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Original Article

Outcomes of overseas kidney transplantation in chronic haemodialysis patients in Taiwan

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KEY WORDS:
kidney transplantation, organ trafficking, post-transplantation outcome.

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SUMMARY AT A GLANCE

In this paper, Hsu and colleagues from Taiwan analyze the outcome of kidney transplantation performed overseas in two time periods, before and after 2001, and show the outcome of kidney transplants performed outside Taiwan after 2001 are comparable to those performed in Taiwan. The implication of this paper is that emphasis on poor mortality and graft outcome from 'transplant tourism' is less sustainable than before and new strategies to deter this will need to be developed.

ABSTRACT:

Aim: **Overseas kidney transplantation has often been reported to have unsatisfactory outcomes. This study aims to compare post-transplantation outcomes between overseas and domestic kidney transplant (KT) recipients in Taiwan.**

Methods: **The Taiwanese National Health Insurance Research Database was used to identify 310 domestic and 643 overseas KT recipients, who survived for longer than 1 month after the transplantation, in a cohort of 45 453 chronic haemodialysis patients in 1997–2002. Cox proportional hazards models were used to assess risks of mortality and graft failure.**

Results: **The 1, 3 and 5 year survival rates for domestic KT recipients were 96.5%, 93.3% and 91.6%, respectively, while those for overseas KT recipients were 94.9%, 87.9% and 77.1%, respectively ($P = 0.015$). For the overseas group, those who received a KT before 2001 had significantly higher hazard ratios of mortality and graft failure (2.85 and 1.71, respectively). However, for those receiving a KT in 2001–2002, no significant outcome difference could be found between overseas and domestic recipients.**

Conclusion: **The risk disparity between overseas and domestic KT recipients is mainly attributable to when the transplantation was performed. In attempting to dissuade potential recipients from organ trafficking, merely emphasizing the previously acknowledged poor outcomes no longer suffices as a valid reason.**

Kidney transplantation is recognized as the most efficient and effective way for patients with end-stage renal disease (ESRD) to prolong their lives.[1] The supply of donated kidneys, however, is insufficient to meet the demand, as the number of ESRD patients waiting for a kidney transplant (KT) has rapidly increased. Consequently, commercial kidney transplantation has been rising rapidly for the last decade. Although some commercial transplants have been acceptable, most commercial KT recipients have experienced unfavourable patient and graft survival, as well as a high incidence of post-transplantation infection and surgical complications.[2–7] Researchers have often cited poor post-transplantation outcomes as one of the major reasons of prohibiting commercial kidney transplantation.

Although studies have focused on commercial kidney transplantation in India, Iran, Pakistan and Iraq,[2–7] post-transplantation outcomes for people receiving commercial kidney transplantation in China have not been fully

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assessed. Inconsistent results from sporadic reports by single medical centres in Taiwan and Hong Kong[8–11] have not clarified the situation of those who receive kidney transplantation in China.

Due to the geographic proximity of Taiwan and China, and the common ethnic origin of most people in these two countries, seeking a KT in China is the usual choice for ESRD patients in Taiwan who need kidney transplantation but are ineligible to receive a domestic transplant or do not want to endure a lengthy wait for a legitimate kidney donation. According to an internal document of the Taiwan Department of Health,[12] all but two of 400 overseas KT recipients who received post-transplantation care in 12 key hospitals in 2001–2003 obtained a transplant in China. Thus, overseas KT recipients in Taiwan may be able to serve as a unique source for studying the outcome of kidney transplantation in China. This study investigates differences in post-transplantation outcomes between overseas and domestic KT recipients, offering a window onto the outcome of kidney transplantation in China.

METHODS

Data source

For this study, we retrieved data from the Taiwanese National Health Insurance Research Database (NHIRD), which has been recognized as one of the most reliable resources for research on medical utilization in Taiwan.[13] Taiwan's National Health Insurance (NHI) is a compulsory and universal health insurance program covering over 99% of the population.[14] Almost all hospitals and 92% of ambulatory clinics in Taiwan are contracted by the Bureau of National Health Insurance, the single payer of the NHI program.[15] Therefore, we could identify nearly all overseas KT recipients in Taiwan for this outcome study.

Study subjects

From the NHIRD, we identified 45 453 chronic haemodialysis patients who started haemodialysis therapy in 1997–2002 and maintained the treatment for more than 3 months. Of these selected haemodialysis patients, 953 subjects received a KT in 1997–2002 and survived transplantation for longer than 1 month.

The kidney transplantation subjects were divided into two groups: domestic and overseas KT recipients. From the NHIRD, we identified 310 recipients of domestic kidney transplants between 1997 and 2002, who survived for at least 1 month after receiving the transplant. For overseas KT recipients, the NHIRD contained no official records of the kidney transplantation procedure. We defined these patients as individuals who had discontinued haemodialysis therapy at least 1 month before the first prescription of post-transplantation immunosuppressant drugs and later continued on post-transplantation immunosuppressant drugs, such as cyclosporine, azathioprine, tacrolimus, mycophenolate mofetil and sirolimus. Using this definition, we identified 643 overseas KT recipients.

Statistical analysis

Baseline characteristics of study subjects

In descriptive analysis, data were expressed as mean ± standard deviation (SD) for continuous variables, or counts and proportions for categorical variables. Student's *t*-tests and χ^2-test analyses were used for continuous and categorical variables, respectively. We conducted multivariate logistic regressions (adjusted for sex, age, pre-transplantation haemodialysis duration, and Charlson comorbidity index (CCI) score)[16] to estimate association between operation sites of kidney transplantation (overseas *vs* domestic) and pre-transplantation comorbidities such as diabetes mellitus, hypertension and glomerulonephritis. For CCI score calculation, we did not include the diagnosis of renal failure (International Classification of Diseases, Ninth Revision code = 403–404, 580–586) because all study subjects were ESRD patients.

Outcome of kidney transplantation

The 6 month incidences (from the 2nd to 7th month after transplantation) of major post-transplantation complications (e.g. diabetes, hypertension, cancer, infection and graft rejection) were calculated to evaluate early impacts of kidney transplantation. The number of subjects at risk for respective complications was counted by excluding those who had the same diagnosis within 1 year prior to transplantation. We also used the multivariate Cox proportional hazards models to compare incident risk of various post-transplantation complications between overseas and domestic KT recipients.

Associations between KT groups and mortality/graft failure were analyzed using Kaplan–Meier survival curves and log–rank tests. Cox proportional hazards models were further used for estimating their multivariate-adjusted associations. The proportional hazards assumption was evaluated by comparing estimated log–log survival curves for all covariates. The log–log survival plots stratified by KT groups graphically showed two parallel lines, indicating no violation of the assumption. Study entry was defined as the date of KT operation. For domestic KT recipients, the date of kidney transplantation was shown in the NHIRD. For overseas KT recipients, the date of kidney transplantation was determined to be 1 month before a patient took the first prescription of post-transplantation immunosuppressant drugs, because the length of overseas post-transplantation stays has been estimated to be approximately 1 month in the published work.[8] In models estimating the hazard ratio (HR) of mortality, observations were censored on 31 December 2003, or the date patients died, whichever occurred first. In models estimating the HR of graft failure, observations were censored on 31 December 2003, the date patients died, or the date on which study subjects resumed their persistent haemodialysis, whichever occurred first. Several pre-transplantation characteristics were adjusted in the multivariate Cox hazards models: sex, age at kidney transplantation, time interval between initiation of haemodialysis and kidney transplantation, and CCI score.

Analyses were performed using SAS software ver. 9.1 (SAS Institute, Cary, NC, USA). A two-sided *P*-value of less than 0.05 was considered statistically significant.

RESULTS

Compared to those who received a KT overseas (Table 1), the domestic KT recipients were younger (39.6 *vs* 47.5 years)

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Table 1 Characteristics of study subjects surviving kidney transplantation for more than 1 month, by transplantation location, 1997–2002

	Overall	Domestic transplant recipients		Overseas transplant recipients		*P*†
	(*n* = 953)	(*n* = 310)	%	(*n* = 643)	%	
Sex (male)	507	165	53.2	342	53.2	0.991
Age at transplantation (years)	44.9 (15.9)	39.6 (15.3)		47.5 (15.5)		<0.001
<20	25	16	5.2	9	1.4	<0.001
20–40	312	140	45.2	171	26.6	
40–60	502	142	45.8	360	56.0	
≥60	115	12	3.9	103	16.0	
Duration of haemodialysis before transplantation (years)	1.6 (1.3)	1.9 (1.3)		1.5 (1.3)		<0.001
Post-transplantation follow-up duration (years)	2.9 (1.5)	3.0 (1.5)		2.8 (1.5)		0.033
CCI score‡	0.9 (1.1)	0.5 (0.6)		1.0 (1.2)		<0.001
0	548	216	69.7	332	51.6	<0.001
1–2	305	76	24.5	229	35.6	
3+	100	18	5.8	82	12.8	
Period transplantation performed						
1997–2000	445	155	50.0	290	45.1	0.156
2001–2002	508	155	50.0	353	54.9	
Initial use of immunosuppressant drugs						
Cyclosporine	502	242	78.0	260	40.4	<0.001
Mycophenolate mofetil	644	171	55.2	473	73.6	<0.001
Tacrolimus	325	67	21.6	258	40.1	<0.001
Crude patient survival rate (%)						0.015
1st year	95.5		96.5		94.9	
3rd year	89.7		93.3		87.9	
5th year	82.9		91.6		77.1	
Crude graft survival rate (%)						0.005
1st year	76.5		85.5		71.8	
3rd year	65.6		78.1		59.3	
5th year	51.5		66.0		44.1	

Note: Results are *n* (%) or means (standard deviation). †The chance to reject null hypotheses that no difference on demographic characteristics between patients receiving a kidney transplant in Taiwan and patients receiving a kidney transplant overseas, by using χ^2-test (for categorical data), Student's *t*-tests (for continuous data), or log–rank test (for patient and graft survival rate). ‡The diagnoses recorded in the National Health Insurance dataset within 1 year before receiving a kidney transplant was used to calculate CCI score. Because patients undertaking haemodialysis defined our study cohort, we excluded the diagnosis of renal failure from index calculations. CCI, Charlson comorbidity index.

and had a longer duration of haemodialysis before kidney transplantation (1.9 *vs* 1.5 years). In the elderly group (>60 years), 103 out of 115 went abroad to receive a KT. Compared to those receiving a KT in Taiwan, the overseas KT recipients generally suffered from more pre-transplantation comorbidities: they had a higher CCI score (1.0 *vs* 0.5; $P < 0.001$; Table 1) and were also more likely to have diabetes mellitus (odds ratio (OR) = 2.26; $P = 0.002$; Table 2). For the initial immunosuppressant drug treatment, cyclosporine was more likely to be prescribed for domestic KT recipients (78.0%), while mycophenolate mofetil and tacrolimus were more likely to be used in the overseas KT group (73.6% and 40.1%, respectively). In terms of patient and graft survival rates, Table 1 shows that domestic KT recipients did significantly better than overseas KT recipients in both crude rates at 1, 3 and 5 years.

Table 3 shows that, in general, overseas KT recipients seemed more likely to experience post-transplantation complications, although the adjusted HR were all statistically insignificant. Moreover, because the diabetic patients in the domestic group were significantly outnumbered by those in the overseas group, some complications that occurred in overseas KT recipients – such as cerebrovascular diseases (0.6%) and ischaemic heart diseases (1.3%) – did not happen in those who received a KT in Taiwan.

Compared to those who received a KT in Taiwan (Table 4), overseas KT recipients generally had a significantly higher adjusted HR for patient mortality (HR = 1.92) and graft failure (HR = 1.48). For those who had a CCI score of 0 (i.e. those without major illness other than ESRD), the survival outcomes for domestic KT recipients were significantly better than those for overseas KT recipients (HR = 2.46). Table 4 also shows that the period when kidney transplantation was performed significantly contributed to the outcome disparity. For those receiving a KT before 2001, the overseas group had a significantly poorer prognosis than the domestic group. For the overseas group, the HR of patient mortality and graft failure were 2.85 and 1.71, respectively. However, for those

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Table 2 Prevalence of various comorbidities for study subjects before they received kidney transplantation

	Overall (*n* = 953)	Domestic transplant recipients (*n* = 310)		Overseas transplant recipients (*n* = 643)		OR†	*P*
	n	*n*	%	*N*	%		
Diabetes mellitus (250)	132	20	6.5	112	17.4	2.26	0.002
Hypertension (401–405)	646	195	62.9	451	70.2	1.22	0.103
Glomerulonephritis (582)	611	231	73.8	380	59.1	0.60	0.002
Polycystic kidney disease (753)	14	4	1.6	10	1.3	0.80	0.533
Lupus related (695, 710)	11	2	0.6	9	1.4	2.57	0.062
Rheumatism (714, 725)	35	8	2.6	27	4.2	2.23	0.069
Chronic hepatitis (070, 571)	150	46	14.8	104	16.2	1.03	0.677
Hepatitis B	9	4	1.3	5	0.8	0.40	0.223
Hepatitis C	7	2	0.6	5	0.8	1.36	0.747
All cancer (140–280)	33	8	2.6	25	3.9	1.66	0.149
Malignancy of kidney (189)	10	2	0.6	8	1.2	3.03	0.155
Malignancy of bladder (188)	5	2	0.6	3	0.5	0.66	0.876

Note: The numbers in parentheses indicate International Classification of Diseases, Ninth Revision (ICD-9) codes for respective diseases. The ICD-9 codes for hepatitis B include 070.2 and 070.3; and for hepatitis C they include 070.41, 070.44, 070.51, and 070.54. †Odds ratio (OR) was used to assess association between pre-transplantation comorbidities and the kidney transplant operation sites (overseas *vs* in Taiwan), by using logistic regression models adjusted for age, sex, haemodialysis duration prior to kidney transplant and Charlson comorbidity index score.

Table 3 Incidence of various complications for study subjects in the 2nd to 7th month after receiving a kidney transplant

	Domestic recipients (*n* = 310)			Overseas recipients (*n* = 643)			HR†	*P*
	Subjects at risk	*n*	%	Subjects at risk	*n*	%		
Diabetes mellitus (250)	287	9	3.1	531	32	6.0	1.13	0.295
Hypertension (401–405)	112	19	17.0	191	43	22.5	1.05	0.312
Chronic hepatitis (070, 571)	261	10	3.8	539	27	5.0	1.10	0.111
Hepatitis B	303	2	0.7	638	5	0.8	1.08	0.108
Hepatitis C	305	1	0.3	639	2	0.3	1.07	0.305
All cancer (140–280)	299	2	0.7	618	5	0.8	1.20	0.247
Malignancy of kidney (189)	305	2	0.7	635	3	0.5	0.95	0.118
Infection-related complications								
Septicaemia (995.91, 995.92, 038)	303	26	8.6	612	38	6.2	0.90	0.325
Tuberculosis (010–018)	307	2	0.7	639	7	1.1	1.11	0.358
Meningitis (320–326)	307	0	0.0	635	3	0.4	–	–
Infection of kidney (590, 595, 597, 599.0)	298	3	1.0	619	11	1.8	1.20	0.254
Cytomegalovirus infection (078.5)	308	1	0.3	643	4	0.6	1.18	0.125
Postoperative infection (998.5)	309	9	2.9	643	18	2.8	1.01	0.473
Brain/liver abscess (324.0, 572.0)	303	3	1.0	619	12	1.9	1.30	0.066
Herpes simplex (054)	307	8	2.6	643	17	2.6	1.04	0.129
Herpes zoster (053)	307	8	2.6	641	19	2.7	1.10	0.293
Endocarditis (421, 391.1, 036.42, 074.22, 093.2, 098.84)	307	2	0.7	638	4	0.6	1.12	0.388
Cerebrovascular disease (430–438)	307	0	0.0	635	4	0.6	–	–
Ischaemic heart disease (410–414)	307	0	0.0	629	8	1.3	–	–
Graft rejection‡	307	48	15.6	643	96	14.9	0.99	0.576
Post-KT complication§	307	34	11.1	643	57	8.9	0.95	0.068

Note: The numbers in parentheses indicate International Classification of Diseases, Ninth Revision (ICD-9) codes for respective diseases. The ICD-9 codes for hepatitis B include 070.2 and 070.3; and those for hepatitis C include 070.41, 070.44, 070.51, and 070.54. †Hazard ratio (HR) was used to estimate excess risks of selected complications in the 2nd to 7th months after transplantation for those receiving transplantation overseas *vs* in Taiwan, by using multivariate Cox proportional hazard regression models adjusted for age, sex, haemodialysis duration prior to transplantation, Charlson comorbidity index score and year of transplantation. ‡Graft rejection is defined for those who had been treated by i.v. methylprednisolone pulse therapy, lymphoglobuline, or thymoglobuline. §Including haematoma (998.12), lymphocele (457.8), bladder urinoma (596.8), urinary tract obstruction (599.6), hydronephrosis (591) and renal vein thrombosis (453.3).

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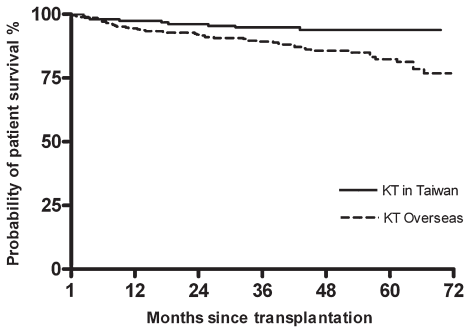
Table 4 Mortality and graft failure hazard ratios (HRs) for study subjects, by comorbidity status and operation time

Subject group	Subjects at risk	No. of deaths	No. of graft failure	HR† for patient mortality		HR for graft failure	
				Age- and sex-adjusted HR (95% CI)	Multivariate-adjusted HR (95% CI)	Age- and sex-adjusted HR (95% CI)	Multivariate-adjusted HR (95% CI)
All subjects (n = 953)							
Domestic	310	17	41	1	1	1	1
Overseas	643	70	128	2.15 (1.52–3.68)	1.92 (1.09–2.98)	1.59 (1.19–2.12)	1.48 (1.10–1.98)
CCI score = 0 (n = 550)							
Domestic	218	10	25	1	1	1	1
Overseas	332	31	56	2.67 (1.60–5.90)	2.46 (1.10–5.59)	1.50 (1.02–2.21)	1.32 (0.89–1.96)
CCI score >0 (n = 403)							
Domestic	92	7	16	1	1	1	1
Overseas	311	39	72	1.44 (0.68–3.05)	1.47 (0.69–3.11)	1.52 (0.97–2.39)	1.50 (0.95–2.37)
Transplantations performed in 1997–2000 (n = 445)							
Domestic	158	9	29	1	1	1	1
Overseas	290	47	94	3.21 (1.55–4.66)	2.85 (1.37–5.95)	1.87 (1.33–2.71)	1.71 (1.18–2.43)
Transplantations performed in 2001–2002 (n = 508)							
Domestic	155	8	12	1	1	1	1
Overseas	353	23	34	1.20 (0.53–2.72)	1.33 (0.56–2.97)	1.26 (0.76–2.08)	1.28 (0.77–2.14)

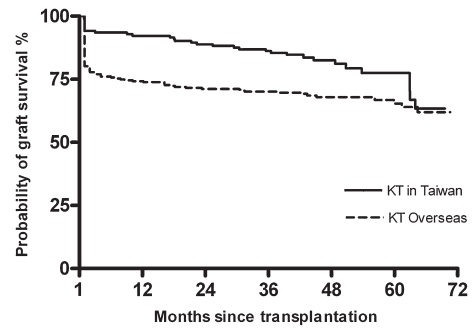
CCI, Charlson comorbidity index; CI, confidence interval. Because patients undertaking haemodialysis defined our study cohort, we excluded the diagnosis of renal failure from CCI calculations. †Hazard ratio (HR) was used to estimate excess risks of mortality and graft failure for those receiving transplants overseas *vs* in Taiwan, by using a multivariate Cox proportional hazards regression model adjusted for age, sex, haemodialysis duration prior to transplantation, CCI score and year of transplantation.



Months since transplantation		1	12	24	36	48	60	72
Taiwan	No. at risk	155	151	149	147	79	37	16
	No. death	4	2	2	1	0	0	–
Overseas	No. at risk	290	274	266	259	151	74	22
	No. death	16	8	7	8	4	4	–

Log-rank test: p=0.0028

Fig. 1 Kaplan–Meier estimates of patient survival for overseas kidney transplant (KT) recipients *versus* those who received KT in Taiwan, 1997–2000. Log–rank test: $P = 0.0028$.



Months since transplantation		1	12	24	36	48	60	72
Taiwan	No. at risk	155	148	141	136	61	25	10
	No. graft failure	7	7	5	2	8	5	–
Overseas	No. at risk	290	263	243	128	95	45	10
	No. graft failure	27	20	15	12	12	8	–

Log-rank test: p=0.0033

Fig. 2 Kaplan–Meier estimates of graft survival for overseas kidney transplant (KT) recipients *versus* those who received KT in Taiwan, 1997–2000. Log–rank test: $P = 0.0033$.

receiving a KT after 2000, no significant difference in hazard ratios could be seen between the overseas and domestic groups.

The Kaplan–Meier survival curves shown in Figures 1–4 also reveal that the outcome difference between overseas and domestic KT recipients is closely related to the period of kidney transplantation. For those receiving a KT before 2001, domestic recipients had significantly better outcomes for both patient and graft survival (Figs 1–2); but for recipients after 2000, the log–rank tests detected no differences between overseas and domestic groups during a 2.5 year follow up (Figs 3–4).

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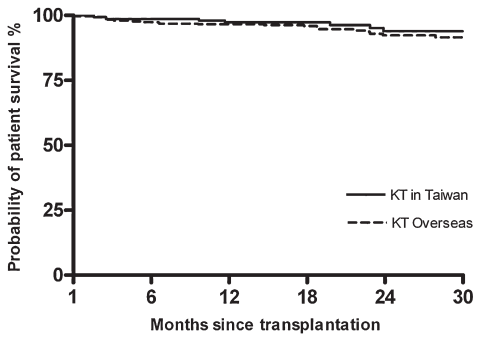
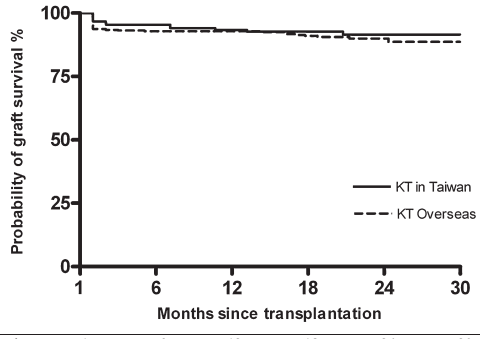


Months since transplantation		1	6	12	18	24	30
Taiwan	No. at risk	155	152	151	105	77	37
	No. death	3	1	1	2	1	–
Overseas	No. at risk	353	344	341	241	140	62
	No. death	9	3	2	7	2	–

Log-rank test: p=0.3520

Fig. 3 Kaplan–Meier estimates of patient survival for overseas kidney transplant (KT) recipients *versus* those who received KT in Taiwan, 2001–2002. Log–rank test: $P = 0.3520$.



Months since transplantation		1	6	12	18	24	30
Taiwan	No. at risk	155	151	149	94	70	33
	No. graft failure	4	2	2	3	1	–
Overseas	No. at risk	353	338	331	218	126	56
	No. graft failure	15	7	8	5	1	–

Log-rank test: p=0.4946

Fig. 4 Kaplan–Meier estimates of graft survival for overseas kidney transplant (KT) recipients *versus* those who received a KT in Taiwan, 2001–2002. Log–rank test: $P = 0.4946$.

DISCUSSION

By examining overall mortality and graft failure rates, we, as others in the published work,[17–19] found that overseas KT recipients had a worse prognosis compared with those who received a KT domestically. The current study, however, also reveals that the survival and graft failure disparity in overseas KT recipients appears to have diminished for operations conducted in 2001–2002. The gap in clinical outcomes between domestic and overseas transplantations appears to have narrowed gradually since the beginning of the 21st century.

Two previous studies also found that the recent clinical outcomes of overseas kidney transplantations are comparable to those of domestic transplantations.[8,9] Sun and colleagues[8] compared 31 overseas KT recipients with 44 domestic KT recipients followed at one medical centre in Taiwan; they could not identify any differences in the survival rate, graft failure rate or post-transplantation complications between these two groups. Shu *et al*.[9] also analyzed data from a single medical centre in Taiwan to compare clinical outcomes between 435 overseas and 200 domestic KT recipients. They found both patient and graft survival rates in 1, 5 and 10 years were all statistically equivalent; within the same group, however, the outcomes of transplantations conducted in 2000–2004 were significantly better than those conducted before 2000. The results revealed in these two studies are similar to what we have shown in the present study; but the fact that their study subjects came from a single medical centre may limit their generalizability. Moreover, the unadjusted Kaplan–Meier survival analyses used in both studies could also sway their conclusions.

One of strengths of the present study is that we were able to identify almost all chronic haemodialysis subjects in Taiwan who went abroad for kidney transplantation, because the NHIRD records we used cover medical utilization information of 99% of the population in Taiwan.[14] The inclusion of data from the whole population prevented selection bias. Furthermore, multivariate-adjusted HR was used to estimate patient and graft survival risk in this study, so we could reduce bias caused by differences between domestic and overseas KT recipients in age, pre-transplantation comorbidity and haemodialysis duration before kidney transplantation. In general, this study validates previous findings and also strengthens evidence that clinical outcomes of overseas kidney transplantation improved after 2000.

Overseas kidney transplantation performed in developing countries has often been reported to have unsatisfactory outcomes because of the many unfavourable conditions entangled in kidney trafficking, such as poor sanitation in operation sites, inadequate pre-transplantation evaluation of both donors and recipients, and insufficient follow up after transplantation.[18,19] These detrimental situations may (at least partially) account for higher mortality and graft failure rates found in this study for overseas transplantations performed before 2001. However, given China's rapid economic development during the past decades, it is reasonable to expect that facilities and sanitation of hospitals performing kidney transplantations have also improved. The large number of kidney transplantations performed in China (~10 000/year)[20,21] facilitates the learning curve of surgeons who perform the procedure. In addition, as shown in Table 1, some improved immunosuppressant drugs, such as mycophenolate mofetil and tacrolimus, have become available and have been prescribed to overseas KT recipients, which could be a substantial contributing factor in preventing acute graft rejection and improving graft survival.[22,23]

There were methodological limitations inherent in this study. First, because the NHIRD does not contain informa-

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tion about lab details and donors' characteristics, we could not control for some important confounders in Cox regression models. We have to interpret the results of this study with caution. Second, the overseas group was made up of subjects who survived the transplantation procedures and returned to Taiwan for follow-up therapy. We may, however, underestimate the immediate post-transplantation complications of overseas KT recipients by neglecting those who died shortly after transplantation and consequently did not return to Taiwan. To ascertain the comparability between domestic and overseas groups, we selected domestic recipients who had survived transplantation for longer than 1 month as the compared group. Third, due to the data availability, for those who received a KT after 2000, the follow-up time (until 2003) may be too short to observe their long-term outcomes; but, in comparing the 2.5 year patient and graft survival curves as well as HR, we found a great improvement in overseas kidney transplantation that may provide clues for us to forecast comparable long-term outcomes between overseas and domestic KT recipients.

This study demonstrates a potential trend of outcome improvement for overseas kidney transplantation. Poor medical prognosis may no longer be a good reason to discourage ESRD patients who want to go abroad for kidney transplantation. However, we must still acknowledge that commercial kidney transplantation brings tremendously adverse physical, mental and economic consequences to paid donors and their families.[5,24,25] Furthermore, it has long been alleged that executed prisoners were one of the major donor sources in China during the time under study.[26–29] This practice of organ procurement not only neglects adverse impacts on donors (particularly prisoners) and their families, it also severely undermines human rights and medical ethics because it subjects the prisoners and their respective families to coercion, which highlights the fact that most prisoners are not in a favourable position to give consent freely.[30] Thus, the international medical and human rights societies have to continuously scrutinize organ transplantation performed in China.

As a member in the global medical society, we have to stand up for the Declaration of Istanbul[31] to condemn organ trafficking and transplant tourism as 'violating the principles of equity, justice and human dignity'. Nevertheless, merely condemning organ trafficking or passively banning overseas organ transplantation might not be able to effectively slow down the illegal business of transplant tourism because the worldwide unmet need for donated kidneys continues its devastating rise. To help solve this problem, the Taipei Recommendations on the Prohibition, Prevention and Elimination of Organ Trafficking in Asia[32] urge Asian countries work to achieve 'national self-sufficiency in organ donation'. Responsible governments should indeed find the means to provide necessary infrastructure and funding to support deceased and living donation to meet its citizens' needs for organ transplantation.

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