

Management of critically ill surgical patients

Case reports



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The acute abdomen (AA) still remains a challenging situation for surgeons. New pathological conditions have been imposed to our attention in this field in recent years.

The definition of abdominal compartmental syndrome (ACS) in surgical practice and the introduction of new biological matrices, with the concepts of tension-free (TS) repair of incisional hernias, prompted us to set up new therapeutic strategies for the treatment of patients with AA.

Thus we reviewed the cases of AA that we observed in recent years in which we performed a laparostomy in order to prevent or to treat an ACS.

They are all cases of acute abdomen (AA), but from different origin, including chronic diseases, as in the course of inflammatory bowel disease (IBD), and acute pancreatitis. In all the cases, the open abdominal cavity was covered with a polyethylene sheet. The edges of the wound were sutured to the plastic sheet, and a traction exerted by a device that causes a negative pressure was added. This method was adopted in several cases without randomization, and resulted in excellent patient's outcomes.

KEY WORDS: Abdominal compartmental syndrome, Acute abdomen, Laparostomy

Introduction

Intra-abdominal infections (IAIs) are a common problem for the general surgeon, and a major source of morbidity and mortality in the intensive care unit (ICU). Some of these patients present with peritonitis and can rapidly progress to septic shock and need prompt resuscitation, antibiotics, and source control. The management of these patients is complex, requiring skills in

ICU management, operative source control, damage control and reconstruction technique. The early detection and a timely therapeutic intervention can improve the prognosis and overall clinical outcome of septic patients. However, early diagnosis of sepsis can be difficult: identifying those patients presenting with signs of infection during an initial evaluation, who do currently have, or will later develop a more serious illness is not an easy task.

Damage control laparotomy (DCL) it's a valid therapeutic strategy to treat patients with IAI and sepsis. DCL refers to a sequence of interventions comprising an initial laparotomy with the only goals of controlling bleeding or contamination, a period of resuscitation, subsequent operations, and a definitive abdominal wall closure¹.

For the first time in 1940, during World War II, Ogilvie provided the definition of open abdomen technique. DCL was formalized subsequently, about 20 years ago by Rotondo and colleagues² as a method of reducing

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the morbidity and mortality associated with severe intra-abdominal injury. Over the past 15 years, there has been widespread adoption of DCL techniques, and the open abdomen has become commonplace in surgical ICUs and been used to treat severe intra-abdominal infections³. Indications for DCL in severe IAI are similar to those in severe abdominal trauma: temperature less than 35°C, pH less than 7.20, a base deficit greater than 8, and laboratory or clinical evidence of coagulopathy^{4,5}. Additionally, indications include the need of massive volume resuscitation, persistent contamination, inadequate source control, hemodynamic instability, need for “second look” procedure, primary prevention of ACS, and development of multisystem organ failure (MOF)⁶. The immediate closure of the abdominal wall following laparotomy may not be possible or desirable, particularly in patients with a severe abdominal catastrophe such as diffuse peritonitis, necrotising pancreatitis or trauma. Attempting to close the abdomen in such cases may result in potentially life-threatening ACS. Therefore, in these circumstances, it is well established the use of laparostomy⁷⁻⁹. But the open abdomen is complex to manage and is itself associated with considerable morbidity and mortality rates in excess of 25%¹⁰. Numerous materials and techniques have been used for temporary closure during the last decade, including skin approximation with towel clips or running suture, the Bogota bag, the Wittmann patch, absorbable or non-absorbable mesh closure, and various systems of Negative Pressure Therapy (NPT) techniques¹¹⁻¹².

In this paper we report three cases successfully treated by our team using a therapeutic strategy comprising:

- 1 – Laparotomy with intra-abdominal exploration, identification of problems, and attempt to solving them;
- 2 - Placement of a feeding jejunostomy and of an intra-abdominal drainage tube;
- 3 - Positioning of the device for the Negative Pressure Therapy, generally changed after three days and always monitored by the patient’s clinical condition.

Case Reports

1 – LI, 56 years Chinese woman, underwent laparotomy for ovarian cancer, performed by Gynecologists colleagues. During bilateral oophorectomy a vascular lesion was provoked in the colon, which had to be treated with emergency total colectomy and ultra-low ileo-rectal anastomosis. In the immediate postoperative period, the patient developed an acute abdomen with suspected anastomotic leak that was managed by performing a loop ileostomy and drainage of the small pelvis. Then the abdominal drainage tube still showed a relevant enteral leakage and a second laparotomy was necessary. A wide leak in the ileum was demonstrated, downstream to the stoma, which was directly sutured. Also a feeding jejunostomy was placed in order to perform a prompt nutri-

tion of the digestive tract. At the edge of a laparotomy was positioned a polyurethane sponge and NPT, intermittent at 60 mmHg (Smith & Nephew, UK) without proceeding to closure of the fascia. During 15 days the sponge was shaped and changed two more times. After this period, the patient underwent abdominal closure placing a porcine matrix (Permacol ©Covidien 1.5 mg USA) of 30 x 40 cm which covered all the laparotomy wound, and was sutured the edge points with non-absorbable stitches; then the matrix was progressively reduced and shaped. The loop ileostomy was not moved and the patient could be fed from the first day. The conditions progressively improved by overcoming the septic state. The patient was successively transferred in Gynecology Department in order to continue the already planned anti-cancer therapies. Two cycles of chemotherapy were performed without evident digestive problems.

2 – BS, 81 years old man presented to our attention because of continuous hypoglycemic crisis. The CT scan showed a globular lesion of about 15 mm in diameter on the upper margin of the pancreas, with typical impregnation of a neuroendocrine tumour. Also a carcinoma involving the cecal end and the last ileal loop was demonstrated. The patient underwent to a laparotomy without evidence of pancreatic formations, the biopsies on the site of suspected pancreatic lesion were negative for malignancies. The procedure ended with a right hemicolectomy with the removal of an intestinal adenocarcinoma of the caecum. The exploration of the pancreatic gland determined a severe pancreatitis with involvement of the body and tail of the pancreas. The appearance of pre- pancreatic free fluid and signs of systemic infection induced the relaparotomy with new exploration of the gland and removal of necrotic and infected tissue. A system with negative abdominal pressure (NPT, Smith & Nephew, UK) was placed and changed every 4 days with reduction of the area of the polyurethane sponge (Fig. 1). After two weeks, a large porcine matrix (Permacol ©Covidien 1.5 mg USA) was placed between the two edges of rectum muscle, even after conducting a components separation, and a further drainage of pancreatic loggia. The postoperative course was without complications and after a period of 10 days the patient was transferred to the Geriatrics Department and then discharged after 20 days.

3 – DT, 30 years old woman affected by Crohn’s disease, was transferred to our department because of an acute abdomen. At laparotomy free faecal slurry in the peritoneum due to a large perforation in the terminal ileal was observed. The ileal perforation was sutured and a drainage was placed near the anastomosis. However, the picture did not improve and a CT scan showed the presence of the drainage in the lumen of the ileal loop. A second laparotomy was performed, with drain removal, and suture of the ileal loop. NPWT was positioned with-



Fig. 1



Fig. 2

out closure of the abdominal wall and a jejunostomy nutrition was performed (Fig. 2). The suction pressure was 60 mmHg, alternated. The sponge was changed every 4 day. A minimum of ileal loop hole remained with a leakage of 50-60 ml per day. Given the difficulty of closing the gap on the loop, it was sutured the margin of the loop to the muscle layer, preferring an entero-cutaneous fistula that entero-peritoneal one. The persistence of the inflammatory disease recommended the transfer of the patient to the specialist center for inflammatory bowel diseases - IBD. Currently, the patient is doing well and she does not need artificial feeding and does not presents febrile episodes.

Discussion

The laparostomy is a surgical procedure proposed many years ago, to solve acute and septic abdomen. The laparostomy is also used in the prevention and treatment of abdominal compartment syndromes (ACS), and in cases needing repeated opening of the peritoneal cavity,

as in the case of necrotic and septic pancreatitis. Typically the war wounds have produced a large series of ACS for the vast debacles and for the damage from the blast but, the open abdomen is a relatively new approach in the treatment of non traumatic abdominal emergencies. The latest studies pointed up the importance of preventing the ACS.

Current methods of treatment and the development of new technologies have led to the resolution of ACS in a single hospitalization. Satisfactory results are reported after adequate treatment of patients with complicated IAIs. Recent clinical trials have demonstrated an overall mortality of 2% to 3% among patients with complicated IAIs^{13,14} reaching, in the CIAO study, 7.7%¹⁵. In this study, analyzing the subgroup of patients with severe sepsis or septic shock at admission to hospital, the mortality rate reached 32.4% (89/274) and in patients with severe sepsis or septic shock in the immediate postoperative period, the mortality rate was 42.3% (110/266). Abdominal sepsis represents the host's systemic inflammatory response to bacterial or yeast peritonitis. In the event of peritonitis gram-negative, gram-positive, as well as anaerobic bacteria, including common gut flora, such as *Escherichia coli*, *Klebsiella pneumoniae*, *Streptococcus spp.* and *Bacteroides fragilis*, enter the peritoneal cavity.

The sequence of DCL as described for trauma has been adapted to IAI with several modifications¹⁶. The initial resuscitation and evaluation period, termed ground zero, is generally longer, requiring several hours to restore adequate systemic perfusion in the septic patient. The goals of this period are to replace circulating volume with crystalloids and to begin correcting acidosis and coagulopathy associated with sepsis. Once the patient has undergone the resuscitation period, an exploratory laparotomy for source control is performed. The goals of this initial surgical step are to drain any intra-abdominal abscess and resect ischemic or necrotic tissue. After source control is obtained, the method of temporary abdominal closure needs to be considered. The ideal method of temporary abdominal closure should prevent evisceration, actively remove any infected or toxic fluid from the peritoneal cavity, prevent the formation of entero-atmospheric fistulas, preserve the fascia and the abdominal wall domain, make the reoperation easy and safe, and achieve early definitive closure.

Numerous materials and techniques have been used for temporary closure during the last decade, including skin approximation with towel clips or running suture, the Bogota bag, the Wittmann patch, absorbable or non-absorbable mesh closure, and various NPT techniques (Table I). Primary skin closure and mesh placement have largely been replaced by vacuum dressings. NPT techniques have revolutionized the management of the open abdomen and improved survival, morbidity, and the success rate of primary fascia closure. This method prevents adhesions between the peritoneum and the bowel, preserves the abdominal wall domain, and actively drains

TABLE I - Description of main temporary abdominal closure techniques (Modified by Atema J.J. et al, Systematic Review and Meta-analysis of the Open Abdomen and Temporary Abdominal Closure Techniques in Non-trauma Patients World J Surg 39:912-25, 2015)

TAC technique	Description
NPT	A perforated plastic sheet cover the intestine and a polyurethane sponge is placed on top. The wound is covered with an airtight seal and is centrally pierced by a suction drain, which is connected to a pump and fluid collection system.
NPT with continuous fascial traction	Modification of NPT using a mesh or sutures sutured to the fascial edges, which can be tightened with every NPT system change
Wittmann patch	Two Velcro pieces are sutured to the fascial edges and facilitate gaining access to the abdominal cavity and gradual re-approximation of the abdominal wall.
Bogota bag	A sterile irrigation bag is sutured between the fascial edges.
Mesh	An absorbable or nonabsorbable mesh is sutured between the fascial edges and can be tightened gradually.
Zipper	A mesh with zipper is sutured between the fascial edges. It is comparable to mere mesh placement but allows for a more easy access to the abdominal cavity
Loose packing	The fascial defect is covered by standard wound dressing

TAC temporary abdominal closure, NPT negative pressure therapy

toxin-rich or bacteria-rich intra-abdominal fluid. The three most commonly used NPT techniques are the Barker vacuum-pack technique, the vacuum-assisted closure (VAC; KCI, San Antonio, TX), and the ABThera (KCI, San Antonio, TX). The first negative pressure method for temporary abdominal wall closure was described in South Africa by Schein and colleagues¹⁷ in 1986. The investigators described a sandwich technique composed of Marlex mesh and OpSite closure with suction catheters. This technique was modified by Barker and colleagues¹⁸ in 1995 and was coined vacuum pack and later the Barker vacuum pack.

NPT has become established in the management of 'slow-to-heal' superficial wounds. In addition, considerable evidence exists in the literature surrounding the role of using vacuum-assisted negative pressure dressings to achieve abdominal closure following trauma. Through the use of a visceral drape this technique prevents visceral adhesions to the anterolateral abdominal wall while maintaining medial fascial traction, which may enhance fascial closure rates among those with an open abdomen^{19,20}. It may also remove fluid and pro-inflammatory cytokines from the peritoneum, which may reduce abdominal third space volume, the systemic inflammatory response, and

resultant organ dysfunction²¹⁻²³. However, relatively few prospective studies have been published evaluating the use of negative pressure therapy to achieve abdominal closure following surgery for intra-abdominal sepsis. An experimental work using a porcine model of intestinal ischemia and peritoneal fecal contamination showed that early application of NPT with VAC Abdominal Dressing prevented the development of ACS and subsequent multi organ dysfunction syndrome (MODS) compared with treatment with passive drainage.

Although it was proposed many years ago, only in the last decade the Companies have provided the most effective means to achieve an adequate negative pressure without negative influence on the jejunal and ileal loops, and has better defined the suction going from continued to an alternating type.

The open abdominal cavity is covered with a polyethylene sheet, fissured to allow the suction of the liquid, while a thick layer of polyurethane is fixed to the edges of the fascia and gradually reduced to allow a closing aid of the wall. The edges of the wound are sutured to the plastic sheet and a negative pressure device can be added.

The method has been adopted in several cases without randomization, and resulted in an excellent patient's outcomes. It seems to us an excellent application in the treatment of severe pancreatitis, where the septic state is always associated with an increase in intra-abdominal pressure. The suction does not adversely affect the status of the intestinal loops, and indeed determines a reimbursement, and a closure of any small fistulae.

With the coming devices it will be possible to treat also esophageal fistulas, even if, with the use of the Endosponge B Braun, the patient's compliance is thought to be scarce. The data sheet recommends this measure for esophageal fistulas, and fistulas after rectal surgery. With regard to the surgery of the rectum and perineum this seems a particularly interesting field for this method as it's easily attacked and the complex of suction can be safely positioned without particular difficulties.

Another main therapeutic element to consider in the treatment of patients with severe IAIs is the enteral nutrition (EN). Generally a polymeric EN together with the parenteral intake of Fish Oils (FO) are used with the purpose to decrease, or modulate, the inflammatory response, physiologically beneficial but probably exaggerated in this case. The FO does just that, by reducing and eliminating the inflammatory response.

It should be emphasized that recourse to the stubborn NE in case of intra-abdominal sepsis can determine the resolution of extremely serious conditions. Indeed, the nutritional status of these patients may be severely compromised, remembering also the prevention or contrast of the so-called bacterial translocation. The effects of nutritional support in critically ill patients has had a great impact on interest in recent years, however, studies have obtained mixed results. Enteral nutrition should

be initiated early in the patient undergoing surgery, such as “early enteral nutrition,” to get to the radicalization of uninterrupted enteral nutrition, to prevent the time where the patient is more susceptible to infection. In agreement of this, Bengmark, even if extreme, speaks in favour of an uninterrupted nutrition during surgery. The most exposed moment remains the operative time and this is the time that the patient is infected. Feeding immediately the intestine, significantly reduces postoperative infections, especially lung infections. This is actually the most used type of nutrition in European intensive care units in recent years.

If NE becomes impossible for intestinal failure or non-compliance of the patient, it should be changed to a mixed nutrition, parenteral and enteral. Both diets with arginine with glutamine appear to have a positive effect on the surgical patient. Products with fish oil (FO) as well as with probiotics may reduce the occurrence of infections in patients undergoing major surgery.

However, we must underline how the administration of arginine to the patient in sepsis might be dangerous to an overproduction of nitric oxide, a potent vasodilator and is therefore not compatible with a patient who tends to septic shock.

Conclusions

In conclusion, in patients with severe IAIs a strategy comprising a Damage Control laparotomy to achieve the source control and the placement of a feeding jejunostomy without closing the abdominal wall followed by the use a Negative Pressure Therapy system and a successively definitive abdominal closure, is a valid therapeutic option.

Riassunto

L'addome acuto resta ancora oggi un arduo campo di prova per il chirurgo. Nuovi quadri patologici si sono imposti alla nostra attenzione seguendo il vecchio filone dell'addome acuto. La definizione di sindrome compartimentale e l'introduzione nella pratica chirurgica di nuove matrici biologiche, con i concetti di riparazione “tension free” delle ernie incisionali, ci hanno spinto a configurare nuovi piani terapeutici per questi importanti aspetti patologici. Abbiamo così rivisto alcuni casi descritti negli ultimi anni e trattati seguendo un medesimo indirizzo tattico. Sono tutti quadri di addome acuto, con diversa eziopatogenesi, anche cronica, come ad esempio quadri di malattia cronica intestinale (IBD) e di pancreatite acuta settica. La laparostomia è un trattamento chirurgico che viene utilizzato nella prevenzione e nel trattamento delle sindromi compartimentali addominali (SCA), e nei casi in cui sono necessarie ripetute aperture del cavo peritoneale. La cavità lasciata aperta viene

ricoperta con un foglio di polietilene. I bordi della ferita vengono suturati al foglio plastico, e si può aggiungere una trazione esercitata da un apparecchio che determini una pressione negativa. La metodica è stata adottata in casi vari senza randomizzazione, e ha determinato un ottimo outcome dei pazienti.

References

1. Waibel BH, Rotondo MF: *Damage control in trauma and abdominal sepsis*. Crit Care Med, 2010; 38(9 Suppl):S421-30.
2. Rotondo MF, Schwab CW, McGonigal MD, Phillips GR, Fruchterman TM, Kauder DR, Latenser, BA, Angood PA: *Damage control: An approach for improved survival in exsanguinating penetrating abdominal injury*. J Trauma, 1993; 35(3):375-82.
3. Ivatury RR, Nallathambi M, Rao PM, Rohman M, Stahl WM: *Open management of the septic abdomen: Therapeutic and prognostic considerations based on APACHE II*. Crit Care Med, 1989; 17(6):511-17.
4. Asensio JA, McDuffie L, Petrone P, Rolda G, Forno W, Gambaro E, Salim A, Demetriades D, Murray J, Velmahos G, Shoemaker W, Berne TV, Ramicone E, Chan L: *Reliable variables in the exsanguinated patient which indicate damage control and predict outcome*. Am J Surg, 2001; 182(6):743-51.
5. Aoki N, Wall MJ, Demsar J, Zupan B, Granchi T, Schreiber MA, Holcomb JB, Byrne M, Liscum KR, Goodwin G, Beck JR, Mattox LR: *Predictive model for survival at the conclusion of a damage control laparotomy*. Am J Surg, 2000; 180(6):540-44.
6. Diaz JJ, Cullinane DC, Dutton WD, Jerome R, Bagdonas R, Bilaniuk JW, Bilaniuk JO, Collier, BR, Como JJ, Cumming J, Griffen M, Gunter OL, Kirby J, Lottenburg L, Mowery Riordan NWP, Martin N, Platz J, Stassen N, Winston ES: *The management of the open abdomen in trauma and emergency general surgery: Part 1-damage control*. J Trauma, 2010; 68(6):1425-438.
7. JHadeed JG, Staman GW, Sariol HS, Kumar S, Ross E: *Delayed primary closure in damage control laparotomy: The value of the Wittmann patch*. Am Surg, 2007; 73(1):10-12.
8. Chorbajian M, Bown M, Graham C, Sayers R: *Laparostomy healing by secondary intention after ruptured abdominal aortic aneurysm repair*. J Tissue Viability, 2004; 14(1):24-27.
9. Finlay IG, Edwards TJ, Lambert AW: *Damage control laparotomy*. Br J Surg, 2004; 91(1):83-85.
10. De Laet IE, Ravyts M, Vidts W, Valk J, De Waele JJ, Malbrain ML: *Current insights in intra-abdominal hypertension and abdominal compartment syndrome: open the abdomen and keep it open!* Langenbecks Arch Surg, 2008; 393(6):833-47.
11. Rutherford EJ, Skeete DA, Brasel KJ: *Management of the patient with an open abdomen: Techniques in temporary and definitive closure*. Curr Probl Surg, 2004; 41(10):815-76.
12. Schecter WP, Ivatury RR, Rotondo MF, Hirshberg A: *Open abdomen after trauma and abdominal sepsis: A strategy for management*. J Am Coll Surg, 2006; 203(3):390-96.
13. Mazuski JE, Solomkin JS: *Intra-abdominal infections*. Surg Clin North Am, 2009; 89(2):421-37.

14. Babinchak T, Ellis-Grosse E, Dartois N, Rose GM, Loh E: *The efficacy and safety of tigecycline for the treatment of complicated intra-abdominal infections: Analysis of pooled clinical trial data.* Clin Infect Dis, 2005; 41(Suppl 5):S354-67.:
15. Sartelli M, Catena F, Ansaloni A, Leppaniemi A, Taviloglu K, van Goor H, Viale P, Lazzareschi, Coccolini F, Corbella D, de Werra C, Marrelli D, Colizza S, Scibe R, Alis H, N. Torer DV, S. Navarro S, B. Sakakushev, D. Massalou, G. Augustin, M. Catani, S. Kauhanen, P. Pletinckx, J. Kenig, Di Saverio, Jovine SE, Guercioni G, M. Skrovina M, Diaz-Nieto R, Ferrero A, Rausei S, Laine, Major P, Angst E, Pittet O, Herych I, Agresta F, Vettoretto N, Poiasina E, Tepp J, Weiss GH, Vasquez G, Vladov N, Trana C, Delibegovic S, Dziki A, Giraudo G, Pereira J, Tzerbinis H, van Dellen D, Hutan M, Vereczkei A, Krasniqi A, C. Seretis, C. Mesina, M. Rems, F. C. Campanile, Coletta P, Uotila-Nieminen, Dente M, Bouliaris K, Lasithiotakis K, Khokha V, Zivanovic D, Smirnov D, Marinis A, Negoii I, Ney L, Bini R, Leon M, Aloia S, Huchon, C, Moldovanu R, B. de Melo R, Giakoustidis D, Ioannidis O, Cucchi M, Pintar M, Krivokapic Z, Petrovic J: *Complicated intra-abdominal infections in Europe: A comprehensive review of the CIAO study.* World J Emerg Surg, 2012; 7(1):36.
16. Waibel BH, Rotondo MF: *Damage control for intra-abdominal sepsis.* Surg Clin North Am, 2012; 92(2):243-57.
17. M. Schein M, Saadia R, Jamieson JR, Decker GA: *The 'sandwich technique' in the management of the open abdomen.* Br J Surg, 1986; 73(5):369-70.
18. Brock WB, Barker DE, Burns RP: *Temporary closure of open abdominal wounds: The vacuum pack.* Am Surg, 1995; 61(1):30-35.
19. Miller PR, Thompson JT, Faler BJ, Meredith JW, Chang MC: *Late fascial closure in lieu of ventral hernia: The next step in open abdomen management.* J Trauma, 2002; 53(5):843-49.
20. Miller R, Meredith JW, Johnson JC, Chang MC: *Prospective evaluation of vacuum-assisted fascial closure after open abdomen: Planned ventral hernia rate is substantially reduced.* Ann Surg, 2004; 239(5):608-14
21. Batacchi S, Matano S, Nella A, Zagli G, Bonizzoli M, Pasquini A, Anichini V, Tucci V, Manca G, Ban K, Valeri A, Peris A: *Vacuum-assisted closure device enhances recovery of critically ill patients following emergency surgical procedures.* Crit Care, 2009; 13(6):R194.
22. Kubiak BD, Albert SP, Gatto LA, Snyder KPMaier KG, Vieau GJ, Roy S, Nieman GF: *Peritoneal negative pressure therapy prevents multiple organ injury in a chronic porcine sepsis and ischemia reperfusion model.* Shock, 2010; 34(5):525-34.
23. Dalfino L, Tullo Donadio I, Malcangi V, Brienza N: *Intra-abdominal hypertension and acute renal failure in critically ill patients.* Intensive Care Med, 2008; 34(4):707-13.