The Relationship between Nicotine Dependence Level and Community-Acquired Pneumonia in Young Soldiers: A Case Control Study

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Abstract

Objective Smoking is an important risk factor in the development of community-acquired pneumonia (CAP). This study was designed to investigate the relationship between nicotine dependence level and the development of CAP.

Materials and Methods The Fagerstrom test for nicotine dependence (FTND) was performed to measure nicotine dependence level (NDL). Subjects with a Fagerstrom score (FS) of 5 or lower were defined as low dependence level and a FS score of 6 or higher was defined as high dependence level.

Results The risk of pneumonia development was higher in smokers than in nonsmokers (OR=2.19, 95% CI 1.13-4.23). The pneumonia development risk was 1.91 times higher in the low dependence level group compared to nonsmokers (OR=1.91, 95% CI 0.95-3.83). In the high nicotine dependence level group pneumonia risk was 2.93 times higher than in nonsmokers (OR=2.93, 95% CI 1.34-6.36). We also studied the relationship between CAP and the time to the first cigarette of the day. Risk was the lowest in the smoker group of after 60 minutes and risk ratios increased with decreased time.

Conclusion In this study, a high nicotine dependence level was found to be a risk factor associated with smoking for CAP development. The time period of the first cigarette after waking up is also important in pneumonia development as well as in the nicotine dependence level.

Key words: community-acquired pneumonia, risk factors, nicotine dependence level

Introduction

Smoking is a well known and important risk factor in the development of community acquired pneumonia (CAP) (1-5). Previous studies have shown that CAP risk is increased with a higher daily consumption of cigarettes (1, 3, 5). Infection incidence increases in smokers due to impaired mucociliary clearance, increased inflammation and adherence of pathogens, epithelial destruction and changes in host defense mechanisms (6, 7). There is a close relationship between the daily consumption of cigarettes and nicotine dependence.

Nicotine dependence is the major cause of smoking behaviour continuity and treatment failure (8). Nicotine, is also an important immunosuppressive component of smoke (2). Data on the relation between the measured nicotine dependence level (NDL) with the number of cigarettes per day, as a theoretically funded construct including other many criterias, and CAP is not sufficient. This case control study was conducted to determine the risk of CAP in subjects with higher NDL in Fagerstrom test for nicotine dependence (FTND).
Table 1. CAP Rates and Odds Ratios According to Nicotine Dependence Levels

<table>
<thead>
<tr>
<th>Age (years ± SD)</th>
<th>22.18±1.22</th>
<th>22.18±1.23</th>
<th>-</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender M/F</td>
<td>58 / 0</td>
<td>580 / 0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>12</td>
<td>211</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Smoking Fagerstrom score ≤ 5</td>
<td>29</td>
<td>267</td>
<td>1.91</td>
<td>0.95-3.83</td>
<td>0.065</td>
</tr>
<tr>
<td>Smoking Fagerstrom score ≥ 6</td>
<td>17</td>
<td>102</td>
<td>2.93</td>
<td>1.34-6.36</td>
<td>0.005</td>
</tr>
<tr>
<td>Total smokers</td>
<td>46</td>
<td>369</td>
<td>2.19</td>
<td>1.13-4.23</td>
<td>0.017</td>
</tr>
</tbody>
</table>

*No adjustment for smoking number done during the calculation of odds ratio

Materials and Methods

**Patient and control group selection**

Patients with CAP diagnosis hospitalised in Izmir Military Hospital were enrolled in the study over a six-month period (December 1, 2005 - May 31, 2006). FTND was performed on soldiers with the diagnosis of CAP. Subjects with a Fagerstrom score (FS) of 5 or lower were defined as a low dependence level and a FS score of 6 or higher was defined as a high dependence level.

The control group was selected randomly and matched in age, gender, and occupation field; 10 healthy control subjects for one patient were included. Matching procedure was performed in the 14 days after CAP diagnosis. The subjects in the control group were asked about their smoking status and also FTND was performed on smokers. Subjects with a Fagerstrom score (FS) of 5 or lower were defined as a low dependence level and a FS score of 6 or higher was defined as a high dependence level.

Ex-smokers were not included in neither the patient group nor control group. Soldiers with chronic diseases (asthma, allergic diseases, valvular heart diseases, etc.) were also excluded from the study.

**Definitions about smoking**

Smoking habits were defined as follows:

- **Smokers**: People who smoked at least 100 cigarettes in whole life and were still smoking at least one cigarette per day
- **Ex-smokers**: People who had quit smoking.
- **Non-smokers**: People who had never smoked or smoked less than 100 cigarettes in their whole life (9).

**CAP diagnosis**

All subjects (patient and control groups) had health insurance in the military. The project was executed with physicians in garrisons and military hospital. Physical examination was performed for patients with the symptoms of fever, cough, sputum production, fatigue, impaired general performance, and chest X-ray, complete blood count, C-reactive protein, sedimentation rate, transaminases, blood urea nitrogen, creatinine and electrolyte measurements were ordered to investigate pneumonia. Patients with clinical, laboratory and radiological findings compatible with pneumonia were hospitalized in the Military Hospital. On admission, 42 patients had only posteroanterior chest X-ray and 16 patients had thorax computed tomography together with posteroanterior chest X-ray. Sputum gram staining and culture were ordered. At least two blood culture samples were taken from patients with ≥ 37.5°C fever. Patients were followed with chest X-ray at five-day intervals. Patients who had identified pathogenic microorganisms were treated with the diagnosis of CAP. Patients who had no identified pathogenic microorganisms but clinical and radiological findings compatible with CAP were started on empirical antibiotic therapy. Patients who had clinical and radiological improvements without any other disease were accepted as CAP after empirical therapy.

**Statistical analysis**

SPSS 15.0 for Windows software programme was used for statistical analysis. Descriptive statistics and chi-squared testing were used for the nominal data. We used estimations of the relative risk through odds ratio (OR) to measure association between degree of nicotine dependence and CAP development and to determine the relation between time until smoking after wake up and CAP development.

**Results**

Subjects enrolled in this study were all male, mean age was 22.18±1.22 in CAP group, and 22.18±1.23 in control group; 58 patients were diagnosed as CAP. Bacterial growth was observed in sputum culture of four patients and blood culture of five patients, but there was no proliferation on the cultures of other patients. Most common isolated pathogen was *Streptococcus pneumoniae*. Smoking status and NDL scores in FTND of the subjects enrolled in the study are shown on Table 1.

Pneumonia development risk was higher in smokers compared to non smokers (OR=2.19, 95% CI 1.13-4.23). Smokers were subdivided into two groups according to their nicotine dependence level. Subjects with FS≤ 5, defined as the low NDL group, and subjects with FS≥ 6 were defined as
Table 2. CAP Development Rate and Odds Ratios According to Time Period to First Cigarette of the Day

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Cases</th>
<th>Controls</th>
<th>OR</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
<td>211</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 60 minutes</td>
<td>11</td>
<td>135</td>
<td>1.43</td>
<td>0.61-3.33</td>
<td>0.403</td>
</tr>
<tr>
<td>31-60 minutes</td>
<td>17</td>
<td>129</td>
<td>2.31</td>
<td>1.07-5.00</td>
<td>0.029</td>
</tr>
<tr>
<td>6-30 minutes</td>
<td>16</td>
<td>96</td>
<td>2.93</td>
<td>1.33-6.43</td>
<td>0.005</td>
</tr>
<tr>
<td>Within 5 minutes</td>
<td>2</td>
<td>9</td>
<td>3.90</td>
<td>0.75-20.12</td>
<td>0.081</td>
</tr>
</tbody>
</table>

In this study, we concluded that, high nicotine dependence level is a risk factor associated with smoking for community-acquired pneumonia development, and also the risk for pneumonia development, increases with the higher levels of the nicotine dependence. The relationship between the amount of smoking and CAP development risk was investigated in the previous studies (1, 3, 5, 10, 11). Researchers found that there was an increase in CAP development risk with an increased amount of smoking. Serum and saliva levels of cotinine, which is the major degradation product of nicotine metabolism, are highly correlated with measures of nicotine dependence (13, 14). Moreover there are also some psychological and physiological factors affecting NDL. Smokers need a daily certain dose of nicotine to improve their mood by the psychotropic effect of nicotine and because of physical dependence (15, 16). There may be some changes in host immune system, related to serum nicotine level and psychological factors.

In this study, patients of adult age were recruited from the military force located near public areas. Therefore, we thought that passive smoking could be higher in this population. But we did not investigate passive smoking in this study process. The study included total of 58 patients with the diagnosis of CAP, during a six-month period. The control group was enrolled from the military force population that the patients come from and FTND was performed. The study and control groups were similar for age, sex, nutrition, living environment, and daily practice. Therefore, matching process was successful however the number of subjects in the control group was higher than in the study group.

We found an increased infection risk in smoker soldiers compared with non smokers (OR=2.19, 95% CI 1.13-4.23). And, also the CAP development risk in soldiers with a high NDL was higher (OR=2.93, 95% CI 1.34-6.36) compared to those who had a lower NDL (OR=1.91, 95% CI 0.95-3.83). The results of this study suggest that the CAP risk increases with higher NDL.

The Fagerstrom test for nicotine dependence (FTND) consists of two major components; the number of cigarettes smoked per day and the time to the first cigarette of the day. The relationship between the amount of smoking and CAP development risk has been already investigated in many studies. The aim of this study was to determine the effect of nicotine dependence on pneumonia development. To determine results on the relationship between CAP and the time to the first cigarette of the day, we asked the first question of FTND ‘How soon after you wake up do you smoke your first cigarette?’ to patient and control groups. The risk was the lowest in the smoker group of after 60 minutes and risk ratios were increased with decreased time. The highest risk was in the smoker group of within 5 minutes. However this group and the control group had a lower number of subjects and there was no statistically significant difference (p=0.081). In conclusion, the time period of the first cigarette after wake up is also important in pneumonia development as well as in nicotine dependence level.

Nicotine affects both cellular and humoral immunity, so it is an important immune supressive agent of smoke as well as other agents (2, 17). When nicotine dependence increases, it is expected that there should be an increase in infection risk.

Pneumonia is still a major cause of mortality and morbidity all over the world. In respect to community health, it is
important to decrease the incidence of CAP together with smoking-related diseases in order to decrease health costs. In this context, the results of this study highlight the importance of campaigns against smoking. In addition, physicians should recommend pneumococcal vaccines to subjects with high NDL although they do not have additional immune supression.

References