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Case Report

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Application of Billroth II gastrojejunostomy and a biliary stent in a dog with gastric adenocarcinoma and the associated extrahepatic biliary obstruction

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Abstract: An 11-year-old intact female chow chow dog was presented for evaluation of intermittent vomiting and anorexia for a month. On ultrasonographic examination, gastric pylorus hypertrophy which compressed common bile duct was identified. The gallbladder was significantly enlarged and mucocele was suspected. Cholecystectomy and gastric full thickness biopsy were performed and gastric adenocarcinoma was diagnosed by histopathological examination. Billroth II gastrojejunostomy using thoracoabdominal-stapler (TA-stapler) was performed. On surgery, hypertrophied tissue suspected of tumour was also found adjacent to the major duodenal papilla. After surgery, vomiting disappeared, and the patient regained appetite. On postoperative day 90, the patient was presented vomiting and jaundice again. On ultrasonography, the common bile duct was dilated and a narrowing of diameter was identified adjacent to major duodenal papilla. Biliary stenting with double wired nitinol uncovered stents was performed. On abdominal radiography, the diameter of bile duct stricture region was increased 7 days postoperatively. The patient had no complications related to biliary stent and died of gastric adenocarcinoma 1 year postoperatively.

Keywords: Billroth II gastrojejunostomy, double wired nitinol biliary stent, malignant extrahepatic biliary obstruction, gastric adenocarcinoma, dog

1. Introduction

Gastric neoplasm in dogs is uncommon [1]. Gastric adenocarcinoma accounts for 60% to 70% of canine gastric cancer, and is usually located along the pyloric antrum or lesser curvature [2]. Clinical signs include chronic intermittent vomiting or regurgitation which responds poorly to symptomatic treatment due to gastric or outflow obstruction [1].

Billroth II gastrojejunostomy, commonly performed in humans, is a bypass operation. The distal stomach is resected and the stump above is anastomosed laterally to the jejunum, and the proximal end of the duodenum is closed [3,4]. In dogs, Billroth II gastrojejunostomy is performed infrequently, probably because practitioners lack surgical experience with this technique, and the incidence of gastric tumour or ulcer is low [4].

In gastric neoplasia, extrahepatic biliary obstruction may occur if the tumour externally compresses the adjacent common bile duct or major duodenal papilla [3]. Biliary stent may be used to dilate the obstructed biliary tract, thereby semipermanently resolving the obstruction without changing hepatobiliary anatomy. In human medicine, biliary stent is widely used to stabilize patients before biliary surgery, to manage short or long-term obstructive biliary disease and pancreatitis-induced stricture of the common bile duct, and for palliation of malignancies [5,6]; it has not yet commonly used in veterinary medicine.

We report a successful Billroth II gastrojejunostomy for gastric adenocarcinoma in a dog, with application of a double-wire uncovered nitinol stent to resolve tumor-induced EHBO. To our knowledge, this technique has not been previously reported in the veterinary literature.

2. Case history

An 11-year-old spayed female chow chow breed dog was presented for evaluation of intermittent vomiting and anorexia over the previous month. Serum biochemistry revealed elevation of liver enzyme level including alanine aminotransferase (391 U/L (reference range from 10–100 U/L)), aspartate aminotransferase (86 U/L (0–50 U/L)), alkaline phosphatase (over 2000 U/L (23–212 U/L)), and gamma glutamyltransferase (9 U/L (0-7 U/L)). Elevation of C-reactive protein was also identified (53 mg/L (0–35 mg/L)). On ultrasonography, the gallbladder was severely distended with sludge, and a kiwi-like pattern was partially

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identified (Figure 1a). The pylorus region showed diffuse thickening of mucosa layer of the gastric wall (Figure 1b) and a polyp. gastric full-thickness biopsy was performed to identify the cause of gastric wall thickening. Digital palpation during surgery confirmed pyloric stenosis, and gastric outflow was compromised. To relieve this, Y-U pyloroplasty was performed after the biopsy. Since the gallbladder was significantly enlarged and we suspected mucocele, we also performed cholecystectomy. On histopathological examination, the thickened gastric wall was diagnosed as gastric adenocarcinoma. Histopathological findings of malignancy prompted us to plan surgical wide resection of the tumour. On computed tomography with heterogeneous contrast-enhancement, rarely-marginated focal wall thickenings were detected in the gastric pylorus. Peripheral lymph nodes including gastric, hepatic and pancreaticoduodenal lymph nodes were enlarged, but no lung metastasis was detected. Billroth II gastrojejunostomy using a TA-stapler was planned. Atropine sulphate (0.04mg/kg subcutaneously), cefazolin (30mg/kg intravenously [IV]), and butorphanol (0.1mg/kg IV) were used as anaesthesia premedication. Anaesthesia was induced with propofol (4mg/kg IV), and maintained with isoflurane (2%) in oxygen.

A ventral midline abdominal incision from the xiphoid process to the pubis was performed. The abdominal wall was retracted using a Balfour retractor, and the stomach was isolated. The pyloric portion showed diffuse thickening of the wall, and was abnormally firm when palpated. We noted hypertrophied tissue, suspected of malignancy, extending to the duodenum adjacent to the location of the major duodenal papilla. Stay sutures were placed on the gastric body, pyloric antrum, and duodenum; we ligated and transected the vascular branches of the right and left gastroepiploic arteries between the pylorus and the point opposite the incisura angularis on the greater curvature. The greater omentum in the region to be removed was then resected close to the greater curvature. We ligated and transected the branches of the right and left gastric arteries supplying from the pylorus to the incisura angularis on the lesser curvature. We transected the hepatoduodenal ligament of the site to be removed, to permit manipulation of the duodenum. During transection, care was taken to prevent damage to the common bile duct, portal vein, and hepatic artery. The duodenal portion was clamped with Doyen intestinal forceps and transected (Figure 2a). Closure of the gastric stump at the incisura angularis was achieved with 2 rows of 90-mm length TA-stapler (Raloadable staplers, Medtronic, Minneapolis, USA) with 3.5 mm cartridge. Closure of the entrance to the duodenum was performed with a 2-layer suture pattern. The mucosa and submucosa were closed with simple continuous suture using 3-0 monofilament absorbable sutures (Maxon; Covidien, Minneapolis, MN, USA) (Figure 2b); a simple interrupted suture pattern was then placed in the seromuscular layer. The residual gastric stump was finished with a simple continuous pattern using 3-0 polyglyconate sutures (Maxon; Covidien). The proximal jejunal loop was then attached to the visceral surface of the stomach body via the antecolic, isoperistaltic route. The seromuscular layer of the proximal jejunum, just distal to the duodenum, was sutured to the gastric stump body

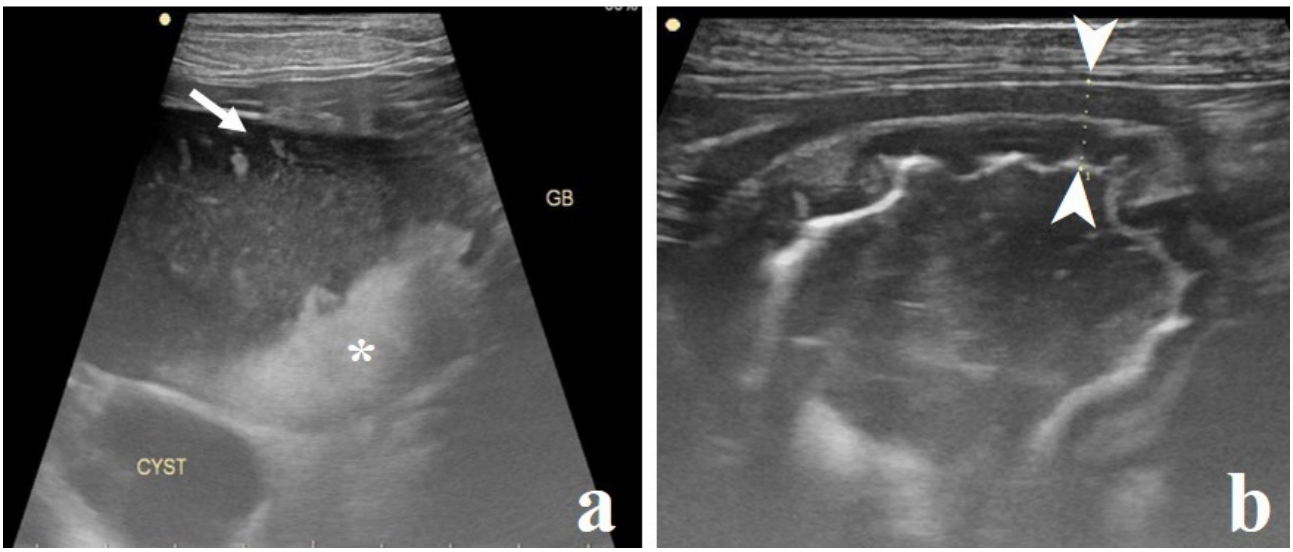

Figure 1. Ultrasonographic images of a gallbladder (a) stomach (b) of a dog with intermittent vomiting and anorexia. (a) Accumulation of gravity-dependent sludge (*) is visible, with partial kiwi-like pattern (arrow) in gallbladder lumen. (b) The overall gastric wall of the pylorus region is diffusely thickened to > 6 mm (arrow heads).

near the greater curvature of the stomach using a simple continuous pattern to reduce tension. A full-thickness 3-cm-long longitudinal incision was made just below the previous seromuscular layer suture into the body of the stomach. After insertion of stay sutures to secure the site, a corresponding incision was made in the antimesenteric surface of the jejunum adjacent to the seromuscular layer suture (Figure 2c). Gastro-jejunal anastomosis was performed in a side-to-side fashion (Figure 2d). The mucosa and submucosa of the stomach were sutured to the corresponding layers of the jejunum in a simple continuous pattern using 3-0 polyglyconate sutures. The seromuscular layers of the stomach and jejunum were then sutured in a simple continuous pattern parallel to and just below the incision line, for relief of tension. Omentalization was performed over the anastomotic site. The abdomen was flushed several times with sterile warm normal saline and closed routinely.

After the surgery, vomiting disappeared and the patient recovered appetite. However, on postoperative day 90, the patient resumed vomiting and showed jaundice with yellow skin and conjunctiva. Serum biochemistry

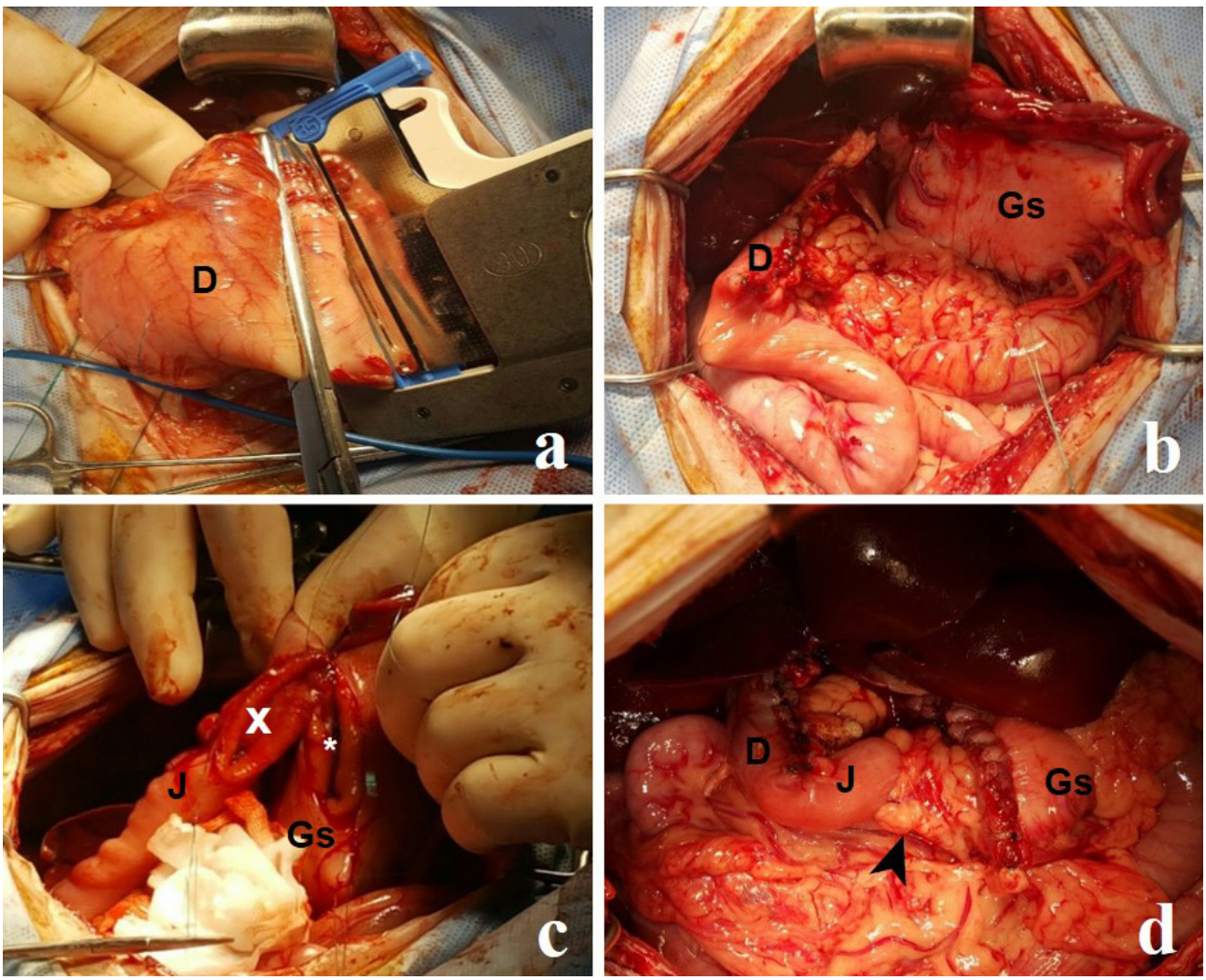

Figure. 2. Intraoperative photographs illustrating the Billroth II gastrojejunostomy procedure using TA stapler. The top of each photograph is cranial, and the bottom caudal (Gs: gastric stump, D: duodenum, J: jejunum). (a) 2 rows of 90 mm length TA-stapler with a 3.5 mm cartridge is used for the closure of the gastric stump at the incisura angularis. The duodenal portion is clamped with Doyen intestinal forceps and transected. (b) The entrance to the duodenum is closed with a 2-layer suture pattern. Simple interrupted suture using 3-0 monofilament absorbable sutures is placed in the seromuscular layer of the jejunum. (c) A full-thickness longitudinal incision is made into the body of the stomach (*) and the corresponding incision is made in the antimesenteric surface of the jejunum (X). (d) Then the gastro-jejunal anastomosis is performed in a side-to-side fashion, and omentalization is performed over the anastomotic site (arrow head).

revealed elevation of liver enzyme levels, including alkaline phosphatase (over 2000 U/L (23–212 U/L)), gamma glutamyltransferase (25 U/L (0–7 U/L)), and total bilirubin (9 mg/dL (0–0.9 mg/dL)). On ultrasonography, the common bile duct was dilated to a maximum of 11.6 mm (Figure 3a), and narrowed in diameter to 1 mm adjacent to the edematous major duodenal papilla (Figure 3b). Palliative biliary stenting using the double-wire nitinol uncovered biliary stent was performed to alleviate clinical signs. During surgery, we observed that the common bile duct was tortuous and dilated. Duodenotomy on the antimesenteric border was performed over the anticipated location of the major duodenal papilla, which was then conspicuous due to oedematous change. A 6 Fr feeding tube was inserted through the major duodenal papilla to secure the common bile duct. After removal of the feeding tube, a stent mounted on a 6 Fr guide wire was inserted through the major duodenal papilla. Two stents with a diameter of 10 mm and a length of 40 mm were overlapped, but the distal end of this enlarged stent failed to reach the duodenal lumen. Therefore, one more stent with a diameter of 10 mm and a length of 60 mm was placed and sutured to the duodenal submucosa using 3-0 non-absorbable sutures (Dafilon; B. Braun, Melsungen, Germany) (Figure 4). For postoperative antibiotic medical treatment, we administered cefotaxime (30mg/kg IV), enrofloxacin (5mg/kg subcutaneously), metronidazole (15mg/kg IV) for 2 weeks. Metoclopramide (0.3m/kg, IV) was administered for 2 weeks to prevent vomiting. For postoperative analgesia, a continuous rate infusion of butorphanol (0.2mg/kg/h) was administered for 24 h after surgery, then oral tramadol (5mg/kg) twice daily for 7 days. Liver supplements including ursodeoxycholic acid (7.5mg/kg orally) were prescribed for 5 months. Immediately after surgery, the serum total bilirubin level decreased to 5.7 mg/dL (0–0.9 mg/dL), and by postoperative day 14 had decreased further to within the normal range (0.5 mg/dL). Postoperative abdominal radiography showed that the diameter of the bile duct stricture had increased to 10 mm 7 days postoperatively (Figure 5). The patient died of gastric adenocarcinoma 1 year postoperatively. No complications related to gastric flow obstruction or the biliary stent, including stent migration and obstruction, were identified until death.

3. Results and discussion

Complete surgical resection is a therapeutic option for gastric adenocarcinoma, but extensive gastric involvement of the neoplasia often hampers complete excision [2]. Such cases require wide ablation and bypass procedures, such as gastrojejunostomy or gastroduodenostomy [7]. In humans, Billroth II gastrojejunostomy is commonly performed for severe gastric or duodenal ulcer, or distal gastric neoplasia [4]. However, in dogs the incidence of gastric tumour is lower than among humans, and the technical challenges of Billroth II surgery limit its application in veterinary medicine. Generally, prognosis of the Billroth II gastrojejunostomy is poor due to complications such

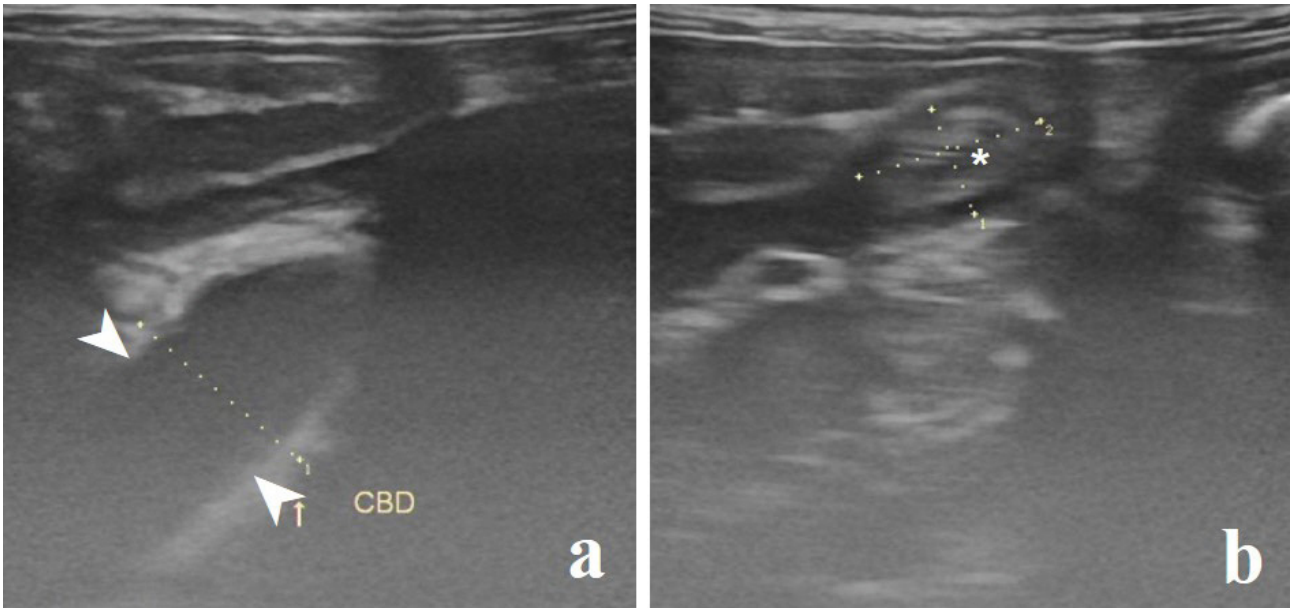

Figure 3. Ultrasonographic images of common bile duct (a) and major duodenal papilla (b) of the patient on postoperative day 90. (a) The common bile duct is dilated to a maximum of 11.6 mm (arrow heads), with narrowing to 1 mm is identified adjacent to the major duodenal papilla. (b) Oedematous major duodenal papilla (6 × 10 mm) is visible (*).

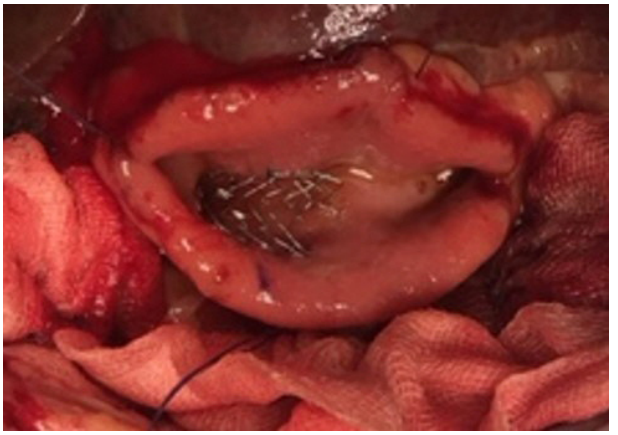

Figure 4. Intraoperative photographs illustrating biliary stenting using the double-wire nitinol uncovered biliary stent. Note the part of biliary stent (10 × 60 mm) residing in the duodenum.

as stomal ulceration and rapid passage of food [3,4,8]. Although the Billroth II procedure immediately alleviates gastric outflow obstruction and results in clinical improvement during the initial postoperative period, it requires extensive surgery with difficult and delicate surgical techniques [8]. In the present case, neoplasia was extensively involved in the gastric pylorus region and the proximal duodenal region adjacent to major duodenal papilla. Therefore, despite the high likelihood of a poor prognosis, we chose the Billroth II gastrojejunostomy rather than simple gastrectomy or Billroth I gastroduodenostomy to maximize removal of neoplastic tissue.

Some surgical considerations may increase the likelihood of success. The presence of residual gastric antrum after Billroth II gastrojejunostomy, stomal diameter, and the length of the afferent intestine loop are important indicators of the likely success of this surgery [4]. Complete resection of the gastric antrum prevents excessive gastric acid secretions from causing stomal ulceration in the gastrojejunostomy junction [4,8,9]. Moreover, the size of the stab incision for stoma formation is an important prognostic factor: a stomal diameter of 2.1 to 2.3 cm is ideal, but if exceeds 3 cm then persistent vomiting is likely [4]. In humans, "dumping syndrome" caused by rapid passage of ingesta from the stomach to the intestine is a common side effect when stomal diameter exceeds 2.8 cm [10]. We performed a 3-cm incision, the highest margin that would not cause persistent vomiting, and were satisfied that no relevant clinical signs were detected. Conversely, a small stab incision may cause stoma constriction and stenosis. The length of the afferent loop should be as short as possible without tension, approximately 25 cm in dogs. Long afferent loops may show "afferent loop syndrome" including gastrointestinal symptoms such as abdominal pain, nausea and vomiting; short afferent loop may cause side effects such as loop twisting [4]. In the present case, the gastric antrum was completely resected to minimize the above complications and we carefully assessed the tension between the afferent loop and the stomach during surgery. Through the above processes, we obtained a successful Billroth II surgery outcome in this case.

Malignant EHBO may be due to extrinsic compression, adjacent inflammation, direct tumour invasion, fibrotic formation from tumours or, more commonly, a combination of these factors [11]. In the present case, we considered extrinsic compression by the gastric adenocarcinoma invading the common bile duct adjacent to the major duodenal papilla to be the cause of EHBO. A biliary stent to dilate the obstructed biliary tract, and surgical diversion of bile flow may be considered in malignant EHBO [3,12]. The case we report showed malignant EHBO caused by extrinsic compression and tumour invasion of gastric adenocarcinoma, but we did not consider bile flow diversion because the patient had previously undergone cholecystectomy due to mucocele. Instead, we chose biliary tract dilation using the double-wire nitinol uncovered biliary stent. In patients with EHBO caused by primary tumours, this technique can relieve hyperbilirubinemia and clinical signs, improving metabolic and nutritional status [13].

Biliary stenting is commonly employed for the treatment of extrahepatic biliary obstruction caused by malignancies and pancreatitis in humans [11] In the veterinary literature to date, there are few case reports that discuss the use of biliary stent as a palliative therapy for the management of biliary tract disease [12, 14–17] Recent use of choledochal tube stenting in dogs was successful for decompression of the biliary tract: red rubber catheters were used in 10 dogs. Nine dogs survived without recurrence of EHBO or other complications [5]. Tube stents of different diameters may be selected to fit the common bile duct with differing degrees of stenosis and in different-sized individuals, and are easy to remove after placement. However, the risks of occlusion due to biliary sludge, and stent migration, are higher for tube than for metallic stents [5,18]. Metallic stents are retained for longer when the neoplasia is in the distal portion of the bile duct, but are difficult to be removed once placed. Also, use of uncovered metallic stents may lead to mucosal hyperplasia, tissue ingrowth, or tumour invasion. In our patient, we identified tumour as the cause of EHBO, obviating the need for later removal of the stent. We also considered prevention of stent migration and re-obstruction more important than tissue ingrowth, and accordingly chose the metallic rather than the tube stent.

The use of uncovered self-expanding wire mesh stents within the canine biliary tract has been reported

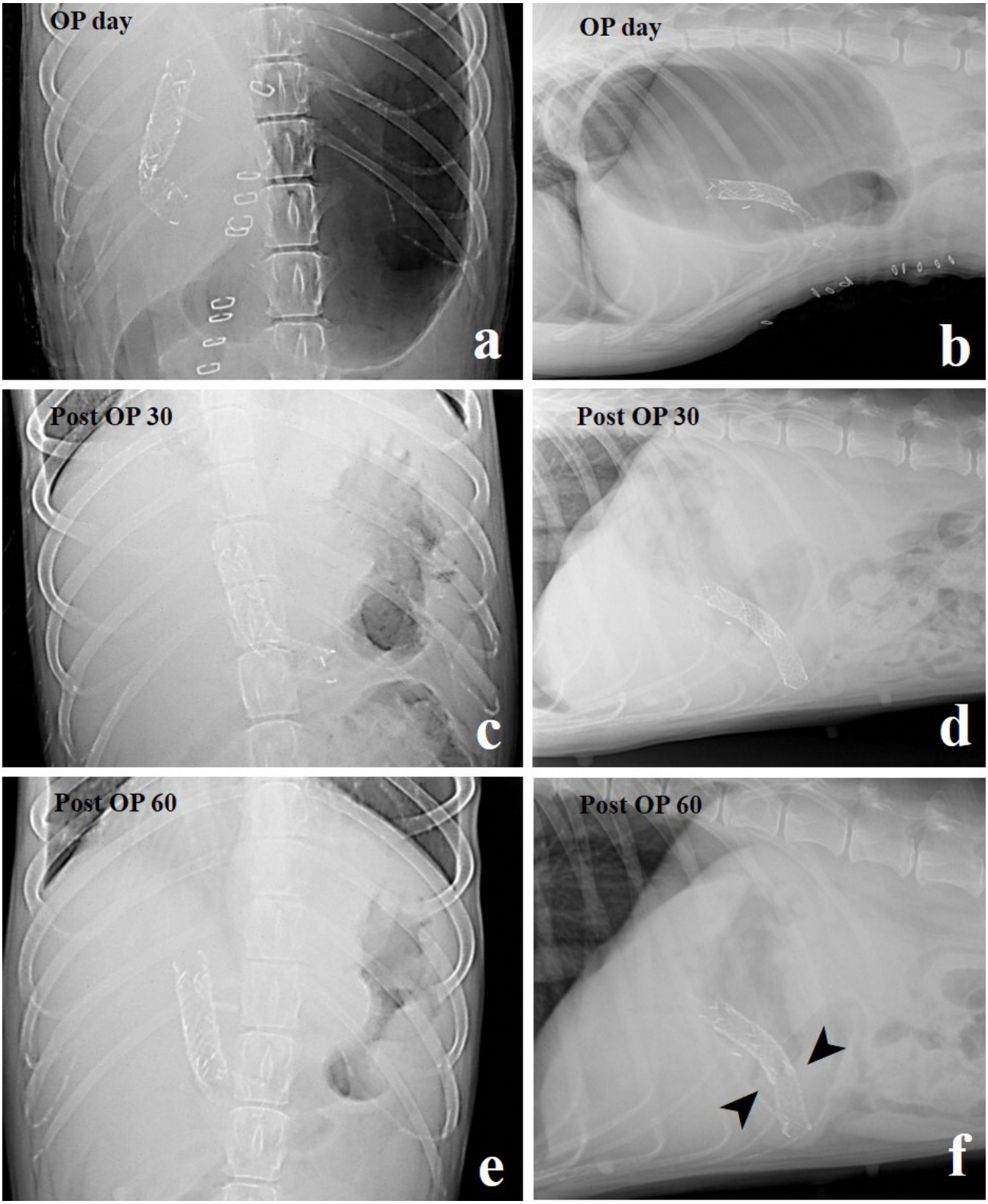

Figure 5. Radiologic images of biliary stent immediate after surgery (a,b), postoperative day 30 (c,d), and postoperative day 60 (e,f). Note the biliary stent is fully expanded to diameter of 10 mm (arrow heads). Complications related to the biliary stent, such as stent migration, breakage or folding were not identified until the patient's death from the tumour.

experimentally in 8 mongrel dogs [19]. Although these authors identified mild to moderate cellular infiltration and mucosal hyperplasia of the bile duct, all stents remained patent in the common bile duct for 30 to 90 days. An investigation of the utility of the metal expandable biliary endoprosthesis in a canine biliary duct for safe relief of biliary obstruction reported microscopic, minimal amounts of necrotic tissue adjacent to the compression sites due to this stent [13], and identified focal fibrosis and chronic inflammation of the submucosa, and thickening of the ductal wall. However, hyperbilirubinemia and icterus due to biliary obstruction improved considerably over up to 6 months, without stent migration. Together, the above studies support use of the metallic biliary stent for palliative decompression of malignant EHBO, because of the considerable capacity of this prosthesis for relieving obstruction with a relatively low complication rate.

In our case, Billroth II gastrojejunostomy was performed prior to biliary stenting due to the gastric neoplasia. This prevented intestinal contents from passing around the major duodenal papilla, an important consideration for prevention of the retrograde cholangitis that is a major complication of the biliary stent.

Comparisons between surgical bypass and application of uncovered nitinol stents for palliative treatment in malignant EHBO patients have been clinically attempted in humans [20], suggesting that the effectiveness of biliary decompression and mean survival time were similar between surgical bypass such as cholecystoenterostomy or choledochoduodenostomy, and application of biliary stents. Whereas the biliary stent has fewer early stage complications and faster recovery, surgical bypass probably results in lower recurrent rates in the long-term. This study concluded that patients not eligible for curative resection may be managed better with biliary stenting, whereas surgical bypass is more appropriate for patients with prognoses of longer survival. Generally, the prognosis of gastric adenocarcinoma is poor. After the onset of clinical signs in untreated dogs, the median survival time is less than 3 months, and when following tumour excision, the median survival time is less than 8 months [3,12]. We were unable to resect the gastric adenocarcinoma completely, because it had spread to the region adjacent to the major duodenal papilla, with strong indications of metastasis to the gastric, hepatic and pancreaticoduodenal lymph nodes on CT examination. Consequently, the likely survival time of our patient was considered to be short. Our patient also underwent prior cholecystectomy to remove the mucocele. However, even if the gallbladder is present, biliary stent with its associated lower early stage complication rate and more rapid recovery, should be considered as a palliative treatment alternative to surgical bypass.

The results of our case report demonstrate that in cases of diffuse gastric pylorus neoplasia and the associated EHBO, Billroth II gastrojejunostomy and biliary stenting can be performed safely and successfully, emerging as a promising palliative approach for malignant EHBO.

Acknowledgments
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