Closed Incision Negative Pressure Therapy Versus Standard of Care Over Closed Abdominal Incisions in the Reduction of Surgical Site Complications: A Systematic Review and Meta-Analysis of Comparative Studies

Ashley Collinsworth, ScD, MPH[1]; Christopher Mantyh, MD[2]; Ronald Silverman, MD[1,3]; Christine Bongards, PhD[1]; Leah Griffin, MS[1]

[1]3M, St. Paul, Minnesota; [2]Duke University Medical Center, Durham, NC; [3]University of Maryland School of Medicine, Baltimore, MD

Introduction

- Surgical site complications (SSCs) can be serious and even life-threatening for patients.
- Although several studies have linked closed incision negative pressure therapy (ciNPT*) to decreases in wound complications across surgical disciplines, the benefit of ciNPT over abdominal incisions remains unclear.

Purpose

- This systematic review and meta-analysis evaluated the effect of ciNPT on post-surgical and healthcare utilization outcomes for patients undergoing open abdominal surgical procedures.

Methods

- A systematic literature search using PubMed, EMBASE, and QUOSA was performed for publications written in English, comparing ciNPT to standard of care (SOC) dressings for patients undergoing abdominal surgical procedures between January 2005 and August 2021.
- Characteristics of study participants, surgical procedure, dressing used, duration of treatment, post-surgical outcomes, and follow up data were extracted.
- Meta-analyses were performed using random-effects models.
- Dichotomous outcomes were summarized using risk ratios and mean differences were used to assess continuous variables.
- A cost analysis was conducted using inputs from the meta-analysis and cost estimates from a national database.

Results

- 22 studies were identified for inclusion in the analysis, including 6 randomized controlled trials, 4 prospective studies, and 12 retrospective studies (**Figure 1**).
- The included studies focused on a variety of elective and/or emergency abdominal procedures including laparotomy (n=11), hernia repair (n=4), colorectal surgery (n=3), loop ileostomy reversal (n=2), abdominal incision repair (n=1) and pancreaticoduodenectomy (n=1).

Figure 1. PRISMA Flow Diagram

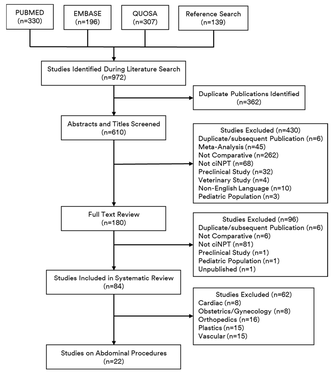


Table 1. Summary of Outcomes from Included Studies

Outcome	Statistic	# of Studies	Relative Risk	Lower Limit	Upper Limit	I^2	Relative Risk Reduction	P-value
SSC	Risk Ratio	11	0.568	0.393	0.821	70.563	43%	**0.003**
SSI	Risk Ratio	20	0.512	0.387	0.678	58.872	49%	**<0.0001**
SSSI	Risk Ratio	8	0.373	0.272	0.510	0.000	63%	**<0.0001**
DSSI	Risk Ratio	9	0.368	0.146	0.922	35.217	63%	**0.033**
Dehiscence	Risk Ratio	12	0.581	0.345	0.979	50.103	42%	**0.042**
Seroma	Risk Ratio	8	0.797	0.514	1.235	44.237	20%	0.310
Hematoma	Risk Ratio	6	1.156	0.332	4.023	44.384	-16%	0.820
Readmission	Risk Ratio	7	0.565	0.359	0.892	20.491	44%	**0.014**
LOS	Diff. in Means	8	-2.611	-3.961	-1.261	62.234		**<0.0001**

SSC, surgical site complication; *SSI*, surgical site infection; *SSSI*, superficial surgical site infection; *DSSI*, deep surgical site infection; *LOS*, length of stay

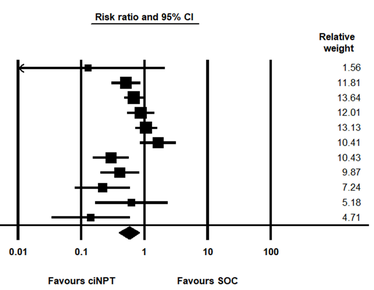
- Patients who received ciNPT had significantly reduced risk of SSC, surgical site infection (SSI), superficial SSI, deep SSI, dehiscence, and readmission and shorter length of stay compared to patients who received SOC dressings (**Table 1**).

Results (cont'd)

- The relative risk of developing an SSC for patients who received ciNPT was 0.568 (95% CI, 0.393-0.821; p=0.003), indicating that ciNPT reduced the risk of an SSC by approximately 43% compared to SOC dressings (**Table 2**).

Table 2. Forest Plot of the Effect of ciNPT over Abdominal Incisions on SSCs

Study name	Statistics for each study: Risk ratio	Lower limit	Upper limit	p-Value	SSC / Total: ciNPT	SOC	Relative weight
Cantero 2016	0.129	0.008	2.096	0.150	0 / 17	9 / 43	1.56
Chambers 2020	0.506	0.303	0.848	0.010	13 / 64	77 / 192	11.81
Diaconu 2018	0.677	0.485	0.946	0.022	29 / 62	29 / 42	13.64
Hopkins 2020	0.875	0.533	1.437	0.598	14 / 34	24 / 51	12.01
Leitao 2021	1.060	0.719	1.563	0.767	44 / 254	41 / 251	13.13
Leuchter 2021	1.636	0.856	3.129	0.137	18 / 54	11 / 54	10.41
Licari 2020	0.295	0.154	0.562	0.000	9 / 70	48 / 110	10.43
Liu 2021	0.409	0.203	0.825	0.012	9 / 70	22 / 70	9.87
Marti 2021	0.217	0.080	0.588	0.003	4 / 58	27 / 85	7.24
Poehnert 2018	0.625	0.167	2.333	0.484	3 / 24	5 / 25	5.18
Zaidi 2016	0.141	0.034	0.580	0.007	2 / 69	23 / 112	4.71
Total	0.568	0.393	0.821	0.003			



- Patients who received ciNPT were 44% less likely to be readmitted and had a 2.6 day decrease in length of stay compared to patients receiving SOC dressings.
- The estimated cost savings associated with ciNPT use in abdominal procedures was $5,146 per patient.

Conclusions

- This study is the largest meta-analysis to date examining the impact of ciNPT on SSCs and health utilization outcomes for patients undergoing open abdominal procedures.
- Study findings indicate that ciNPT for patients undergoing open abdominal procedures can help reduce the risk of SSCs and associated hospital length of stay, readmissions, and costs of care.

Presented at Symposium on Advanced Wound Care Spring/Wound Healing Society Meeting, April 26-30, 2023, National Harbor, MD

NOTE: Specific information, contraindications, warnings, precautions and safety information exist for these products and therapies. Please consult a clinician and product labeling prior to use.

***3M™ Prevena™ Incision Management System (3M, St. Paul, MN)**

Dr. Mantyh is a paid consultant for 3M. The authors thank 3M for assistance with poster preparation and production.