Assessment and Transplantation of Declined Human Kidneys using Ex-vivo Normothermic Kidney Perfusion

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Introduction

Ex-vivo normothermic kidney perfusion (EVKP) allows a functional assessment of a kidney prior to transplantation. Applying this technology may prevent the unnecessary discard of donated kidneys. The aim of this study was to use EVKP technology to assess the quality of kidneys declined for transplantation and if suitable, transplant them.

Methods

Ethical approval was granted for this research study. After being declined for transplantation by all UK transplant centres and approval granted for research, kidneys were offered to the research team by the NHSBT duty office. Kidneys underwent 60 minutes of EVKP with an oxygenated plasma-free red cell solution at $35.2 \pm 0.2^{\circ}\text{C}$. During EVKP the quality of each kidney was assessed using a scoring system based on macroscopic appearance during perfusion, renal blood flow and the amount of urine produced (Figure 1).

Quality Assessment Score

Macroscopic Score 1, 2, 3 = 1 - 3
RBF <50ml/min/100g = 1
U/O <43ml = 1
Total scores range from 1 (least injury) to 5 (most severe)

Results

In a 12 month period, 74 kidneys from 51 donors were offered to the research study. Only 10 of these kidneys were recruited into the study. Of the kidneys not recruited, prolonged cold ischaemia at the time of offering was a significant factor in many cases and the primary reason for non-recruitment in a third of the cases.

Ten kidneys from donation after circulatory death (DCD) donors were accepted for EVKP assessment. Eight out of ten kidneys were declined for transplantation primarily due to poor *in-situ* flush at the time of retrieval (Table 1).

	Donor Age (y)	Reason for Decline	Cold Ischaemia (h. min)
QAS 01	35	Poor in-situ flush	17.24
QAS 02	35	Poor in-situ flush	19.44
QAS 05	53	Poor in-situ flush + stripped ureter	18.55
QAS 08	51	Poor in-situ flush	7.49
QAS 09	51	Poor in-situ flush	9.27
QAS 03	75	Poor in-situ flush	14.04
QAS 04	36	Poor in-situ flush	15.27
QAS 06	78	Older donor	12.30
QAS 07	78	Older donor	14.27
QAS 10	60	Poor in-situ flush	17.14

Table 1. Kidneys recruited, reason for decline and first cold ischaemic time (CIT)

Conclusion

EVKP technology has the potential to increase the number kidney transplants by assessing their quality prior to transplantation. Identifying these kidneys at an earlier stage to minimise the cold ischaemic time would allow more kidneys to be assessed and potentially transplanted. Kidneys that have been inadequately flushed at retrieval and discarded based on their macroscopic appearance may particularly benefit from this application.

Results

Of the ten recruited kidneys, 5 were not transplanted due to the following reasons; prolonged cold ischaemia due to delayed access to theatre (n = 1), high Remuzzi biopsy score (n = 2), poor perfusion parameters during EVKP (n = 2) (Table 2).

Unused kidneys	QAS Score	Declined
QAS 03	3	Logistics – prolonged CI after EVKP
QAS 04	3	Damaged kidney
QAS 06	1	High Remuzzi score (chronic injury)
QAS 07	4	QAS score and high Remuzzi score
QAS 10	4	QAS score

Table 2. Kidneys recruited but not transplanted

Five kidneys were successfully transplanted without any complications (Table 3)

	QAS 01	QAS 02	QAS 05	QAS 08	QAS 09
QAS Score	1	2	3	2	2
Donor age (y)	35	35	53	51	51
Gender	M	M	M	F	F
Cause of Death	ICH	ICH	Hypoxia	ICH	ICH
WIT (min)	13	13	12	17	17
1 st CIT (h. min)	19.36	24.51	22.02	16.12	12.34
Recipient age (y)	30	68	55	49	45
2 nd CIT (min)	132	247	187	503	187
Anastomosis (min)	33	33	39	34	38
Total Ischaemia (h. min)	21.09	26.24	23.41	17.46	14.12

Table 3. Transplanted kidneys. Quality assessment score, donor and recipient demographics, warm ischaemic time (WIT) and first and second cold ischaemic time (CIT), anastomosis and total ischaemic time.

Four of the recipients had initial graft function and 1 delayed graft function (DGF). There were no complications during perfusion or after transplantation.