Association of a Disintegrin and Metalloproteinase 33 Gene Polymorphisms with Chronic Obstructive Pulmonary Disease in Iraqi Population

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Abstract

Background:
“Chronic obstructive pulmonary disease (COPD) is predisposed by environmental and hereditary factors. A disintegrin and metalloproteinase 33 gene (ADAM33) has been one of the most stimulating gene for asthma since of their first association with the disease in Caucasian population. Recently, ADAM33 was shown to be associated with decrease of lung function and COPD. The target of this study was to evaluate the potential correlation between polymorphisms of ADAM33 and COPD in Iraqi population.

Methods:
This study included, 400 cases of COPD and 400 healthy individuals as control group. Two polymorphic loci (V4 and Q-1) of ADAM33 were selected for genotyping that determined by using the polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) method

Results:
“Statistically significant distinctions in the distribution of the wild and mutant genotypes between patients and control. In addition, significant association (P <0.0001) between COPD and mutant genotypes (V4/GG and Q-1/AA) are detected.

Conclusion:
The results of this study designate that ADAM33/V1 and Q-1 polymorphisms is a hazard factor for COPD among Iraqi society.

Key words: COPD, ADAM33, Polymorphism, Genotype

INTRODUCTION
Chronic obstructive pulmonary disease is characterized by the development of airflow limitation that is progressive and not completely reversible [1, 19], and is a major and growing public health burden as the 4th leading cause of mortality and morbidity by 2030 [3]. The relationship between gene polymorphisms and COPD susceptibility has recently been paid special attention and was explored in a large number of studies on hundreds of genes, however the results varied between studies and populations of people [8]. Multiple genes have been found for asthma and COPD. In addition to genes unique to these diseases, some shared genetic risk factors exist. Moreover, there are common host risk factors and environmental risk factors for asthma and COPD. Based on the data available, some studies put forward that genes that affect lung development in utero and lung growth in early childhood in interaction with environmental detrimental stimuli, such as smoking and air pollution, are contributing to asthma in childhood and the ultimate development of COPD [16]. A disintegrin and metalloproteinase 33 gene, belonging to the disintegrin and metalloproteinase family, plays a vital role in cell adhesion, proliferation, difference, signaling, apoptosis, and other responses [4, 20]. van Eerdewegh et al., (2002) found a relationship between the ADAM33 gene with asthma and bronchial hyper responsiveness. In the past decade, an increasing number of studies have shown associations between ADAM33 polymorphisms and asthma susceptibility, as well as other pulmonary diseases in several populations [5,6,7,15]. van Diemen et al., (2005) reported, for the first time, that single nucleotide polymorphisms (SNPs) in ADAM33 were associated with accelerated lung. The present study is the first attempt to detect the association between ADAM33/V4 and Q-1 polymorphisms and COPD in Iraqi population.

MATERIAL AND METHODS
Study design: The current study was conducted on 400 patients (237 males, 163 females) their ages from 30-80 year were seen in Al-Diwaniya Teaching Hospital. The patients were diagnosed clinically by physician as having COPD. The diagnosis of COPD performed by using special criteria or standards: {1} record of cigarette smoking (at least for 9 years ago) in patients who were current smokers at the time of evaluation {2} not exposition to other substances that identified to cause lung abnormalities {3} nonexistence of atopy {4} no history of systemic or other pulmonary disease or congenital and/or acquired systemic immunodeficiency {5} forced expiratory volume in the first second (FEV1)/forced vital capacity (FVC) <70% and FEV1 after inhalation of 200 mg salbutamol <80% [9]. Another group consist of 400 apparently healthy individuals (210 males and 190 female) their ages from 30-80 year without smoking or any history of systemic disease were clinically considered as a control group.

Molecular study: genomic DNA was extracted from blood according to manufacturers' instructions of Genomic
DNA Mini Kit (Geneaid). The ADAM33 was amplified by PCR by using Professional TR/O Thermocycler and information on the chosen SNPs is exposed in table 1. In RFLP technique, the PCR product were digested overnight with restriction enzymes (Table 1) according to manufacturers' procedure, and analyzed by 2% agarose gel electrophoresis

**Statistical analysis:** Statistical analyses were performed by the Statistical Package for Social Sciences version 20 for Windows software and Microsoft Excel 2010. Strong correlation between variables are determine by OR and \( \chi^2 \) test or Fisher's exact test. A \( P \)-value of <0.05 was considered to be statistically significant

**RESULTS**

The presence of family history is an important contributory factor in COPD. This study showed 260 (65%) of COPD patients have positive family history, Figure (1). The distribution of ADAM33 polymorphism was detected by PCR-RFLP technique. ADAM33-V4C/G locus have three genotypes; GG, GC and CC with band sizes of 168/206 bp, 168/206/374 bp and 374 bp respectively (Figure 2). Also in ADAM33-Q-1 A/G locus there're three genotype; GG, AA and AG with band sizes of 158 bp, 138/20bp and 158/138/20 bp respectively as in Figure (3). Deviations from Hardy-Weinberg equilibrium for ADAM33-Q-1 and V4 polymorphisms were seen in the COPD or healthy group. The genotypes and alleles frequencies of the ADAM33 SNPs in the COPD and healthy group are revealed in table 2. Mutant homozygous genotype (GG) of ADAM33-V4 and Mutant homozygous genotype of ADAM33/Q-1(AA) significantly association with COPD in compared with control (p <0.0001). ADAM33/Q-1(AA) and ADAM33-V4(GG) genotypes appeared as risk factors in COPD (EF = 0.329 and EF =0.446 respectively). In contrast, wild homozygous genotype (CC) of ADAM33-V4 and wild homozygous genotype of ADAM33/Q-1(GG) mainly detected in control group (p <0.0001) and not have any risk in COPD but wild homozygous genotypes of ADAM33 SNPs have Protective role (PF=0.328 and PF=0.326 for V4/CC and Q-1/GG respectively). Heterozygous genotype of ADAM33 SNPs (V4/CG and Q-1/AG) not considerably association with COPD (p>0.05) but Q-1/AG act as moderate risk factors (EF =0.088). ADAM33/Q-1(A) and ADAM33-V4(G) alleles are Mutant alleles and significantly association with COPD in compared with control (p<0.0001) also appeared as risk factors (EF=0.487 and EF=.0.569 for V4/G and Q-1/A respectively).

**Table (1): SNP characterized, Sequences of primers and Restriction Enzymes for ADAM33 genotyping.**

<table>
<thead>
<tr>
<th>chromosome position</th>
<th>Reference SNP ID</th>
<th>SNP name</th>
<th>Allele</th>
<th>Primer sequence</th>
<th>Restriction enzyme</th>
</tr>
</thead>
<tbody>
<tr>
<td>3592207</td>
<td>612709</td>
<td>Q-1</td>
<td>A/G</td>
<td>F: 5'-GGATTCAAACGGCAAGGAG-3'</td>
<td>PstI [9]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R: 5'-GTTCACCTAGATGGCCAGGA-3'</td>
<td></td>
</tr>
<tr>
<td>3589161</td>
<td>2787094</td>
<td>V4</td>
<td>C/G</td>
<td>F: 5'-ACACACAGAATGGGGAGAGGAG-3'</td>
<td>BtsCl [9]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R: 5'-CCAGAAGCAAAAGGTACACACA-3'</td>
<td></td>
</tr>
</tbody>
</table>

Figure (1): A Pie Chart showing the association between family history and COPD in cases.
Table (2): prevalence of genotypes and alleles of ADAM33/V4 and Q-1 in case-control

<table>
<thead>
<tr>
<th>Genotype/Allele</th>
<th>Genotype/Allele</th>
<th>Genotype</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>P value</th>
<th>OR</th>
<th>95% CI</th>
<th>OR</th>
<th>$\chi^2$</th>
<th>EF</th>
<th>PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADAM33-V4 (rs2787094)</td>
<td>Genotype</td>
<td>GG</td>
<td>41</td>
<td>10.2</td>
<td>201</td>
<td>50.3</td>
<td>&lt;0.0001</td>
<td>8.844</td>
<td>(6.06 - 12.91)</td>
<td>151.7</td>
<td>0.446</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allele</td>
<td>CG</td>
<td>162</td>
<td>40.5</td>
<td>160</td>
<td>40</td>
<td>0.888 [NS]</td>
<td>0.969</td>
<td>(0.731 - 1.286)</td>
<td>0.021</td>
<td>0.013</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC</td>
<td>197</td>
<td>49.3</td>
<td>39</td>
<td>9.7</td>
<td>&lt;0.0001</td>
<td>0.166</td>
<td>(0.114 - 0.242)</td>
<td>150.04</td>
<td>0.328</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>ADAM33-Q1 (rs612709)</td>
<td>Genotype</td>
<td>AA</td>
<td>99</td>
<td>24.8</td>
<td>198</td>
<td>49.5</td>
<td>&lt;0.0001</td>
<td>2.98</td>
<td>2.208-4.022</td>
<td>52.49</td>
<td>0.329</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allele</td>
<td>AG</td>
<td>150</td>
<td>37.5</td>
<td>172</td>
<td>43</td>
<td>0.068 [NS]</td>
<td>1.257</td>
<td>0.947-1.669</td>
<td>3.338</td>
<td>0.088</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GG</td>
<td>151</td>
<td>37.7</td>
<td>30</td>
<td>7.5</td>
<td>&lt;0.0001</td>
<td>0.134</td>
<td>0.088-0.204</td>
<td>104.54</td>
<td>0.326</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>348</td>
<td>43.5</td>
<td>568</td>
<td>71</td>
<td>&lt;0.0001</td>
<td>3.179</td>
<td>2.585-3.911</td>
<td>123.6</td>
<td>0.487</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>G</td>
<td>452</td>
<td>56.5</td>
<td>232</td>
<td>29</td>
<td>&lt;0.0001</td>
<td>0.315</td>
<td>0.256-0.387</td>
<td>123.6</td>
<td>0.387</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

** OR=Odd ratio, EF=Etiology fraction, PF=Preventive fraction, NS=No significant (p >0.05).

Figure (2): Agarose gel electrophoresis image that show the PCR - RFLP product of ADAM33/V4 polymorphism by using PstI restriction enzyme.

Figure (3): Agarose gel electrophoresis image that show the PCR - RFLP product of ADAM33/Q-1 polymorphism by using BtsCI restriction enzyme.

**DISCUSSION**

Decline in lung function is a threat factor for the development of COPD and cardiovascular disease [10]. Lee and coworkers demonstrated that ADAM33 protein levels in bronchoalveolar lavage fluid are inversely correlated with predicted FEV1 values in patients with asthma [11, 14]. Associations of polymorphisms in ADAM33 with FEV1 decline may therefore represent a risk for the development of COPD as well [12]. In present study, ADAM33 SNPs (Q-1 and V4) extensively association with...
FEV1 decline and COPD and this agreed with Wang et al., (2009) who detected that the intrinsic Q-1 SNP may influence the splicing of the ss-variant and disturb the growth of ADAM33. Subsequent results on protease activity may cause a defect in tissue repair after inflammation-induced damage. This may lead to progressive damage of alveolar tissue and thereby enhance accelerated decrease in lung function [9]. In a Dutch population, the SNPs S1, S2, and Q-1 were associated with FEV1 decline, and the SNPs S1, S2, F+1, and T2 were associated with the presence of COPD while paper of Simpson et al., (2005) on European children showed that SNPs F+1, M+1, T1, and T2 significantly associated with lower FEV1 and COPD [13].

Current research in line with Xiao et al., (2005) who point out there is a relationship between ADAM33-V4 polymorphism and COPD in Tibetan population of China [17] but inconsistent with study of Pabst, et al., (2009) who show no genetic association between polymorphic variants in ADAM33 and the onset or course of COPD [18,21]. Finally, only present study in Iraq are detected that ADAM33-V4 and Q-1 SNPs have role in development of COPD and other researches on genetics of COPD should be completed to determine the causative factors of COPD in this population.

CONCLUSION
COPD not causes by smoking or other environmental factors only but also strongly associated with genetic polymorphism. ADAM33/V4 and Q-1 SNP polymorphisms significantly correlated with COPD patients and this mean that individual who has ADAM33/V4 and Q-1 SNP polymorphisms more susceptible to COPD in this population.

REFERENCES