Gastric Emptying After Elective Abdominal Aortic Aneurysm Surgery: the Case for Early Postoperative Enteral Feeding

R. Avrahami*, J. D. Cohen1, M. Haddad, P. Singer1 and A. Zelikovski

Department of Vascular Surgery and 1General Intensive Care, Rabin Medical Center, Beilinson Campus, Petah Tiqva and Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

Objective: to assess gastric emptying with a view to early postoperative enteral nutrition after elective abdominal aortic aneurysm (AAA) surgery.

Methods: the paracetamol absorption test was used to assess gastric emptying in 13 consecutive patients at 6, 18 and 32 h following elective AAA surgery. All patients received postoperative analgesia with marcaine given via an epidural catheter during the first 48 postoperative hours. Normal emptying was defined as an area under the plasma paracetamol concentration curve at 60 min (AUC-60) of >600 mg/min/l.

Results: the median time to normal gastric emptying was 18–7.7 h. One patient (7.6%) had normal emptying at 6 h, nine (69%) at 18 h and 12 (92%) at 32 h. The nasogastric tubes were removed at a median of 3.2 days after surgery, and enteral feeding was commenced on day 4.

Conclusions: gastric emptying was normal 18 h post-AAA surgery as assessed by the paracetamol absorption test. In view of the importance of maintaining an intact gastrointestinal mucosa, enteral nutrition may be commenced on the second postoperative day.

Key Words: Nutrition; Enteral; Postoperative.

Introduction

Many authors claim that changes in the gut mucosa as a result of ischaemia or reperfusion during elective abdominal aortic aneurysm (AAA) surgery play a role in the development of postoperative multiorgan dysfunction syndrome (MODS).1,2 Another potential complication of mucosal ischaemia is stress ulceration, noted on gastroscopy in up to 80% of patients after routine AAA surgery.3 Early postoperative enteral nutrition (EN), apart from providing calories, has been shown to counteract intestinal ischaemia4 and to eliminate the need for stress ulcer prophylaxis.5 However, the decision of when to start EN after abdominal surgery is traditionally based on the return of bowel sounds and the volume of the gastric aspirate, even though these may be poor markers of intact gastric function6 and may result in unnecessary delay in initiating EN.

We prospectively assessed gastric emptying with the more objective non-invasive paracetamol absorption test, which has been widely used for this purpose in a variety of contexts.7,8 The analgesic paracetamol is not absorbed in the stomach, but rapidly enters the bloodstream from the small intestine. Significant plasma paracetamol levels therefore reflect normal gastric emptying and motility.

Patients and Methods

Local ethics committee approval and informed consent from the patients were obtained. We included 13 consecutive patients undergoing elective infrarenal AAA surgery. None of them had undergone previous gastric surgical procedures. All were anaesthetised and operated on by the same anaesthetist and surgeon. Access was obtained through a transperitoneal incision and standard operative techniques were used. Immediately following surgery, patients were transferred to the intensive care unit for routine postoperative care. A nasogastric (NG) tube was inserted in the operating room and its position confirmed by X-ray; it opened into a drainage bag for gastric decompression. Postoperative stress ulcer prophylaxis with sucralfate 1 gm through the NG tube four times daily was employed.
No paracetamol or gastrokinetic drugs were given during the study period. Analgesia was standardised to marcaine given via an epidural catheter during the first 48 h and to fentanyl given intravenously, as necessary. The NG tube was removed by the surgeon, who was blinded to the results of the gastric emptying studies, when he considered the ileus to be alleviated, on the basis of the return of bowel sounds and NG aspiration <250 ml/day; eight patients were extubated immediately following surgery, three patients 6 h later and two at 12 and 18 h. EN was started within 12 h of NG tube removal. All patients were haemodynamically stable throughout the study period and none received pressor agents.

The paracetamol absorption test was performed three times, at 6, 18 and 32 h after surgery. Patients were placed in the supine position, with the head of the bed elevated about 15 degrees. After the stomach was emptied by aspiration, 1 g of powdered paracetamol in 100 ml of water was introduced into the stomach via the NG tube. The tube was clamped for 2 h, during which time the patient was moved as little as possible. Arterial blood samples were collected from an indwelling arterial catheter at 15, 30, 60 and 120 min after paracetamol administration. The plasma was separated and stored at 4 °C until measurement of paracetamol concentrations with high performance liquid chromatography with electrochemical detection. After 2 h the NG tube was declamped and the residual volume measured. The area under the paracetamol absorption curve from 0–60 min (AUC-60) was calculated by the trapezoid rule between time zero and each sample time. Peak plasma paracetamol concentration (Cmax) and time to peak plasma paracetamol concentration (Tmax) were also noted. Normal gastric emptying was defined as an AUC-60 of >600 mg/min/l.

Positive end points of the study were: (i) median time to normal gastric emptying (AUC-60 >600 mg/min/l); (ii) residual volume (<50 ml/h); (iii) time to removal of the NG tube; and (iv) time to start of EN. Results are expressed as median ± standard deviation. Student’s t-test was used to determine the significance of the differences in plasma paracetamol concentration among the three time points.

### Results

The results of the paracetamol absorption tests are shown in Table 1. Median AUC-60 was 127.0 ± 168.7 mg/min/l at 6 h, and increased to 691.5 ± 283.3 mg/min/l at 18 h (p<0.001). The value at 32 h was 709.0 ± 397.0 mg/min/l. A level of >600 mg/min/l was attained at 6 h in one patient, 18 h in nine patients and 32 h in 12 patients; the remaining patient had a prolonged ileus requiring prokinetic agents. Median residual volume/hour was 25 ml at 6 h, 10 ml at 16 h and 10 ml at 32 h.

### Discussion

The study shows that gastric emptying as assessed by the paracetamol absorption test is normal at a median of 18 h after elective AAA surgery. This finding is important because the decision to initiate EN depends on normal gastric function. Early EN after elective gastrointestinal surgery has been shown to result in better preservation of hand grip strength and to decrease the number of postoperative infections. It also stimulates hepatic and splanchnic circulations and improves mucosal blood flow, thereby preventing intramucosal acidosis and permeability disturbances. In the study by Carr et al., postoperative patients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>6 h</th>
<th>18 h</th>
<th>32 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cmax (mg/l)</td>
<td>2.4 ± 4.2</td>
<td>9.5 ± 4.8</td>
<td>12.15 ± 5.3</td>
</tr>
<tr>
<td>Tmax (min)</td>
<td>60 ± 38.6</td>
<td>60 ± 38.9</td>
<td>60 ± 29.5</td>
</tr>
<tr>
<td>AUC-60 (mg/min/l)*</td>
<td>127 ± 168.7</td>
<td>691.5 ± 283.3</td>
<td>709 ± 397.0</td>
</tr>
<tr>
<td>Residual volume (ml)</td>
<td>25 ± 48.5</td>
<td>10 ± 152.3</td>
<td>10 ± 65.5</td>
</tr>
<tr>
<td>Number of patients (%) with normal result</td>
<td>1 (7.6%)</td>
<td>9 (69%)</td>
<td>12 (92%)</td>
</tr>
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* p<0.001 for value 6 h vs. 18 h.
who received immediate enteral feeding showed no increase in intestinal permeability, as assessed by the lactulose:mannitol ratio, compared to those who did not; indeed, the latter group had a five-fold increase in permeability. This is of particular relevance to patients undergoing AAA surgery who are prone to endotoxaemia and elevated levels of cytokines,21,22 probably as a consequence of bowel mucosal ischaemia due to low flow states (haemorrhage or hypotension) or to reperfusion following aortic cross-clamping.12 This, in turn, causes an increase in intestinal permeability and translocation of potentially pathogenic micro-organisms. Soong et al.14 confirmed this assumption in a post-mortem study. They found that patients who died following AAA surgery had developed intraoperative intramucosal acidosis (a marker of bowel ischaemia) of the sigmoid colon, and there was a significant correlation between the decreased intramucosal pH and the postoperative concentration of antidiotoxin core antibodies (measured systemically). Reciprocal changes in the serum concentrations of the cytokines interleukin-6 (IL-6) and p55TNF were observed as well. Stress ulcers are also related in part to mucosal ischaemia. In the setting of AAA surgery, one study showed that 80% of patients had endoscopically proven stress ulcers in the immediate postoperative period. Affected patients often receive prophylactic treatment with either H2 blocking agents or mucosa-protecting agents, both of which may disrupt the gastric-acid barrier. EN, on the other hand, has been shown to prevent stress ulcer bleeding and to eliminate the need for prophylaxis.5

The only question then, with regard to EN after AAA surgery, is how early it may be started. It is generally accepted that postoperative adynamic ileus involves the stomach for at least the first 48 h after abdominal surgery.15 During this time patients invariably undergo NG decompression despite evidence that it is of no use after elective abdominal or gastrointestinal surgery16 and may even be associated with an increased incidence of respiratory complications, such as atelectasis, aspiration and pneumonia.17 Early NG removal has not resulted in a greater incidence of vomiting.18 Traditionally, surgeons have relied on the presence or absence of bowel sounds and significant gastric residue to indicate the return of propulsive function. However, these clinical measures have not been proven to be reliable indicators.19 In our hospital, these traditional markers of emptying were used during the study period so that NG tubes were removed only after 3.4 days and EN commenced after 4 days. Since the completion of the study, NG tubes are routinely removed on the first postoperative day. Early removal of NG tubes and provision of EN may also allow us to discharge these patients earlier, which may have both health and cost implications.

It should be stressed that all our patients received postoperative analgesia with marciaine given via an epidural catheter for the first 48 h. It has been shown that continuous postoperative epidural infusion of local anaesthetics improves gastric emptying and reduces postoperative ileus.9,20 This may be due to the fact that epidural analgesia blocks or avoids some of the factors known to delay postoperative gastric emptying, such as pain, opioid analgesics and increased sympathetic nervous system activity.21 The addition of opioids, such as fentanyl, to the epidural marcaine may disrupt gastric emptying22 and we therefore do not use it.

In conclusion, gastric emptying after AAA surgery as assessed by the paracetamol absorption test usually returns to normal by the second postoperative day. In light of evidence pointing to the beneficial and protective effects of EN, we suggest that EN be started in the immediate postoperative period.

References
12 ROUMEN RMH, PRIELING JTM, VAN TITS WHJ, VAN DER VLIEG


Accepted 10 September 1998