

Supplement

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1. SUPPLEMENTARY METHODS

1.1. Interpretation of statistical analyses

The aim of discrimination is to distinguish between patients who experience an event and those who do not. The C-index estimates the proportion of all pairwise patient combinations from the sample data whose survival time can be ordered such that the patient with the highest predicted survival is the one who actually survived longer (discrimination). The C-index ($0 \leq C \leq 1$) is the probability of concordance between predicted and observed survival, with C-index=0.5 for random predictions and C-index=1 for a perfectly discriminating model.

1.2. Calculation of the Kidney Donor Risk Index (KDRI) and the Kidney Donor Profile Index (KDPI)

The KDRI and KDPI are scores derived from 10 deceased donor variables and predict risk of kidney allograft failure after transplantation. Lower values for the KDRI and KDPI indicate kidneys with better projected allograft survival. These indices were developed for the purpose of enabling clinicians to try to make rough assessments of allograft quality and graft failure risk across donors with different attributes.¹¹ A guidance document from the United Network for Organ Sharing states “The Kidney Donor Profile Index (KDPI) is a numerical measure that combines ten donor factors, including clinical parameters and demographics, to summarize into a single number the quality of deceased donor kidneys relative to other recovered kidneys.”²⁶

The KDRI score for any kidney allograft estimates the risk of failure for that allograft compared to a kidney from a reference donor. This reference donor is defined as 40 years old, non-African-American, 170 cm tall, weighing 80 kg, with a creatinine level of 1 mg/dL, as well as negative history of hypertension, diabetes and hepatitis C virus serostatus. Notably, race/ethnicity for organ donors cannot be collected and reported according to French national bioethics rules. As a result, as we entered “non-black” as the race for all French donors when calculating KDRI. This approach to calculating the KDRI of the French pool of donated kidneys will have the net effect of slightly over-estimating the quality of these organs. Nonetheless, as shown in the results, French transplant centers are still much more likely to accept kidneys with the highest KDRI scores (i.e. lowest quality kidneys) compared to US centers.

The KDRI is not formally used in kidney allocation in France, but donor characteristics used to calculate the scores (with the exception of donor race) are presented to transplant centers with organ offers.

2. SUPPLEMENTARY TABLES

Appendix Table 1A: Association of day-0 biopsy results with kidney allograft loss: univariate analysis.

			Number of patients	Number of events	HR	95% CI	P
Day-0 biopsy ^a	Percentage of glomerulosclerosis	0-5%	818	143	1	-	
		6-10%	278	47	1.014	(0.730 – 1.410)	
		11-15%	180	49	1.817	(1.313 – 2.515)	
		16-20%	129	35	1.734	(1.198 – 2.510)	
		> 20%	224	61	1.828	(1.353 – 2.468)	<0.0001
	Interstitial fibrosis and tubular atrophy	Low score: 0 or 1	1,537	306	1	-	
		High score: ≥ 2	92	29	2.100	(1.433 – 3.078)	0.0001
	Arteriolar hyalinosis	Low score: 0 or 1	1,302	249	1	-	
		High score: ≥ 2	322	84	1.487	(1.161 – 1.904)	0.0017
	Arteriosclerosis	Low score: 0 or 1	1,083	200	1	-	
		High score: ≥ 2	546	135	1.494	(1.200 – 1.859)	0.0003

Appendix Table 1B: Determinants of kidney allograft loss in multivariate analysis with

addition of day-0 biopsy results

		Number of patients	Number of events	HR	95% CI	P
KDRI (log transformation)		1,540	312	2.500	(1.839 - 3.397)	<0.0001
Prior kidney transplant	No	1,270	244	1	-	
	Yes	270	68	1.338	(1.007 - 1.778)	0.0447
Anti-HLA DSA on day 0	No	1,206	222	1	-	
	Yes	334	90	1.761	(1.362 - 2.277)	<0.0001
Interstitial fibrosis and tubular atrophy	Low score: 0 or 1	1,450	284	1	-	
	High score: ≥ 2	90	28	1.507	(1.004 - 2.263)	0.0480

Abbreviations: CI, Confidence interval; HR, Hazard ratio; ECD, Expanded criteria donor.; HLA, human leucocyte antigen; KDRI, Kidney Donor Risk Index

Appendix Table 2: Factors associated with kidney allograft loss in univariate analysis in the validation cohort.

			Number of patients	Number of events	HR	95% CI	P
Baseline recipients characteristics	Age (per 1-yr increment)		1,107	163	1.012	(0.999 – 1.025)	0.0604
Baseline donor characteristics	Age (per 1-yr increment)		1,096	163	1.017	(1.005 – 1.029)	0.0043
	Gender	Female	493	79	1	-	
		Male	607	84	0.856	(0.630 – 1.164)	0.6297
	Death of CV disease	No	528	73	1	-	
		Yes	579	90	1.132	(0.831 – 1.541)	0.4321
	Hypertension	No	759	96	1	-	
		Yes	192	35	1.451	(0.985 – 2.138)	0.0594
	ECD	No	825	109	1	-	
		Yes	282	54	1.706	(1.230 – 2.366)	0.0014
	KDRI* (Log transformation)		888	129	3.238	(1.804 – 5.814)	0.0001
Transplant characteristics	Prior kidney	No	953	134	1	-	
	Transplant	Yes	154	29	1.315	(0.880 – 1.965)	0.1808
Immunologic factor	No. of HLA A/B/DR mismatches		1,107	163	1.134	(0.998 – 1.288)	0.0529

Abbreviations: CI, Confidence interval; HR, Hazard ratio; CV, Cardio-vascular; ECD, Expanded criteria donor; DSA, Donor-specific anti-HLA antibodies; HLA, human leucocyte antigen; KDRI, Kidney Donor Risk Index

* The KDRI score was calculated based on the following donor parameters: age, height, weight, history of hypertension, history of diabetes, cause of death (cerebral stroke), serum creatinine at donation, hepatitis C virus (HCV) serostatus, and donation after circulatory death status.

Appendix Table 3: Baseline characteristics of the US discarded kidneys matched to transplanted French kidneys based on histology and the KDRI, and the unmatched US and French kidneys

	Matched discarded kidneys (US) (n=493)		Matched transplanted kidneys (France) (n=493)		Unmatched discarded kidneys (US) (n=610)		Unmatched transplanted kidneys (France) (n=1,136)		p [*]
	n		n		n		n		
Donor's characteristics									
Donor age (years), mean (SD)	493	55.16 (11.88)	493	61.73 (11.33)	610	55.64 (10.16)	1,136	48.65 (17.08)	<0.0001
Donor male gender , No. (%)	493	236 (47.87)	493	268 (54.36)	610	341 (55.90)	1,136	690 (60.74)	<0.0001
Height (cm), mean (SD)	493	169.17 (10.71)	493	168.44 (9.19)	610	169.08 (10.40)	1,135	170.89 (10.69)	<0.0001
Weight (kg), mean (SD)	493	84.86 (22.38)	493	74.64 (16.03)	610	86.04 (22.36)	1,135	73.44 (15.35)	<0.0001
BMI , mean (SD)	493	29.62 (7.31)	493	26.26 (5.15)	610	30.08 (7.38)	1,135	25.05 (4.52)	<0.0001
Hypertension , No. (%)	493	337 (68.36)	493	219 (44.42)	594	465 (78.28)	1,094	254 (23.22)	<0.0001
Diabetes mellitus , No. (%)	493	150 (30.43)	493	52 (10.55)	594	172 (28.96)	1,078	74 (6.86)	<0.0001
Donor serum creatinine (mg/dL), mean (SD)	493	1.82 (1.34)	493	1.05 (0.51)	610	1.95 (1.32)	1,120	1.02 (0.58)	<0.0001
Death from cerebrovascular disease , No. (%)	493	396 (80.32)	493	335 (67.95)	610	530 (86.89)	1,136	576 (50.70)	<0.0001
Expanded criteria donor , No. (%)	493	286 (58.01)	493	344 (69.78)	610	373 (61.15)	1,133	343 (30.27)	<0.0001
KDRI , mean (SD)	493	1.88 (0.53)	493	1.88 (0.55)	592	1.88 (0.42)	1,047	1.45 (0.63)	<0.0001

Data are the mean (SD) or n (%).
Abbreviations: KDRI, Kidney Donor Risk Index; BMI, Body Mass Index.
^a χ^2 tests were conducted for the comparison of proportions, and ANOVA were conducted for the comparison of continuous variables.
* Ethnicity for donors is not permitted to be collected per the French data protection regulations (CNIL)

Appendix Table 4: Distribution of KDRI and biopsy characteristics in the pre and post-match cohorts

	Pre-Match		Post-Match		Pre-Match	Post-Match
	Discarded	Transplanted	Discarded	Transplanted	Standardized	Standardized
	Kidneys	Kidneys	Kidneys	Kidneys	difference	difference
	(US)	(France)	(US)	(France)		
	N = 1085	N = 1540	N = 493	N = 493		
KDRI, mean (SD)	1.89 (0.47)	1.59 (0.64)	1.88 (0.53)	1.88 (0.55)	-0.5265	-0.0044
% Glomerulosclerosis						
0 – 5 (%)	185 (17.1%)	765 (49.7%)	104 (21.1%)	104 (21.1%)	0.3262	0
6 – 10 (%)	159 (14.7%)	261 (17%)	97 (19.7%)	97 (19.7%)	0.0229	0
11 – 15 (%)	145 (13.4%)	172 (11.2%)	67 (13.6%)	67 (13.6%)	-0.022	0
16 – 20 (%)	123 (11.3%)	124 (8.1%)	54 (11%)	51 (10.3%)	-0.0328	-0.0061
>20 (%)	473 (43.6%)	218 (14.2%)	171 (34.7%)	174 (35.3%)	-0.2944	0.0061
IFTA Score						
0	174 (16%)	1081 (70.2%)	174 (35.3%)	177 (35.9%)	0.5416	0.0061
1	240 (22.1%)	369 (24%)	240 (48.7%)	240 (48.7%)	0.0184	0
2	663 (61.1%)	68 (4.4%)	71 (14.4%)	68 (13.8%)	-0.5669	-0.0061
3	8 (0.7%)	22 (1.4%)	8 (1.6%)	8 (1.6%)	0.0069	0
CV Score						
0	273 (25.2%)	494 (32.1%)	147 (29.8%)	144 (29.2%)	0.0692	-0.0061
1	154 (14.2%)	524 (34%)	139 (28.2%)	142 (28.8%)	0.1983	0.0061
2	634 (58.4%)	442 (28.7%)	187 (37.9%)	184 (37.3%)	-0.2973	-0.0061
3	24 (2.2%)	80 (5.2%)	20 (4.1%)	23 (4.7%)	0.0298	0.0061

Abbreviations: SD, Standard deviation; KDRI, Kidney Donor Risk Index; IFTA, Interstitial Fibrosis and Tubular Atrophy; CV, Cardio-vascular

Appendix Table 5: Determinants of non-death censored kidney allograft loss in the derivation cohort: univariate and multivariable analyses

			Number of patients	Number of events	HR	95% CI	P
Univariate analysis							
Baseline recipient characteristics	Age (per 1-yr increment)		1,629	578	1.036	(1.029 – 1.043)	<0.0001
	Gender	Female	663	229	1	-	
		Male	966	349	1.054	(0.892 – 1.245)	0.5364
	Prior kidney transplant	No	1,346	456	1	-	
		Yes	283	122	1.312	(1.074 – 1.602)	0.0078
Baseline donor characteristics	Age (per 1-yr increment)		1,629	578	1.028	(1.022 – 1.033)	<0.0001
	Gender	Female	671	255	1	-	
		Male	958	323	0.862	(0.732 – 1.016)	0.0770
	Death of CV disease	No	718	199	1	-	
		Yes	911	379	1.632	(1.375 – 1.938)	<0.0001
	Hypertension	No	1,114	335	1	-	
		Yes	473	226	1.882	(1.589 – 2.229)	<0.0001
	Diabetes mellitus	No	1,445	491	1	-	
		Yes	126	62	1.671	(1.283 – 2.176)	0.0001
	Creatinine (mg/dL)	< 1.5	1,401	486	1	-	
		≥ 1.5	212	85	1.300	(1.032 – 1.637)	0.0257
	ECD	No	939	250	1	-	
		Yes	687	326	2.159	(1.830 – 2.547)	<0.0001
	KDRI* (Log transformation)		1,540	312	3.533	(2.843 – 4.392)	<0.0001
	Baseline Immunologic factors	No. of HLA A/B/DR mismatches		1,628	578	0.997	(0.934 – 1.063)
Anti-HLA DSA on Day 0		No	1,286	435	1	-	
		Yes	343	143	1.542	(1.275 – 1.866)	<0.0001
Multivariable analysis							
	Recipient's age (per 1-yr increment)		1,540	543	1.018	(1.009 - 1.028)	<0.0001
	KDRI* (log transformation)		1,540	543	2.624	(1.932 - 3.563)	<0.0001
	Prior kidney transplant	No	1,270	428	1	-	
		Yes	270	115	1.4947	(1.199 - 1.863)	<0.0001
	Anti-HLA DSA on Day 0	No	1,206	405	1	-	
		Yes	334	138	1.546	(1.262 - 1.894)	<0.0001

Abbreviations: CI, Confidence interval; HR, Hazard ratio; CV, Cardio-vascular; ECD, Expanded criteria donor; DSA, Donor-specific anti-HLA antibodies; HLA, human leukocyte antigen; KDRI, Kidney Donor Risk Index

* The KDRI score was calculated based on the following donor parameters: age, height, weight, history of hypertension, history of diabetes, cause of death (cerebral stroke), serum creatinine at donation, hepatitis C virus (HCV) serostatus, and donation after circulatory death status.

Appendix Table 6: Distribution of donor age and biopsy characteristics in the pre and post-match cohorts*

	Pre-Match		Post-Match		Pre-Match	Post-Match
	Discarded	Transplanted	Discarded	Transplanted	Standardized	Standardized
	Kidneys	Kidneys	Kidneys	Kidneys	difference	difference
	(US)	(France)	(US)	(France)		
	N = 1103	N = 1629	N = 496	N = 496		
Donor Age in years, mean	55.4 (11)	52.6 (16.7)	56.1 (11.9)	56.2 (12.1)	-0.2003	0.0086
(SD)						
% Glomerulosclerosis						
0 – 5 (%)	190 (17.2%)	818 (50.2%)	114 (23%)	117 (23.6%)	0.3299	0.006
6 – 10 (%)	161 (14.6%)	278 (17.1%)	101 (20.4%)	100 (20.2%)	0.0247	-0.002
11 – 15 (%)	145 (13.2%)	180 (11.1%)	66 (13.3%)	69 (13.9%)	-0.021	0.006
16 – 20 (%)	124 (11.2%)	129 (7.9%)	60 (12.1%)	58 (11.7%)	-0.0332	-0.004
>20 (%)	483 (43.8%)	224 (13.8%)	155 (31.3%)	152 (30.7%)	-0.3004	-0.006
IFTA Score						
0	175 (15.9%)	1154 (70.8%)	175 (35.3%)	178 (35.9%)	0.5498	0.006
1	241 (21.9%)	383 (23.5%)	241 (48.6%)	242 (48.8%)	0.0166	0.002
2	679 (61.6%)	69 (4.2%)	72 (14.5%)	69 (13.9%)	-0.5732	-0.006
3	8 (0.7%)	23 (1.4%)	8 (1.6%)	7 (1.4%)	0.0069	-0.002
CV Score						
0	274 (24.8%)	523 (32.1%)	152 (30.7%)	149 (30%)	0.0726	-0.006
1	159 (14.4%)	560 (34.4%)	129 (26%)	132 (26.6%)	0.1996	0.006
2	644 (58.4%)	463 (28.4%)	197 (39.7%)	194 (39.1%)	-0.2996	-0.006
3	26 (2.4%)	83 (5.1%)	18 (3.6%)	21 (4.3%)	0.0274	0.006

Abbreviations: SD, Standard deviation; KDRI, Kidney Donor Risk Index; IFTA, Interstitial Fibrosis and Tubular Atrophy; CV, Cardio-vascular

*Sensitivity analysis – matching on donor age instead of the KDRI

Appendix Table 7: Baseline characteristics of the US discarded kidneys matched with transplanted French kidneys based on histology and the donor's age and the unmatched transplanted French kidneys*

	Matched discarded kidneys (US) (n=496)		Matched transplanted kidneys (France) (n=496)			Unmatched kidneys (US) (n=607)		Unmatched kidneys (France) (n=1,133)		p [*]
	n		n		n		n			
Donor's characteristics										
Donor age (years), mean (SD)	496	56.06 (11.95)	496	56.20 (12.05)	607	54.91 (10.06)	1,133	51.03 (18.13)		<0.0001
Donor male gender , No. (%)	496	233 (46.98)	496	313 (63.10)	607	344 (56.67)	1,133	645 (56.93)		<0.0001
Height (cm), mean (SD)	496	168.95 (10.50)	496	170.73 (9.10)	607	169.26 (10.57)	1,132	169.90 (10.80)		0.0305
Weight (kg), mean (SD)	496	83.95 (22.07)	496	75.94 (15.16)	607	86.79 (22.55)	1,132	72.87 (15.66)		<0.0001
BMI , mean (SD)	496	29.39 (7.28)	496	26.04 (4.93)	607	30.27 (7.40)	1,132	25.15 (4.65)		<0.0001
Hypertension , No. (%)	493	338 (68.56)	487	178 (36.55)	594	464 (78.11)	1,100	295 (26.82)		<0.0001
Diabetes mellitus , No. (%)	491	146 (29.74)	481	50 (10.40)	596	176 (29.53)	1,090	76 (6.97)		<0.0001
Donor serum creatinine (mg/dL), mean (SD)	496	1.76 (1.26)	493	1.09 (0.57)	607	2.00 (1.37)	1,120	1.01 (0.55)		<0.0001
Death from cerebrovascular disease , No. (%)	496	401 (80.85)	496	296 (59.68)	607	525 (86.49)	1,133	615 (54.28)		<0.0001
Expanded criteria donor , No. (%)	496	297 (59.88)	494	256 (51.82)	607	362 (59.64)	1,132	431 (38.07)		<0.0001
KDRI , mean (SD)	491	1.91 (0.54)	473	1.64 (0.51)	594	1.86 (0.40)	1,067	1.56 (0.69)		<0.0001

Data are the mean (SD) or n (%).

Abbreviations: KDRI, Kidney Donor Risk Index; BMI, Body Mass Index.

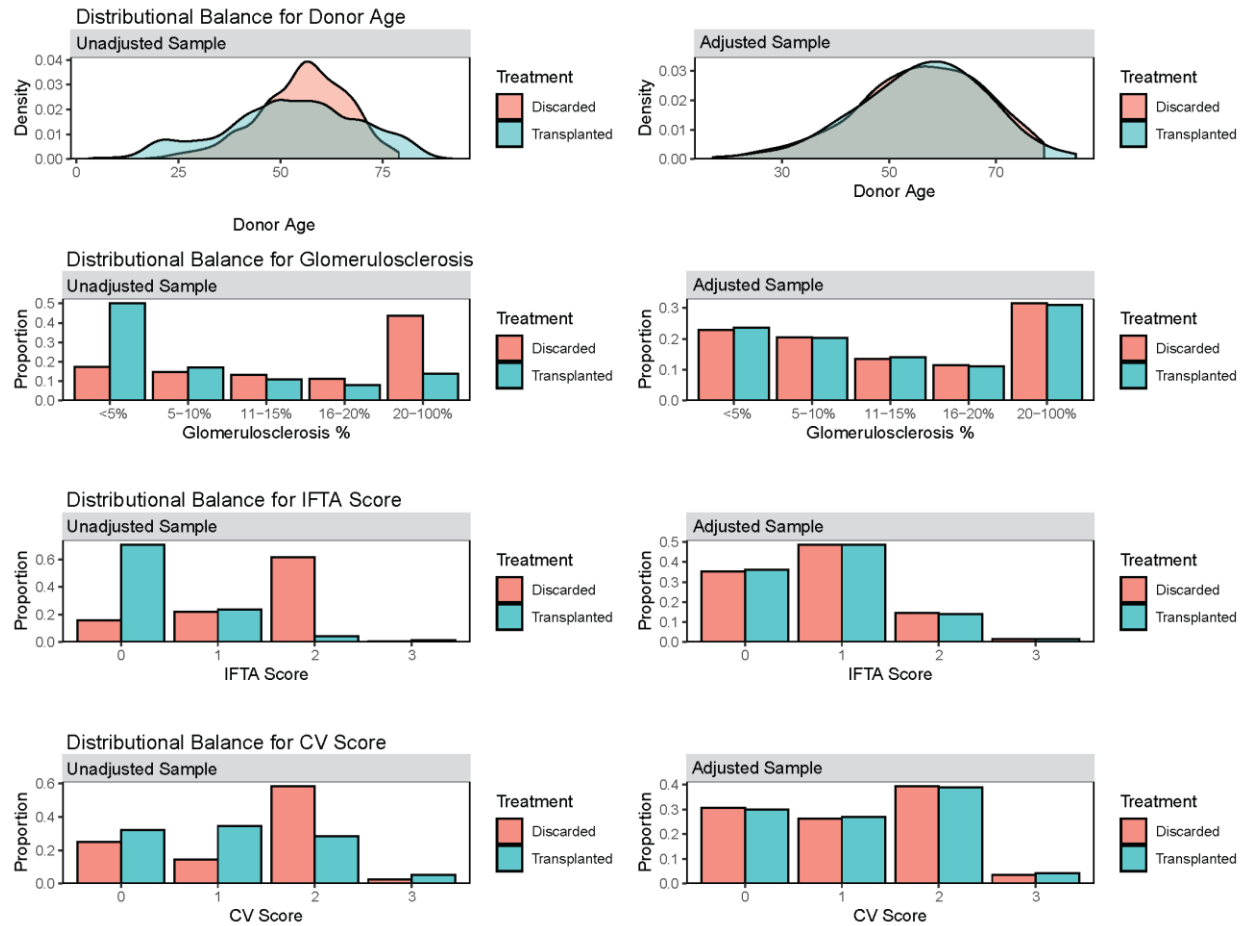
^a χ^2 tests were conducted for the comparison of proportions, and Annova were conducted for the comparison of continuous variables.

*Sensitivity analysis – matching on donor age instead of the KDRI

* Ethnicity for donors is not permitted to be collected per the French data protection regulations (CNIL)

3. SUPPLEMENTARY FIGURES

Appendix Figure 1: Distributional balance of the donor's age and biopsy characteristics before and after matching French transplanted kidneys with kidneys discarded in the US due to biopsy findings.



Appendix Figure 2: Kaplan-Meier curves of allograft survival rates for kidneys transplanted in France matched and unmatched to US discarded kidneys using donor’s age instead of KDRI for matching. Panel A shows the allograft survival probability of the kidneys transplanted matched to US discarded kidneys (red curve) to the rest of the population (unmatched kidneys; black curve). Panel B shows the allograft survival probability of the matched kidneys (red curve) to the rest of the population according to the ECD status (kidneys transplanted with standard criteria donor; solid black curve, kidneys transplanted with expanded criteria donor; dashed black curve).

