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## Changing paradigms in critical care: Variation in Oropharyngeal Microbiota as a deciding factor to Antibiotic Resistance in ICU patients

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### ABSTRACT

Oropharyngeal colonization by pathogenic organisms especially in the initial crucial days of ICU admission, is the main cause of predisposition to nosocomial infections. Hence, identifying bacterial flora, in respect to hospitalization will help in further management to prevent morbidity and mortality of these patients. Determining changes in bacterial flora in oropharynx of patients with nasogastric tube, admitted in ICU. One year prospective observational study including 40 patients between 18 and 70 years, Group A 20 cases- with nasogastric tube in situ, Group B 20 controls including those without tube. Oropharyngeal swab taken on Day 0 and 7 of ICU admission respectively. There was nearly equal distribution of gender, with 19 females and 21 males, majority in the age group of 35-74 years. Most of patients had no growth on day 0 (35% cases) but as the day of ICU admission progressed, there was increased growth of Gram negative bacteria like *Pseudomonas aeruginosa* (20%), *Klebsiella pneumoniae* (25%) especially in cases group. The progressive increase of pathogenic organism and the variation to gram negative bacteria further confirmed predispositions to pathogen carriage at these sites and the subsequent risk of infection within the crucial 48 hours. Hence, need for consistent oral cleansing procedures, maintaining good oral hygiene in these prolonged tube-fed patients will help prevention of nosocomial infections.

**Keywords:** Nasogastric tube, Oropharyngeal flora, ICU

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## INTRODUCTION

Nasogastric tube insertion is commonly used for enteral feeding, mainly in ICU patients. It may cause mucosal inflammation, edema leading to stomatitis, gingivitis and glossitis. It can also cause blockage of sinuses, leading to nosocomial infections.<sup>1</sup>

Pathogenic microbial colonization of oropharynx is typically prevented by mastication and swallowing but this mechanism is absent in patients who are tube-fed, hence predisposing them to aspiration pneumonia with increased morbidity, especially in elderly patients.<sup>2</sup> In this study, we will observe the variations in nasopharyngeal flora in respect to hospitalization as well as further management to prevent nosocomial infections.

### Objective

To determine the changes in bacterial flora in the oropharynx of patients with nasogastric tube, admitted in the ICU.

## MATERIALS AND METHOD

**Study design:** A Prospective Observational study.

**Study period:** 1<sup>st</sup> Jan 2021 to 31<sup>st</sup> December 2021

**Study population:** Patients of both sexes between the age group of 18 - 70 years who are admitted in ICU, with nasogastric tube in situ, in KLE Dr. Prabhakar Kore Hospital.

### Inclusion Criteria:

Patients of both sexes, conscious as well as unconscious, who are admitted in ICU, with nasogastric tube in situ, in KLE Dr. Prabhakar Kore Hospital, and

- Aged between age group of 18-70 years
- Give consent to take high oropharyngeal swab
- Nasogastric tube in situ for minimum 48 hrs
- After excluding certain patients mentioned under exclusion criteria

### Exclusion Criteria:

Following patients are excluded:

- Planned or undergoing naso or oropharyngeal surgery
- Having pre-existing clinical infection in ear, nose or throat and those diagnosed with community acquired pneumonia

**Sample size (n):** 2 Comparison groups, cases and controls, consisting of 20 samples each.

### Methodology:

- After taking informed consent from the patients, detailed clinical history was obtained, all patients were clinically examined with examination of ear, nose and throat.

- 2 comparison groups were taken, one cases group including 20 patients with nasogastric tube that was retained for more than 48hrs for enteral feeding, and second controls group, including patients that don't need nasogastric tube.
- Using a standard bacteriologic throat swab technique, in cases group, high oropharyngeal swabs were taken from the lateral and posterior pharyngeal walls before inserting the nasogastric tube (Sample A). A second swab was taken on day 7 of admission (Sample B).
- Similarly, in controls group, high oropharyngeal swabs was taken at day 0 and day 7 of admission.
- Each specimen were inoculated onto culture plates.

### **Statistical Analysis:**

The study is focused on comparison of two groups. For the continuous quantitative variables mean and standard deviation were calculated. Suitable statistical procedures were used. Nonparametric tests were used for comparing discrete variables. The comparison was represented using the appropriate graphs. The value of p less than 5% (0.05) was deemed significant for all tests.

## **RESULTS AND DISCUSSION**

After taking informed consent, study included total 40 patients. 20 were divided into group A and 20 into group B. Majority of patients in current study were in 30- to 70-yr-old age range, and there was no discernible difference in age distribution across groups. Nearly equal distribution of gender is noted in present study, with 19 female patients and 21 male patients.

### **Group A**

In group A patients on day 0, 35% of the patients showed no growth on culture report and 65% were positive. Among the organism, 20% with *Klebsiella pneumonia*, followed by Coagulase Negative Staphylococci species, *Pseudomonas aeruginosa* and *Staph. epidermidis*. On day 7, 20% of the patients showed no growth on culture report. Among the 80% rest, 25% were positive for *K. pneumonia*, followed by 20% with *P. aeruginosa*, as depicted in Table 1. The comparison for the organism growth on respective days is depicted in Figure 1.

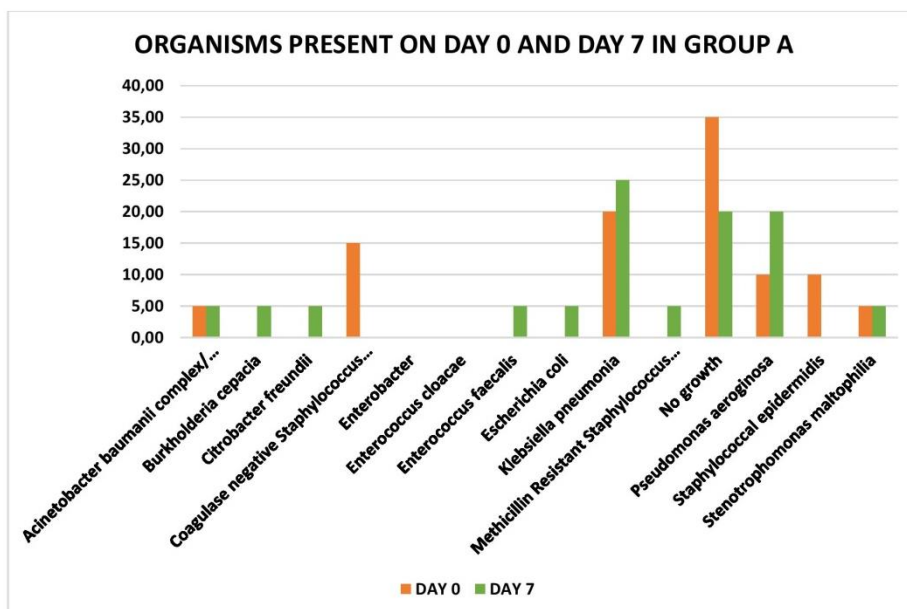


Figure 1: Graph representing culture of organisms in group A on Day 0 and Day 7.

Table 1: Culture of the organism in group A on Day 0 and Day 7.

Organism	Day 0	%	Day 7	%
Acinetobacter baumannii complex/ hemolyticus	1	5.00	1	5.00
Burkholderia cepacia	0	0.00	1	5.00
Citrobacter freundii	0	0.00	1	5.00
CONS species	3	15.00	0	0.00
Enterobacter	0	0.00	0	0.00
Enterococcus cloacae	0	0.00	0	0.00
Enterococcus faecalis	0	0.00	1	5.00
E. coli	0	0.00	1	5.00
K. pneumonia	4	20.00	5	25.00
Methicillin Resistant Staph. aureus	0	0.00	1	5.00
<b>No growth</b>	7	35.00	4	20.00
P. aeruginosa	2	10.00	4	20.00
Staph. epidermidis	2	10.00	0	0.00
Stenotrophomonas maltophilia	1	5.00	1	5.00
	20	100.00	20	100.00

**Group B**

In group B patients on day 0, 45% of patients showed no growth on culture report and 55% were positive for organism. Among the species, 15% were positive for Coagulase Negative Staphylococci species, Enterococcus faecalis, followed by commensals and other organisms. On day 7, 65% of the patients showed no growth. Rest showed similar growth as Group A with K. pneumonia and P. aeruginosa, amongst others, as shown in Table 2. The comparison for the organism growth on respective days is depicted in Figure 2.

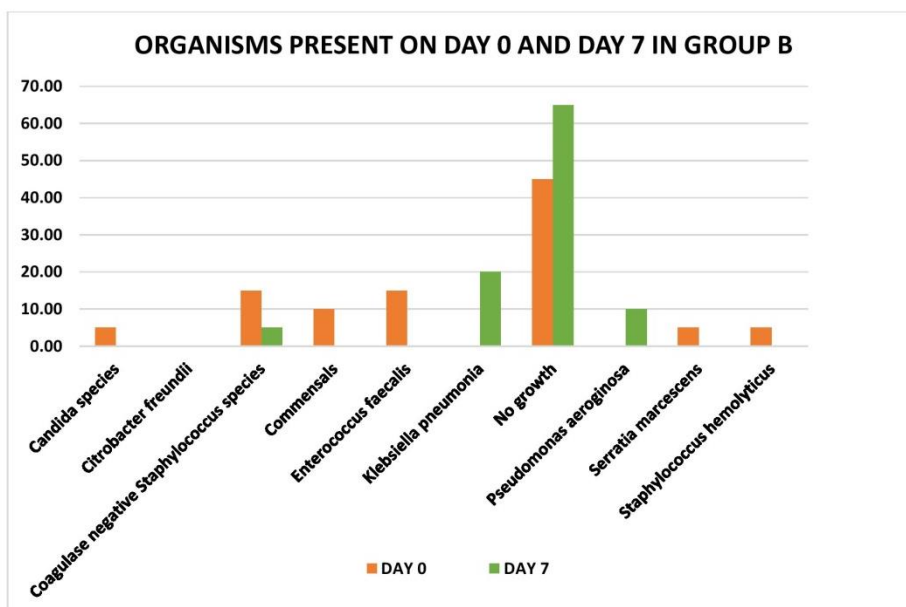


Figure 2: Graph representing culture of organisms in group B on Day 0 and Day 7.

Table 2: Culture of the organism in group B on day 0 and Day 7.

Organism	Day 0	%	Day 7	%
Candida species	1	5.00	0	0.00
Citrobacter freundii	0	0.00	0	0.00
CONS species	3	15.00	1	5.00
Commensals	2	10.00	0	0.00
Enterococcus faecalis	3	15.00	0	0.00
K. pneumonia	0	0.00	4	20.00
<b>No growth</b>	9	45.00	13	65.00
P. aeruginosa	0	0.00	2	10.00
Serratia marcescens	1	5.00	0	0.00
Staph. hemolyticus	1	5.00	0	0.00
	20	100.00	20	100.00

DISCUSSION:

Pathogenic bacterial colonisation of the oropharynx is typically prevented by mastication and further food-transit but in tubo-enterally feeding patients, this mechanism is absent. Hence, predisposing them to aspiration pneumonia with increased morbidity, especially in elderly patients.<sup>2</sup> The oropharynx is exposed to various microbes, which are cleared by mucociliary mechanisms.<sup>3</sup>

From gram positive streptococcal predominance to gram negative pseudomonal predominance, microbial ecology of patients admitted to ICU changes significantly. Due to presence of more aggressive organisms, there is increased chance of developing nosocomial pneumonia.<sup>5</sup>

*Age and Sex Distribution*

The distribution of gender within the categories did not differ significantly. There was nearly equal distribution of gender, with 19 female patients and 21 male patients. Age group wise distribution was also similar between the groups. The majority of the patients were in the 35–74 age range. In a study by Ewan<sup>4</sup>, the average age of the patients included was 82.9 years, and 59% of them were female and 41% were male.

#### ***Culture isolates on Day 0***

In our study, group A patients on day 0, 35% of the patients showed no growth on culture report and 65% were positive. Among the organism, 20% with *K. pneumonia*, followed by 15% were positive for Coagulase Negative Staphylococci species, 10% with *P. aeruginosa*, *Staph. epidermidis* and 5% with *Acinetobacter baumannii* complex/ hemolyticus, *Stenotrophomonas maltophilia*. In group B patients on day 0, 45% of patients showed no growth on culture report and 55% were positive for organism. Among the species, 15% were positive for Coagulase Negative Staphylococci species, *Enterococcus faecalis*, 10% with commensals and 5% with candida species, *Serratia marcescens* and *Staph. hemolyticus*.

This was different from the results of study done by Frandah W et al.<sup>5</sup>, where most prevalent bacteria that were isolated on 1<sup>st</sup> sample were *Strep. Viridans*, *Micrococcus spp. non-Group D non-haemolytic strep* with *Lactobacillus spp.* and *N. non-meningitidis*.

#### ***Culture isolates on Day 7***

In our study, on day 7, 20% of the patients showed no growth on culture report and 80% were positive. Among the organism, 25% were positive for *K. pneumonia*, followed by 20% with *P. aeruginosa* and 5% with *Acinetobacter baumannii* complex/ hemolyticus, *Burkholderia cepacia*, *Enterococcus faecalis*, *Citrobacter freundii*, *E. coli*, MRSA, *Stenotrophomonas maltophilia*. In group B patients on day 7, 65% of the patients showed no growth on culture report and 35% were positive. Among the positive organism, 20% positive for *K. pneumonia* followed by 10% with *P. aeruginosa* and 5% with Coagulase Negative Staphylococci species. Most of the patients were resistant to all the antibiotics, especially the patients showing positive growth for *Klebsiella* and *Pseudomonas*.

These findings were consistent with a research by Leibovitz A et al.<sup>2</sup> which showed that feeding via a tube had a higher incidence of possibly pathogenic isolations: 81% in nasogastric group and 51% in feeding by percutaneous enterogastric tube, against 17.5% in feeding via oral means. 31% of those in nasogastric group and 10% of those receiving percutaneous enterogastric tube feeding, had *P. aeruginosa* grown from them but none of the people receiving oral feeding showed any growth. Majority of *Klebsiella* and *Proteus* identifications came from nasogastric subjects.

**CONCLUSION:**

The present study demonstrates a higher prevalence of the pathogenic isolates from the nasogastric tube inserted patients compared to the ones without. On 7<sup>th</sup> day, 80% of the patients in the Nasogastric Tube group were positive for the pathogenic organism and in group without Nasogastric Tube were positive in 35% of patients. Common and highly pathogenic bacteria isolate on day 7<sup>th</sup> in Nasogastric Tube group was 25% were positive for *K. pneumonia*, followed by 20% with *P. aeruginosa* and non- Nasogastric Tube group was 20% positive for *K. pneumonia* followed by 10% with *P. aeruginosa*.

Our outcomes support that mechanical cleaning brought about by appropriate mastication and swallowing provides chief protection against bacterial adulteration of oral cavity.

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