Effect of Various Antibacterial Preparations on the Pathogenic Oral Flora in Elderly Patients Fed via Nasogastric Tube

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Oropharyngeal colonization by pathogenic gram-negative bacilli (GNB) and Staphylococcus aureus is associated with aspiration pneumonia. Decolonization in high-risk populations may be important. We prospectively evaluated six antiseptic compounds in nasogastric tube-fed frail elderly patients; only polymixine reduced oropharyngeal colonization with GNB. None had an effect on S. aureus colonization.

Increasing numbers of elderly frail patients with oropharyngeal dysphagia receive hydration, nutrition, and medications via tube-enteral feeding (TEF) (6). A major complication of TEF is aspiration pneumonia, and the oropharyngeal microbial flora serves as the main reservoir for causative organisms of this complication (5, 13). While events of aspiration may be common in certain high-risk populations, the inoculum and the virulence of the aspirated organisms influence the probability of development of pneumonia (13). Among pathogens conferring risk for severe aspiration pneumonia are gram-negative bacteria (GNB) and Staphylococcus aureus (S. aureus).

GNB are found in the oropharynx of up to 71% of nasogastric tube (NGT)-fed patients and in 44% of those fed by percutaneous enterogastric tube, compared with only 7.5% of their orally fed counterparts (10, 11). Moreover, Pseudomonas aeruginosa (P. aeruginosa) has been isolated exclusively from the oropharynx of patients receiving TEF (31% versus 0%; \( P < 0.001 \)).

Poor oral hygiene, lack of standards of care, and insufficient attention paid to preventive oral health care is well known in nursing home patients, and improved oral care may reduce the occurrence of pneumonia (3, 4, 8, 12, 19, 22, 24).

This study evaluates the efficacy of six oral decontamination protocols in eliminating or reducing the load of pathogenic bacteria from the oropharynx of NGT-fed elderly patients.

The studies were performed in the long-term-care division of a 180-bed geriatric hospital. All patients in stable clinical condition on NGT feeding for at least 1 month were eligible for inclusion. Patients who had received antibiotics during the 2 weeks prior to the study were excluded. The institutional ethical committee approved the study protocols, and written informed consent was obtained from the patients or their proxies.

The routine oral care of these patients, which consists of cleansing with lemon-glycerin-impregnated swabs (23), was discontinued for the duration of this study. In each study, one compound was used for oral cleansing for 7 days. For patients who participated in more than one phase, a treatment-free interval of at least 2 weeks was required between the various phases.

Cleansing the mucosal surface was performed by trained nurses, who applied the study preparations using cotton swabs, or sponges to the entire oral surfaces and teeth, twice daily for seven consecutive days. The following agents were examined:

(i) chlorhexidine solution (Tarodent, Taro Pharmaceuticals, Haifa, Israel) (0.2%) as well as a varnish formula preparation (0.2%) to achieve a slow releasing effect;
(ii) troclosene sodium, an organic chloride donor in the form of effervescent tablets (Klorsept, Concept Pharmaceuticals, Kfar-Saba, Israel), in a concentration of 400 ppm (it was used also in the form of a paste to achieve longer releasing effect);
(iii) a two-phase oil-water mixture mouthwash (Assuta, Agis Pharmaceuticals, Yerucham, Israel) containing cetlypyridinium chloride (0.05%), a food color which also serves as a biological stain (FD & C blue no. 1), and artificial sweetener, overlaid with a discrete oil phase containing a mixture of olive oil and essential oils (7);
(iv) allicin oil (2 mg/ml) purified from garlic (Allium sativum) (obtained from the department of chemistry at the Weizmann Institute of Science, Rehovot, Israel) (this agent has antimicrobial properties against many bacteria, fungi, and viruses) (1);
(v) taurolidine, an antibiotic/antiseptic preparation in a solution of 2% (Taulolin, Geistlich Pharma AG, Wolhusen, Swiss) (17); and
(vi) polymixine sulfate B (PMX) (Taro Pharmaceuticals, Haifa, Israel) (0.4%).

Oropharyngeal culture tests were performed on the first day just before the decolonization process and at the end of each treatment regimen (day 7). Samples were obtained with sterile swabs in the early morning before oral cleansing or a meal. Cultures were inoculated within 1 h of collection on blood, MacConkey’s, and chocolate agar plates and incubated at 37°C for 48 h. Staphylococcus aureus and the various GNB were identified by routine bacteriological methods.

Semiquantitative culture was used to measure the bacterial load for each bacterial group (enteric GNB, Pseudomonas spp., and Staphylococcus aureus) by counting the number of bacterial colonies on each plate. The following grading was used for each of the study organisms: 0, no growth; 1, up to 10 colonies; 2, 10 to 20 colonies; and 3, more than 20 colonies. The mean bacterial load was calculated as the mean of the scores accorded for the colonies count of each patient.

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Two treatment outcomes were examined: (i) the presence of pathogenic bacteria (S. aureus, P. aeruginosa, all other enteric GNB); (ii) the change in the mean bacterial load for each pathogen.

Statistical analysis was performed using SPSS software. Efficacy of treatment response was evaluated by Wilcoxon signed rank testing, paired t testing, and Pearson correlations for confounding factors which may affect treatment response.

Overall, 68 patients with NGT feeding participated in the various phases of this study. For each phase a group of 20 to 35 patients, fulfilling the inclusion/exclusion criteria, were recruited. Demographic and medical characteristics of participants are presented in Table 1.

Results of the various cleansing trials are presented in Table 2. With the exception of PMX no significant effects were noted with any of the antiseptic preparations tested, i.e., no disappearance or reduction in the load of any pathogenic organism. The only significant decrease in the rate and load of GNB growth (from 77% to 46%) and S. aureus (from 31% to 13%) was achieved by the use of the antibiotic preparation (PMX).

None of the tested compounds reduced the growth rate of S. aureus. On the contrary, an increase in its colonization rate was observed following the use of most agents (Table 2), from ~25% at the initiation of the study to ~45% at its completion. There was no significant change in the occurrence of GNB throughout the study period.

We evaluated possible confounding factors, including duration of hospital stay, duration of NGT feeding, medical comorbidities, medications or dental status, and none had influence on the therapeutic outcome.

It has been emphasized that since microaspirations cannot be fully prevented, efficient strategies to eliminate pathogenic microorganisms from the oropharynx should be developed (2, 18, 21). However, this study demonstrates the difficulties of decontamination of the oral pathogenic flora with various agents examined. We hypothesize that the lack of mastication and mechanical effect of food passing the oral cavity is the main culprit in this process of oral bacterial colonization (14). As with the blind loop syndrome, the oral cavity of the NGT-fed patients constitutes a kind of “open blind loop.” Another possible explanation consists of the bacterial biofilms formed on the NGT, as we have recently shown (9).

NGT-fed patients scattered all over the long-term-care system are a growing source of resistant oral flora. Thus, they constitute an epidemiological threat to their fellow residents and, in cases of transfer to general hospitals, to a much larger patient population (16, 20). For this study we selected antisep tic preparations to refrain from “antibiotic pressure” and to avoid development of resistance.

However, the results were indeed disappointing, some measure of efficacy being observed only with the antibiotic preparation, PMX, chosen due to its reported efficacy in preventing ventilator-associated pneumonia (in combination with vancomycin and neomycin) (15) and to the fact that it has not been frequently used. However, renewed interest in these agents due to emergence of pan-resistant organisms may be an obstacle to their routine use as an oral decontamination agent despite their effectiveness.

There is an urgent need to develop and investigate new effective antiseptic compounds and adopt new oral health care techniques.

### Table 1. Demographic and medical characteristics of NGT-fed patients (n = 68)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr) ± SD</td>
<td>78 ± 8</td>
</tr>
<tr>
<td>No. (%) of males</td>
<td>28 (40)</td>
</tr>
<tr>
<td>No. (%) of females</td>
<td>40 (60)</td>
</tr>
<tr>
<td>No. (%) with stroke</td>
<td>31 (48)</td>
</tr>
<tr>
<td>No. (%) with dementia</td>
<td>28 (40)</td>
</tr>
<tr>
<td>No. (%) with hypertension</td>
<td>28 (40)</td>
</tr>
<tr>
<td>No. (%) with ischemic heart disease</td>
<td>23 (33)</td>
</tr>
<tr>
<td>No. (%) with diabetes mellitus</td>
<td>18 (28)</td>
</tr>
</tbody>
</table>

### Table 2. Response to mouth cleansing with various antiseptic preparations in NGT-fed geriatric patients

<table>
<thead>
<tr>
<th>Treatment (no. of patients)</th>
<th>Time point (before or after treatment)</th>
<th>Any GNB</th>
<th>Pseudomonas spp.</th>
<th>S. aureus</th>
<th>Mixed floras (2+)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% Mean</td>
<td>% Mean</td>
<td>% Mean</td>
<td>% Mean</td>
</tr>
<tr>
<td>Chlorhexidine (35)</td>
<td>Before</td>
<td>76</td>
<td>1.8 ± 1.3</td>
<td>25</td>
<td>0.7 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>76</td>
<td>1.6 ± 1.4</td>
<td>25</td>
<td>0.8 ± 1.3</td>
</tr>
<tr>
<td>Troclosene (35)</td>
<td>Before</td>
<td>57</td>
<td>1.0 ± 1.3</td>
<td>34</td>
<td>0.8 ± 1.1</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>54</td>
<td>0.9 ± 1.1</td>
<td>26</td>
<td>0.7 ± 1.2</td>
</tr>
<tr>
<td>CPCh* (25)</td>
<td>Before</td>
<td>67</td>
<td>1.7 ± 1.3</td>
<td>36</td>
<td>0.9 ± 1.3</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>64</td>
<td>1.6 ± 1.2</td>
<td>32</td>
<td>0.8 ± 1.2</td>
</tr>
<tr>
<td>Allicin (20)</td>
<td>Before</td>
<td>62</td>
<td>1.6 ± 1.1</td>
<td>35</td>
<td>1.0 ± 1.4</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>55</td>
<td>1.0 ± 0.9</td>
<td>30</td>
<td>0.9 ± 1.3</td>
</tr>
<tr>
<td>Taurolidine (25)</td>
<td>Before</td>
<td>78</td>
<td>1.7 ± 1.3</td>
<td>23</td>
<td>0.8 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>75</td>
<td>1.6 ± 1.2</td>
<td>33</td>
<td>0.9 ± 1.3</td>
</tr>
<tr>
<td>Polymyxin (35)</td>
<td>Before</td>
<td>77</td>
<td>1.8 ± 1.3</td>
<td>31</td>
<td>0.8 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>46</td>
<td>1.1 ± 1.3</td>
<td>14</td>
<td>0.3 ± 0.9</td>
</tr>
</tbody>
</table>

*a The number of patients in each therapeutic trial.

*b Data are presented as the percentage of occurrence and the mean bacterial load of pathogens (see the text).

c 2+ or more than two types of pathogenic bacteria were present.

d $P < 0.05$ by Wilcoxon signed rank or paired t tests for evaluation of treatment response.

e CPCh, cetylpyridinium chloride.
REFERENCES