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RESEARCH ARTICLE

COMPARISON OF VACUUM-ASSISTED CLOSURE (VAC) THERAPY AND CONVENTIONAL THERAPY FOR DEEP STERNAL WOUND INFECTIONS (DSWI) POST-OPEN HEART SURGERY

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Abstract

Deep sternal wound infections (DSWI) represent a serious postoperative complication in cardiothoracic surgery, leading to significant morbidity, prolonged hospital stays, and increased mortality. Traditionally, DSWI has been managed through debridement, antibiotic regimens, and conventional wound care methods, but Vacuum-Assisted Closure (VAC) therapy has recently emerged as an alternative approach. This article compares VAC therapy with conventional therapy, assessing their respective impacts on wound healing time, infection rates, and overall patient outcomes. Findings suggest that VAC therapy offers promising advantages over traditional methods in DSWI management.

Introduction:-

Post-sternotomy wound infections, including superficial wound infections and deep sternal wound infections (DSWI) with mediastinitis, present significant challenges due to high morbidity, mortality, and healthcare costs. The incidence of which remains high, ranging from 0.5% to 6.8%, with in-hospital mortality rates between 7% and 47%. Risk factors include age, obesity, diabetes, smoking, and prolonged surgery. Common pathogens include *Staphylococcus aureus* and *coagulase-negative staphylococci*. Vacuum-assisted closure (VAC) therapy, or negative pressure wound therapy (NPWT), has emerged as an effective adjunctive treatment for managing these infections. By promoting wound healing, reducing edema, and enhancing infection control, VAC therapy offers significant benefits over traditional wound management, potentially improving patient outcomes and reducing complications. (1) (2) (3) (4)

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Figure 1:- Image of DSWI and vac dressing.

Methods

This prospective observational study was conducted in the Department of Cardiothoracic and Vascular Surgery at Government Medical College, Kottayam, over a 12-month period. The study included 44 patients who developed deep sternal wound infections (DSWI) following open heart surgery. Sample size calculation was based on data from a prior study, with a precision of 5%.Patients who met the inclusion criteria (undergoing open heart surgery with DSWI) were enrolled after obtaining ethical approval and informed consent. Exclusion criteria included patients who did not meet the diagnostic criteria for DSWI.

Data were collected through structured proformas, capturing demographics, clinical details, risk factors, microbiological culture results, and postoperative outcomes. Patients were treated with either vacuum-assisted closure (VAC) therapy or conventional wound closure methods. The VAC group received debridement, open sternum with VAC therapy, and pectoral flap closure, while the conventional group received debridement, sternum fixation, and retrosternal irrigation. Statistical analysis was performed using SPSS software to compare clinical outcomes.

Results

This study aimed to compare the clinical outcomes of two patient groups undergoing open heart surgery: the Vacuum-Assisted Closure (VAC) group (n=22) and the Non-VAC group (n=22). The results were analyzed across various preoperative, intraoperative, and postoperative parameters.

In terms of demographics and clinical characteristics, the two groups were similar. The mean age was 56.5 ± 8.48 years for the VAC group and 58.41 ± 8.81 years for the Non-VAC group, with no significant difference (p=0.468). Similarly, no significant differences were found between the groups regarding creatinine levels (p=0.631), HbA1c levels (p=0.106), height (p=0.804), weight (p=0.826), or body mass index (BMI) (p=0.909). The STS operative mortality score, a preoperative risk factor, was also comparable between the two groups (VAC: 1.61 ± 2.03, Non-VAC: 2.04 ± 2.34, p=0.523). Additionally, there were no significant differences in the STS score for deep sternal wound infection (DSWI) (VAC: 11.79 ± 7.71, Non-VAC: 10.48 ± 6.13, p=0.535) or for prolonged hospital stay (>14 days) (VAC: 3.54 ± 3.67, Non-VAC: 2.26 ± 0.86, p=0.21).

Intraoperatively, the two groups did not show significant differences in key parameters such as inotropic support at 24 hours (VAC: 13.39 ± 5.22, Non-VAC: 13.02 ± 10.21, p=0.882), lactate levels (VAC: 2.29 ± 0.91, Non-VAC: 2.59 ± 0.83, p=0.26), cardiopulmonary bypass (CPB) time (VAC: 79.43 ± 24.1 minutes, Non-VAC: 90.78 ± 18.75 minutes, p=0.306), or X-clamp time (VAC: 59.57 ± 20.26 minutes, Non-VAC: 68.56 ± 19.51 minutes, p=0.384). The ICU stay was slightly shorter in the VAC group (3.32 ± 1.25 days) compared to the Non-VAC group (4.18 ± 5.37 days), but this difference was not statistically significant (p=0.466). Similarly, the total hospital stay did not differ significantly between the groups, with a mean of 16.14 ± 9.83 days in the VAC group and 17.23 ± 18.45 days in the Non-VAC group (p=0.808).

Regarding postoperative outcomes, there were no significant differences between the two groups in terms of postoperative arrhythmias (VAC: 59.1%, Non-VAC: 54.5%, p=0.093), readmission rates (VAC: 63.6%, Non-VAC: 50.0%, p=0.834), or conditions at discharge (Stable: VAC: 86.4%, Non-VAC: 86.4%, p=1.000). However, the type of wound closure varied between the groups. A higher percentage of patients in the VAC group (77.8%) underwent closure using a PMMC flap compared to the Non-VAC group (42.9%, p=0.004). Conversely, more patients in the Non-VAC group (57.1%) had secondary closure, compared to 22.2% in the VAC group.

Microbiological findings also revealed some interesting trends. In the VAC group, there was a lower prevalence of multidrug-resistant (MDR) organisms compared to the Non-VAC group, which was dominated by *Klebsiella* species and *Pseudomonas*. While no statistically significant differences were found in bacterial growth between the groups (p>0.05), the VAC group exhibited a slightly lower incidence of infections caused by MDR organisms.

Finally, the potassium levels were significantly different between preoperative and postoperative assessments. In both groups, potassium levels increased postoperatively, with the VAC group showing a mean increase from 3.809 ± 0.276 mEq/L to 3.968 ± 0.225 mEq/L (p=0.001), and the Non-VAC group showing an increase from 3.777 ± 0.197 mEq/L to 3.973 ± 0.253 mEq/L (p<0.001). These changes were statistically significant, suggesting some differences in postoperative electrolyte management between the two groups.

In summary, the study found no significant differences between the VAC and Non-VAC groups in terms of most clinical outcomes, including mortality, ICU stay, hospital stay, and major risk scores.

Table 1- Demographic details

Parameters	VAC (n=22)		Non VAC (n=22)		P value
	Mean	SD	Mean	SD	
Age	56.5	8.48	58.41	8.81	0.468
Ht	158.64	7.69	158.05	7.97	0.804
Wt	59.35	7.22	58.77	9.78	0.826
BMI (kg/m2)	23.61	2.73	23.51	3.3	0.909

Table 2- Preoperative, intraoperative and postoperative assessment

Parameters	VAC (n=22)		Non VAC (n=22)		P value
	Mean	SD	Mean	SD	
STS operative mortality	1.61	2.03	2.04	2.34	0.523
STS score for DSWI	11.79	7.71	10.48	6.13	0.535
STS score for long hospital stay gt14d	3.54	3.67	2.26	0.86	0.21

Inotropic score at 24 hrs	13.39	5.22	13.02	10.21	0.882
Lactate post op	2.29	0.91	2.59	0.83	0.26
Post op ICU	3.32	1.25	4.18	5.37	0.466
Hospital stay	16.14	9.83	17.23	18.45	0.808

Discussion

Deep sternal wound infection (DSWI) remains a serious complication following cardiac surgery, impacting patient recovery and healthcare costs. The present study aimed to compare the outcomes of Vacuum-Assisted Closure (VAC) therapy versus conventional therapy in patients with Deep Sternal Wound Infections (DSWI) after open-heart surgery.

Perezgrovas-Olaria, Roberto et al. from a meta-analysis, reported an incidence of DSWI ranging between 0.2% to 8.0%. The incidence of DSWI observed in our study (3.5%) reflects the middle of the spectrum reported in the literature. Studies have documented varying rates of DSWI, often influenced by surgical techniques, patient demographics, and infection control practices. For instance, the incidence of DSWI in a comprehensive review ranged from 0.2% to 8.0% corroborating our findings. (5)

Microbiological profiles in our study revealed a diverse array of pathogens. Gram-negative bacteria, including Klebsiella and Pseudomonas species, were predominant. These results are consistent with previous studies by **Brook I et al(1999) &Splindler et al(2020),** that have reported similar microbial profiles, with a high prevalence of multi-drug resistant organisms (MDROs) in DSWI cases. Notably, MDR Klebsiella and Acinetobacter species were identified, aligning with the literature highlighting the growing challenge of MDROs in postoperative infections. (6) (7)

In our study, the outcomes between VAC therapy and conventional wound closure showed no statistically significant differences in terms of infection resolution and wound healing. VAC therapy is known for its ability to promote wound healing through negative pressure, which enhances granulation tissue formation and reduces edema. Despite these theoretical benefits, the practical differences observed in our study were minimal compared to conventional methods.

Malmsjö et al. (2007)&**Von Oppell UO et al.(2011)** found VAC therapy significantly reduced wound infection rates and accelerated healing compared to conventional methods in complex wounds. Numerous researchs has demonstrated mixed results regarding the superiority of VAC therapy over conventional closure. However, other studies have reported negligible differences in outcomes between VAC and conventional closure techniques in DSWI management.(8) (9)

Christodoulou et al(2024) from a meta-analysis, reported lower mortality, length of hospital stay, ICU stay and cost of treatment when compared with a non-VAC group. Our analysis showed that the length of ICU stay, and overall hospital stay were comparable between the VAC and conventional groups. The mean ICU stay was 3.32 days for the VAC group and 4.18 days for the conventional group, with a p-value of 0.466, indicating no significant difference. Similarly, the hospital stay was not significantly different between the two groups, again probably due to smaller sample size. These findings contrast with some studies suggesting that VAC therapy might reduce hospital stay due to improved wound healing.(10)

The inotropic scores at 24 hours post-surgery did not differ significantly between the VAC and conventional groups, with mean scores of 13.39 and 13.02, respectively. This suggests that VAC therapy did not impact hemodynamic stability or the need for inotropic support in this cohort.

The lack of significant differences in age, creatinine, HbA1c, height, weight, and BMI suggests that the two groups were well-matched in terms of baseline characteristics. Additionally, the similar STS operative mortality scores, STS

scores for DSWI, and STS scores for long hospital stay (>14 days) indicate that the severity of illness and surgical risk were comparable between the two groups.

In terms of outcomes, we found no significant differences in lactate levels, CPB time, X-clamp time, post-op ICU stay, and hospital stay between the VAC and Non-VAC groups. This suggests that VAC therapy may not offer a significant advantage over conventional therapy in terms of reducing morbidity and mortality in patients with DSWI.

Our results show that there were no significant differences in demographics, clinical parameters, and outcomes between the two groups, despite studies with proven benefits of VAC therapy over conventional therapy. However, it is essential to note that the small sample size (n=22 in each group) may have limited the power of our study to detect significant differences between the two groups.

Conclusion

Our study evaluated the effectiveness of vacuum-assisted closure (VAC) therapy versus conventional wound closure for deep sternal wound infections (DSWI) following cardiac surgery. Further studies with larger sample sizes and randomized controlled designs are necessary to confirm our findings and provide more robust evidence on the effectiveness of VAC therapy in patients with DSWI. Nevertheless, our study contributes to the existing literature by providing insights into the comparative outcomes of VAC and conventional therapy in this patient population.

References

1. Naser N, Hadziomerovic N. Sudden Cardiac Deaths. Int J Biomed Healthc. 2018;6(2):110.
2. Ma JG, An JX. Deep sternal wound infection after cardiac surgery: a comparison of three different wound infection types and an analysis of antibiotic resistance. Journal of Thoracic Disease [Internet]. 2018 Jan [cited 2024 Jun 29];10(1). Available from: https://jtd.amegroups.org/article/view/18173
3. Dessap AM, Vivier E, Girou E, Brun-Buisson C, Kirsch M. Effect of time to onset on clinical features and prognosis of post-sternotomy mediastinitis. Clinical Microbiology and Infection. 2011 Feb 1;17(2):292–9.
4. Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment: clinical experience. Ann Plast Surg. 1997 Jun;38(6):563–76; discussion 577.
5. Perezgrovas-Olaria R, Audisio K, Cancelli G, Rahouma M, Ibrahim M, Soletti GJ, et al. Deep Sternal Wound Infection and Mortality in Cardiac Surgery: A Meta-analysis. The Annals of Thoracic Surgery. 2023 Jan 1;115(1):272–80.
6. Brook I. Microbiology of postthoractomy sternal wound infection. Journal of Clinical Microbiology. 1989 May;27(5):806–7.
7. Spindler N, Biereigel C, Pieroh P, Schroeter T, Misfeld M, Josten C, et al. Clinical and Microbiological Analysis of Deep Sternal Wound Infections in Fifty-Two Consecutive Patients. Surgical Infections. 2020 May;21(4):370–7.
8. Malmsjö M, Ingemansson R, Sjögren J. Mechanisms Governing the Effects of Vacuum-Assisted Closure in Cardiac Surgery: Plastic and Reconstructive Surgery. 2007 Oct;120(5):1266–75.
9. Von Oppell UO, Dimitrakakis G. Management of deep sternal wound infections; placed in perspective! Interactive CardioVascular and Thoracic Surgery. 2011 Aug 1;13(2):188–188.
10. Christodoulou N, Wolfe B, Mathes DW, Malgor RD, Kaoutzanis C. Vacuum-assisted closure therapy for the management of deep sternal wound complications: A systematic review and meta-analysis. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2024 Jul;94:251–60.