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Effect of bronchial asthma on the condition of the oral cavity

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ABSTRACT

BACKGROUND: High-quality dental rehabilitation of patients suffering from bronchial asthma is one of the priority tasks of an integrated approach to the treatment of a general somatic pathology. To date, changes in the oral cavity are polyetiological and can be associated with xerostomia, nutrition, nature of treatment, and poor hygiene. Thus, the microbial factor may play an important role in the development of pathological changes in the oral cavity.

AIM: Through a literature review, this study aimed to examine typical and atypical types of microbial colonies developing in the oral cavity of patients with bronchial asthma and study ways to correct the pathogenic microflora of the oral cavity.

MATERIALS AND METHODS: An analysis was made of information sources in the international databases of Google Scholar, PubMed, and eLIBRARY.RU from 2000 to 2023. The keywords of the query were "oral cavity", "bronchial asthma", "microbes", "antimicrobial therapy".

RESULTS: The literature search extracted 118 sources, of which 34 were relevant. Patients diagnosed with bronchial asthma were found to have dental problems associated with conditions associated with bacterial flora, such as caries, periodontal diseases, and candidiasis. Inflammatory and autoimmune processes were activated by the action of pathogenic microflora.

CONCLUSION: Changes in the microbial balance have affected the development of oral cavity pathologies. Correct hygiene and use of antibacterial and antifungal agents, intake of low-dose drugs, or avoidance of drugs that stimulate the increase in pathogenic microbes, contribute to a decrease in the microbial pathological potential in the oral cavity.

Keywords: oral cavity; bronchial asthma; microbes; antimicrobial therapy.

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К вопросу о влиянии бронхиальной астмы на состояние полости рта

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АННОТАЦИЯ

Актуальность. Качественная стоматологическая реабилитация пациентов, страдающих бронхиальной астмой, — одна из приоритетных задач комплексного подхода к лечению общесоматической патологии. На сегодняшний день считается, что изменения в полости рта имеют полиэтиологичный характер и могут быть связаны с ксеростомией, питанием, характером проводимого лечения, неудовлетворительной гигиеной. Микробный фактор может быть ведущим в развитии патологических изменений в полости рта за счёт изменения качества и количества слюны, являющейся буферной системой, а также других сопутствующих факторов.

Цель исследования — изучить по литературным источникам данные о состояние полости рта пациентов, страдающих бронхиальной астмой и применяющих ингаляционные препараты для её коррекции.

Материалы и методы. Проведён анализ работ, опубликованных с 2000 по 2023 год в международных базах данных Google Scholar, PubMed, eLIBRARY.RU. Ключевыми словами запроса были “oral cavity”, “bronchial asthma”, “microbes”, “antimicrobial therapy”.

Результаты. Обнаружено 118 источников, из которых 34 были релевантными. На основании полученных литературных данных у пациентов, страдающих бронхиальной астмой, выявлены стоматологические проблемы, связанные с возможным влиянием бактериальной флоры, среди них кариес, болезни пародонта, кандидоз. Вышеуказанные патологии могут развиваться вследствие воспалительного и аутоиммунного процессов, активизируя действие патогенной микрофлоры.

Заключение. Изменение микробного баланса оказывает влияние на развитие патологий полости рта. Коррекция гигиены и использование антибактериальных, противогрибковых средств, а также снижение концентрации или отмена лекарственных средств, стимулирующих увеличение количества патогенных микробов, способствуют снижению микробного патологического потенциала в полости рта.

Ключевые слова: полость рта; бронхиальная астма; микробы; противомикробная терапия.

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BACKGROUND

According to the World Health Organization (WHO), there are 262 million patients with asthma worldwide, with more than 250,000 deaths each year [1]. Asthma is a prevalent chronic inflammatory respiratory disease. Its prevalence in children and adults is steadily increasing, as are mortality rates, making asthma a significant cause of disability [2]. The air spaces in the lungs diminish due to inflammation and muscle strain around the small airways, causing cough, wheezing, shortness of breath, and tightness in the chest. These symptoms are intermittent and frequently increase at night or on exertion. Moreover, there are other common triggers that can worsen asthma symptoms. These triggers differ between individuals, but generally include changes in oral microbiota, viral infections (common cold), and weather changes. Other common triggers are dust, smoke, fumes, pollen, animal fur and feathers, various detergents, and perfumes [1]. There are numerous factors that increase the risk of asthma; however, it is sometimes difficult to find the main cause.

Asthma is more likely to affect individuals who have a family history of this condition (in parents or siblings). Moreover, the risk of asthma is higher in patients with allergies, eczema, and rhinitis. Low birth weight, prematurity, exposure to tobacco smoke, air pollution, and viral respiratory infections affect the development of lungs and increase the risk of asthma.

Children and adults with overweight or obesity have a higher risk of asthma. In adults, the risk of asthma increases due to environmental allergens, indoor and outdoor air pollution, house dust, mold, and occupational exposure to chemicals [1, 3, 4].

The treatment of asthma is aimed at eliminating airway inflammation (anti-inflammatory drugs) and smooth muscle spasms (bronchodilators). There are two types of asthma drugs: those for quick relief (rescue medications) and those for long-term disease control. Quick-relief drugs include short-acting bronchodilators, systemic corticosteroids, and anticholinergic agents, whereas long-term control drugs comprise anti-inflammatory agents, long-acting bronchodilators, and leukotriene modifiers [5, 6]. The majority of asthma drugs are administered using various types of inhalers or nebulizers. Patients are taught to use these devices properly and informed about the required frequency and duration of drug therapy.

Microbiota composition varies between individuals and body areas. In asthma, oral microbiota may become the critical factor for upper and lower respiratory tract infections [6–12], considering that the lungs are not sterile, as was previously thought [8]. Inhaled microorganisms and pathogens discharged from the upper and lower respiratory tract via mucociliary mechanisms and found in saliva promote oropharyngeal infections [13]. The clinical significance of the oropharyngeal wall microbiota is poorly understood. However, antibiotics, probiotics, diet, and intestinal microflora have been shown to affect the oral microbiota composition [14, 15].

Several studies [6, 16, 17] assessed the association between respiratory tract microbiota and chronic respiratory diseases. However, only lower respiratory tract samples, like sputum and bronchoalveolar lavage, were examined. The upper respiratory tract microbiota in patients with asthma is insufficiently studied. The induction or inhibition of systemic immune tolerance to infection-associated antigens can be explained by the association between oral tolerance and airway tolerance. Bacterial infections have been shown to be involved in the development and progression of respiratory diseases; however, there have been no systemic studies of respiratory tract microorganisms [12]. Therefore, it is critical to determine the characteristics of oropharyngeal microbiota and the pathogenicity of its components. This may aid in identifying potential targets and developing new approaches to the prevention and treatment of oral complications of systemic disorders such as asthma [18, 19].

Dental prophylaxis and adequate oral hygiene can help reduce the role of microorganisms in oropharyngeal diseases [20].

The prevalence of asthma is steadily increasing; therefore, problems associated with asthma drugs may cause serious disorders, including in the oral cavity.

This review aimed to assess published data on the oral health of patients with asthma who receive inhaled asthma drugs.

SEARCH METHODOLOGY

The review included works published in Russian and English between 2000 and 2023. The search was performed in Google Scholar, PubMed, and eLIBRARY.RU. The following search terms in Russian and English were used: полость рта / oral cavity, бронхиальная астма / bronchial asthma, микробы/microbes, противомикробная терапия / antimicrobial therapy, бронходилататоры короткого и длительного действия / short- and long-acting bronchodilators, and модификаторы лейкотриенов / leukotriene modifiers. Eligible publications included clinical and laboratory studies and meta-analyses that assessed changes in the oral cavity during asthma treatment. The search yielded 118 publications; of these, 34 were included in the study conducted between January 2023 and December 2023.

RESULTS

The review identified oral diseases in asthma patients with the greatest significance in terms of microorganism involvement. These included xerostomia, disorder of hard tissues of teeth, periodontal diseases, and fungal infections. Eligible publications included 11 articles on the association between asthma and disorder of hard tissues of teeth, 9 articles on the association between asthma and periodontal diseases, 3 articles on the association between asthma and xerostomia, and 11 articles on the association between asthma and fungal infections of the oral mucosa (Table 1).

Samec and Jan [21] and Ersin et al. [22] described the development of dental caries in patients who received asthma drugs that act by decreasing salivary flow rate and modifying saliva pH. The duration and treatment of asthma significantly affect the risk of dental caries. Reddy et al. [23] and Chuang et al. [24] found a high prevalence of dental caries in patients with asthma, which increases with the severity of asthma.

Stensson et al. [25] reported that preschool children with asthma have a higher prevalence and severity of dental caries than children without asthma due to mouth breathing and increased consumption of sugary drinks. Another study by the same authors found that patients with asthma aged 18–24 years have a higher prevalence and severity of dental caries than healthy individuals [26]. Mehtonen et al. [27] and Alavaikko et al. [28] also reported a higher prevalence of dental caries in patients with asthma.

Shashikiran et al. [29] found a high severity of dental caries in patients with asthma who use salbutamol inhalers. Ryberg et al. [30] and Gani et al. [31] reported that a higher risk of dental caries in children with asthma who received beta-2-agonists was most frequently associated with decreased salivary flow rate, xerostomia, and increased *Lactobacilli* and *Streptococcus mutans* counts.

Any factor that reduces the quality and quantity of saliva can compromise oral homeostasis, where saliva plays a critical role [32]. According to studies, long-term use of beta-2-agonists can reduce salivary flow rates [30, 33]. Patients must be instructed to wash their mouths after using an inhaler. Dry mouth can be prevented by using artificial saliva, drinking more water, or using fluoride mouthwash on a daily basis.

Samec and Jan [21] and Kargul et al. [34] reported a significant decrease in saliva pH to 5.5 in patients with asthma 30 minutes after using beta-2-agonist inhalers, which is below the threshold for enamel demineralization. Kargul et al. [34] found that chewing sugar-free gum for at least one minute after using an inhaler improved dental plaque pH. Moreover, it is recommended to use sugar-free gum to promote saliva production and buffer oral acids. Reduced saliva production may impair the removal of fermentable substances from the oral cavity and decrease its buffering capacity.

Ryberg et al. [30] found that parotid saliva production decreased by 26% and 36%, respectively, in patients with asthma who received drug therapy compared to controls without asthma. In patients with asthma, parotid saliva showed decreased production of total protein, amylase, hexosamine, peroxidase, lysozyme, and IgA per minute [35, 36].

The high incidence of dental caries in patients with asthma can be also associated with fermentable carbohydrates in asthma drugs. Some powder inhalers contain lactose monohydrate to improve the drug's taste. Fathima et al. [37] found that frequent oral inhalations of sugar-containing drugs, along with reduced salivary flow rates, may increase the risk of dental caries. Reddy et al. [23] reported that patients receiving asthma syrups have the highest incidence of dental caries.

Frequent consumption of cariogenic drinks due to excessive thirst may increase the incidence of dental caries in patients with asthma. Increased consumption of these drinks may be associated with several factors, including attempts to drown out the taste of inhaled drug, mitigate the drying effect of mouth breathing,

Table 1. Publications included in the review

Oral diseases in patients with asthma	*n*	%
Association between asthma and disorder of hard tissues of teeth	11	32.3
Association between asthma and xerostomia	3	8.8
Association between asthma and periodontal diseases	9	26.5
Association between asthma and fungal infections	11	32.3

or reduce salivation caused by beta-2-agonist therapy [25]. Moreover, patients with asthma may overlook oral hygiene due to their condition [23]. Prevention measures such as more frequent dental check-ups, use of fluorides, and dental caries prophylaxis may reduce the risk of dental caries in patients with asthma. According to Gani et al. [31], fluoride supplementation is required in all patients with asthma, especially those receiving beta-2-agonists (Table 2 [38–45]).

The association between asthma and periodontal diseases was assessed in 9 articles (26.5%).

The association between asthma and periodontal diseases may include abnormal immune and inflammatory responses, side effects of asthma drugs, or a combination of these factors. According to Mehta et al. [38], asthma is associated with periodontal diseases. Ferreira et al. [39] reported a high prevalence of periodontal diseases in patients with asthma. Inhaled corticosteroids (ICS) can enter the circulation through the lungs or by swallowing, when the drug does not reach the lungs but is deposited in the posterior pharynx [46, 40]. According to studies, ICS may reduce bone mineral density [40–43, 47]. As early as in 1995, Hanania et al. [47] reported that regular use of standard ICS doses in patients with asthma may inhibit adrenal gland function and reduce bone mineral density in a dose-dependent manner. Systemic bone loss caused by these drugs, especially in long-term use at high doses, may promote periodontal disease progression [48]. Han et al. [49] and Choi et al. [50] reported tooth loss in patients with asthma due to long-term treatment with potent topical ICS, followed by a decrease in bone mineral density, especially in the mandible. Therefore, bone mineral density must be regularly assessed in patients who receive ICS, particularly in the presence of risk factors for osteoporosis. Minimum permissible doses of ICS must be used for asthma control [21, 31, 37, 40]. The association between bacterial and immunological factors is the main cause of periodontal tissue destruction. Saliva undoubtedly influences this association via its protective mechanisms. Many asthma drugs alter saliva secretion in a substantial proportion of patients, which impairs periodontal health.

The association between asthma and fungal infections was assessed in 11 articles (32.3%). Oropharyngeal candidiasis is typically associated with inhaled corticosteroids [51]. This may be due to the topical effect of these drugs on the oral mucosa, because only 10%–20% of the dose actually reach the lungs, while the majority of the drug remains in the oropharynx. The prevalence of oral candidiasis in ICS therapy may reach 77%, with variability attributable to differences in detection methods. This local side effect is especially common in patients who regularly receive high ICS doses [52]. The general immunosuppressive and anti-inflammatory effects of steroids are thought to play a critical role in candidiasis [53]. Fukushima et al. [44, 45] reported that ICS may decrease IgA levels in saliva, promoting oral candidiasis. Ellepola and Samaranayake [53] also reported that ICS and topical steroids may cause candidiasis. Moreover, many dry-powder inhalers contained 10–25 mg of lactose monohydrate per dose [54, 55]. Elevated glucose levels may also promote the growth, proliferation, and adhesion of *Candida* to oral mucosa cells [55, 56]. Several preventive measures can be taken to minimize the risk of candidiasis during ICS inhalations [53]. Selroos et al. [57] found that mouthwash reduced *Candida* colonization in the oral cavity of patients who used dry powder inhalers. Spacers may reduce the topical effect of steroids that cause oral candidiasis by minimizing drug deposition in the oropharynx and facilitating its passage into the lungs [58]. Salivary flow stimulation in patients with low salivary flow rates may also prevent oral candidiasis. Artificial saliva and sugar-free gum can help increase salivary flow rates. Other methods to reduce *Candida* colonization include antifungal mouthwashes, such as nystatin [59].

Table 2. Impact of asthma drugs on dental problems in patients with asthma

Problem	Manifestation	References
Inflammatory periodontal diseases	Gingivitis and periodontitis secondary to asthma	Mehta et al. [38] Ferreira et al. [39]
Osteoporosis	Reduced bone mineral density secondary to inhaled corticosteroid therapy	Irwin, Richardson [40] Mortimer et al. [41] Heffler et al. [42] Shen et al. [43]
Reduced IgA and IgE levels	Reduced IgA and IgE levels secondary to inhaled corticosteroid therapy may cause candidiasis	Fukushima et al. [44] Fukushima et al. [45]

DISCUSSION

There is disagreement among dental practitioners on the association between asthma and oral diseases, such as dental caries, periodontal diseases, and changes in oral mucosa. The association between asthma and oral diseases, including dental caries, and its primary cause (beta-2-agonist therapy) were studied and confirmed by Almeida et al. [32], Johansson and Ericson [33], Ryberg et al. [30], Shashikiran et al. [29], Stensson et al. [25], and Fathima et al. [37].

McDerra et al. [60] reported a higher prevalence of dental caries affecting permanent teeth in patients with asthma. Kenny and Somaya [61] found that long-term use of liquid oral sugar-containing formulations can increase the incidence of dental caries.

However, Reddy et al. [23], Kargul et al. [34], and Samec and Jan [21] reported that dental caries in patients with asthma is associated with a carbohydrate-rich diet and carbohydrates used as sweeteners in asthma drugs.

In contrast, some other studies found no positive correlation between asthma and dental caries. Bjerkeborn et al. [62] found that asthma or its severity have no effect on the prevalence of dental caries. Eloot et al. [63] also found no correlation between the severity of asthma, treatment duration, and prevalence of dental caries.

However, the association between asthma and periodontal diseases reported by Kenny and Somaya [61], Hyyppä et al. [64], Wactawski-Wende et al. [48], and Han et al. [49], was not disputed in subsequent studies.

For example, Hyyppä et al. found that gingivitis in patients with asthma may be associated with altered immune response. Patients with asthma have elevated IgE levels in periodontal tissues, which may cause their destruction [64].

Problems associated with candidiasis during ICS therapy, reported by Roland et al. [51], Kurt et al. [52], Ellepola and Samaranayake [53], Selroos et al. [57], and Salzman and Pyszczynski [58], were not disputed. Knight and Fletcher [65] found that patients who received corticosteroids had higher glucose levels in saliva than patients who did not.

CONCLUSION

Controversial data on the association between asthma and oral diseases, such as dental caries, associated with microbial activity in the oral cavity and reduced protective mechanisms due to asthma therapy with agents such as salbutamol, dipropionate, and budesonide, necessitate further research on the pathogenesis of dental caries in patients with asthma. The introduction of novel pathogen identification methods and asthma drugs highlights the importance of oral disease prevention in patients with asthma.

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