Reconstructing the abdominal wall with a biocompatible patch

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When there is massive intestinal edema after laparotomy for abdominal trauma or infection, the wound is often difficult to close. We describe the use of a simple-to-use Velcro-like fascia prosthesis (Wittmann Patch; STARSURGICAL Inc., Burlington, Wisc.) designed specifically to provide temporary closure until swelling subsides and the wound can be closed.

Case report

A 54-year-old man had considerable visceral swelling after laparotomy for intra-abdominal infection, and primary closure could not be achieved. We provided temporary abdominal closure with a presterilized 3-L cystoscopy fluid bag (Fig. 1). The following day we inserted a Wittmann Patch using a cellophane sheet to prevent adhesions between the intestine and the abdominal wall and wound. We sutured 2 sheets of material to opposing fascial edges that bordered the abdominal opening. The softer loop sheet was sutured to the right fascia by a running, looped 1-0 nylon suture with the harder hook sheet similarly sutured to the left fascia. We gently pressed the hooks into the loops of the loop sheet, thus providing safe closure (Fig. 2). On top of the patch sheets we placed gauze material around a large bore suction drain establishing a wound dressing; the skin edges were opposed loosely with 2-0 Prolene suture to prevent skin retraction. We covered the entire wound with an occlusive self-adhesive plastic drape.

As the abdominal swelling subsided, we gradually reapproximated the fascial edges by drawing the 2 sheets closer together, cutting away excess material and following the dressing regimen described previously. When the 2 fascial edges were sufficiently close (day 12), we removed the remaining patch material and closed the abdominal wall, fascia-to-fascia, and skin.

Discussion

Massive intestinal edema often follows laparotomy for major trauma or intra-abdominal infection in patients suffering

FIG. 1. Excessive peritoneal edema covered with the "Bogota" bag.

FIG. 2. Left: loop sheet attached to 1 fascia. Centre: the 2 sheets adhere to each other when compressed together to form a secure temporary closure and can be peeled apart to allow abdominal re-entry. Right: reducing the size of the hook sheet as peritoneal edema decreases.

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prolonged shock. Crystalloid resuscitation, capillary leakage due to activated inflammatory mediators and reperfusion injury all contribute to this tissue swelling, rendering the abdomen difficult or impossible to close. Recently, the definition and clinical importance of abdominal compartment syndrome has been refined, and indications for peritoneal decompression have been standardized.[1] Abdominal compartment syndrome refers to an increased pressure within the celomic cavity that ultimately compromises renal, pulmonary, gastrointestinal or cardiovascular function.[2] The diagnosis can be confirmed by intra-abdominal pressure measurement, directly through a Foley catheter in the bladder or a nasogastric tube in the stomach. A pressure greater than 25 cm H_2O is suggestive and greater then 30 cm H_2O is diagnostic. In addition, tissue perfusion can be examined; the effects of decompression in improving tissue perfusion parameters have been described (Table 1).[3] It is better to anticipate the development of abdominal compartment syndrome and use an alternative technique of wound closure to prevent its occurrence. However, once intra-abdominal hypertension has been diagnosed, the cavity should be decompressed.

Surgeons have used temporary abdominal wall closure after laparotomy for trauma since World War II.[4] One of the most popular ways to accomplish this is by using a 3-L intravenous bag. The "Bogota" bag, a gas sterilized 3-L polyvinyl chloride intravenous bag, is specifically fitted to the wall defect. The properties that make this technique appealing include cost, availability and strength. However, the bag has limitations, which include tearing at the suture line and difficult access to the visceral contents once applied. Others have used GORE-TEX soft tissue patches (W.L. Gore and Associates Inc., Flagstaff, Ariz.) for temporary abdominal wall closure with good results.[5] This temporary closure is then covered with wide mesh gauze and a catheter allowing 10–20 mL/h of normal saline to be applied to the surface in an attempt to prevent desiccation.

The Wittmann Patch comprises 2 sheets of biocompatible material, which are sutured to the opposing fascia. The 2 sheets adhere to each other when compressed together and provide a secure temporary closure over the abdominal wall opening between laparotomies. Access to the abdominal cavity is achieved by simply peeling back the 2 adhering sheets. It allows fast abdominal re-entry and is easily adjusted to accommodate changes in intra-abdominal pressure. The adhesive strength of the 2 sheets has been shown to be stronger than the forces required to disrupt normal, intact or sutured fascia.[6] Fascial edges can be reapproximated without disturbing sutures until the wound is close enough for formal closure.

In conclusion, the Wittmann Patch is effective for temporary bridging of abdominal wall openings where primary closure is not possible or repeat abdominal entry is necessary. Uses include treating and preventing abdominal compartment syndrome after trauma, ruptured abdominal aortic aneurysm, intra-abdominal infections, pancreatitis, bowel ischemia, loss of fascia and failed hernia repairs with mesh prostheses. It also avoids the cost of extensive secondary reconstructive procedures. The Wittmann Patch may offer realistic prospects for achieving final fascia-to-fascia closure and avoiding costly and difficult repairs.

Competing interests: None declared.

Table 1

Effects of decompression on systemic and regional tissue perfusion[3]

Variable	Result; mean (and SD)		*p* value
	Before decompression	After decompression	
Arterial lactate, mmol/L	4.4 (2.3)	3.9 (1.5)	0.35
Arterial base deficit, mmol/L	11 (5.4)	8.5 (5.0)	0.04
Hemoglobin, g/L	118 (15)	127 (20)	0.17
Oxygen delivery index,* mL/min·m^{-2}	570 (115)	663 (189)	0.08
Oxygen consumption index,* mL/min·m^{-2}	124 (44)	142 (43)	0.16
Arterial oxygen saturation,%	96 (3)	98 (3)	0.18
Mixed venous oxygen saturation, %	75 (10)	77 (10)	0.14
Arterial pH	7.26 (0.14)	7.32 (0.08)	0.22
Gastric intramucosal pH	7.15 (0.13)	7.20 (0.14)	0.01
Urine output,† mL/h	105 (85)	188 (127)	0.007

SD = standard deviation.
*Indexed to body surface area.
†For the 4 hours before and after decompression.

References

1. Saggi BH, Sugerman HJ, Ivantury RR, et al. Abdominal compartment syndrome. *J Trauma* 1998;45:597-609.
2. Ivatury RR, Porter JM, Simon RJ, et al. Intra-abdominal hypertension after life threatening abdominal trauma: prophylaxis, incidence, and clinical relevance to gastric mucosal pH and abdominal compartment syndrome. *J Trauma* 1998;44:1016-23.
3. Chang MC, Miller PR, D'Agostino R Jr, et al. Effects of abdominal decompression on cardiopulmonary function and visceral perfusion in patients with intra-abdominal hypertension. *J Trauma* 1998;44:440-5.
4. Ogilvie WH. The late complications of abdominal war wounds. *Lancet* 1940;2:253-6.
5. Cohen M, Morales R, Fildes J, et al. Staged reconstruction after gunshot wounds to the abdomen. *Plast Reconstr Surg* 2001;108:83-92.
6. Wittmann DH, Aprahamian C, Bergstein JM. Etappenlavage: advanced diffuse peritonitis managed by planned multiple laparotomies utilizing zippers, slide fastener, and Velcro analogue for temporary abdominal closure. *World J Surg* 1990;14:218-26.