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Basement Membrane Biological Graft as a Visceral Protective Layer During Negative Pressure-Assisted Temporary Abdominal Closure: An Exploratory Case Series

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Abstract:

Background /Aim: Entero-atmospheric fistula (EAF) is a devastating complication of open abdomen (OA) therapy. Visceral protective layers (VPLs) reduce direct contact between exposed bowel and negative pressure materials. We describe the clinical use of a basement membrane biological graft as the VPL during negative pressure wound therapy–assisted temporary abdominal closure (NPWT–TAC).

Materials and Methods: Retrospective single-center case series of consecutive adults receiving NPWT–TAC in whom a basement membrane biological graft was placed directly over exposed viscera. The primary outcome was new EAF during OA therapy. Secondary outcomes included delayed primary fascial closure, duration of NPWT–TAC, complications (Clavien–Dindo), length of stay, and incisional hernia on follow-up.

Results: Seven patients (3 men, 4 women; mean age 58.4±9.8 years) underwent NPWT–TAC with the biologic graft VPL. Mean NPWT–TAC duration was 18.1 days (range –36) with a mean of 3.9 dressing changes. No patient developed EAF during therapy. Delayed primary fascial closure was achieved in four patients; three underwent skin grafting-based definitive coverage (one with subsequent abdominal wall reconstruction). Complications included pulmonary infection (n=3), wound bleeding (n=2), urinary tract infection (n=1), gastric retention (n=1), and fungal infection (n=1). Follow-up ranged from 2 to 12 months (median 5); all wounds healed and one patient developed an incisional hernia.

Conclusions: In this exploratory case series, a basement membrane biological graft was feasible as a VPL during NPWT–TAC and no EAF occurred during therapy. Larger comparative studies are needed to determine whether biologic interfaces offer advantages over established inert VPLs within modern OA protocols.

Key words: open abdomen; burst abdomen; negative pressure wound therapy; temporary abdominal closure; visceral protective layer; basement membrane biological graft; entero-atmospheric fistula

Introduction

Open abdomen (OA) therapy is used when immediate primary fascial closure is unsafe or when early re-exploration is necessary, such as in severe peritonitis, abdominal compartment syndrome, or selected damage control settings [1]. Although OA therapy can be life-saving, it carries substantial morbidity including fluid and protein loss, loss of abdominal domain, ventral hernia, and entero-atmospheric fistula (EAF). EAF is particularly challenging because it opens directly to the atmosphere without a mature tract; it is associated with prolonged hospitalization, recurrent sepsis, and complex wound management [2]. Negative pressure wound therapy–assisted temporary abdominal closure (NPWT–TAC) is widely adopted because it enables controlled effluent evacuation and helps limit fascial retraction while allowing staged re-exploration [3, 4]. However, bowel injury can occur when exposed viscera are subjected to shear, desiccation, or direct contact with foam and negative pressure interfaces, particularly in contaminated fields or after repeated dressing changes. A visceral protective layer (VPL) placed between bowel and the negative pressure interface is therefore a core element of NPWT–TAC. Plastic films and commercial interfaces are commonly used and effective for short-term visceral protection [5]. Biologic matrices have been explored as alternative interfaces because they may act as both a barrier and a scaffold for organized granulation. Basement membrane–based materials are engineered to approximate native extracellular matrix micro-architecture and are proposed to support structured granulation and potentially reduce dense adhesions [6]; however, clinical data for their use as VPLs during NPWT–TAC remain limited. In colorectal and oncologic surgery, many OA cases are not planned at the index operation but arise secondarily after full-thickness wound dehiscence ("burst abdomen") or after re-operation for intra-abdominal sepsis. These scenarios often involve contamination, bowel edema, and compromised tissue quality, which may increase the risk of bowel injury and EAF [7, 8]. We describe an initial clinical experience using a basement membrane biological graft as the VPL during NPWT–TAC in this high-risk setting. Our main aim was to validate its safety and efficacy, thereby offering a new therapeutic option for clinical practice.

Materials and Methods

Study design and reporting: Retrospective, single-center observational case series of consecutive patients treated with NPWT–TAC in whom a basement membrane biological graft was used as the VPL. The manuscript follows STROCSS reporting guidance for observational surgical studies [9]. Ethics: Informed consent was waived owing to the retrospective design and anonymized data handling.

Participants and definitions: Adult patients managed with OA therapy and NPWT–TAC in whom the basement membrane biological graft was applied as the VPL were included. "Planned OA" refers to OA intentionally left open at the index operation; "secondary OA" includes OA arising from full-thickness dehiscence/burst abdomen or inability to close at re-operation for sepsis. Patients with a pre-existing enteric fistula at the time of OA creation were excluded.

Materials: A basement membrane biological graft was used as the visceral protective layer (VPL) in this series. The graft is a decellularized porcine extracellular matrix composite formed from porcine urinary bladder basement membrane and porcine small intestinal submucosa, assembled into a sandwich-structured sheet with through-pores. It is ethylene-oxide sterilized and supplied sterile for single use and is non-crosslinked and resorbable. Its intrinsic material characteristics are that it is thin, pliable and highly conformable, allowing it to be trimmed and draped broadly over exposed bowel and omentum to maintain continuous separation between viscera and the foam/suction interface.

Operative technique: After debridement and meticulous hemostasis, peritoneal lavage was performed. Exposed bowel was gently separated from the anterior abdominal wall to reduce focal tethering. The graft was trimmed and draped broadly over exposed bowel and omentum, with overlap beyond the wound edges. Where feasible, coverage was extended into dependent gutters so that foam and suction interfaces did not contact bowel. A porous interface and polyurethane foam were placed above the graft and covered with an occlusive adhesive drape, then connected to the negative-pressure device.

Negative pressure settings and dressing changes: Negative pressure was typically set at 100–125 mmHg. Continuous or intermittent therapy was selected according to effluent burden and bowel condition (for example, marked edema or concern for perfusion). Dressing changes were planned every 3–5 days and performed earlier for uncontrolled contamination, persistent enteric soiling, bleeding, loss of seal, or inadequate drainage. At each change, the bowel was inspected and the VPL was replaced if integrity or positioning was compromised, or if adherence made safe removal uncertain.

Adjunct care: Broad-spectrum antibiotics were guided by cultures and clinical response. Nutritional support (enteral when feasible, otherwise parenteral) was provided to mitigate protein loss during OA therapy.

Outcomes: The primary outcome was new EAF during OA therapy, defined as a communication between the gastrointestinal lumen and the atmosphere within the open abdominal wound. Secondary outcomes included delayed primary fascial closure, duration of NPWT–TAC, complications graded using the Clavien–Dindo classification, total length of stay, and incisional hernia on follow-up.

Follow-up: Patients were reviewed in clinic or contacted by phone. Routine imaging was not performed; therefore, asymptomatic incisional hernia may be under-detected.

Statistical analysis: Given the descriptive design and small sample, data are presented as mean± standard deviation or median (range), as appropriate. No hypothesis testing was planned.

Results

Seven patients were included Table 1. Indications for OA therapy were predominantly secondary OA after burst abdomen or septic re-operation in the setting of complex colorectal/oncologic surgery.

Across dressing changes, the bowel remained covered and separated from the foam interface. Progressive granulation enabled delayed primary fascial closure in four patients, while three patients underwent skin grafting-based definitive coverage (one with subsequent abdominal wall reconstruction) (Table 2).

Mean NPWT–TAC duration was 18.1 days (range –36) with a mean of 3.9 dressing changes. Mean length of hospital stay was 35.1±14. days.

No patient developed EAF during OA therapy. Complications included pulmonary infection (n=3), wound bleeding (n=2), urinary tract infection (n=1), gastric retention (n=1), and fungal infection (n=1). Follow-up ranged from 2 to 12 months (median .5); all wounds healed, and one patient developed an incisional hernia managed conservatively.

Case	Gender	Age	BMI	Primary disease	Surgical history	Postoperative duration of open abdomen (Days)	Abdominal exploration and closure method
1	M	62	24.8	Peritoneal metastases	CRS + intraoperative HIPEC	5	Abdominal lavage + ileostomy + VAC
2	F	5	21.9	Rectal cancer invading bladder	Pelvic multivisceral resection	7	Abdominal lavage + wound debridement + VAC
3	M	45	28.3	Rectal cancer invading sacrum	Pelvic multivisceral resection	5	Abdominal lavage + wound debridement + NPWT
4	M	68	22.1	Sigmoid colon perforation	Radical colectomy + ileostomy	3	Abdominal lavage + wound debridement + NPWT
5	F	59	25.9	Rectal cancer perforation	Radical rectal resection + ileostomy	5	Abdominal lavage + wound debridement + NPWT
6	F	4	22.8	Peritoneal metastases	CRS + intraoperative HIPEC	4	Abdominal lavage + ileostomy + NPWT
7	F	1	2.6	Bowel obstruction with perforation	Exploratory laparotomy + bowel resection and anastomosis	3	Abdominal lavage + ileostomy + NPWT

Table 1: Baseline characteristics of patients

Case	No. of NPWT sponge changes	Time to GI function recovery (Days)	Duration of NPWT therapy (Days)	Definitive closure method	Time to skin grafting (Days)	Time to abdominal wall reconstruction (Days)	Complica tions	Total hospital stays (Days)
1	2	2		Tension-reducing full-thickness closure	–	–	Wound bleeding	23
2	5	3.5	26	Skin grafting only	51	–	Urinary tract infection	40
3		13	36	Skin grafting + abdominal wall reconstruction	48	8	Gastric retention	55
4	2	2.5	8	Tension-reducing full-thickness closure	–	–	Pulmonar y infection	24
5	3	3	9	Tension-reducing full-thickness closure	–	–	Wound bleeding	21
6	2	2	8	Tension-reducing full-thickness closure	–	–	Pulmonar y infection	25
7	6	5	33	Skin grafting only	46	–	Pulmonar y infection, fungal infection	58

Table 2: Clinical outcomes during and after NPWT–TAC

Discussion

This exploratory case series describes the use of a basement membrane biological graft as the visceral protective layer (VPL) during negative pressure wound therapy–assisted temporary abdominal closure (NPWT–TAC) in a small cohort of high-risk open abdomen patients, most of whom had secondary open abdomen after burst abdomen or septic reoperation following major colorectal and oncologic procedures. The clinically important observation was the absence of new entero-atmospheric fistula (EAF) during therapy.

Although this series is not comparative, the mechanism by which NPWT–TAC precipitates EAF is well recognized: serosal injury is typically initiated by focal direct bowel contact with foam or suction interfaces, compounded by repeated dressing changes that create shear and traction on inflamed, oedematous bowel [7]. A stable VPL that reliably prevents any direct bowel–foam contact is therefore the most proximal and modifiable step in EAF prevention [10]. In our patients, the basement membrane graft was applied deliberately to create an uninterrupted anti-contact plane across all exposed viscera at every dressing cycle, and we consider this interface protection a major contributor to the absence of new EAF during therapy.

In practical terms, the graft behaved like a drape rather than a rigid barrier: it conformed to bowel contours, maintained coverage during intermittent suction cycles, and reduced the likelihood of edge roll or focal exposure—the scenarios most likely to permit inadvertent foam contact. The through-pore architecture also allowed effluent to pass without requiring fenestration of the sheet, while preserving a continuous protective surface over the bowel [11].

Why consider a biologic graft rather than an inert plastic film? Plastic VPLs are inexpensive, widely available, and effective for short-term protection, and they remain an appropriate standard in many settings. The potential incremental advantage of the basement membrane composite is its combination of conformability and scaffold-like behavior, which may stabilize the interface over oedematous bowel and lessen adhesion-related traction during dressing changes [12]. In this cohort, the observed 'zero EAF' outcome is consistent with that mechanism, though comparative data are required to quantify any incremental benefit over standard inert interfaces.

The clinical context of our cohort strengthens the relevance of this observation. Secondary open abdomen after burst abdomen or septic re-operation concentrates multiple EAF risk factors—contamination, repeated manipulation, bowel oedema, and impaired tissue quality—within the same patient [13]. In such a setting, consistent visceral interface protection becomes even more critical [14]. Accordingly, while causality cannot be proven in an uncontrolled series, the most plausible explanation for the absence of EAF is effective prevention of bowel-interface injury throughout NPWT–TAC.

Two patients developed wound bleeding, reinforcing that safety depends on meticulous technique regardless of interface choice. Bleeding may arise from friable granulation tissue, coagulopathy or anticoagulation, and focal pressure or shear. Practical risk reduction measures include meticulous hemostasis, avoiding focal pressure points (particularly over staple lines or marginally perfused bowel), and selecting negative pressure settings that balance effluent control with tissue perfusion. If adherence is encountered at dressing change, separation should be performed with irrigation and without forceful traction.

This study has important limitations. The sample size is small and retrospective, documentation is variable, and there is no comparator group treated with standard inert VPLs; therefore, incremental benefit cannot be quantified. Case-mix and sepsis severity were heterogeneous. Follow-up relied on clinical assessment without routine imaging, which may underestimate asymptomatic incisional hernia. Finally, cost, availability, and supply-chain considerations—which are central to real-world adoption—were not evaluated.

Future work should focus on prospective comparative evaluation of biologic versus inert VPLs within standardized open abdomen protocols. A pragmatic design would use a matched cohort or registry-based comparative analysis in comparable indications (e.g., burst abdomen or septic re-operation), with prespecified outcomes including new EAF incidence, bleeding requiring intervention, number of dressing changes, time to delayed primary fascial closure, ICU and hospital length of stay, and long-term abdominal wall integrity assessed at standardized intervals.

Conclusion

In this small case series, a basement membrane biological graft was feasible as a visceral protective layer during NPWT–TAC and no entero-atmospheric fistula occurred during therapy. Larger comparative studies are needed to determine whether biologic interfaces offer advantages over established inert VPLs within modern open abdomen protocols.

List of Abbreviations

(EAF)Entero-atmospheric fistula, (OA)open abdomen, (VPLs)Visceral protective layers, (NPWT-TAC) Negative Pressure Wound Therapy-Temporary Abdominal Closure, (CRS)Cytoreductive Surgery, (HIPEC)Hyperthermic Intraperitoneal Chemotherapy

Declarations section

Conflict of interest: The authors declare no competing interests.

Ethics approval: Approved by the Ethics Committee of the Second Affiliated Hospital of Naval Medical University (No. 2025SL105).

Consent to participate: Waived due to retrospective design and anonymized data.

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Data availability: De-identified data are available from the corresponding authors upon reasonable request.

Author contributions: Guoliang Chen, Jia Miao, Siqi Wang and Hang Jia contributed equally to study conception and data collection. Co-authors contributed to patient management, data verification, analysis, and drafting. Darius Aw Kang Lie and Jian Zhang supervised the project and critically revised the manuscript. All authors approved the final version.

References

1. Coccolini F, Roberts D, Ansaloni L, et al. (2018). The open abdomen in trauma and non-trauma patients: WSES guidelines. World J Emerg Surg. 13:7.
2. Cristaudo AT, Hitos K, Gunnarsson R, et al. (2022). Development and validation of a multivariable prediction model in open abdomen patients for entero-atmospheric fistula. ANZ J Surg. 92:1079-1084.
3. Cheng Y, Wang K, Gong J, et al. (2022). Negative pressure wound therapy for managing the open abdomen in non-trauma patients. Cochrane Database Syst Rev. 5:Cd013710.
4. Prete FP, De Luca GM, Sgaramella LI, et al. (2025). Late closure of the open abdomen in emergency abdomino-pelvic surgery: Advanced indications to negative pressure wound therapy? World J Emerg Surg. 21:4.
5. Schaaf S, Schwab R, Wöhler A, et al. (2023). Use of a visceral protective layer prevents fistula development in open abdomen therapy: results from the European Hernia Society Open Abdomen Registry. Br J Surg. 110:1607-1610.
6. Chen GL, Wang YL, Zhang X, et al. (2023). [Clinical study of using basement membrane biological products in pelvic floor reconstruction during pelvic exenteration]. Zhonghua Wei Chang Wai Ke Za Zhi. 26:268-276.

7. Anastasiu M, Şurlin V, Beuran M. (2021). The Management of the Open Abdomen - A Literature Review. Chirurgia (Bucur). 116:645-656.
8. Rodríguez-Silverio JE, García-Núñez LM, Hernández-García EF, et al. (2023). Enteroatmospheric fistulas in open abdomen in trauma associated with abdominal reintervention and VAC therapy. Cir Cir. 91:658-663.
9. Rashid R, Sohrabi C, Kerwan A, et al. (2024). The STROCSS 2024 guideline: strengthening the reporting of cohort, cross-sectional, and case-control studies in surgery. Int J Surg. 110:3151-3165.
10. Willms AG, Schaaf S, Zimmermann N, et al. (2021). The Significance of Visceral Protection in Preventing Enteroatmospheric Fistulae During Open Abdomen Treatment in Patients With Secondary Peritonitis: A Propensity Score-matched Case-control Analysis. Ann Surg. 273:1182-1188.
11. Lech GE, Neves BH, Oliveira GT, et al. (2024). Vacuum-assisted wound closure and mesh-mediated fascial traction for temporary closure in open abdomen: A single-arm meta-analysis. World J Surg. 48:2391-2399.
12. Chen GL, Wang YL, Xie QF, et al. (2024). [Clinical application of reconstruction of pelvic floor with pedunculated omentum flap combined with basement membrane biological products in pelvic exenteration with sacrococcygeal bone]. Zhonghua Wei Chang Wai Ke Za Zhi. 27:1162-1167.
13. Kalaiselvan R, Slade DAJ, Soop M, et al. (2023). Impact of negative pressure wound therapy on enteroatmospheric fistulation in the septic open abdomen. Colorectal Dis. 25:111-117.
14. Bobkiewicz A, Walczak D, Smoliński S, et al. (2017). Management of enteroatmospheric fistula with negative pressure wound therapy in open abdomen treatment: a multicentre observational study. Int Wound J. 14:255-264.

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