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Comparison of Oral Opportunistic Pathogens between Short-Term and Long-Term Stay Patients in Hospital, Dhaka Bangladesh

Mohammad Sayeem Rahman Bhuiyan[1], Md. Saiful azam[2], Md. Mostafizur Rahaman[3], KM Rafiqul Islam[4], Md. Mozammel Haque[5], Anjumun Ara[6], Sheikh Forhad[7]

[1]Medical Officer, Department of Oral and Maxillofacial Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[2]Medical Officer, Department of Oral and Maxillofacial Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[3]Consultant, Department of Periodontology & Oral Pathology, Dhaka Dental College, Dhaka, Bangladesh

[4]Medical Officer, Department of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[5]Medical Officer, Department of Oral and Maxillofacial Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh

[6]Medical Officer, Department of Obs and Gynae, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[7]Medical Officer, Department of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Corresponding Author: Mohammad Sayeem Rahman Bhuiyan, Medical Officer, Department of Oral and Maxillofacial Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, Email: rahmansayeem@yahoo.com

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ABSTRACT

Background: Hospitalized elderly patients often harbour opportunistic microbes in the oral cavity due to imbalances in resident flora, leading to pathogenic colonization. Factors such as dry mouth from cancer treatment, antibiotic use, malnutrition, and prolonged hospitalization increase this risk. Oral commensal bacteria and salivary IgA protect against pathogens, but antibiotic-resistant bacteria can emerge after treatment. Nutritional status, assessed by the Geriatric Nutritional Risk Index (GNRI), may influence oral pathogen colonization.

Aim of the study: The study compares oral opportunistic pathogens between short-term and long-term hospitalized patients.

Methods: This comparative observational study was conducted at the Oral and Maxillofacial Surgery Department of BSMMU, Dhaka, over 1 year and 6 months. A total of 70 patients aged over 30 years were divided into two groups: 35 long-term hospitalized patients (more than 25 days) and 35 short-term hospitalized patients (less than 25 days). Pre- and post-operative BMI, serum albumin levels, and GNRI scores were assessed. Oral opportunistic pathogens were collected postoperatively and analyzed via culture. Data collection involved face-to-face

interviews, clinical exams, and predesigned forms. Data were analyzed using SPSS v22, applying Chi-square and t-tests, with $p<0.05$ considered significant.

Results: This study compared two patient groups (A and B) across several variables. Group A had older patients (mean age 59.11 years) compared to Group B (50.89 years) with a significant difference ($p<0.05$). Both groups had more male patients, but gender distribution was not significantly different ($p=0.79$). Group A had lower BMI (18.69±2.34 kg/m²) and albumin levels (35.31±5.37 g/dl) compared to Group B, both statistically significant ($p<0.05$). Oral opportunistic pathogens, particularly *Pseudomonas aeruginosa* (42.86%) and *Candida albicans* (17.14%), were significantly more common in Group A ($p=0.001$). Group A also had higher NG tube feeding rates ($p<0.05$), with no significant differences in denture use or remaining teeth.

Conclusion: Long-term hospital stays (60% of patients) were linked to oral opportunistic pathogen colonization, influenced by low serum albumin, GNRI scores, and BMI. Short-term patients showed no colonization. Denture use and remaining teeth count were unaffected. Serum albumin levels were assessed postoperatively to evaluate these associations.

Keywords: Oral Opportunistic Pathogens, Oral Microbiota Comparison**,** Short and Long-Term Hospital Stay.

INTRODUCTION

The oral cavity of the hospitalized elderly patient is often a reservoir for opportunistic microbes. Oral commensal flora and the host interact in a balanced fashion, and oral infections are considered to appear following an imbalance in the oral resident microbiota, leading to the emergence of pathogenic flora. The colonization process by opportunistic pathogens needs to be elucidated, and the factors responsible for the transition of the microbiota from commensal to pathogenic flora must be identified. Oral flora play an important role in suppressing the growth and colonization of pathogens from the external environment. Several studies prove that commensal bacteria suppress pathogenic bacteria [1,2]. Salivary IgA plays a crucial role in mucosal immune function, and it is the first line of defence for the human body against pathogenic microbial invasion [3]. After cancer surgery, radiotherapy and chemotherapy are given, which causes dry mouth; some authors confirm that oral colonization by potentially pathogenic Gram-negative bacteria and staphylococcus aureus was observed in patients with dry mouth [4,5]. Hospitalized elderly patients often receive multiple antibiotic doses, increasing the risk of microbial community changes [6]. The appearance of antibiotic-resistant bacteria represents a serious superinfection problem in clinical medicine [7,8]. Some reports have also shown the isolation of antibiotic-resistant bacteria from dental plaque after antibiotic administration [9-11]. After a major surgery, patients who are malnourished and stay long in the hospital have a higher risk of opportunistic infections in the oral cavity. The Geriatric Nutritional Risk Index (GNRI) has been introduced to provide more precise nutritional information about elderly patients [12]. This study will help to diagnose the cause of oral opportunistic pathogen colonization in long-term hospitalized patients. In this study, to confirm the role of the GNRI score as a marker of oral opportunistic infection, we will investigate the association between oral opportunistic pathogens (OOP) and nutritional factors. Other factors, such as the method of nutrition, the number of remaining teeth and the presence and absence of dentures/obturators, were examined. Oral hygiene was also examined. Some authors described that periodontal infection may worsen systemic diseases, for example, respiratory diseases such as pneumonia and chronic obstructive pulmonary disease, which may be caused by the aspiration of bacteria from the oropharynx into the lower respiratory tract [13,14]. The study compares oral opportunistic pathogens between short-term and long-term hospitalized patients.

METHODOLOGY & MATERIALS

The comparative observational study included a total of 70 subjects who were admitted to the Oral and Maxillofacial Surgery Department at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Out of 70 patients, 35 were selected who were admitted to the hospital for a long term (more than 25 days), and another 35 patients were admitted for a short term (less than 25 days). The study duration was 1 year and 6 months from March 2016 to September 2017. All the patients were divided into two groups; there were 35 patients in each group.

Group A (long-term-staying patients): 35 patients admitted for more than 25 days but not more than 3 months.

Group B (short-term staying patients): 35 patients admitted for less than 25 days.

Inclusion Criteria:

- Long-term hospitalized patients (patients admitted for more than 25 days).
- Short-term hospitalized patients (patients admitted for more than 25 days).
- Age group: Above 30 years.

Exclusion criteria:

- Systemic diseased patient (DM, Chronic kidney disease).
- Patients with space infection

Pre-operative BMI calculation was done. The oral opportunistic pathogens were collected by scraping the dorsum of the tongue with a sterile cotton swab postoperatively. After swab collection, samples were immediately sent to the Biomedical Laboratory (Department of Microbiology and Immunology of BSMMU) to analyze opportunistic pathogens. The isolated bacteria and fungi were identified using culture procedures. The samples were poured into chocolate agar, blood agar, and other culture media and incubated in an atmosphere of 5% CO2 at 370 C for 48 hours. Representative colonies identified opportunistic pathogens. Post-operative BMI calculation and serum albumin estimation were done. In each patient, the GNRI score, the nutrition intake method, the number of remaining teeth and the presence or absence of dentures were examined.

Data Collection: Written informed consent was obtained for participation after explaining the purpose and design of the study to each subject. The prior patient was informed that refusal to participate in the study would not lead to any detrimental consequences or affect treatment. If necessary, a detailed medical history, clinical examination, and radiological examination were performed. Findings were collected and recorded in a predesigned data collection sheet. Data was collected during a face-to-face interview. Ethical clearance for this study was taken from the Institutional Review Board (IRB), BSMMU.

Data analysis: The data were screened and checked for any missing values and discrepancies. Computer-based statistical analysis was carried out using appropriate techniques and systems. Data were processed and analyzed using SPSS version 22.0 for Windows. Both qualitative and quantitative variables were checked. For comparison between groups, the Chi-square (X2) tests were performed for qualitative variables and student ‘t’ was performed for quantitative variables. The significance level set all 0.05 and $p<0.05$ is considered significant. The summarized data were interpreted accordingly and presented in tables, graphs, and bar diagrams. The two groups were compared using the data the pathologist/microbiologist made available. The relationship of the study is shown in graph format on the following pages as a study dummy.

RESULTS

In this study, Table 1 shows the majority of 14(40.00%) patients aged 51-60 years in group A and 7(20.00%) in group B. The mean age was 59.11±8.86 years, ranging from 35 to 80 years in group A and 50.89±6.62 years from 40 to 65 years in group B. The difference between the two groups was statistically significant ($p<0.05$). Figure 1 shows the gender distribution of the study population, revealed a slightly higher proportion of male patients in both groups. In Group A, 60% were male, and 40% were female; in Group B, 66% were male, and 34% were female. The comparison between the two groups showed no statistically significant difference in gender distribution ($P = 0.79$). More than half of 18(51.43%) patients belonged to ≤18.5 (underweight) in group A and 7(20.00%) in group B. The mean BMI was found to be 18.69±2.34 kg/m2, with a range from 16.66 to 26.2 kg/m2 in group A and 20.85±2.75 kg/with a range from 16.34 to 25.83 kg/m2 in-group B. The difference was statistically significant ($p<0.05$) between the two groups (Table 2). According to Table 3, the Serum concentration of albumin in 15 patients (42.86%) of group A was below normal (≤35) with mend±SD of 35.31±5.37 g/dl, but the serum concentration of albumin in all 35 patients of group B was within normal limit with mend±SD of 40.09±3.33g/dl which is statistically significant (p-value 0.001). The mean GNRI was 86.54(SD±9.41), ranging from 72.08 to 115.6 in group A and 97.91±7.08, ranging from 86.12 to 111.9 in group B. The difference was statistically significant ($p<0.05$) between the two groups (Table 4). Regarding Table 5, the OPPs were found in 60% of cases in group A, and no Oral Opportunistic Pathogens were found in group B. The difference was statistically significant (p-value 0.001) between the two groups. In group A, Pseudomonas aeruginosa was found in 15 patients (42.86%), and Candida albicans was found in 6 patients (17.14%). Table 6 shows the method of nutrition used by the study patients. Most 31(88.57%) patients had NG tube-fed in group A and 17(48.57%) in group B. The difference between the two groups was statistically significant ($p<0.05$). Table 7 shows the denture use of the study patients. Four (11.43%) patients used dentures/obturators in group A and five (14.29%) in group B. The difference between the two groups was not statistically significant ($p>0.05$). Table 8 shows the denture use of the study patients. The number of remaining teeth was>10 in 25(71.43%) patients in group A and 27(77.14%) in group B. The difference between the two groups was not statistically significant ($p>0.05$).

Table 1: Distribution of the study patients by age (N=70)

Age (in years)	Group-A (n=35)		Group-B (n=35)		P value
	n	%	n	%	
31-40	1	2.86	3	8.57	<0.05
41-50	6	17.14	21	60.00	
51-60	14	40.00	7	20.00	
61-70	12	34.29	4	11.43	
71-80	2	5.71	0	0.00	
Mean±SD	59.11±8.86		50.89±6.62		

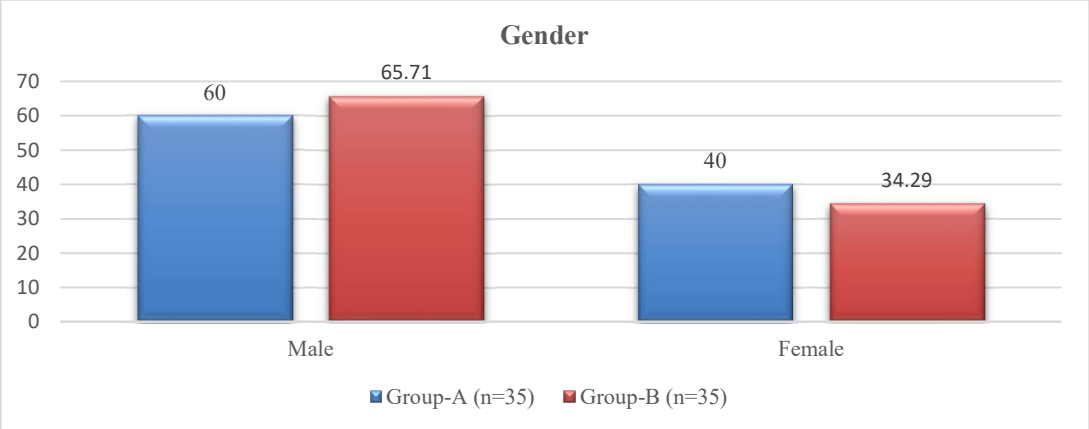

Figure 1: Gender distribution of the study groups (N=70)

Table 2: Distribution of the study patients by BMI (N=70)

BMI (kg/m^2)	Group-A (n=35)		Group-B (n=35)		P value
	n	%	n	%	
Underweight (≤18.5)	18	51.43	7	20.00	0.001^S
Normal (19-25)	15	42.86	17	48.57	
Over weight (>25)	2	5.71	11	31.43	
Mean±SD	18.69±2.34		20.85±2.75		
Range (min-max)	16.66-26.2		16.34-25.83		

s=significant

Table 3: Distribution of the study patients by S. Albumin (N=70)

S. Albumin (g/dl)	Group-A (N=35)		Group-B (N=35)		P value
	n	%	n	%	
≤35	15	42.86	0	0.00	0.001^s
35-55	20	57.14	35	100.00	
Mean±SD	35.31±5.37		40.09±3.33		
Range (min-max)	26-46		35-46		

s=significant

Table 4: Distribution of the study patients by GNRI (N=70)

GNRI	Group-A (N=35)		Group-B (N=35)		P value
	n	%	n	%	
≥82	13	37.14	0	0.00	0.001^s
<82	22	62.86	35	100.00	
Mean±SD	86.54±9.41		97.91±7.08		
Range (min-max)	72.08-115.6		86.12-111.9		

s=significant

Table 5: Distribution of the study patients by Oral opportunistic pathogens (N=70)

Oral Opportunistic pathogens (OPPs)	Group-A (N=35)		Group-B (N=35)		P value
	n	%	n	%	
Pseudomonas	15	42.86	0	0.00	0.001^s
Candida albicans	6	17.14	0	0.00	
No OOPs	14	40.00	35	100.00	

s=significant

Table 6: Distribution of the study patients by method of nutrition (N=70)

Method of Nutrition	Group-A (N=35)		Group-B (N=35)		P value
	n	%	n	%	
NG tube fed	31	88.57	17	48.57	0.001
Oral fed	4	11.43	18	51.43	

s=significant

Table 7: Distribution of the study patients by denture/obturator use (N=70)

Denture use	Group-A (N=35)		Group-B (N=35)		P value
	n	%	n	%	
Yes	4	11.43	5	14.29	0.500^{ns}
No	31	88.57	30	85.71	

ns=non-significant

Table 8: Distribution of the study patients by number remaining teeth after surgery (N=70)

No. of remaining teeth	Group-A (N=35)		Group-B (N=35)		P value
	n	%	n	%	
0-10	10	28.57	8	22.86	0.584^{ns}
>10	25	71.43	27	77.14	

ns=non-significant

DISCUSSION

The study aimed to determine the relationship between oral opportunistic pathogens' colonization and short- and long-term hospitalized patients. This study was carried out in the Oral and Maxillofacial Surgery Department of BSMMU. 35 long-term and 35 short-term patients were selected according to inclusion and exclusion criteria. In this study, most of the oral opportunistic pathogens were identified in middle-aged patients (40%) than elderly patients (34.29%) of long-term stay patients (Group A0. In group B, 21(60%) OOPs were found in between 41-50 years of age group and 7(20%) OOPs were found in between 61-70 years age group but no opportunistic pathogens were identified in short-term stay patients, may be due to their strong immunity. The difference was statistically significant between the two groups. In the previous studies, the frequency of oral opportunistic infection in ages varied from 10-80% and differed based on factors such as population and the pathogens included in the observation [15-18]. Pseudomonas aerigunosa and MRSA were the most commonly detected bacteria in older patients and were seen in 20-40% of Pseudomonas aeroginosa and 15-35% of MRSA [19]. Generally, opportunistic infections are higher in institutionalized elderly patients [20-21]. A study by Horie et al. showed that oral opportunistic pathogens were found in 64.2% of hospitalized hospitalized elderly patients [22]. Our study found that in Group A, 60% were male, and 40% were female; in Group B, 66% were male, and 34% were female. The comparison between the two groups showed no statistically significant difference in gender distribution (P = 0.79). Previous studies have shown no sex predilection in colonizing oral opportunistic pathogens. This study found that low BMI is associated with more opportunistic pathogen colonization in long-term stay patients [22]. OOPs were found in 18(51.43%) patients with BMI <18.5 kg/m^2 and 15(42.86%) patients with normal BMI of long-term staying patients, but OOPs were not found in short-term staying patients, which is statistically significant between the two groups. Previously, Patients with low BMI showed higher rates of opportunistic infections [23]. This study found a significant relationship between low serum albumin levels and colonization of oral opportunistic pathogens in long-

term hospitalized patients. In this study, OOPs were found in 15(42.86%) patients with serum album levels ≤35 gm/l and in 20(57.14%) patients with serum albumin levels 35-46 gm/l, but no OOPs were found in short-term staying patients whose serum albumin levels were 35-46 gm/l, and the difference is statistically significant between two groups. Several studies showed that low serum albumin level is associated with increased rates of opportunistic infection in elderly patients [12,24]. A study showed that a significant link between MRSA colonization and malnutrition and MRSA was isolated from 18.2% of elderly patients who have low levels of serum albumin concentration [25]. Another study showed that compromised immune functions, i.e. T cell, B cell subsets and functions, and innate immunity, strongly correlate with the protein nutritional status in elderly patients with protein malnutrition, and there is an increased rate of opportunistic infection [26]. This study observed low GNRI scores, which were significantly associated with colonizing oral opportunistic pathogens in hospitalized patients. OOPs were found in 22(62.86%) patients with GNRI <82, 13(37.14%) patients with GNRI ≥82 in group A. All patients of group B had GNRI of <82, which is statistically significant between the two groups. GNRI is an established indicator of morbidity and mortality in long-term hospitalized hospitalized patients [12]. A study conducted by Horie et al. showed a low GNRI score with OOPs positivity; in his study, OOPs were found in 15 out of 16 patients with GNRI<82 and 19 out of 37 patients with GNRI>82 [24]. In this study, 15(42.86%) were Pseudomonas perigones, 6(17.14%) were Candida albicans, and 40% of patients had no OOPs in long-term group. But OOPs were not found in short-term staying patients, which is statistically significant between the two groups [Table 5]. A study was conducted in Heiseinomori Kawashima Hospital, a long-term nursing hospital in Japan, among 53 patients ages 39-99 years. Oral opportunistic pathogens were found in 64.2% of the patients, and Pseudomonas aeruginosa was the most commonly detected (43.4%) [24]. Among 53 patients, Oral opportunistic pathogens were found in 34 patients, which included 24 cases of Pseudomonas aeruginosa, 6 of Serratia mercescens, 6 of MRSA, 5 of Candida albicans, 4 of Klebsiella pneumonia [24]. In this study, it was observed that 31(88.57%) of patients were NG tube fed, and only four were orally fed long-term staying patients. Pseudomonas aeruginosa and Candida albicans were found in long-term stay patients, and all 21 OOP-positive patients were NG tube-fed. However, OOPs were not found in short-term stay patients, which is statistically significant between the two groups. A study in Japan consisted of 53 elderly patients, of which 35 were women and 20 were men, and ages ranged from 60-90 years, and they were admitted for more than 2 months [24]. The sample was collected from dental plaque, and culture was done in culture media. Pseudomonas aeruginosa was found in 8 out of 15 tube-fed patients (53.3%); on the other hand, Pseudomonas aeruginosa was found in only 3 out of 40 orally fed patients (7.5%). The detection rate of Pseudomonas aeruginosa was 20 times higher in tube-fed patients than in orally fed patients [25]. However, in this study, no significant differences were found in the denture/obturator wearer between the two groups; 4(11.43%) obturator wearers were in long-term staying patients and five obturator wearers in short-term staying patients, but no OOPs were identified in obturator wearers in two groups, may be due to their increased awareness of oral hygiene. According to some studies, denture wearers had a higher rate of opportunistic infection than non-denture wearers, and dentures are a reservoir of opportunistic pathogens [27-30]. In this study, no significant relationship was found between the colonization of oral opportunistic pathogens and the number of remaining teeth between the two groups. Some studies showed that more remaining teeth cause more plaque accumulation and a higher risk of opportunistic infection [30,31].

Limitations of the study: The study was conducted in a limited area and the same population group. The study findings may not be significant for the entire population of Bangladesh. The time frame is very short, so obtaining the necessary data from the study population and outcome

is difficult. Further research is needed to include the vast majority of the population and enough time for follow-up to achieve the goal of the object. The culture of microorganisms by the FAN method and anaerobic microorganisms is not easily available, cost-effective, and time-consuming; such a culture for all microorganisms was impossible.

CONCLUSION AND RECOMMENDATIONS

OOPs were found in 21 patients (60%) of long-term-staying patients, and OOPs were not found in short-term-staying patients in the hospital. It was observed that long-term hospital stay is closely related to colonization of oral opportunistic pathogens and low serum albumin-influenced oral opportunistic pathogen colonization. Long-term hospital stays, low GNRI scores, and low BMI also influenced the colonization of oral opportunistic pathogens. However, they did not affect denture wearing and the number of remaining teeth. In this study, serum albumin was estimated postoperatively. Further study is needed to determine the relationship between the colonization of opportunistic pathogens and the preoperative and postoperative albumin levels.

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