



Combined management of open abdomen with enteroatmospheric fistula by negative pressure instill wound therapy and dermal matrix wound dressing

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Combined management of open abdomen with enteroatmospheric fistula by negative pressure instill wound therapy and dermal matrix wound dressing.

AIM: The management of open abdomen with enteroatmospheric fistula is a real nightmare for surgeons; negative pressure with fluid instillation is affordable and effective. After improvement of general conditions, a good strategy for promoting tissue granulation around the fistula could be the application of a matrix wound dressing.

MATERIALS AND METHODS: A 45-year-old man was admitted to our Emergency Department for abdominal compartment syndrome following a previous intervention for bowel occlusion; at exploration we found a frozen abdomen that was managed by negative pressure wound therapy with fluid instillation (AbThera® device, VAC Instill®, 3M+KCI). The condition was complicated by an enteroatmospheric fistula that we managed by negative pressure and fistula diversion according to "Baby Bottle Nipple VAC technique".

After improvement of general and local conditions, in order to obtain a faster reepithalization around the stoma, we decided to apply a dermal substitute (Integra® Bilayer Wound Matrix, LifeSciences Corporation).

RESULTS: We obtained a good reepithalization and five months after admittance the patient was dismissed in a good health with a stoma bag applied on the fistula. Six month later bowel continuity was restored.

CONCLUSIONS: The role of negative pressure with instillation in the management of open abdomen is defined; it allows to preserve healthy bowel integrity and to improve septic environment control. If an enteroatmospheric fistula is present, the application of a dermal substitute can be a good strategy for promoting tissue granulation around the fistula, thus allowing the application of a stoma bag and a faster regain of the upright position.

KEY WORDS: Dermal Substitute, Enteroatmospheric fistula, Negative pressure Wound therapy, Open abdomen

Introduction

The management of open abdomen for abdominal compartment syndrome is one of the most challenging activities both for the emergency and the trauma surgeon;

this condition becomes a real nightmare if complicated by one or more enteroatmospheric fistula and still carries a high rate of morbidity. Negative pressure wound therapy with fluid instillation is an affordable tool, bringing two main advantages: a significant reduction of inflammatory mediators that enter the blood stream, and preservation of abdominal fascia integrity. After patient's condition improvement, a good granulation of tissue around the fistula plays a central role for the protection of the fragile bowel and the regain of the upright position, allowing the application of a stoma bag. We present the association of negative pressure with a dermal matrix wound dressing in the management of open abdomen with spontaneous fistula.

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Materials and Methods

A 45-year-old man was admitted to our Emergency Department with the complaint of abdominal pain and distension, nausea and vomiting. He also reported anuria lasting for several hours. Past history was significant for rheumatoid arthritis, laparotomy for bleeding Meckel's diverticulum during childhood, laparoscopic incisional hernia repair with mesh (polypropylene) positioned one year earlier; one week before admittance he had been operated for a bowel occlusion due to abdominal adhesions and the mesh had been removed.

Parameters were: blood pressure 130/80 mmHg, heart rate 75, respiratory rate 25, oxygen saturation 92%, fever 37 °C. Clinical exam: abdomen was distended with rebound tenderness at mesogastric region. Intra-abdominal pressure (IAP) was equal to 26 mmHg. Blood and laboratory test results were as follows: white blood cell count 13 300/mm³, hemoglobin 11.3 g/dL, platelet count 275 000 mm³, blood urea nitrogen 90mg/dL (normal 17-50), creatinine 1.8 mg/dL (normal 0.7-1.3), bilirubin 1.6 mg/dL (normal 0.2-1.2).

Abominal X-ray showed hydroaeric levels and bowel distension; A CT-scan also showed small bowel wall thickening.



Fig. 1: A typical picture of frozen abdomen type 3A found at first surgical exploration.

The patient underwent emergent surgical exploration; a midline incision was performed. Surgery confirmed the diagnosis of abdominal compartment syndrome with the picture of a “frozen abdomen” (Fig. 1). Dissection of viscera without causing bowel perforation was virtually impossible, so we decided for a damage control strategy: AbThera[®] device (VAC Instill[®] Therapy Unit, 3M+KCI) was positioned (Fig. 2) and instillation with 0.9 sodium chloride solution was started (total volume of instillation approximately 3 L per day).

The patient was transferred to ICU on mechanical ventilation; empiric antimicrobial treatment with meropenem 1 gm IV q8h was started and parenteral nutrition was administered. After 48 hours we decided for a surgical reexploration: once the VAC dressing was removed, we found a general improvement: there was a good granulation tissue (neoperitoneum) and a good preservation of fascial edges (Fig. 3A). General conditions and parameters continued to improve, such as laboratory tests; dressing changes were performed in the operating room every 48 hours with constant and gradual improvement; thus till the 10th day after admission, when we noticed the presence of an enteric leakage due to an anteroatmospheric fistula (EAF) at the left side of the abdomen (Fig. 3B); the patient underwent a CT scan and a X-ray fistulogram which showed that the middle tract of the ileum was involved.

Therefore we decided to transfer the patient from ICU to our surgical unit and to manage the EAF through “Baby Bottle Nipple VAC technique”¹: a baby bottle



Fig. 2: AbThera[®] device as it appeared at the end of first application.

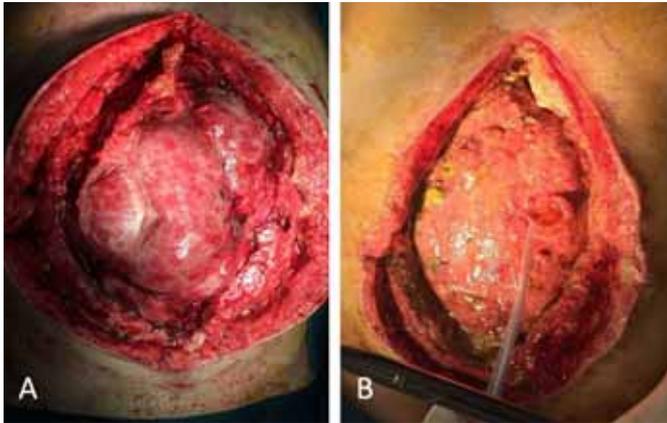


Fig. 3: A: second look at 48 hours: a good granulation tissue and a good preservation of fascial edges is shown; B: an enteroatmospheric fistula is present at the left side of the abdomen.

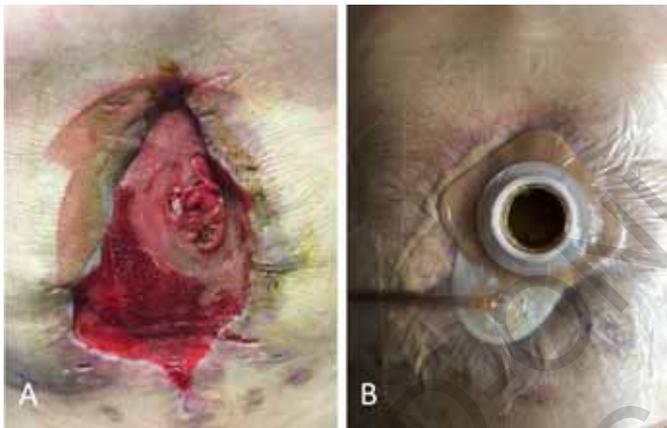


Fig. 4: A: compartmentalization of the fistula and good granulation achieved by negative pressure; B: a stoma bag is applied on the fistula through the Wound Crown® device; negative pressure is applied around it and hydrocolloid-based paste is used as barrier and filler.

rubber is placed over the fistula opening and sealed by a round layer of colostomy paste; a drain tube is connected to a small hole at the tip of the nipple; the surrounding tissue (neoperitoneum) is then covered with Whitefoam™ and a layer of Granufoam™ above it and the entire wound is covered by the VAC dressing (a little hole is needed to allow the drain tube passage). Negative pressure with instillation is then activated as described above. The nipple was replaced by the Wound Crown® device as soon as it was available. VAC therapy was applied both on the fistula stoma and on the tissue around through an Y-connector. All medications were performed bedside, under mild sedation obtained with i.v. infusion of midazolam (3-5 mg). The edges of the wound were gradually tightened by full-thickness non-resorbable-synthetic-sutures (Ethibond Excel® 5). This approach was possible because of fascial edges preservation achieved by negative pressure.



Fig. 5: Integra® wound matrix just after application.



Fig. 6: A significant reduction of wound size around the fistula 12 days after application of dermal substitute.

Patient's conditions continued to improve, parenteral nutrition was still administered and a high protein diet per os was given; at this point (5 weeks after admission), we had a double enteroatmospheric fistula surrounded by a thin granulation tissue (neoperitoneum) obtained through VAC-instill therapy (Fig. 4A); we continued to medicate in the fashion described above (Fig. 4B).

In order to obtain a faster reepithalization around the stoma we decided to use a dermal substitute; due to our previous experiences (burn care and necrotizing fasciitis) we opted for Integra®, a bilayer matrix composed of a cross-linked bovine tendon collagen-based dermal matrix linked with glycosaminoglycans (GAG). We placed the



Fig. 7: A healthy small bowel (partially eviscerated) six months after first admittance.



Fig. 8: Patient's abdomen one month after bowel continuity restoration.

sheet directly on the neoperitoneum surrounding the fistula device; it was then stapled to the skin (Fig. 5); the Granufoam® dressing was then positioned and VAC therapy was re-applied on it and on the fistula stoma through an Y-connector.

After 12 days of therapy (the dressing was never changed in order to reduce risk of matrix infection) we obtained a good reepithalization and a clear reduction of the wound size around the fistula (Fig. 6). Negative pressure therapy was suspended at that time.

Patient's conditions continued to improve, as well as laboratory tests; five months after admittance he was dismissed in a good health with a stoma bag applied on the fistula, that we properly called ileostomy at that time. He was newly admitted six months later in order to restore bowel continuity, when the abdomen showed a partial evisceration with a healthy small bowel, that we considered as a sign of right time for reintervention (Fig. 7); a midline laparotomy was done; the bowel was in a good health, so the ileal tract involved in the fistula – about 30 cm - was resected and a L-L mechanical anisoperistaltic anastomosis was performed. The patient was dismissed seven days later in a good health; one month later his abdomen appeared as shown in Fig. 8.

Discussion

Abdominal compartment syndrome (ACS) is defined as a sustained intra-abdominal hypertension (IAP) that is

associated with organ dysfunction/failure; abdominal “mass effect”, although caused by several mechanisms, is always present²; in our case bowel distension and wall thickening, associated to size-reduction of abdominal cavity due to mesh removal, were essential for developing ACS.

ACS can be primary, if associated with a disease originated into the abdominal cavity, or secondary if sustained by an extra-abdominal condition.

In case of severe ACS abdominal decompression is mandatory: we often observe a rapid improvement in blood pressure, vascular resistance and oxygenation after decompression, even if the real indicators of clinical improvement are cardiac output and urine output³.

After decompression, the open abdomen technique (OA) with temporary abdominal closure (TAC) is effective in the care of patients with ACS, allowing a progressive recovery from the shock state and creating a possibility for further surgery in a second time (concept of Damage Control Surgery)⁴.

Negative pressure wound therapy (NPWT) is an affordable tool in managing OA; it carries two main advantages: the continuous evacuation of inflammatory ascites results in a significant reduction of inflammatory mediators that enter the blood stream, thus decreasing organ damage⁵; on the other hand, preservation of abdominal fascia integrity allows an anatomical and gradual closure, reducing the risk for ventral hernias⁶.

In the last few years, beside the classic NPWT, fluid instillation has been described as a good method in man-

aging OA⁶: the use of normal saline, when compared to traditional NPWT, showed reduced mortality and lower incidence of enteric fistula formation⁷. Some authors suggested irrigation with antibiotics or hypochlorous acid solutions in order to reduce bacterial contamination; others suggested anesthetics (such as bupivacaine) to achieve a post-surgical analgesia: there is little evidence about it and further investigations are needed⁴.

In our case, even though NPWT and fluid instillation, patient developed an enteroatmospheric fistula (EAF).

This event, i.e. the presence of an enteric fistula in the middle of an open abdomen, is a real challenge for the surgeon and involves metabolic, nutritional, psychological and nursing aspects; it still carries a mortality up to 40%, mostly due to the continuous spillage of enteric fluid inside the peritoneal cavity⁸. The golden rule in the management of an EAF is the diversion of fistula output and the protection of the surrounding tissue, thus allowing a good granulation and the protection of the residual bowel. While NPWT has been considered as a risk factor for fistula formation in open abdomen, now we know that not only it is a safe technique, but also that sometimes, during NPWT, an EAF can heal spontaneously⁹.

In 2015 Di Saverio et al. reviewed all treatment options described in the literature for EAF diversion⁸: among these, we prefer the “baby bottle nipple VAC”, in the way we described above, as first proposed in 2010 by Layton et al.¹. We always prefer not to place catheters directly into the stoma, for the high risk of bowel damage.

Our goal, while patient conditions were improving, was to “surround the enemy” (i.e. the EAF) and to promote growth of skin tissue so that a stoma bag could be applied to the abdominal wall. This step is a real turning point for patients affected by EAF: from a psychological point of view, regaining the upright position plays a central role in the global healing process.

Based on our experience in treating burns and necrotizing fasciitis, we decided to improve dermal growth by applying a dermal substitute, i.e. Integra® Bilayer Wound Matrix (LifeSciences Corporation, Plainsboro, NJ, USA). This kind of substitutes has become increasingly widespread in the last few years: they act as a scaffold and promote wound healing¹⁰, mimicking the properties of extracellular matrix thanks to their particular characteristics, such as biocompatibility and resistance.

Integra® is an advanced wound care device comprised of a porous matrix of cross-linked bovine tendon collagen and glycosaminoglycan and a semi-permeable polysiloxane (silicon layer). The semi-permeable silicone membrane controls water vapor loss, provides a flexible adherent covering for the wound surface and adds increased tear strength to the device. The collagen-glycosaminoglycan biodegradable matrix provides a scaffold for cellular invasion and capillary growth.

Among other benefits, Integra is very simple to use and doesn't require any kind of preparation; however, for a good result, wound bed must be very clean: this is maybe the hardest step in case of open abdomen with EAF, because any leakage into wound bed would eventually result in infection and consequent healing failure: this is the reason why a complete diversion of fistula effluent is mandatory before application.

We decided not to perform a skin graft after matrix positioning, considering the risk for donor site morbidity and, on the other hand, the high incidence of failure in skin grafting a site potentially exposed to enteric contamination¹¹.

As mentioned above, the effective and complete diversion of effluents from the fistula played a key role for the successful granulation of the artificial dressing: we consider this step an essential prerequisite for any kind of treatment around an EAF.

Conclusions

Management of open abdomen with enteroatmospheric fistula is one of the most challenging problem for surgeons. The role of negative pressure is well defined, and the use of instillation could play a central role in preserving healthy bowel integrity and improving septic environment. After initial management, the application of a dermal substitute can be a good strategy for promoting tissue granulation around the fistula, thus allowing the application of a stoma bag and a faster regain of the upright position.

Riassunto

La gestione di una fistola entero-atmosferica nel trattamento di un “addome aperto” rappresenta, oltre che una sfida estrema, un vero incubo per il chirurgo; si tratta di una condizione che, nonostante le recenti acquisizioni tecniche, comporta tuttora una mortalità molto elevata. Accanto all'utilizzo della pressione negativa associata ad instillazione, il ricorso ad un sostituto dermico artificiale può rappresentare una strategia innovativa ed efficace nel promuovere la granulazione attorno alla fistola stessa e ridurre il rischio di ulteriori fistole, oltre a consentire il recupero della stazione eretta.

Presentiamo il caso di un paziente di 45 anni giunto alla nostra osservazione per un quadro di sindrome compartimentale addominale insorto dopo un intervento di viscerolisi e rimozione di una protesi di parete precedentemente impiantata; il reperto operatorio di una condizione di “frozen abdomen” ci ha suggerito il ricorso al trattamento mediante pressione negativa associata ad instillazione (sistema AbThera® VAC Instilli®, 3M+KCI). Nonostante il notevole miglioramento sia delle condizioni locali che sistemiche, il paziente ha sviluppato

una fistola entero-atmosferica ad elevata portata che abbiamo gestito mediante la tecnica nota come “baby bottle nipple VAC”. Una volta stabilizzato definitivamente il paziente ed ottenuta una importante riduzione del difetto di parete attorno alla fistola abbiamo pensato, sulla base della nostra esperienza nella gestione di ferite complesse, di ricorrere all'utilizzo di un sostituto dermico artificiale (Integra® Bilayer Wound Matrix, LifeSciences Corporation) al fine di ottenere una più rapida epitelizzazione e poter trasformare la fistola da entero-atmosferica ad entero-cutanea. Ciò è avvenuto nell'arco di cinque mesi, quando il paziente è stato dimesso in buone condizioni generali con una sacca enterostomica applicata alla fistola, ormai divenuta di fatto una ileostomia. Sei mesi dopo la dimissione il paziente è stato nuovamente ricoverato e sottoposto ad intervento di ricanalizzazione mediante resezione del tratto fistolizzato e confezionamento di anastomosi. A tutt'oggi, a distanza di oltre un anno dal secondo intervento, il paziente gode di ottima salute.

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