Evaluating the Impact of Exudate Viscosity and Airflow on the Negative Pressure Delivered to a Model Wound during Negative Pressure Wound Therapy

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STUDY OBJECTIVE

The study aims to characterize pressure and exudate management efficacy of different negative pressure wound therapy (NPWT) systems when challenged with simulated exudates at varying viscosity and exudate rates.

BACKGROUND

A wound managed by NPWT represents a dynamic environment that changes over time[1,2]

- Wound changes impact exudate
- Patient movement can impact dressing leakage
- Inaccurate pressure delivery can limit benefits of NPWT

Previous research demonstrates that a single lumen NPWT system with a Controlled Air Leak can manage a simulated serous exudating wound model with similar efficacy to a Multi-lumen system with no air leak[2]

- Demonstrated the importance of air flow through a dressing interface to move fluid
- Identified potential limitations of systems with no air flow through the dressing interface

This study investigates how a Multi-lumen system with a continuous controlled leak manages normal and high viscosity exudate at different exudate rates compared to common NPWT configurations used clinically

METHODS

Experimental Model and Test Conditions

- Testing utilized an acrylic wound model with 125 cm^3 volume
- All wound models dressed with identical drape and black foam
- Wound bed pressure measured from under the wound filler
- Simulated exudate introduced distal to the dome
- 50-cc pre-fill utilized to eliminate dead space in the model wound
- NPWT devices placed 3 feet above wound model
- Devices set to deliver -125 mmHg to the wound bed

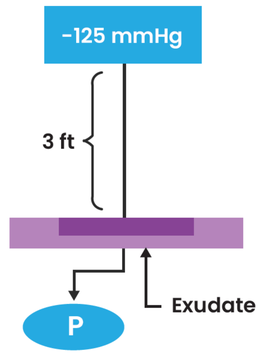

Figure 1: Experimental diagram

NPWT Systems Evaluated

- Closed system (Negative pressure with no air-leak; negative control)
- Single lumen system with a continuous Controlled Air Leak (CTLD)
- Multi-lumen system without a continuous Controlled Air Leak
- Multi-lumen system with a Controlled Air Leak

Conditions Evaluated

Simulated Viscosity Conditions:

- Normal: 1.158 cP3
- High: 35.5 cP4

Exudate Rates:

- Bolus (100 ccs/2min)
- 50 cc/hr
- 4 cc/hr

PRESSURE MANAGEMENT AT DIFFERENT EXUDATE RATES AND VISCOSITIES

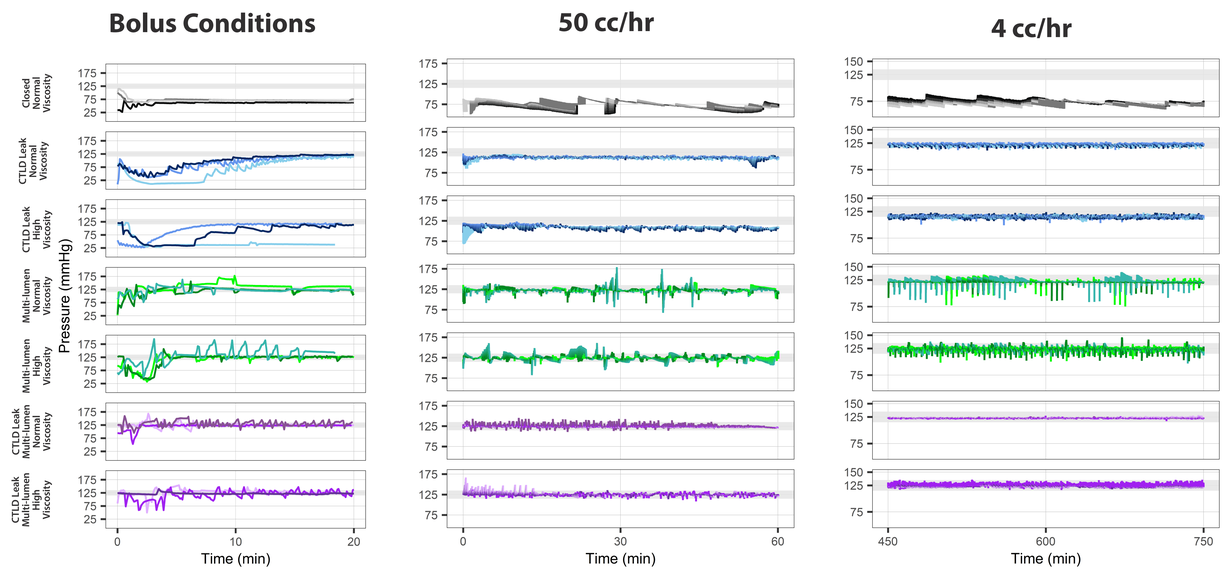

Figure 2: Pressure management time courses under different exudating conditions demonstrating different NPWT system behavior under different exudate rate and viscosities. Gray shading indicates 125 ± 10 mmHg.

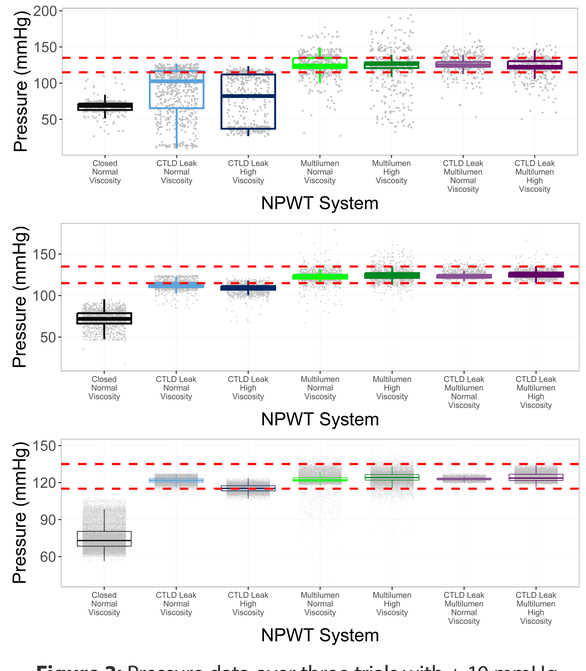

Figure 3: Pressure data over three trials with ± 10 mmHg range of target pressure indicated by red dashed lines

DISCUSSION AND CONCLUSIONS

High exudate rate and viscosity increase work NPWT systems must do to move fluid and deliver prescribed pressure to the wound bed

- Continuous Controlled Air Leak helps minimize work by continuously moving fluid; this decreases volatility of the overall system
- Multi-lumen systems help manage build up that exceeds intrinsic dressing air leak's ability to move fluid, but increases overall system volatility

Multi-lumen PLUS a continuous Controlled Air Leak demonstrates benefits over other systems while providing accurate delivery of the prescribed therapy to the wound site

References:

1. Holm et al. J WCON 2024;51(5S):S9-S12
2. Fidalgo de Faria et al. Int J of Nursing Studies Advances 2022; 4:100078
3. Fernandex et al. Int Wound J 2020; 17(6):1829-1834

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