



An In Vivo Comparative Evaluation of Serum Fucose Levels in Oral Leukoplakia Patients and Oral Cancer Patients: An Original Research Study

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Abstract:

Aim: This study aims to evaluate serum fucose levels in patients with oral leukoplakia and oral cancer.

Materials and Methods: The study evaluated 60 patients with significant complaints related to ulcer pain and white patches in the oral cavity. All patients; both men and women those exhibited non-removable white or gray patches on sites like the tongue and buccal mucosa. Symptoms included rough texture, burning sensations, discomfort, swelling, and non-healing ulcers. Patients were divided into three groups of 30: Group 1 had oral leukoplakia, Group 2 had oral squamous cell carcinoma, and Group 3 was a control group with no lesions. Blood samples were collected after an overnight fast to measure serum fucose levels using a spectrophotometer with the cysteine-sulfuric acid method.

Results: Participants were divided into three groups: Group 1 had patients with oral leukoplakia, a precancerous condition characterized by white patches in the mouth; Group 2 included patients with OSCC, known for its aggressive nature; and Group 3 served as a control group of healthy individuals. Biochemical parameters, specifically serum fucose levels, were measured across the groups. Group 1 had an average fucose level of 14.95 ± 5.86 mg/dL; Group 2 had 10.08 ± 2.06 mg/dL; and Group 3's healthy individuals had 6.12 ± 4.16 mg/dL. The Pearson Chi-Square test was utilized to determine the significance of these findings, while one-way ANOVA in Table 5 provided a comprehensive comparison across all groups.

Conclusion: This study concluded that elevated serum fucose levels in individuals with oral squamous cell carcinoma (OSCC) and leukoplakia compared to normal controls. This indicates that serum fucose may be a reliable biomarker for disease progression.

Introduction

Oral leukoplakia is classified as a potentially malignant disorder characterised by firm white patches or plaques on the oral mucosa. These lesions can appear in various regions of the mouth, including the tongue, gums, and the inner surfaces of the cheeks. One of the hallmark characteristics of oral leukoplakia is that these white patches cannot be scraped off, distinguishing them from other oral conditions. The aetiology of oral

leucoplakia is closely linked to lifestyle factors, particularly the use of tobacco products, whether smoked, chewed, or inhaled.^{1,2} Additionally, excessive alcohol consumption is a significant contributor to the development and progression of this condition. Due to these associations, individuals who engage in these behaviours are at elevated risk of developing oral leukoplakia. Therefore, it is critically important for those presenting with this condition to receive a



comprehensive dental evaluation. This evaluation often includes a biopsy, which enables the assessment of the tissue for dysplastic changes abnormalities that can signify a progression toward malignancy.^{3,4} The management of oral leukoplakia can involve several therapeutic approaches. One common strategy is the removal of any irritating substances, such as tobacco or sharp teeth that may be contributing to the lesions. In some cases, surgical excision of the lesions may be warranted, particularly if there are concerns about dysplastic changes.^{5,6} Laser therapy has also emerged as a treatment option for some patients, offering a less invasive method for lesion removal. Due to the inherent risks associated with oral leukoplakia, close monitoring and regular follow-up appointments are essential to detect any signs of potential progression to oral cancer. In this context, oral squamous cell carcinoma (OSCC) is considered the most prevalent malignancy of the oral cavity, accounting for more than 90% of all cases of oral cancer diagnosed. The symptoms of OSCC can be diverse but typically include persistent, non-healing ulcers; the appearance of red or white patches; and the formation of lumps on the tongue or the floor of the mouth.^{7,8} The primary risk factors that contribute to the development of OSCC mirror those of oral leukoplakia, encompassing tobacco use, heavy alcohol consumption, exposure to betel quid, and infection with high-risk types of the human papillomavirus (HPV). Timely diagnosis of OSCC is critical, as late-stage detection can significantly heighten the risks of mortality and

morbidity associated with this malignancy. Serum fucose levels have emerged as an important biomarker in this context, as they can indicate various health conditions.^{9,10} In healthy individuals, normal serum fucose levels are typically around 7.22 ± 0.26 mg/dl, with a reference range spanning from 2.7 to 8.9 mg/dl. In contrast, elevated serum fucose levels are frequently documented in patients with malignancies, particularly oral cancer, and can serve as a valuable diagnostic indicator of tumour progression. Research has shown that serum fucose levels are significantly higher in individuals diagnosed with oral leukoplakia and those with oral squamous cell carcinoma when compared to healthy control groups. This correlation underscores their potential role as reliable biomarkers for diagnosis. Moreover, it has been observed that serum fucose levels tend to increase progressively from precancerous conditions, like oral leukoplakia, to established cases of OSCC, establishing a clear link between elevated fucose levels, malignant transformation, and the advancement of cancer.^{11,12} This study aims to evaluate serum fucose levels in patients with oral leukoplakia and oral cancer.

Materials and Methods

The study encompassed a comprehensive evaluation of 60 patients who presented with significant clinical complaints related to ulcer pain and the presence of white patches in the oral cavity. This study was conducted in the department of oral medicine and radiology of the institute.



Initially, a thorough clinical examination led to the inclusion of 90 patients, comprising both men and women, all of whom exhibited white or gray patches located on various oral sites, including the tongue, floor of the mouth, and buccal mucosa. Crucially, these patches were notable for their non-removable nature upon examination. The participants reported a range of symptoms that included a rough texture in the oral cavity, a burning sensation, general discomfort, and in certain cases, non-healing ulcers. Some patients also experienced swelling and persistent patches that had lasted over two weeks. In more advanced stages of their conditions, patients exhibited additional signs such as pain, bleeding from oral tissues, loose teeth, and swollen neck masses. To qualify for inclusion in the study, patients had to meet several specific criteria: they needed to have clinically and histopathologically confirmed leukoplakia, a documented history of tobacco or alcohol use, lesions located in high-risk oral sites, and, for some, confirmed incidences of primary oral squamous cell carcinoma. Additionally, the lesions had to be situated at designated anatomical sites, and patients were required to provide informed consent to participate. Conversely, exclusion criteria were strictly adhered to, ruling out individuals with white lesions attributable to other medical conditions, those who were pregnant or lactating, patients with uncontrolled systemic illnesses, individuals with secondary oral cancers, those with a previous history of cancer, and participants lacking complete biopsy

reports. In this study, the patient cohort was meticulously organized into three well-defined groups, each comprising 30 individuals, to facilitate a comprehensive analysis. Group 1 consisted of patients who had been diagnosed with oral leukoplakia, a condition characterized by white patches in the mouth that may indicate a precancerous state. Group 2 included patients diagnosed with oral squamous cell carcinoma, a type of cancer that arises in the tissues of the mouth and throat. Finally, Group 3 served as a control group, comprising healthy individuals devoid of any oral lesions, thereby providing a baseline for comparison. To assess the participants' serum fucose levels, blood samples were meticulously collected via venous draw after the patients had undergone an overnight fast. This fasting period was crucial to ensure the accuracy and reliability of the biochemical analysis. The laboratory process involved utilizing a spectrophotometer, an advanced instrument designed to measure the specific absorption of light, employing the cysteine-sulfuric acid method, which is recognized as a standard technique for quantifying serum fucose levels. In order to determine any statistically significant differences in serum fucose levels across the three groups, a robust statistical analysis was performed using ANOVA (One-Way Analysis of Variance), followed by appropriate post-hoc tests to delve deeper into the data. The primary aim of this study was to clarify the variation in serum fucose levels among patients diagnosed with oral leukoplakia and oral cancer. By doing so, the research was to



contribute valuable insights into the biochemical markers associated with these oral pathologies, enhancing the understanding of their roles in disease progression and diagnosis.

Statistical Analysis

In this study, all statistical analyses were carried out using the SPSS 31.0 version software, a powerful tool designed for statistical computing and data analysis in the social sciences. This approach enabled a thorough and precise comparison of categorical data, ensuring that our results effectively highlight the underlying trends and relationships present in the dataset.

Results

This study comprises a total of 60 affected patients, encompassing both male and female participants aged between 20 and 45 years. Each participant has been clinically diagnosed with either oral leukoplakia or oral squamous cell carcinoma (OSCC), conditions that have significant implications for oral health. A comprehensive statistical description, as presented in Table 1, outlines the age and gender demographics of the individuals involved in the study, shedding light on the distribution of these conditions across different segments of the population. Graph 1 visually represents the demographic distribution, illustrating that the cohort consists of 33 male and 27 female participants, which provides insight into any potential gender-related trends in these oral diseases. For the purpose of conducting a thorough analysis, the patient

cohort was systematically divided into three distinct groups, each comprising 30 individuals. Group 1 consisted of patients diagnosed with oral leukoplakia. This condition is characterized by the appearance of white patches on the mucous membranes of the mouth, and it is often considered a precancerous lesion, warranting careful monitoring and management due to its potential for malignant transformation. Group 2 included patients suffering from oral squamous cell carcinoma, which is a type of malignant neoplasm arising from the epithelial tissues of the oral cavity and throat. This group is particularly significant as OSCC is known for its aggressive behaviour and poor prognostic outcomes if not diagnosed and treated promptly. Group 3 served as a control group, consisting of healthy individuals without any oral lesions. This group was included to provide a baseline for comparative analysis, allowing for a clearer understanding of the disease's impact on specific serum markers. In examining the biochemical parameters of interest, Table 2 presents findings for Group 1, wherein the serum fucose levels of patients diagnosed with oral squamous cell carcinoma were measured. This analysis aimed to explore the correlation between serum fucose levels and the malignancy of the condition. The results yielded an average serum fucose level of 14.95 ± 5.86 mg/dL. To establish the statistical significance of these measurements, the researchers employed the Pearson Chi-Square test, a robust statistical method designed to assess



associations between categorical variables, thereby enhancing the reliability of the findings. Moving to Table 3, the focus shifts to Group 2, comprised of patients diagnosed with oral leukoplakia. Similar to the previous analysis, serum fucose levels were meticulously measured in this group to investigate their potential relationship to the presence of leukoplakic lesions. The average serum fucose level recorded for these patients was 10.08 ± 2.06 mg/dL, with the Pearson Chi-Square test once again utilized to evaluate the significance of the observed results. Table 4 presents the investigation of Group 3, the control group, wherein serum fucose levels were measured to acquire additional insights into the normal physiological range of fucose levels among individuals without any disease. The average serum fucose level for healthy individuals was determined to be 6.12 ± 4.16 mg/dL. The Pearson Chi-Square test was also employed for this group, ensuring a consistent approach to statistical analysis across all participant categories. Finally, Table 5 compiles a comprehensive overview of the data from all studied groups and utilizes one-way ANOVA to facilitate comparisons and thorough statistical analysis among the various patient groups. This structured approach aids in elucidating the potential relationships between serum fucose levels and the presence of different oral lesions. The outcomes of this research are critical for enhancing our understanding of the implications for diagnosis and treatment strategies, thereby improving patient care in the context of oral health.

Table 1: Age & gender based statistical description of contributing patients

Age Group (Yrs)	Male	Female	Total	P value
20-25	11	9	20	0.05
26-30	10	10	20	0.70
31-35	9	8	17	0.02*
36-40	8	7	15	0.80
41-45	10	8	18	0.90
Total	48	42	90	*Significant

*p<0.05 significant

Graph 1: Patients demographic distribution and associated details

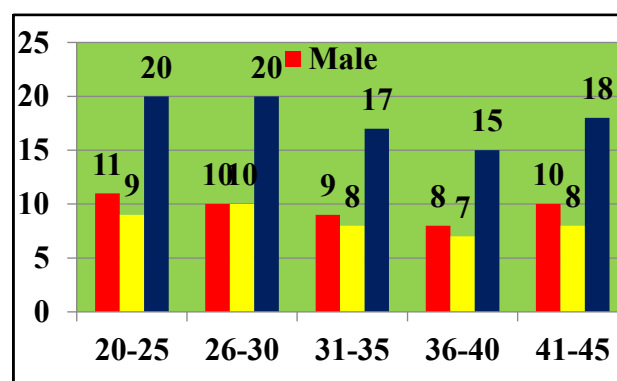


Table 2: Group 1 (N= 30) Patients diagnosed with oral squamous cell carcinoma, the levels of serum fucose were measured to better understand their relationship with the disease. To evaluate the significance of the results obtained from these measurements, the researchers employed the Pearson Chi-Square test, a



statistical method used to determine associations between categorical variables

Confirmed Diagnosed condition	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Oral squamous cell carcinoma	14.95±5.86 mg/dl	1.4	1.08	1.08	1.09	1.03	1.07
*p<0.05 significant							

Table 3: Group 2 (N= 30) Patients diagnosed with oral leukoplakia, the levels of serum fucose were measured to better understand their relationship with the disease. To evaluate the significance of the results obtained from these measurements, the researchers employed the Pearson Chi-Square test, a statistical method used to determine associations between categorical variables

Confirmed Diagnosed	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Healthy individual	6.12±4.16mg/dl	1.4	1.03	1.03	1.02	1.02	1.01*

Confirmed condition	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Oral leukoplakia	10.08±2.06mg/dl	1.09	1.05	1.07	1.06	1.05	1.04
*p<0.05 significant							

Table 4: Group 3 (N= 30) consists of healthy individual; the levels of serum fucose were measured to better understand their relationship with the disease. To evaluate the significance of the results obtained from these measurements, the researchers employed the Pearson Chi-Square test, a statistical method used to determine associations between categorical variables

Confirmed Diagnosed condition	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Healthy individual	6.12±4.16mg/dl	1.4	1.03	1.03	1.02	1.02	1.01*



*p<0.05 significant

Table 5: Estimation amongst all studied groups using one-way ANOVA

Variab les	Degre e of Freed om	Sum of Squa res Σ	Mea n Sum of Squa res m Σ	F	Lev el of Sig. (p)
Between Groups	8	2.45 3	3.82 5	1. 5	0.0 3*
Within Groups	26	3.48 2	2.62 8	–	
Cumula tive	261.3 6	4.78 1	*p<0.05 significant		

Discussion

Li Y et al reviewed in their study that Oral leukoplakia is characterised by painless white or gray patches that appear on the mucous membranes of the oral cavity, such as the gums, tongue, or inside the cheeks. Though generally benign, it is classified as a potentially malignant disorder, which means there is an increased risk of it progressing to oral cancer. The patches are typically thick, rough, or wrinkled and cannot be scraped off. Sometimes, they may present with red spots, indicating a higher risk of malignancy. The primary causes of leukoplakia include tobacco use, chronic irritation from dental issues, heavy alcohol consumption, and potential links to

HPV or nutritional deficiencies.^{13,14} Aguirre-Urizar JM et al showed in their study that diagnosis is usually confirmed through a tissue biopsy. Management involves eliminating irritants, such as tobacco and alcohol, and surgical removal may be necessary if moderate-to-severe dysplasia is detected. Regular follow-up appointments are crucial, as leukoplakia can recur. While most cases are non-cancerous, there is a malignant transformation rate of 0.6% to 20%, making early detection key to a favorable prognosis.^{15,16} Zhou J et al included in their study that oral squamous cell carcinoma (OSCC) arises from squamous epithelial cells, often due to genetic alterations like TP53 mutations. Symptoms include persistent mouth pain, non-healing ulcers, and difficulties with chewing and swallowing. Diagnosis primarily involves tissue biopsy, and advanced imaging techniques can determine the extent of the disease.^{17,18} Sur S et al reviewed in their study that treatment typically includes surgical resection, radiotherapy, and chemotherapy, with emerging therapies such as targeted treatments and immunotherapy also being explored. Risk factors for OSCC mirror those for leukoplakia, prominently featuring tobacco and alcohol use, along with betel quid and areca nut consumption. High-risk HPV is also a concern, especially in oropharyngeal cases. The tongue, floor of the mouth, and buccal mucosa are common sites for OSCC development.^{19,20} Mishra VK et al showed in their study that recent research has highlighted serum fucose levels as a promising biomarker for oral cancer and



its precursors. In individuals diagnosed with oral squamous cell carcinoma (OSCC) and other related oral conditions, elevated serum fucose levels have been consistently observed, providing a vital early warning sign of potential malignancies. Notably, this increase in fucose levels typically occurs independently of demographic factors such as age or gender and tends to rise as diseases like oral submucous fibrosis advance.²¹ Rai NP et al showed in their study that investigations have demonstrated a progressive increase in serum fucose concentrations, starting from healthy tissue, through stages like leukoplakia, and culminating in cancerous growths. This pattern underlines the importance of serum fucose as a reliable biomarker for the early detection and ongoing monitoring of OSCC. It not only reflects the metabolic alterations occurring within tumour cells but also offers insights into the disease's prognosis. Elevated serum fucose levels have emerged as an important biomarker in the assessment of patients with leukoplakia, particularly in distinguishing those who may have a higher risk of malignant transformation.²² Kumar S et al included in their study that this is particularly significant in individuals who partake in habits or lifestyle choices that are associated with an increased likelihood of developing oral cancers, such as tobacco use, alcohol consumption, or poor oral hygiene. The correlation between these elevated fucose levels and the potential for carcinogenic changes underscores the importance of implementing serum fucose testing in

clinical settings. Such testing can aid healthcare providers in effectively identifying and monitoring high-risk patients, ultimately guiding more proactive management strategies to mitigate the risk of progression to malignancy. This proactive approach highlights not only the utility of serum fucose as a diagnostic tool but also its potential to impact patient outcomes through early intervention.²³

Conclusion

The authors conducted a study exploring serum fucose levels in patients diagnosed with oral leukoplakia and oral cancer. Their findings concluded that serum fucose levels were significantly elevated in individuals with oral squamous cell carcinoma (OSCC) and leukoplakia when compared to normal controls. This suggests that measuring serum fucose can serve as a reliable biomarker for evaluating disease progression in these conditions. The authors emphasize that further research is necessary to expand on these findings and enhance our understanding of the relationship between serum fucose levels and oral cancers.

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