Temporary Abdominal Wall Closure

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Open Abdomen (OA)

Definition

- One that requires a temporary abdominal closure due to the skin and fascia not being closed after laparotomy


- Laparotomy in which the fascia is left open intentionally to avoid elevation of intra-abdominal pressure and where surgical re-exploration is desirable
Indications of OA

- Damage control surgery
  - Life threatening severe injuries

- Abdominal compartment syndrome
  - Intra-abdominal hypertension
  - Abdominal compartment syndrome

- Intra-abdominal infection
  - Septic abdomen
  - Repeated irrigation & negative pressure wound therapy
Complications of OA

• Fluid loss
• Protein loss
  • Loss of protein rich fluid (about 2 g/L of fluid)
• Loss of abdominal wall domain
  • Lateralization of abdominal wall muscle
• Fistula formation
  • Entero-cutaneous/ entero-atmospheric fistula
  • About 20% after OA
• Bleeding
Temporary Abdominal Wall Closure (TAC)

• To cover the abdominal wall defect during open abdomen
Goals of TAC

• Abdominal coverage to protect bowel and prevent contamination

• Control fluid losses
  • Evacuate residual fluids and blood
  • Avoid IAH and ACS

• Minimize the loss of domain to facilitate abdominal closure
  • Avoid lateralization
  • Avoid adhesion
Techniques of TAC

• No ideal techniques

• Negative pressure systems
  • Best results of achieving delayed fascial closure
  • Continuous fascial traction
Systematic review and evidence based recommendations for the use of Negative Pressure Wound Therapy in the open abdomen

A. Bruhin a, F. Ferreira b, M. Chariker c, J. Smith d,*, N. Runkel e,f

HIGHLIGHTS

- NPWT is a widely adopted method of managing the OA but has a weak evidence base.
- We present the first evidence-based recommendations to describe the use of NPWT in OA.
- Recommendations divided by grade of open abdomen.
- Published literature analysed to compare NPWT with other methods of TAC.

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ABSTRACT

Introduction: Negative Pressure Wound Therapy (NPWT) is widely used in the management of the open abdomen despite uncertainty regarding several aspects of usage. An expert panel was convened to develop evidence-based recommendations describing the use of NPWT in the open abdomen. Methods: A systematic review was carried out to investigate the efficacy of a range of Temporary Abdominal Closure methods including variants of NPWT. Evidence-based recommendations were developed by an International Expert Panel and graded according to the quality of supporting evidence. Results: Pooled results, in non-septic patients showed a 72% fascial closure rate following use of commercial NPWT kits in the open abdomen. This increased to 82% by the addition of a ‘dynamic’ closure method. Slightly lower rates were showed with use of Wittmann Patch (68%) and home-made NPWT (vac-pack) (58%). Patients with septic complications achieved a lower rate of fascial closure than non-septic patients but NPWT with dynamic closure remained the best option to achieve fascial closure. Mortality rates were consistent and seemed to be related to the underlying medical condition rather than being influenced by the choice of dressing. Treatment goals for open abdomen were defined prior to developing eleven specific evidence-based recommendations suitable for different stages and grades of open abdomen. Discussion and conclusion: The most efficient temporary abdominal closure techniques are NPWT kits with or without a dynamic closure procedure. Evidence-based recommendations will help to tailor its use in a complex treatment pathway for the individual patient.
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<thead>
<tr>
<th>Device/method</th>
<th>Condition of abdomen</th>
<th># Patients (#studies)</th>
<th>Fascial closure %</th>
<th>Mortality (%)</th>
<th>Fistula (%)</th>
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<td>NPWT kit</td>
<td>Non-septic&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>72.0</td>
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Ideal TAC methods

• Universally available
• Easy and fast to apply
• Porous
• Controls fluid loss
• Prevent ACS
• Leaves fascia and skin intact
• Not reactive to bowel and other organs
• Easy to remove and to replace
• Maintains peritoneal cavity sterile
• Inexpensive
Types of TAC

- First generation: abdominal coverage
  - Skin closure
    - Running suture
    - Towel clipping
  - Synthetic coverage
    - Bogota bag
    - Mesh
    - Velcro burr

- Second generation: fluid control
  - Vacuum pack

- Third generation: negative pressure
  - VAC abdominal dressing
  - ABThera closure
Methods of TAC

• Towel Clipping
  • 1 cm apart, 1 cm away
  • Rapid closure
  • Not decompress adequately

• Increased IAP => ACS
Methods of TAC

• Towel Clipping
  • 1 cm apart, 1 cm away
Methods of TAC

• Open packing of the abdomen
  • Gauze packing in the wound
  • Whole layer retention suture
  • After resolution of bowel edema, gauze removal and approximation of suture
Methods of TAC

- Open packing of the abdomen
  - Gauze packing in the wound
  - Whole layer retention suture
- After resolution of bowel edema, gauze removal and approximation of suture
Methods of TAC

• Zipper closure
  • Rapid, simple, well-tolerated
  • Spare the wound
  • Suture to the edges of fascia or skin
Methods of TAC

• Zipper closure

Methods of TAC

- Wittman patch
  - Suture to the fascia
  - Velcro-like closure
  - Dynamic fascial closure
  - High rate of delayed closure
Methods of TAC

- Wittman patch
- Suture to the fascia
- Velcro-like closure
- Dynamic fascial closure

Tieu BH, et al. J Trauma 2008;65:865-70
Use of the Wittmann patch

Sequential fascial re-approximation at the bedside vs. OR
Easy & quick re-entry into the abdomen
Limit the handling of the fascia
Low serious complication rate
High rate of delayed fascial closure
High cost (1,440 vs. 70 $)
Methods of TAC

• Poly-tetrafluoroethylene (PTFE) patch
  • Anchored to the fascia
  • Serial plication of the patch
  • Create granulation tissue
  • Replaced by absorbable mesh or silastic dressing
Methods of TAC

• Poly-tetrafluoroethylene (PTFE) patch
Methods of TAC

- Polypropylene (Marlex) mesh
  - Cause long-term complications
  - Enteric fistula and bowel injuries
  - Increased infection
  - Do not use in infected abdomen
Methods of TAC

- Polypropylene (Marlex) mesh
  - Cause long-term complications

*Cha SW et al. J Trauma Inj, 2012;25:172-7*
Methods of TAC

• Silastic (plastic) closure
  • Presterilized soft 3L plastic fluid bag
  • Stapled or sutured to the skin edge
  • Faster, effective temporary closure
  • Difficult to control fluid
Methods of TAC

- Silastic (plastic) closure
  - Presterilized soft 3L plastic fluid bag
  - Stapled or sutured
  - Faster, effective temporary closure
  - Difficult to control fluid

Quinto AAM et al. Cirugia Espanola, 2014;92:570-1
# Temporary Intravenous Bag Silo Closure in Severe Abdominal Trauma

Fernandez, Luis MD, FACS, FICS; Norwood, Scott MD, FACS; Roettger, Richard MD, FACS; Wilkins, Harry E. III, MD

<table>
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<th>Patient</th>
<th>Age (years)</th>
<th>ISS</th>
<th>Survived</th>
<th>LOS (days)</th>
<th>Number of Silo Applications</th>
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* Died one week post discharge to home from acute myocardial infarction.

ARDS, acute respiratory distress syndrome; DIC, disseminated intravascular coagulation; ISS, Injury Severity Score; LOS, length of hospitalization; MSOF, multi system organ failure.
Methods of TAC

• Vacuum pack
  • VacPack, Sandwich Vacuum Pack technique
  • To overcome the fluid loss
  • Barrier function
  • Negative pressure : 20 ~ 25 mmHg
  • Easy control of fluid accumulation
Methods of TAC

Barker's Vacuum Pack

To overcome the fluid loss:

- Barrier function
- Negative pressure: 20 ~ 25 mmHg
- Easy control of fluid accumulation

VacPack, Sandwich Vacuum Pack technique

Methods of TAC
Methods of TAC

• Negative pressure therapy
  • Evacuation of excess abdominal fluid
  • Constant tension of the fascia
  • Lowest fistula rate
  • Attenuated systemic inflammation
    • Faster recovery
Methods of TAC

- Negative pressure therapy
Systematic Review and Meta-analysis of the Open Abdomen and Temporary Abdominal Closure Techniques in Non-trauma Patients

J. J. Atema · S. L. Gans · M. A. Boermeester

Abstract

Background Several challenging clinical situations in patients with peritonitis can result in an open abdomen (OA) and subsequent temporary abdominal closure (TAC). Indications and treatment choices differ among surgeons. The risk of fistula development and the possibility to achieve delayed fascial closure differ between techniques. The aim of this study was to review the literature on the OA and TAC in peritonitis patients, to analyze indications and to assess delayed fascial closure, enteroatmospheric fistula and mortality rate, overall and per TAC technique.

Methods Electronic databases were searched for studies describing the OA in patients of whom 50 % or more had peritonitis of a non-traumatic origin.

Results The search identified 74 studies describing 78 patient series, comprising 4,358 patients of which 3,461 (79 %) had peritonitis. The overall quality of the included studies was low and the indications for open abdominal management differed considerably. Negative pressure wound therapy (NPWT) was the most frequent described TAC technique (38 of 78 series). The highest weighted fascial closure rate was found in series describing NPWT with continuous mesh or suture mediated fascial traction (6 series, 463 patients: 73.1 %, 95 % confidence interval 63.3–81.0 %) and dynamic retention sutures (5 series, 77 patients: 73.6 %, 51.1–88.1 %). Weighted rates of fistula varied from 5.7 % after NPWT with fascial traction (2.2–14.1 %), 14.6 % (12.1–17.6 %) for NPWT only, and 17.2 % after mesh inlay (17.2–29.5 %).

Conclusion Although the best results in terms of achieving delayed fascial closure and risk of enteroatmospheric fistula were shown for NPWT with continuous fascial traction, the overall quality of the available evidence was poor, and uniform recommendations cannot be made.
Overall lack of good quality evidence
How to prevent complications

- Adhesion
  - Adhesion of bowel and peritoneum
  - Bowel injury during 2\textsuperscript{nd} look operation
- Protection of the bowel and peritoneum
- Use of poly-vinyl chloride bag or film
- Cover the entire bowel
How to prevent complications

- Adhesion
  - Adhesion of bowel and peritoneum
  - Bowel injury during 2nd look operation

- Protection
  - Use of polyvinyl chloride bag or film
  - Cover the entire bowel
How to prevent complications

- **Fluid loss**
  - Increased risk of infection due to leakage of fluid or blood
  - Large bore drainage tube/catheter
  - Complete seal-off using occlusive dressing
  - Negative pressure
How to prevent complications

- Fluid loss
  - Increased risk of infection due to leakage of fluid or blood
  - Large bore drainage tube
  - Complete seal-off using occlusive dressing
  - Negative pressure
How to prevent complications

• Abdominal compartment syndrome
  • Frequent/serial monitoring of abdominal pressure
  • Urinary bladder pressure using Foley catheter
  • Porous membrane or drainage catheter
  • Reopen and remove the hematoma or ongoing bleeding
How to prevent complications

- Lateralization
  - Retraction of abdominal wall laterally due to natural elasticity
  - Increased risk of bowel injury and fistula
  - Frozen abdomen under long-term open abdomen

- Negative pressure therapy
- Early closure as soon as possible (within 7 days)
- Retention suture/ Silastic catheter
- Staged approximation
How to prevent complications

- Lateralization
  - Retraction of abdominal wall laterally due to natural elasticity
  - Increased risk of bowel injury and fistula
  - Frozen abdomen under long-term open abdomen

- Negative pressure therapy
- Early closure as soon as possible (within 7 days)
- Staged approximation
How to prevent complications

• Enterocutaneous Fistula
  • Protect the bowel using omentum or barrier
  • Low negative pressure (< 50 mmHg)
How to prevent complications

• Postoperative infection
  • Sterile change of vaccum pack or VAC
  • Planned re-exploration
  • Antibiotics : controversial
How do I maintain TAC?

• Bowel protection
  • Using poly-vinyl isolation bag with pore
  • Entire cover the bowel and separate from the peritoneum
• 2<sup>nd</sup> look operation between 48 ~ 72 hours
• Vacuum pack (gauze packing) or VAC foam system
  • Drainage catheter : chest tube or JP drain
• Cover with Iovan or transparent film
• Negative pressure : about 100 ~ 150 mmHg
SUMMARY

1. Use the easy/fast method
2. Consider negative pressure therapy
3. Protect the bowel securely
4. Consider porous membrane
5. Monitoring the complications, and IAP
6. Early closure as soon as possible