Spontaneous volume changes in gastric banding devices: complications of a semipermeable membrane

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Abstract The goal of this study was to prove that adjustable laparoscopic gastric banding (LAP-BAND) is semipermeable and that luminal adjustment with saline leads to spontaneous fluid loss, luminal widening, and effect loss which makes repeated readjustments necessary. In 64 patients stoma adjustment was performed with saline according to the guidelines of the manufacturer (group 1). In 32 patients hyperosmolar contrast material was used for stoma readjustments with the intention to detect a system leakage after spontaneous fluid loss and spontaneous luminal widening was observed (group 2). After spontaneous luminal narrowing had occurred in group 2, all patients from group 2 and all additional patients (n = 148) underwent stoma (re-) adjustment with iso-osmolar contrast material (group 3). Spontaneous fluid changes which led to spontaneous changes of the luminal width were then analyzed for the different filling substances in each group. Fifty-two patients from group 1 presented with effect loss because a spontaneous luminal widening had occurred secondary to a fluid loss of 0.1–0.2 ml/month. All 32 patients from group 2 presented with increasing obstruction and food intolerance because a spontaneous luminal narrowing had occurred secondary to a spontaneous fluid gain of 0.1–0.3 ml/month. In our patients from group 3, where stoma adjustment was performed with iso-osmolar contrast material, no spontaneous fluid changes were observed and luminal width/degree of obstruction did not change. The LAP-BAND is semipermeable. Stoma adjustment should not be performed with saline in order to avoid spontaneous luminal widening and the need for repeated readjustments. Stoma adjustments with hyperosmolar contrast material are clearly contraindicated since osmotic fluid gain leads to increasing obstruction. Stoma adjustments should be performed using iso-osmolar filling media which provide a stable luminal obstruction.

Keywords Obesity · Postoperative complications · Iodine contrast material · Gastric banding · Pouch dilatation

Introduction

Since 1983 adjustable laparoscopic gastric banding (ALGB) has evolved as a well-established surgical therapy in the treatment of morbidly obese patients [1, 2]. It is well known that following the implantation of an ALGB, a stoma adjustment to 3–4 mm is essential to obtain optimal weight loss [3]. According to the guidelines provided by the manufacturer of the LAP-BAND system (Bioenterics, Carpinteria, Calif.) saline should
be used for stomal adjustments. In contrast to other systems (e.g., the Swedish adjustable gastric banding system), the LAP-BAND is radiopaque and therefore visible already on plain radiographs, so that filling the system with water-soluble contrast material is not necessary for visualization of the catheter or the band. The LAP-BAND has been used at our institution since 1995, and based on the manufacturer’s guidelines, stoma adjustments have been performed with saline from the beginning according to our standard protocol [6]. In 1998 we began to realize that some patients present with a slowly decreasing obstruction at the site of the band and slow effect loss secondary to a slow and spontaneous luminal widening. These patients required readjustment of their stoma width several months following stomal adjustment with saline. We initially suspected leakage of the system in these patients and began to analyze the documented stoma width and the exact amount of fluid injected into or aspirated from the port in all patients. After we had detected that most patients in whom luminal adjustment had been performed with saline showed a spontaneous fluid loss in the follow-up, we started using hyperosmolar water-soluble contrast material for stoma adjustments in order to detect the suspected leakage. We immediately changed the filling substance to iso-osmolar water-soluble contrast material after we encountered that all patients in whom hyperosmolar contrast material had been used for stomal adjustment presented with increasing obstruction, luminal narrowing, and food intolerance in the follow-up. The study describes the problem of spontaneous volume changes in ALGB systems secondary to the semipermeable nature of the silicon band and points out the problem of spontaneous luminal widening, decreasing obstruction, and slow effect loss after luminal adjustment with saline.

Materials and methods

In 64 morbidly obese patients treated with an ALGB saline was used for stomal adjustment according to the guidelines of the manufacturer (group 1). In all these patients stomal adjustment to 3–4 mm was possible by instillation of 3–3.5 ml of saline into the system. Stoma width was measured using a radiopaque ruler which was positioned on the abdominal surface in all patients during a barium meal with respect to the slight magnification resulting from the distance between band and ruler. For measurement of the stoma width the minimal diameter of the stoma was regarded as the representative value for the degree of obstruction. In 32 patients hyperosmolar contrast material (Uromiro 300, 1591 mosm/kg, Bracco, Milan, Italy) was used for stomal adjustment to 3–4 mm (group 2) with the intention to detect a leakage of the system after a slow and spontaneous fluid loss with subsequent spontaneous stoma widening and decreasing obstruction was observed in these patients. The decision to ignore the manufacturers’ recommendations to use saline for stomal adjustment was made by a consensus of the surgeons, the radiologists, and the involved clinicians since the encountered spontaneous fluid loss and spontaneous luminal widening led to an effect loss in our patients with the consequence that repeated readjustments would have been necessary for an optimal weight management. Filling the system with contrast material was the only way to exclude a perforation of the system in these patients and to explain the pathogenesis of spontaneous fluid loss that had occurred.

After the first complications (see below) occurred in the hyperosmolar contrast agent group 2, all these patients from group 2 (n = 32) underwent readjustment using iso-osmolar water soluble contrast material (Visipaque 270, 290 mosm/kg, Nycomed, Oslo, Norway; group 3) and in the further follow-up all readjustments and all new adjustments in a total of 148 patients were performed with iso-osmolar solutions only.

In all patients from groups 1–3 the port was punctured under sterile conditions using a special 20 G deflected tip needle (Access Port Needle, BioEnterics, Carpinteria, Calif.). The total amount of fluid injected into the system was aspirated once immediately after filling to make sure that the filling substance was really injected into the system and to prove that the total amount of fluid could be aspirated from the system. The adjusted stoma width was then documented by means of fluoroscopy during a barium meal using a radiopaque ruler and the exact amount of fluid (saline or contrast material) injected into or aspirated from the system was documented using a closed and strictly air-free system consisting of a needle, connecting tube, and a 5-ml Luer lock syringe. This procedure was repeated whenever a patient was examined and spontaneous fluid changes within the system, which led to subsequent spontaneous changes of the stoma width at follow-up, were retrospectively analyzed by two of the authors who were not blinded to the different filling substances and correlated with the different fluids injected into the ALGB port.

According to our own results (see below), all readjustments as well as all new adjustments were performed with iso-osmolar solutions at our institution in a total of 148 patients until present where always special emphasis was given to detect spontaneous changes of obstruction whenever a patient was controlled clinically.

Results

In group 1 [64 patients, stoma adjustments using saline (0.9 % NaCl, 230 mosm/l)] slowly decreasing obstruction at the site of the band was found in 52 cases (81 %). In these patients repeated barium meals documented a slowly progressing and spontaneous luminal (stoma) widening of up to 4 mm over 6 months. This spontaneous stoma widening corresponded to a significant decrease in obstruction with subsequent effect loss. Repeated punctures of the ALGB system with exact assessment of the amount of saline in the system yielded a spontaneous fluid loss of 0.1–0.2 ml/month (Fig. 1). In all 32 patients from group 2 who underwent stoma adjustments with hyperosmolar water soluble contrast material (Uromiro 300, 1591 mosm/kg, Bracco, Milan, Italy) slowly progressing and spontaneous stomal narrowing of up to 3 mm over 6 months was found. This spontaneous stoma narrowing resulted in a significant increase in obstruction in these patients. Therefore, all these patients presented with upper abdominal dis-