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Feasibility of surgical technique and evaluation of postoperative quality of life after laparoscopic treatment of intrathoracic stomach

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Abstract *Background:* Because of the risk of life-threatening complications, the discovery of a complete intrathoracic stomach demands urgent surgery with the aim of repositioning the stomach and gastropexy, and secondarily, to improve life quality. In this study the feasibility of surgical technique and postoperative quality of life after laparoscopic treatment of complete intrathoracic stomach has been evaluated.

Methods: From June 1999 to December 2001 16 patients with an intrathoracic stomach (hiatus hernia Types IIB and III) were treated by laparoscopic techniques, including the repositioning of the stomach, hemi-fundoplication and anterior gastropexy. During the postoperative follow-up the recurrence rate and quality of life (Eypasch index) were evaluated. *Results:* All operations were performed laparoscopically

without conversion, with a mean operating time of 155 min. Pleural injuries occurred in 31% of patients and pleural effusions in 38%, which required puncture in three cases. Complete follow-up showed no recurrences at a median of 14 months. The median quality of life index was 84.6 preoperatively and had significantly improved to 117.8 after the operation. *Conclusion:* Laparoscopic access for the treatment of intrathoracic stomach represents a minimally invasive and safe treatment option for complete intrathoracic stomach, with a low level of perioperative morbidity and significant improvement in quality of life.

Keywords Para-oesophageal hernias · Laparoscopy · Toupet fundoplication · Polypropylene mesh · Quality of life · Feasibility

Introduction

Complete intrathoracic stomach represents a rare form of hiatus hernia (5–10%), which appears in two different forms [1]. In cases of fixed gastro-oesophageal junction, the fundus or the rest of the stomach wall can be shifted into the posterior mediastinum (Type IIA, para-oesophageal hernia) and can be displaced completely (Type IIB, upside-down stomach, Fig. 1c) [4]. An additional axial shift of the gastro-oesophageal junction into the posterior mediastinum, e.g. in cases of extremely large hiatus hernias, results in a complete intrathoracic stomach as well (Type III) [1].

Even though the acute symptoms, e.g. postprandial nausea, sensations of fullness, retrosternal pressure, dysphagia or heartburn, may be comparatively mild, a complete intrathoracic stomach may lead to dramatic mechanical complications. In the case of an organo-axial volvulus, the herniated stomach rotates along its longitudinal axis, resulting in obstruction and impairment of blood supply [10, 12, 13, 16, 22]. Since the perioperative mortality in patients with such complications rises to over 50%, an absolute indication for surgical repair is given, provided the cardiopulmonary and anaesthetic risks permit this [3].

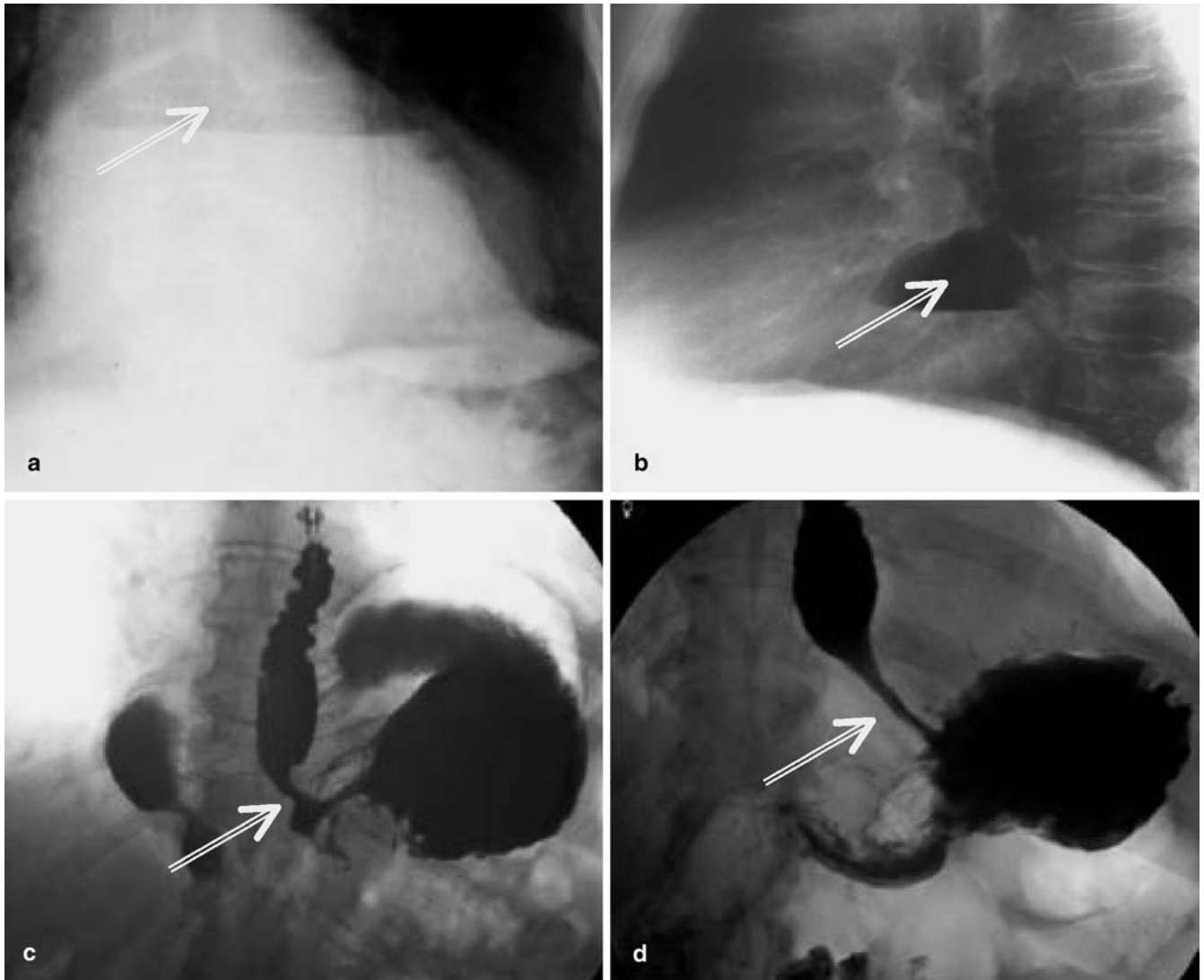


Fig. 1a–d Preoperative and postoperative radiological diagnostics. **a** Preoperative chest X-ray; **b** preoperative chest X-ray lateral with mediastinal fluid levels (→); **c** preoperative gastrointestinal passage with mediastinal position of the stomach and gastro-oesophageal

junction at the hiatus level (→); **d** postoperative gastrointestinal passage with intra-abdominal position of the stomach and typical narrowing of the lower oesophagus after hemi-fundoplication (→)

Surgical access can be obtained by a low, left, thoracotomy, median laparotomy or laparoscopy [1, 12, 16, 19, 22]. The thoracic access has proved advantageous only in patients with acute complications, because of the superior view which it gives when repositioning of the stomach is impossible and the stomach has to be resected. The transabdominal access represents the standard for elective cases of intrathoracic stomach because repositioning of the stomach and fundoplication as a precaution against symptoms of reflux are possible. However, open transabdominal surgery of the intrathoracic stomach is frequently complicated by pneumonia, atonia of the

stomach, wound infection, incisional hernia, gastro-oesophageal reflux and recurrence of the hernia [15].

Laparoscopic access offers another, relatively new, option for the management of complete intrathoracic stomach, with the hypothetical advantages of minimally invasive procedure and a better view of the hiatal crura. However, because of the different surgical techniques and the absence, so far, of quality assurance, it has not yet found wide acceptance as the treatment of choice for complete thoracic stomach. In this study we evaluated the feasibility of the surgical technique and quality of life after laparoscopic treatment of complete intrathoracic stomach.

Table 1 Patient data

Characteristic	<i>n</i>
Total number of patients with intrathoracic stomach	16
Gender	8 Male, 8 female
Mean age in years (range)	64 (36–80)
Operating risk (as classified by the American Society of Anesthesiologists)	ASA II 5 ASA III 11
Mean body-mass index in kg/m ² (range)	28.7 (19.4–31.3)
Co-morbidity (a single patient may have more than one condition)	
Obstructive airways disease	10
Coronary heart disease	8
Heart failure	7
Arterial hypertension	6
Diabetes mellitus	2
Stroke	1
Symptoms before operation	
Epigastric pain	9
Postprandial vomiting	8
Heartburn	8
Retrosternal pressure	6
Sensations of fullness and nausea	5
Dysphagia	5
Diarrhoea	5
Cough at night	4
Weight loss	3
Regurgitation	1
None	4
Intraoperative complications	
Injury to spleen	0
Injury to aorta	1
Conversion to open operation	1
Tachycardia	1
Injury to oesophagus	1
Postoperative complications	
Pneumothorax (pleural drainage)	5 (1)
Pleural effusion (puncture)	6 (3)
Persistent reflux	0
Short-term difficulty in swallowing	2
Dysphagia >3 months	0
Distension by gas	4
Diarrhoea	2
Mean duration of hospital stay in days (range)	9 (7–23)
Mean duration of operation in minutes (range)	155 (85–252)
Mean time elapsed before postoperative interview in weeks (range)	61 (24–126)

Patients and methods

Patients

From June 1999 to December 2001 16 patients with complete intrathoracic stomach (Types IIB and III) were treated laparoscopically in our surgical department. According to our preoperative radiological findings (barium follow-through), most of our cases had typical upside-down stomachs with no displacement of the gastro-oesophageal junction ($n=11$, Fig. 1c). All data were collected prospectively. Specific preoperative diagnostic investigation included radiological examination of the position of the stomach and oesophagogastrosocopy (Fig. 1 a, b). Table 1 shows the demographic data, ASA classification, body-mass-index and pre-operative symptoms of patients. Previous abdominal operations included appendicectomies, cholecystectomies and hysterectomies in some patients.

Surgical technique

The operation was performed under general anaesthesia. The patient was placed in a 30° anti-Trendelenburg, “modified lithotomy” position and received single-shot antibiotic prophylaxis with cefuroxime and a gastric tube. After inducing an appropriate pneumoperitoneum and placing the optical trocar in the conventional position for upper abdominal procedures, we inserted four further working trocars and then exposed the surgical field by raising the left lobe of the liver. All operations were conducted by a standardised procedure divided into five steps.

First, the stomach and greater omentum were pulled out of the thoracic hernial cavity and back into the abdomen. The right crus of the diaphragm was then exposed and dissected by use of an ultrasound dissector (Ultracision, Ethicon, Germany) (Fig. 2a, b). The second step included the excision of the peritoneal hernial sac, mainly by blunt dissection, and replacement of the stomach in its entirety. The oesophagus was supported with a silicone sling

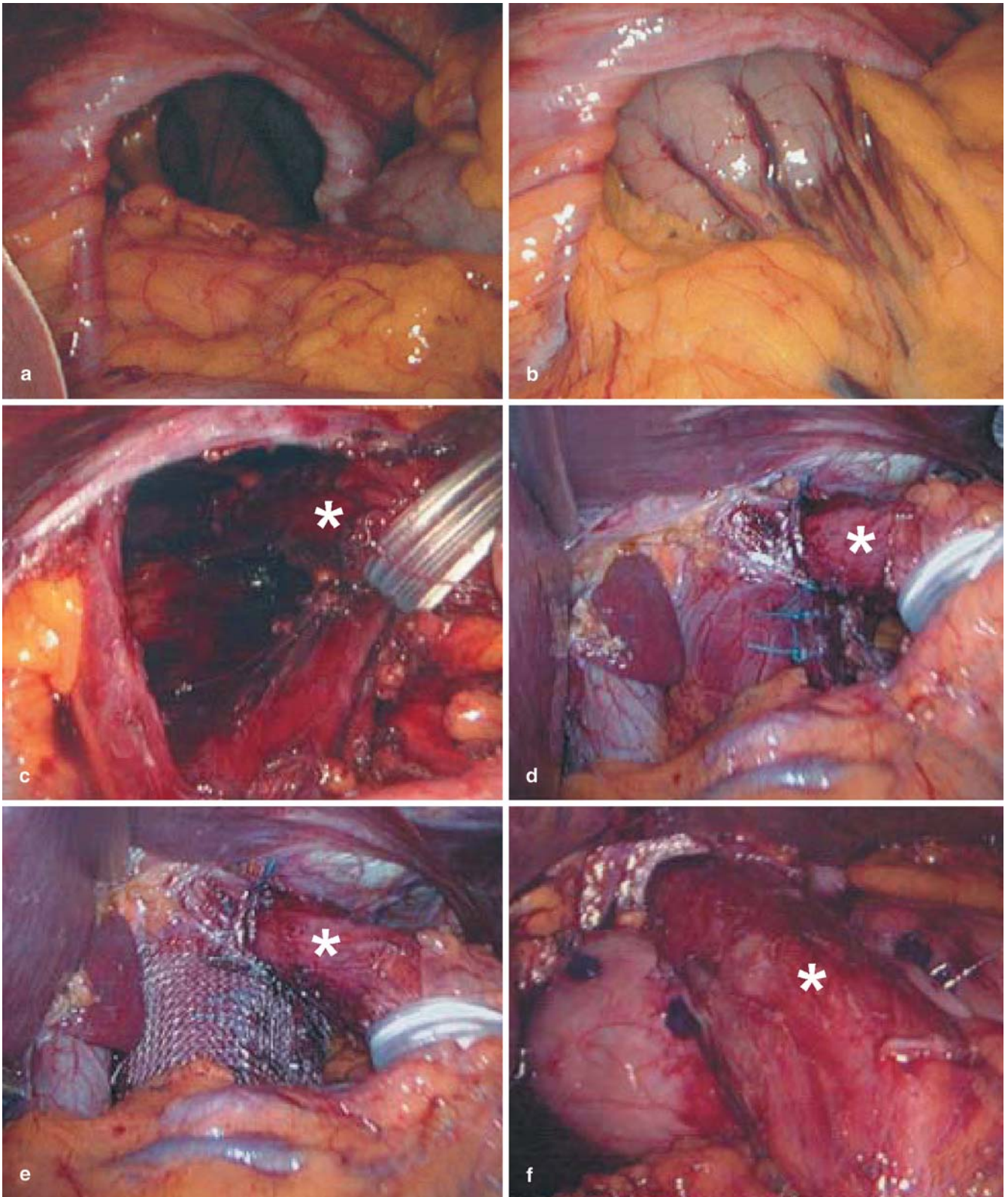


Fig. 2a–f Steps in the operation for laparoscopic treatment of complete thoracic stomach. **a** Repositioning 1; **b** repositioning 2; **c** view of the hernial orifice; **d** closure of hernial orifice; **e** mesh repair of hernia; **f** hemi-fundoplication. *Oesophagus

Table 2 Questionnaire for appraisal of quality of life (modified from Eypasch [7]), showing mean values for the normal population

Category	Sub-headings	Maximum points
1. Symptoms	Abdominal pain Epigastric sensations of fullness Belching, regurgitation, dysphagia Heartburn Nausea Lack of appetite Diet, restriction of food intake Eating slowly Diarrhoea, tenesmus Constipation Gaseous distension Blood in the stool Uncontrolled defaecation	76
2. Emotions	Coping with stress Sadness about the disease Nervousness, anxiety Contentment Frustration	20
3. Physical factors	Tiredness, feeling unwell Waking at night Bodily appearance Strength, stamina, fitness	28
4. Social function	Everyday activity, leisure activity Relations to those close to the patient Sex life	16
5. Drug treatment	Adverse effects of drug treatment	4

(Fig. 2c). Thirdly, the widely gaping diaphragmatic crura were coated dorsally to the oesophagus with 5–7 non-absorbable single sutures (Ethibond gauge 0, Ethicon, Norderstedt, Germany) (Fig. 2d, e). Even if inspection showed a seemingly tension-free closure, the hiatoplasty was routinely reinforced by a polypropylene mesh measuring approximately 3×6 cm. Fourthly, a hemi-fundoplication was performed by Toupet's technique (angle of hemi-fundoplication 210°), and, finally, a bilateral fundophrenicopexy was performed, with the use of absorbable Vicryl gauge 2/0 for the sutures (Ethicon) (Fig. 2f). No abdominal drains were used.

Postoperatively, the gastric tube was removed on the same day as the operation and patients were able to receive liquid enteral foods 1 day after surgery.

Follow-up check

The outcome of the operation was assessed in terms of recurrence and postoperative quality of life, as compared with the period before the operation. To exclude any recurrence, we gave all patients a radiological position check (chest radiograph, gastrointestinal follow-through) of the stomach on the fifth postoperative day and at the time of follow-up (see below), with attention to the position and motility of the stomach. Quality of life was assessed by the gastrointestinal life quality index (GQLI) devised by Eypasch et al. [7]. The GQLI comprises 36 questions giving a score of between 0 and 144 points (Table 2). For evaluation of the quality of life after surgery, 16 patients with intrathoracic stomach underwent the test preoperatively and again at the time of postoperative follow-up. Their results were compared with those from 16 people from the normal population, who were asked the same questions. Differences in quality of life were tested for significance by the Mann–Whitney U-test ($P < 0.05$).

Results

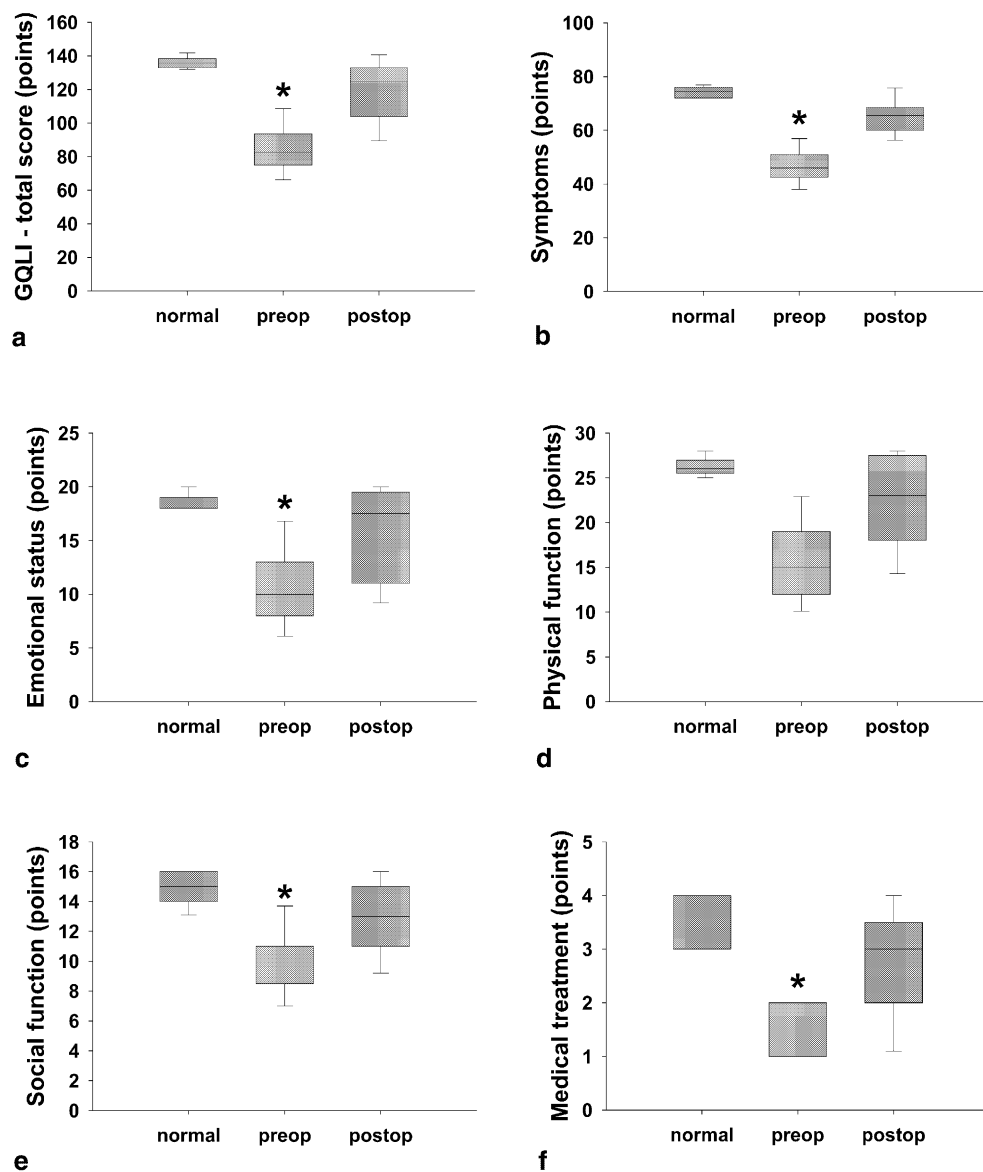
Intraoperative results

In 16 patients with complete thoracic stomach the anatomical abnormality was corrected laparoscopically in a mean operating time of 155 min (85–252 min). All patients had a radiologically demonstrated Type IIB ($n=11$) or Type III hernia with a definite dislocation of the gastro-oesophageal junction ($n=5$). Only in one operation was it necessary for us to change over to the open procedure. In this case, because of a previously unnoticed elongation of the aorta, it sustained an injury in its dorsolateral area during the excision of the hernial sac. Brisk arterial bleeding ensued and proved uncontrollable by laparoscopy. The bleeding point was oversewn, and the hernia was dealt with by the standard procedure through a midline upper abdominal incision. In one case, iatrogenic injury to the oesophagus was immediately recognised and dealt with by a suture. Except in the case mentioned above, blood losses were slight, and transfusion was necessary only in the one case.

Perioperative complications

Perioperative morbidity (within the first 30 days) arose mainly from pulmonary complications (Fig. 1). In five patients (31%) the parietal pleura was damaged during

Fig. 3a–f Quality of life after laparoscopic treatment of intrathoracic stomach. Comparison between preoperative status, postoperative status and the normal population. **a** Overall gastrointestinal quality of life; **b** symptoms of the disease; **c** emotional status; **d** physical function; **e** social function; **f** outcome of medical treatment. * $P < 0.05$



radical excision of the hernial sac, but the damage was visible during the operation. Despite some weakening of the patients' breath sounds, these operations were completed without problems with the aid of appropriate positive-pressure ventilation. In the postoperative chest radiographs, because of the prompt re-absorption of the CO₂, a pneumothorax was demonstrated only in one patient, and occurred due to a lesion of the visceral pleura. This required short-term chest drainage. In six patients (38%) postoperative ultrasound examination showed pleural effusions of varying extent, requiring drainage by needle puncture in three cases. In one of these cases a mediastinal seroma was also observed by CT. This necessitated a longer period of fasting together with antibiotic treatment. Despite intensive breathing exercis-

es, one patient had a definite ventilation disorder with formation of atelectasis. No patient required surgical revision. Mortality was 0%. Postoperatively, two patients complained of symptoms on swallowing, but these cleared up completely within 6 weeks. No patients complained of heartburn, and there were no wound infections.

Position of the stomach

In every patient the correct intra-abdominal position of the stomach was confirmed on the fifth postoperative day and on the follow-up by radiological examination with contrast medium (Fig. 1d). The mean follow-up time was

14 months (6–32 months) and the follow-up rate was 100%. There was no radiological evidence of any recurrence of the diaphragmatic hernia at that time.

Quality of life (Eypasch score)

Preoperatively, all the patients with a complete intrathoracic stomach had a significantly poorer quality of life (84.6 ± 14.8 points) than the normal population (136.3 ± 3.4 points, Fig. 3a). In particular, the patients had significantly more symptoms such as abdominal pain, sensations of fullness in the epigastrium, heartburn (46.9 ± 7.1 points, Fig. 3b) and significantly higher emotional lability in the form of sadness, frustration and anxiety about the disease (10.4 ± 3.9 points, Fig. 3c) than the normal population. In addition, all the patients experienced significant impairment of their physical activities, such as strength, stamina and fitness (15.7 ± 4.6 points, Fig. 3d) and social activities (10.2 ± 2.6 points, Fig. 3e) when compared with the normal population and stated that they were taking significantly larger amounts of medicines (1.4 ± 0.5 points, Fig. 3f) than the normal population.

After the operation all patients were subjectively symptom-free and had a significantly better quality of life (117.8 ± 18.9 points), this being as good as that of the normal population (Fig. 3a). After the operation—as compared with their preoperative state—patients had significantly fewer symptoms (64.5 ± 7.9 , Fig. 3b), less emotional lability (15.5 ± 4.5 points, Fig. 3c), and less evidence of physical (22.1 ± 5.2 points, Fig. 3d) or social impairments (12.8 ± 2.6 points, Fig. 3e) and were receiving significantly lesser amounts of medicines, particularly PPI medication (2.8 ± 1.1 points, Fig. 3f).

Discussion

This study shows that laparoscopic treatment of large para-oesophageal hernias with a complete intrathoracic stomach is technically feasible and offers the patients an attractive alternative to open surgery, thanks to the advantages of minimally invasive access. After an average follow-up time of 14 months, we were able to record satisfactory results as shown by low morbidity and gain in quality of life.

One necessary precondition is the standardisation of the surgical steps in the laparoscopic treatment of intrathoracic stomach.

- The repositioning of the stomach and the excision of the hernial sac are the first steps in the operation. Although, in open surgery, the excision of the hernial sac is frequently regarded as unnecessary, e.g. owing to the risk of damage to the parietal pleura, we routinely excise the hernial sac because, if the hernial

sac is left behind, a mediastinal seroma may develop within it, and will then need to be drained [15, 18, 25].

- Various methods have been described for the closing of the hernial opening between the two diaphragmatic crura—an opening that is usually of some size [15]. For coaptation of the diaphragmatic crura we, in principle, utilise non-absorbable single button sutures (Ethibond size 2/0) posterior to the oesophagus, because any attempt at anterior closure would displace the oesophagus backwards and would thus shorten its intra-abdominal portion [24]. Additionally, we recommend the strengthening of the diaphragmatic crura as a preventive measure, with an alloplastic polypropylene mesh, because it is known that especially in those patients with intrathoracic stomach there are predisposing factors leading to elevation of intra-abdominal pressure, e.g. obesity and constipation, or to a drop in pressure within the thoracic cavity, e.g. emphysema [2, 11, 12]. Using a polypropylene mesh measuring approximately 3×6 cm, we took care to narrow its cranial end so that we were able to attach it below the last diaphragmatic suture and, hence, prevent it from coming into contact with the oesophagus. In more than 500 operations for the treatment of gastro-oesophageal reflux disease, we have never seen any erosion of the oesophagus or any infection caused by the polypropylene mesh. Posterior hemi-fundoplication by Toupet's technique, in which portions of the gastric fundus are placed between the mesh and the oesophagus, provides further reinforcement of the hiatus and distances the mesh from the oesophagus.
- In open surgery for para-oesophageal hernias, especially those of Type II, fundoplication as a precaution against symptoms of reflux is not recommended, because reflux is not regarded as an essential problem. Recently, however, various workers have demonstrated a high incidence of gastro-oesophageal reflux, so that this has come to be regarded as an important factor in postoperative morbidity [8, 22, 26]. Even preoperatively, more than 30% of patients with Type II hernias had symptoms of gastro-oesophageal reflux, e.g. heartburn and regurgitation, and showed abnormal exposure of the oesophagus to acid and reduced pressure at the lower oesophageal sphincter (LES) [8]. Because of the necessity for complete mobilisation of the distal oesophagus, the gastro-oesophageal junction loses its anchorage, with the result that many patients develop reflux disease after the operation [17]. Furthermore, the posterior fundoplication further reinforces the diaphragmatic crura, so that this can be regarded as an additional step for the prevention of any recurrence. In fact, the diameter of the distal oesophagus at its connection with the cuff of fundus is larger than the reconstructed opening in the diaphragm, so that migration of the gastro-oesophageal junction into the thoracic cavity is made even more difficult [2].

- By an anterior gastropexy situated between the greater curvature and the anterior abdominal wall, postoperative gastric volvulus can be avoided, and the risk of recurrence of a para-oesophageal hernia can be diminished [6, 11, 21]. In addition, we perform a bilateral fundophrenicopexy. The area of the fundus posterior to the distal oesophagus, fixed in this way much further cranially, provides further reinforcement of the diaphragmatic crura and guarantees that the polypropylene mesh will not come into contact with the oesophagus. In our series, thanks to all these precautions, we did not encounter any cases of postoperative gastric volvulus or of recurrent hernia during the follow-up period.
- The occurrence of a pneumothorax after laparoscopic treatment of intrathoracic stomach does not usually require the placement of a chest drain, since carbon dioxide gas in the pleural cavity is rapidly reabsorbed, e.g. by short-term ventilation with positive end-expiratory pressure at the completion of the procedure, allowing the lung to re-expand rapidly [9, 20, 25]. In our study, one patient required short-term chest drainage due to a lesion of the visceral pleura.

Besides the performance of the operation in standardised steps, the operating skill of the surgeon has proved to be crucial to the success of the operation, and we therefore recommend that these rather uncommon operations should be carried out in centres where the surgeons deal with adequate numbers of laparoscopic interventions on the oesophagus, stomach and diaphragm. The limits of laparoscopic treatment also depend on the experience of the surgeon. Previous operations in the upper abdomen, even if they have led to distinct adhesions, do not present any obstacle, thanks to the excellent view obtained by the laparoscope. Laparoscopic access, however, comes up against its limits when the surgeon is dealing with emergencies such as incarcerated or strangulated gastric volvulus, if re-positioning of the stomach has been unsuccessful [14].

The recurrence rate after conventional treatment of thoracic stomach is stated to be 8–10% after 5 years [6,

23]. A similar recurrence rate can be expected after the laparoscopic procedure, although the technique is still too young for adequate long-term follow-up. The recurrence rate is, in fact, dependent on factors unconnected with the mode of access. For example, Edye et al. compared the rate of early recurrence of the hernia in a consecutive series of 58 patients after operation for para-oesophageal hernia [5]. In the first 25 patients the hernial sac was not excised, whereas this was done in the following 30 patients. All patients underwent hiatoplasty together with fundoplication or gastropexy. An unacceptably high rate of recurrent hernias was observed in the first group. Early recurrences were not observed in the patients who had undergone resection of the hernial sac. The authors regard hernial-sac resection as an essential part of the treatment of para-oesophageal hernias.

Besides the fear of mechanical complications from a complete intrathoracic stomach, any improvement in quality of life ranks as a secondary objective, though one which is not unimportant for the patient. The Eypasch score, as modified by us, embraces all the relevant social and bodily limitations imposed by the underlying disease. In our series we have shown that laparoscopic therapy can improve the previously impaired quality of life to levels identical to that enjoyed by the normal population. The low levels of perioperative and postoperative morbidity together with the faster convalescence—all attributable to minimally invasive access—contribute largely to these gains.

To maintain the future quality of the results of treatment of complete intrathoracic stomach, it will be important for surgeons to adopt a standardised procedure for the surgical steps, as presented in this study. Minimally invasive access is a goal to be striven for, and because of the good view of the surgical field that it provides, to say nothing of its low intraoperative and perioperative morbidity, it will achieve optimal improvement in quality of life. Clearly, however, the operation should be performed only at centres having wide experience of laparoscopy.

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