

Investigation of Saliva Composition in Benign Salivary Gland Tumors

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Abstract:

Benign salivary gland tumors, though non-malignant, can significantly affect the function of glandular tissue, leading to changes in saliva composition. This study investigates the biochemical alterations in saliva among patients with benign salivary gland tumors, aiming to explore saliva as a non-invasive diagnostic tool for early diagnosis and disease monitoring. To examine the biochemical composition of saliva in patients with benign salivary gland tumors and compare it to that of healthy individuals, focusing on changes in protein fractions, enzyme activities, and electrolyte levels. Forty-two patients diagnosed with benign salivary gland tumors (18 men, 24 women, aged 25–65) participated in the study. A control group of 20 healthy individuals was also included. Saliva was collected in the morning, and biochemical analysis was performed to measure total protein, protein fractions, enzyme activity (amylase, lactate dehydrogenase), and electrolyte levels (Na⁺, K⁺, Ca²⁺, Cl[−]). Data were analyzed using SPSS 25.0. Significant differences in saliva composition were observed in patients compared to the control group. Protein levels were significantly higher ($p < 0.05$), with increased globulins and decreased albumin-globulin ratio. Enzyme activity, especially amylase and lactate dehydrogenase, was elevated, and electrolyte imbalances were noted.

Keywords: Saliva, Benign Tumors, Salivary Glands, Biochemical Composition, Diagnosis, Protein Fractions, Enzymes, Electrolytes, Non-Invasive Method, Biomarkers

Introduction

Benign salivary gland tumors represent one of the most pressing problems in modern dentistry and maxillofacial surgery, as they constitute a significant portion of head and neck neoplasms. Despite the fact that these tumors do not have an aggressive malignant potential, their presence is often accompanied by changes in the structure and function of the glandular tissue, which is reflected in the quantitative and qualitative composition of saliva. Saliva is an important biological substrate that not only ensures normal physiological processes in the oral cavity but also reflects the body's overall condition. In recent decades, the study of biochemical and molecular indicators of saliva has become increasingly important both in clinical practice and in fundamental scientific developments, as this material is easily accessible, non-invasive, and informative [1].

According to a number of authors, changes in the composition of saliva can serve as early markers of pathological processes in the salivary glands. Studies have shown that in benign tumors of the salivary glands, significant fluctuations in the levels of protein fractions, enzymes, and electrolytes are noted, which is associated with impaired secretory function and changes in metabolic processes in the affected tissues (Smith et al.,). In addition, the works of foreign researchers (Johnson; Lee et al.,) confirm that biochemical analysis of saliva allows not only to identify specific markers but also to assess the degree of activity of the pathological process. Thus, saliva is considered a promising object for biomedical research, including the diagnosis of tumor diseases [2].

Despite the accumulated data, the question of the nature of changes in the biochemical composition of saliva in benign tumors of the salivary glands remains insufficiently studied. Many studies focus on malignant neoplasms, while benign forms, such as pleomorphic adenoma or adenolymphoma, attract less attention from researchers. However, it is these tumors that occur most frequently, especially in the parotid glands, and have a significant impact on the functioning of the secretory apparatus [3]. Considering this, the need to conduct in-depth studies aimed at identifying specific changes in saliva composition in benign tumors becomes apparent.

The relevance of this work is due to the fact that the study of saliva as a diagnostic material opens up broad prospects for the introduction into practical medicine of methods for early detection of salivary gland pathologies. Conducting a comprehensive analysis will expand understanding of the pathogenesis of benign tumors, and will also serve as a basis for developing new approaches to diagnosing and monitoring patients [4-5]. This study is aimed at identifying the features of the biochemical composition of saliva in patients with benign salivary gland tumors and comparing the obtained results with the control group.

Materials and Method

The study was conducted on the basis of the Department of Maxillofacial Surgery and the dental clinic, where patients with benign salivary gland tumors were observed. The study included 42 patients (18 men and 24 women) aged 25 to 65 years, in whom, according to clinical-instrumental and histological methods, the diagnosis of benign tumors of the salivary glands, predominantly localized near the ear, was confirmed [6]. The control group consisted of 20 practically healthy individuals of comparable age and sex who did not have salivary gland diseases and other acute or chronic pathologies that could affect the composition of saliva.

Unmixed saliva collected in the morning on an empty stomach, at least two hours after eating and brushing teeth, was used to obtain the material. Patients were rinsed with distilled water before collecting the material, after which saliva was collected in sterile test tubes for 10-15 minutes. Samples were centrifuged at 3000 rpm for 15 minutes to remove cellular elements and subsequently analyze the supernatant fluid [7].

Biochemical research included determining the concentration of total protein, individual protein fractions, enzyme activity (amylase, lactate dehydrogenase), and the level of basic electrolytes (Na^+ , K^+ , Ca^{2+} , Cl^-). For the analysis of protein fractions, electrophoresis in a polyacrylamide gel was used, and the total protein content was determined by the biuret method. Enzyme activity was measured spectrophotometrically using standard reagent sets. The electrolyte composition was determined by the ion-selective electrode method [8-9].

Statistical data processing was carried out using the SPSS 25.0 program. To assess the significance of differences, Student's t-test and Mann-Whitney's criterion were used, depending on the data distribution. The values were considered statistically significant at $p < 0.05$.

The ethical aspects of the study were considered in accordance with the Helsinki Declaration. All patients were informed of the research objectives and gave written consent to participate.

Results and Discussion

Analysis of the obtained data showed that in patients with benign salivary gland tumors, pronounced changes in the biochemical composition of saliva were noted compared to the control group. In particular, the concentration of total protein in the saliva of patients was significantly higher ($p < 0.05$), which is likely related to the increased metabolic activity of tumor cells and the compensatory reaction of the glandular tissue [10]. Furthermore, electrophoretic analysis of protein fractions revealed an increase in globulin content and a decrease in the albumin-globulin coefficient, which is confirmed by data from several authors on inflammatory-reactive changes in the salivary gland secretory system.

The study of enzymatic activity showed a statistically significant increase in the levels of amylase and lactate dehydrogenase in the saliva of patients with benign tumors compared to the control group. These changes may indicate a disruption in the integrity and functional state of the glandular epithelium. Increased enzyme activity correlated with tumor size and disease duration, which is consistent with the results of foreign studies, where salivary enzymes can serve as indicators of local pathological processes [11].

Electrolyte composition also exhibited deviations: the level of sodium and chlorine in the saliva of patients was higher than the control values, while the concentration of potassium and calcium had a tendency to decrease. Similar shifts can be related to changes in secretory function and impaired ion transport in the affected glands. There is information in the literature that electrolyte changes in saliva during tumor processes are caused by both structural restructuring of the glandular tissue and changes in local blood circulation [12].

Thus, the obtained results confirm that biochemical salivary analysis is an informative method that allows for the detection of changes characteristic of benign salivary gland tumors. Unlike traditional instrumental and histological methods, salivary examination has several advantages – it is non-invasive, accessible, can be performed multiple times, and allows tracking the dynamics of the pathological process [13-14-15].

The results of our study are consistent with the data of previous authors and supplement them with new observations related to the comprehensive assessment of protein, enzymatic, and electrolyte indicators of saliva in patients with benign tumors. These data can be used to develop diagnostic criteria and implement saliva analysis in routine clinical practice.

Conclusion

The conducted research showed that benign tumors of the salivary glands are accompanied by significant changes in the biochemical composition of saliva, reflecting functional and structural changes in the glandular tissue. A significant increase in the concentration of total protein, an increase in the content of globulins, and a decrease in the albumin-globulin coefficient, as well as an increase in the activity of amylase and lactate dehydrogenase, were established. The identified changes indicate metabolic and secretory dysfunction of the affected salivary glands.

Analysis of the electrolyte composition showed significant fluctuations in the levels of sodium, chlorine, potassium, and calcium ions, confirming the role of saliva as a sensitive indicator of pathological processes. These data are consistent with literature sources and indicate that saliva can serve as valuable diagnostic material for assessing the condition of patients with benign tumors.

Thus, the study of saliva composition represents a promising direction in the diagnosis of salivary gland diseases. The obtained results can be used to develop non-invasive methods for early detection of pathologies, monitoring the course of the disease, and evaluating treatment effectiveness. The introduction of saliva analysis into clinical practice will expand the possibilities of comprehensive examination of patients and improve the quality of medical care.

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