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Alimentary Tract Surgery and Lysozyme Activity

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Introduction

In recent years, relationship between lysozyme activity and a series of clinical situations has been discussed. Lysozyme is closely correlated with protective mechanism in human body, such as anti-bacterial, anti-viral, anti-inflammatory, anti-allergic, anti-neoplastic and so on. Therefore, it is assumed that postoperative patients in an early stage are reduced their protective capacity by anesthesia or operative procedures.

In the present investigation, changes of lysozyme activities in serum and saliva in patients with alimentary tract disease were examined before and after the operation to clarify the significance of the enzyme in the field of gastroenterological surgery.

Materials and Methods

1. Group 1 (control group) consisted of 11 healthy subjects. They are of both sexes aged 21-50 years.

Table 1. Operation performed in the group 2.

MAJOR SURGERY	(11 Cases)
Gastric carcinoma (subtotal or total gastrectomy)	6
Rectal carcinoma	4
Esophageal carcinoma	1
MINOR SURGERY	(8 Cases)
Gastric carcinoma (partial gastrectomy)	6
Gastric ulcer	1
Cholelithiasis	1

Key words : Alimentary tract surgery, Lysozyme, Muramidase, Protective mechanism
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2. Group 2 consisted of 19 patients suffering from alimentary tract disease, being 10 men and 9 women. The age range was 23 to 73 (mean, 55.1 years).
3. Group 2 was divided into two subgroups, judging from receiving either major or minor surgery as listed in Table 1.
4. All the subjects were starved overnight, and then their venous blood was drown. At that time, their saliva was also collected.

   With patients in group 2, the specimens were taken at several intervals, that is, 3, 5, 7 and 14 days after operation.
5. Lysozyme activity in serum and saliva thus obtained was determined by the turbidometric method of LITWACK (1).

Results

The lysozyme activity in normal subjects and preoperative patients.

As shown in Fig. 1, control values of lysozyme activities in serum and saliva were $12.4 \pm 0.65 \mu g/ml$ (mean$\pm$SE) and $17.0 \pm 1.28 \mu g/ml$, respectively. On the other hand, the enzyme activities in serum and saliva from preoperative patients were $11.2 \pm 0.44 \mu g/ml$ and $14.8 \pm 0.91 \mu g/ml$, respectively.

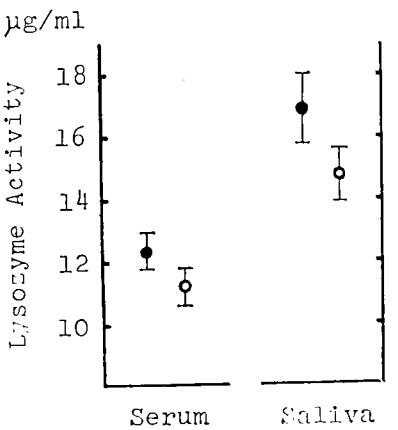

Fig 1. Lysozyme activities in serum and saliva. Each point represents the mean ± SE.
●, control; ○, preoperative patients.

The effect of surgery on lysozyme activity in serum.

The results are given in Fig. 2. The serum lysozyme level decreased and continued to decline until the 7th postoperative day. On the 7th postoperative day, the activity revealed the nadir, showing a 22 per cent reduction compared to the preoperative level, and then

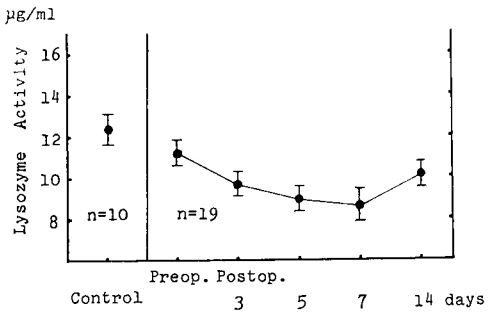

Fig 2. The effect of surgery on lysozyme activity in serum. Each point represents the mean ± SE.

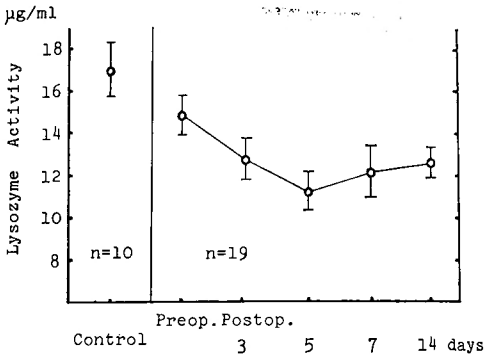

Fig 3. The effect of surgery on lysozyme activity in saliva. Each point represents the mean ± SE.

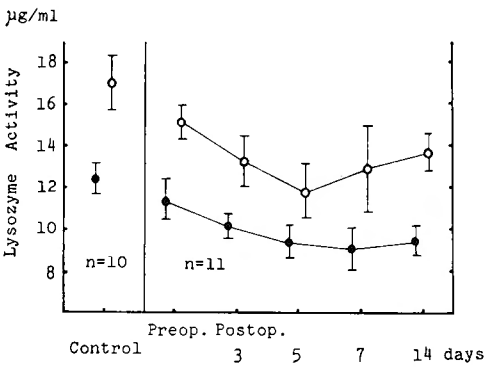

Fig 4. Changes of lysozyme activities in serum and saliva in patients receiving major surgery. Each point represents the mean ± SE.
●, serum; ○, saliva.

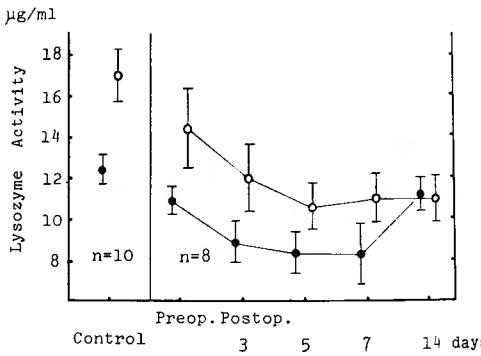

Fig 5. Changes of lysozyme activities in serum and saliva in patients receiving minor surgery. Each point represents the mean ± SE.
●, serum; ○, saliva.

the activity began to increase to the level of a 9 per cent reduction on the 14th postoperative day.

The effect of surgery on lysozyme activity in saliva.

As is evident from the Fig. 3, changes of lysozyme activity in saliva showed the similar pattern observed in serum. While in this case, the nadir was observed on the 5th postoperative day with a 24 per cent decrease compared to the preoperative value, and then the activity increased gradually to the level of a 15 per cent reduction on the 14th postoperative days.

Major surgery and lysozyme activity (*Fig.* 4).

After surgery, serum activity decreased gradually and reached minimum 7 days later, showing a 20 per cent reduction of the preoperative value, and kept the lowered level until the 14th postoperative day.

The salivary lysozyme activity reduced to minimum on the 5th postoperative day, and then increased, reaching the preoperative level on the 14th postoperative day.

Minor surgery and lysozyme activity (*Fig.* 5).

In patients receiving minor surgery, serum lysozyme activity completely returned to preoperative level after 14 days, while the activity in saliva showed a slight recovery even on the 14th postoperative day.

Discussion

Lysozyme (EC 3.2.1.17, mucopeptide N-acetylmuramylhydrolase, also known as muramidase) was discovered by FLEMING in 1922 as a "remarkable bacteriolytic element found in tissues and secretions" (2). It hydrolyses the β-(1→4)-links of N-acetylmuramic acid residues in a polysaccharide component of the walls of certain bacteria (3). The enzyme is very widely distributed in human tissues, milk, tears, saliva and serum (4,5,6).

Some reports (7, 8, 9) describe that the enzyme is closely related to the protective mechanism in human body on the base of anti-bacterial, anti-viral, anti-inflammatory, anti-allergic and anti-neoplastic actions. However a detailed mechanism concerning the enzyme action has not yet been recognized enough.

As clearly shown in our study, lysozyme activities in serum and saliva decreased postoperatively and reached their nadirs on the 7th and 5th postoperative day, respectively. These results indicate, in part, that protective mechanism in postoperative patients lowers at an early stage and is recovered gradually subsequent to the period.

Some works (10, 11) state that 70-80 per cent of the total body lysozyme is either existent in or released from neutrophils or monocytes, and lysozyme in tears, saliva and other secretions probably represents synthesis by glandular cells (4).

The basic mechanism of lysozyme action is thought to be dependent upon the enzymatic and cellular effects (12). The enzymatic effect of lysozyme is, as described above, a cleavage of mucopolysaccharides, chiefly those known to be constituents of bacterial cell walls. The cellular effect of the enzyme is due to a combination of its cationic properties, facilitating interaction with the negatively charged cell surfaces. As a result of the latter effect, viruses, foreign bodies in the inflammatory lesions, degenerated cells and malignant cells are easily conjugated with lysozyme, and therefore, these conjugates are more likely to be phagocyted by macrophages.

As shown in Fig. 4 and 5, in the case of major surgery, the lysozyme level in saliva returned nearly to the preoperative range after 14 days although serum lysozyme activity was not completely recovered yet, and the relationship of the activity between serum and saliva showed the reverse in the case of minor surgery. On the basis of these findings, it seems reasonable to suspect that the origin of lysozyme activities in serum and saliva differs from each other, and that these results indicate a rational phenomenon in which the activity from salivary glands supplements a serum lysozyme level decreased by operative procedures.

Summary

In the present paper, postoperative changes of lysozyme activities in serum and saliva

in patients with alimentary tract diseases are examined and its relation to protective mechanism at an early stage after surgery is discussed.

1. After surgery, the activities in serum and saliva descreased and showed a recovering trend 2 weeks later.

2. In the case of major surgery, lysozyme level in saliva returned nearly to the preoperative range after 2 weeks, although serum lysozyme was not recovered yet.

3. The relationship of the activity between serum and saliva showed the reverse in patients receiving minor surgery.

4. Considering a lysozyme function, it may be concluded that protective mechanism in postoperative patients lowers at an early stage, and the activity from salivary glands supplements a serum lysozyme level decreased by operative procedures.

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和文抄録

消化器系手術前後における血清および唾液 Lysozyme 活性の変動

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Lysozyme（以下 LZM）は生体内組織，体液中に広く分布する mucopolysaccharide 分解酵素であり，生体内にあっては抗細菌，抗ウィルス，抗炎症，抗腫瘍作用など生体内防御機構に関与している．そこで著者らは消化器系手術患者（胃癌12例，直腸癌4例，食道癌，胃潰瘍，胆石症各1例の計19例）を対象として術前術後の血清および唾液 LZM 活性を測定し，加えられた手術侵襲と本酵素活性の消長との関係について検討した．

1)．術後，血清および唾液 LZM 活性は低下し，2週後には回復の傾向を示した．

2)．対象を手術侵襲の大小により2群に分け，活性の変動を分析した．

3)．大侵襲群においては，唾液 LZM 活性は術後2週目にはほぼ術前値に回復したが，血清中の LZM 活性は回復傾向を示さなかった．

4)．小侵襲群についてみると大侵襲群とはまったく逆の関係を示した．すなわち，血清 LZM は術後2週目には完全に術前値に復したが，唾液 LZM 活性は術後2週経過しても回復の傾向はみられなかった．

5)．以上の結果は，手術侵襲により生体の防御能が術後一時的に低下することの一端を表していると考えられ，また血清と唾液では LZM の origin が異なっており，血中濃度の低下を補おうとする反応の一部が唾液に出たものと解釈される．