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Modern Methods Of Research And Diagnostics Of Diseases Of The Salivary Glands

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Abstract. Salivary gland diseases represent a significant proportion of dental pathologies, yet their diagnosis remains complex due to the heterogeneity of clinical manifestations and limitations of existing diagnostic tools. Despite the availability of conventional methods such as sialography, ultrasonography, and computed tomography, there is no unified diagnostic approach, leading to frequent diagnostic errors and delayed or inadequate treatment. This study addresses the gap in comprehensive, high-precision diagnostic strategies, particularly focusing on the underexplored potential of advanced imaging and integrative diagnostic methods.

The research employs a комплекс approach combining clinical examination, radiological techniques, multispiral computed tomographic (MSCT) sialography, endoscopic evaluation, and biochemical analysis of saliva. Special emphasis is placed on modern diagnostic modalities, including digital dynamic sialography, sialendoscopy, and analysis of salivary crystallization and oxidative protein modification.

The findings demonstrate that MSCT sialography and sialendoscopy significantly improve differential diagnosis by providing detailed visualization of ductal structures and pathological changes. Biochemical and morphological analyses reveal that reactive-dystrophic processes alter salivary composition, crystallization patterns, and oxidative activity, offering additional diagnostic markers. However, retrospective analysis indicates that only 24% of cases are correctly diagnosed at the initial stage, highlighting persistent systemic shortcomings.

The results confirm that integrating advanced imaging with biochemical and endoscopic methods enhances diagnostic accuracy and supports more effective treatment planning. The study implies the necessity of multidisciplinary approaches and the expansion of specialized diagnostic technologies in clinical practice to reduce errors and improve patient outcomes.

Keywords: salivary gland diseases, sialadenitis, sialolithiasis, diagnostic methods, MSCT sialography, sialendoscopy, differential diagnosis, salivary analysis, oxidative stress, crystallization patterns.

Introduction

Salivary gland diseases constitute a clinically significant group of conditions, accounting for approximately 3–7% of dental pathologies, including sialolithiasis, chronic sialadenitis, sialadenosis, congenital anomalies, and neoplasms. These disorders are characterized by diverse etiologies and complex clinical presentations, which complicate accurate diagnosis and timely treatment. Modern diagnostic practice relies on a combination of clinical, radiological, and functional assessment methods, reflecting the theoretical framework that effective diagnosis requires integration of structural and physiological evaluation. However, the relationship between diagnostic accuracy and the choice of investigative modality remains insufficiently optimized, particularly in differentiating reactive, inflammatory, and obstructive processes within the salivary glands.

Previous studies have explored conventional techniques such as sialography, ultrasonography, and computed tomography, demonstrating their utility but also highlighting significant limitations in visualizing ductal architecture and identifying small or radiolucent lesions. Emerging approaches, including multispiral computed tomographic sialography and sialendoscopy, are grounded in the concept of high-resolution, minimally invasive diagnostics that enable both visualization and intervention. Despite these advances, a clear knowledge gap persists regarding the integration of imaging, endoscopic, and biochemical analyses into a unified diagnostic protocol. Prior research remains fragmented, often focusing on isolated methods rather than a комплекс diagnostic framework.

This study adopts an integrated methodological approach combining clinical examination, advanced imaging techniques, endoscopic evaluation, and biochemical analysis of saliva to enhance diagnostic precision. It is expected that such a multidisciplinary strategy will improve differential diagnosis, reduce diagnostic errors, and support targeted treatment planning. The anticipated findings aim to demonstrate the superiority of combined diagnostic modalities, with implications for establishing standardized protocols and improving clinical outcomes in patients with salivary gland diseases.

Methodology

The study was conducted using a comprehensive and integrative diagnostic approach aimed at evaluating the effectiveness of modern methods for diagnosing salivary gland diseases. A cohort of patients presenting with clinical signs of salivary gland pathology was examined using a combination of general, specific, and specialized diagnostic techniques. Initial assessment included patient history collection, clinical examination, palpation, and standard laboratory tests such as blood and urine analysis to establish baseline health conditions. Radiological evaluation was performed using conventional imaging methods, followed by advanced techniques including multispiral computed tomographic sialography to obtain detailed visualization of glandular structures and ductal systems [1]. Multiplanar and three dimensional reconstructions were applied to enhance diagnostic accuracy.

In addition, sialosonography was used to assess tissue structure and detect calculi or neoplasms, while digital dynamic sialography enabled real time evaluation of ductal filling and evacuation. Endoscopic examination of the salivary ducts was carried out using microendoscopic equipment, allowing direct visualization of intraductal changes and, when necessary, simultaneous minimally invasive therapeutic interventions [2] [3]. Morphological assessment was performed through biopsy of minor salivary glands, focusing on fibrosis, infiltration patterns, and ductal alterations. Biochemical analysis of saliva included evaluation of crystallization patterns and measurement of oxidative modification of proteins to identify pathological changes associated with reactive dystrophic processes. The collected data were comparatively analyzed to determine the diagnostic value of each method and to identify the most informative combination of techniques for improving differential diagnosis and clinical decision making.

Result and Discussion

According to some authors, salivary gland diseases account for 3 to 7% of dental pathologies. These include: salivary lithiasis (up to 60%), various forms of chronic sialadenitis and sialadenosis (up to 30%), congenital anomalies (up to 1%), and tumors (up to 5%) [4]. Despite the existence of a large number of different salivary gland examination methods (sialography, sialosonography, computed tomography of the salivary glands, etc.) that can identify various forms of pathology, differential diagnosis remains challenging. Radiological diagnostic methods are particularly important, allowing for the study of both the organ's topography and its functionality [5]. However, a unified diagnostic and therapeutic approach to the study of salivary gland pathology remains lacking.

Various diagnostic methods for salivary gland diseases do not fully satisfy physicians' requirements for making a final decision on treatment options for various salivary gland pathologies, resulting in patients receiving untimely or inadequate care. In these cases, prolonged disease progression leads to complications, the treatment of which presents significant challenges. Widely used sialosonography endless trust computer Sialtomography does not allow to evaluate the anatomical features of the ductal system [6] [7].

Recently, in order to diagnose various diseases of the salivary glands, the method of multispiral computed tomographic sialography (MSCT sialography) has begun to be used, allowing for a high level of differential diagnosis of various pathological processes.

There are isolated reports in the literature on the use of MSCT in the diagnosis of GS diseases. At the same time, it seems appropriate to explore the capabilities of MSCT sialography to improve the efficiency of GS diagnosis. Another important component of MSCT sialography is the ability to evaluate information obtained from the analysis of multiplanar and 3D reconstructions. The above facts formed the basis for this study. To diagnose GS diseases, it is necessary ¬to widely apply not only general examination methods (questioning, inspection, palpation, urine and blood tests, radiography), but also specific (used in examining ¬patients with specific diseases) and specialized methods (requiring specific medical skills and specialized equipment and allowing for the acquisition of additional data to clarify the diagnosis) [8].

Specific methods include probing of the excretory ducts and plain radiography of the parotid duct area, ¬examination of their secretory function, qualitative analysis of saliva (study of physicochemical properties), cytological examination of secretion smears, sialography, and pantomosialography. However, radiographic -examination of the parotid ducts and their ducts in lateral projections is often uninformative, since even if a salivary calculus ¬is radiopositive, it falls within the shadow of the mandibular bone [9]. Furthermore, it is known that calculi localized in the parotid ducts contain a large number of radiolucent organic substances, which makes radiography of the parotid ducts ineffective in diagnosing sialosis. Contrast sialography in most cases identifies an intraductal obstruction without providing precise information on its qualitative composition [10].

The most informative and reliable are special methods of studying the gastrointestinal tract, which dictates the ¬need to expand the indications for their use.

Digital (subtraction) dynamic sialography enhances ¬the diagnostic capabilities of sialography through subtraction, i.e., subtraction of the surrounding ¬bone tissue background. The use of modern digital technologies not only reduces the patient's radiation exposure severalfold but also enables real-¬time visualization of the filling of the glandular ducts with contrast agent and its evacuation, assessing the amplitude of calculus movement along the duct and the degree of duct obstruction by the stone, which is important for subsequent ¬treatment selection [11].

Computer and magnetic resonance sialotomography are effective when the calculus falls within the plane ¬of the section; with a small diameter of the calculus (less than 5 mm), the information content of the method decreases sharply.

Sialosonography method (Ultrasound) is based on the varying degrees of absorption and reflection of ultrasound by scrotal tissues with varying acoustic impedance. Sialosonography provides insight into the macrostructure of the scrotal tissue.

An echogram can be used to judge the size, shape and relationship ¬of gland tissue layers with different densities, to identify sclerotic changes, salivary stones and the boundaries of neoplasms [12].

Thermosialography (thermal imaging) allows one ¬to observe dynamic changes in temperature in the gastrointestinal tract, determining the effectiveness of the treatment.

The method of radiosialography of the parotid scrotum (radioisotope sialometry) consists of recording the intensity curves of radioactive radiation over the parotid ¬scrotum and the heart after intravenous administration of sodium pertechnetate and allows for the evaluation of scrotum function.

Diagnostic puncture refers to morphological ¬research methods. However, due to its low information content, biopsy of small glandular tissues is most often used. Currently, clear ¬quantitative and qualitative criteria for assessing the data of biopsy of small glandular tissue have been developed. The most common condition of glandular tissue is fibrosis, which can be localized in the stroma or periductally. The second most important parameter is the presence of infiltration, which varies in localization (in the stroma or periductally), by type (mononuclear, eosinophilic, neutrophilic, lymphoid) and by the degree of manifestation (weak, moderate, strong). The type of infiltration allows us to assume ¬the type of pathological process [13]. Thus, lymphoid infiltration indicates the need to differentiate lymphoma, rheumatoid granuloma, autoimmune process; neutrophilic infiltration indicates a primary, most often bacterial process; Mononuclear atrophy is a reactive-dystrophic process caused by viruses (cytomegalovirus, Epstein ¬-Barr, herpes), intracellular bacteria (chlamydia, toxoplasma, mycoplasma), or fungi. Quantitative assessment is the number of cells in the infiltrate. Atrophy is characterized by the number of non-functioning glands per unit area. The histological description of the specimen also includes an assessment of the condition of the excretory ducts, which may be unchanged, narrowed (in sialosis), and cystically dilated ¬(in sialodochitis). Comparison of the results of small gland biopsy with the data of primary and secondary ¬research methods, taking into account the presence of general somatic pathology, significantly reduces the likelihood of an erroneous diagnosis.

A modern diagnostic and therapeutic method is sialendoscopy of large ductal glands using microendoscopes, allowing visualization of the extraglandular portion of the gland's excretory duct. The examination area also includes most areas of the intraglandular ductal system, including ducts of the second and third order, and in some cases, fourth and fifth order [14]. The presence of a second working channel in the endoscope tube allows for the simultaneous diagnostic examination of the ductal system and the necessary therapeutic procedures (bougienage, balloon ablation, intraductal focal laser treatment, complete removal or fragmentation of stones or foreign bodies).

To conduct a sialendoscopic examination, special diagnostic criteria have been developed, such as the color of the duct wall, its elasticity; the presence of vascular injections in the duct wall; the presence of pathological ¬inclusions in the lumen of the duct - stones (fixed in the duct or mobile, migrating, mucous plugs, fixed elastic plaques obstructing the ducts, polyps; the presence of stenosis.

Endoscopic examination of large sialomas is ¬a minimally invasive, simple, and highly informative procedure. Importantly, each form of reactive- dystrophic sialosis has a specific endoscopic ¬picture, allowing for a high degree of accuracy in determining the type of sialosis.

The endoscopic picture of sialosis is characterized by the presence of unevenly dilated areas of the third- and fourth-order ducts. In these ¬patients, parietal mucous plaques are found on the inner surface of the duct. Most patients have mucous plugs in the second- and third-order ducts, which partially or completely obstruct the duct lumen. The duct walls are typically light pink with pale pink ¬and whitish areas.

In sialosis, the duct system is characterized by edema and pastosity of the wall. Individual ducts of the second and third order are sharply narrowed and difficult to pass with the endoscope tube. In some ¬patients, the duct openings are surrounded by fibrous rings, which is classified as ductal furcation stenosis. The color of the inner surface of the ducts is uniform, pale yellow or grayish- ¬pink.

The main symptom of sialosis is vascular injections ¬in the walls of the main duct and ducts of the first, second, and third order. The vascular pattern is uneven—areas of the duct wall with a prominent vascular network alternate with anemic fragments [15]. Hyperemia of various sections of the ducts is observed at all levels, ¬alternating with areas of ischemia and sclerotic fragments. Pathological inclusions in the form of irregularly shaped flocculent formations are found within the duct lumens. The color of the duct wall varies from bright pink to burgundy with a smooth, shiny surface reminiscent of mother-of-pearl.

The possibility of performing a single-stage surgical ¬intervention on the duct system makes sialendoscopy the method of choice in the diagnosis and treatment of reactive- dystrophic diseases of large ducts.

The crystalline structure of saliva undergoes significant changes under the influence of metabolic disturbances accompanying reactive- dystrophic processes. Of the samples examined, those lacking crystallization foci predominate. Perpendicular crystal growth and destruction are observed, along with the presence of amorphous inclusions (additional signs of inflammation).

Given the above changes, it is reasonable to conclude that reactive-dystrophic processes significantly alter crystalline structures. This is evidenced by disruption of structural organization, significant inhibition of crystal formation, and the formation of defective morphological forms. The latter circumstance may be related to changes in the chemical composition of saliva during the development of a pathological process in the salivary gland.

When studying gas-discharge images of saliva from patients with various reactive-dystrophic diseases of the major salivary glands and from individuals in the control group, changes in all six studied parameters are clearly visible.

Thus, the shape and structure of GDV images of saliva changes depending on its chemical composition, which directly depends on the state of physiological and pathological processes occurring in the tissues of the gland.

Protein peroxidation is a free-radical process in which reactive oxygen species react with endogenous substrates to form peroxides. Alterations in this mechanism at one level or another lead to pathological disorders.

An analysis of the activity of the POB processes in the saliva of patients with various forms of reactive- dystrophic diseases of the major salivary glands was carried out in order to assess the effectiveness of the treatment.

During the study, protein oxidation products that reacted with 2,4-dinitrophenylhydrazine were detected in saliva.

Quantitative parameters of carbonyl derivatives of proteins in the saliva of patients with sialosis indicate the presence of characteristic features depending on the form of the disease.

The extremely high content of carbonyl derivatives of proteins in the saliva of patients with acute purulent mumps reflects the level of salivary peroxidation, which indicates the suppression of the body's antiradical defense and leads to pathological changes, both at the biochemical and clinical levels.

A study of the degree of oxidative modification of salivary proteins in patients with reactive-dystrophic diseases of the salivary glands after a course of treatment made it possible to evaluate the effectiveness of the complex treatment administered to them.

The indicators of the intensity of oxidative modification of salivary proteins in patients upon admission to the hospital and before discharge from the hospital (approximately 10-12 days) revealed positive changes during a biochemical study.

Conclusion

Differential diagnosis of gastrointestinal diseases is associated with a high rate of diagnostic errors. A retrospective analysis of patient records ¬shows that only 24% of cases are initially diagnosed correctly ¬. Causes of diagnostic errors include insufficient physician qualifications, incomplete patient history collection, and inadequate patient examination procedures. Most physicians lack specialized diagnostic techniques, and many medical facilities lack the equipment for in-depth gastrointestinal examination. Therefore, a thorough history and comprehensive examination of patients with sialosis and its chronic forms are essential for establishing a ¬definitive diagnosis. In cases of persistent, recurrent disease, examination and treatment should be conducted in a multidisciplinary hospital setting with the participation of specialists such as rheumatologists, gastroenterologists, endocrinologists, ophthalmologists, neurologists, and others.

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