

# Rectus Abdominis Muscle and Peritoneal Flap as a Novel Alternative Technique for Repair of Gastric Perforations

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<b>Background</b>	Gastric perforation is life-threatening and requires urgent surgical treatment with a reliable and durable repair. We describe a novel technique in which a pedicled rectus abdominis muscle and peritoneal (RAMP) “pull-in” flap is used as an alternative technique for the repair of a large iatrogenic gastric perforation when faced with the inability to use other conventional approaches.
<b>Summary</b>	A 66-year-old man was diagnosed with a 2.5-cm iatrogenic gastric perforation during an emergent re-exploration of the abdomen 16 days after a laparoscopic distal transverse colectomy that was complicated by an anastomotic leak requiring resection of the anastomosis. The perforation was located on the anterior wall of the mid-body of the stomach, near the greater curvature. There was no remaining omentum to be used as a patch for the repair as it was removed during prior surgeries. Mobilizing a loop of jejunum to use as a serosal patch over the perforation was not considered safe given that small bowel loops were matted and adhered together. We decided against a simple closure of the perforation as sutures placed through inflamed and friable tissues are unlikely to hold. The falciform ligament could not reach the site of our gastric perforation to be used as a pedicle flap. Performing a partial gastrectomy to exclude the perforation in the presence of significant gastric wall inflammation in a critically ill patient was considered potentially harmful. Faced with the lack of conventional options for repair of the gastric perforation, a novel approach was performed by using a RAMP “pull-in” flap based on the superior epigastric vessels for patching the perforated stomach. A swallow study two weeks after the successful RAMP flap confirmed the integrity of the repair.
<b>Conclusion</b>	The RAMP flap based on the superior epigastric artery is a useful technique for repair of gastric perforations when other approaches are not possible.
<b>Keywords</b>	gastric perforation; rectus abdominis muscle and peritoneal flap

**DISCLOSURE STATEMENT:**

The authors have no conflicts of interest to disclose.

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## Case Description

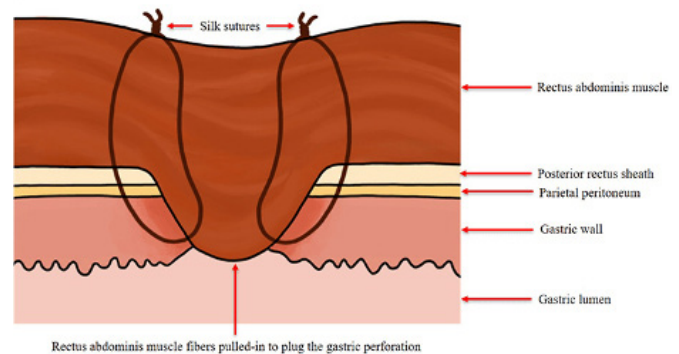
A 66-year-old man with cancer of the distal transverse colon underwent a laparoscopic partial transverse colectomy with an anastomosis between the proximal transverse and the left colon. His postoperative course was complicated by an anastomotic leak requiring an urgent laparotomy on postoperative day (POD) four. The colonic anastomosis was found to be necrotic and it was resected. A right colectomy was performed, and an ileocolic anastomosis was created. postoperatively patient developed intra-abdominal abscesses that were managed with percutaneous drainage. On POD 16 patient became febrile, hypotensive, and developed significant abdominal pain. A computed tomography scan of the abdomen showed a gastric perforation with gross extravasation of administered oral contrast into the abdominal cavity. After fluid resuscitation, broad-spectrum intravenous antibiotics and vasopressors were started, the patient was taken emergently to the operating room for re-exploring the abdomen.

At surgery, purulent fluid and gastric contents were encountered in the left upper quadrant. Upon further inspection of the stomach, a 2.5-centimeter (cm) perforation was identified in the anterior wall of the mid-body of the stomach, near the greater curvature. While evaluating our options for repair of the perforation, it was determined that simple closure was not possible as sutures placed through inflamed and friable tissues are unlikely to hold.

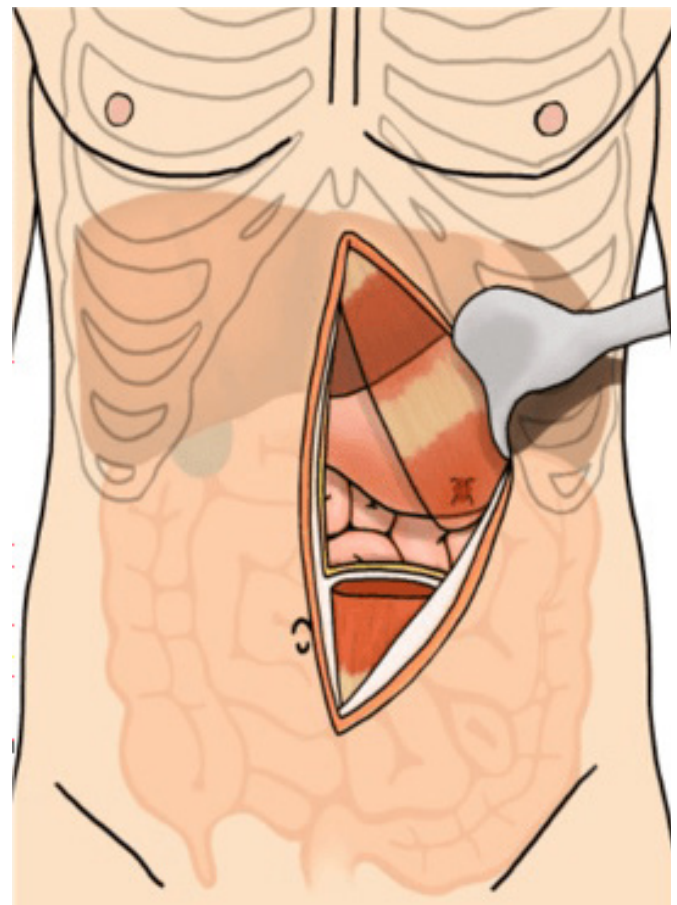
There was no remaining omentum to be used as a patch for the repair as it was removed during prior surgeries. In addition, small bowel loops were matted and adhered together. Therefore, mobilizing a loop of jejunum to use as a serosal patch over the perforation was not considered safe. Upon further inspection and measurement of the falciform ligament, it was determined that it would not reach the site of our gastric perforation as a pedicle flap. Performing a partial gastrectomy to exclude the perforation in the presence of significant gastric wall inflammation in a critically ill patient requiring vasopressor support was considered potentially harmful.

Faced with the lack of known options for repair of the gastric perforation, a novel approach was performed by using a RAMP “pull-in” flap based on the superior epigastric vessels for patching the perforated stomach. To harvest the flap, the peritoneum and posterior rectus sheath were divided transversely approximately 2 cm proximal to the umbilicus, until the rectus muscle was exposed and mobilized from the anterior rectus sheath for a total length of

eight cm. After a two-cm opening on the posterior rectus sheath and the peritoneum of the RAMP flap was created, rectus muscle fibers from the posterior aspect were pulled in through this opening and placed as a plug into the gastric perforation (Figure 1). The RAMP flap was then sutured into place on the stomach wall using interrupted silk sutures (Figure 2), while incorporating the pulled-in rectus muscle fibers to secure them in place (Figure 1).



**Figure 1.** Coronal section of the RAMP “pull-in” flap sutured over the gastric perforation with interrupted silk sutures.



**Figure 2.** The RAMP flap secured over the gastric perforation.

In the presence of significant contamination of the peritoneal cavity from the gastric perforation, we decided against the use of synthetic mesh for reinforcement of the abdominal wall at the harvest site to avoid the risk of mesh infection. Given the fact that the anterior rectus sheath remained intact, we concluded that the use of expensive biologic mesh would not add strength to the abdominal wall. The midline incision was then closed by re-approximating the linea alba with running monofilament synthetic absorbable sutures. A swallow study two weeks after the successful RAMP flap confirmed the integrity of the repair. Subsequently patient was discharged to home and had an unremarkable recovery. Physical examination and an abdominal CT scan at 5 months after surgery ruled out a bulge of the abdominal wall and a ventral hernia at the harvest site of the RAMP flap.

## Discussion

Gastric perforations are associated with significant morbidity and mortality.<sup>1</sup> The risk of death increases with the length of the interval between perforation and surgery.<sup>2,3</sup> This indicates the importance of prompt, correct diagnosis and immediate surgery in patients with gastric perforations.

Omental patch closure has remained the most common surgery for gastro-duodenal perforations since its first use in 1937.<sup>4</sup> Alternative surgical approaches that have been used when omentum is not technically utilizable or in patients in whom omentum is completely absent, include jejunal serosal patch<sup>5,6</sup> and falciform ligament flap.<sup>7,8</sup> Herein, we report the successful use of a RAMP pedicled flap based on the superior epigastric artery as a novel alternative technique for the repair of a large gastric perforation when faced with the inability to use other approaches.

Anatomically, the rectus abdominis muscle (RAM) originates from the pubic symphysis and inserts at the fifth to seventh inter-costal cartilages. The RAM makes a robust muscle flap with dual blood supply (deep inferior epigastric and superior epigastric arteries) making it a Mathes and Nahai Type III muscle flap.<sup>9</sup>

Breast reconstruction literature shows that harvesting of rectus abdominis muscles could result in abdominal bulge and hernia.<sup>10</sup> The odds of occurrence of these donor site complications is reduced by placement of mesh for fascial closure<sup>10</sup> and mobilizing only a partial rectus muscle flap.<sup>10,11</sup> The deep inferior epigastric and superior epigas-

tric arteries are located on the lateral aspect of the rectus sheath, with transverse perforating branches supplying blood to the medial aspect of the rectus abdominis muscles.<sup>9</sup> For a partial muscle flap, only the medial segment of the rectus muscle is harvested, and the lateral fibers are preserved to increase the strength of the abdominal wall.<sup>11</sup>

While there are limited reports of the RAMP flap being used in the management of duodenal fistulas,<sup>12,13</sup> to the best of our knowledge, this represents the first case report describing the RAMP flap utilization for the repair of a large gastric perforation. This case report is significant because it presents a quick, safe, and durable option for the intraoperative management of a gastric perforations. The RAMP flap is a useful addition to the armamentarium of techniques for the surgeons who find themselves in the peritoneal cavity with a gastric perforation and unexpected anatomical anomalies that prevent the use of other conventional repair techniques.

## Conclusion

Early recognition and treatment of gastric perforation is essential in minimizing the potentially fatal adverse effects of gross gastric content spillage into the abdominal cavity. When no other repair options exist, the rectus abdominis muscle and peritoneal flap could be used as a dependable and durable technique for closure of gastric perforations.

## Lessons Learned

Gastric perforations represent a significant surgical challenge. Surgeons should be prepared to employ all possible approaches for the repair of gastric perforations, including the RAMP flap that was successfully used on our case.

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