Research

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Negative Pressure Wound Therapy for Closed Laparotomy Incisions in General and Colorectal Surgery

A Systematic Review and Meta-analysis

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Introduction

Background

- Postoperative wound complications are a common occurrence after open abdominal surgery
  - Including: Surgical site infections (SSIs), seroma or hematoma formation, & wound dehiscence
- Surgical site infections constitute **36% of all health care-associated infections** in the United States
- **Colorectal surgery** is associated with the **highest rate of SSI (≥45%)** due to the inherent contaminated nature of the surgery.
- Traditional care bundles aim to target these different components
  - Use of preoperative antibiotic prophylaxis, aseptic surgical technique, maintenance of intraoperative normothermia, and preoperative optimization of patient risk factors
- Negative pressure wound therapy (NPWT) consists of the continuous delivery of negative pressure to the wound bed via a vacuum device
  - Removing excess tissue edema & promoting granulation tissue formation
  - Include: Vac, PREVENA, PICO
- Numerous studies in orthopedic and cardiothoracic surgery have demonstrated **decreased SSI rates with the use of NPWT in closed incisions**


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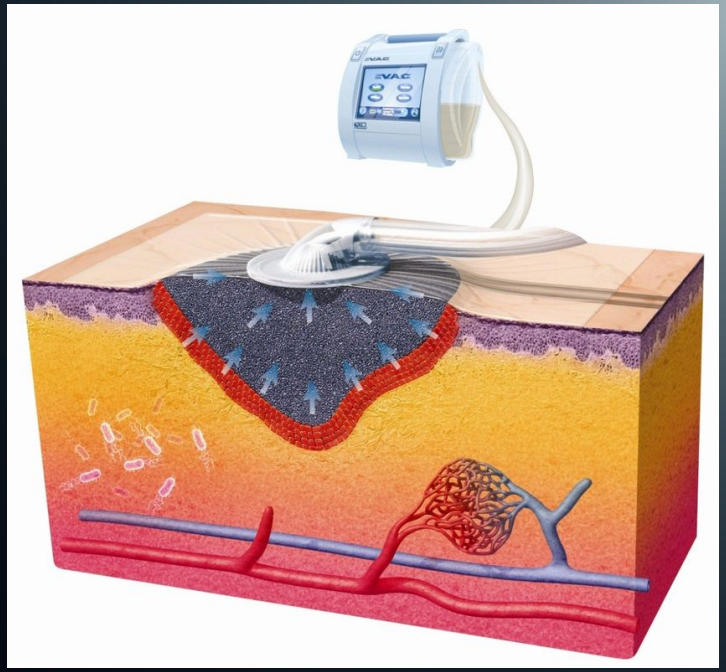
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Objective:

To perform a systematic review and meta-analysis to assess the association of prophylactic NPWT in closed laparotomy wounds in general and colorectal surgery, compared with conventional surgical dressings

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General & Colorectal surgical patients who underwent open laparotomy…

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are at increased risk of developing SSI…

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but use of NPWT on closed laparotomy incisions…

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compared to standard wound dressings…

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can decreased the risk of developing SSI in these populations.

Methods

Followed Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines

Inclusion Criteria:

- Studies that directly compared NPWT with standard dressings for closed laparotomy wounds in general and/or colorectal surgery
- Randomized clinical trials (RCTs) and nonrandomized studies
- Elective and emergency laparotomies

Exclusion Criteria:

- Unpublished reports and studies that examined NPWT (or standard non-pressure) dressings only, without a comparator group
- Studies that evaluated the use of NPWT in open abdominal incisions
- Involved placement of foreign material (eg, mesh, drain) in the subcutaneous space

Search Strategy

- Online literature was searched using the following combination of medical subject heading terms:
  - “laparotomy incisions” OR “closed laparotomy” AND “negative pressure wound therapy” OR “negative pressure dressings.”
- Medline, Embase, Cochrane Central Register of Controlled Trials, and Google Scholar
- No language restrictions
- Search was performed from inception until December 2017

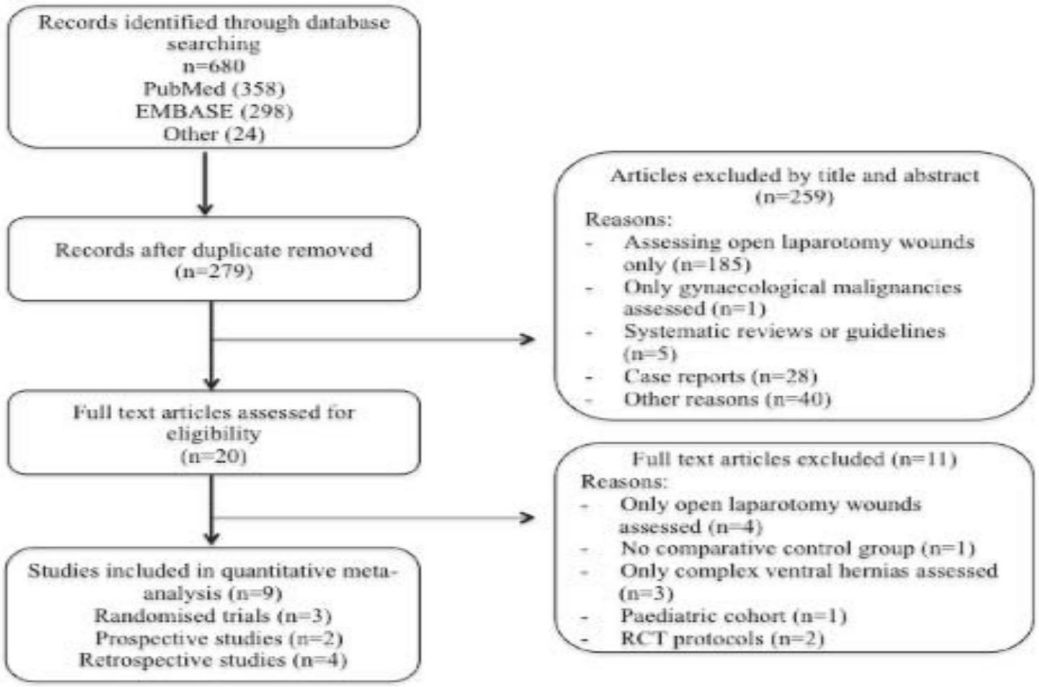
Methods (con't)

Data Analysis:

- Demographics extracted to a excel spreadsheet
- Random-effects model was used to define all pooled outcome measures
- Odds ratio (OR) was estimated with its variance and 95% CI.
- Prevailing heterogeneity between ORs for the comparable outcomes between different studies was calculated using the I^2 inconsistency test
    - Depicts the percentage of total variation across studies and reflects heterogeneity rather than chance

Results

eFigure 1. PRISMA Diagram of Studies Included in the Meta-analysis

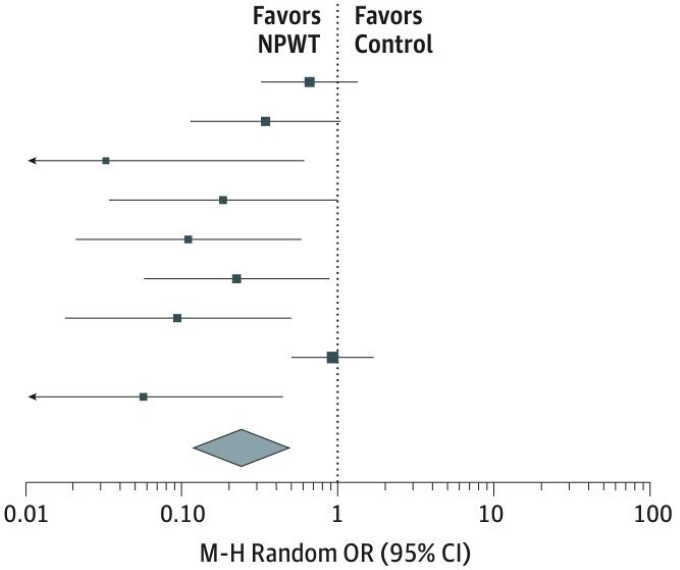


Results

Figure 1. Meta-analysis of Surgical Site Infection (SSI) Rates Between Negative Pressure Wound Therapy (NPWT) and Standard Dressings

Source	NPWT Group No. of Events	NPWT Group Total No. of Incisions	Control Group No. of Events	Control Group Total No. of Incisions	M-H Random OR (95% CI)	Weight, %
Blackham et al,[36] 2013	19	104	22	87	0.66 (0.33-1.32)	16.6
Bonds et al,[35] 2013	4	32	65	222	0.35 (0.12-1.02)	13.5
Lozano-Balderas et al,[32] 2017	0	25	10	27	0.03 (0.00-0.59)	4.6
O'Leary et al,[30] 2017	2	25	8	25	0.18 (0.03-0.98)	9.5
Pellino et al,[34] 2014	2	25	11	25	0.11 (0.02-0.57)	9.6
Schurtz et al,[37] 2018	3	48	11	48	0.22 (0.06-0.86)	11.6
Selvaggi et al,[33] 2014	2	25	12	25	0.09 (0.02-0.49)	9.6
Shen et al,[31] 2017	27	132	29	133	0.92 (0.51-1.66)	17.3
Zaidi and El-Masry,[38] 2017	1	69	23	112	0.06 (0.01-0.43)	7.6
Total	60	485	191	704	0.25 (0.12-0.52)	99.9

Heterogeneity: $\tau^2 = 0.68$; $\chi^2 = 23.59$; $df = 8$ ($P = .003$); $I^2 = 66\%$
Test for overall effect: $z = 3.77$ ($P < .001$)



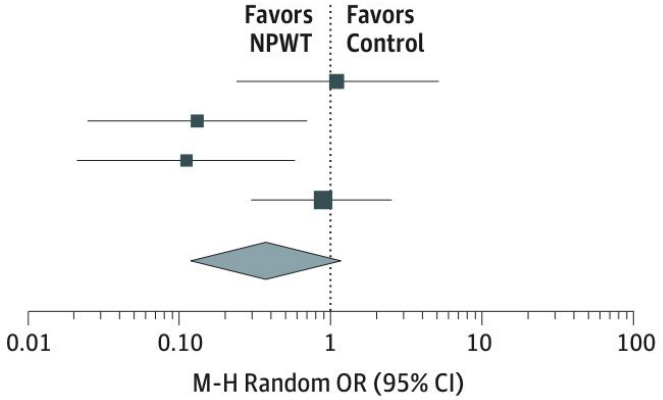
Different marker size indicates weight; diamond, pooled OR. M-H indicates Mantel-Haenszel; OR, odds ratio.

Results

Figure 2. Meta-analysis of Seroma Rates Between Negative Pressure Wound Therapy (NPWT) and Standard Dressings

Source	NPWT Group		Control Group		M-H Random OR (95% CI)	Weight, %
	No. of Events	Total No. of Incisions	No. of Events	Total No. of Incisions		
Blackham et al,[36] 2013	4	104	3	87	1.12 (0.24-5.15)	24.1
Pellino et al,[34] 2014	2	25	10	25	0.13 (0.03-0.68)	22.5
Selvaggi et al,[33] 2014	2	25	11	25	0.11 (0.02-0.57)	22.6
Shen et al,[31] 2017	7	132	8	133	0.88 (0.31-2.49)	30.8
Total	15	286	32	270	0.38 (0.12-1.23)	100

Heterogeneity: $\tau^2 = 0.86$; $\chi^2 = 7.95$; $df = 3$ ($P = .05$); $I^2 = 62\%$
Test for overall effect: $z = 1.62$ ($P = .11$)



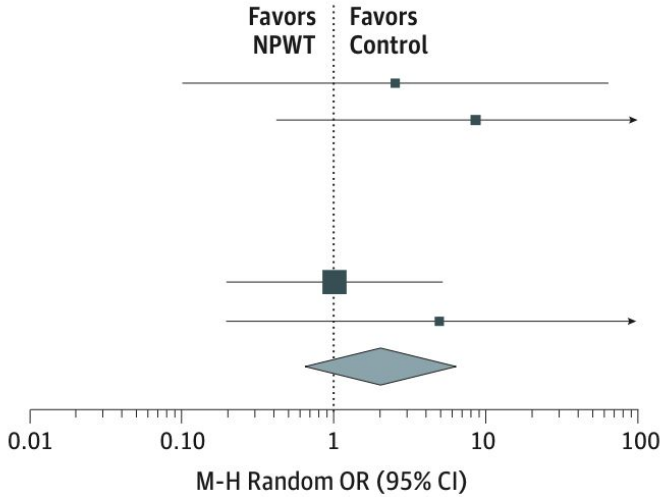
Different marker size indicates weight; diamond, pooled OR. M-H indicates Mantel-Haenszel; OR, odds ratio.

Results

Figure 3. Meta-analysis of Wound Dehiscence Rates Between Negative Pressure Wound Therapy (NPWT) and Standard Dressings

Source	NPWT Group		Control Group		M-H Random OR (95% CI)	Weight, %
	No. of Events	Total No. of Incisions	No. of Events	Total No. of Incisions		
Blackham et al,[36] 2013	1	104	0	87	2.54 (0.10-63.05)	14.1
Lozano-Balderas et al,[32] 2017	3	25	0	27	8.56 (0.42-174.46)	16.1
O'Leary et al,[30] 2017	0	25	0	25	Not estimable	
Pellino et al,[34] 2014	0	25	0	25	Not estimable	
Selvaggi et al,[33] 2014	0	25	0	25	Not estimable	
Shen et al,[31] 2017	3	132	3	133	1.01 (0.20-5.09)	55.7
Zaidi and El-Masry,[38] 2017	1	69	0	112	4.93 (0.20-122.66)	14.1
Total	8	405	3	434	2.03 (0.61-6.78)	100

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 1.94$; $df = 3$ ($P = .58$); $I^2 = 0\%$
Test for overall effect: $z = 1.14$ ($P = .25$)



Different marker size indicates weight; diamond, pooled OR. M-H indicates Mantel-Haenszel; OR, odds ratio.

POEM

- More than US $1.6 billion in costs and 1 million extra hospital days in affected patients, thus representing a substantial health economic burden.
- The net outcomes of SSI include prolonged hospital stays, delay in adjuvant treatment, potential development of incisional hernias, and ultimately a decrease in patient quality of life.
- Cause of SSI is multifactorial, resulting from an interplay between patient-related, environmental, and surgical factors.

Limitations

Most studies were non-randomized

- **Potential for bias**

Different NPWT devices used

- Each with varying recommendations regarding optimal pressure settings and duration of application

Economic Evaluation not performed

- To determine the cost-effectiveness of NPWT compared with standard surgical dressings

Elective vs. Emergent

- Unable to evaluate elective and emergency surgery outcomes separately owing to insufficient data reported in the studies

Conclusions

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Colorectal surgical procedures endure the highest rates of SSI, reported to be as high as 45%, despite established prophylactic measures such as wound protectors, maintenance of normoglycemia perioperatively, and appropriate antibiotic selection.

- Presence of a stoma has been shown to be an independent risk factor for postoperative SSI development

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NPWT use in the colorectal surgical population may be beneficial in the setting of a stoma,

- Isolating the wound
- Promoting effective wound healing

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Further research is required to determine the wound category (clean vs clean contaminated vs contaminated vs dirty) in which NPWT has the greatest benefits before recommending its routine use in surgical practice.

Thanks!

Do you have any questions?

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