Pathogenic Colonization of Oral Flora in Frail Elderly Patients Fed by Nasogastric Tube or Percutaneous Enterogastric Tube

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Background. Aspiration of infected oropharyngeal content is the main cause of aspiration pneumonia. This complication, mainly related to gram-negative bacteria, threatens percutaneous enterogastric tube as well as nasogastric tube (NGT) fed patients. The objective of this study was to examine the oral microbiota of tuboenterally fed patients and compare it with that of orally fed counterparts.

Methods. Patients were recruited for this study from six nursing and skilled nursing facilities with an overall number of 845 beds. Enrolled were 215 patients: Group 1 consisted of 78 patients on NGT feeding, Group 2 consisted of 57 patients on percutaneous enterogastric tube feeding, and Group 3 consisted of 80 patients fed orally who were from the same facilities. Cultures were performed by sampling the oropharynx of each subject in order to identify gram-negative bacteria and Staphylococcus aureus.

Results. A high prevalence of potentially pathogenic isolations was found in tuboenterally fed patients: 81% in Group 1 and 51% in Group 2, as compared with only 17.5% in Group 3 (p < .0001). Pseudomonas aeruginosa was cultured from 31% of the subjects in Group 1 and 10% of Group 2, but in none of Group 3 (p < .001). Klebsiella and Proteus were isolated mainly from the NGT fed patients (p < .003). No correlation was found between the time duration on tube feeding or the presence of residual dentition and pathogenic microbiota.

Conclusion. This study shows that tuboenteral feeding in elderly patients is associated with pathogenic colonization of the oropharynx. These findings are related to the risk of aspiration pneumonia and are compelling for the reevaluation of current oral cleansing procedures.

Enteral feeding, either by percutaneous enterogastric tube (PEG) or by nasogastric tube (NGT), is becoming increasingly common for providing nutrition and hydration to frail elderly patients with severe oropharyngeal dysphagia (1). This procedure is fraught with ethical and medical concerns regarding the extent of life-maintaining procedures and their complications in frail patients (2–4). Whereas the ethical concerns are a subject of debate for the whole society, it is our duty as physicians to explore the medical problems associated with these procedures.

Aspiration pneumonia, with its high morbidity and mortality, is a major threat for enteral fed patients. Its main cause is the aspiration of infected oropharyngeal content (5,6). Aspiration of saliva is not a rare phenomenon, but it is the presence of pathogenic organisms, especially gram-negative bacteria (GNB), that increases the risk for pneumonia (6,7). Physiologically, oropharyngeal colonization by pathogenic organisms is prevented by the mechanical clearance provided by chewing and swallowing (8). However, in tuboenterally fed patients, the oropharynx is devoid of this protective effect, rendering it prone to colonization by pathogenic organisms. Such a process could be crucial with regard to aspiration pneumonia. Colonization of dental plaque by respiratory pathogens has been previously reported in medical intensive care patients (9). However, data on the impact of prolonged enteral feeding on oral microbiota are scanty, because frail elderly patients are seldom included in such epidemiological studies (10,11). Therefore, we initiated this study with the purpose of examining the pathogenic oral flora found in tuboenterally fed patients, whether fed by PEG or by NGT, and comparing it with that found in a similar group of orally fed subjects.

Methods

This cross-sectional comparative survey was conducted in six nursing and skilled nursing facilities with a total number of 845 beds. Skilled nursing facilities are those that are licensed for providing care for nursing patients that also have an active disease that requires close medical supervision (e.g., such patients might require NGT feeding or suffer from severe bed sores, advanced cancer, or hemodynamic instability). Eligible for the study were all patients on tuboenteral nutrition, either by NGT or by PEG. Excluded were patients with advanced cancer and those with a history of irradiation to the neck. The control group consisted of matched orally fed patients with no swallowing disturbances who resided in the same facilities. Excluded from both groups were patients who had received any antibiotic treatment up to 2 weeks prior to the study. Informed consent was obtained from the patients or from their proxies.
RESULTS

Cultures were performed by sampling the oropharynx with swabs; these samples were taken from the base of the tongue dorsum by rubbing the buccal mucosa with a sterile cotton swab, which was then placed in transport medium. The samples were taken during the morning hours, before breakfast and before the daily oral cleansing procedure. Routine oral hygiene for the tube-fed patients was performed by cleaning the oral cavity before meals three times a day with lemon-glycerine wadding sticks impregnated with a solution of glycerine-citric acid, lemon flavoring, and sodium benzoate 0.1% (12).

Cultures were inoculated within 1 hour of collection on blood, MacConkey’s, and chocolate agar plates, and they were aerobically incubated at 35°C. *Staphylococcus aureus* was identified by manual methods, using tryptic soy blood agar (TSA, Hy-Labs Laboratories, Israel), and then Gram stained. It was further identified by coagulase and catalase tests and then by subculturing on chromium and manitol agar (Hy-Labs). Gram-negative bacterial identification was performed by specific biochemical tests (Kligler iron agar, UMI [urea motility indol], MIO [ornitine decarboxylase], Lysin, MRVP [methyl red Voges-Proskauer], and Oxydase). In a few inconclusive cases, the BBL Crystal Enteric/Nonfermenter ID System was used (Becton Dickinson, Cockeysville, MD). Only moderate or heavy growth was considered to be a positive result. Culture of fungal organisms was not performed.

Statistical processing was performed by using the SPSS software (SPSS, Chicago, IL). A chi-square or Fisher’s exact test was used for comparative studies, and a Pearson test was used for correlations.

Table 1. Demographic and Medical Data of Study Patients

<table>
<thead>
<tr>
<th>Medical Data</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (n = 78)</td>
<td>Group 2 (n = 57)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>12 (15)</td>
</tr>
<tr>
<td>COPD</td>
<td>10 (13)</td>
</tr>
<tr>
<td>Stroke</td>
<td>54 (69)</td>
</tr>
<tr>
<td>Dementia</td>
<td>65 (84)</td>
</tr>
<tr>
<td>Dentures</td>
<td>29 (37)</td>
</tr>
</tbody>
</table>

Notes: Group 1: fed by nasogastric tube; 61 women, 17 men, and age range 82 ± 9 years. Group 2: fed by percutaneous enterogastric tube; 24 women, 33 men, and age range 77 ± 16 years. Group 3: fed orally; 54 women, 26 men, and age range 81 ± 9 years. COPD = Chronic obstructive pulmonary disease.

*Statistical significance (p < .05 by chi square) vs Groups 1 and 2.

DISCUSSION

The main finding in this study is the significantly by higher rate of pathogenic isolations from the oropharynx of tube-fed patients. GNB have been isolated from 81% of the NGT-fed patients and from 51% of the PEG-fed patients, as opposed to only 17.5% of the orally fed group (p < .0001). The prevalence of *Pseudomonas* in the oral flora was extremely high and was found only in those fed by NGT or PEG. Some of the highly pathogenic bacteria such as *P. aeruginosa* and *Klebsiella*, uncommon in the oral flora of normal persons (13), have been cultured exclusively in tube-fed patients. Interestingly, *S. aureus* isolations, half of them methicillin resistant, were similar in all study groups. In the majority of the cases, colonization was of a single species of pathogen, whereas two or three species were found in 6.8% of the samples only.

No correlation was found between the length of stay in the facility or the duration on tube feeding (either NGT or PEG) and bacterial isolations (Pearson’s correlation and t test). The presence of residual dentition was not significantly different among the study groups (Table 1). No correlation was found between the presence of residual dentition and pathogenic microbiota.
such as the tube itself may constitute a site of biofilm formation, bolstering the growth of bacteria such as *Pseudomonas* (16). Moreover, an association has been reported between the short-term use of NGTs and sinusitis (17). Prolonged use could have a higher impact on the pathological colonization of the sinuses, leading to chronic sinusitis that may be a source of pathogenic bacteria.

Tuboenteral feeding, in spite of existing reservations, is the only present solution for providing hydration and nutrition and reducing aspiration in patients with severe oropharyngeal dysphagia (2,18). Nevertheless, aspiration pneumonia is the main complication of tuboenterally fed patients. Apart from high morbidity and mortality, this process constitutes a high expenditure for the health system, with a cost recently estimated for PEG alone at $800,000,000 a year (19).

**Conclusions**

The relationship between oropharyngeal pathogenic colonization in prolonged tuboenterally fed patients and the risk of aspiration pneumonia should be investigated further. One factor to be studied is the flow and composition of the saliva. Detailed dental status of prolonged tuboenterally fed patients should also be evaluated. The lack of a thorough dental examination in our patients was a limitation of our study. Recent reports suggest that dental and oral factors are significant in the control of aspiration pneumonia in the elderly population (20). The role of oral care in preventing pneumonia in nursing home patients was also recently emphasized (21). A successful attempt at oropharyngeal decontamination with a resulting decrease in pneumonia was reported in patients on mechanical ventilation (22).

Our results suggest the need for a reexamination of the existing oral cleansing procedures in prolonged tube-fed patients and a search for new methods of decontamination.

**ACKNOWLEDGMENTS**

Address correspondence to Arthur Leibovitz, MD, Shmuil Haroof Hospital, Geriatric Medical Center, P.O. Box 2, Beer-Yaakov, Israel.

**REFERENCES**

10. Pajukoski H, Meurman JH, Odont D, Snellman-Grohn S, Sulkava R. Presence of any GNB or gram-negative bacteria; NS = not significant (statistical significance was considered $p < .05$, two tail, by chi square). *Group 1: NGT fed, n = 78; Group 2: PEG fed, n = 57; Group 3: orally fed, n = 80.*

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**Table 2. Pathogenic Oral Flora in LTC Patients Fed by NGT or PEG**

| Isolation     | Group 1 |          |          |          |           | Group 2 |          |          |          |           | Group 3 |          |          |           |          |     |     |     |
|--------------|---------|----------|----------|----------|-----------|---------|----------|----------|----------|-----------|---------|----------|----------|-----------|----------|     |     |     |
|              | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation | Isolation |     |     |     |
|              | No.      | %        | No.       | %        | No.       | %        | No.       | %        | $\chi^2$  | 1 vs 2     | 1 vs 3    | 2 vs 3    | 1 vs 2     | 1 vs 3    | 2 vs 3    |     |     |     |
| *Pseudomonas*| 24       | 31       | 6         | 10       | 0         | 0        | <.001     | .004      | .001      | .008       |          |          |          |          |          |     |     |     |
| *Klebsiella* | 12       | 15       | 1         | 2        | 2         | 2.5      | .003      | .006      | .012      | NS         |          |          |          |          |          |     |     |     |
| *Proteus*    | 12       | 15       | 4         | 7        | 0         | 0        | <.001     | .076      | <.001     | .04        |          |          |          |          |          |     |     |     |
| *Escherichia coli* | 4   | 5        | 5         | 9        | 2         | 2.5      | NS        | NS        | NS        | NS         |          |          |          |          |          |     |     |     |
| *Enterobacter* | 7     | 9        | 7         | 12       | 1         | 1        | .053      | NS        | .06       | .024        |          |          |          |          |          |     |     |     |
| Other GNB    | 4        | 5        | 3         | 5        | 1         | 1        | .001      | .015      | <.001     | <.001      | <.001     |          |          |          |          |     |     |     |
| Any GNB      | 50       | 71       | 25        | 44       | 6         | 7.5      | <.001     | .024      | NS        | NS         | NS        |          |          |          |          |     |     |     |
| *Staphylococcus aureus* | 16  | 20.5     | 3         | 7        | 10        | 12.5     | NS        | .024      | NS        | NS         |          |          |          |          |     |     |     |
| Any pathogen | 63       | 81       | 29        | 51       | 14        | 17.5     | <.001     | <.001     | <.001     | <.001      |          |          |          |          |     |     |     |
| 2 or 3 pathogens | 11     | 14       | 4         | 7        | 2         | 2.5      | <.001     | .003      | <.001     | <.001      | <.001     |          |          |          |     |     |     |

**Notes:** LTC = long-term care; NGT = nasogastric tube; PEG = percutaneous enterogastric tube; GNB = gram-negative bacteria; NS = not significant (statistical significance was considered $p < .05$, two tail, by chi square). *Group 1: NGT fed, n = 78; Group 2: PEG fed, n = 57; Group 3: orally fed, n = 80.*

$^1$Presence of any GNB at all. $^2$Presence of any GNB or *S. aureus*. $^3$Presence of any two or three pathogenic bacteria.

