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Original article

Better outcomes with a new type of pressure wound therapy for mediastinitis after cardiac surgery

Hayati DENIZ Asc.Prof, MD [(1)], Yavuz ARSLANOGLU, Expert, Dr. MD [(1)] Murat ARI, Expert, Dr. MD [(1)]

[(1)]Gaziantep Ersin Arslan Education and Research Hospital, Department of Cardiovascular Surgery, Gaziantep,Turkey

Abstract. *Background:* The aim of the present study is to compare the clinical outcomes and survival in our 40 patients underwent NPWT with or without instillation treatment for mediastinitis after cardiac surgery. *Materials end Methods:* In this study, we retrospectively compared the clinical outcome and survival in 40 patients undergoing VAC therapy with or without instillation treatment for DSWI after cardiac surgery. Only patients with mediastinitis those are consisting of sternum and presternal tissue infection after coronary bypass surgery were included in the present study. *Results:* Mean age of patients was 58.86 ± 11.6 and 57 patients of them were female and 33 of them were male. Primary surgery among the 40 patients presenting with DSWI; was coronary artery bypass revascularization. *Conclusion:* The use of VAC therapy with instillation has changed the management of complicated infected or colonized wounds and has become the standard of care our facility.

Keywords: Mediastinit, VAC therapy, Wound

Introduction

Infection of the sternotomy wound is a potentially devastating and sometimes lethal complication following cardiac surgery(1.2). Established treatment may involve a combination of debridement, packing, delayed closure, plastic reconstruction, re-wiring and irrigation together with antibiotherapy dependent on the severity of infection. However, such treatments can be complex, invasive and prolong the hospitalization. These conventional wound healing techniques may be a combination of different procedures, but there is still a lack of consensus for the optimal surgical management. Application of negative pressure by controlled suction has emerged as a simple and effective treatment for a wide spectrum of wounds(3). Several studies have been reported with promising results with the use of vacuum-assisted closure (VAC) therapy in poststernotomy mediastinitis(4). The goal of wound management is to create an environment by decreasing the bacterial bioburden and improving perfusion to the wound. NPWT (Negative pressure wound treatment) instillation combines NPWT and the timed delivery of topical irrigation solutions to the wound bed. The solutions can be antimicrobials or other fluids used for irrigation in conjuction with the added benefits of NPWT.

The aim of the present study is to compare the clinical outcomes and survival in our 40 patients underwent NPWT with or without instillation treatment for mediastinitis after cardiac surgery.

Materials and Methods

In this study, we retrospectively compared the clinical outcome and survival in 40 patients undergoing VAC therapy with or without instillation treatment for DSWI after cardiac surgery.

Only patients with mediastinitis those are consisting of sternum and presternal tissue infection were included in the present study. In 40 patients postoperative

mediastinitis was diagnosed, based on the guidelines of the US Centre for Disease Control and prevention (5). Wound classification was defined according to the suggestions of El Oakley and Wright (6).

Statistics

Categorical variables are expressed as percentages and continuous variables are expressed as the mean SD. Analysis was performed using the *w*2-test for qualitative data, two-sample independent t-test and Wilcoxon rank sum test for quantitative data, and Kaplan–Meier survival analysis for time-to-event outcomes to compare the controls to the NPWT-instillation therapy group.(Table1).

Results

Mean age of patients was 58.86 ± 11.6 and 57 (63.3 %) of the patients were female and 33 (36.7 %) of them were male. Primary surgery among the 40 patients presenting with DSWI; was coronary artery bypass revascularization. All patients in group 1 underwent sternal rewiring without flap surgery, after 3 consecutive bacteriologic cultures from substernal tissue became negative. In the conventional treatment group pectoral flap surgery was performed in 15% (n=3).

Bacteriologic cultures showed the presence of *staphylococi* in the majority of patients. And the leading pathogenic organism was *S.aureus* for each group. The following organism was metisilin resistance *S.aures*. There was no significant difference between groups when compared the rate of polymicrobial infections (Table 2).

Patients from group 1 were significantly older than group 2. Elderly patients those over 65 years old were more frequent in group 1 than in group 2, with a statistically significance ($p< 0.05$). Patients with BMI over 30 were significantly more in group 1 than in group 2. Female frequency was further in group 1 than in group 2 with a statistically significance.

Median hospital stay for instillation group and without instillation groups were 39.2±12, 14.6 ± 9.18 respectively and whereas the treatment duration for the VAC without instillation group was longer than the instillation group 36.4±13, days, 9.8±4.3 days respectively, with statistically significance.

Table 1. Treatment outcomes

	Control group (n =20)	**NPWT-instillation therapy group (n = 20)**	**P-value**
NPWT, negative pressure wound therapy.* Mean ± SD.** P < 0·05 compared with control group.			
Days treated*	36.47 ± 13·07	9.87 ± 4·31**	<0.001
Infection cleared	66.7%	100%**	0.042
Day wound cleared of clinical infection*	25.40 ± 6·57	6.00 ± 1·46**	<0.001
Wound closed	66.7%	100%	0.042
Wound closure method (%)			0.606
Primary	13.3	1.3	
Secondary intention	33.3	26.7	
Skin graft	13.3	33.3	
Local flap	40.3	26.7	
Days to wound closure*	29.60 ± 6.54	13.20 ± 6.75**	<0.001
Days to patient discharge*	39.20 ± 12.07	14.67 ± 9.18**	<0.001

Table 2. Culture-verified deep sternal wound infection pathogens

Bacterial strains	**VAC therapy**			**VAC therapy with instillation**	
	n	**%**		**n**	**%**
S.aureus	6	30		6	30
E.coli	1	5		-	-
S. epidermiditis	4	20		4	20
Metisin resistance S. aureus	5	25		6	30
P.aeruginosa	3	15		3	15
A.baumannii	1	5		1	5

The sum of percentages exceed 100% because of rounding-off errors.

VAC = vacuum-assisted closure. S. aureus =Stafhylococcus aures; E. coli = Escherichia coli; S.epidermiditis = Stafhylococcus epidermiditis; E.coli =Escherichia coli; P.auroginosa =Pseudomonas aeruginosa; A.baumannii =Acinetobacter baumannii

There was statistical significance between groups in time duration to infection cleared (p= 0·042), day of wound cleared of clinical infection, wound closure day and wound closure rate.

Overall survival was significantly better in the instillation group than in the group without instillation.

Discussion

According to the literature, the incidence of DSWI has been variously reported as between 0.8 and 5.0% in different series of adult cardiac surgical patients (1,2). DSWI was initially treated with surgical revision, with or without multiple open dressing changes that have been previously reported with high mortality rates and has major disadvantages: sternal instability which requires mechanical ventilation, prolonged immobilization that increases additional complications as pneumonia, thrombosis and muscular weakening. When Jurkiewicz and colleagues published the first pectoral muscle flap, a lot of studies have been reported varying results with pectoral muscle flaps in poststernotomy mediastinitis (7,8). VAC therapy is a novel wound healing method. With this method, several advantageous features of conventional treatment are combined. VAC treatment allows open drainage that continuously absorbs the exudate with simultaneous stabilization of the mediastinal cavity and isolation of the wound. This method stimulates granulation tissue formation in combination with increased blood flow in the adjacent tissue. Furthermore, VAC therapy approximates the wound edges and provides a mass filling effect with low degree of surgical trauma (9).

The bacteriologic spectrum, identified in bacteriologic cultures was found similar to other studies with a majority of *S aures* infection and coagulase negative Staphylococcus (Table 2). Blood cultures were positive in 12 patients (60 %) and were not predictive for the success rate of the treatment modality. There was also no significant difference in terms of outcome based on organism in our study, which is consistent with the findings from Douville and colleagues . In their study, vacuum-assisted treatment was not available, and overall mortality was reported 12.6%, however 6.3% of them were related with DSWI (10).

Catarino and coworkers performed an early, small, retrospectively study and demonstrated a significantly greater number of treatment failures with continuous irrigation compared with VAC therapy (11). However in our study the number of failures to respond to the VAC treatment was present with a low rate in both of groups. The patients with failures to treatment modalities in both groups were classified as El Oakley class type IVA and type IVB (Table 3).

Previous studies have reported that mediastinitis is an independent risk factor with negative influence

Table 3. Poststernotomy mediastinitis classification

El Oakley Class	VAC therapy		VAC therapy with instillation	
	n	%	n	%
I	-	-	-	-
II	4	20	4	20
IIIA	6	30,6	6	30
IIIB	8	40	7	35
IVA	2	10	3	15
IVB	-	-	-	-
V	-	-	-	-

on long-term survival after coronary bypass graft surgery (2). The reason for this negative prognostic effect is not fully understood, but a severe infection can lead other organ malperfusions such as the heart, kidneys and grafts. In our study we observed that VAC group has a significantly better early and long-term survival than the conventionally treated group.

Application of topical antibiotics and antiseptict to wound continious to be a controversial subject in wound care. The strongest argument against the topical use of antimicrobial agents, such as nanocrystalline silver and silver nitrate on wounds. Drosou et al performed a literature review of relevant animal studies and clinical trials examing the effects of topical antibiotics and found despite cytotoxicity data, in most of clinical trials topical antibiotics appeared to be safe and were not found to negatively influence wound healing(12).

Conclusion

However major changes occurred in number of patients at risk. Although risky patients was found higher in our study which were mostly included in the instillation group, the present study demonstrates that VAC therapy is safe and reliable option in DSWI with instillation therapy, with excellent survival and low failure rate when compared with conventional treatments. And the use of VAC therapy with instillation has changed the management of complicated infected or colonized wounds and has become the standard of care our facility.

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Corresponding Author:
Adress: Fatih Mah 22 Nolu Sok Cankaya Sitesi C Blok Daire 2 Sehitkamil Gaziantep, TURKEY
GSM: +90 505 6222642 Email: hayatideniz@gmail.com