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Reopening of the Gastroduodenal Pylorus After Its Closure in Rats

Jorge Miguel Schettino César, M.D., M.S., Andy Petroianu, M.D., Ph.D.,[1]
Agostinho Pinto Gouvêa, M.D., Ph.D., and Dierre Roberto Alvin, M.D.

Department of Surgery, Faculty of Medicine, Federal University of Minas Gerais, Belo Horizonte, Brazil

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Background. **Duodenal injury occurs in 3% to 12% of patients with abdominal trauma. The best procedure to treat major duodenal ruptures continues to be a challenge. The purpose of the present study was to analyze differences between the time of gastroduodenal pylorus reopening after its closure with different suture materials and to verify the influence of vagotomy on local tissue changes.**

Methods. **Thirty rats were submitted to closure of the gastroduodenal pylorus and gastrojejunal anastomosis. The animals were divided into three groups ($n = 10$) according to the type of suture material used: plain catgut, polyglycolic acid, and polypropylene. Half of the animals in each group ($n = 5$) were also submitted to truncal vagotomy. Postoperative assessment included weekly abdominal X-ray following intragastric contrast injection until re-establishment of the gastroduodenal transit or for a maximum period of 4 wk. At the end of the follow-up period, the pyloric regions and the gastrojejunal anastomosis were removed for histological analysis. The groups were compared by the Kaplan-Meier test, with the level of significance set at $P < 0.05$.**

Results. **The polypropylene suture maintained the pylorus closed for a longer period of time (36.3 ± 11.6 d) ($P < 0.05$). No difference was observed between the polyglycolic acid suture (25.8 ± 14.2 d) and the plain catgut suture (18.7 ± 10.2 d). Vagotomy did not influence the time of pyloric reopening, but was associated with a less intense gastric inflammatory reaction.**

Conclusions. **The nonabsorbable suture was the most adequate for exclusion of pyloric transit. Vagotomy had no influence on the time of pyloric reopening but reduced gastric inflammation.** © 2008 Elsevier Inc. All rights reserved.

Key Words: **duodenal injury; pylorus; closure; gastrojejunal anastomosis; vagotomy; treatment; complications.**

INTRODUCTION

Duodenal injuries are observed in 3% to 12% of patients with abdominal trauma [1–5] and represent one of the major challenges in traumatology [6]. Duodenal injuries are more frequently observed in men between the third and fifth decades of life [4, 5]. The number of duodenal injuries has been increasing mainly as a result of car accidents, in addition to aggressions with cutting and stabbing weapons and firearms [7–9]. This injury can also occur as an iatrogenic complication in 1% to 7% of endoscopic procedures involving the duodenum and bile duct [1], as well as during surgical treatment of gastroduodenal peptic ulcer [3]. Fistulas and infections are the main intra-abdominal complications of duodenal injuries and are observed in 2% to 14% of cases [4, 10].

No consensus exists regarding the most adequate treatment of duodenal injuries [6, 11, 12]. The authors agree that the best approach to simple wounds is suturing in two layers and draining the region. This procedure, which was described for the first time by Herczel [13] in 1896, is sufficient in 75% to 85% of all lesions restricted to the duodenum [5, 7, 11, 12, 14, 15]. In contrast, in the case of complex and more extensive injuries, total duodenectomy accompanied by cephalic pancreatectomy is preferred, [16, 17] as first suggested by Thal and Wilson [9] in 1964.

However, the surgical approach to duodenal injury of an intermediate level continues to be controversial [12]. The first operation for such injury was performed

[1] To whom correspondence and reprint requests should be addressed at Department of Surgery, Faculty of Medicine, Federal University of Minas Gerais, Avenida Afonso Pena, 1.626, apto.1.901, 30130-005, Belo Horizonte, MG, Brazil. E-mail: petroian@medicina.ufmg.br.

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by Moynihan [18] in 1901, who closed the distal end of the duodenum and performed an end-to-side gastrojejunal anastomosis. In 1904, Summer [19] corroborated the concept of digestive transit deviation for severe traumatic injuries to the duodenum. In 1907, Berg [20] proposed closure of the pylorus with a tape and a digestive shunt through gastrojejunostomy. However, jejunal mucosa is not appropriate to receive the gastric acid juice, and anastomotic ulcers are not uncommon. To prevent these adverse events, many surgeons prefer to combine gastrojejunostomy with vagotomy. Some questions related to pyloric exclusion and gastrojejunal shunting are still controversial, including the best suture material in terms of its efficacy in maintaining the pylorus closed during the period necessary for healing of the duodenal injury. In addition, it is important to know the influence of vagotomy on the outcomes of this surgery, since it is well known that gastrojejunal shunt is an ulcerogenic procedure.

MATERIALS AND METHODS

The study was conducted according to the norms of the Brazilian College for Animal Experimentation and was approved by the Ethics Committee of the Department of Surgery, School of Medicine, Federal University of Minas Gerais.

Thirty Holtzman rats were studied. The animals remained confined in cages appropriate for five animals per cage [21] and had free access to water and ration.

The animals were randomly divided into three groups ($n = 10$) according to the 4-0 suture material used for closure of the gastroduodenal pylorus and gastrojejunal anastomosis: group 1, polypropylene (Prolene; Ethicon, Somerville, NJ); group 2, polyglycolic acid (Dexon, Ethicon); and group 3, plain catgut (Ethicon). Each group was subdivided into two subgroups ($n = 5$): A, without vagotomy; and B, submitted to trunk vagotomy. The surgeries were performed under sulfuric ether anesthesia by median laparotomy.

In animals submitted to vagotomy, the vagus nerve was cut at the level of the esophagogastric junction [16]. The gastrojejunostomy consisted of a 1-cm continuous suture anastomosis and was performed side to side as an isoperistaltic precolic procedure in a single layer. The pylorus was closed with a crossing suture with the same thread as used for the anastomosis (Fig. 1).

The gastroduodenal flow was studied under fluoroscopy with injection of 8 mL 50% barium sulfate (Bariogel, São Paulo, Brazil) through a 6 Fr orogastric catheter. The opening of the pylorus was observed every 7 d during a period of up to 2 min [22, 23].

After the follow-up period, the animals were killed with a sulfuric ether overdose. The pyloric regions and anastomoses were removed and processed for histology. The histological sections were stained with hematoxylin and eosin. Histological analysis was performed by an examiner who was blinded to the group to which the surgical specimen belonged. Presence of ulcers and the intensity of the inflammatory process were assessed by a semiquantitative method under common and polarized light [24]. (Table 1, Fig. 2).

Comparisons of the types of suture material regarding time of pyloric opening, intensity of fibrosis, and mono- or polymorphonuclear infiltrates were performed by the Kruskal-Wallis test. The χ^2 test and analysis of variance were used to determine the relationship between the types of suture material and the presence of giant cells, microscopic identification of the surgical suture and the presence of mono- or polymorphonuclear cells and gastric mucosal atrophy. The Kaplan-Meier test was used to analyze differences between the three types of suture and the time of pyloric reopening. Differences higher than 95% ($P < 0.05$) were considered to be significant.

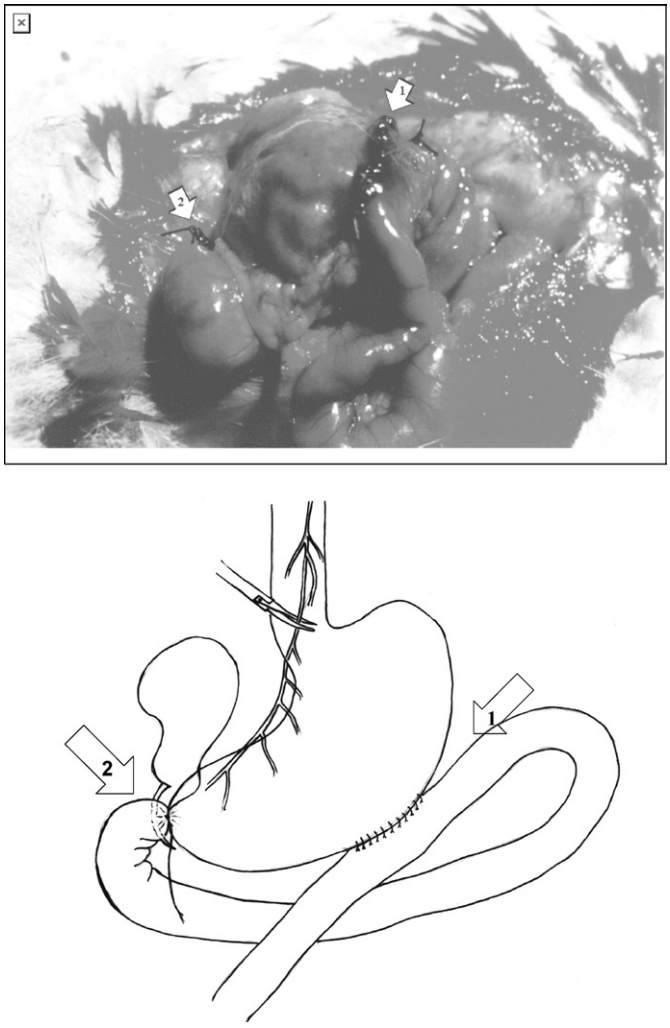

FIG. 1. Final surgical aspect showing the gastrojejunal anastomosis (arrow 1) and closure of the pylorus (arrow 2).

RESULTS

The animals showed good postoperative evolution with no alterations in feeding habits or behavior. Adhesions in the abdominal cavity were observed between the pyloric region and the inferomedial side of the liver and between the gastrojejunal anastomosis, the greater omentum, and the transverse colon.

With respect to the time of pyloric reopening, the nonabsorbable polypropylene suture maintained the pylorus closed for a longer period of time than the absorbable plain catgut suture ($P = 0.003$) and the hydrolyzable polyglycolic acid suture ($P = 0.047$). No difference in the time of pyloric reopening was observed between the plain catgut and polyglycolic acid suture ($P = 0.113$).

There was a 40% and 60% probability that the pylorus of animals of the polyglycolic acid and plain catgut

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