Case Report

Successful use of flexible silicone mesh for management of prolonged open abdomen

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Background: Open abdomen management (OAM) is used not only for trauma but also for treatment of peritonitis. However, the rate of successful fascial closure in patients with OAM remains low.

Case Presentation: The patient was a 38-year-old morbidly obese man who underwent laparoscopic sleeve gastrectomy. Twenty days after surgery, postoperative leakage resulted in panperitonitis. In this case, we undertook drainage by open laparotomy. The patient's status was generally unstable and he was treated with OAM. We used flexible silicone mesh as the dressing material for negative-pressure wound therapy. Open abdominal management continued until status improvement (32 days). Fascial closure was eventually successful because of good granulation growth.

Conclusion: When combined with negative-pressure wound therapy, silicone mesh prevents wound adhesions and infection after surgery. Silicone mesh is useful for patients with increased risk of infection, such as those with diffuse peritonitis.

Key words: Fascial closure, open abdomen management, sepsis, silicone mesh

BACKGROUND

PERITONITIS IS AMONG the most critical complications after abdominal surgery.[1] In severe peritonitis, the first choice of treatment is drainage using laparotomy. However, it is difficult to achieve primary closure in these patients because of high abdominal pressure resulting from edematous intestine. In such cases, open abdomen management (OAM) with negative-pressure wound therapy (NPWT) is used to improve general status and promote wound healing without closing the abdominal wall.[2] Although this technique was originally developed as a treatment for abdominal trauma, in recent years it has been used more generally for acute abdomen.[3] Fascial closure is easier in the early postoperative period than in the later postoperative period.[4] Silicone mesh (SI Aid-Mesh; ALCARE, Tokyo, Japan) is a wound dressing covered with silicone adhesive material to reduce adhesion to tissues while keeping the permeability of intra-abdominal fluids. Silicone mesh is also easy to replace without damaging the wound surface; therefore, growth of healthy granulation tissue is expected. We report a case of peritonitis in which silicone mesh was used as a dressing material for NPWT with eventual successful fascial closure.

CASE

A 38 -year-old morbidly obese man (body mass index, 37.3 kg/m^2) underwent laparoscopic sleeve gastrectomy at our hospital. He was discharged without complications on the sixth postoperative day. Twenty days after surgery, the patient was transferred to our hospital with abdominal pain. Computed tomography revealed intra-abdominal free air and fluid. The patient was diagnosed with peritonitis resulting from postoperative leakage. Because of the patient's obesity, we anticipated that abdominal closure would be difficult if we chose surgical treatment; therefore, we decided to treat conservatively, and administration of

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broad-spectrum antibiotics tazobactam/piperacillin (TAZ/PIPC) was started. However, the patient's general status deteriorated. On his second day in hospital, he was intubated and continuous hemodiafiltration was started for fluid control. On the fifth hospital day, abdominal free fluid increased. Purulent ascites was confirmed with abdominocentesis. The patient's general condition continued to deteriorate; we decided to carry out an emergency laparotomy and drainage for treatment and macroscopic search of leakage. At laparotomy, we confirmed massive infectious ascites. However, no obvious source of leakage was found in the residual stomach, bowel, or colon. We placed three drainage tubes: one in the left subphrenic space, one in the right subphrenic space, and one near the staple line of the residual stomach.

Because of the risk of infection and high abdominal pressure from the patient's body shape and the edematous intestinal tract, primary abdominal closure was impossible. We left the abdomen open after surgery; silicone mesh (Fig. 1A) was placed as a covering material. An iodine-impregnated drape was applied on top of the mesh, and a suction device was connected for NPWT (Fig. 1B). After surgery, the patient's general condition gradually improved; the ventilator was removed on the 13th postoperative day. Antibiotics were de-escalated dependent on culture results of ascites or drain effluent.

The inflammatory reaction was prolonged and minor leaks might have been sustained; therefore, enteral nutrition was started prior to parenteral feeding during intubation and weaning at the seventh postoperative day. After confirming that there was no leakage by computed tomography and transnasal endoscopy, parenteral feeding was started 1 week after extubation (calorie intake was calculated from standard body weight). The silicone mesh was replaced every 3 or 4 days until confirmed resolution of infectious ascites (Fig. 1C). We successfully closed the peritoneum and fascia under general anesthesia on the 32nd postoperative day. Good growth of granulation tissue with adhesion to the lateral abdominal wall was found intraoperatively (Fig. 1D). Intra-abdominal fat decreased compared to the previous surgery. After adhesiolysis between the outer abdominal wall and the intestine, there was sufficient length of the abdominal wall and fascia. The abdominal wall was closed by shoelace sutures; the skin was left open. Open skin-wound management was carried out with vacuum-assisted closure (Fig. 1E,F). After fascial closure, rehabilitation for walking began. The incision gradually healed without skin suturing (Fig. 1G). During NPWT, there was no machine trouble in the NPWT device and no skin damage by mesh. On the 39th postoperative day (44th hospital day), the patient was discharged from hospital. His laparotomy wound finally healed 42 days after discharge (86 days after he entered the intensive care unit). We have been following the patient for 4.5 years, and there are currently no complications.

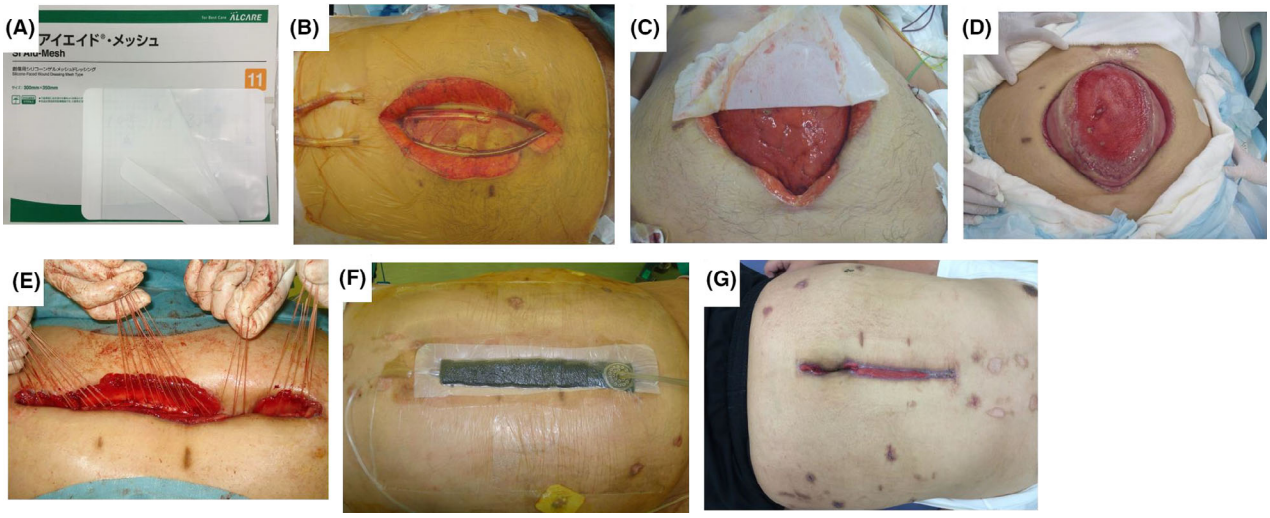

Fig. 1. Open abdomen management for treatment of peritonitis in a 38-year-old morbidly obese man. A, Silicone mesh (SI Aid-Mesh; ALCARE, Tokyo, Japan). B, Laparotomy wound after open drainage. Wound and border of intra-abdominal space were covered with iodine-impregnated drape. C,D, Silicone mesh was easy to remove; granulomatous hyperplasia is developing. Intestinal tract edema caused by massive infusion after surgery causes the granulation tissue to appear swollen. E, Body wall closure on postoperative day 32. F, Vacuum-assisted closure system placed after secondary closure. G, Laparotomy wound before discharge.

DISCUSSION

IN OPEN ABDOMINAL drainage for peritonitis, primary abdomen closure is associated with a markedly high rate of surgical site infection and an increased risk of abdominal compartment syndrome.[5,6] Open abdomen management is used to avoid these complications. In these cases, the minimum required treatment, such as lavage and drainage, is carried out with the abdomen open, followed by general management in the intensive care unit for patients with severe peritonitis.[7,8] Although OAM was originally proposed as a damage-control strategy in patients with severe trauma, the technique has been adapted for non-trauma patients, including those with severe peritonitis.[2,3] In this case, it took 32 days for fascial closure from first laparotomy. According to Mizushima *et al*.,[4] the rate of successful fascial closure in patients with OAM lasting more than 8 days was only 5.2%. However, in the present case, delayed fascial closure was achieved without complications. The patient was morbidly obese (body mass index, 37.3 kg/m^2); his abdominal pressure was very high as a result of subcutaneous fat, visceral fat, and intestinal tract edema resulting from infection and large infusion volumes. However, NPWT allowed healthy granulation tissue to develop and edema improved,[9] which resulted in decreased abdominal pressure, making fascial closure possible. We selected silicone mesh as an NPWT dressing material. Silicone mesh is covered with a silicone adhesive, which prevents it from damaging newly formed granulation tissue while maintaining permeability. Also, the silicone material does not dissolve in blood or exudate, and thus, it maintains non-adhesion to tissue until replacement. Therefore, silicone mesh does not prevent the growth of granulation and it is possible to remove the mesh without damaging the tissue, thus also reducing pain. Silicone mesh has mainly been used as a covering for open wounds; there are few reports of its use as a covering during NPWT in OAM. Shin *et al*.[10] reported a case of abdominal wall defect by necrotizing fasciitis with NPWT and silicone mesh. Finally, the defect was closed by mesh for hernia. However, our case suggested that the fascia can be closed (this was partly because the patient was severely obese, and hospitalization reduced abdominal fat and pressure, making it easier for the abdominal wall to close.). Our patient developed good granulation without signs of wound infection. The mesh did not adhere to granulation tissue and was easy to remove, with very little bleeding. Because silicone mesh is percutaneous as well as permeable, it could be used in all cases of OAM, such as trauma, and in cases where early muscle layer closure is not possible and long-term indwelling mesh is needed. Silicone mesh might also be useful for myofascial closure.

CONCLUSION

SILICONE MESH AS a covering material during NPWT in a patient with peritonitis promoted wound healing while preventing adhesion to tissues. Muscle layer closure was possible even after long-term indwelling mesh use, indicating that this is an effective treatment in OAM when early fascial closure is not possible.

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DISCLOSURE

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Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None.

REFERENCES

1 Doklestić SK, Bajec DD, Djukić RV *et al*. Secondary peritonitis – evaluation of 204 cases and literature review. J. Med. Life 2014; 7: 132–8.
2 Leppäniemi A, Kimball EJ, De Laet I, Malbrain ML, Balogh ZJ, De Waele JJ. Management of abdominal sepsis – a paradigm shift? Anaesthesiol. Intensive Ther. 2015; 47: 400–8.
3 Weber DG, Bendinelli C, Balogh ZJ. Damage control surgery for abdominal emergencies. Br. J. Surg. 2014; 101: e109–18.
4 Mizushima Y, Masunaga M, Yoshiaki Y *et al*. A retrospective, multicenter study of clinical outcome after management of the open abdomen. J. Jpn. Assoc. Acute Med. 2015; 26: 116–24.
5 Shah SK, Jimenez F, Letourneau PA *et al*. Strategies for modulating the inflammatory response after decompression from abdominal compartment syndrome. Scand. J. Trauma Resusc. Emerg. Med 2012; 20: 25.
6 Bhangu A, Singh P, Lundy J, Bowley DM. Systemic review and meta-analysis of randomized clinical trials comparing primary vs delayed primary skin closure in contaminated and dirty abdominal incisions. JAMA Surg. 2013; 148: 779–86.
7 Mutafchiyski VM, Popivanov GI, Kjossev KT, Chipeva S. Open abdomen and VAC® in severe diffuse peritonitis. J. R. Army Med. Corps 2016; 162: 30–4.
8 Pliakos I, Michalopoulos N, Papavramidis TS, Arampatzi S, Diza-Mataftsi E, Papavramidis S. The effect of vacuum-assisted closure in bacterial clearance of the infected abdomen. Surg. Infect. (Larchmt) 2014; 15: 18–23.

9 Lavery LA, La Fontaine J, Thakral G, Kim PJ, Bhavan K, Davis KE. Randomized clinical trial to compare negative-pressure wound therapy approaches with low and high pressure, silicone-coated dressing, and polyurethane foam dressing. Plast. Reconstr. Surg. 2014; 133: 722–6.

10 Shin JS, Choi HJ. Application of a silicone sheet in negative-pressure wound therapy to treat an abdominal wall defect after necrotizing fasciitis. Arch. Plast. Surg. 2017; 44: 76–9.