

Modern Surgery

Laparoscopic Gastric Banding in the Rat Model as a Means of Videolaparoscopic Training

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Background: The development of laparoscopy in bariatric surgery has attracted a large number of surgeons. Learning this method for future clinical practice requires intensive training with inert tissues, simulators and experimental surgery in animals. Performing these procedures in small animals, with the same equipment used in humans, is feasible, allowing familiarization with and comprehension of the basic techniques. Wistar rats weighing 300-600 g were used. The animals were kept in standard laboratory conditions. A laparoscopic video-system, Veress needle, three ports, a 0° optic, a laparoscopic needle-holder, two 5-mm graspers, a 5-mm dissection clamp and a 5-mm scissors were used. An orogastric catheter with three 4-0 nylon sutures and one 6-0 nylon suture were also utilized. For the gastric band, we used a plastic device similar to the human gastric band. The present study describes a simple, inexpensive and reproducible technique for laparoscopic gastric banding in a rat model utilizing the same instruments developed for humans. The experimental rat model is more motivating than simulators, requires less space, and has easier maintenance compared with bigger animals, and consequently allows the use of more animals for teaching, training and application in many scientific studies.

Key words: Laparoscopy, rat, model, animal, gastric band, bariatric surgery

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Introduction

The global obesity epidemic has led to a dramatic increase in bariatric surgery. The number of bariatric operations in USA has increased from 16,000 in the early 1990s to 103,000 in 2003.¹ There are almost 750 surgeons in Brazil who are members of the Brazilian Society of Bariatric Surgery (SBCB), a chapter of IFSO.² Bariatric Surgery is the only therapy that provides effective long-term weight loss for morbid obesity,³ and the laparoscopic approach has been found to be similar in efficacy to the open approach but offers rapid return to activities and significantly fewer wound complications.⁴

The development of videolaparoscopy in bariatric surgery has attracted a large number of surgeons. Learning this method for future clinical practice requires intensive training with inert tissues, simulators and experimental surgeries in animals. Medium- and large-sized animals are utilized in many experimental models using videolaparoscopy, for physiologic studies, development of instruments and surgical training.⁵⁻⁷ Performing these procedures in small animals with the same equipment used in humans is also feasible and allows familiarization with the material and understanding of the basic techniques. Rats are widely used for basic research in open and laparoscopic surgery.⁸ Initial training with this method is safe, and the cost is low. The rat is also the animal in which the pathways involved in appetite and gut-brain interaction are better defined.⁹

The objective of this study is to demonstrate a simple and reproducible technique for videolaparoscopic gastric banding in a low-cost experimental model and offer this option to a larger number of medical students as well as surgeons interested in bariatric surgery.

Materials and Methods

Animals

The experiments were performed according to national guidelines and were approved by the Escola Bahiana de Medicina Research and Ethics Committee.

A total of 13 adult Wistar rats weighing between 300 and 600 g were used in the development of this experimental model. The animals, after being kept in standard laboratory conditions (temperature 20-24°C, relative humidity 50-60%, under controlled light conditions – 12 hours of light receiving food and water “ad libitum”), were kept without food and water for 8 hours before the surgery.

Equipment and Instruments

The following materials were used for this procedure (Figure 1): 1) A video system with micro-camera; 2) A CO₂ insufflator; 3) A light source; 4) An electrocautery; 5) A Veress needle; 6) A 10-mm trocar; 7) Two 5-mm trocars; 8) A 0° optic; 9) A laparoscopic needle holder; 10) Two 5-mm graspers; 11) A 5-mm dissection clamp; 12) A 5-mm scissors; 13) An orogastric catheter; 14) Three 4-0 nylon threads; 15) One 6-0 nylon thread. A polypropylene tie was used as the gastric band (Figure 2).

Procedure

Anesthetic induction was obtained by intraperitoneal injection of 40 mg/kg ketamine hydrochloride solution (Cetamin-F[®], Cristália, Brazil) and 10 mg/kg xilidine-dihidrotiazine hydrochloride (Rompun[®], Bayer, Brazil). Sedation was controlled by evaluating reflex to painful stimulus. When necessary, a second dose of the anesthetic was used. The rat was placed in a dorsal decubitus position with the 4 limbs fixed to the surgical table (Figure 3). Preoperative depilation of the abdomen was performed using a hair trimmer, followed by antisepsis with polyvinyl-

pyrrolidineiodine solution. A pneumoperitoneum was performed with the Veress needle through a 5-mm skin incision below the xiphoid process. Manual traction of the anterior abdominal wall of the rat enabled safe puncture with the needle without injury to intraperitoneal structures. Insufflation of the cavity with CO₂ proceeded until reaching a maximum pressure of 8 mmHg. Another 5-mm skin incision was made 10 mm above the pubic symphysis. The 11-mm trocar was inserted and the 0° optic passed. Two additional 5-mm lateral incisions were made, 15 mm apart, where the two trocars will be introduced into the peritoneal cavity under direct vision for dissection and manipulation. Trocar passage should also be preceded with manual traction of the rat's anterior abdominal wall, to avoid organ injuries. All trocars were fixed to the skin with 4-0 nylon suture to avoid inadvertent introduction or withdrawal during clamp maneuvers (Figures 4 and 5).

The first step of the procedure is the introduction of an orogastric catheter. The catheter seen inside the esophagus and stomach allows the surgeon to determine the level of initial dissection. In this experimental model, we introduced 10 mm of the catheter into the rat's stomach just below the gastroesophageal (GE) junction, and started the dissection at this level. The lesser curvature was dissected with the coagulating hook. Under direct vision the gastrohepatic ligament was dissected from the gastric wall to produce an opening. Dissection on the stomach's greater curvature was usually not necessary. The retrogastric tunnel was created by dissection under direct vision, avoiding injury to the posterior gastric wall (Figure 6). The band was introduced intraperitoneally through the 5-mm trocar, looped around the stomach and tightened 5 mm below the GE junction and in the mid part of the gastric rumen (Figures 7 and 8). The orogastric catheter previously introduced was used as a marker. The band was locked by traction in opposite directions with the two graspers, and the band was held in place by one 6-0 nylon gastrogastic suture anteriorly (Figure 9). Finally, the abdominal cavity was inspected, and the trocar openings were closed with 4-0 nylon. All animals survived the procedure, and bleeding was negligible. Euthanasia was performed by intracardiac injection of 40 mg/kg thiopental sodium (Thionembotal[®], Abbot, Brazil).



Figure 1. Instruments utilized.

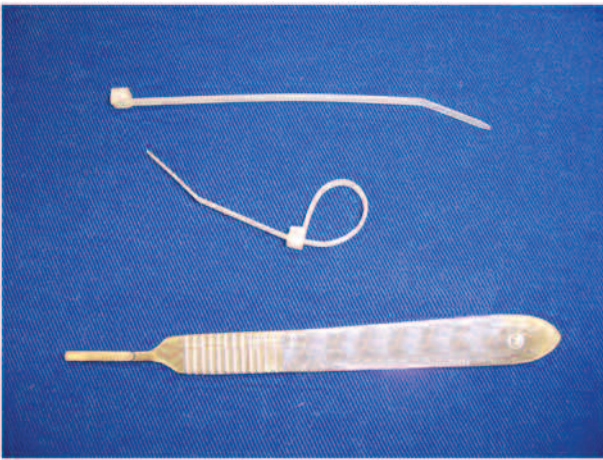


Figure 2. Gastric band (tie-wrap).

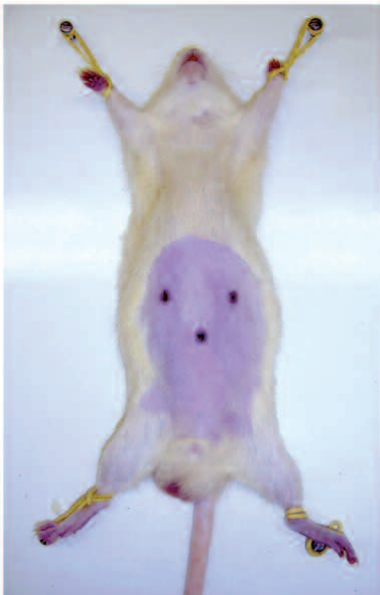


Figure 3. Wistar rat positioned.



Figure 4. Medical student performing operation.

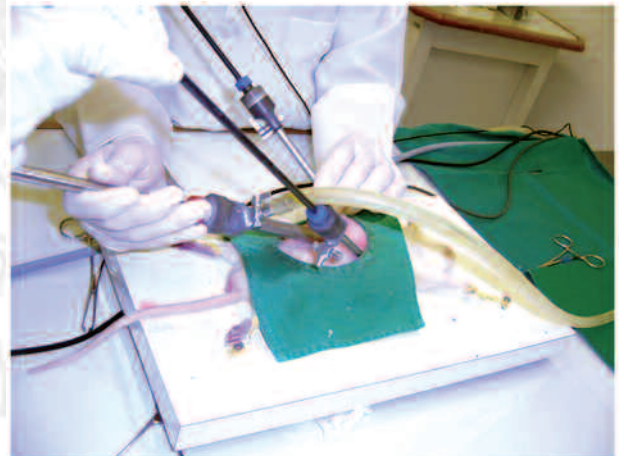


Figure 5. Trocars positioned.

Discussion

Potential benefits of the laparoscopic approach include: 1) decreased perioperative morbidity; 2) less ileus; 3) low incidence of wound complications; 4) less cardiopulmonary adverse events; 5) decreased perioperative mortality; 6) shorter recovery time with less postoperative pain, less immobility and possibly less deep vein thrombosis and rhabdomyolysis;³ 7) fewer incisional hernias.

In 1990, Belachew et al¹⁰ described adjustable gastric band placed laparoscopically, and this technique became so popular that seven new models of gastric

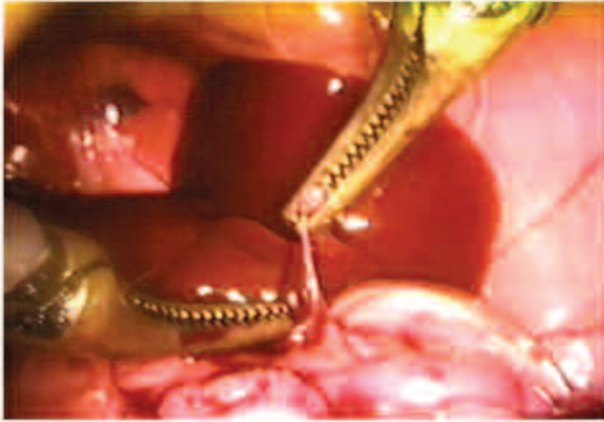


Figure 6. Dissection commenced to create the retrogastric tunnel.

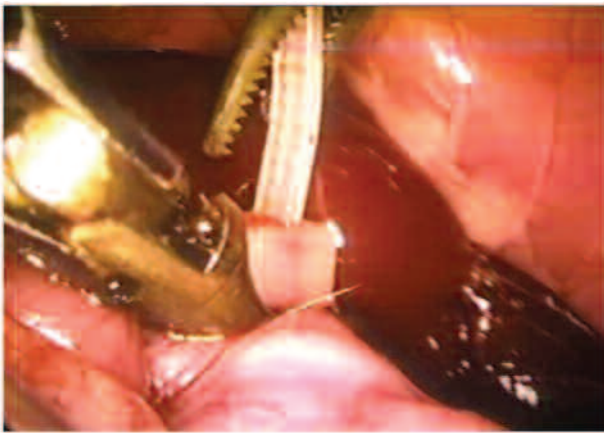


Figure 7. Gastric band about to be tied.

band have been created.¹¹ Laparoscopic adjustable gastric banding has become increasingly popular in Europe, Australia, Mexico and Brazil. This method has been found to have advantages compared with open vertical banded gastroplasty, which resulted in superior weight loss but had more severe postoperative complications and a significantly higher reoperation rate. Shorter hospital stay and quicker return to normal activities made the laparoscopic approach superior.¹²

Our experimental gastric band is not adjustable. We used a plastic device similar to the human gastric band, which cost 3 cents of the American dollar and can be easily found in electronic equipment stores.

Laparoscopic banding for future clinical practice requires intensive training with inert tissues, simulators and experimental surgery in animals. Traditionally, medium-sized animals such as dogs and pigs have been used in experimental videola-

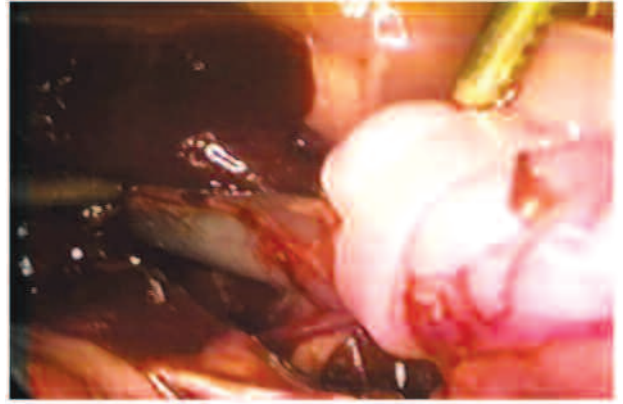


Figure 8. Gastric band tied.

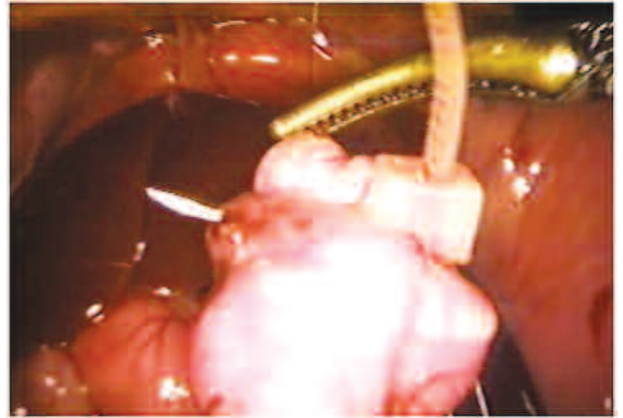


Figure 9. Gastro-gastric suture for band fixation.

paroscopy for the technical facility provided by their size, anatomic similarity and possibility of using the same instruments as in humans.¹³ However, their physiology is not very well studied when compared to other models and the costs to acquire and maintain them are high.⁶ Legal restrictions and public opinion have also provided difficulty to use large animals as models in experimental studies.⁷ Small animals are also used in videolaparoscopy experimental models. Many techniques have been described in rats (splenectomy, nephrectomy, hepatic resection, herniorrhaphy, colostomy, colectomy, retroperitoneal exploration and orchietomy).^{6,7,14,15} The rat is a universally established important small animal model in basic research into open and laparoscopic surgical procedures. It offers the advantage of being a well-studied laboratory animal with an abundance of internationally reported research results.⁸

Laparoscopic gastric banding in rats has proved to be a simple and feasible procedure. In our model, we used the same videolaparoscopic equipment as used in human operations; however, only three trocars were used because of the rat size. Another adaptation was the gastric band and the orogastric catheter without the need for sophisticated technology.

Monteiro et al⁹ compared one group of 5 rats submitted to open gastric banding and another group of 4 rats undergoing sham gastric banding, followed for 21 days. The rats submitted to gastric banding showed a significant decrease in weight gain and food intake, compared to the sham-operated rats. Monteiro's group¹⁶ in further open gastric banding studies in rats, found weight loss but also increased feeding frequency in the banded rats, compared to control rats.

The rat's stomach comprises two anatomical parts.^{9,17} The upper part (the rumen), equivalent to the gastric fundus and greater curvature in humans, functions as a reservoir. The epithelium is thin and similar to that of the esophagus. The lower part, known as the pyloric or glandular region,¹⁷ would be located in the regions of the lesser curvature, body and antrum in the human.¹⁸ Unlike Monteiro et al,⁹ we placed the band higher, in the mid part of the rumen. The device could be placed lower, and this may cause variations in weight loss.

Galvão Neto et al¹⁹ established the value of experimental surgery in rats for training students and even surgeons in laparoscopic surgery. Experimental study helps students and residents in basic training of laparoscopic technique and stimulates the study of bariatric surgery.

Conclusion

The experimental rat model of gastric banding, besides being more motivating than the simulators and other inert models, minimizes costs, requires less space, has easier maintenance compared with bigger animals and consequently allows the use of more animals for teaching and training, and can be applied in many scientific studies.

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