

**NHS BLOOD AND TRANSPLANT
ORGAN & TISSUE DONATION AND TRANSPLANTATION DIRECTORATE**

KIDNEY ADVISORY GROUP

Urine Dipstick Testing

INTRODUCTION

- 1 Urinalysis (Dipstix) has been a standard component of potential deceased kidney donor assessment in the UK since 2016.
- 2 This paper investigates the completeness of urinalysis for deceased kidney donors and the association of urinalysis results with kidney offer acceptance and one-year graft survival, with the aim of assessing whether urinalysis results can meaningfully be used as a prognostic marker as part of organ quality assessment.
- 3 Protein, blood, leukocytes and nitrites are noted as potential indicators of organ quality. Presence of urine protein or blood could be interpreted as markers of donor native kidney (glomerular) disease (or less commonly urinary tract cancers, kidney stones or other structural causes for haematuria). Leukocytes and nitrites are potential markers of donor urinary tract infection.
- 4 Urinalysis results are known to be relatively inaccurate, especially in the context of patients who are catheterised and have raised intracranial pressure, diabetes insipidus, and other significant acute illness +/- co-morbidities. These issues raise the question of whether or not urinalysis results influence offer acceptance decisions and/or are useful prognostic markers of graft survival. Recent published work does not support continued use of proteinuria in organ offer acceptance decision making or as a risk prediction tool¹.
- 5 This paper only deals with urine dipstix results and associated outcomes. Other forms of urine testing including UACR/UPCR or C&S etc are not explored and/or recommendations made on use of such tests.

DATA

- 6 Data on deceased adult donors where at least one kidney was offered for transplant in the UK between 7 January 2016 and 31 December 2021 and any adult (aged ≥ 18 years at time of transplant) single kidney-only transplants resulting from the donor cohort were obtained from the UK Transplant Registry.

METHODS

- 7 Throughout this paper, kidney offer acceptance is defined at a donor level as the acceptance of at least one kidney offer, and does not indicate whether a kidney was ultimately transplanted.
- 8 The proportion of donors with urinalysis performed and the completeness of individual test results were analysed. Due to small numbers in some categories, test results were grouped as positive, negative and unknown, as defined in **Table 1**. Due to the clinical importance of the protein result, it was analysed using the test result as reported as well as the derived group.

Table 1: Urinalysis result groupings		
Urine dipstick test	Reported test result	Derived group
Protein	Negative	Negative
	Trace	Negative
	30 Mg/Dl (+)	Positive
	100 Mg/Dl (++)	Positive
	300 Mg/Dl (+++)	Positive
	2000 Mg/Dl Or More (++++)	Positive
	Not reported / no result	Unknown
Blood	Negative	Negative
	Non-Haemolyzed Trace	Negative
	Non-Haemolyzed Moderate	Positive
	Haemolyzed Trace	Negative
	Haemolyzed Small (+)	Positive
	Haemolyzed Moderate(++)	Positive
	Haemolyzed Large(+++)	Positive
	Not reported / no result	Unknown
Leukocytes	Negative	Negative
	Trace	Negative
	Small (+)	Positive
	Moderate (++)	Positive
	Large (+++)	Positive
	Not reported / no result	Unknown
Nitrites	Negative	Negative
	Positive	Positive
	Not reported / no result	Unknown
Infection	Leukocytes positive	Positive
	Nitrites positive	Positive
	Leukocytes negative and nitrites not positive	Negative
	Nitrites negative and leukocytes not positive	Negative
	Leukocytes and nitrites not reported	Unknown

- 9 Multivariable logistic regression analysis was used to describe the association between the protein, blood and infection results and offer acceptance, in the presence of confounding factors. Factors considered for inclusion in the model were donor age, donor sex, donor type, cause of death, BMI, smoking status (ever/never), diabetes, hypertension, terminal creatinine and UK DRI. For donor cause of death and the urinalysis results, missing data were categorised as “Unknown”. If data were missing for any of the other factors, the donor was excluded from this cohort. This cohort only included donors where a urinalysis test had been performed.
- 10 Multivariable Cox regression analysis was used to describe the association between the protein, blood and infection results and one-year graft survival, in the presence of confounding factors. Factors considered for inclusion in the model were donor age, donor sex, donor type, cause of death, BMI, smoking status (ever/never), diabetes, hypertension, terminal creatinine, UK DRI, recipient age, recipient sex, graft number (first/retransplant), primary renal disease, dialysis status at time of transplant, sensitisation, HLA mismatch level, cold ischaemia time and recipient waiting time. For donor cause of death, primary renal disease and the urinalysis results, missing data were categorised as “Unknown”. If data were missing for any of the other factors, the transplant was excluded from this cohort. This cohort only included transplants where a urinalysis test had been performed for the donor.

RESULTS

- 11 10,764 (99%) of 10,839 deceased adult donors where at least one kidney was offered for transplant in the UK between 7 January 2016 and 31 December 2021 had urinalysis performed. Urinalysis is defined as having been performed if at least one test result was reported.
- 12 For the 10,764 donors with urinalysis reported, protein was reported for 99%, blood for 97% and infection for 92%.
- 13 **Table 2** shows a summary of the urinalysis results in both the kidney offer acceptance cohort and the graft survival cohort. 47% of all donors have a positive protein test result.

Table 2: Summary of urinalysis results				
Cohort	Urine dipstick test	Negative	Positive	Unknown
Kidney offer acceptance cohort	Protein	5650 (52.5%)	5033 (46.8%)	81 (0.8%)
	Blood	4554 (42.3%)	5847 (54.3%)	363 (3.4%)
	Infection	8204 (76.2%)	1705 (15.8%)	855 (7.9%)
Graft survival cohort	Protein	6723 (55.1%)	5392 (44.2%)	87 (0.7%)
	Blood	5451 (44.7%)	6315 (51.8%)	436 (3.6%)
	Infection	9368 (76.8%)	1885 (15.4%)	949 (7.8%)

- 14 The cohort used in the kidney offer acceptance model included 10,423 (97%) of the 10,764 donors – this was after exclusions were made due to missing data. The factors included in the model were donor type (DBD, DCD), terminal reported creatinine (<100, 100 to <150, ≥150), donor age (years) (18 to 29, 30 to 39, 40 to 49, 50 to 59, 60+), history of diabetes (yes/no), history of hypertension (yes/no), and donor BMI (<20, 20 to <25, 25 to <30, ≥30).
- 15 **Table 3a** shows the association between the protein, blood and infection results and kidney offer acceptance when added individually to the risk-adjusted logistic regression model defined above. Similarly, **Table 3b** shows the association between the significant urinalysis results and kidney offer acceptance in the presence of other significant urinalysis results.
- 16 The protein and blood results, when looked at individually, have a statistically significant association with kidney offer acceptance, with a positive result decreasing the likelihood of the kidney offer being accepted. When considered together, protein is statistically significant whilst blood is borderline significant.
- 17 The infection result has no statistically significant association with kidney offer acceptance.

Parameter	Level	Total offers N	Offers accepted N (%)	Odds ratio (95% CI)	Likelihood Ratio p-value
Protein (by reported result)	Negative	3243	2769 (85.4)	1.00 (-)	<0.001
	Trace	2231	1880 (84.3)	0.96 (0.82, 1.12)	
	30 Mg/Dl (+)	3046	2452 (80.5)	0.78 (0.67, 0.89)	
	100 Mg/Dl (++)	1348	1032 (76.6)	0.66 (0.56, 0.79)	
	300 Mg/Dl (++++)	422	305 (72.3)	0.5 (0.39, 0.64)	
	2000 Mg/Dl Or More (++++)	58	47 (81.0)	0.86 (0.43, 1.75)	
	Unknown	75	57 (76.0)	0.57 (0.32, 1.02)	
Protein (-/+)	Negative	5474	4649 (84.9)	1.00 (-)	<0.001
	Positive	4874	3836 (78.7)	0.73 (0.65, 0.81)	
	Unknown	75	57 (76.0)	0.58 (0.32, 1.03)	
Blood (-/+)	Negative	4403	3733 (84.8)	1.00 (-)	0.001
	Positive	5671	4521 (79.7)	0.81 (0.73, 0.91)	
	Unknown	349	288 (82.5)	0.91 (0.67, 1.23)	
Infection (-/+)	Negative	7941	6544 (82.4)	1.00 (-)	0.12
	Positive	1655	1334 (80.6)	0.9 (0.78, 1.04)	
	Unknown	827	664 (80.3)	0.85 (0.70, 1.03)	
Risk adjustment factors: donor type (DBD, DCD), terminal reported creatinine (<100, 100 to <150, ≥150), donor age (years) (18 to 29, 30 to 39, 40 to 49, 50 to 59, 60+), history of diabetes (yes/no), history of hypertension (yes/no), and donor BMI (<20, 20 to <25, 25 to <30, ≥30)					

Table 3b: Association of significant urinalysis results with risk-adjusted kidney offer acceptance

Urinalysis results included in model	Parameter	Level	Total offers N	Offers accepted N (%)	Odds ratio (95% CI)	Likelihood Ratio p-value
Protein (-/+) + Blood (-/+)	Protein (-/+)	Negative	5474	4649 (84.9)	1.00 (-)	<0.001
		Positive	4874	3836 (78.7)	0.75 (0.67, 0.83)	
Unknown		75	57 (76.0)	0.59 (0.33, 1.05)		
	Blood (-/+)	Negative	4403	3733 (84.8)	1.00 (-)	0.05
		Positive	5671	4521 (79.7)	0.87 (0.78, 0.98)	
		Unknown	349	288 (82.5)	1.00 (0.73, 1.36)	

Risk adjustment factors: donor type (DBD, DCD), terminal reported creatinine (<100, 100 to <150, ≥150), donor age (years) (18 to 29, 30 to 39, 40 to 49, 50 to 59, 60+), history of diabetes (yes/no), history of hypertension (yes/no), and donor BMI (<20, 20 to <25, 25 to <30, ≥30)

- 18 The cohort used in the one-year graft survival model included 11,756 (96%) of the 12,202 transplants – this was after exclusions were made due to missing data. The factors included in the model were donor age (18 to 29, 30 to 39, 40 to 49, 50 to 59, 60+ years), dialysis at transplantation (yes/no), retransplant (yes/no), donor history of hypertension (yes/no), donor type (DBD, DCD), donor cause of death (trauma, CVA, hypoxia, other, unknown), and recipient sensitisation (unsensitised, sensitised, highly sensitised).
- 19 **Table 4** shows the association between the protein, blood and infection results and one-year graft survival when individually added to the risk-adjusted Cox-regression model defined above.
- 20 The infection result has a borderline statistically significant association with graft failure at one-year, with slightly increased risk of graft failure at one year. Protein and blood results have no statistically significant association with graft failure at one-year.

Table 4: Association of urinalysis results with risk-adjusted one-year graft survival

Parameter	Level	Total transplants N	Graft failures within 1 year N (%)	Hazard ratio (95% CI)	Likelihood Ratio p-value
Protein (by reported result)	Negative	3881	229 (5.9)	1.00 (-)	0.83
	Trace	2590	145 (5.6)	0.98 (0.79, 1.20)	
	30 Mg/Dl (+)	3346	185 (5.5)	0.96 (0.79, 1.17)	
	100 Mg/Dl (++)	1392	65 (4.7)	0.85 (0.65, 1.12)	
	300 Mg/Dl (+++)	393	20 (5.1)	0.9 (0.57, 1.43)	

	2000 Mg/Dl Or More (++++)	73	2 (2.7)	0.58 (0.14, 2.33)	
	Unknown	81	6 (7.4)	1.41 (0.63, 3.17)	
Protein (-/+)	Negative	6471	374 (5.8)	1.00 (-)	0.48
	Positive	5204	272 (5.2)	0.94 (0.80, 1.09)	
	Unknown	81	6 (7.4)	1.42 (0.63, 3.19)	
Blood (-/+)	Negative	5237	299 (5.7)	1.00 (-)	0.76
	Positive	6103	331 (5.4)	0.94 (0.81, 1.10)	
	Unknown	416	22 (5.3)	0.99 (0.64, 1.53)	
Infection (-/+)	Negative	9028	480 (5.3)	1.00 (-)	0.09
	Positive	1814	124 (6.8)	1.25 (1.03, 1.53)	
	Unknown	914	48 (5.3)	1.01 (0.75, 1.36)	
Risk adjustment factors: donor age (18 to 29, 30 to 39, 40 to 49, 50 to 59, 60+ years), dialysis at transplantation (yes/no), retransplant (yes/no), donor history of hypertension (yes/no), donor type (DBD, DCD), donor cause of death (trauma, CVA, hypoxia, other, unknown), and recipient sensitisation (unsensitised, sensitised, highly sensitised)					

SUMMARY

- 21 Positive protein and blood urinalysis results increase the likelihood of a kidney offer being declined but have no association with one-year graft survival for those kidneys transplanted.
- 22 Urinalysis results for infection markers are not associated with kidney offer acceptance but has a borderline statistically significant association with one-year graft outcomes.

RECOMMENDATIONS

- 23 In light of the analyses findings, Kidney Advisory Group members are asked to support a recommendation for removal of mandatory urine dipstix assessment as part of deceased donor characterisation.

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1. Utilization and clinical outcomes of kidney transplants from deceased donors with albuminuria in the UK: a national cohort study. GH Greenhall et al. NDT; 2022 Oct 19;37(11):2275-2283.