ORIGINAL ARTICLE

ANALYSIS OF HUMAN BRADYKININ RECEPTOR GENE AND ENDOTHELIAL NITRIC OXIDE SYNTHASE GENE POLYMORPHISMS IN END-STAGE RENAL DISEASE AMONG MALAYSIANS

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ABSTRACT

The aim of this study was to determine the association of the c.894G>T; p.Glu298Asp polymorphism and the variable number tandem repeat (VNTR) polymorphism of the endothelial nitric oxide synthase (eNOS) gene and c.181C>T polymorphism of the bradykinin type 2 receptor gene (B2R) in Malaysian end-stage renal disease (ESRD) subjects. A total of 150 ESRD patients were recruited from the National Kidney Foundation’s (NKF)dialysis centers in Malaysia and compared with 150 normal healthy individuals. Genomic DNA was extracted from buccal cells of all the subjects. The polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) method was carried out to amplify the products and the restricted fragments were separated by agarose gel electrophoresis. Statistical analyses were carried out using software where a level of $p < 0.05$ was considered to be statistically significant.

The genotypic and allelic frequencies of the B2R gene (c.181C>T, 4b/a) and eNOS gene (c.894G>T) polymorphisms were not statistically significant ($p > 0.05$) when compared to the control subjects. The $B2R$ and $eNOS$ gene polymorphisms may not be considered as genetic susceptibility markers for Malaysian ESRD subjects.

Keywords: Bradykinin type 2 receptor ($B2R$) gene; Endothelial nitric oxide synthase ($eNOS$) gene; End-stage renal disease (ESRD); Polymorphism

INTRODUCTION

End-stage renal disease (ESRD) is also known as a stage of chronic renal disease in which renal replacement therapy, dialysis or kidney transplantation is needed to sustain life [1]. End-stage renal disease is a complex phenotype and multifactorial disease caused by both environmental and genetic factors [2]. Several studies have shown that genetic factors may also contribute to the development of ESRD [3,4]. Bradykinin B$_2$ receptor ($B2R$) and the endothelial nitric oxide synthase ($eNOS$) genes have been proven to be candidate genes associated with ESRD [5,6]. Meta analysis studies showed that the candidate genes involved in the development of ESRD led to contradictory results in various populations [7]. This may be due to the difference of genetic predisposition causing this association of polymorphism with ESRD to differ between populations. In Malaysia, there is a lack of literature on the association of the bradykinin receptor and the $eNOS$ gene polymorphisms with the development of ESRD. Taking this into account,
we sought to determine the association of $B_2R$ and $eNOS$ gene polymorphisms and the ESRD subjects in Malaysians.

**MATERIALS AND METHODS**

The study was approved by the Ethical Committee of the Faculty of Medicine and Health Science (RUGS project no. 91104) and permission was obtained from the National Kidney Foundation (NKF) of Malaysia. A total of 320 subjects were approached and 300 [150 patients from the NKF undergoing dialysis treatment and 150 unrelated healthy individuals, randomly selected by conducting health screening programs at various places in and around the Universiti Putra Malaysia (UPM) Serdang, Malaysia area], were recruited for this study; some subjects were excluded due to inconsistent genotyping results and extreme values. Written consent was obtained from all subjects who participated in this study and buccal cells were collected from ESRD subjects using cytology brushes. Genomic DNA was extracted to determine the genetic polymorphisms of the $eNOS$ and $B_2R$ genes. The polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) method was carried out for all subjects according to the available protocols [8,9]. All the amplified products were separated using 2.0% agarose gel electrophoresis and the gel was stained using Gel Red (Biotium, Hayward, CA, USA). The stained gel was visualized under UV light using an Alpha Imager (Alpha Innotech, San Leandro, CA, USA). Identical results were obtained when genotyping was performed on two separate occasions for 10.0% of the samples. All the statistical analyses were carried out using the Statistical Package for the Statistical Sciences (SPSS) (Chicago, IL, USA) software, version 18.0 for Microsoft Windows. A $p$ value of $<0.05$ was considered to be significant.

**RESULTS**

**Clinical Characteristics of All Subjects.** This study comprised 150 patients (87 males and 63 females) and 150 controls (67 males and 90 females). The sex ratio was 51.3% males to 48.7% females. The ages of the ESRD patients ranged from 31 to 75 years old, with a mean age of $45.82 \pm 13.39$ years in the controls. The mean serum creatinine (SCr) level for ESRD patients was $9.59 \pm 2.95$ compared to $0.62 \pm 0.23$ in the controls, suggesting that patients with a higher level of creatinine are more likely to develop ESRD. There were significant differences for age, creatinine level, systolic blood pressure (SBP), total cholesterol (TC) and triglyceride (TG) levels between ESRD subjects and controls ($p < 0.05$). Creatinine levels, as well as SBP, TC and TG levels in ESRD subjects were higher compared to control subjects. However, there were no significant differences observed in diastolic blood pressure (DBP), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) between ESRD subjects and controls ($p > 0.05$).

**Genotype and Allele Analysis.** Table 1 shows the distribution of genotype and allele frequencies of the $eNOS$ and $B_2R$ genes. There was no significant difference observed in both genotype and allele frequencies of the studied polymorphisms between ESRD and controls ($p > 0.05$). The T allele frequency of the c.894G>T gene polymorphism was not significantly different in patients (37.67%) and control subjects (37.33%) ($p > 0.05$). The wild type (4b/b; 87.33%) genotype of variable number tandem repeat (VNTR) in intron 4 of the $eNOS$ gene was dominant, followed by the heterozygous type (4b/a; 11.33%) and the least frequent was the mutant type (4a/a; 1.33%) compared to 79.33, 18.67 and 2.0%, in control subjects, respectively. The derived allele frequency of the T allele of c.181C>T polymorphism was 2.0% in ESRD subjects compared to 1.0% in controls. There was no association found in the c.181C>T polymorphism of the $B_2R$ gene among ESRD and control subjects ($p > 0.05$).

**DISCUSSION**

Genetic polymorphisms of the $B_2R$ and $eNOS$ genes might be involved in the development of ESRD as they were involved in the impairment of renal functions [4,8]. Several studies have been conducted to assess the association of the $B_2R$ and $eNOS$ polymorphisms with the risk of ESRD in several populations with contradictory results [9-11]. The c.181C>T; p.Arg14Cys polymorphism in exon 2 of the $B_2R$ gene had a similar genotypic frequency in ESRD (98.0%) and control subjects (99.0%) and were well in accordance with the other studies ($p$
Thus, the c.181C>T polymorphism was not functionally significant in Malaysian ESRD subjects. Studies had suggested that the c.894G>T polymorphism may be a predisposing factor in hypertension, diabetes and ESRD [13,14]. In this study, the T allele frequency for ESRD and control subjects was 37.67 and 37.33%, respectively, and were not significantly different. The eNOS 4a allele may have a role in the development of chronic renal failure [11]. The carriers of the 4a allele were found to be less frequent among ESRD cases compared with controls (7.0 vs. 11.3%) but the difference did not reach statistical significance. These findings were not in agreement with other populations [6,11]. The results found in this study were contradictory to the other association studies in several populations, which might be due to population stratification caused by ethnic differences, sampling bias, environmental factors and racial differences that may contribute to the contradictory results. This study did not match either with age or gender between case and control subjects, and all the subjects were not homogenous. Further studies are recommended to confirm the association of these and the other polymorphisms in the eNOS and B2R genes in Malaysians subjects with ESRD. In conclusion, the results of this study suggest that the c.181C>T polymorphism of the B2R gene, 4b/a and c.894G>T polymorphisms in the eNOS gene, were not associated with ESRD susceptibility in Malaysians.

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**Declaration of Interest.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.
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