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Original Research Paper

Correlation of poor oral hygiene and Ascitic fluid infection in patients with decompensated cirrhosis

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ABSTRACT:

Background and Aims: Ascitic fluid infection [AFI] is one of the important complications of cirrhosis which has a poor prognosis. Bacterial translocation from gastrointestinal tract (GIT) is considered to be the most important mechanism that leads to development of AFI. Cirrhotic patients have bacterial overgrowth in the GIT and oral bacteria could be a source of infection. This study was conducted to assess correlation between AFI in patients with decompensated cirrhosis having poor oral hygiene. **Methods:** A diagnostic paracentesis was performed under strict aseptic precautions. Ascitic fluid analysis was done within one hour of collection. Ascitic fluid was sent for microscopy, biochemistry and for culture sensitivity. Oral hygiene was examined for all patients by using the mouth mirror and shepherds hook to look calculate the simplified oral hygiene index (OHI-S) **Results:** Two hundred patients of decompensated cirrhosis were enrolled in the study with mean age of 50.9 $\pm$ 9.85 years. There were 78 % males with a mean body mass index (BMI) of 18.9 $\pm$ 1.9 kg/m^2. Alcohol was the major cause of cirrhosis (57%). Mean MELD and CTP scores were 18.6 $\pm$7.43 and 10.2 $\pm$ 1.28 respectively. Mean OHI- S was 1.8$\pm$1.07. Poor oral hygiene was found in 61.54% patients with AFI compared to 17.57 % in patients without AFI ($p<0.001$). S – OHI so predicted presence of AFI with AUROC of 0.82**. Conclusion:** We suggest screening for oral hygiene in all patients of decompensated cirrhosis as it may be a harbinger of ascitic fluid infection

Key words: Decompensated Cirrhosis; Oral hygiene; Debris index; Calculus index; Simplified oral hygiene index

INTRODUCTION:

Infections are one of the significant causes of mortality in pateints with cirrhosis. It is a known fact that cirrhotic patients are immunocompromised and they are very much susceptibile for development spontaneous bacterial infections, hospital-acquired infections, and other various of infections due to uncommon pathogens.[1,2] Dental infections, have also been implicated in the pathophysiology of several systemic diseases including cardiovascular diseases,

respiratory diseases, diabetes, chronic kidney disease both in cirrhotic and non cirrhotic patients .[3,4] It is found that a simple flora predominately with the presence of gram-positive cocci, gram-positive bacilli and some gram-negative cocci is present in individuals with good oral hygiene, but a more diverse and complex flora dominated by anaerobic gram-negative organisms will be present in persons with poor oral hygiene.[5] Prevalence of ascitic fluid infections (AFI) is 20-30% including spontaneous bacterial peritonitis (SBP), bacterascites, and culture negative neutrocytic ascites (CNNA) in hospitalized patients with decompensated cirrhosis .[6,7].Studies have shown that bacteraemia is more common in patients with poor oral hygiene. Streptococcus viridans a bacteria which typically involved in oral infections, are increasingly being recognized as a cause of SBP among patients with cirrhosis.[8] This study is conducted to assess whether AFI is more common in cirrhotic patients with ascites, having poor oral hygiene.

MATERIAL AND METHODS:

This was a prospective observational study conducted at a tertiary care center in western India. It was conducted from March 2021 to October 2021. Institutional ethical clearance was taken prior to study and informed consent was taken from the patients prior to study enrollment. All cases diagnosed as cirrhosis with ascites between the ages of 18 - 80 years, who were screened for enrollment of the study. The patients with past history of dental manipulation, cause of ascites other than cirrhosis, uncontrolled diabetes, liver metastasis, patients on immunosuppressive drugs, pregnant patients, Human immunodeficiency virus (HIV) positive patients and those who refuse to give consent were excluded. (Figure 1) A diagnostic paracentesis was performed under strict aseptic precautions. Ascitic fluid analysis was done within one hour of collection. Ascitic fluid was sent for microscopy, biochemistry and for culture sensitivity. SBP was defined as an ascitic fluid absolute polymorphonuclear leukocyte (PMN) count of at least 250 cells/mm^3 and a positive ascitic fluid bacterial culture without an intra-abdominal surgically treatable source of infection. Culture negative neutrocytic ascites (CNNA) was defined as ascitic fluid PMN more than 250 cells/mm^3 with ascitic fluid culture negative for bacteria. Approximately 2 mL of ascitic fluid was transferred directly into a Ethylenediamine tetraacetic acid (EDTA) container for the cell count and differential analysis. In the case of a traumatic paracentesis (ascitic fluid red cells counts >10,000 cells/mm^3), the PMN count was corrected by subtracting one PMN for every 250 red cells/mm^3 from the absolute PMN count. At least 10 ml of ascitic fluid was directly inoculated into a blood culture bottle for culture at the bedside prior to receiving the first dose of antibiotic. BMI was calculated for all patients. Corrected body weight was calculated by subtracting a percentage of weight based upon the severity of ascites (mild - 5%; moderate - 10%; severe - 15%), with an additional 5% subtracted if bilateral pedal edema is present.[9] Child Turcotte Pugh (CTP) and Model for end stage liver disease (MELD) scores were calculated on the basis of laboratory values obtained within 24 hours of admission. The CTP score included two continuous variables (bilirubin and albumin) and three discrete variables (ascites, encephalopathy and international normalized ratio [INR]). This score was divided into three classes: class A(5–6), class B(7–9) and class C(10–15). The formula used for the calculation of MELD was as follows: MELD score = 3.78 × ln(serum bilirubin [mg/dL]) + 11.2 × ln(INR) + 9.57 × ln(serum creatinine [mg/dL]) + 6.43 [10] Socioeconomic status of the studied population was classified into 5 classes as per modified Kuppuswamy scale.[11] Oral hygiene was examined for all patients of cirrhosis with ascites by using the dental mirror. The six surfaces examined for the simplified oral hygiene index (S-OHI) are selected from four posterior and two anterior teeth, and S-OHI is calculated after calculating calculus index (CI) and debris index (DI) to determine good or poor oral hygiene. [12] S-OHI was calculated by a resident trained for calculating the same by the Dentistry department at the hospital.

ORAL HYGIENE EXAMINATION

ORAL HYGIENE INDEX

The oral hygiene index was developed in 1960 by John C Greene and Jack R Vermillion to classify and assess oral hygiene status . The index was developed to study variations in gingival inflammation in relation to the degree of mental retardation in children .It was depicted as a sensitive ,simple and rapid method for assessing group or individual oral hygiene quantitatively. The oral hygiene index comprises of 2 components Debris index (DI) and the Calculus Index (CI) .Each of these index is based on 12 numerical determinations representing the amount of debris or calculus found on the buccal and lingual surfaces of each of the three segments of each dental arch namely

Segment 1 : Distal to the right cuspid on the maxillary arch

Segment 2 : Medial to the right and left first bicuspids on the maxillary arch

Segment 3: Distal to the left cuspid on the maxillary arch

Segment 4:Distal to the left cuspid on the mandibular arch

Segment 5: Medial to the right and left first bicuspids on the mandibular arch

Segment 6: distal to right cupsid on mandibular arch

Each segment is examined for debris or calculus .From each each segment one tooth is used for calculating the individual index ,for the particular segment .The tooth used for the calculation must have the greatest area covered by either debris or calculus.

Instruments used:

Mouth mirror No. 23 exolorer (Shepherd's Hook)

Examination method and scoring system

The OHI-S has two components ,the Simplified Debris Index (DI-S) and the Simplified Calculus Index(CI-S)

Debris Index Simplified (DI-S)

The surface area covered by debris is examined by running the side of an explorer (Shepherd's hook) along the tooth surface being examined .The occlusal or incisional extent of the debris is noted as it is removed .The oral hygiene examination and scoring for the DI always should precede the oral examination and scoring for the CI.

Calculus Index Simplified (CI-S)

There are two main types of dental calculus which are differentiated primarily by location on the tooth in relation to the free gingival margin.

Supragingival calculus -denotes deposits ,usually white to yellowish brown in colour ,occlusal to the free gingival margin.

Subgingival calculus -denotes deposits usually light brown to black in colour ,apical to the free gingival margin.

Calculation

The buccal /labial and lingual scores are tabulated and totaled for each segment and arch.The debris and calculus scores are tabulated separately and the indices fir rach are calculated independently.

Calculation of the Index

For each individual ,the debris and calculus scores are totaled and divided by the number of tooth surfaces scored.

$$\text{Calculation of DI-S score} = \frac{\text{Total score}}{\text{No. of surfaces examined}}$$

$$\text{Calculation of CI-S score} = \frac{\text{Total score}}{\text{No. of surfaces examined}}$$

Once the DI-S and CI-S are calculated separately, then they are added together to get the OHI-S score.

Interpretation

For the DI-S and CI-S score

Good - 0.0 to 0.6,Fair - 0.7 to 1.8, Poor – 1.9 to 3.0

For the OHI-S score

Good - 0.0 to 1.2,Fair - 1.3 to 3.0,Poor – 3.1 to 6.0

Statistical analysis was performed using SPSS statistics 21.0. Continuous variables were reported as mean $\pm$ standard deviation (SD), Median {Interquartile range (IQR)} and range. Discrete variables are summarized in terms of frequencies and percentages. Shapiro-Wilk test was used to determine whether data sets differed from a normal distribution. For comparison of continues variables between two groups unpaired t test or Mann Whitney U test were used based on normality testing. Pearson's correlation coefficient was used to analyse relation between S-OHI and clinical and laboratory variables. We assessed the differences in categorical variables with the Fisher's exact test. All test were two tailed and result were been considered significant at p value <0.05.

RESULTS:

Two hundred patients of decompensated cirrhosis with ascites were studied during this period. Mean age of the patients was 50.9 ± 9.8 years with 156 (78%) males. Mean corrected body mass index (BMI) was 18.9 ± 1.9 kg/m^2. Alcohol was the most common cause of cirrhosis (57%). Mean MELD and CTP scores were 18.6 ± 7.43 and 10.2 ± 1.28 respectively. Mean S-OHI was 1.8 ± 1.07. AFI was found in 56 (28%) patients. Amongst AFI, SBP and CNNA were found in 2 (3.57%) and 54 (96.43%) respectively. Poor oral hygiene (S-OHI > 3) was seen in 58 (29 %) patients.

In this study, 121 (60.5 %) patients had completed their primary schooling. Amongst patients with poor oral hygiene 73 (36.71 %) were illiterate as compared to 48 (23.97 %) who had completed their primary education. As per modified Kuppuswamy scale, 115 (57.5%) belonged socioeconomic status >3. Among the patients with AFI, mean MELD was 24.27 as compared to 16.01 in patients without AFI. [$p<0.005$]. Poor oral hygiene was more prevalent in patients with MELD > 18 (45%) versus MELD < 18 (13%) [$p<0.001$]. Poor oral hygiene was found in 61.54 % patients with AFI compared to 17.57 % in patients without AFI [$p<0.001$]. (Figure 2) S – OHI predicted the presence of AFI with a AUROC of 0.82**. (**Figure 3)

DISCUSSION:

In this cohort, poor oral hygiene was seen in 58 patients (29%). Prevalence of AFI was higher in patients with poor oral hygiene (61.6 %) which was statistically significant. Mean MELD and CTP scores were 24.27 and 10.82 in who had AFI as compared to 16.01 and 9.08 in patients without AFI respectively. Primary schooling had been completed by 121 (60.5%) patients. Amongst patients with poor oral hygiene, 73 (36.71%) were illiterate as compared to 48 (23.97%) who had completed their primary education ($p<0.05$). According to modified Kuppuswamy scale 115 (57.5%) belonged socioeconomic status > 3. AFI is a

major complication of cirrhosis and associated with high mortality and morbidity. AFI is thought to arise from bacteremia via the seeding of ascitic fluid. Bacterial translocation from the gut is one of the most the important source for development of infection, but other sources can also contribute to it . Dental infection is a recognized source of infection and we thus hypothesized that poor oral hygiene may cause AFI. Being part of dental plaque, bacteremia might be caused by entry of bacteria into blood stream through this route. A double-blind randomized controlled clinical trial has demonstrated a relation of bacteremia to poor oral hygiene.[13] In healthy conditions, normal flora are in equilibrium with periodontal pathogens. When there is a microbial dysbiosis , pathogenic gram-negative organisms of periodontal area become predominant. In cirrhotic patients there are multiple factors which predispose for poor oral hygiene such as Decreased blood flow of the mucogingival junction, poor immunity, decreased salivation due to diuretic drugs and increased levels of serum alkaline phosphatase [14]. Thus, it was hypothesised that poor oral hygiene my lead to bacteremia and that will lead AFI among patients with cirrhosis. It was found that patients with poor oral hygiene had higher prevalence of AFI in this study, suggesting that poor oral hygiene could be an additional risk factor for AFI. In this study group patients with poor oral hygiene have higher CTP and MELD may suggest the link between oral bacterial flora and progression of liver disease. Numerous studies have demonstrated that gut-derived bacteria may contribute to the progression of liver disease[15,16]. Recent studies indicate that periodontitis associated systemic inflammation may cause liver injury and precipitate liver disease.[17,18]. Although these studies focused on gastrointestinal bacteria, it is hypothesized that oral cavity might be source for these bacteria and that certain bacteria may have arisen from the oral cavity which leads to hepatocyte and endothelial cell injuries and the progression of liver disease by release of inflammatory mediators like Interleukin-12/23, Tumor Necrosis Factor-α, and Interleukin-1 which leads to the recruitment of activated neutrophils[19,20] A study showed that people who are literates and higher SES (Class I) had more good practices for oral hygiene compared to illiterates, and lower SES (Class V), respectively; the differences appeared to be statistically significant ($P < 0.05$).[21] Another study showed that there was a strong association of lifestyle, education level, and socioeconomic status with periodontal health. [22] These findings are in agreement with the findings reported in the present study. Bacterial translocation is considered to be the most important pathophysiological mechanism leading to development of AFI. Till date, intestinal bacterial overgrowth, the structural and functional alterations of the intestinal mucosal barrier and local immune response deficiencies are considered to be the main factors leading to bacterial translocation. Studies involving infective endocarditis have shown that bacteraemia is more common in patients with periodontitis. [23] Hence we hypothesize that same might increase bacteremia and lead to AFI However, to our knowledge there are no studies as yet looking at the correlation of poor oral hygiene and AFI. The study was limited by small sample size. Another limitation was that whether interventions to improve oral hygiene would result in decrease in the occurrence of AFI and subsequently have a mortality benefit was not analysed. It is difficult to prove the causal relationship between poor oral hygiene and AFI because this was a cross sectional observational study. Further prospective studies to study the improvement in AFI rates with improvement in oral hygiene should be planned. In conclusion, our preliminary findings showed association with poor oral hygiene could also be a predisposing factor for AFI in cirrhotic patients and we suggest screening for oral hygiene in all patients of decompensated cirrhosis as it may be a harbinger of ascitic fluid infection.

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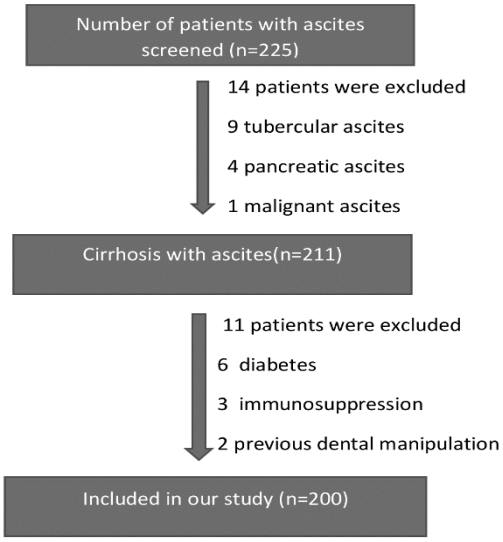
Figure Legends

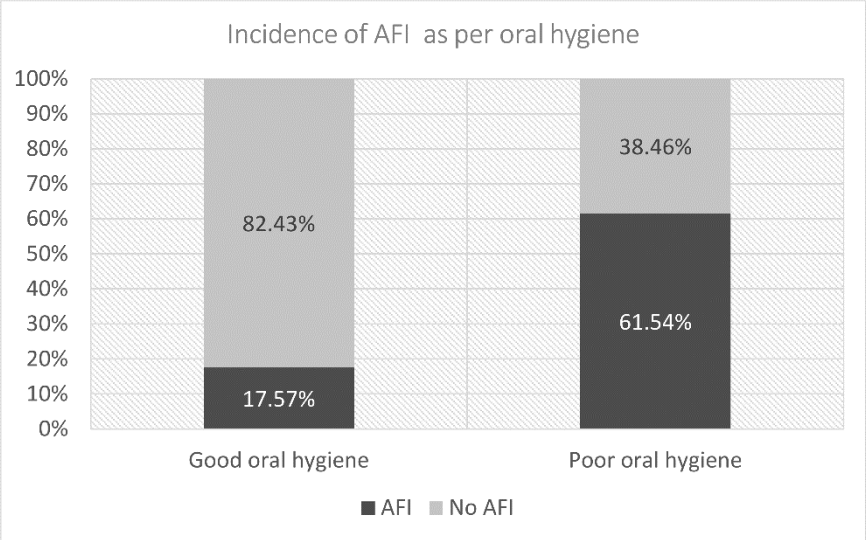
"Figure 1 "- CONSORT Diagram

"Figure 2" Correlation of Oral Hygiene with AF

"Figure" 1.CONSORT Diagram



"Figure" 2. Correlation of Oral Hygiene with AFI



"Figure" 3.ROC curve OHI-S predicting AFI

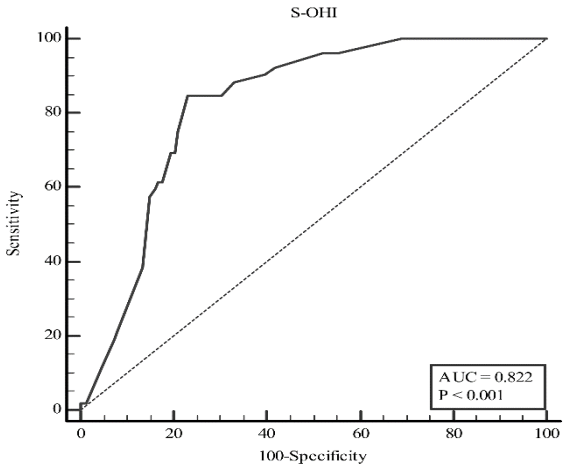


Table 1 Criteria for classifying debris and calculus (12)

Scores	Criteria-debris	Criteria-calculus
0	No debris or stain present	No calculus present
1	Soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered	Supragingival calculus covering not more than third of the exposed tooth surface.
2	Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface.	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.

3	Soft debris covering more than two thirds of the exposed tooth surface.	Supragingival calculus covering more than two third of the exposed tooth surface or a continues heavy band of subgingival calculus around the cervical portion of the tooth or both.

Table 2: Baseline characteristics

Parameters	Mean ± SD
Age (years)	50.9±9.85
BMI (kg/m^2)	18.9±1.89
Hemoglobin (Hb) (gm/dl)	8.5±1.09
Platelet count (10^5/dl)	0.70±0.29
Total bilirubin (mg/dl)	5.5±5.41
Aspartate Aminotransferase (AST) IU/L	58.8±34.70
Alanine Aminotransferase (ALT) IU/L	39.1±17.79
Total Protein (gm/dl)	6.0±0.49
Serum Albumin (gm/dl)	2.2±0.36
International Normalized Ratio (INR)	1.7±0.37
Creatinine (mg/dl)	1.1±0.45
MELD	18.1±7.43
CTP	10.2 ±1.28
S-OHI	1.81±1.07
DI	0.9±0.57
CI	0.8±0.64

Table 3: Correlation coefficient of S- OHI with other variables

Variable	**S OHI**		
	Correlation coefficient (r)	95% CI	p value
BMI(kg/m^2)	-0.3093	-0.4296 to -0.1782	0.0001
Hemoglobin(gm/dl)	-0.2775	-0.4009 to -0.1444	0.0001
Platelet count(10^5/dl)	-0.2858	-0.4084 to -0.1532	0.0001
AST (IU/L)	0.0375	-0.1018 to 0.1753	0.5981
ALT (IU/L)	-0.09631	-0.2320 to 0.04300	0.1749
Serum Albumin(gm/dl)	-0.3758	-0.4890 to -0.2501	0.0001
INR	0.4617	0.3451 to 0.5643	0.0001
Creatinine (mg/dl)	0.2962	0.1642 to 0.4178	0.0001
Ascitic fluid PMN (cells /mm3)	0.4382	0.3189 to 0.5439	0.0001
Ascitic fluid total protein (gm/dl)	-0.3666	-0.4809 to -0.2400	0.0001
MELD	0.4757	0.3608 to 0.5764	0.0001