Serum gamma-glutamyl transferase level in cigarette smokers

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ABSTRACT: Gamma-glutamyl transferase (GGT) is an enzyme derived from the endoplasmic reticulum of the cells of the hepatobiliary tract. To evaluate the serum gamma-glutamyl transferase level in cigarette smokers and compare with normal subjects, that is non-smokers and to establish if there is any significant difference between these levels. Serum gamma-glutamyl transferase (GGT) activity was assayed using standard procedures in sixty (60) subjects comprising thirty (30) subjects who are cigarette smokers and thirty (30) who do not smoke, which serves as control. All samples were obtained by random sampling. The mean ± standard deviation (S.D) of serum GGT levels in cigarette smokers and non-smokers were 49±16.26 U/L and 15±7.04 U/L respectively, showing a significant increase in serum level of GGT (P<0.05) when compared with controls. The mean±S.D. of smokers with alcohol consumption and smokers without alcohol consumption were 73±4.96 U/L and 43±11.86 U/L respectively. The mean ± S.D of male smokers and male non-smokers were 53±13.23 U/L and 17±6.20 U/L and also female smokers and female non-smokers were 32±1.33 U/L and 8±0.68 U/L which show significant difference between male and female GGT levels in respective of smoking (P<0.05). This work shows that alcohol consumption and smoking have synergistic effect in serum GGT activity causing a significant rise in its level in serum (P<0.05). This work also reveals a significant difference in the levels of serum GGT in males and females, irrespective of smoking. Therefore in the assay of GGT in the laboratory for investigation of disease, smoking and drinking habits of the patients should be put into consideration as this could cause an increase in its activity in serum.

Key words: Gamma-glutamyl transferase, cigarette, alcohol.

INTRODUCTION

Gamma-glutamyl transferase (GGT) is a member of the transpeptidase, that is they act as amino acid transferase¹, it is also known as gamma-glutamyl transpeptidase (GGTP). GGT transfers the gamma-glutamyl group from peptides and other compounds that contain it to an acceptor molecule². The glutamyl acceptor can be the substrate itself, some amino acids or peptide, or even water in which case, a simple hydrolysis takes place³. This enzyme reacts only on peptide or peptide-like compound containing a terminal (5 or gamma) carboxyl². GGT is present in high concentration in the kidney cells, pancreas, thymus, prostrate and all other tissues except those of the muscle. It is also present in the serum with its source mainly present from the liver origin. In the liver, however, GGT is predominantly present in the cell membrane of the hepatocytes, with small proportion found in the cytosol⁴.
As a transpeptidase predominantly present in the cell membranes, GGT transport amino acids and peptides into cells in the form of gamma-glutamyl peptides. It is also involved in some aspects of glutathione metabolism, with glutathione being its major substrate in plasma. Even though renal tissue has the highest level of GGT, the enzyme present in serum appears to originate from the hepatobiliary system, and GGT activity is elevated in any and all forms of liver disease, hence a sensitive indicator of liver disease.

Cigarette smoking is a significant factor in the predisposition of individuals to hepatic damage. There are harmful substances (nicotine and carbon monoxide) in cigarette smoke that, when inhaled have an adverse effect on various delicate organs in the body, including the lungs, brain and liver.

Hoffman and Hecht reported that tobacco smoke is an ever changing and extremely complex mixture of chemicals. It is formed when tobacco, itself being a mixture of over two thousand (2000) chemical constituents, is burnt incompletely during the smoking process.

However, it was found out that, the number of cigarettes smoked daily, the total duration of smoking, alongside alcohol consumption caused a significant increase in gamma-glutamyl transferase (GGT) activity. Since the source of serum GGT is mainly from the liver origin, damage to the hepatocytes will result in increased GGT levels.

SUBJECTS AND METHOD

Subject of study
A total of sixty (60) subjects were used for this study. Thirty (30) were cigarette smokers, consisting of twenty-five males and five females. The remaining thirty (30) serves as control also consisting of twenty-five males and five females.

Project questionnaires were used to obtain information such as age, number of cigarette sticks smoked per day, and how often, and whether or not they consume alcohol alongside smoking.

5ml of venous blood were collected aseptically by veni-puncture at the point of smoking into sterile plain containers. The blood samples were allowed to clot and centrifuged, and the serum separated into sterile plain well- labeled containers. These were kept in the refrigerator until analyzed.

Reagent
Gamma-glutamyl transferase reagent kit (szasz-tris) for quantitative determination of gamma-glutamyl transferase (Ref: 4076) was used.

Method
The kinetic method was used in the determination of gamma-glutamyl transferase.

Principle
L-\(\gamma\)-glutamyl-3-carboxy-4-nitroanilide+ glycine-GGT---- L-\(\gamma\)-glutamyl-glycylglycine + 5-amino- 2- nitrobenzoate. The amount of 5-amino-2 – nitrobenzoate formed is proportional to gamma- glutamyl transferase activity in the sample.

RESULTS
The results of the investigation carried out are represented on the tables below.

The results obtained in this study showed that the serum gamma- glutamyl transferase (GGT) levels of smokers vary considerably with that of non-smokers.

Table 1 shows the mean ± standard deviation (S.D.) of serum GGT levels in both smokers and non-smokers (49± 16.26U/L and 15± 7.04U/L respectively), and was compared using student t-test at 95% confidence level. There was a significant difference between the mean GGT concentration of smokers and non-smokers (P< 0.05).

Table 2 shows the mean ± S.D. of individuals smoking >20 sticks of cigarette per day and those smoking <20 sticks (73 ± 4.69U/L and 43 ± 11.86U/L respectively). There was a significant difference in this comparison (P< 0.05).

Table 3 shows the comparison between individuals drinking alcohol alongside smoking...
and those that smoke alone. There was also a significant difference in this comparison ($p < 0.05$).

**Table 1:** Mean ± standard deviation (s.d) of serum ggt in cigarette smokers and non-smokers

<table>
<thead>
<tr>
<th>NUMBER OF SAMPLES</th>
<th>MEAN ± S.D (U/L)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smokers</td>
<td>49 ± 16.26</td>
<td>10.6</td>
<td>$&lt; 0.05$</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>15 ± 7.04</td>
<td></td>
<td></td>
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</tbody>
</table>

**Table 2:** Mean ± s.d of individuals smoking >20 sticks of cigarette per day and >20 sticks of cigarette.

<table>
<thead>
<tr>
<th>NUMBER OF SAMPLES</th>
<th>MEAN ± S.D (U/L)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;20 sticks per day</td>
<td>73 ± 4.69</td>
<td>9.7</td>
<td>$&lt; 0.05$</td>
</tr>
<tr>
<td>&lt;20 sticks per day</td>
<td>43 ± 11.86</td>
<td></td>
<td></td>
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</table>

**Table 3:** Mean ± s.d of smokers and alcohol consumer and non-alcohol consumer.

<table>
<thead>
<tr>
<th>NUMBER OF SAMPLES</th>
<th>MEAN ± S.D (U/L)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smokers and alcohol consumer</td>
<td>73 ± 4.69</td>
<td>9.7</td>
<td>$&lt; 0.05$</td>
</tr>
<tr>
<td>Smokers and non-alcohol consumer</td>
<td>43 ± 11.86</td>
<td></td>
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</tbody>
</table>

**DISCUSSION**

In this study, individuals who smoke cigarette showed higher levels of serum gamma-glutamyl transferase (GGT) than non-smokers.

Several previous studies have noted higher levels of serum GGT in cigarette smokers. Whitehead et al.\(^7\) reported a significant increase in serum GGT activity among cigarette smokers which tallies with our work. The effect of smoking on GGT activity is as a result of enzyme induction by nicotine and polycyclic hydrocarbons present in cigarette smoke.

We also compared the serum GGT levels of smokers according to the number of cigarette sticks smoked. Here, it was observed that, a significant rise in GGT activity occurred among smokers of twenty (20) cigarette sticks and above when compared with those less than twenty (20) sticks per day. This also corresponds with the work of Whitehead et al.\(^1\).

When GGT activity in smokers of ten (10) sticks and less was compared with non-smokers, there was also a significant rise in GGT activity. It is reasonable to assume that, even when few cigarette sticks were taken per day, GGT activity rose significantly above normal. This is due to enzyme induction caused by nicotine and also GGT activity in serum rises earlier in any and all forms of liver diseases than with other liver enzymes, and rise persists longer.
Ten (10) individuals out of the thirty (30) smokers in this study also consume alcohol alongside smoking. We observed here that alcohol and nicotine in cigarette had a synergistic effect on the GGT activity causing a significant rise as against those smokers that do not consume alcohol. This corresponds with the earlier findings by Perkins and Leone\(^8\) that drinking can aggravate, the course of liver damage caused by smoking and vice versa. Also this corresponds with the work of Goya and Gerald\(^9\) that smoking may affect the liver through inflammatory pathways and may aggravate the pathogenic effects of alcohol on the liver.

Finally, GGT activity in males and females, irrespective of smoking, showed a significant difference as this was higher in both male smokers and non-smokers when compared with their female counterpart, this is because of its sources from tissues especially the prostate, which may account for the higher activity of GGT in males than females.

**CONCLUSION**

In conclusion, attempts have been made in this study to establish whether or not serum GGT activity is significantly increased in smokers and we have been able to affirm that smokers have approximately three (3) folds higher serum GGT activity due to enzyme induction. The number of cigarette sticks smoked per day caused a significant rise in serum GGT activity (especially >20 sticks per day).

Nicotine in cigarette smoke and alcohol had a synergistic effect on the serum GGT activity. Therefore, smoking and drinking habits should be taken into account when assessing the significance of an individual’s GGT activity.

**REFERENCES**