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ORIGINAL ARTICLE

Laparoscopic gastrostomy: the preferred method of gastrostomy in children

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Abstract We present a paediatric institutional experience with laparoscopic gastrostomies (LG) and evaluate its appropriateness as the recommended method for gastrostomy placement. We also sought to evaluate the efficacy of a simple technique for LG and collected information on long-term follow-up after LG. LG was performed in 112 children over a 6-year-period. The procedure involves visualization of the stomach through an umbilical port and a second epigastric gastrostomy site to select and anchor the stomach with sutures prior to the placement of a low profile gastrostomy feeding device (LPGD). The follow-up details of the patients were analysed. A review of literature was done to compare LG with percutaneous endoscopic gastrostomy (PEG). The median operating time for the procedure in 112 patients was 48 min. There was one open conversion. Median postoperative length of stay was 6 days. Other complications were vomiting (11%), perigastrostomy leak (26%), granulation tissue (42%), accidental dislodgement of the LPGD (4%), faulty device requiring replacement (10%), gastric mucosal prolapse (2%) and localized infection (2%). Follow-up ranged from 6 to 75 months with a cumulative gastrostomy usage of 2,352 months. The advantages of the described technique are virtual feasibility in all patients, primary placement of a LPGD, simplicity with requirement of minimal laparoscopic expertise and safety. Comparison with reports of PEG in the literature indicates that LG should be the preferred method of gastrostomy placement in children.

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Introduction

Gastrostomy for enteral access is a commonly performed procedure both in children and adults. Though percutaneous endoscopic gastrostomy (PEG) is a popular method, there exist major potential risks during the performance of a PEG. Laparoscopic gastrostomy (LG) has been suggested as a safer alternative [1–5]. We report our experience with laparoscopic gastrostomy in a large series of children.

Materials and methods

Technique

The technique used for gastrostomy is simple and requires only basic laparoscopic instrumentation. Techniques with some similarities to ours have been previously reported in small series of patients [6, 7]. The proposed site for the gastrostomy is marked on the left subcostal area prior to insufflation. This prevents the inadvertent placement of the stoma too close to the costal margin due to deformation of the abdominal wall from the pneumoperitoneum. A Hasson technique using an umbilical incision is utilized to create the pneumoperitoneum. A 30 degree 5 mm telescope was used in all our patients. Laparoscopy confirms the size and position of the stomach and evaluates any adhesions. A 6–8 mm incision is made over the appropriate gastrostomy site. The abdominal wall layers are incised under vision. Four quadrant sutures are passed through the posterior rectus sheath and the needles are left in place. If the patient

has a thick abdominal wall, these sutures may be placed through the anterior rectus sheath. A Babcock forceps is inserted through the centre of these sutures (Fig. 1). The body of the stomach is grasped under vision along the greater curvature, well away from the pylorus and the cardio-oesophageal junction. The stomach is brought out and fixed to the posterior rectus sheath by completing the sutures in place. The anchored portion of the stomach is opened with diathermy. Entry into the stomach using a thin metal probe is confirmed laparoscopically. Thereafter, a low profile gastrostomy feeding device (LPGD) is inserted over the probe into the stomach (Fig. 2). Placement within the stomach is confirmed by vision and by observing distension of the LPGD balloon within the stomach and the free flow of water instilled through the LPGD (Fig. 3). An additional anchoring suture is used to attach the button to the underlying skin to prevent accidental dislodgement. This suture is retained for 7–10 days. The gastrostomy is left on free drainage for the first postoperative night after which feeds are started. Essential enteral medications continue to be given through the gastrostomy immediately after surgery.

Methods

Patients who underwent a laparoscopic gastrostomy alone were included in this study. Data was retrospectively evaluated for a period of 6 years from 1 June 2000 to 31 May 2006. Hospital records and the data collected by the stomal therapist were used to analyse different parameters including indications for the operation, age, sex, duration of surgery, length of hospital stay, complications and follow-up. The study was approved by the Hospital Ethics Committee.

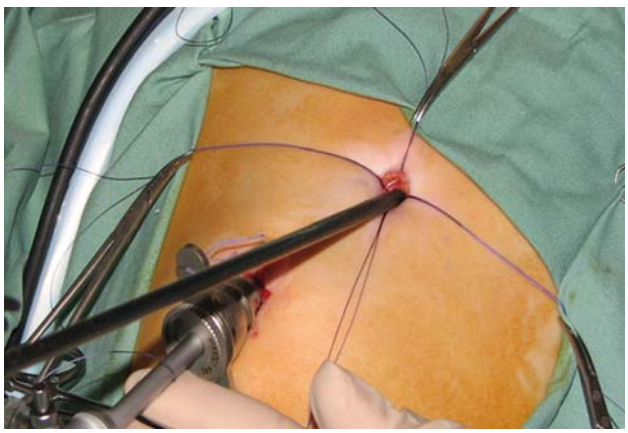

Fig. 1 Umbilical port for camera and a subcostal port with placement of 4 quadrant sutures through the posterior rectus sheath with insertion of laparoscopic Babcock forceps through the centre of these sutures

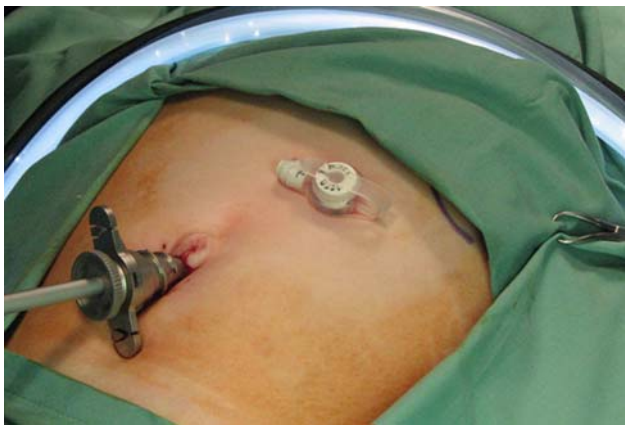

Fig. 2 Primary placement of the low profile gastrostomy feeding device

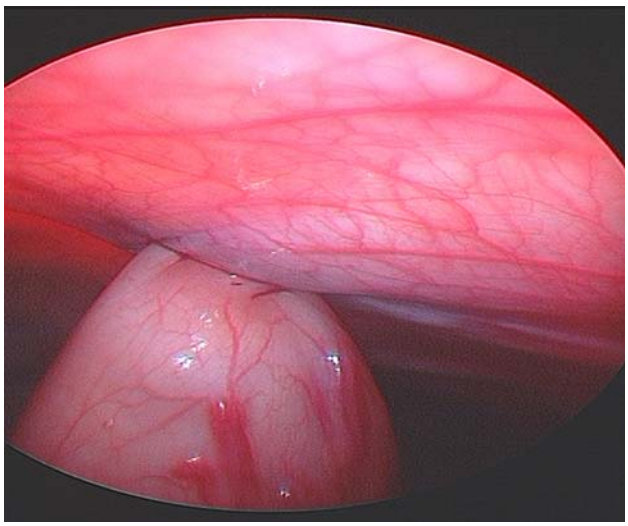

Fig. 3 Endoscopic view showing the well-anchored stomach and inflation of the gastrostomy device balloon within the lumen

Results

During this period, a total of 112 patients underwent LG. An additional 89 patients who had a concomitant fundoplication were excluded from analysis. The male/female ratio was 58/54. The age ranged from 0 to 17 years with a median of 4 years. Infants (aged 1 year or less) constituted a group of 23 patients.

The indication for a gastrostomy was varied. Neurologic impairment was present in 62 (55.3%) patients and 6 (5.4%) had cystic fibrosis. Inability to feed due to vomiting, oesophageal dysmotility, myopathy and syndromal anomalies formed a group of 25 (22.3%) patients. Failure to thrive due to other miscellaneous causes like cardiac and respiratory ailments, malignancies, renal failure and metabolic disorders was seen in 19 (17%) patients. The operating time was calculated from the time of incision to

the last suture. The median operating time was 48 min with a range of 27–125 min. This is prolonged compared to other reports and reflects the fact that 90% of LG's in our institute are done by junior trainees as one of their initial laparoscopic operations. Median postoperative length of stay was 6 days. This again is a reflection of prolongation of stay due to underlying medical conditions as opposed to post-operative recovery.

Among the complications identified, only those related to the procedure were listed for analysis (Table 1). The complications were classified as early (within 2 weeks of surgery) and late (2 weeks after surgery). They were also classified as major (requiring hospital admission) and minor (requiring outpatient treatment). One patient required conversion to an open procedure as the stomach could not be identified due to severe adhesions from a previous ventriculoperitoneal shunt insertion. Early post-operative vomiting was seen in 11 patients resulting in a delay in the achievement of full feeds. In two of these patients, the LPGD caused an obstruction of the pylorus and changing to a shorter device resolved the symptoms.

Among the late complications, the only major complication was gastric mucosal prolapse in 2 patients requiring surgical correction. Peri-gastrostomy infection requiring oral antibiotics was seen in 2 patients (2%). The commonest minor complications were peri gastrostomy leak in 29 patients (26%) and peri-gastrostomy granulation tissue in 47 patients (42%). These responded adequately in all patients with change to a more appropriate length feeding device or feeding regimen and chemical cauterization, respectively. Accidental dislodgement of the LPGD occurred in 4% of patients and a faulty device requiring replacement was seen in 10%. Both of these were more common in the balloon-based device as compared to the mushroom-based LPGD. The overall major complication rate was 3%. The incidence of minor complications was 54% (61 patients).

The total usage time was calculated from insertion to removal, last follow-up or patient's death. The mean usage time was 21 months with a range of 6–75 months. The cumulative usage time was 2,352 months (196 years). Follow-up was terminated in 1 patient due to death from myodystrophy, 4 years after the LG. Gastrostomy was removed in 4 patients when they no longer needed it, with spontaneous closure of the tract.

Discussion

Advances in surgery are towards procedures that are both safer and less invasive. PEG is popular because it is minimally invasive and has economic advantages when compared to open gastrostomy [8]. PEG, however, is not particularly safe and known to be associated with complications of a serious nature. There are no randomized controlled trials comparing LG and PEG. A review of the literature comparing between the data available for both procedures has been summarized in Table 2. PEG has a major complication rate of up to 11% [2, 9–12]. The major complication rate after a LG is not only lower, but of a less serious nature. Previous attempts have been made to compare different methods of gastrostomy [2, 13, 14]. However, the definition of complications varies between different studies and long-term follow-up is absent in most studies. The review presented herein shows that whereas the overall complication rates appear to be similar for PEG and LG, the latter has been demonstrated to be consistently safer with respect to the incidence of major complications.

When compared to a LG, PEG has other disadvantages. PEG is not advisable in certain conditions and will usually require a second anaesthesia to change the gastrostomy tube to a LPGD [2]. The operating times are comparable for both and will depend on the experience of the surgeon with either technique. The cost will also vary depending on different variables like the facilities existing at a particular centre, operative time, etc., but is likely to be more for a PEG as it involves two procedures as compared to one for a LG.

The procedure described for a LG varies from the simple to the complex [1–7, 13, 15, 16]. Most reports use T anchors and intracorporeal sutures to hitch the stomach to the abdominal wall [1, 5, 13]. Intra-corporeal stitches can unnecessarily increase the complexity of the procedure [5]. The bars of the T anchors may not always be evacuated in

Table 1 Complications after laparoscopic gastrostomy in our series

Early		Late	
Major	Minor	Major	Minor
Conversion to open procedure (1%)	Vomiting (10%)	Gastric mucosal prolapse (2%)	1. Granulation (42%) 2. Leak (26%) 3. Faulty device (10%) 4. Device dislodgement (4%) 5. Localized infection (2%)

Table 2 Comparison between laparoscopic gastrostomy (LG) and percutaneous endoscopic gastrostomy (PEG)

Parameter	Laparoscopic gastrostomy	Percutaneous endoscopic gastrostomy
Procedure related mortality	None reported	0–2% [9, 14]
Major complication rate	0–4% [1, 2, 4]	0–11% [2, 9, 10, 14]
Nature of major complications	Gastric perforation, gastrostomy tube dislodgment, conversion to open procedure [1, 13,18]	Gastro-colic fistula, aspiration pneumonia, failed PEG placement, intestinal obstruction, haemorrhage [2, 9, 10]
Overall complication rate (major + minor)	4–50% [1–3, 13, 18]	17–53% [8, 9, 14]
Anaesthesia	Single	Usually two [2]
Lack of feasibility	None	Adhesions, previous gastric surgery, ascites, oesophageal obstruction, portal hypertension, kyphoscoliosis [8, 13]
Operating time	15–57 min [2, 4]	12–55 min [2, 14]

the stool after they are cut 12–14 days postoperatively [1]. The technique we used has the advantage of simplicity and can, therefore, be duplicated easily. Accurately guiding the button or the tube into the stomach can be the challenging part of the operation. Tomicic et al. used a guide wire with the Seldinger technique to create a tract into the stomach for the placement of a gastrostomy tube [1]. They, however, encountered two posterior gastric wall perforations with this technique. In our technique, which is simpler and safer, the stomach was everted through the wound and incised prior to the gastrostomy button being guided over a thin metal probe in its journey into the stomach. This insertion is done with direct laparoscopic vision controlling against inadvertent perforation. The additional placement of an anchoring suture to the LPGD prevents accidental premature dislodgment whilst the gastrostomy tract matures. Single port LG has been described [15, 17]. While the presumption is that a single incision is cosmetically better, it has some disadvantages. Firstly, both papers describe a fairly large 15 mm port at the gastrostomy site. Moreover, once the incision is made, the site of gastrostomy cannot be changed. This is particularly important in the paediatric population with a high proportion of developmental delay and for children with previous abdominal surgery. Skeletal deformities and adhesions, respectively, may necessitate a change in the site of the gastrostomy and this can be best done after laparoscopy. A recent report of a large series of LG in children using the U stitch reports a favourable outcome in terms of ease and low morbidity [18]. However, the inadequacy of the tract formed with that technique is the probable reason for the occurrence of complications like omental herniation and intraperitoneal placement.

Reports on long-term follow-up with a gastrostomy are scarce [3, 19, 20]. The largest follow-up we came across in literature was 1,086 cumulative usage months [20]. With a cumulative usage time of 2,352 months, our report provides a large follow-up experience for the evaluation of a gastrostomy. Probably, it is also the reason why the observed incidence of minor late complications was as high as 54%. The incidence of granulation tissue and leaks will increase with usage and are considered acceptable components of ongoing stoma care. The high rate of minor complications might also be attributed to the fastidious records of the stomal therapist who is the first and often the only point of contact for patients with a complaint following a gastrostomy. Previous studies that have attempted a detailed long-term follow-up after LG have shown a similar increased incidence of minor complications [3, 20].

In conclusion, experience with our series of patients and review of literature indicates that LG has significant advantages in children when compared to a PEG. The technique we used is easily reproducible with minimal laparoscopic expertise. Our comprehensive data on follow-up adds to the meagre information available in the literature and attests to the longevity of a LG.

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References

1. Tomicic JT, Luks FI, Shalon L, Tracy TF (2002) Laparoscopic gastrostomy in infants and children. Eur J Pediatr Surg 12:107–110
2. Zamakhshary M, Jamal M, Blair GK, Murphy JJ, Webber EM, Skarsgard ED (2005) Laparoscopic vs. percutaneous endoscopic gastrostomy tube insertion: a new paediatric gold standard? J Pediatr Surg 40:859–862
3. Backman T, Arnbjornsson E, Berglund Y, Larsson LT (2006) Video-assisted gastrostomy in infants less than 1 year. Pediatr Surg Int 22:243–246

4. Rothenberg SS, Bealer JF, Chang JH (1999) Primary laparoscopic placement of gastrostomy buttons for feeding tubes. A safer and simpler technique. Surg Endosc 13:995–997
5. Humphrey GM, Najmaldin A (1997) Laparoscopic gastrostomy in children. Pediatr Surg Int 12:501–504
6. Andersson L, Mikaelsson C, Arnbjornsson E, Larsson LT (1997) Laparoscopic aided gastrostomy in children. Ann Chir Gynaecol 86:19–22
7. Luck A, Hewett P (1998) Laparoscopic gastrostomy: towards the ideal technique. ANZ J Surg 68:281–283
8. Stiegmann GV, Goff JS, Silas D, Pearlman N, Sun J, Norton L (1990) Endoscopic versus operative gastrostomy: final results of a prospective randomized trial. Gastrointest Endosc 36:1–5
9. Sheehan JJ, Hill AD, Fanning NP, Healy C, McDermott EW, O'Donoghue DP, O'Higgins NJ (2003) Percutaneous endoscopic gastrostomy: 5 years of clinical experience on 238 patients. Ir Med J 96:265–267
10. van der Merwe WG, Brown RA, Ireland JD, Goddard E (2003) Percutaneous endoscopic gastrostomy in children—a 5 year experience. S Afr Med J 93:781–785
11. Seguel Ramirez F, Ollero Fresno JC, Morato Robert P, Rollan VillamarinV, Alvarez Bernaldo de Quiros M (2003) Experience in performance of percutaneous endoscopic gastrostomy in 60 children. Cir Pediatr 16:125–127 (in Spanish)
12. Sasaki T, Fukumori D, Sakai K, Sato M, Ohmori H, Yamamoto F (2004) The safety and feasibility of percutaneous endoscopic gastrostomy placement. Hepatogastroenterology 51:1062–1065
13. Bankhead RR, Fisher CA, Rolandelli RH (2005) Gastrostomy tube placement outcomes: comparison of surgical, endoscopic, and laparoscopic methods. Nutr Clin Pract 20:607–612
14. Saitua F, Acuna R, Herrera P (2003) Percutaneous endoscopic gastrostomy: the technique of choice? J Pediatr Surg 38:1512–1515
15. Mikaelsson C, Arnbjornsson E (1998) Single-puncture laparoscopic gastrostomy in children. Pediatr Surg Int 14:43–44
16. Adham M, Baulieux J (2000) Laparoscopic gastrostomy. Surg Endosc 14:500
17. Kawahara H, Kubota A, Okuyama H, Shimizu Y, Watanabe T, Tani G, Hiroaki Y, Okada A (2006) One-trocar laparoscopy-aided gastrostomy in handicapped children. J Pediatr Surg 41:2076–2080
18. Aprahamian CJ, Morgan TL, Harmon CM, Georgeson KE, Barnhart DC (2006) U-stitch laparoscopic gastrostomy technique has a low rate of complications and allows primary button placement: experience with 461 paediatric procedures. J Laparoendosc Adv Surg Tech A 16:643–649
19. Hull MA, Rawlings J, Murray FE, Field J, McIntyre AS, Mahida YR, Hawkey CJ, Allison SP (1993) Audit of outcome of long-term enteral nutrition by percutaneous endoscopic gastrostomy. Lancet 341:869–872
20. Peitgen K, von Ostau C, Walz MK (2001) Laparoscopic gastrostomy: results of 121 patients over 7 years. Surg Laparosc Endosc 11:76–82