9	85.0
Guys	22	399	281	24	93	1	0	19.9	80.1	76.4
Hull	50	274	166	10	80	18	0	13.6	86.4	64.2
Inverns	39	73	47	16	8	2	0	34.8	65.2	86.3
Ipswi	150	103	68	1	34	0	0	39.8	60.2	67.0
Kings	112	262	172	17	67	6	0	24.5	75.5	72.1
Klmarnk	21	108	56	3	48	1	0	31.6	68.4	54.6
Leeds	101	156	121	2	31	2	0	38.6	61.4	78.9
Leic	140	487	333	4	122	7	21	30.1	69.9	69.2
Livrpl	210	335	225	14	75	16	5	25.1	74.9	71.3
ManWst	73	248	163	4	81	0	0	37.7	62.3	67.3
Middlbr	146	237	174	4	57	2	0	9.5	90.5	75.1
Newc	86	226	122	4	96	4	0	16.9	83.1	55.8
Norwch	15	272	136	12	123	1	0	15.3	84.7	54.4
Nottm	91	307	160	25	121	1	0	30.1	69.9	60.3
Oxford	111	312	228	6	71	0	7	31.3	68.7	75.0
Plymth	30	109	58	14	37	0	0	27.8	72.2	66.1
Prestn	46	307	228	6	60	1	12	26.6	73.4	76.2
Redng	68	168	112	4	52	0	0	36.1	63.9	69.1
Sheff	17	547	412	33	100	2	0	22.4	77.6	81.4
Stevng	36	324	204	4	116	0	0	14.1	85.9	64.2
Sthend	41	124	96	0	26	2	0	15.1	84.9	77.4
Swanse	77	262	226	9	4	23	0	22.7	77.3	89.7
Truro	65	148	110	4	34	0	0	23.7	76.3	77.0
Tyrone		109	55	0	51	3	0	9.2	90.8	50.5
Ulster	46	45	28	0	17	0	0	4.3	95.7	62.2
Wirral	53	161	98	6	56	1	0	14.8	85.2	64.6
Wolve	15	279	156	15	106	2	0	16.2	83.8	61.3
Wrexm	29	84	49	11	22	2	0	32.8	67.2	71.4
York	58	116	81	7	27	1	0	20.0	80.0	75.9

PD = peritoneal dialysis, HD = haemodialysis, AVF = arteriovenous fistula, AVG = arteriovenous graft, Tunnel = tunnelled, cuffed dialysis catheter, Temp = temporary dialysis catheter, definitive access = AVF or AVG in use

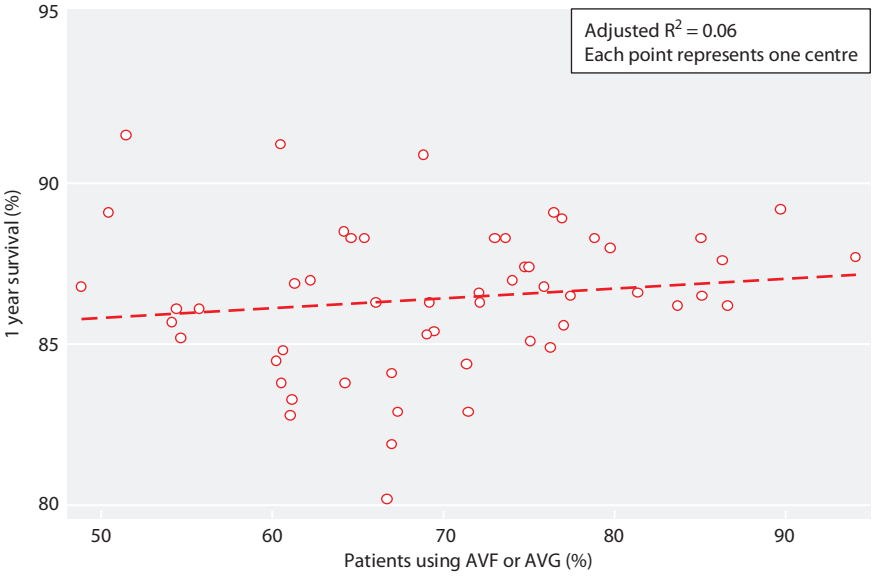

Fig. 7.1. Correlation between percentage of haemodialysis patients using definitive access in a centre and 1 year survival (adjusted to age 60)

Discussion

There was a small increase in mortality with higher rates of dialysis catheter use at centre level. This study was unable to adjust for individual patient characteristics as this level of data was unavailable. To some extent, this study has repeated work done by DOPPS and in the US but for the first time has studied only prevalent dialysis patients and looked at the UK dialysis population.

The rate of AVF/AVG use in this study was similar to rates in prevalent patients within the DOPPS 1 and 2 studies [4]. A 20% higher risk of death was noted in DOPPS 2 for those patients dialysing in centres with >10% catheters [10]. When DOPPS 1 and 2 patients were combined, a 12 % higher risk of death was seen in facilities with greater than 10% catheter rates [11]. However there was little evidence that the proportion of patients using a catheter was the determinant of worse survival as centres with between 20–100% catheter use had only a 13% higher risk of death [11] and one might expect a dose related increase in risk of death with higher catheter use if this was the causal mechanism [12]. The analysis of change in facility achievement over time within DOPPS 2 only compared the combination of several factors thought to be associated with improved survival rather than catheter use alone. However, when these data were reanalysed, case-mix adjusted mortality increased by 20% for every 20% higher rate of catheter use [5].

Vascular access for haemodialysis needs to be reliable, durable and efficient at providing adequate dialysis dose. There was a higher rate of access intervention required for each AVG (1.0 per patient/year) compared to AVF (0.2 per patient/year) [13]. There was no evidence of difference in flow rate or adequacy achieved between AVF and AVG [14] and some evidence of reduced flow rates leading to poorer achievement of dialysis adequacy comparing AVF with catheters [13]. This was not borne out in a recent study in Scotland where catheter mean blood flow rate of 300mls/min was achieved and only 13% of catheters had to be removed due to poor flow rates over a 2 year period [15]. Rates of infection are the most significant complication of catheters with rates being far lower in other types of access. In a large meta-analysis involving 373,563 tunnelled, cuffed dialysis catheters, there were 1.6 (95% CI: 1.5–1.7) infections per 1,000 catheter days [16]. The relative risk of AVG related infection compared to AVF was 1.47 (95% CI: 0.36–5.96) and 8.49 (95% CI: 3.03–28.20) compared to tunnelled, cuffed dialysis catheters [17]. However recent advances in exit site management and antibiotic line locks may alter these outcomes.

There are no randomised controlled trials (RCT) demonstrating improved patient survival with use of AVF/AVG and whilst efforts have been made to reduce the impact of unmeasured confounders in the relationship between catheter use and survival this can never be assured within observational analyses. Nevertheless the Renal Association clinical practice guidelines suggest 65% of incident and 85% of prevalent HD patients use an AVF with an AVG being second choice. The UK National Health Service is about to introduce a dialysis

tariff which will pay more for dialysis sessions performed with an AVF or AVG than with a venous catheter in an effort to encourage what is perceived as good practice [18]. Given the preponderance of professional opinion favouring AVF/AVG use, it is unlikely a RCT will ever take place and so the analysis that will be possible with data from the current large vascular access audit within the UK will be important to determine best practice in the UK.

In this observational study whilst increased venous catheter use was associated with an increase in one year mortality of prevalent established haemodialysis patients, this effect was very small and only accounted for some 6% of the variation in one year mortality between renal centres.

Conflicts of interest: none

References

1 Astor BC, Eustace JA, Powe NR, Klag MJ, Fink NE, Coresh J, *et al*. Type of Vascular Access and Survival among Incident Hemodialysis Patients: The Choices for Healthy Outcomes in Caring for ESRD (CHOICE) Study. *Journal of the American Society of Nephrology*. 2005;16(5):1449–55

2 Xue JL, Dahl D, Ebben JP, Collins AJ. The association of initial hemodialysis access type with mortality outcomes in elderly medicare ESRD patients. *American journal of kidney diseases: the official journal of the National Kidney Foundation*. 2003;42(5):1013–9

3 Allon M. Current Management of Vascular Access. *Clinical Journal of the American Society of Nephrology*. 2007;2(4):786–800

4 Pisoni RL, Young EW, Dykstra DM, Greenwood RN, Hecking E, Gillespie B, *et al*. Vascular access use in Europe and the United States: Results from the DOPPS. *Kidney Int*. 2002;61(1):305–16

5 Pisoni RL, Arrington CJ, Albert JM, Ethier J, Kimata N, Krishnan M, *et al*. Facility Hemodialysis Vascular Access Use and Mortality in Countries Participating in DOPPS: An Instrumental Variable Analysis. *American Journal of Kidney Diseases*. 2009;53(3):475–91

6 Polkinghorne KR. Vascular Access Practice in Hemodialysis: Instrumental in Determining Patient Mortality. *American journal of kidney diseases: the official journal of the National Kidney Foundation*. 2009; 53(3):359–62

7 Byrne C, Ford D, Gilg J, Ansell D, J. F. UK Renal Registry 12th Annual Report (December 2009): chapter 3: UK ESRD incident rates in 2008: national and centre–specific analyses. *Nephron Clin Pract*. 2010; 115(Suppl 1):c9–39

8 Quarello F, Forneris G, Borca M, M. P. Do central venous catheters have advantages over arteriovenous fistulas or grafts? *J Nephrol* 2006;19(3): 265–79

9 Ansell D, Feest T. The sixth annual report. Chapter 2: Introduction to the 2003 report. Bristol: UK Renal Registry; 2003. p. 3–14

10 Wikstrom B, Jacobson SH, Bragg-Gresham J, Eichleay M, Pisoni R, Port F. Dialysis Outcomes and Practice Patterns Study estimate of patient life-years attributable to modifiable haemodialysis practices in Sweden. *Scandinavian Journal of Urology and Nephrology*.44(2):113–20

11 Mendelssohn DC, Pisoni RL, Arrington CJ, Yeates KE, Leblanc M, Deziel C, *et al*. A practice-related risk score (PRS): a DOPPS-derived aggregate quality index for haemodialysis facilities. *Nephrology Dialysis Transplantation*. 2008;23(10):3227–33

12 Hill A. The environment and disease: Association or causation? *Proceed Roy Soc Medicine*. 1965;58:298–300

13 Hodges TC, Fillinger MF, Zwolak RM, Walsh DB, Bech F, Cronenwett JL. Longitudinal comparison of dialysis access methods: Risk factors for failure. *Journal of vascular surgery: official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter*. 1997;26(6):1009–19

14 Ifudu O, Mayers JD, Matthew JJ, Fowler A, Friedman EA. Haemodialysis dose is independent of type of surgically-created vascular access. *Nephrology Dialysis Transplantation*. 1998;13(9):2311–6

15 Thomson P, Stirling C, Traynor J, Morris S, Mactier R. A prospective observational study of catheter-related bacteraemia and thrombosis in a haemodialysis cohort: univariate and multivariate analyses of risk association. *Nephrology Dialysis Transplantation*. 2010;25(5):1596–604

16 Maki DG, Kluger DM, Crnich CJ. The Risk of Bloodstream Infection in Adults With Different Intravascular Devices: A Systematic Review of 200 Published Prospective Studies. *Mayo Clinic Proceedings*. 2006;81(9): 1159–71

17 Taylor G, Gravel D, Johnston L, Embil J, Holton D, Paton S, *et al*. Incidence of bloodstream infection in multicenter inception cohorts of hemodialysis patients. *American Journal of Infection Control*. 2004; 32(3):155–60

18 www.renal.org/Libraries/Tsars/RenalNSFUpdate27April2010.sflb.ashx