ORIGINAL ARTICLE

Finney and Jaboulay pyloroplasties for the treatment of benign gastric outlet lesions in dogs and cats: technique and outcome in 13 cases (2015-2024)

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Objectives: To describe the use, complications and outcome of Finney or Jaboulay pyloroplasties for the treatment of benign gastric outlet lesions in dogs and cats.

Materials and Methods: The medical records of dogs and cats surgically treated with Finney or Jaboulay pyloroplasty for benign gastric outflow tract disease in three institutions between January 1, 2015 and August 31, 2023 were retrospectively reviewed.

Results: Eight dogs and five cats were diagnosed with benign obstructive or perforating gastric outlet lesions, including chronic hypertrophic pyloric gastropathy ($n = 4$), perforating pyloro-duodenal peptic ulcer (4), sub-obstructive pyloro-duodenal eosinophilic sclerosing fibroplasia (2) and antral or proximal duodenal obstructive mass (3). Nine cases were treated using hand-sewn Finney pyloroplasty and four cases were treated using stapled Jaboulay pyloroplasty. No major complications were recorded. Cases were followed for a median of 16.1 [11 to 29.6] months. At the last follow-up, the outcome was excellent in all cases, with no clinical signs recorded and no medical treatment required.

Clinical Significance: This case series suggests that Finney and Jaboulay pyloroplasties were safe and effective procedures for the surgical treatment of benign obstructive or perforating gastric outlet lesions in dogs and cats.

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INTRODUCTION

Gastric outflow tract disease is an umbrella term used to describe a variety of antral, pyloric or proximal duodenal conditions that affect the patency of the gastric outlet (Bright, 2010). These conditions include both obstructive and perforating lesions occurring at this site.

Gastric outlet obstructions can result from either malignant or benign (neoplastic or non-neoplastic) causes. Benign obstructive conditions, such as congenital pyloric stenosis, acquired chronic hypertrophic pyloric gastropathy, benign or inflammatory masses and sclerotic lesions, are the most commonly found in dogs and cats (Bright, 2010). Because of the mechanical obstruction they create, they all result in delayed gastric emptying and subsequent chronic vomiting. Medical management is often inadequate in the presence of an anatomical obstruction and definitive treatment is usually surgical, with the aim of removing the obstruction and restoring normal gastric outlet patency.

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Several surgical techniques have been described in veterinary medicine in this setting, among which the Heineke-Mikulicz and the Y-U antral advancement flap pyloroplasties are currently the most commonly performed (Bellenger et al., 1990; Matthiesen & Walter, 1986; Safdar et al., 2013; Stanton et al., 1987). There is a paucity of data on the outcome of these pyloroplasties in dogs, but one author reported up to 25% of cases having persistent vomiting after Heineke-Mikulicz pyloroplasty, suggesting the persistence of a partial gastric outlet obstruction (Bellenger et al., 1990).

Among lesions responsible for gastric outflow tract disease, parietal perforations of the gastric outlet can also occur consecutively to the presence of peptic ulcers (Weiland et al., 1982). Their management has been described historically by either gastroduodenostomy (Billroth I) or gastrojejunostomy (Billroth II), both of which are technically challenging and associated with high morbidity and mortality (Eisele et al., 2010; Syrcle et al., 2013; Walter et al., 1985). An alternative is to perform primary repair of the perforated peptic ulcers, which has been recently described as an effective and less demanding procedure (Dobberstein et al., 2022); however, it is still associated with a 27% mortality rate and it is not feasible in cases of extensive loss of mural substance, in which a secure closure, implying (i) a correct debridement of the ulcer edges and (ii) a preservation of an adequate calibre of the pyloro-duodenal region to avoid consequent luminal stenosis, is sometimes precluded, even with a transverse closure.

In human medicine, benign diseases of the gastric outflow tract, including both obstructive and perforating gastric outlet lesions, are commonly treated using Finney and Jaboulay pyloroplasties (Cobbs, 2010a, 2010b; Moggia et al., 2016; Søreide et al., 2006). The Finney pyloroplasty is a side-to-side anastomosis between the gastric antrum, the pyloric area and the proximal part of the duodenum (Søreide et al., 2006). A Jaboulay procedure is similar to a Finney pyloroplasty in that it is a side-to-side anastomosis between the gastric antrum and the proximal part of the duodenum, excepting that the pylorus is preserved, suggesting that the Jaboulay procedure is not technically a true pyloroplasty, but rather an antroduodenostomy that bypasses the affected pylorus (Søreide et al., 2006). These techniques lead positively to a larger gastric outlet than the Heineke-Mikulicz pyloroplasty and improve the post-operative gastric emptying (Papageorges, Bonneau, & Breton, 1987). Furthermore, in cases of wide pyloro-duodenal perforations, they allow a safer closure of the digestive wall in healthy debrided tissue, while preserving a good diameter of the pylorus and duodenum (Moggia et al., 2016). Their implementation and description in veterinary medicine is, however, limited to experimental studies in healthy dogs (Khan et al., 2015; Papageorges, Bonneau, & Breton, 1987; Papageorges, Breton, & Bonneau, 1987a, 1987b; Sánchez-Margallo, Ezquerra-Calvo, et al., 2005; Sánchez-Margallo, Loscertales, et al., 2007).

The aim of this study was to describe the application of Finney and Jaboulay pyloroplasties for the surgical management of benign gastric outflow tract disease in dogs and cats, and the associated complications and outcome.

MATERIALS AND METHODS

Study design, medical records search and inclusion criteria

The medical records of dogs and cats surgically treated with Finney or Jaboulay pyloroplasty for benign gastric outlflow tract disease in three institutions between January 1, 2015 and August 31, 2023 were retrospectively reviewed. The search was conducted in September 2023 using the integrated medical records search function of the institution's management software, by two operators independently performing the same search, with the keywords "Finney pyloroplasty" and "Jaboulay pyloroplasty." Inclusion criteria were evidence of benign obstructive or perforating gastric outlet lesion, complete records and a minimum follow-up of 1 month. Cases with incomplete medical records were excluded from the study. Follow-up information was collected until March 13, 2024.

Data extracted

Data collected from the medical records included: signalment, history, presenting clinical signs and physical examination findings, diagnostic investigations performed and final diagnosis, specific treatments prior to surgery, surgical procedure, intra- and post-operative complications, details on post-operative care (duration of hospitalisation, post-operative medical treatment), and outcome. Outcome was defined as "excellent" if surgery lead to complete resolution of the presenting clinical signs without the need for further symptomatic medical treatment; "good" if mild presenting clinical signs persisted after surgery and symptomatic medical treatment was required; "poor" if the presenting clinical signs were unchanged after surgery, did not respond to symptomatic medical treatment and/or if further surgery was required. The short-term outcome was evaluated on the post-operative period from the time of surgery to 1 month post-operatively, and the long-term outcome was considered to be at least 6 months post-operatively. Follow-up information was obtained from the medical records and by contacting the owners. Quantitative data were expressed as median and interquartile range (Microsoft® Excel Software, ver. 16.54, USA).

Surgical procedures

Due to the long study period and patient-specific requirements, various anaesthetic and analgesic protocols were used. Premedication was mainly provided by dexmedetomidine [Dexdomitor®, Zoetis™, 0.005 mg/kg intravenously (iv)] and/or methadone (Comfortan®, Dechra™, 0.2 mg/kg iv). Induction consisted of a combination of midazolam (Midazolam®, Mylan™, 0.2 mg/kg iv) and propofol (PropoVet Multidose®, Abbott™, 2 to 4 mg/kg iv) or alfaxolone (Alfaxan®, Zoetis™, 1 mg/kg iv). After endotracheal intubation, general anaesthesia was maintained with isoflurane (1.5 to 2%) in oxygen. Antimicrobials such as ampicillin-sulbactam (20 mg/kg iv, Unacim®, Pfizer™) were administered 30 minutes before the skin incision and every 90 minutes until completion of surgery.

Dogs and cats were placed in dorsal recumbency, the abdomen was clipped and prepared for aseptic surgery. After a ventral

midline coeliotomy, the falciform ligament was excised using electrocoagulation.

Finney procedure (Fig 1) was performed using a hand-sewn technique. After mobilisation of the duodenum, the midpoint of the pylorus was grasped and a first stay suture was placed at its antimesentric border using a 3-0 absorbable monofilament with a taper point needle (glycomer 631, Biosyn®, Medtronic™). The duodenum and antrum of the stomach were apposed and a second stay suture was placed between them, approximately 6 to 8 cm caudal to the first one. A seromuscular continuous appositional suture was placed between the antrum and duodenum using a 4-0 monofilament

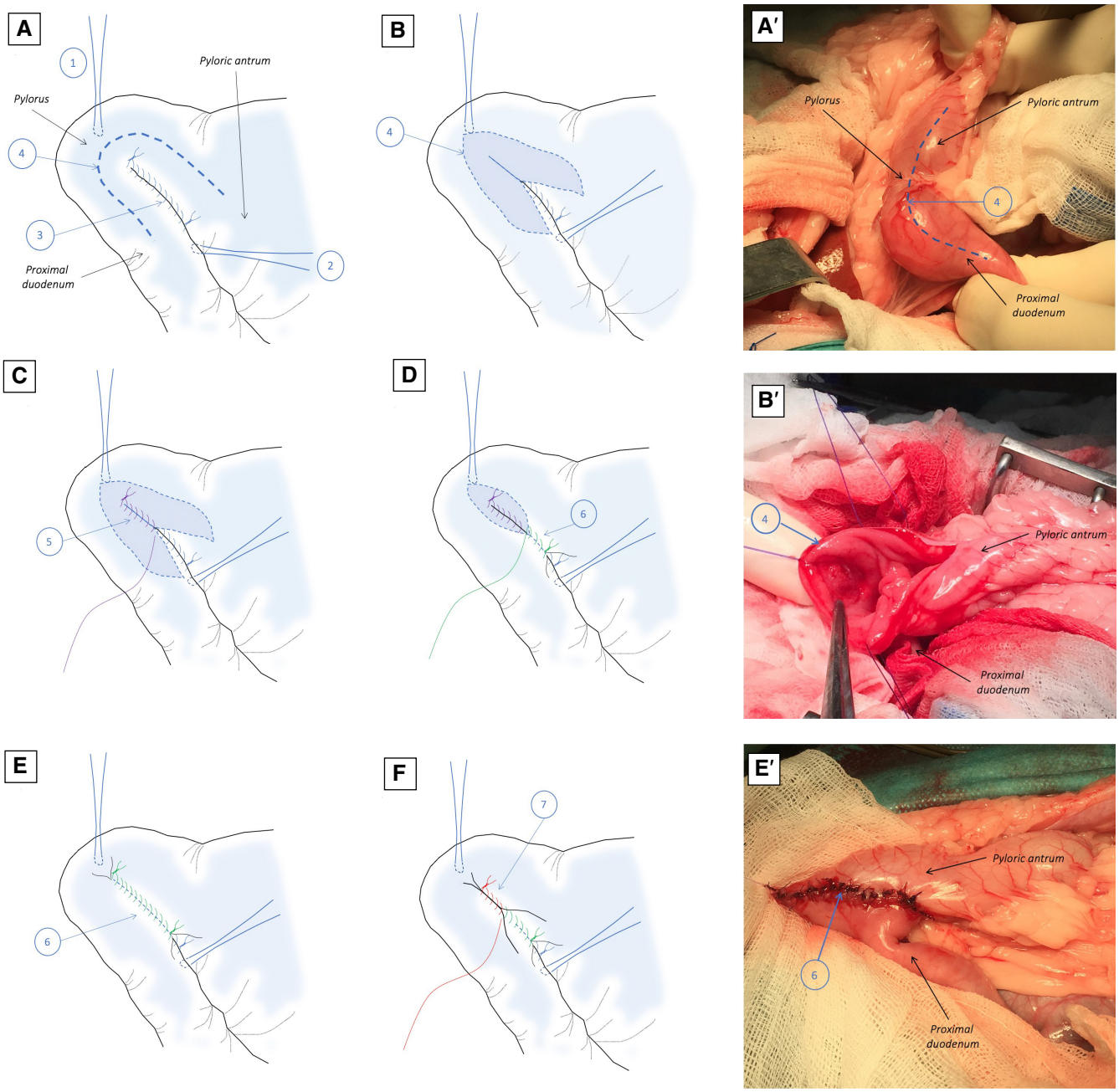

FIG 1. Hand sewn Finney pyloroplasty. (A) After mobilisation of the duodenum, the midpoint of the pylorus is grasped and a first stay suture is placed (1). The duodenum and antrum of the stomach are apposed and a second stay suture is placed between the duodenum and antrum at approximately 6 to 8 cm from the first (2). A seromuscular continuous appositional suture (in blue) is placed between the antrum and duodenum to relieve tension on the further suture line (3). (B) A U-shaped incision involving all layers of the ventral wall of the antrum, the pylorus and the antimesenteric border of the duodenum is made approximately 5 mm ventral to the appositional suture (4). (C, D, E) An antropyloroduodenal side-to-side anastomosis is performed with full-thickness simple continuous patterns between the dorsal edges (in purple) (5) of the wound on the one hand, and ventral edges (in green) of the wound on the other hand (6). (F) An appositional seromuscular continuous suture (in red) is placed ventrally to the anastomosis to reduce the tension on the antropyloroduodenal surgical wound (7). (A′, B′, E′) Intraoperative views corresponding to step (A), (B) and (E) respectively.

absorbable suture with a taper point needle (glycomer 631, Biosyn®, Medtronic™) to prevent further tension on the suture line. A U-shaped incision was then made approximately 5 mm ventrally to the appositional suture, involving all layers of the ventral wall of the antrum, the pylorus and the antimesenteric border of the duodenum. An antropyloroduodenal side-to-side anastomosis was performed, with a full thickness simple continuous pattern between the dorsal edges of the wound on the one hand, and between the ventral edges of the wound on the other hand, using 4-0 absorbable monofilament suture with a tapered point needle (glycomer 631, Biosyn®, Medtronic™). An appositional seromuscular continuous suture with interrupted 4-0 absorbable monofilament suture with a tapered point needle (glycomer 631, Biosyn®, Medtronic™) was then placed ventrally to the anastomosis to prevent tension on the antropyloroduodenal surgical wound.

A stapled technique was used for the Jaboulay procedure (Fig 2). The gastric antrum and duodenum were apposed and secured with a seromuscular continuous suture as previously described for the Finney procedure. A first stab incision was then performed at the antimesenteric border of the duodenum and a second at the pyloric antrum, close to the second stay suture, approximately 6 cm away from the pylorus. A gastrointestinal anastomosis linear stapler (ENDOPATH® ETS45 Endoscopic Linear cutter 3.5 mm/45 mm, Ethicon™) was then introduced through the stab incisions to perform the side-to-side anastomosis and the stab incisions were closed transversally with a simple appositional continuous suture pattern using a 4-0 monofilament absorbable suture with a taper point needle (glycomer 631, Biosyn®, Medtronic™). A ventral seromuscular continuous suture was then placed to reinforce the anastomosis.

The surgical site was systematically omentalised. In all cases, the abdominal cavity was rinsed with sterile isotonic solution and closed according to standard procedures. Post-operatively, the cases received fluid therapy, analgesia, gastroprotectants and anti-emetic drugs.

RESULTS

Signalment

A total of 13 records, including eight dogs and five cats, were found using the above keywords during the mentioned study period. All fulfilled the inclusion criteria and no case was excluded (Table 1). Median age was 4.3 [3.8 to 6.7] years at the time of diagnosis. There were eight males and five females, 10 of which were neutered. Breeds recorded included French bulldogs ($n = 2$), Yorshire Terriers (2), Griffin of Brittany (1), Eurasier (1), Shih-Tzu (1), Jack Russel Terrier (1), domestic shorthaired cats (2), Maine Coon (1), Korat (1) and Chartreux (1).

History and presenting clinical signs

Eight cases were presented with chronic clinical signs and five with an acute clinical presentation. Among the eight cases (cases 1, 3, 4, 5, 6, 7, 8 and 13) presented with chronic disease, clinical signs included vomiting (8/8), decreased appetite (4/8), diarrhoea (2/8), regurgitation (2/8) or constipation (1/8). Median duration of chronic clinical signs before presentation was 9.0 [0.8 to 18] months. All these cases had previously received symptomatic medical treatment for which no or only a partial response was elicited on the long term.

Among the five cases (cases 2, 9, 10, 11 and 12) presented with an acute clinical presentation, clinical signs included anorexia (3/5), vomiting (2/5) and acute abdominal pain (1/5) of a median duration of 5.5 [5.0;8.5] days. Four out of these five cases had a recent history of accidental or intentional ingestion of medications, whether it be non-steroidal anti-inflammatory drugs (NSAIDs) (cases 2 and 11), a combination of NSAIDs and corticosteroids drugs (case 10), or antimicrobials overdose (case 9, who accidentally ingested four tablets of 500 mg amoxicillin, i.e. 95 mg/kg, including the aluminium packaging).

Diagnostic investigations

Abdominal ultrasound was performed in all cases (13/13). In the 8 cases with chronic clinical signs (cases 1, 3, 4, 5, 6, 7, 8 and 13) an upper gastrointestinal endoscopy was also performed, by the same senior clinician. In all these chronic cases, biopsies of the stomach, pylorus and/or duodenum were taken during endoscopy. Histologic analysis was then performed according to the WSAVA guidelines (Washabau et al., 2010).

(i) In nine of 13 cases, a benign sub-obstructive to obstructive lesion was suspected on abdominal ultrasound and further confirmed by endoscopy and/or histology:

In cases 1, 3 and 5, a thickened pylorus was seen on abdominal ultrasound. In case 6, only an abnormal gastric dilatation was visualised on ultrasound; in these four cases (cases 1, 3, 5 and 6), upper gastrointestinal endoscopy revealed chronic hypertrophic pyloric gastropathy and histology suggested lymphoplasmocytic infiltration of the pylorus, stomach and/or duodenum. In case 3, spiral-shaped bacteria were also identified in the gastric mucosa.

In cases 4 and 8, a thickening of the proximal duodenum and pylorus was observed on ultrasound. Endoscopy revealed a chronically ulcerated and dysplastic circumferential lesion in the proximal duodenum in case 4, and a severely stenotic and inflamed pylorus that obstructed the progression of the endoscope in case 8. In both cases, feline eosinophilic sclerosing fibroplasia of the duodenum was diagnosed on histology. In addition, spiral-shaped bacteria were identified in the gastric mucosa in case 4.

In cases 7, 12, and 13, a focal sub-obstructive parietal mass was identified on ultrasound, located in the pyloric antrum (cases 7 and 12) or in the proximal duodenum (case 13). In case 7, endoscopy revealed a proliferative mass in the pyloric antrum and histology led to the diagnosis of an ulcerated inflammatory polyp with amyloid deposition and lymphoplasmocytic infiltration – also found in adjacent mucosal biopsies. In case 12, the antral parietal mass of 2 cm diameter was homogenous on ultrasound and originated from the muscular layer, consistent with a leiomyoma (further confirmed by post-operative histology). In case 13, a broad-based polyp-like lesion in the proximal duodenum

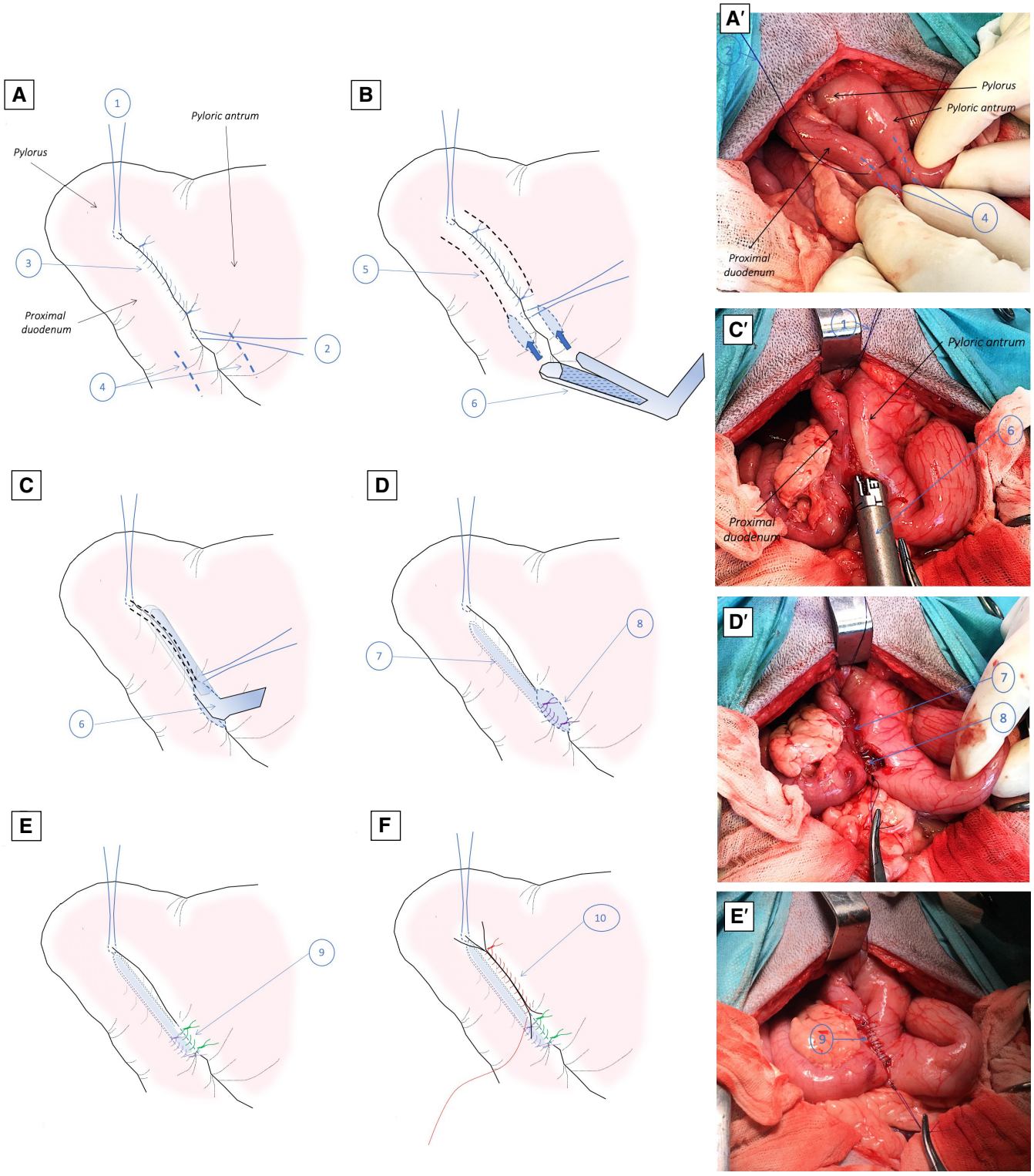

FIG 2. Stapled Jaboulay pyloroplasty. (A, B) The midpoint of the pylorus is grasped and a first stay suture is placed (1). The duodenum and antrum of the stomach are apposed and a second stay suture is placed between the duodenum and the antrum approximately 6 to 8 cm from the first (2). A seromuscular continuous appositional suture (in blue) is placed between the antrum and duodenum to avoid tension on the further suture line (3). A first stab incision is made on the antimesenteric border of the duodenum and a second one on the pyloric antrum, close to the stay suture (4). The black dotted lines represent the future site of the stapled side-to-side pyloro-duodenal anastomosis (5). (C) Introduction of the gastrointestinal anastomosis linear stapler (6) through the stab incisions to create the side-to-side anastomosis (7). (D) Dorsal closure of the stab incisions with a simple appositional continuous suture pattern (in purple) between the dorsal edges of the duodenal and antral stab incisions (8). (E) Ventral closure of the stab incision with an appositional suture pattern (*in green*) between the ventral edges of the duodenal and antral stab incisions (9). (F) A ventral seromuscular continuous suture (in red) is performed to reinforce the anastomosis (10). (A′, C′, D′, E′) Intraoperative views of steps (A), (C), (D) and (E), respectively.

Table 1. Clinical details for all 13 cases

Case n°	Breed	Age (years)	Sex	Weight (kg)	Symptoms	Diagnostic	Previous relevant medical or surgical treatment (other than symptomatic treatment of vomiting) *and clinical response*	Surgical procedure	Short-term outcome (post-operative clinical signs)	Long-term outcome	Follow-up duration (months)
1	Domestic shorthair cat	7.5	Male castrated	2.8	1-month history of vomiting and inappetence	Chronic hypertrophic pyloric gastropathy	—	Finney pyloroplasty	Excellent	Excellent	81.3
2	Yorkshire terrier	4.3	Male castrated	3.5	Acute abdominal pain	Perforating proximal duodenal peptic ulcer	—	Ulcer debridement + Finney pyloroplasty	Excellent	Excellent	29.6
3	French bulldog	3.0	Male castrated	7.8	1.5year history of vomiting	Chronic hypertrophic pyloric gastropathy	Palatoplasty ➞*Persistence of clinical signs*	Jaboulay pyloroplasty	Good (episodes of vomiting and regurgitations for 3 weeks)	Excellent	49.1
4	Maine Coon cat	4.3	Male castrated	9.6	1.5-year history of vomiting and diarrhoea	Sub-obstructive pyloro-duodenal eosinophilic sclerosing fibroplasia	Immunosuppressive therapy ➞*Persistence of clinical signs*	Finney pyloroplasty	Excellent	Excellent	20.1
5	French bulldog	3.9	Female	9.2	10-month history of vomiting and regurgitations	Chronic hypertrophic pyloric gastropathy	Palatoplasty ➞*Persistence of clinical signs*	Jaboulay pyloroplasty	Good (episodes of vomiting for 48 hours)	Excellent	20.8
6	Griffin of Brittany	3.8	Male	14.5	1-year history of vomiting and weight loss	Chronic hypertrophic pyloric gastropathy	—	Jaboulay pyloroplasty	Good (six episodes of vomiting during the first 3 weeks)	Excellent	41.2
7	Yorkshire terrier	9.7	Female neutered	3.8	2-week history of vomiting, 48 hours of diarrhoea, inappetence, lethargy	Pyloric inflammatory polyp with adjacent antral tissue invasion	—	Mass resection + Finney pyloroplasty	Excellent	Excellent	12.4
8	Domestic shorthair cat	4.5	Female neutered	4.3	2-week history of vomiting, inappetence and weight loss First episode 2 years before	Sub-obstructive pyloro-duodenal eosinophilic sclerosing fibroplasia	Immunosuppressive therapy ➞*Persistence of clinical signs*	Jaboulay pyloroplasty	Excellent	Excellent	16
9	Eurasier	1.1	Female	21	6-day history of vomiting and lethargy following accidental ingestion of medications (95 mg/kg of amoxicilline)	Perforating pyloric peptic ulcer	—	Ulcer debridement + Finney pyloroplasty	Good (three episodes of vomiting during the first week after surgery)	Excellent	13.8
10	Shih tzu	5.8	Female neutered	8.9	11-day history of dysorexia	Perforating proximal duodenal peptic ulcer	—	Ulcer debridement + Finney pyloroplasty	Good (one episode of vomiting, diarrhoea and anorexia at day 8 after surgery)	Excellent	11
11	Korat cat	6.6	Male castrated	3.5	5-day history of anorexia	Perforating pyloric peptic ulcer	—	Ulcer debridement + Finney pyloroplasty	Good (dysorexia persisting 3 days after surgery)	Excellent	7.7
12	Jack Russel	16	Male castrated	8.1	3-day history of dysorexia	Sub-obstructive antral leiomyoma	—	Mass resection + Finney pyloroplasty	Good (dysorexia and regurgitations for 48 hours)	Excellent	8.7
13	Chartreux cat	5.8	Male castrated	8.4	1.5-month history of vomiting, regurgitations, dysorexia, constipation	Broad-based duodenal adenomatous polyp	—	Mass resection + Finney pyloroplasty	Good (dysorexia 3 days after surgery)	Excellent	6.3

was visualised on endoscopy and Brunner's gland hyperplasia was diagnosed on histological analysis.

(ii) In four of 13 cases, a pyloro-duodenal perforated peptic ulcer was identified (case 10) or strongly suspected (cases 2, 9 and 11) on abdominal ultrasound, based on the presence of pneumoabdomen, diffuse peritonitis, gastritis/duodenitis, peritoneal effusion compatible with a septic ± biliary effusion, without further identification of a digestive tract lesion.

In summary, benign gastric outlet lesions were diagnosed in all cases:

(i) Nine cases had gastric outlet obstructive lesions: three dogs and one cat had chronic hypertrophic pyloric gastropathy (cases 1, 3, 5 and 6), two cats had pyloro-duodenal stenosis related to feline eosinophilic sclerosing fibroplasia (cases 4 and 8), two dogs and one cat had an obstructive antral or duodenal mass of either inflammatory or benign neoplastic nature (cases 7, 12 and 13).
(ii) Four cases (three dogs and one cat) had gastric outlet perforating peptic ulcers, either visualised on ultrasound in the proximal duodenal region (case 10) or strongly suspected based on history and ultrasound in the pyloric region and confirmed at this location after exploratory laparotomy (cases 2, 9 and 11).

Previous specific treatments

Cases 4 and 8 were treated primarily with immunosuppressive medical therapy to manage their feline eosinophilic sclerosing fibroplasia [cyclosporine (Atopica®, Novartis™) 5 to 6.8 mg/kg/day PO and prednisolone (Dermipred®, CEVA™) 0.5 to 1 mg/kg/day PO] but the disease progressed and surgery was indicated to relieve the persistent gastric outflow obstruction. Cases 3 and 5, which were brachycephalic dogs, underwent surgery for their brachycephalic airway obstruction syndrome (rhinoplasty and palatoplasty) several years prior to presentation with gastric outflow disease, and they did not present any concurrent respiratory clinical signs at that time.

Surgical procedure

Nine cases underwent Finney pyloroplasty (cases 1, 2, 4, 7, 9, 10, 11, 12 and 13) and four cases underwent Jaboulay pyloroplasty using an automatic stapling device (cases 3, 5, 6 and 8). In the dogs with the antral masses (cases 7 and 12), an incision was first performed in the antrum to resect the lesion with 1 cm margins; this incision was then extended to the duodenum and closed by incorporating it into a Finney procedure. The same procedure was performed in case 13, but the duodenal broad-based polyp was resected with close margins because of the proximity to the duodenal papilla. In the cases diagnosed with perforating peptic ulcers (cases 2, 9, 10 and 11), the ulcerated area (approximately 1 cm in diameter in each case), located in the ventral part of the proximal duodenum (cases 2 and 10) or in the pyloric area (cases 9 and 11), was debrided and closed by incorporation into a Finney pyloroplasty, carried out as described above.

Post-operative care

Median hospitalisation time was 3.5 [3.0 to 4.0] days. Post-operatively, all cases received fluid therapy (Ringer's lactate 2 to 4 mL/kg/hour iv), analgesia [analgesic protocols were administered at the discretion of the attending clinician and adjusted according to pain scores assessment using the 4A-vet post-operative pain scale; they consisted mainly of opioids such as methadone (Comfortan®, Dechra™) 0.1 to 0.3 mg/kg iv q4h or buprenorphine (Buprecare®, Axience™) 0.02 mg/kg iv q6h], antiacids [pantoprazole (Pantoprazole®, Biogaran™) 1 mg/kg iv q12h, sucralfate (Ulcar®, Sanofi™) 100 mg/kg PO q8h], antiemetic treatment [maropitant citrate (Cerenia®, Zoetis™) 1 mg/kg SC q24h and/or metoclopramide (Emeprid®, CEVA™) 0.3 mg/kg iv q8h] and were fed a hyperdigestible diet. Gastroprotective and anti-emetic medications were continued orally after discharge from the hospital, for 1 to 2 weeks depending on clinical evolution. In addition, cases 2, 9, 10 and 11 were given antibiotics for 15 days [amoxicillin-clavulanic acid (Augmentin®, GlaxoSmithKline™) 20 mg/kg iv q12h and then PO (Kesium®, CEVA™) when able to eat]. Fifteen days after surgery, cases 4 and 8 received corticosteroids [prednisolone (Dermipred®, CEVA™) 0.2 and 0.5 mg/kg PO q12h, respectively], immunosuppressive drugs [case 8 only, cyclosporine (Cyclavance®, Virbac™) 0.75 mg/kg PO q12h] for the management of their feline eosinophilic sclerosing fibroplasia; the administration of these drugs was further adjusted according to the clinical evolution of the animal and the echographic aspect of the lesions.

Complications

No intraoperative complications were reported. A minor post-operative complication was recorded in one dog and consisted of a seroma formation. Post-operative ultrasounds were performed in all cases between 48 hours and 4 days post-operatively and showed no evidence of complications at the surgical site. No major post-operative complication requiring revision surgery was recorded.

Outcome

The cases were followed up for a median of 16.1 [11 to 29.6] months.

Short-term outcome

Seven out of 13 cases recovered spontaneous appetite the day after surgery (cases 1, 4, 5, 6, 7, 8 and 9). Five out of 13 cases were free of clinical signs immediately after surgery (cases 1, 2, 4, 7 and 8).

Episodes of vomiting and/or regurgitation were, however, recorded post-operatively in six of 13 cases (cases 3, 5, 6, 9, 10 and 12), during the first week (cases 5, 9, 10 and 12) until the third week following surgery (cases 3 and 6). These six cases had ultrasonographic or endoscopic signs of gastritis, either visualised pre- (cases 3, 5, 9, 10 and 12) and/or post-operatively (cases 3, 6, 9 and 10). Three cases (cases 3, 5, 6) required the administration of symptomatic

treatment, consisting of anti-acids [esomeprazole (Inexium®, AstraZeneca™) 1 mg/kg PO q12h], gastroprotectants [aluminium phosphate (Phosphaluvet®, Med'Vet™) 145 mg/kg PO q8h] and/or anti-emetic drugs [metoclopramide (Emeprid®, CEVA™) 0.2 mg/kg PO q8h] during a prolonged period, that is, over 2 to 3 months.

Cases 11, 12 and 13 experienced post-operative persisting dysorexia. All had pre-operative echographic signs of acute pancreatitis. Cases 11 and 12 recovered spontaneously 48 to 72 hours after surgery, and case 13, in which a cholangite was subsequently identified, recovered after a 4-day hospital stay, during which he received analgesia [methadone (Comfortan®, Dechra™) 0.1 mg/kg iv q4h], antibiotics [amoxicillin-clavulanic acid (Augmentin®, GlaxoSmithKline™) 20 mg/kg iv q8h], anti-emetics [maropitant citrate (Cerenia®, Zoetis™) 1 mg/kg iv q24h] and anti-acids [esomeprazole (Inexium®, AstraZeneca™) 1 mg/kg PO q12h]. The short-term outcome was thus considered good in eight of 13 cases (cases 3, 5, 6, 9, 10, 11, 12 and 13) and excellent in five of 13 cases (cases 1, 2, 4, 7 and 8).

Long-term outcome

At long-term follow-up, the outcome was excellent in all cases, all being completely cured and not requiring further medical treatment for their presenting clinical signs. Only the cats with feline eosinophilic sclerosis fibroplasia required long-term corticosteroid and/or ciclosporine administration for the stabilisation of their underlying lesions. Three cases underwent upper gastroduodenal endoscopy at 1 month (case 6), 1 year (case 5) and 1.8 years post-operatively (case 4). No evidence of gastritis was noted in these three cases, although biliary reflux was observed in one (case 6), and the anastomosic site was well healed and patent at the time of examination.

DISCUSSION

The present case series reports eight dogs and five cats presenting benign gastric outlet lesions successfully treated with Finney or Jaboulay pyloroplasties. In all cases, both techniques were safe and effective in restoring the gastroduodenal patency. No major complications occurred in the post-operative period. The median duration of hospitalisation was 3.5 days, which is comparable to any digestive surgery on small intestine, and reflects the low morbidity of the procedures. Some cases experienced vomiting episodes over the month following surgery, but all digestive disturbances resolved with appropriate medication. At long-term follow-up, all cases were completely cured from their gastric outflow tract disease without any further symptomatic treatment.

The outcome observed in the present study, which contrasts with other pyloroplasty techniques in which approximately 25% of dogs had persistent vomiting (Bellenger et al., 1990), may be due to the increased size of the gastrointestinal junction provided by the Finney and Jaboulay techniques. Indeed, in an experimental study on healthy dogs, the lumen of the gastrointestinal junction was increased by 12 and 7.2 times, respectively, by the Finney and Jaboulay procedures, in contrast to the only 4.5-fold increase observed with the Heineke-Mikulizc procedure (Papageorges, Bonneau, & Breton, 1987). However, it remains unclear whether this increase allows for better gastric drainage in dogs with gastric outflow tract obstruction. Indeed, data are only based on experimental studies and results are conflicting across studies: on the one hand, some experimental studies have shown that neither the performance of a gastric drainage procedure nor the size of the gastrointestinal stoma accelerates gastric emptying of canned food in normal dogs (Papageorges, Bonneau, & Breton, 1987; Papageorges, Breton, & Bonneau, 1987b); on the other hand, some others and more recent studies have suggested improved post-operative gastric emptying times in normal dogs following either Finney or Jaboulay pyloroplasty (Khan et al., 2015; Sánchez-Margallo et al., 2007; Stanton et al., 1987). A specific evaluation of gastric emptying was not performed in the present study, but the good clinical outcomes supported the potential interest of these techniques.

In the present study, the Finney procedure was performed in nine cases and the Jaboulay procedure in four cases. The rationale for choosing either the Finney or Jaboulay procedure remains controversial. No clear differences in terms of outcome or morbidity between the two procedures have been described in human medicine, but an experimental study in dogs suggests a potential superiority of Jaboulay over Finney pyloroplasty in terms of minimal organ manipulation and preservation, minimal complications and better drainage of gastric contents (Khan et al., 2015). While the hand-sewn Finney procedure is commonly performed in human medicine, the Jaboulay procedure can be performed using either a hand-sewn or a stapled technique. These data suggest that the Jaboulay procedure should be preferred if a stapled technique can be used, especially when there is a lesion in the pyloric area that precludes the safe healing of this area, as in case 8 in the present study. The Finney pyloroplasty, however, must be elected when it is necessary to incise the pylorus, in order to (i) debride a pyloric ulcer and incorporate the edges of the debrided ulcer into the anastomosis (Cobbs, 2010a) (as performed in the present study in cases 2, 9, 10 and 11), or (ii) remove a resectable mass located at or close to the pylorus (as performed in cases 4, 7 and 12). In cases 1 and 4, a Finney procedure was chosen because the duodenum was subjectively considered to be too small in diameter to allow a safe use of the stapled device. The authors nevertheless believe that the Finney and Jaboulay procedures would have been interchanged in these cases if the hand-sewing technique had been used to perform the Jaboulay pyloroplasty.

A major advantage of these techniques is their application in cases of large perforated peptic ulcers, as seen in four cases in our study. While small digestive perforations can be successfully treated by primary closure (Dobberstein et al., 2022), the repair of severe wall defects in these regions remains a challenge, as safe closure of the defect is hampered by the limited ability to debride the margins and the associated risk of luminal stenosis. Although there is no defined cut-off value in veterinary medicine to classify perforated ulcers according to their size, the pyloric and duodenal perforations observed in the present study were considered

too large to perform primary closure without negatively affecting the calibre of the digestive tract; thus, ulcer debridment and incorporation into a Finney pyloroplasty was chosen to treat these lesions. Indeed, Finney pyloroplasty allows the closure of large wall defects while preserving an adequate diameter of the pylorus or duodenum, even when there is insufficient healthy tissue around the ulcer allowing for a good primary closure, as the wound is incorporated into the anastomosis, further limiting the risk of post-operative stenosis (Moggia et al., 2016). In addition, these techniques allow a complete removal of the ulcer for histological examination, to confirm the intraoperative diagnosis (Moggia et al., 2016). Although performed in a very limited number of cases in the present study, the four cases with perforated ulcers surgically treated with Finney pyloroplasty were discharged from the hospital, suggesting a low morbidity and mortality rate of the procedure in this context, and contrasting with the 27% mortality reported with primary closure (Dobberstein et al., 2022).

Although the Finney and Jaboulay procedures appear to be more technically demanding than the Y-U and Heineke-Mikulizc pyloroplasties, no major intra- or post-operative complications occurred in the present study, which is consistent with the results of experimental studies in healthy dogs (Papageorges, Breton, & Bonneau, 1987b; Sánchez-Margallo et al., 2007). Five dogs had post-operative vomiting episodes that responded well to medication and were completely free of clinical signs at the last follow-up without medical treatment, suggesting that these vomiting episodes may have been imputable to non-specific post-operative gastritis.

However, it should be noted that the increased gastroduodenal opening provided by the Finney and Jaboulay procedures inevitably leads to abnormal retrograde transit from duodenal content into the stomach. Indeed, in human medicine, some cases may suffer from alkaline gastritis following post-operative duodenogastric reflux, causing epigastric pain, bilous vomiting and weight loss (Søreide et al., 2006; Zobolas et al., 2006). In an experimental study in normal dogs, duodenogastric reflux appeared to be markedly increased after Finney or Jaboulay pyloroplasty but only slightly increased after the Heineke-Mikulicz procedure; these features were however not associated with clinically persistent post-operative gastrointestinal disorders (Papageorges, Breton, & Bonneau, 1987b). In another experimental study, no histological or gross lesions were observed in three dogs with noteworthy duodenogastric reflux 1 month after Y-U pyloroplasty (Stanton et al., 1987), suggesting that either duodenogastric reflux has no clear clinical incidence or its clinical consequences appear later in the post-operative period, as in human patients in whom clinical signs appear 1 to 3 years after gastric surgery (Zobolas et al., 2006). In our study, nine cases were followed up for more than 1 year and none of them had clinical or imaging signs compatible with alkaline gastritis following duodenogastric reflux, including one in which moderate bilous reflux were identified on gastroduodenoscopy performed 1 month post-operatively.

Despite the retrospective nature of this study and the small number of cases reported, the results of this small case series suggest that the Finney and Jaboulay procedures may be valuable alternatives to other pyloroplasty and pylorectomy techniques for the treatment of benign obstructive lesions involving the antrum, pylorus, or proximal duodenum, and seem particularly interesting to manage wide perforations in these regions, allowing for their efficient debridement and safe closure with preservation of adequate calibre of the digestive tract. These surgical techniques were associated with low morbidity and mortality and cured all cases. Further studies are however required in larger cohorts of cases to determine precisely the complications and outcomes in dogs and cats.

Author contributions

E. Maurice: Conceptualization (lead); data curation (lead); formal analysis (lead); investigation (equal); methodology (equal); writing – original draft (lead). **B. Dekerle:** Conceptualization (equal); data curation (equal); formal analysis (equal); investigation (equal); methodology (equal). **P. Garnier:** Investigation (equal); visualization (supporting). **A. Fournet:** Investigation (equal); visualization (supporting). **J. Vial:** Data curation (equal); investigation (equal); visualization (supporting). **V. Freiche:** Investigation (equal); methodology (equal); supervision (equal); validation (equal); visualization (equal); writing – review and editing (equal). **V. Viateau:** Investigation (equal); visualization (supporting). **M. Manassero:** Conceptualization (equal); formal analysis (equal); investigation (equal); methodology (equal); supervision (lead); validation (lead); visualization (lead); writing – review and editing (lead).

Conflict of interest

None of the authors of this article has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

Data availability statement

The authors confirm that the data of this study are available within the article.

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