

EFFECT OF PYLORIC DRAINAGE ON THE HEALING OF ESOPHAGOGASTRIC ANASTOMOSES IN RATS

Yingjie Cui, MD;* John D. Urschel, MD;† Nicholas J. Petrelli, MD*

BACKGROUND AND OBJECTIVES: Esophagogastric anastomotic leaks complicate 5% to 20% of esophagectomies for esophageal cancer and are responsible for approximately one-third of perioperative deaths. Poor gastric emptying is a predisposing factor for anastomotic leakage. An animal experiment was used to test the hypothesis that a pyloric drainage procedure (pyloromyotomy) would have a positive effect on esophagogastric anastomotic healing.

METHODS: In 40 rats single-layer esophagogastric anastomoses were constructed with interrupted 7-0 polypropylene sutures. A pyloromyotomy was done in the experimental group (20 rats) but not in the control group (20 rats). Rats were sacrificed on the 7th postoperative day and their anastomoses were excised, mounted in a tensiometer, and distracted at 10 mm/min to measure breaking strength. After that, the hydroxyproline concentration (an indicator of wound collagen) of the anastomotic tissue was measured.

RESULTS: There were no anastomotic leaks. The mean (and standard deviation) breaking strength of the esophagogastric anastomosis was 3.96 (1.14) N in the pyloromyotomy rats and 4.11 (0.75) N in the control rats ($p = 0.64$). The mean (and SD) hydroxyproline concentration in esophagogastric anastomotic tissue was 368.6 (31.5) nmol/mg in the pyloromyotomy rats and 376.6 (31.3) nmol/mg in the control rats ($p = 0.77$).

CONCLUSION: Pyloric drainage (pyloromyotomy) did not have any effect on esophagogastric anastomotic wound healing in this rat model.

CONTEXTE ET OBJECTIFS : Les fuites de l'anastomose œsophagogastrique compliquent de 5 % à 20 % des œsophagectomies pratiquées à la suite d'un cancer de l'œsophage et causent environ le tiers des décès périopératoires. Une mauvaise vidange gastrique est un facteur prédisposant à la fuite de l'anastomose. On a utilisé une expérience sur des animaux pour vérifier l'hypothèse selon laquelle une intervention de drainage du pylore (pyloromyotomie) aurait un effet positif sur la guérison de l'anastomose œsophagogastrique.

MÉTHODES : On a construit des anastomoses œsophagogastriques à simple épaisseur chez 40 rats en utilisant des sutures en polypropylène 7-0 interrompues. On a procédé à une pyloromyotomie chez les 20 rats expérimentaux mais non chez les 20 rats témoins. Les rats ont été sacrifiés sept jours après l'intervention et l'on a excisé leur anastomose, que l'on a montée ensuite dans un tensiomètre et étirée à raison de 10 mm/min pour mesurer la résistance à la rupture. On a ensuite mesuré la concentration en hydroxyproline (indicateur du collagène de la plaie) du tissu de l'anastomose.

RÉSULTATS : Il n'y avait pas de fuite à l'anastomose. La résistance moyenne (et l'écart type) à la rupture de l'anastomose œsophagogastrique s'est établie à 3,96 (1,14) N chez les rats qui ont subi une pyloromyotomie et à 4,11 (0,75) N chez les rats témoins ($p = 0,64$). La concentration moyenne (et l'ET) d'hydroxyproline dans le tissu de l'anastomose œsophagogastrique s'est établie à 368,6 (31,5) nmol/mg chez les rats qui ont subi une pyloromyotomie et à 376,6 (31,3) nmol/mg chez les rats témoins ($p = 0,77$).

CONCLUSION : Le drainage du pylore (pyloromyotomie) n'a pas eu d'effet sur la guérison de la plaie de l'anastomose œsophagogastrique chez ce modèle de rat.

From the *Department of Thoracic Surgery, Roswell Park Cancer Institute, Buffalo, NY, and the †Department of Surgery, McMaster University, Hamilton, Ont.

Accepted for publication Oct. 18, 1999.

Correspondence to: Dr. John Urschel, Department of Surgery, St. Joseph's Hospital, 50 Charlton Ave. E, Hamilton ON L8N 4A6; fax 905-521-6190, urschelj@fhs.mcmaster.ca

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Esophagogastric anastomotic leaks complicate 5% to 20% of esophagectomies for esophageal cancer and are responsible for approximately one-third of perioperative deaths after esophagectomy.¹ Poor gastric emptying can be a predisposing factor for anastomotic leakage.² Randomized controlled clinical trials have produced conflicting results regarding the overall value of pyloric drainage, and there is little information on the effect of pyloric drainage on esophagogastric anastomotic leakage.³⁻⁵ An animal experiment was done to test the hypothesis that a pyloric drainage procedure (pyloromyotomy) would have a beneficial effect on esophagogastric anastomotic healing.

METHODS

Forty female Sprague-Dawley rats (Harlan, Indianapolis, Ind.), weighing 200 to 250 g, were housed 3 to a cage in conventional suspension cages and allowed food and water up to 4 hours before operation. They were anesthetized with intraperitoneal pentobarbital sodium (50 mg/kg) (Abbott Laboratories, Abbott Park, Ill.). With the use of sterile technique, a 4-cm midline laparotomy was done. The distal esophagus was mobilized, and its anterior aspect was incised transversely at a point 5 mm proximal to the gastroesophageal junction. A gastrotomy 4-mm long was made in the glandular portion of the proximal anterior stomach. A side-to-side single-layer esophagogastric anastomosis was constructed with interrupted 7-0 polypropylene (Ethicon, Somerville, NJ) sutures, as previously described.⁶

In the experimental group (20 rats), the pylorus muscle (a distinct anatomic entity in the rat) was divided without penetrating the gastric or duodenal mucosa. This was not done in the 20 control rats. The linea alba was closed with a continuous 5-0 suture Polyglactin 910 (Ethicon). Skin was closed with the

same suture by a running horizontal mattress technique. Animals were allowed free access to food and water after recovery from anesthesia.

Rats were killed on postoperative day 7 with an intraperitoneal injection of pentobarbital sodium (120 mg/kg). Four rats died or were sacrificed early because of aspiration pneumonia (1 in the control group and 3 in the experimental group). This left 36 rats for wound-healing studies. Anastomoses were excised, mounted in an Instron mini-44 tensiometer (Instron, Canton, Mass.) and distracted at 10 mm/min to measure breaking strength (in newtons). After that, anastomotic tissue (wound plus 1 mm of tissue on each side) was excised and the hydroxyproline concentration of the tissue (an indicator of wound collagen formation) was measured.⁷

Measured data are presented as means (and standard deviations). Differences in breaking strength and hydroxyproline concentration were analyzed by the 2-tailed Student's *t*-test. A probability value of less than 0.05 was taken to be significant. The study was approved by the Institutional Animal Care and Use Committee and conducted in accordance with the National Research Council's guide for the care and use of laboratory animals.⁸

RESULTS

There were no anastomotic leaks. Esophagogastric anastomotic breaking strength was 3.96 (1.14) N in the experimental group of rats and 4.11 (0.75) N in the control group ($p = 0.64$). Hydroxyproline concentration in the esophagogastric tissue was 368.6 (31.5) nmol/mg in the experimental group and 376.6 (31.3) nmol/mg in the control group ($p = 0.77$).

DISCUSSION

Most experienced esophageal surgeons recommend initial nasogastric

tube decompression after esophagectomy.^{1,2} Early postoperative gastric distension unduly stresses the anastomosis and may worsen occult ischemia of the gastroplasty tube.^{1,2,9} However, many cervical esophagogastric anastomotic leaks occur late (after day 7) in the postoperative course, at a time when nasogastric tubes have been removed.¹ Poor gastric emptying can occur if a drainage procedure (pyloromyotomy or pyloroplasty) is not done at the time of esophagectomy.^{3,5} Therefore, the presence or absence of a pyloric drainage procedure may influence the occurrence of esophagogastric anastomotic leaks.

We have previously noticed a tendency for gastric stasis in our rat esophagogastric anastomotic experiments.^{6,7} Stasis occurs despite seemingly adequate preservation of the vagal nerves. This laboratory observation, along with the clinical information already outlined, led us to hypothesize that a pyloromyotomy would have a positive effect on the healing of esophagogastric anastomoses.

Our experiment failed to show any effect of pyloric drainage on esophagogastric anastomotic wound healing as evaluated by measurement of anastomotic breaking strength and hydroxyproline concentration. These parameters of wound repair are commonly used in laboratory studies even though the important issue in clinical gastrointestinal surgery is anastomotic leakage.¹⁰ Nevertheless, the lack of any anastomotic leaks in this experiment is problematic. The side-to-side esophagogastric anastomoses in this rat model may be too secure.⁶ We developed the side-to-side anastomotic technique because of difficulties with end-to-end esophagogastric anastomoses in rats; early stricture formation led to profound postoperative weight loss in animals in some of our previous experiments.⁷ Other investigators have had similar experiences with end-to-end anastomoses in rats.¹¹

These difficulties have prompted most investigators to use large animals for esophagogastric anastomotic experiments.⁶ Finally, the timing of anastomotic assessment (postoperative day 7) may have had some impact on the experimental results. However, previous studies in our laboratory have shown that this is an appropriate time to make comparisons of anastomotic wound healing.¹²⁻¹⁴

This study of the effect of pyloric drainage on esophagogastric anastomotic wound healing in rats showed no difference in anastomotic strength, hydroxyproline concentration or number of leaks. Despite the limitations in study design, the results suggest that pyloric drainage simply had no effect on esophagogastric anastomotic healing.

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Books and Other Media Received

Livres et autres documents reçus

This list is an acknowledgement of books and other media received. It does not preclude review at a later date.

Cette liste énumère des livres et autres documents reçus. Elle n'en exclut pas la critique à une date ultérieure.

Cerebral Reorganization of Function After Brain Damage. Edited by Harvey S. Levin and Jordan Grafman. 392 pp. Illust. Oxford University Press, Inc., New York; Oxford University Press, Toronto. 2000. Can\$88. ISBN 0-19-512026-4

Control of Hospital Infection. A Practical Handbook. 4th edition. Edited by Graham A.J. Ayliffe, Adam P. Fraiese, Alasdair M. Geddes and the late Kathy Mitchell. 401 pp. Arnold, London, UK; Oxford University Press, Toronto. 2000. Can\$128. ISBN 0-340-75911-9

Oxford Textbook of Sports Medicine. 2nd edition. Edited by Mark Harries, Clyde Williams, William D. Stanish and Lyle J. Micheli. 937 pp. Illust. Oxford University Press, Inc., New York; Oxford

University Press, Toronto. 2000. Can\$143.95. ISBN 0-19-262717-1 (Hbk); 0-19-263236-2 (Pbk)

Update: Surgery for the Morbidly Obese Patient. The Field of Extreme Obesity Including Laparoscopy and Allied Care. Edited by Mervyn Deitel and George S.M. Cowan Jr. 539 pp. Illust. FD-Communications Inc., Toronto. 2000. US\$195. ISBN 0-9684426-1-7

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