NHS BLOOD AND TRANSPLANT

PATIENT SURVIVAL FROM TIME OF LISTING FOR TRANSPLANT

SUMMARY

INTRODUCTION

1 Registry data are widely used to provide information on graft and patient survival time following transplantation, and factors affecting these outcomes. However, the likely survival from the point at which a patient is listed for transplant is also of interest to both clinicians and patients. This paper thus summarises analysis of survival times from transplant list registration for patients registered for their first kidney, liver, kidney/pancreas, heart or lung transplant in the UK, and reports centre specific survival rates. The analyses are adjusted for risk factors as reported at the time of listing.

METHODS

2 Data were obtained for all adult (≥ 18 years) patients registered for the first time for a kidney, liver, kidney/pancreas, heart or lung transplant between 1 January 2000 and 31 December 2011. Survival time was defined as the time from joining the transplant list to death, regardless of the length of time on the transplant list, whether or not the patient was transplanted and any factors associated with such a transplant eg donor type. Survival time was censored at either the date of removal from the list, or at the last known follow up date post transplant when no death date was recorded, or at 30 April 2012 if the patient was on the transplant list at time of analysis.

3 Renal patients may receive a live donor kidney without prior registration on the transplant list, although centre practices differ in relation to listing of potential live donor recipients. Consequently, patients who received a live donor kidney transplant within 6 months of listing were excluded from the analysis to minimise centre bias.

4 Exclusions from the analysis:

- All analyses - patients with intestinal failure and liver disease (IFALD), patients with ethnic group not reported (36 kidney, 4 liver, 1 heart, 1 lung), patients with unknown gender (9 kidney) or blood group (2 lung)
- Kidney analysis - patients first registered for a kidney/pancreas
- Kidney/Pancreas analysis – patients first registered for a pancreas only transplant (137 of 1792 registrations)
- Liver analysis - patients first registered for a super urgent liver transplant
- Cardiothoracic patients – patient registered for a heart-lung block or other multiorgan transplant, patients who were not listed prior to transplant, patients first registered on another transplant list (e.g. kidney list), registered outside the UK, not entitled to NHS treatment, and adult patients registered at paediatric centres were also excluded.

5 In addition, for heart and lung registrations, patients with missing BMI were excluded (3 heart, 2 lung), but for other organs, larger numbers of patients had no BMI reported and all cases were retained for analysis. Patients registered for

a heart transplant who were non-urgent and then urgently listed on the same day (or vice-versa) were recorded as urgent at registration. Patients who received a VAD and were registered on the transplant list on the same day were assumed to have received the VAD prior to registration (n=6).

6 In risk-adjusted survival analysis, factors recorded at time of transplant listing were adjusted for. These are detailed in **Table 1** and were included in the modelling whether or not statistically significant.

Table 1. Factors used in risk-adjusted models for patient survival from listing

Organ registered for	Factors for risk adjustment (at registration)
Kidney	Age, gender, ethnicity, blood group, BMI, cRF*>85%, primary disease, dialysis status
Kidney/Pancreas	Age, gender, ethnicity, blood group, BMI, cRF*>85%
Liver	Age, gender, ethnicity, blood group, serum creatinine, serum bilirubin, serum sodium, INR, primary disease
Heart	Age, gender, ethnicity, blood group, BMI, urgency status, primary disease, previous heart surgery, in hospital at registration, on VAD/ECMO support at registration
Lung	Age, gender, ethnicity, blood group, BMI, primary disease, previous thoracotomy, in hospital at registration

* calculated Reaction Frequency

7 The levels of the factors used and numbers of patients in the data sets are shown in **Table 2**. Additionally, a cohort effect (2000-2003, 2004-2007, 2008-2011) was built into the model to account for any change over the twelve year period.

8 For liver registrations, the values of serum creatinine, serum sodium, serum bilirubin and INR were only available from 1 April 2003, so it is only possible to estimate nine year survival rates at most for these patients.

Table 2. Patient characteristics at registration

Characteristic	Kidney	Kidney/ Pancreas	Liver	Heart	Lung
Number of patients	23334	1655	6688	1717	2260
Mean age in years (range)	49.6 (18-84)	40.8 (18-66)	52.3 (18-78)	46.5 (18-68)	46.6 (18-68)
Gender: % male	61	59	64	77	54
Ethnicity: % white	78	92	88	90	96
Primary disease (%)	Diabetes 10		Cancer 6	Heart dis 36	COPD 31
	GN 18		HCV 16	Dilated CM 54	Fibrosis 27
	Other 61		ALD 26	Other 9	Suppurative 28
	Not reported 11		HBV 4		Other 14
			PSC 9		
			PBC 12		
			AID 11		
			Metabolic 6		
			Other 9		
Blood group (%)					
O	46	48	45	43	48
A	37	39	39	40	39
B	14	9	12	12	10
AB	4	3	4	5	3
BMI					
Mean (n)	26.4 (15072)	25.5 (1233)	26.7 (6466)	25.5 (1717)	23.4 (2260)
Range	12-49	16-48	10-54	14-42	14-39
Sensitisation					
% with reaction frequency>85%	2.5	2.8	-	-	-
Dialysis status		-	-	-	-
% haemodialysis	38				
% peritoneal dialysis	21				
% not on dialysis	27				
% not known	14				
Mean sodium (range) n=4688	-	-	136 (112-150)	-	-
Mean bilirubin (range) n=4688	-	-	85.9 (2-1270)	-	-
Mean serum creat (range) n=4688	-	-	90.3 (8-400)	-	-
Mean INR (range) n=4688	-	-	1.5 (1-9.9)	-	-
Urgency status(% urgent heart)	-	-	-	18	-
% with previous heart surgery (n)	-	-	-	29 (1698)	-
% in hospital at registration (n)	-	-	-	37 (1707)	5 (2256)
% on VAD/ECMO support at listing	-	-	-	8	-
% with Previous thoracotomy (n)	-	-	-	-	9 (2254)

9 Survival rates at one, five and ten years post registration were calculated from the risk adjusted survival rate (RASR), obtained as 1 – {observed number of deaths in follow up period/expected number) x national mortality rate}. The expected survival rates were estimated from fitting a Cox model to the national data, excluding transplant centre, evaluated at each patient's observed survival time. Interval estimates for one, five and ten year rates, and the significance of differences between them across centres, were found using Poisson regression models for the logarithm of the observed number of deaths, with centre as a random effect.

RESULTS

10 **Table 3** shows the overall unadjusted survival rates at one, five and ten years (or nine years in the case of liver registrations). The lowest and highest centre-specific risk-adjusted rates are also shown. Only in the case of registration for a kidney transplant is there a difference in centre survival rates at five and ten years (p=0.03, p=0.02, respectively). Although two centres have 5 year adjusted survival rates that are a little greater than the others, this variation seems to be the result of an amalgamation of centre differences at these time points. If these two centres are excluded, the centre variation in five and ten year adjusted survival rates is significant at the 10% level, p=0.07 and p=0.06, respectively. Had there been as many registrations for other organs as there have been for kidney, significant variation in the survival rates following registration for a kidney/pancreas, liver, heart or lung may have been apparent.

11 The centre specific rates for each transplant type are given in **Appendix A**.

SUMMARY

12 Risk-adjusted analyses of patient survival from the point of transplant list registration demonstrate no statistically significant variation with the exception of kidney patient survival at five and ten years. At five years, centre-specific risk adjusted kidney survival rates range between 84% (95% CI 80-87%) and 94% (95% CI 90-96%), p=0.03 and at ten years between 67% (95% CI 60-73%) and 86% (95% CI 81-89%), p=0.02. The data indicate that there are no centres whose performance is out of line.

Statistics and Clinical Studies
September 2013

Table 3 Summary of survival rates

Organ	Survival time (years)	Overall unadjusted survival	Minimum RASR over centres (95% CI)	Maximum RASR over centres (95% CI)	p-value for centre differences
Kidney	One	0.98	0.97 (0.96,0.98)	0.99 (0.98,0.99)	0.165
	Five	0.86	0.84 (0.80,0.87)	0.94 (0.90, 0.96)	0.031
	Ten	0.74	0.67 (0.60, 0.73)	0.86 (0.81, 0.89)	0.024
Kidney/	One	0.96	0.93 (0.85, 0.97)	0.98 (0.94, 0.99)	0.32
Pancreas					
	Five	0.84	0.81 (0.68, 0.88)	0.89 (0.82, 0.93)	0.29
	Ten	0.75	0.71 (0.62, 0.77)	0.82 (0.71, 0.89)	0.33
Liver	One	0.79	0.76 (0.71, 0.79)	0.82 (0.78, 0.85)	0.31
	Five	0.67	0.63 (0.57, 0.68)	0.69 (0.64, 0.73)	0.41
	Nine*	0.54	0.53 (0.46, 0.60)	0.62 (0.56, 0.67)	0.37
Heart	One	0.79	0.73 (0.65, 0.78)	0.83 (0.77, 0.87)	0.27
	Five	0.66	0.59 (0.45, 0.69)	0.71 (0.63, 0.77)	0.30
	Ten	0.57	0.50 (0.35, 0.62)	0.62 (0.55, 0.67)	0.34
Lung	One	0.74	0.73 (0.69, 0.77)	0.75 (0.71,0.79)	0.68
	Five	0.43	0.38 (0.28, 0.46)	0.49 (0.41, 0.56)	0.99**
	Ten	0.25	0.20 (0.09, 0.30)	0.30 (0.21, 0.38)	0.99**

* missing values in covariates mean that maximum survival time is 9 years
** computed using fixed effects as variance component for centres is near zero

APPENDIX A

Kidney

Centre specific risk adjusted patient survival rates and interval estimates at one, five and ten years after listing for kidney transplant

Transplant Unit	One Year		Five Year		Ten Year	
	Rate	Interval	Rate	Interval	Rate	Interval
Belfast	0.98	0.97 - 0.99	0.89	0.86 - 0.91	0.76	0.70 - 0.80
Birmingham	0.98	0.98 - 0.99	0.90	0.87 - 0.92	0.79	0.74 - 0.83
Bristol	0.98	0.98 - 0.99	0.89	0.86 - 0.91	0.75	0.70 - 0.80
Cambridge	0.99	0.98 - 0.99	0.93	0.91 - 0.95	0.86	0.81 - 0.89
Cardiff	0.98	0.98 - 0.99	0.90	0.87 - 0.92	0.78	0.73 - 0.83
Coventry	0.98	0.98 - 0.99	0.90	0.86 - 0.92	0.76	0.68 - 0.81
Edinburgh	0.98	0.98 - 0.99	0.90	0.87 - 0.92	0.76	0.71 - 0.80
Glasgow	0.99	0.98 - 0.99	0.94	0.90 - 0.96	0.84	0.78 - 0.88
Leeds	0.98	0.98 - 0.99	0.87	0.85 - 0.89	0.74	0.70 - 0.77
Leicester	0.98	0.97 - 0.99	0.84	0.80 - 0.87	0.67	0.60 - 0.73
Liverpool	0.98	0.98 - 0.99	0.90	0.87 - 0.93	0.79	0.73 - 0.84
London, Guy's	0.99	0.98 - 0.99	0.91	0.89 - 0.93	0.81	0.77 - 0.85
London, St George’s	0.99	0.98 - 0.99	0.92	0.89 - 0.93	0.82	0.78 - 0.86
London, The Royal Free	0.98	0.97 - 0.99	0.87	0.82 - 0.91	0.75	0.67 - 0.81
London, The Royal London	0.98	0.98 - 0.99	0.89	0.86 - 0.92	0.75	0.69 - 0.80
London, WLRTC	0.98	0.97 - 0.99	0.89	0.83 - 0.93	0.77	0.67 - 0.84
Manchester	0.98	0.97 - 0.99	0.88	0.85 - 0.91	0.77	0.70 - 0.81
Newcastle	0.98	0.97 - 0.99	0.86	0.82 - 0.89	0.70	0.62 - 0.77
Nottingham	0.99	0.98 - 0.99	0.90	0.87 - 0.92	0.79	0.74 - 0.83
Oxford	0.98	0.98 - 0.99	0.87	0.84 - 0.89	0.71	0.66 - 0.76
Plymouth	0.98	0.97 - 0.99	0.89	0.85 - 0.91	0.77	0.71 - 0.82
Portsmouth	0.97	0.96 - 0.98	0.85	0.81 - 0.88	0.71	0.65 - 0.76
Sheffield	0.98	0.97 - 0.99	0.90	0.87 - 0.92	0.80	0.75 - 0.85

Kidney/Pancreas

Centre specific risk adjusted patient survival rates and interval estimates at one, five and ten years after listing for kidney/pancreas transplant

Transplant Unit	One Year		Five Year		Ten Year	
	Rate	Interval	Rate	Interval	Rate	Interval
Cambridge	0.97	0.94 - 0.99	0.89	0.81 - 0.93	0.82	0.71 - 0.89
Cardiff	0.94	0.87 - 0.97	0.83	0.72 - 0.89	0.73	0.58 - 0.83
Edinburgh	0.98	0.94 - 0.99	0.87	0.81 - 0.91	0.78	0.69 - 0.84
London, Guy's	0.98	0.95 - 0.99	0.89	0.83 - 0.92	0.81	0.73 - 0.87
London, WLRTC	0.98	0.94 - 0.99	0.88	0.80 - 0.92	0.81	0.70 - 0.87
Manchester	0.96	0.93 - 0.98	0.82	0.75 - 0.86	0.71	0.62 - 0.78
Newcastle	0.93	0.84 - 0.97	0.81	0.68 - 0.88	0.72	0.57 - 0.82
Oxford	0.95	0.93 - 0.97	0.82	0.77 - 0.86	0.73	0.66 - 0.78

Liver

Centre specific risk adjusted patient survival rates and interval estimates at one, five and ten years after listing for liver transplant

Transplant Unit	One Year		Five Year		Ten Year	
	Rate	Interval	Rate	Interval	Rate	Interval
Birmingham	0.79	0.76 - 0.81	0.67	0.63 - 0.70	0.58	0.54 - 0.62
Cambridge	0.82	0.78 - 0.85	0.69	0.64 - 0.73	0.62	0.56 - 0.67
Edinburgh	0.79	0.76 - 0.82	0.67	0.63 - 0.71	0.60	0.54 - 0.64
King's	0.81	0.78 - 0.83	0.67	0.64 - 0.71	0.59	0.55 - 0.64
Leeds	0.76	0.71 - 0.79	0.63	0.57 - 0.68	0.53	0.46 - 0.60
London, The Royal Free	0.79	0.76 - 0.82	0.66	0.61 - 0.70	0.58	0.53 - 0.63
Newcastle	0.81	0.77 - 0.84	0.68	0.63 - 0.73	0.60	0.54 - 0.65

Heart

Centre specific risk adjusted patient survival rates and interval estimates at one, five and ten years after listing for heart transplant

Transplant Unit	One Year		Five Year		Ten Year	
	Rate	Interval	Rate	Interval	Rate	Interval
Birmingham	0.73	0.65 - 0.78	0.60	0.51 - 0.67	0.50	0.39 - 0.59
Glasgow	0.75	0.65 - 0.82	0.59	0.45 - 0.69	0.50	0.35 - 0.62
Harefield	0.81	0.76 - 0.85	0.66	0.60 - 0.72	0.58	0.51 - 0.65
Manchester	0.83	0.77 - 0.87	0.71	0.63 - 0.77	0.61	0.52 - 0.68
Newcastle	0.76	0.70 - 0.81	0.61	0.53 - 0.68	0.53	0.43 - 0.60
Papworth	0.83	0.79 - 0.86	0.70	0.65 - 0.75	0.62	0.55 - 0.67

Lung

Centre specific risk adjusted patient survival rates and interval estimates at one, five and ten years after listing for lung transplant

Transplant Unit	One Year		Five Year		Ten Year	
	Rate	Interval	Rate	Interval	Rate	Interval
Birmingham	0.74	0.71 - 0.77	0.38	0.23 - 0.50	0.21	0.03 - 0.36
Harefield	0.75	0.71 - 0.79	0.47	0.40 - 0.54	0.30	0.21 - 0.38
Manchester	0.75	0.71 - 0.79	0.49	0.41 - 0.56	0.29	0.18 - 0.38
Newcastle	0.73	0.69 - 0.77	0.41	0.35 - 0.47	0.23	0.15 - 0.31
Papworth	0.74	0.71 - 0.77	0.38	0.28 - 0.46	0.20	0.09 - 0.30