Gastric Candida Counts Following Gastric Surgery: 
A Prospective Study

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Abstract
Forty patients undergoing gastric surgery were tested for the prevalence and population of yeast cells in their gastric aspirates. Sixty five per cent were positive for yeasts in the pre-operative period as compared to 53% of 63 patients who were undergoing surgery for non-gastric diseases. The counts of yeasts in the two groups were insignificant, counts of $\geq 1 \times 10^6$ yeast cells/ml being found in 20% (gastric) and 15.9% (non-gastric) of cases. However, there was a rise in $\geq 3$ logs of yeasts cells/ml in the post-operative period in 46.9% of cases in the gastric group as compared to 10.7% in the non-gastric group. This rise correlated well with the antibody rise as detected by tube agglutination and immunodiffusion tests. These patients may be susceptible to subsequent bezoar formation in the stomach.

Key words: Candida, gastric surgery, bezoar.

Introduction
Yeasts often occur as saprophytes in the oral cavity and the gastrointestinal tract. Upper gastrointestinal candidiasis is only rarely documented, except in the esophagus where it is being reported with increasing frequency. Previously such infections were reported primarily in autopsy series. Recently, gastric candidiasis has been reported in a significant number of patients, especially in those undergoing gastric surgery. A gastric acidity acts as a barrier to the growth and propagation of Candida albicans. Thus an attention in gastric secretory pattern and motility due to gastric surgery may permit the development of gastric candidiasis. A common presentation of gastric candidiasis is a retained mucous mass swarming with yeast cells, presenting as a bezoar-like lesion discernable on gastric radiology.

The present study was undertaken (i) to find out the prevalence of yeast cells in the stomach of patients with or without gastric diseases, (ii) to estimate the change in the prevalence and population of yeast cells in the stomach in the post-operative period after gastric and non-gastric surgery, and (iii) to detect any Candida bezoar formation following gastro-duodenal surgery during the immediate post-operative period.

Material and Methods
Forty patients undergoing gastric surgery over a one year period (1982-83) were included in this study. These included cases with chronic duodenal ulcer (28), chronic duodenal ulcer with pyloric obstruction (5), carcinoma stomach (2) and pancreatic pseudocyst (5). The gastric surgical procedures performed were vagotomy and gastrojejunostomy or pyloroplasty (28), gastrojejunostomy (3), gastrectomy (2), cystogastrostomy (5) and closure of perforation (2). Sixty three cases undergoing surgery for non-gastric causes included those with biliary disease (35), colonic disease (12), perforation (5), small bowel lesions (4) and other conditions (7).

Gastric aspirates were collected through a large bore sterile Ryle's tube before surgery, at the time of operation, at various periods post-operatively (days 1, 2, 3, 4, 6 and 10) and, whenever the aspirates were persistently positive, up to 3 weeks post-operative.

The aspirates were first digested with 0.5% N-acetyl cysteine hydrochloride in 2% sodium citrate solution. The smears from the centrifuged deposits were obtained with 10% KOH and Gram stain for the demonstration of yeast cells and pseudomyecelia. The centrifuged specimens were cultured on two sets of Sabouraud's dextrose agar (SDA) slopes with antibiotics (chloramphenicol 0.05 mg/ml and gentamicin 20 mg/ml) and incubated at 22°C and 37°C for 3 weeks. Yeasts isolated were identified, and quantitative yeast cell counts performed. The digested gastric aspirates were resuspended in PBS, pH 7.2, bringing it to its original volume before quantitative culture on SDA plates.

A piece of gastric mucosa was taken from each of the 40 patients undergoing gastric surgery. These pieces were homogenised and the homogenates were examined by smear and culture as for gastric aspirates. Small pieces of biopsy were also placed on a slide and in a tube with 10% KOH each, for digestion of the tissue and demonstration of yeasts and pseudomyecelia.

Spumum specimens were examined in 6 patients showing very high yeast counts in gastric aspirates. The specimens were processed as with gastric aspirates.

Serum samples were collected for serological tests pre- and post-operatively with an interval of 2 or 3 weeks in both groups of patients. Tube agglutination test using whole Candida cells and immunodiffusion (1D) test using cytoplasmic antigen of C. albicans type A were performed to detect antibody levels against Candida in the serum.
Results

Yeast belonging to the species *C. albicans*, *C. tropicalis*, *Candida* (unidentified species), *Torulopsis glabrata* and unidentified yeasts were isolated from gastric aspirates prior to operation in 26 (65%) of 40 gastric cases and 34 (53%) of 63 non-gastric cases (Table 1). *C. albicans* was the main isolate from both groups. *C. albicans* and *C. tropicalis* were isolated in combination in 2 patients from the non-gastric group.

A count of \( \geq 1 \times 10^4 \) yeast cells/ml was found in 20% of gastric cases (these showed the presence of virulent pseudomycelia in 15% on smear) and in 15.1% of non-gastric cases (pseudomycelia in 4.1%) (Table 1). None of the patients with counts of \( < 1 \times 10^4 \) yeast cells/ml showed pseudomycelia.

Of 32 gastric surgery patients screened post-operatively, 19 were positive for yeasts in the preoperative period. Fifteen of the 32 (46.8%) showed an increase of \( \geq 3 \log \) in the yeast count in any one of the serial aspirations collected post-operatively, whereas only 3 of 38 (10.5%) non-gastric cases showed a similar increase (Table 2).

Of the 6 smears investigated in patients with high yeast count and the presence of pseudohyphae on smears of the gastric aspirates, there was high count in only 2 patients; the other 4 cases had scanty, non-significant growth on culture or SDA slopes.

None of the 40 gastric mucosa specimens tested showed any yeast on smear or culture.

Of 21 patients with gastric surgery tested for agglutinating antibodies in the serum, significant titres \( (t_e > 1:64) \) or four fold rise in paired sera, were seen in 9 (42.9%) patients. Immunodiffusion (ID) test was positive in 2 (22.2%) of these 9 patients. The yeast counts varied from 3 to 10 log/ml post-operatively in the gastric aspirates in all those 9 cases. All patients having low yeast count \((<1 \times 10^4 \) cells/ml) showed low titres of agglutinins and were negative by ID test. On the other hand, of 32 cases tested serologically from the non-gastric group, significant agglutinin titres were seen in 10 (31.2%) and ID test was positive in 6 (18.7%). Correlation with the presence of high yeast count was seen in 4 (12.5%) cases only.

Discussion

There was no significant difference in the presence of yeast cells in the gastric aspirates of patients with or without gastric disease. Franklin and Skoryna17 and

<table>
<thead>
<tr>
<th>Yeast counts</th>
<th>Positive</th>
<th>Yeast isolated</th>
<th>Yeast count/ml of gastric aspirates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>YM*</td>
<td><em>C. albicans</em></td>
<td><em>C. tropicalis</em></td>
</tr>
<tr>
<td>Gastric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>26 (65%)</td>
<td>6 (3.5%)</td>
<td>3 (0.6%)</td>
</tr>
<tr>
<td>Non-Gastric</td>
<td>34 (55.7%)</td>
<td>6 (6.6%)</td>
<td>29 (22.6%)</td>
</tr>
</tbody>
</table>

*YM = Yeast and pseudomycelia

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Total cases</th>
<th>Initially positive</th>
<th>Initially negative</th>
<th>Post-operative change in Yeast counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No change or drop</td>
</tr>
<tr>
<td>Gastric</td>
<td>32</td>
<td>19</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>13</td>
<td>12 (63.2%)</td>
<td>5 (26.3%)</td>
</tr>
<tr>
<td>Non-Gastric</td>
<td>28</td>
<td>25</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>9 (39.3%)</td>
</tr>
</tbody>
</table>

* Maximum change in counts in serial gastric aspirates collected during 10 day post-operative period.

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Brooks et al.1 reported isolation of yeasts in 35% and 6% of cases respectively as compared to 65% and 35% in our study. With regard to cell count, there was again no significant difference in the two groups. No such quantitative data are available in literature for comparison.

The presence of pseudomyecia in the direct smear examination was associated with higher counts, i.e., >1 x 10^4 Candida cells/ml in gastric juice. Here also, there was no significant difference between the two groups. The presence of these pseudomyecia in the non-gastric group is difficult to explain as none of these patients had history of respiratory, oral or oesophageal lesion. None had received any antibiotic pre-operatively.

All follow-up patients showed the presence of Candida in the post-operative period. On the other hand, the Candida counts showed an increase which was statistically significant in the gastric group. Brooks et al.1 reported an increase in the number of patients showing the presence of Candida from 8% in the pre-operative to 80% in the post-operative period. In the present study, there was a rise of 1-2 log in 15-6% and 39-5% of patients in the gastric and non-gastric groups respectively, and a rise of >3 log was detected in 46-9% and 10-7%, respectively.

Patients with gastric disorders appear to be more prone to yeast overgrowth and infection after gastric surgery. This concurs with observations made earlier. However, serial cell counts have not been done before.

It also appears that surgical procedures on the stomach or elsewhere in the body may be associated with a rise of 1-2 log Candida counts in stomach contents, but significant rise following gastric surgery and the critical rise in the yeast count may be 3 log/ml.

In order to verify the source of yeasts and pseudomyecia, sputum cultures were done in patients showing high yeast counts. Sputum was not the source of yeasts in the stomach of 65-6% of patients who had undergone gastric surgery.

The positive serological tests (tube agglutination and ID) correlated well with yeast overgrowth and the development of pseudomyecia in the gastric aspirates and thus can be utilized in the assessment of yeast overgrowth. Although the yeast count in the stomach was persistently raised in one patient, serological tests showed negative ID and low tube agglutinin titre. The source of this count in the gastric contents may possibly be mucosal lesions in the respiratory tract and swallowed sputum. Unfortunately, the sputum was not tested at that time.

All the gastric mucosal specimens tested showed no evidence of pre-operative invasion by Candida. It seems, therefore, that the luminal contents in the stomach alone support the growth and active multiplication of Candida in the lumen. This may explain why post-operative candida candidiasis presents in the form of yeast mucous bovine-like filling defects in the stomach lumen.2,11 In the present study, no filling defect was detected radiologically in the two patients investigated one month post-operatively. Other patients had progressed well and did not justify barium meal investigation. Pertanna et al.10 reported that yeast bozaars did not develop up to 1 year of follow up of patients undergoing gastric surgery.

Patients having yeast counts in gastric aspirates of >1 x 10^4 cells/ml pre-operatively should be followed up by culture examination of gastric aspirates and sputum, with serological tests and radiological examination if necessary, for the development of bozaars, especially when suggestive symptoms occur.

References