A 10-Year Review of a Vascular Access Service for Patients Receiving Hemodialysis: Analysis of Procedural Modifications and Service Innovations

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Abstract

Objective: *We aimed to identify trends in vascular access modalities for renal hemodialysis and to evaluate the influence of service modifications on service performance and patient outcomes.*

Methods: *Retrospective analysis of incident and prevalent hemodialysis patients treated by the Gold Coast Hospital and Health Service, Queensland, Australia, between January 2004 and December 2013 was conducted. A comparison of patient demographic characteristics and analysis of trends in access modality and outcomes was performed for each group over the study period. Modifications to service structure and practice changes were also evaluated.*

Results: *A total of 1787 patients (456 incident and 1331 prevalent) and 1671 procedures were examined. The proportion of patients starting hemodialysis on a catheter decreased from 79.2% to 63.6%. Patients starting hemodialysis on a fistula increased from 16.7% to a peak of 61.5% but fell to 27.3% in 2003. Catheter use in prevalent patients decreased from 11.7% to 6.1%, whilst fistula use increased from 60.6% to 88.5%. Graft access remained low for the incident group (0.0%-9.1%) and was reduced in prevalent patients from 27.7% to 4.9%. Bloodstream infection rates were reduced from 1.88 to 1.60 per 1000 dwelling-days. Endovascular and surgical revision of arteriovenous access was increased.*

Conclusions: *Coordinated and multidisciplinary access service provided earlier referral for planned incident access with fewer catheters and increased fistulas with reduced bloodstream infection rates. Modifications to this vascular access service are associated with improved permanent access rates for incident and prevalent patients. There was an overall improvement of service performance and patient outcomes.*

Keywords: *arteriovenous fistula, arteriovenous graft, hemodialysis, vascular access*

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Introduction

An autologous arteriovenous fistula (AVF) is recognized as the optimal mode of vascular access for hemodialysis in patients requiring long-term dialysis.[1] Reported advantages of using an AVF include lower thrombosis rates and fewer emergency interventions, providing greater longevity associated with lower maintenance costs.[2,3] Further, AVFs have lower bloodstream infection (BSI) rates compared with other access modalities, with reduced morbidity and mortality.[4] Despite these advantages, AVF access rates are historically low in favor of arteriovenous grafts (AVGs) and hemodialysis catheters (HDCs).[5] Barriers to higher AVF rates include prolonged maturation periods requiring earlier surgical referral and creation in advance of incident dialysis, wait time for surgical referral and operating theatre capacity constraints, poor superficial veins and restricted timing and availability of preoperative ultrasound vein mapping, and the need for coordination between different disciplines in patient management.[6]

First published in 1997 with subsequent updates, the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) provides evidence-based guidelines for improving diagnosis and treatment of kidney disease.[7] The NKF-KDOQI recommends autologous AVF access for long-term dialysis patients due to reduced morbidity and mortality compared with other access types. Current NKF-KDOQI recommendations are for prevalent AVF access rates $> 65\%$ and HDC rates $< 10\%$.

The Gold Coast region is located in southeast Queensland, Australia, with a population of 539,890 in June 2012. The region is served by 2 public hospitals: Gold Coast University Hospital and Robina Hospital, which together provide secondary and tertiary health care services, including all major specialties except burns. The renal dialysis service has between 110 and 160 prevalent dialysis patients annually and also provides an outreach vascular access service to renal replacement therapy patients in regional areas.

The aim of this study was to identify trends in vascular access modalities for patients receiving renal dialysis and to evaluate the influence of service modifications on patient outcomes and compliance with NKF-KDOQI guidelines.

Methods

This was a retrospective study of incident and prevalent hemodialysis patients treated by the Gold Coast Hospital and Health Service (GCHHS) vascular access service between January 2004 and December 2013.

The incident group was defined as new patients starting hemodialysis for the first time (whether or not permanent access was established). The prevalent group was defined as all patients established to receive hemodialysis for > 30 days and at any time point thereafter. HDCs included both tunneled and nontunneled catheters. Exclusion criteria included patients commencing and discontinuing hemodialysis for the first time within a 30 day period (eg, acute renal failure, patient death, or patient requesting conservative management or palliation), patients commencing for the first time and then discontinuing hemodialysis at GCHHS although access was created elsewhere, patients changing dialysis modalities (eg, unexpected failure of peritoneal dialysis and failure of vascular access requiring a catheter), and failed renal transplant where the patient has had hemodialysis in the past.

Data were sourced from the Australia and New Zealand Dialysis and Transplant (ANZDATA) registry (Adelaide, Australia) and service records. Approval to conduct this study was granted by the GCHHS Human Research Ethics Committee (HREC/14/QGC/32). Analysis of trends was performed for patient demographic characteristics, access type, surgical and endovascular procedures, patient outcomes, and service modifications. Statistical analysis was performed using IBM SPSS version 19 (IBM-SPSS Inc, Armonk, NY). Descriptive statistics including mean, standard deviation, frequencies, and percentages were used in the analysis. A correlation analysis was performed using Pearson's correlation coefficient. Correlations between 0 and 0.2, 0.2 and 0.5, 0.5 and 0.8, and $>$ 0.8 were deemed low, moderate, high, and very high, respectively. A 2-tailed t test was used to determine if the correlation was significantly different from zero. Correlations with a P value $< .05$ were deemed significant.

Results

A total of 1787 patients (456 incident and 1331 prevalent) and 1671 procedures were examined over the 10-year study period. Patient demographic characteristics, referral time, and access types are shown in Table 1. Incident patient characteristics did not significantly change over the study period. The number and percentage of incident patients taking more than 30 days from surgical referral to creation of access significantly increased from 34.0% to 42.9% (0.414; $P = .029$) over the study period, yet remained below 50% of referrals. There was a significant increase in the number of prevalent patients cared for by the service from 94 to 148 patients (0.960; $P = .011$). There was a close to significant increase in prevalent male patients from 57.5% to 62.8% (0.804; $P = .005$) and decrease in BSI rate from 1.88 to 1.60 per 1000 dwelling-days (-0.619; $P = .057$). Incident AVF rates were close to significantly improved from 16.7% to 27% of all incident access modalities (0.631; $P = .051$), there was a nonsignificant overall decrease in AVG rates, and a significant reduction of HDCs from 79.2% to 63.6% (-0.703; $P = .023$). There was a significant increase of prevalent AVF access rates from 60.6% to 88.5% of all prevalent modalities (0.940; $P < .001$), significant reduction of AVG access from 27.7% to 5.41% (-0.927; $P < .001$), and HDC access from 11.7% to 6.1% (-0.681; $P = .030$).

Details of surgical and endovascular procedures performed during the study period are shown in Table 2. Overall there was not a significant change in the number of surgical procedures performed; however, endovascular procedures were significantly increased from 0 to 81 per year (0.892; $P = .001$) reflecting the introduction of angioplasty revision of access in 2005 and later endovascular stents from 2008. There