Rapid progression of chronic kidney disease in five years prior to haemodialysis initiation in Central Australia

Anna Holwell, Cherian Sajiv, Federica Barzi, Stephen Brady & Jaquelyne T Hughes

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Abstract

The Northern Territory has the highest Australian incidence rate per population of haemodialysis (HD)-dependent chronic kidney disease (CKD). Our aim was to describe the average annual estimated glomerular filtration rate (eGFR) decline in the five years for adults commencing HD in Central Australia in 2012. No patients were started on peritoneal dialysis in Central Australia in this period. Central Australian clinical databases were retrospectively audited for serum creatinine (sCR), albuminuria (ACR), glycated Hb (HbA1c), and eGFR for the five years preceding HD-start. All results were included for the audit duration (from the earliest date for five years (audit entry, AE) prior to HD-start); an average annual eGFR decline was calculated using the CKD epidemiology collaborative (CKD-EPI) equation. Forty-nine clients initiated HD in 2012 (96% Indigenous, 65% female, age 45 years, diabetes primary renal disease 80%). The median (IQR) audit duration was 3.8 (2.5, 4.6) years. At audit-entry, the mean ACR and eGFR were 157 mg/mmol and 51 ml/min/1.73m² respectively, corresponding to 91% clients having macroalbuminuria (ACR >30 mg/mmol), and 15% having an eGFR <30 ml/min/1.73m². The average annual eGFR decline was 14 ml/min/1.73m². We observed rapid CKD progression in Central Australian clients commencing HD in 2012, and related to macroalbuminuria with moderately impaired eGFR at audit entry. Slowing CKD progression in this region requires adequately supported clinical systems identifying and tracking clients with high CKD risk.

Keywords

Chronic kidney disease, end-stage kidney disease, haemodialysis, health services, high-risk populations.

Anna Holwell, MBBS, BMedSci, FRACP, Consultant General Physician, Alice Springs Hospital
Alice Springs, NT, Australia

Cherian Sajiv, MBBS, MD, DNB, MNAMS, FRACP, Sr Staff Specialist & Head, Central Australian Renal Services; Director, NT Renal Services, Alice Springs Hospital/Royal Darwin Hospital, NT; Senior Lecturer (Adjunct), Flinders University, SA, Australia

Federica Barzi, PhD, Senior Research Fellow in Biostatistics, School of Health Sciences, Centre for Population Health Research, University of South Australia, Adelaide, SA, Australia; Senior Research Fellow in Biostatistics, The Menzies School of Health Research, Darwin, NT, Australia

Stephen Brady, BMed, FRACP, Consultant General Physician, Alice Springs Hospital, Alice Springs, NT, Australia

Jaquelyne T Hughes, BMed, FRACP, PhD, NHMRC Early Career Research Fellow, The Menzies School of Health Research, Charles Darwin University & Consultant Nephrologist, Royal Darwin Hospital, NT, Australia

Correspondence to: Dr Anna Holwell, Department of Medicine, Alice Springs Hospital, Alice Springs, NT 0870, Australia
Tel: +61 (0) 8 8951 7777 Email: anna.holwell@nt.gov.au
Introduction

In 2014, the Northern Territory (NT) had the highest incidence rate of haemodialysis (HD)-dependent end-stage kidney disease (ESKD) among Indigenous people in Australia at 1397 patients per-million-population, far exceeding rates in other states. This was almost double the next highest state of Western Australia, whose incidence rate of ESKD was 693 patients per-million-population (ANZDATA Registry, 2016). The NT incidence rate was also more than 10 times the overall ESKD incidence rate for Australia, which in 2014 was 111 per-million-population (ANZDATA Registry, 2016).

In the Central Australia (CA) region of the NT, ESKD is endemic, with incidence rates among some communities approaching 30 times the national levels, and which affect a relatively young Indigenous population (35–64 years) (Cass et al., 2011). In 2012, all adults initiating renal replacement therapy in Central Australia did so with HD. The low frequency of peritoneal dialysis in Central Australia is consistent with national data, which reported that 85% of Indigenous Australians undertaking dialysis were using HD based at a hospital or satellite facility (ANZDATA Registry, 2016).

The nephrology hub for this vast and very remote region (exceeding 1.5 million km2) is located in Alice Springs (AIHW, 2004). The Alice Springs nephrology hub services a population of 48,000 residents (45% Indigenous) living across four state-territory borders (southern Northern Territory, northern South Australia, eastern Western Australia and western Queensland). Despite a high frequency of chronic kidney disease (CKD) markers (such as albuminuria), and local CKD management guidelines (Central Australian Rural Practitioners Association, 2003–2014), there is little information describing CKD surveillance and trajectory in the years preceding HD initiation.

Our aim was to describe the annual decline of eGFR over the five years preceding HD initiation in adults commencing treatment in 2012 in Central Australia.

Methods

The retrospective audit was approved by the Central Australia Human Research Ethics Committee, and all adults (>18 years) initiating HD in Central Australia (as their first form of renal replacement therapy) in 2012 were included. For every client, dates and results of all biochemical tests for serum creatinine (sCr), albuminuria (urinary albumin to creatinine ratio [ACR]), and glycated haemoglobin (HbA1c) were recorded for the audit period (five years preceding the date of HD-start), from hospital and community health centre electronic health records. eGFR was calculated using the CKD-EPI formula (Maple-Brown et al., 2012). Additional clinical data (ethnicity, date of HD-start, cause of primary renal disease and comorbidities), which were recorded at HD-start, were linked from the Australian and New Zealand Dialysis and Transplantation Registry (www.anzdata.org).

The length of time within the five-year audit period from the first recorded biochemistry test to HD-start defined the audit duration. Many clients initiating dialysis are required to relocate from their community into Alice Springs for arteriovenous fistula preparation, complex medical evaluations and dialysis initiation. Client relocation is personally burdensome and requires a greater level of client–clinician engagement and logistic support in the transition period when commencing dialysis. Therefore, we categorically recorded residence prior to HD as Alice Springs (NT), non-Alice Springs (NT), and non-NT. Pathology data were described for all clients with at least two biochemical measures in the audit period. Each individual date of pathology ordering was counted as a health-care interaction.

Statistical analysis was performed using STATA v13.0 (Stata Corp Texas, 2013). Normally distributed variables are presented as mean (standard deviation) or number (percentage). Variables with a skew distribution were log-transformed and presented as geometric mean (95% confidence interval), except for audit duration and health care interactions, which were presented as median (interquartile range). Comparisons of continuous data were performed by students t-test. Forced linear modelling of eGFR over time was used to calculate change of eGFR. P values <0.05 were considered statistically significant.

Results

Forty-nine clients initiated HD in 2012 (65% female, 96% Indigenous Australian, 80% diabetes as primary renal disease, age [mean (standard deviation)] 47.6 (9.3) years). Life-long non-smoking was described in 65%; 20% had their first dialysis treatment with an arteriovenous fistula. Ninety-six per cent of clients were NT residents immediately prior to HD-start, though only 18% were residing within Alice Springs.

Ninety per cent of clients had at least two biochemical measures recorded from individual audit durations spanning one day to five years [median [IQR]: 3.8 (2.5, 4.6) years]. Four clients (8%) with audit durations less than 95 days recorded only one biochemical measure. The median (interquartile) health care interaction count was 14 (9–24) (range: 1–64) (Table 1). At audit-entry 91% of clients had macroalbuminuria (ACR >30 mg/mmol), and 15% had an eGFR <30 ml/min/1.73m2. As expected, there were significant differences in biochemical parameters at audit-entry and HD-start (Table 1). The average annual eGFR decline was 14 ml/min/1.73m2 (Figure 1).

Discussion

We retrospectively described the CKD trajectory preceding incident HD treatments provided in 2012 for all Central Australian clients. Our findings include: 1) a rapid CKD progression, strongly associated with baseline macroalbuminuria; and 2) despite short audit durations, there were frequent health care interactions once CKD was confirmed.
Increasing ACR concentration has been linked continuously with risk for progressive CKD (Amin et al., 2013; Hoy et al., 2001). Furthermore, albuminuria, which is also associated with decreased eGFR, is reported to also be synergistically predictive of mortality (Amin et al., 2013). Both these factors were present in the majority of audited clients in our study. 

Rapid CKD progression is described as a sustained annual eGFR decline of at least 5ml/min/1.73m² (Inker et al., 2014; Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group, 2013). We reported an average annual eGFR-decline in clients initiating HD of almost three times this rate, which is consistent with Aboriginal people from one other isolated NT community (Hoy, 2001a; Hoy et al., 2001b). In this study annual eGFR decline was higher than the mean 3ml/min/1.73m² recently reported from a prospective cohort of more than 550 Indigenous Australians living across diverse regions of northern and Western Australia (Maple-Brown et al., 2016). In that study, macroalbuminuria associated with eGFR<60ml/min/1.73m² was reported to powerfully predict eGFR decline in Indigenous Australians (Maple-Brown et al., 2016). We suggest, at baseline, our clients reflected a high-risk group, owing to substantially higher prevalence of macroalbuminuria (91%), and higher absolute ACR concentration at audit-entry.

During the audit-duration, we observed median testing frequencies of five and twenty-two for albuminuria and creatinine respectively. Thus testing frequencies were consistent with local and international testing frequencies of that period as described for CKD monitoring and management; which recommended yearly ACR testing in at-risk patients (clients with documented albuminuria, and CKD and/or diabetes) (Central Australian Rural Practitioners Association, 2003–2014; Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group, 2013). We note at the conclusion of the audit period international updating of CKD staging classification were reported focussing on the importance of both albuminuria and eGFR (Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group, 2013), but cannot conclude if this may have affected CKD monitoring for clients with established kidney impairment.

We audited the clinical record for all incident Central Australian HD clients in 2012. Due to the retrospective nature of this study, we were unable to assess an annual eGFR decline in adults with similar baseline indices, but whose endpoint was not HD initiation. Health care in Central Australia is provided by public hospitals (with a unique Northern Territory-wide hospital record number) and government and private primary care clinics. Each service has separate clinical record systems, which do not integrate easily, presenting significant challenges for this audit. These same challenges exist in day-to-day clinical work in the Central Australian region, and directly impact on patient management. Retrospective data linkage studies for CKD are important to inform practice (Lawton, Cunningham, Hadlow, Zhao, & Jose, 2015), but may lack details which can only be informed by individual chart review (Brameld, Thomas, Holman, Bass, & Rouse, 1999).

Effective clinical management for adults at high risk for progressive CKD requires well integrated health systems,

Table 1: Pathology test result and frequency over five-year audit period

<table>
<thead>
<tr>
<th></th>
<th>Total number tests recorded during audit</th>
<th>Results at audit entry</th>
<th>Results at HD-start</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (interquartile range)</td>
<td>Geometric mean (95% confidence interval)</td>
<td></td>
</tr>
<tr>
<td>HbA1c, %</td>
<td>8 (3, 15)</td>
<td>8.8 (8.1, 9.7)</td>
<td>6.7 (6.3, 72)</td>
</tr>
<tr>
<td>Creatinine, mmol/L</td>
<td>22 (13, 41)</td>
<td>127 (105, 154)</td>
<td>859 (773, 953)</td>
</tr>
<tr>
<td>eGFR, ml/min/1.73m²</td>
<td>-</td>
<td>51 (40, 64)</td>
<td>5 (4, 6)</td>
</tr>
<tr>
<td>urine ACR, mg/mmol</td>
<td>5 (2,7)</td>
<td>157 (47, 426)</td>
<td>379 (240, 680)</td>
</tr>
</tbody>
</table>

n=45 clients with at least two biochemical measures recorded; differences between audit entry and HD-start were significant (p<0.001)
particular between primary and specialist health care. We suggest a comprehensive Central Australian prospective clinical database for every client is necessary to support health care systems, provision of renal care and facilitate evaluation cycles. We acknowledge unmeasured factors may have contributed to the rapid annual eGFR decline, including residency outside of Alice Springs or across state-territory boundaries, individual residential mobility, and achieving balance in health care systems supporting both acute and follow-up care (Ballie et al., 2014). We note the Central Australian Renal Study (Cass et al., 2011), also recommended cross-jurisdictional co-operation and supporting a range of care models in order to close the gap in health outcomes between Indigenous and non-Indigenous Australians.

Management of CKD requires an integrated approach from all stakeholders. The majority of clients in this audit were Indigenous and lived a remote distance from the primary nephrology service. Thus remote health clinics are integral to CKD management in Central Australia, and although monitoring programmes such as traffic light systems are in place in government health clinics, maintaining consistent staff, including chronic disease nurses and public health practitioners, is a chronic challenge, and impacts on service provision. Furthermore, the clients’ choices about accessing centralised nephrology services from their remote community can have a profound effect on the timing of dialysis initiation. Our experience is that clients carefully weigh the personal costs related to interrupting connection to homelands, and maintaining cultural beliefs, which may have greater importance than their individual health.

Conclusions

Macroalbuminuria was identified in clients at 3.8 years prior to HD-initiation, and was associated with an annual eGFR decline of 14ml/min/1.73m². The majority of clients were Indigenous and lived a remote distance from the primary nephrology service. CKD management requires a cohesive approach from all stakeholders, and a clear understanding of the components required to effectively support this. We recommend a whole of region baseline evaluation of the operational, system and client-related components essential to CKD management to determine the priority for subsequent system changes and system enhancers, with predefined frequent monitoring cycles to determine the effect on client outcomes.

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References