Deceased donor kidney transplantation in New Zealand: use and audit of a survival prediction tool

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ABSTRACT

AIMS: New Zealand follows the guideline that only patients with projected five-year survival of 80% are listed for deceased donor kidney transplantation. An algorithm derived from US data estimates survival after transplantation, however, this may not be as applicable to the New Zealand population.

We review use of the US derived algorithm in New Zealand. We assessed accuracy of scores calculated by referring units and audited whether the system is applied in New Zealand.

METHODS: Data on 422 patients assessed for transplantation was entered into the algorithm to calculate a projected survival score. Scores were generated by an independent investigator and compared with those calculated by local units. Scores and demographics of listed and not-listed patients were also compared.

RESULTS: Three hundred and twenty-five of 420 (77%) patients assessed were accepted onto the New Zealand transplant list. Mean estimated five-year survival in listed patients was 89.4% compared to 79.8% in those not accepted ($p<0.0001$). Listed patients were younger and less likely to have coronary artery disease (CAD). There was no significant difference in scores calculated by the independent assessor and referring centres ($p=0.185$).

CONCLUSION: The algorithm is universally and accurately used. Future studies are required to determine the validity of the system in New Zealand patients.

Kidney transplantation is the treatment of choice for most patients with ESKD. Mortality is significantly reduced in transplant recipients compared to those patients who are listed for transplantation but remain on dialysis in all patient sub-populations examined.[1] In New Zealand, and internationally, the number of patients listed for kidney transplantation significantly exceeds the number of kidneys available from deceased donors and waiting times have increased substantially over the last decade.

The Transplantation Society of Australia and New Zealand (TSANZ) recommends that patients listed for deceased donor kidney transplantation should have an estimated five-year survival of 80%.[2] In order to assist transplant teams in New Zealand to make this estimation, all patients being considered for listing have had their five-year probability of survival following deceased donor kidney transplantation estimated using a multivariable equation developed based on the outcome of 169,393 patients transplanted in the US between 1995 and 2006.[3] The current listing criteria for deceased donor renal transplantation is to accept patients with a projected survival threshold of 70% using the US algorithm assuming they are in all other respects suitable for kidney transplantation. A cut off of 70% is used to account for a confidence interval around the estimated score, the lack of complexity of predictive factors in the calculator (eg, a patient with severe triple vessel coronary artery disease will have the same score for that factor as a patient with single vessel disease) and the potential demographic differences between the US and New Zealand populations.

The use of this predictive algorithm commenced on 1 February 2013 and since that date all patients considered for kidney transplant listing are scored using this tool.[4] Patients are scored at the date which they are first considered by the transplant team for listing. The score forms part of the assessment for deceased donor transplant listing and does not replace the multidisciplinary team (MDT) assessment. Patients with adequate scores may not necessarily be listed if deemed unsuitable by the MDT. Equally, those patients with scores below 70% can be reviewed by the National Renal Transplant Committee if they are felt to be suitable. Patients on deceased donor waiting list are rescored at least bi-annually or when they develop new comorbidities that may affect the risk score. Patients on the waiting list whose probability of survival at five years falls below 70% due to new comorbidity or advancing age are removed from the waiting list.

We aimed to assess the use of the survival score algorithm by comparing calculated scores in a prospective cohort of patients, discussed for deceased donor transplantation listing in two of the three transplant units in New Zealand, between 1 June 2015 and 30 April 2016. We audited the decisions to list patients scored using the algorithm and compared scores calculated at the time of listing by the individual units with scores calculated by an independent researcher.

Methods

Ethical approval for the study was undertaken through the New Zealand Ministry of Health Ethics Committee (Approval 15/CEN/1).

Data collection and statistical analysis

Patients who were assessed and discussed for deceased donor renal transplant listing by the transplant groups in Auckland and Christchurch, New Zealand between 1 June 2015 to 30 April 2016 were included. Four hundred and twenty-two patients were identified and information prospectively collected. All patients had the following information collected: date of birth, gender, date of first renal replacement therapy and type of renal replacement therapy (RRT), date listed, date discussed by transplant team (used in calculator as a surrogate for transplant date), albumin, BMI, cause of chronic kidney disease (CKD), COPD or chronic lung disease, non-ambulatory, chronic heart failure, diabetes, insulin, coronary artery disease, peripheral vascular disease, cerebrovascular disease, hypertension, smoker (at start of RRT), employment status, ethnicity and peak PRA. Employment included voluntary work and active home responsibilities. Smokers were considered to be ex-smokers after a three-month cessation period. Smoking status was recorded at the start of RRT as ANZDATA records this information upon entry to the registry, which equates to the point of commencing RRT. Information was collected from the electronic record system and from patients' transplant assessment notes. The variables of albumin and BMI were taken from the time of listing (or time of discussion if not yet listed), as this was the most reliable point that data could be extracted from records. Some patients were being discussed for the first time during the period of data collection, while others had been previously discussed and their cases were being reviewed to ensure suitability to remain listed or review reasons for not listing previously. Components of the score are listed in Table 1.

Patients under the age of 18 or those undergoing assessment for multiple organ transplantation were excluded.

Scores calculated by the transplant units were compared to those calculated by the independent (unallied) researcher. Where there was a discrepancy between scores of >5%, they were re-calculated by the researcher. If the discrepancy remained then the individual data entry points were reviewed by the senior supervising nephrologist to ensure the correct data was entered.

Statistical analysis was undertaken using Systat 9.0. Mean and median scores were calculated separately for patients who were listed and not listed for kidney transplantation. A Students T test comparing mean and median scores and ages between those listed and not listed was applied. A comparison of demographics of listed vs not listed patients was undertaken using an ANOVA. A p value of <0.05 was considered

Table 1: Data collected at time of discussion for survival scoring algorithm.

Variable
Age
Gender
Ethnicity
Date 1st Renal replacement therapy (RRT)
Type RRT
Date listed
Date discussed (if being re-discussed, the new date is entered)
Albumin (best of last three results over previous three months)
BMI
Cause ESKD
COPD (as per documented problem list or Spirometry FEV1/FVC<70% without improvement on bronchodilator)
Non-ambulatory (cannot walk into clinic room (prosthesis ok))
Chronic heart failure (admission with heart failure or ejection fraction <40% on echo in the last year)
Insulin
Coronary artery disease (symptoms, positive stress test, coronary angiogram showing >50% vessel stenosis or any prior intervention)
Peripheral vascular disease (symptoms, positive provocation test, >50% stenosis on angiography or any prior intervention)
Cerebrovascular disease (history of stroke, TIA, carotid bruit or revascularisation)
Hypertension (current or prior treatment required)
Smoker (ex-smoker must be for >3 months)
Employment (whether paid or otherwise)

significant. A correlation coefficient between the scores calculated by the independent investigator and the listing units was also applied, with a c score of >0.7 considered to be a strong correlation.

Results

Participant characteristics

The prospective cohort of those considered for renal transplant listing comprised of 420 people, as complete data was unavailable on two patients. Three hundred and twenty-five (77%) of these patients were accepted for listing. Demographic data for the whole cohort is listed in Table 2, alongside demographic comparators for those listed vs not listed. Patients who were listed for transplantation were younger and less likely to have coronary artery disease than those not listed.

Listing eligibility and transplant scoring

All patients assessed for transplantation had the US algorithm calculated at the time of formal assessment for transplantation. Of the 325 patients listed for deceased donor transplantation, scores calculated by the local units ranged from 68–98.8% while the scores ranged from 46.6–99.3% when calculated by the independent investigator. The mean and median scores for those listed and not listed are shown in Table 3. Overall, there was no significant difference between the mean scores calculated by the local units and those calculated by an independent investigator for listed (p=0.185) or unlisted patients (p=0.558). Local scores were available for 204 of the listed patients and 42 of the unlisted patients.

There was a significant difference in both mean and median scores between those listed and those not listed both when analysing scores calculated by the local units and by the independent investigator (p=<0.0001).

When scores were calculated by the assessing unit, 27 (8%) of listed patients scored 70–80% and one patient scored <70%. The patient scoring <70%, when the score was calculated locally, also scored <70% when calculated by the independent investigator, and went through an arbitration process in order to be listed.

Of the patients that were discussed and not listed, the locally calculated score ranged from 52–97.3%. When calculated by the independent investigator, 24 patients in this cohort (25%) had a score of <70% and were primarily assessed as not suitable

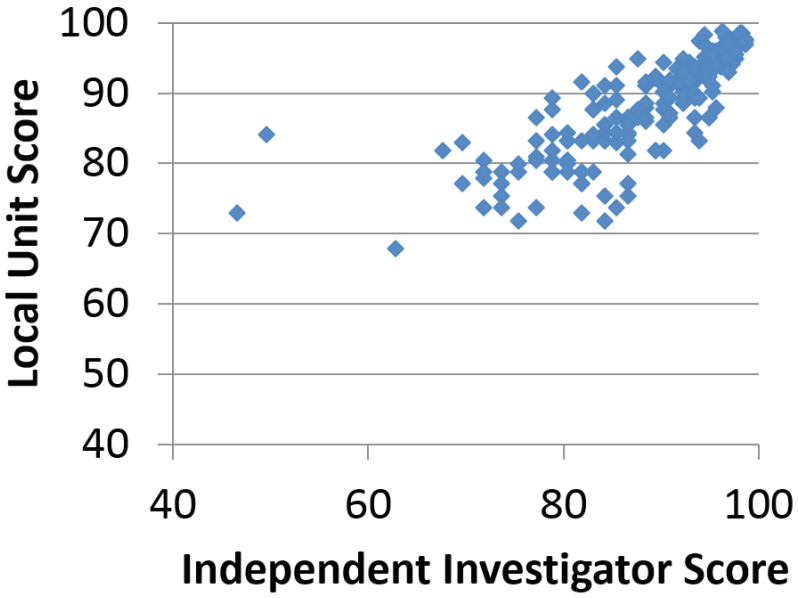
Table 2: Demographic data including comparators between listed and not listed patients.

Demographic	Median (interquartile range) or number of patients (%)	Listed	Not listed	P value
Age	53 (45–61)	51	57	<0.001
Gender				
Male	257 (61%)	198 (61%)	59 (62%)	0.869
Female	163 (39%)	127(39%)	36(37%)	
Ethnicity				
European	150 (36%)			
Māori	125 (30%)			
Pacific	78 (19%)			
Asian	60 (14%)			
Other	7 (2%)			
Cause of CKD				0.413
Glomerulonephritis	145 (35%)	120 (37%)	26 (27%)	
Diabetes	129 (31%)	97 (30%)	33 (34%)	
Polycystic kidney disease	28 (7%)	22 (7%)	6 (6%)	
Hypertension	21 (5%)	16 (5%)	5 (5%)	
Reflux	19 (5%)			
Other	78 (19%)			
Renal replacement therapy				
Pre-dialysis	99 (24%)			
HD	170 (40%)			
PD	99 (24%)			
Home haemodialysis	52 (12%)			
Albumin	37 (34–40)			
Diabetic	165 (39%)	123 (38%)	42 (43%)	0.335
Insulin	109 (26%)	79 (24%)	30 (31%)	0.192
Coronary artery disease	69 (16%)	41 (13%)	28 (29%)	<0.001
BMI	29 (24–33)			
Employed	213 (51%)			
Smoker				
No	233 (55%)			
Yes	71 (17%)			
Ex	116 (28%)			
Accepted for listing	325 (77%)			
Time to list from commencing RRT (months)	21 (8.25–39.5)			
Listed pre-dialysis	125 (30%)			

Table 3: Scores of patients comparing those calculated by an independent investigator with those calculated by the local units.

	Mean score independent (%)	Mean score local (%)	Median score independent (%)	Median score local (%)	P values independent vs local
Listed patients	89.4	88.5	91.6	89.4	0.185
Unlisted patients	79.8	81.1	81.8	84.3	0.558
P values listed vs unlisted patients	<0.0001	<0.0001	<0.0001	<0.0001	

Figure 1: Correlation between independent investigator scores and local unit scores.



for listing on the deceased donor kidney transplant list due to multiple comorbidities as assessed by the scoring algorithm. The remaining patients who were not listed had a significant comorbidity precluding transplantation despite a score of >70%. Sixteen (17%) of the cohort scored between 70–80%. Similarly the recorded data available from local units showed a calculated score of <70% in 11 (26%) of patients and a score of 70–80% in six patients (14%).

Correlation between the scores calculated by an independent investigator and those calculated by the local units is shown in Figure 1. The correlation coefficient between the independently calculated and locally calculated scores is 0.829881.

Discussion

This is the first report of the use of a survival algorithm in patients being assessed for deceased donor kidney transplantation. This algorithm has been in use since February 2013 and has been applied rigorously to all patients prospectively assessed in New Zealand over a six-month period.

This study demonstrates that the majority of patients who complete a full assessment for kidney transplantation and brought for discussion by the transplant groups in New Zealand are listed for deceased donor transplantation. On assessment of the currently used scoring algorithm, most patients listed meet the TSANZ recommendation of a predicted five-year survival of 80% post-transplantation and the majority also met the current New Zealand requirement of a 70% predicted five-year survival.

It was agreed that transplant units in New Zealand would not list patients with a predicted probability of five-year survival of less than 70%, unless in exceptional circumstances, and after discussion with and agreement of the Transplantation Subcommittee of the New Zealand Renal Advisory Board (subsequently replaced by the National Renal Transplant Leadership Team). It is important to note that patients with poorer survival may still benefit from kidney transplantation and are offered the option of living donor transplantation if they are otherwise suitable. Additionally, as the predicted probability of survival is only one tool in the assessment of a patient's suitability for transplantation, a predicted survival probability of 80% at five years after transplant does not guarantee listing in circumstances where there were other factors contraindicating kidney transplantation.

New Zealand has adopted an algorithm that has been validated in patients assessed for kidney transplantation in the US. Twelve variables independently predicting death were used to create the US model. There are

a number of key differences in a number of these variables between the US and New Zealand end stage kidney disease populations. These include ethnicity, in addition to a low exposure to peritoneal dialysis (PD) in the US (6.8%[5]) compared to New Zealand, where 31% of patients are treated with this dialysis modality.[6] PD is associated with a lower serum albumin due to protein loss through the peritoneum. Hypoalbuminaemia is a strong prognostic factor for death in the USRDS algorithm but we hypothesised that this may not be as relevant to patients on PD.

A comparison study of seven risk scoring algorithms for mortality prediction after kidney transplant in 2,033 patients across 64 UK centres, with seven-year follow up, showed that the score with the best predictive performance (the recipient risk score) was based on age, diagnosis of diabetes, ischaemic heart disease and dialysis duration < or >1 year.[7] The primary outcome measure in this study was death with graft function and age was shown to be an independent predictor of mortality. There were low numbers of diabetic patients and those from ethnic minorities included and the grafts tended to be well HLA matched. Variables of albumin, employment status, hypertension and delay to transplant wait listing have been shown to significantly impact on survival previously[4] and our findings support this. We were unable to identify any one factor or pattern of factors that reliably predict five-year survival after transplantation.

There are a number of limitations in this analysis. Only patients who completed a full assessment for kidney transplantation to the stage of discussion at a formal listing meeting were assessed. It is highly likely that other patients have been assessed by individual renal units and a contraindication to kidney transplantation has precluded full assessment and presentation for listing. Additionally, there are factors in the scoring algorithm that are open to interpretation. An example of this is employment where patients may be considered as employed if they are 'homemakers', however, no clear guidance is available.

Two listed patients demonstrated large discrepancies in scores when comparing those generated by the independent assessor and those generated by the local units. In both cases, the local units calculated the patients to be suitable for listing (scores of 73% and 84%), however, the independent assessor calculated the patients to be unsuitable for listing (scores of 46.6% and 49.6% respectively). The independent assessors' scores were re-checked and also passed on to the senior supervising nephrologist for confirmation. We are unable to explain the reasons that the local scores were comparatively higher. One of these patients has been de-listed since the data was collected and the other remains on the waiting list. Though these two patients show a large discrepancy in score correlation, this does not translate into an overall statistically significant difference. This paper shows universal use of the risk calculator and only one patient listed for kidney transplantation with a locally calculated score of less than 70%. This case went through an appeals process and does not reflect the functionality of the scoring system. Our findings demonstrate acceptance of the algorithm in transplantation centres in New Zealand. We aim to examine this cohort again in five years in order to determine mortality and hence the efficacy of the risk calculator in this New Zealand cohort.

Competing interests:
Dr Pilmore reports grants from A+ Trust during the conduct of the study; personal fees from Abbvie Pharmaceuticals outside the submitted work.

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