Association of Human Leukocyte Antigen Haplotypes With End-Stage Renal Disease in Vietnamese Patients Prior to First Transplantation

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ABSTRACT

Introduction. The prevalence of chronic kidney failure is significantly increasing in Vietnam, causing a burden for health care. This study assessed the relationship of HLA-A, -B, and −DRB1 alleles with end-stage renal disease (ESRD).

Method. A retrospective, cross-sectional study and a comparative study using secondary data analysis were conducted on 196 ESRD patients and 187 controls from 2009 to 2017. The patient and donor profiles were collected from medical records, including age, sex, etiology of renal failure, and HLA phenotypes. HLA-A*, -B*, and -DRB1* typing were done by polymerase chain reaction-sequence specific primers.

Result. The most frequent HLA alleles in Vietnamese patients with ESRD were HLA-A*02, -A*11, -B*15, -B*46, -DRB1*04, -DRB1*09, and -DRB1*12. The haplotypes HLA-A*0233 (odds ratio [OR] = 0.40, 95% CI: 0.15–0.98) had a negative association for ESRD. The haplotypes HLA-B*1515 (OR = 4.14, 95% CI: 1.52–11.26) and HLA-DRB1*1212 (OR = 2.01, 95% CI: 1.06–3.81) had a positive association for ESRD. The haplotypes HLA-B*1515 (OR = 4.69, 95% CI: 1.69–13.03) and -DRB1*1212 (OR = 2.15, 95% CI: 1.10–4.21) had a positive association for ESRD related to glomerulonephritis. The HLA-B*1557 (OR = 17.34, 95% CI: 2.70–11.49) had a positive association for ESRD related to hypertension.

Conclusion. The haplotypes of HLA class I and II had significant relationships with ESRD. The results of our study should be confirmed in further investigations.

THE PREVALENCE of chronic kidney disease is significantly increasing, and the consequence is end-stage renal disease (ESRD). ESRD has been a rising public health concern because of its adverse medical condition and economic burden [1,2]. In Vietnam, the data on chronic kidney disease are limited, and most of the reports were in epidemic regions [3]. A study in 2017 reported the prevalence was around 12.7% [1]. ESRD is managed by dialysis or renal transplantation if a suitable donor is available.

HLA is important in cellular and humoral immune response that determines the success of transplantation [4–6]. The HLA genes encode the major histocompatibility complex and is located on chromosome 6 (6p21) [4,5]. The HLA system also participates in the induction, regulation of the immune response, and selection of the T-cell repertoire. Kidney transplantation is the optimal therapeutic strategy for end-stage renal failure. The HLA system plays a part of the host immune defense mechanism, and HLA matching is a major challenge for graft rejection in transplantation [5]. The HLA genes are divided into 2 classes: I and II. HLA class I includes 3 main loci: HLA-A, HLA-B, and HLA-C. HLA class II includes HLA-DP, HLA-DQ, and HLA-DR, which is a glycopeptide [4,5]. In kidney transplantation, the loci HLA-A, -B, and -DR are the most important [5,6].

Many studies have shown the relationship between HLA phenotypes and the pathophysiology of ankylosing spondylitis, rheumatoid arthritis, chronic hepatitis [4], lupus

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erythematous [4,7], hepatic cancer, lung cancer [4,8], and ESRD [2,4,8–11]. However, associations between HLA alleles and haplotypes in Vietnamese patients with ESRD are unclear. This study aimed to investigate the frequencies of each allelic group, genotype, and haplotype in the genetic loci of HLA class I (HLA-A, -B) and class II (HLA-DRB1) in Vietnamese patients with ESRD and to determine which HLAs are associated with ESRD.

METHODS

Patients

A total of 196 patients were undergoing kidney transplantation because of kidney failure from January 2009 to January 2018 in 103 Military Hospital and 108 Military Central Hospital (75% men, 37.8 ± 11.8 years old) participated in the study. One hundred and eighty-seven kidney donors (living and brain dead) were used as controls (57.7% men, 39.0 ± 11.8 years old). The characteristics of the patients are described in Table 1.

Study Design

This was a retrospective, cross-sectional and case-controlled study. Secondary data analysis was done based on noncontinuous data from 103 Military Hospital and 108 Military Central Hospital. Characteristics of patients and donors were collected, including age, sex, etiology of renal failure, and phenotypes of HLA. A doctor who was not involved in data analysis collected the data.

HLA Phenotyping

Genotyping of HLA class I (HLA-A*, -B*) and HLA class II (HLA-DRB1*) was performed using low-resolution or polymerase chain reaction qualitative detection of sequential specific primers. The SSO Luminex Technique (TBG Biotechnology Corp, New Taipei City, Taiwan) was used to replicate genetic loci HLA-A, -B, -DRB1. The reaction products were separated by agarose gel electrophoresis. All results were analyzed by the specific kit.

Data Analysis

The HLA allele was determined if at least 1 locus was positive. All statistical analyses were conducted using SPSS software version 21 (IBM, Armonk, NY, United States). Categorical variables were presented in frequency (n) and percentage (%). Continuous variables (age) were presented in means and standard deviation. The association of HLAs with causes of chronic kidney disease were indicated by odds ratio (OR) and confidence interval (95% CI). A 2-sided P value less than .05 was considered statistically significant. For multiple factor analyses between HLA haplotypes and ESRD, binary logistic regression was performed.

Table 1. General Information About Participants

General Characteristic	
Sex (male), No. (%)	
ESRD (n = 196)	147 (75.00)
Controls (n = 187)	109 (58.28)
Average age, mean ± SD, y	
ESRD (n = 196)	37.81 ± 11.80
Controls (n = 187)	38.97 ± 11.87
Primary disease, No. (%) n = 196	
Chronic glomerulonephritis	149 (76.02)
Hypertension	19 (9.70)
Diabetic mellitus	11 (5.61)
Polycystic kidney disease	8 (4.08)
Others (lupus, chronic pyelonephritis)	9 (4.59)

Abbreviations: ESRD, end-stage renal disease; SD, standard deviation.

RESULTS

General Characteristics of the Study Population

HLA polymorphism was analyzed to determine the difference between 187 healthy controls and 196 ESRD patients (Table 1). Chronic glomerulonephritis was the most common cause of ESRD (n = 149, 75.6%).

Frequency and Comparison of Allele Frequencies Between ESRD Patients and Controls

In this study, we analyzed loci HLA-A, -B (class I), and HLA-DRB1 (class II) of 383 Vietnamese people with 766 alleles in each HLA haplotype. In total, 57 different alleles were found in Vietnamese patients with ESRD: 18 HLA-A alleles, 24 HLA-B alleles, and 15 HLA-DRB1 alleles. A*11 and A*02 (25.07% and 20.05%, respectively); B*15 and B*46 (24.67% and 9.79%, respectively); and DRB1*12 (25.02%), DRB1*04 (9.14%), and DRB1*09 (9.14%) were the most common alleles in each locus. HLA-A*02, HLA-B*46, and HLA-DRB1*15 were the 3 most common alleles in 20.50%, 9.79%, and 9.01%, of ESRD patients, respectively. In the control group, the 3 most frequent alleles were HLA-A*11 (22.72%), -B*15 (22.18%), and -DRB1*12 (23.53%). Several alleles were found in the ESRD group but not in the control group, which were HLA-A*16, *25, and *69; HLA-B*53, and *95; and HLA-DRB1*2 and *5. In contrast, the HLA-A*21, -A*32, -A*36, and -A*68 and HLA-B*45, -B*61, and -B*73 were found only in the donor group. The frequencies of alleles in the 2 groups is shown in Table 2.

Association of HLA Phenotypes and Patients with ESRD

Two alleles, HLA-B*7 (OR = 0.475, 95% CI: 0.277–0.814) and HLA-DRB1*10 (OR = 0.547, 95% CI: 0.314–0.954), showed a negative association with ESRD (Table 2). Table 3 shows the association of HLA phenotypes and diseases related to ESRD. ESRD caused by glomerulonephritis had a negative association with HLA-B*07 (OR = 0.53, P = .03) and B*13 (OR = 0.43, P = .02) and a positive association with HLA-A*11 (OR = 1.55, P = .04), -B*15 (OR = 1.576, P = .03), and DRB1*14 (OR = 2.256, P = .02). Two haplotypes HLA-B*1515 (OR = 4.68, P < .01) and -DRB*1212 (OR = 2.15, P = .02) also had a negative association. People who had alleles identified in class I HLA-A*01 (OR = 4.72, P = .02), -A*30 (OR = 4.82, P = .02), and -B*57 (OR = 13.00, P < .001); and two haplotypes, HLA-A*0202 (OR = 4.19, P < .01), and HLA-B*1557 (OR = 17.34, P < .01) had a significantly higher risk of developing ESRD with hypertension. Two haplotypes, HLA-B*1515 and HLA-DRB1*0909, had a significantly higher risk of ESRD caused by diabetes mellitus. The

Table 2. The Distribution of Alleles HLA-A, -B, and -DRB1 in ESRD Patients and Healthy Donors

Allele	Total 2n (%)	ESRD 2n (%)	Control 2n (%)	P (χ^2)	P (Fisher-exact)
A*01	23 (3.00)	13 (3.32)	10 (2.67)	NS	
A*02	157 (20.50)	82 (20.92)	75 (20.05)	NS	
A*03	15 (1.96)	9 (2.30)	6 (1.60)	NS	
A*11	192 (25.07)	107 (27.30)	85 (22.73)	NS	
A*16	1 (0.13)	1 (0.26)	-		NS
A*21	1 (0.13)	-	1 (0.27)		NS
A*23	3 (0.39)	2 (0.51)	1 (0.27)		NS
A*24	107 (13.97)	54 (13.78)	53 (14.17)	NS	
A*25	1 (0.13)	1 (0.26)	-		NS
A*26	17 (2.22)	9 (2.30)	8 (2.14)	NS	
A*29	60 (7.83)	26 (6.63)	34 (9.09)	NS	
A*30	15 (1.96)	8 (2.04)	7 (1.87)	NS	
A*31	4 (0.52)	2 (0.51)	2 (0.53)		NS
A*32	2 (0.26)	-	2 (0.53)		NS
A*33	81 (10.57)	34 (8.67)	47 (12.57)	NS	
A*34	10 (1.31)	4 (1.02)	6 (1.60)		NS
A*36	3 (0.39)	1 (0.26)	2 (0.53)		NS
A*66		1 (0.26)	2 (0.53)		NS
A*68	5 (0.65)	2 (0.51)	3 (0.80)		NS
A*69	1 (0.13)	1 (0.26)	-		NS
A*74	4 (0.52)	1 (0.26)	3 (0.80)		NS
A*92	1 (0.13)	-	1 (0.27)		NS
B*07	**69 (9.01)**	**25 (6.38)**	**44 (11.76)**	**< .01***	
B*08	3 (0.39)	1 (0.26)	2 (0.53)		NS
B*13	43 (5.61)	16 (4.08)	27 (7.22)		NS
B*15	189 (24.67)	106 (27.04)	83 (22.19)		NS
B*18	9 (1.17)	5 (1.28)	4 (1.07)		NS
B*27	18 (2.35)	12 (3.06)	6 (1.60)	NS	
B*35	40 (5.22)	20 (5.10)	20 (5.35)	NS	
B*37	4 (0.52)	1 (0.26)	3 (0.80)		NS
B*38	53 (6.92)	26 (6.63)	27 (7.22)	NS	
B*39	17 (2.22)	10 (2.55)	7 (1.87)	NS	
B*40	46 (6.01)	27 (6.89)	19 (5.08)	NS	
B*41	2 (0.26)	2 (0.51)	-		NS
B*44	19 (2.48)	8 (2.04)	11 (2.94)	NS	
B*46	75 (9.79)	38 (9.69)	37 (9.89)	NS	
B*48	8 (1.04)	5 (1.28)	3 (0.80)		NS
B*51	18 (2.35)	6 (1.53)	12 (3.21)	NS	
B*52	9 (1.17)	5 (1.28)	4 (1.07)		NS
B*55	14 (1.83)	6 (1.53)	8 (2.14)	NS	
B*56	3 (0.39)	3 (0.77)	-		NS
B*57	16 (2.09)	11 (2.81)	5 (1.34)	NS	
B*58	55 (7.18)	24 (6.12)	31 (8.29)	NS	
B*61	1 (0.13)	-	1 (0.27)		NS
B*73	2 (0.26)	-	2 (0.53)		NS
B*95	1 (0.13)	1 (0.26)	-		NS
DRB1*01	6 (0.78)	2 (0.52)	4 (1.07)		NS
DRB1*02	1 (0.13)	1 (0.26)	-		NS
DRB1*03	48 (6.27)	22 (5.61)	26 (6.95)	NS	
DRB1*04	70 (9.14)	37 (9.44)	33 (8.82)	NS	
DRB1*05	1 (0.13)	1 (0.26)	-		NS
DRB1*07	40 (5.22)	19 (4.85)	21 (5.61)	NS	
DRB1*08	32 (4.18)	14 (3.57)	18 (4.81)	NS	
DRB1*09	70 (9.14)	30 (7.65)	40 (10.70)	NS	
DRB1*10	**62 (8.09)**	**24 (6.12)**	**38 (10.16)**	**.03†**	
DRB1*11	15 (1.96)	5 (1.28)	10 (2.67)	NS	
DRB1*12	193 (25.20)	105 (26.79)	88 (23.53)	NS	
DRB1*13	32 (4.18)	15 (3.83)	17 (4.55)	NS	
DRB1*14	39 (10.09)	25 (6.38)	14 (3.74)	NS	
DRB1*15	69 (9.01)	38 (9.69)	31 (8.29)	NS	
DRB1*16	16 (2.09)	6 (1.53)	10 (2.67)	NS	

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; NS, not significant; OR, odds ratio.
*OR = 0.475, 95% CI: 0.277–0.814.
†OR = 0.547, 95% CI: 0.314–0.954.

ESRD caused by polycystic kidney disease was found to have a positive association with 6 haplotypes of HLA class I and 2 haplotypes class II.

Regression of ESRD With HLA Haplotypes

The multiple binary logistic analyzed separately each type of HLA haplotype with age, sex, and etiology of chronic kidney failure. With these covariate variables, we found the models with −2 log likelihood less than 100 a good model to predict the risk of ESRD. Table 4 showed that the HLA-A haplotypes -A*0102 (OR = 40.94, $P < .01$), -A*2433 (OR = 22.16, $P < .01$), -A*2403 (OR = 37.57, $P < .05$); HLA-B*1313 (OR = 22.5, $P < .05$); and HLA-DRB1*0909 (OR = 19.83, $P < .05$) could be risk factors of ESRD in Vietnamese people.

DISCUSSION

The frequencies of HLA alleles HLA-A and HLA-B (Class I) and HLA-DRB1 (Class II) were similar to the results of Hai et al [12] in 761 Kinh people at the National Institute of Hematology and Blood Transfusion and of the study on HLA alleles' frequency in potential recipients and donors for kidney transplantation at 103 Hospital [13]. However, these studies did not show the differences of HLA allele frequencies between recipient and donor groups. HLA alleles such as HLA-A*11, -A*02, -B*15, -B*46, and DRB1*04 were easier to find in several countries, such as China, Taiwan, Yemen, and Brazil [8,9,14–16]

In this study, we did not find a statistically significant difference in the proportion of HLA-A alleles between the ESRD group and the control. Some studies have shown that HLA-A*26 [4,10] and A*28 [2] were protective factors for ESRD. The HLA-A*11, one of the most common HLA allele in Vietnamese people, was found to be a risk factor for ESRD in Iranian and Egyptian people [4]. Cohort studies in Taiwan [8], China [17], Turkey [11], Brazil [14], and a study in the Federation of Bosnia and Herzegovina [16] proved no relationship between HLA-A and ESRD.

In the HLA-B phenotype, our study suggested that HLA-B*07 had a negative association with ESRD in Vietnamese patients. The association was also found in the Turkish population in a study conducted in 2009 [4]. Many studies showed that the prevalence of some HLA-B alleles are significantly lower than the others: HLA-B*39, -B*50 [10],

Table 3. The Relationship Between HLA Typing and the Etiology of ESRD (Only *P* < .05 Presented)

Etiology	HLA Type	ESRD	Control	*P*	OR (95% CI)
Glomerulonephritis		n = 149	n = 187		
	A*11	84 (56.38)	85 (45.45)	.04	1.55 (1.01–2.39)
	B*07	21 (14.09)	44 (23.53)	.03	0.53 (0.30–0.94)
	B*13	10 (6.71)	27 (14.44)	.02	0.42 (0.19–0.91)
	B*15	83 (55.70)	83 (44.39)	.03	1.57 (1.02–2.43)
	DRB1*14	23 (15.44)	14 (7.49)	.02	2.25 (1.11–4.55)
	A*2933	0 (-)	6 (3.21)	.02*	Undefined
	B*1515	17 (11.41)	5 (2.67)	< .01	4.68 (1.68–13.02)
	DRB1*1212	25 (16.78)	16 (8.56)	.02	2.15 (1.10–4.20)
Hypertension		n = 19	n = 187		
	A*01	4 (21.05)	10 (5.35)	.02	4.72 (1.32–16.87)
	A*25	1 (4.75)	0 (-)	< .01*	Undefined
	A*30	3 (63.16)	7 (3.74)	.02	4.82 (1.13–20.47)
	B*57	5 (7.92)	5 (2.67)	< .001	13.00 (3.35–50.32)
	A*0202	3 (37.89)	8 (4.28)	< .01	4.19 (1.021–17.39)
	B*1557	8 (21.11)	2 (1.07)	< .01*	17.34 (2.69–11.48)
	DRB1*0713	2 (9.47)	2 (1.07)	.04*	10.88 (1.44–82.19)
Diabetes mellitus		n = 11	n = 187		
	B*1515	2 (18.18)	5 (2.64)	< .01	8.08 (1.37–47.54)
	DRB1*0909	1 (9.09)	1 (0.53)	< .01*	18.60 (1.082–319.59)
Polycystic kidney disease		n = 8	n = 187		
	A*26	2 (25.00)	6 (3.21)	< .01	7.45 (1.29–42.92)
	B*56	1 (12.50)	0 (-)	.04*	Undefined
	A*1126	1 (12.50)	1 (0.53)	< .01*	26.57 (1.05–469.90)
	A*0226	1 (12.50)	2 (1.07)	.01*	13.21 (1.06–163.92)
	B*4638	1 (12.50)	1 (0.53)	< .01*	26.57 (1.05–469.90)
	B*5840	1 (12.50)	2 (1.07)	.01*	13.21 (1.06–163.92)
	DRB1*0709	1 (12.50)	1 (0.53)	< .01*	26.57 (1.05–469.90)
	DRB1*0410	1 (12.50)	2 (1.07)	.01*	13.21 (1.06–163.92)

Abbreviations: CI, confidence interval; ESRD, end–stage renal disease; OR, odds ratio.
*The *P* value was calculated by Fisher exact test.

-B*52 [11], and -B*58 [4,11]. The population with allele HLA-B*05 in Yemen [15], -B*08 in Kuwait [2], -B*15, -B*18, and -B*49 in Saudi Arabia [10], and -B*44 and -B*51 in Brazil [14] had higher risks of ESRD than the controls.

Significantly higher frequency of DRB1*10 was found in the control group compared with the ESRD group (P = .032). Other studies showed that DRB1*03 [14], DRB*11 [2], HLA-DRB1*12 [17] had a protective effect against ESRD. The current study also found a positive association between haplotypes of HLA-B*1515 (OR = 4.14, 95% CI: 1.52–11.26) and HLA-DRB1*1212 (OR = 2.01, 95% CI: 1.06–3.81) with ESRD (Table 5).

This study also evaluated the association of HLA phenotypes and the main causes of ESRD (Table 3). From this results, alleles B*07 and B*13 were negatively associated with glomerulonephritis. A study in Taiwan reported allele DR*08 was a protective factor for ESRD [8]. It also showed other alleles that are risk factors for ESRD caused by glomerulonephritis: HLA-A*11, HLA-B*15, and DRB1*14. A study in China showed that the prevalence of ESRD caused by glomerulonephritis in patients who were HLA-A*11-positive was significantly higher than in the patients negative for it [9]. A study in Saudi Arabia had a similar result as this study; the HLA-B*15 allele was a risk factor for ESRD caused by glomerulonephritis [10]. In this study, the OR of people with HLA-B*15 developing ESRD was higher than people who were -B*15–negative (OR = 1.576), while the OR of people with an HLA-B with 2 loci B*1515 was 4.688. In further analysis on the risk between people who had a B*15 allele and those who had a pair of B*15, we found that the risk of ESRD in the group that had 2 B*15 was 1.53 times higher (relative risk = 1.526, 95% CI: 1.195–1.948). Analysis of HLA class II genotyping showed that DRB1*12 did not have significant association; however, the haplotype DRB1*1212 showed a positive association (OR = 2.15, 95% CI: 1.10–4.20). A study in Turkey also proved that population with HLA-DRB1*12 had a higher prevalence of ESRD than the control population (8.3% and 3.2% respectively, P = .028) [11]. Other HLA alleles that

Table 4. Association of HLA Haplotypes With End–Stage Renal Disease

HLA haplotypes	β	SE	OR (95% CI)	*P**
A*0102	3.712	1.193	40.94 (3.94–424.64)	< .01
A*2433	3.099	1.103	22.16 (2.55–192.40)	< .01
A*24A3	3.626	1.585	37.56 (1.68–838.94)	.02
B*1313	3.114	1.573	22.51 (1.03–491.67)	.04
DRB1*0909	2.987	1.492	19.82 (1.06–368.87)	.04

Abbreviations: CI, confidence interval; OR, odds ratio; SE, standard error.
*The *P* value was adjusted by age, sex, and etiology.

Table 5. The Relationship Between Top Haplotypes of HLA and ESRD (n > 10 presented)

Haplotypes	Total n (%)	ESRD n (%)	Control n (%)	*P* Value	OR (95% CI)
A*0111	10 (2.61)	5 (2.55)	5 (2.54)	NS	
A*0202	22 (5.74)	14 (7.14)	8 (4.06)	NS	
A*0221	50 (13.05)	30 (15.31)	20 (10.15)	NS	
A*0224	33 (8.62)	18 (9.18)	15 (7.61)	NS	
A*0229	12 (3.13)	4 (2.04)	8 (4.06)	NS	
A*0233	23 (6.01)	7 (3.57)	16 (8.12)	.04	.39 (0.15–0.98)
A*1111	24 (6.27)	13 (6.63)	11 (5.58)	NS	
A*1124	32 (8.36)	17 (8.67)	15 (7.61)	NS	
A*1129	25 (6.53)	14 (7.15)	11 (5.58)	NS	
A*1133	28 (7.31)	18 (9.18)	10 (5.08)	NS	
A*2433	10 (2.61)	5 (2.55)	5 (2.54)	NS	
B*1507	28 (7.31)	12 (6.12)	16 (8.12)	NS	
B*1513	11 (2.87)	6 (3.06)	5 (2.54)	NS	
B*1515	25 (6.53)	20 (10.20)	5 (2.54)	.03	.13 (1.51–11.26)
B*1535	18 (4.70)	10 (5.10	8 (4.06)	NS	
B*1538	13 (3.39)	6 (3.06)	7 (3.55)	NS	
B*1540	13 (3.39)	9 (4.59)	4 (2.03)	NS	
B*1546	25 (6.53)	13 (6.63)	12 (6.09)	NS	
B*1558	16 (4.18)	8 (4.08)	8 (4.06)	NS	
DRB1*0312	13 (3.39)	5 (2.55)	8 (4.06)	NS	
DRB1*0412	24 (6.27)	14 (7.14)	10 (5.08)	NS	
DRB1*0415	10 (2.61)	5 (2.55)	5 (2.54)	NS	
DRB1*0912	22 (5.74)	9 (4.59)	13 (6.60)	NS	
DRB1*1012	22 (5.74)	9 (4.59)	13 (6.60)	NS	
DRB1*1212	47 (12.27)	31 (15.82)	16 (8.12)	.03	2.01 (1.05–3.80)
DRB1*1215	20 (5.22)	13 (6.63)	7 (3.55)	NS	
DRB1*1214	11 (2.87)	8 (4.08)	3 (1.52)	NS	

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; NS, not significant; OR, odds ratio.

were confirmed as risk factors for ESRD included: B*18 and B*49 (Arab Saudi) [10]; B*40, DRB*12, CW*04, and DQB1*03 (Turkey) [11]; B*8 (Kuwait) [2]; DR*3 and DR*11 (Taiwan) [8]; B*55, B*54, B*40, and DRB1*04 (China) [17]. In the relationship between the phenotypes of HLA and ESRD caused by hypertension, the population with 6 HLA class I alleles (HLA-A*01, -A*25, -A*30, -A*0202, -B*57, and -B*1557) had a positive association with hypertension. The conclusion from a study in Turkey showed the frequencies of the HLA-B*52 and B*58 alleles were significantly lower in patients with ESRD [11]. The relationship between the phenotypes of HLA and ESRD caused by diabetes mellitus was also investigated. In the current study, the positive association between HLA-B1515 (OR = 8.09) and HLA-DRB1*0909 (OR = 18.6) with diabetes mellitus cause were found with a *P* value of less than .01. We noted that HLA-DRB1*1502 in Mexican [18] and HLA-A*02 in Egypian [19] and Canadian [20] people were positively associated with diabetic ESRD. With the cause of polycystic kidney disease, the HLA haplotypes -A*1126, -A*0226, -B*3846, -B*4058, -DRB1*0709, -DRB1*0410 were associated with ESRD (*P* value $< .05$). However, the number of patients with polycystic kidney disease was too small to conclude. This study also reported several alleles and haplotypes of HLA that showed significant association with the risk of developing ESRD. Although the sample size in both ESRD and healthy donor groups were small, we adjusted with related covariate variables

CONCLUSION

The phenotypes of the HLA class I and II and ESRD had significant association for ESRD in Vietnamese population. This study confirmed strongly that 4 haplotypes of HLA class I (A*0102, A*2433, A*2403, and B*1313) and a haplotype of HLA class II (HLA-DRB1*0909) associated with the risk of ESRD in the Vietnamese population. This analysis used small population case and control data set, and the results of our study should be confirmed in further investigations.

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