BRIEF ARTICLES

Topical negative pressure in managing severe peritonitis: A positive contribution?

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Abstract

AIM: To assess the use of topical negative pressure (TNP) in the management of severe peritonitis.

METHODS: This is a four-year prospective analysis from January 2005 to December 2008 of 20 patients requiring TNP following laparotomy for severe peritonitis.

RESULTS: There were 11 males with an average age of (59.3 ± 3.95) years. Nine had a perforated viscus, five had anastomotic leaks, three had iatrogenic bowel injury, and a further three had severe pelvic inflammatory disease. TNP and the VAC® Abdominal Dressing System were initially used. These were changed every two to three days. Abdominal closure was achieved in 15/20 patients within 4.53 ± 1.64 d. One patient required relaparotomy due to residual sepsis. Two patients with severe faecal peritonitis due to perforated diverticular disease received primary anastomosis at second look laparotomy, as sepsis and their general condition improved. In the remaining 5/20 cases, the abdomen was left open due to bowel oedema and or abdominal wall oedema. Dressing was switched to TNP and VAC® GranuFoam®. Three of the five patients returned a few months later for abdominal wall reconstruction and restoration of intestinal continuity. Two patients developed intestinal fistulae. All 20 patients survived.

CONCLUSION: The use of TNP is safe. Further studies are needed to assess its value in managing these difficult cases.

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Key words: Severe peritonitis; Open abdomen; Topical negative pressure; VAC® Abdominal Dressing System; VAC® GranuFoam®

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INTRODUCTION

The principles of managing peritonitis have not changed for decades. They include elimination of the septic focus, removal of necrotic tissue, and drainage of purulent material[1]. Despite advances in antibiotics therapy and intensive care support, mortality and morbidity remain high[2]. In certain cases of severe peritonitis, the surgeon may feel that a further look is required to achieve these goals[1]. This can be achieved by leaving the abdomen open at the index operation[3]. While this concept of a planned second look following major abdominal trauma is well recognised[4], its use following abdominal catastrophe due to severe peritonitis remains controversial[3]. Several different techniques have been tried to facilitate a second look[5-9]. Recently, topical negative pressure (TNP) with the VAC® Abdominal Dressing System was introduced[3,7]. However, concerns were raised about its safety[8-10]. We report our experience using TNP in managing patients with advanced peritonitis.

MATERIALS AND METHODS

This is a four-year prospective analysis from January 2005 to December 2008 of 20 patients who developed severe peritonitis and whose abdomens were left open requiring TNP to allow a second look laparotomy. This
decision was taken independently by the operating surgeon. Patients’ demographics, type and cause of peritonitis were noted. APACHE II scoring\textsuperscript{[11]} and hospital mortality probability were calculated independently by critical care staff. Morbidity, mortality and delayed abdominal closure were recorded. TNP and the VAC\textsuperscript{®} Abdominal Dressing System (Kinetic Concepts Inc., San Antonio, Texas, USA) were initially used to allow further exploration of the abdomen every 48 to 72 h. The TNP was set at 125 mmHg continuous. Once the abdomen was judged to be clean, and if delayed abdominal closure was not possible due to bowel oedema and or abdominal wall oedema, the dressing was switched to TNP and a VAC\textsuperscript{®} GranuFoam\textsuperscript{®} dressing with a non-adherent silicone dressing underneath. Tissue viability staff could carry this out in the ward. Dressing techniques are described elsewhere\textsuperscript{[3-7]}. All data are presented as mean ± SE.

**RESULTS**

There were 11 males and 9 females with an average age of (59.3 ± 3.95) years. Seven patients developed severe peritonitis following elective surgery and 13 were initially admitted as emergencies. 10/20 patients required TNP from the onset and the remaining half after they developed a complication requiring further surgical intervention. Nine patients developed faecal peritonitis, four had a perforated stomach or duodenum, another four developed severe peritonitis due to small bowel perforation, and the remaining three patients had severe pelvic sepsis. Peritonitis was due to perforated vesci in nine patients, five had an anastomotic leak, three sustained an iatrogenic bowel injury, and in a further three patients peritonitis was due to severe pelvic inflammatory disease. The APACHE II scoring was (16.7 ± 1.9) and the hospital mortality probability was (37.2% ± 5.2%). The length of stay in the critical care unit (level III and level II) was (19.8 ± 4.48) d. The VAC\textsuperscript{®} Abdominal Dressing System and TNP were initially used in all patients, with a change of dressing every two to three days in theatre (Table 1).

Abdominal closure was achieved in 15/20 patients within (4.53 ± 1.64) d. This required (2.35 ± 1.81) dressings. Two of those fifteen patients required a biological mesh to assist in abdominal wall closure. One patient required relaparotomy due to residual sepsis. In two patients who had severe faecal peritonitis due to perforated diverticular disease, primary anastomosis was possible at second look laparotomy because sepsis and their general condition improved. No covering stoma was required and they made an uneventful recovery.

For the remaining five cases, the abdomen was left open due to bowel and or abdominal wall oedema and the dressing was switched to TNP and a VAC\textsuperscript{®} GranuFoam\textsuperscript{®} dressing with a non-adherent silicone dressing underneath. This was carried out in the ward. Two patients developed intestinal fistulae. In the first patient, a small bowel anastomosis broke down on the fifth postoperative day, which was converted to an end ileostomy. The second patient had multiple enterotomies, of which two leaked on the ninth postoperative day and these were treated conservatively. These two patients and a further third patient returned a few months later for abdominal wall reconstruction and restoration of intestinal continuity. One patient underwent surgery after 6 mo and the remaining two around 12 mo from their initial surgery. One patient is awaiting reversal of a stoma and abdominal wall reconstruction.

**DISCUSSION**

Surgery is the cornerstone of treatment of abdominal sepsis\textsuperscript{[12]}. It is every surgeon’s desire to achieve this goal with a single operation, but this is not always possible\textsuperscript{[1]}.

The concept of a planned relaparotomy was suggested\textsuperscript{[1]}. When some authors found that one extra laparotomy failed to show any advantage of “planned relaparotomy” compared to “laparotomy on demand”. A further randomised study by Robledo et al\textsuperscript{[9]} comparing open with closed “on demand”. management of severe peritonitis was terminated after the inclusion of 40 patients because of a mortality disadvantage for the open abdomen group (55 vs 30%). However in this study, the “open abdomen” was managed with a non-absorbable polypropylene mesh.

Billing et al\textsuperscript{[13]} in a case control study found no advantage of planned relaparotomy, but for a subgroup analysis of patients in whom source control was not achieved during the index operation, a lower mortality rate was reported with planned relaparotomy. Furthermore, Koperna et al\textsuperscript{[16]} have shown that patients reoperated on after 48 h had a higher mortality rate than those operated on earlier.

Barker et al\textsuperscript{[4]} reported their 15 years experience using
a locally designed vacuum-pack system in 258 patients (116 trauma and 142 general and vascular surgery). Primary closure was achieved in 68% and they reported a 5% fistula rate. Perez et al.[8] reported similar results using TNP and the VAC® Abdominal Dressing System in a series of 37 patients following severe abdominal sepsis and compartment syndrome.

The use of TNP in the management of severe peritonitis was never subjected to a randomised study. Bee et al.[7], after damage control surgery following abdominal trauma, compared temporary abdominal closure of the open abdomen (using polyglandin mesh) with TNP and the VAC® Abdominal Dressing System or a locally designed vacuum-pack system. They failed to show a clear benefit of the latter. Furthermore, the fistula rate in the second group was 21%, but this was not statistically different from the 5% rate for the mesh group. These fistulae were related to feeding enterostomies or anastomotic dehiscences, and they all occurred with the vacuum-pack system. Adkins et al.[9] compared the outcome of 81 patients with severe peritonitis managed with the vacuum-pack system with a historical control group. Hospital mortality was 33% and 25%, respectively. This did not reach statistical significance. A fistula rate of 14.8% was demonstrated in the open group.

TNP facilitates temporary abdominal wall closure,[3] controlled collection of exudate[4] and the small bowel “cocoons” inside the abdominal cavity, preventing interloop abscesses[5]. Furthermore the Abdominal Dressing System allows easy access for a second look[5]. While the Bogota bag[5] is a cheap alternative in managing the open abdomen; it does not control exudate and the bowel can adhere to the abdominal wall, making re-exploration difficult.

It was suggested[5] that a second look to be beneficial for patients with an APACHE II score of 10 to 25. A score greater than 26 has a high mortality rate regardless of the strategy used, and a score less than 10 has a good prognosis whatever the approach used. In our study, the operating surgeon was not aware of the APACHE II score, which was calculated independently by the intensive care staff. 14/20 had an APACHE II score of 10 to 25 and 3/20 had a score greater than 26. In addition, half of the patients had a hospital mortality probability greater than 30%. All patients in this study survived their surgical admission. Delayed abdominal wall closure was achieved in 75% of patients and intestinal continuity was restored in two patients when conditions became favourable; this is known as delayed primary anastomosis.[7]

There are very few reports of the use of TNP and the Abdominal Dressing System in peritonitis.[7] Most reports include patients with compartment syndrome[9] or trauma patients. Others include both TNP and the abdominal dressing that we used in this study, which was developed by the Wake Forest group or the vacuum-pack system that was popularized by the Chattanooga group.[7]. Trevelyan and Carlson[9] suggested that the results of TNP use following sepsis should be evaluated separately from trauma cases. Its safety in the open septic abdomen should not be assumed simply because of data gathered in trauma patients and they reported a high fistula rate.[6-10] However, it is not always clear in these reports what type of dressings were used. Over the last five years we used TNP and the Abdominal Dressing System in the open abdomen in 42 patients, of whom 20 had severe peritonitis. Two patients (2/20) developed intestinal fistulae. This is an acceptable figure in these difficult cases.

We believe patients who would benefit most from the use of this technique are: (1) Patients with anastomotic leak and iatrogenic bowel injuries; (2) Damage control for unstable patients, particularly in the presence of hypothermia, severe acidosis or coagulopathy[20]; (3) Bowel and or abdominal wall oedema making closure difficult[19]; (4) Source of sepsis not identified[12]; (5) Sepsis not fully controlled[6]; (6) Doubtful tissue viability requiring a further look[22]; and (7) Severe faecal peritonitis, particularly if delayed primary anastomosis can be considered at a second look[5].

Leaving an abdomen open is a decision that should not be taken lightly. It can have a negative impact on quality of life if used inappropriately.

In conclusion, the management of patients with abdominal catastrophe requires the close cooperation of surgeon, intensivist and microbiologist. In 1991 Schein[21] suggested that the open abdomen technique in the management of peritonitis generated great interest and hope. Fifteen years later, Wild et al.[1] declared that the Abdominal Dressing System set a new standard in the management of the open abdomen following peritonitis. In our study, TNP appears to be safe and we feel its use had a positive contribution to a group of patients who were severely ill. However, used unwisely, it might lead to unnecessary morbidity. Further studies are needed to identify patients for whom this technique would be beneficial.

**Comments**

**Background**

Surgery is the cornerstone in the management of severe peritonitis, which can be life threatening. A planned second look operation might be required. This can be achieved by leaving the abdomen open at the index operation. Over the years, different techniques have been suggested to facilitate this. Recently topical negative pressure (TNP) with VAC® Abdominal Dressing (Kinetic Concepts Inc., San Antonio, Texas, USA) were introduced. Some studies have raised concerns about its value and safety.

**Research frontiers**

TNP is a wound management system that was modified to assist in the management of the open abdomen following major abdominal trauma. The research hot spot is its efficacy and safety in the management of the open abdomen following severe peritonitis.

**Innovations and breakthroughs**

The management of the open abdomen is challenging. Various methods have been tried but none proved to be optimal. An ideal temporary dressing allows easy access for further surgery, controls exudate from the abdomen, reduces bowel oedema and ultimately makes abdominal closure possible when conditions are favourable. TNP with the VAC® Abdominal Dressing appears to fit these criteria.

**Applications**

This study suggests that the use of TNP with the VAC® Abdominal Dressing System in patients with severe peritonitis is safe, with acceptable morbidity. Delayed closure can be achieved if conditions become favourable.
Terminology
Peritonitis is an inflammatory process of the peritoneum caused by any irritant/agent such as bacteria, fungi, virus, t alc, drugs, granulomas, and foreign bodies. TNP and the VAC® Abdominal Dressing System: Encapsulated foam with a non-adherent fenestrated layer is placed between the abdominal wall and the exposed abdominal content. On top of this, a layer of perforated Granufoam® is placed; this is covered by an adhesive drape to create an airtight seal. A Pad lies on top of the foam and is connected to a fluid collection canister contained in a programmable computer controlled vacuum pump creating negative pressure at the wound surface. The dressing is changed every 48-72 h.

Peer review
It is an interesting prospective non-comparative analysis of 20 patients with severe peritonitis and open abdomen. Fifteen patients underwent primary closure of the abdomen using VAC and TPN. In the remaining five cases, the abdomen was left open with TNP and VAC.

REFERENCES
1 Robledo FA, Luque-de-León E, Suárez R, Sánchez P, de-la-Fuente M, Vargas A, Mier J. Open versus closed management of the abdomen in the surgical treatment of severe secondary peritonitis: a randomized clinical trial. Surg Infect (Larchmt) 2007; 8: 63-72
2 Ordoñez CA, Puyana JC. Management of peritonitis in the critically ill patient. Surg Clin North Am 2006; 86: 1323-1349
3 Perez D, Wildi S, Demartines N, Bramkamp M, Koehler C, Clavien PA. Prospective evaluation of vacuum-assisted closure in abdominal compartment syndrome and severe abdominal sepsis. J Am Coll Surg 2007; 205: 586-592
4 Barker DE, Green JM, Maxwell RA, Smith PW, Mejia VA, Dart BW, Cofer JB, Roe SM, Burns RP. Experience with vacuum-pack temporary abdominal wound closure in 258 trauma and general and vascular surgical patients. J Am Coll Surg 2007; 204: 784-792; discussion 792-793
5 Fernandez L, Norwood S, Roetger R, Wilkins HE 3rd. Temporary intravaneous bag silo closure in severe abdominal trauma. J Trauma 1996; 40: 258-260
6 Aprahamian C, Wittmann DH, Bergstein JM, Quebeman EJ. Temporary abdominal closure (TAC) for planned relaparotomy (etappenlavage) in trauma. J Trauma 1990; 30: 719-723
7 Wild T, Stortecy S, Stremitzer S, Lechner P, Humpel G, Glaser K, Fortelny R, Karner J, Sautner T. [Abdominal dressing -- a new standard in therapy of the open abdomen following secondary peritonitis?] Zentralbl Chir 2006; 131 Suppl 1: S111-S114
8 Rao M, Burke D, Finan PJ, Sagar PM. The use of vacuum-assisted closure of abdominal wounds: a word of caution. Colorectal Dis 2007; 9: 266-268
9 Trevelyan SL, Carlson GL. Is TNP in the open abdomen safe and effective? J Wound Care 2009; 18: 24-25
10 Fischer JE. A cautionary note: the use of vacuum-assisted closure systems in the treatment of gastrointestinal cutaneous fistula may be associated with higher mortality from subsequent fistula development. Am J Surg 2008; 196: 1-2
11 Bohnen JM, Mustard RA, Oxholm SE, Schouten BD. APACHE II score and abdominal sepsis. A prospective study. Arch Surg 1998; 133: 225-229
12 Boermeester MA. Surgical approaches to peritonitis. Br J Surg 2007; 94: 1317-1318
13 Steinberg D. On leaving the peritoneal cavity open in acute generalized suppurative peritonitis. Am J Surg 1979; 137: 216-220
14 van Ruler O, Mahler CW, Boer KR, Reuland EA, Gooszen HG, Opmee BC, de Graaf PW, Lamme B, Gerhards MF, Steller EP, van Till JW, de Borge CJ, Gouma DJ, Reitsma JB, Boermeester MA. Comparison of on-demand vs planned relaparotomy strategy in patients with severe peritonitis: a randomized trial. JAMA 2007; 298: 865-872
15 Billing A, Fröhlich D, Mialkowski Y, Stokstad P, Schüldberg FW. [Treatment of peritonitis with staged lavage: prognostic criteria and course of treatment] Langenbecks Arch Chir 1992; 377: 305-313
16 Koperna T, Schulz F. Relaparotomy in peritonitis: prognosis and treatment of patients with persisting intra-abdominal infection. World J Surg 2000; 24: 32-37
17 Bee TK, Croce MA, Magnotti LJ, Zarzaur BL, Maish GO 3rd, Minard G, Schroeppehl T, Fabian TC. Temporary abdominal closure techniques: a prospective randomized trial comparing polyglactin 910 mesh and vacuum-assisted closure. J Trauma 2008; 65: 337-342, discussion 342-344
18 Adkins AL, Robbins J, Villalba M, Bendick P, Shelley CJ. Open abdomen management of intra-abdominal sepsis. Am J Surg 2004; 187: 137-140, discussion 140
19 Moore AF, Hargest R, Martin M, Delicata RJ. Intra-abdominal hypertension and the abdominal compartment syndrome. Br J Surg 2004; 91: 1102-1110
20 Jansen JO, Loudon MA. Damage control surgery in a non-trauma setting. Br J Surg 2007; 94: 789-790
21 Schein M. Planned reoperations and open management in critical intra-abdominal infections: prospective experience in 52 cases. World J Surg 1991; 15: 537-545

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