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Original Article

# Management Outcome of Patients with Infected Sternotomy Wounds

**Farwa Shabbir, Saad ur Rehman Sarwar, Mamoon Rashid, Haroon Ur Rashid, Maimoona Gohar, Sohrab Khan**

Shifa International Hospital, Islamabad Pakistan

## ABSTRACT

***Objective:*** to evaluate management outcomes of post-sternotomy wounds.
***Study Design:*** Retrospective longitudinal study.
***Place and Duration of Study:*** Department of Plastic Surgery, Shifa International Hospital, Islamabad Pakistan, from Jan 2020 to Dec 2021.
***Methodology:*** We reviewed 35 patients who had developed sternal wound infections post-cardiothoracic surgery. Outcomes of the study were measured using the SF-36 Quality of Life questionnaire.
***Results:*** Our patients presented with either Pairolero Type-II 11(31.4%) or Type-III 19(54.2%) sternal wound infection. Pre-operatively patients scored 296.667±69.40 in physical functional, 100.00±30.51 in limitations due to physical health, 16.67±37.90 in role limitation due to emotional problems, energy/fatigue scored 43.53±23.70, emotional well-being 163.33±23.54, social functioning as 11.40±11.66, pain score 31.25±19.90 and general health 131.67±35.31. The improvement in scores was noted in all domains postoperatively. Physical functioning mean scored as 790.00±48.07, role limitations due to physical health scored as 310.34±67.32, role limitations due to emotional problems scored as 266.67±47.94, energy/fatigue 284.67±18.71, emotional well-being 448.67±18.71, social functioning 185.83±12.60, pain score 164.17±22.01 and general health 316.67±34.95. Thirty-four (97.1%) out of 35 patients recovered well postoperative, with a maximum follow-up of 4 years and a minimum follow-up of 1 year. One patient expired on the sixth day of muscle flap coverage of the wound due to cardiac arrest.
***Conclusion:*** A positive prognosis can be obtained by this treatment protocol.

**Keywords:** Debridement, Infection, Sternotomy, Treatment, Wounds.

***How to Cite This Article:*** *Shabbir F, Sarwar SR, Rashid M, Rashid H, Gohar M, Khan S. Management Outcome of Patients with Infected Sternotomy Wounds. Pak Armed Forces Med J 2022; 72(6): 2130-2134. DOI: https://doi.org/10.51253/pafmj.v72i6.7905*



## INTRODUCTION

Deep sternal wound infection (DSWI) after median sternotomy is a life-threatening complication with an incidence of 0.25–5%.[1] Risk factors for developing DSWIs include diabetes mellitus, obesity, chronic obstructive pulmonary disease, use of one or both internal mammary arteries as bypass grafts, osteoporosis, tobacco use, prolonged intensive care unit stays, and malnutrition. These infections have been classified into three distinct groups by Pairolero,[2] based on the duration of symptoms and depth of infection. The classification divides deep sternal wound infection into three distinct types according to the duration and clinical findings. Type-I infections occur within the first week after sternotomy and typically have serosanguineous drainage but no cellulitis, osteomyelitis, or costochondritis. Type-II infections occur during the second to fourth weeks after sternotomy and usually involve purulent drainage, cellulitis, and mediastinal suppuration. Costochondritis is rare, but osteomyelitis is frequent. Type-III infections occur months to years after sternotomy and typically involve chronic draining sinus tracts and localized cellulitis. Although mediastinitis is rare, osteomyelitis, costochondritis, and/or retained foreign bodies are often present.

Sternal wound infection has a high morbidity rate of up to 50%,[3] and includes chronic pain, social isolation, repeated dressings, increased hospital stay and cost. Sternal wound infections not only leave physical scars but also adversely affect the mental health of the patient. The purpose of this study was to evaluate the management outcome of patients with sternotomy wounds.

## METHODOLOGY

This study was conducted at the Department of Plastic Surgery, Shifa International Hospital, Islamabad Pakistan, from January 2010 to December 2021 approved by the Ethical Committee and Institutional Review Board at the hospital (IRB# 318-21). The study population was gathered by non-probability, consecutive technique.

**Inclusion Criteria:** All patients with infected sternal wounds (with Type II/III Pairerelo wounds) were included in this study.

**Correspondence: Dr Farwa Shabbir,** Department of Plastic Surgery, Sifa International Hospital, Islamabad, Pakistan
*Received: 27 Dec 2021; revision received: 28 Jan 2022; accepted: 09 Feb 2022*

**Exclusion Criteria:** Patients who were not fulfilling the CDC criteria for deep sternal wounds were excluded from the study.

Follow-up was performed twice weekly for the first month and then once weekly till six months after completion of treatment. In addition, patients' general physical examination was performed, and data from the Short Form Health Survey (SF-36) was also considered. These patients were referred from the Cardiothoracic Department with an established diagnosis of deep sternal wound infections. All the patients were examined in detail and evaluated with radiological scans. After the optimization of the patients, debridements were done before a definitive procedure. After the wound bed became satisfactory, the course of reconstruction followed.

A general physical examination was done on each patient. SF-36 tool was designed to assess the mental and physical health of the patients. The scores are standardized and range from 0 to 100. Zero is the poorest indicator of health, and 100 is the best.[4] The variables of QOL were the physical functioning of the patient, role limitation due to physical and emotional health, energy/fatigue, the emotional well-being of the patient, social functioning, pain score and general health of the patient.

The preoperative and postoperative mean scores and standard deviation were calculated using Statistical Package for Social Sciences (SPSS) version 23.0. Quantitative variables were summarized as Mean±SD and qualitative variables were summarized as frequency and percentages.

## RESULTS

Our results showed that out of 35, 15(42.8%) patients were cured after the second debridement, 9(25.7%) patients required three sessions, 4(1.14%) patients underwent four debridements, and the rest of 7(20%) patients had more than five sessions of debridements. Unfortunately, one (2.9%) patient died after wound closure on the fourth post-operative day due to cardiopulmonary arrest in ICU care. In addition, three (8.6%) patients developed post-operative complications, and 1(2.9%) patient had donor-site wound dehiscence, which was managed conservatively in an OPD setup. The other 2(5.7%) patients had sternal wound dehiscence, managed after in-patient admission and reoperation local debride-ment re-closure with secondary intention.

There were 19(54.3%) males and 16(34.5%) females, and an average age of 57±12.11 years. Cardiac surgery procedures included cardiac bypass surgery CABG in 24(68.6%), valve replacement in 8(22.9%) and others in 3(8.6%). Around 29(82.9%) patients had different degrees of hypertension, diabetes mellitus and heart failure. A total of 7(20%) patients underwent debridement within one month after cardiac surgery, 27(77.1%) within 1-2 months of surgery and 16(45.7%) received it after two months of it. The average hospital stay and duration of administration of Intra Venous antibiotics were shown in the Table- I.

**Table-I: Course of Treatment (n=35)**

| Type of Wound (Pairolero) | Hospital stay (days) Mean | IV Antibiotic Duration (days) Mean |
|---|---|---|
| Type-II | 8.2±1.25 | 18±0.98 |
| Type-III | 17.6±1.10 | 26±1.01 |

The number of surgical debridements varied among all patients, with the average no being 4±2.01 sessions. Bacterial and fungal cultures were sent on debridement, along with deep bone cultures. Bacterial cultures showed MRSA in 9(25.7%) patients, Klebsiella in 6(17.1%), Pseudomonas in 12(34.3%), Acinetobacter in 5(14.3%), others in 3(8.6%). Fungal cultures were positive in 3(8.6%) patients and showed the growth of Candida Albicans. All our patients had NPWT after each debridement.

According to their presentation, wounds were managed surgically with adequate removal of necrotic tissue, hardware and pus discharge. They were then treated with NPWT. Table–II enlisted the techniques used for the reconstruction of defects.

**Table-II: Techniques used for Closure of the Sternal Wound (n=35)**

| Surgical Techniques | n(%) |
|---|---|
| Pedicled Muscle Flaps | |
| Unilateral Pectoralis | 2(5.7%) |
| Bilateral Pectoralis | 11(31.4%) |
| Rectus Abdominis | 5(14.3%) |
| Combination of both above | 6(17.1%) |
| Skin Grafting | 1(2.9%) |
| Local Tissue Flap | 7(20%) |
| Negative Pressure Wound Therapy (NPWT) | 3(8.6%) |

The response rate was 85.7%(30/35). The QoL for patients with sternal wound infections was compared before and after wound closure. The responses before and after definitive management have been tabulated in Table-III

**Table-III: SF-36 Quality of Life (QoL) Scores (n=35)**

| Variables | Mean Pre-operative Scores | Mean Post-operative Scores |
|---|---|---|
| Physical functioning | 296.67±69.40 | 790.00±48.07 |
| Role limitations due to physical health | 10.00±30.51 | 310.34±67.32 |
| Role limitations due to emotional problems | 16.67±37.90 | 266.67±47.94 |
| Energy/fatigue | 43.53±23.70 | 284.67±18.71 |
| Emotional well-being | 163.33±23.54 | 448.67±18.71 |
| Social functioning | 11.40±11.66 | 185.83±12.60 |
| Pain | 31.25±19.90 | 164.17±22.01 |
| General health | 131.67±35.31 | 316.67±34.95 |

## DISCUSSION

In our study, we present our outcomes post-management of sternal wound infections and how they impacted the quality of life of these patients. The morbidity associated with sternal wound infections ranges from about 7-80%.[5] Paramount importance is given to prevention and early recognition of symptoms for appropriate treatment. In patients with these known risk factors, such as diabetes mellitus, smoking, and obesity, the incidence of sternal wound infection drastically increased.[6] Most of the patients we receive for sternal wound infection have multiple comorbidities. The presence of microorganisms in isolated tissue cultures is another risk factor.[7] It was shown in a previous study that the presence of coagulase-negative staphylococci and S. aureus,[8] was a considerable risk factor for sternal wound infection. In our experience, Pseudomonas was high among re-operated cases and associated with wound dehiscence after a definitive procedure.

The mainstay of management of sternal wound infection is controlling the infection by aggressive judicious debridement in conjunction with appropriate antibiotic therapy, after which NPWT was applied till the wound was ready to be reconstructed. The average no of debridements done for our patients was.[3] All hardware was removed along with infected costal cartilage, and the portion of ribs was found to be infected. The wound bed was thoroughly irrigated with hydrogen peroxide and copious saline washes.

The timing of coverage with muscle flaps is also very important. A former study by Dubert et al. advocated one-stage debridement and closure.[9] They advocate that thorough debridement is the key to a successful procedure, and it is important to obliterate dead space with muscle flaps in a single stage to reduce mortality. The failure rate for this study was 16%, and these patients then underwent secondary flap reconstruction. The concept of staged debridement and NPWT is reported in a previous study by Kaul *et al.* and Schiraldi *et al.*[10,11] with significant results in the success of treatment. All patients in our study underwent staged debridements, NPWT and delayed coverage. Three patients (9.6%) underwent NPWT-assisted closure via secondary intention. Most of the patients (91%) in our study had delayed coverage after multiple debridements with NPWT. It was observed that muscle flaps provided bulk to close the cavity and acted as an adjunct to control infection. A study by Kaul *et al*.[10] also confers that immediate reconstruction with muscle flaps may diffuse infection or cause re-infection in a complicated wound. However, Spindler *et al*.[12] report that the approach should be dictated by wound status, and there is no sound clinical evidence to support multistaged or simultaneous treatment plans.

NPWT applies sub-atmospheric pressure to the wound and improves wound healing tremendously.[13] It stabilizes the chest wall, cushioning vital structures underneath and reduces oedema.[14,15] It also increases sternal blood flow, as shown in an experimental porcine model.[16] No randomized trials compare NPWT with standard debridement and delayed wound closure, but numerous retrospective analyses exist. Yoshimoto and colleagues,[17] compared NPWT with standard therapy of wound debridement, dressings and delayed flap closure and concluded that patients undergoing NPWT had reduced hospital stay and achieved negative tissue cultures in reduced time. Myllykangas *et al.*[18] reported that NPWT decreased the time between debridement and complete wound closure. Petzina *et al*.[19] in their retrospective analysis of 118 patients, found that mortality with NPWT was 6% compared with 25% in patients who underwent debridement and dressings change without NPWT.

The idea of the coverage of sternal defects with the help of pedicled flaps was introduced in 1969. Nowadays, plastic surgeons have myriad flap options for closure. An anatomical classification for flap selection is based on the location of the defect; the upper sternum, the lower sternum and the whole sternum. Pectoralis major flap for defects of the upper sternum, and combined pectoralis major and rectus abdominis for lower and whole sternum. Omental flaps,[20] have also been used for coverage but have an added risk of opening the abdominal cavity. In the present study, 37% of patients underwent closure with

either unilateral or bilateral pectoralis major flaps, and 14.3% underwent rectus abdominis flaps for closure. In 17.1% of patients, closure was done by a combination of rectus abdominis and pectoralis major flaps. Spindler *et al*. reported using myocutaneous latissmus dorsi for closure over the pectoralis major flap.[12] They advocated that latissmus dorsi fills the dead space left in the mediastinum.

QoL-SF36 tool was used to determine the quality of life among the patients before and after the management of sternal wound infection. The SF-36 is a survey instrument to detect changes in function, pain and health status. It asses patients' mental wellbeing physical, and social well-being through a specifically designed questionnaire. The scores recorded before the debridement were low. Marked improvement in the scores was noted after the management of wounds.

The 30-day mortality after surgery in the previous studies,[12,21] was 20% compared with a larger study group and had higher strata of risk factors. Our 30-day mortality was 2.8%. Dubert *et al*.[9] report 17% mortality in their patient group. High mortality is associated with multiple risk factors.

Sternal wound infections pose a health risk and profoundly affect a patient's mental well-being. Therefore, treating these as early as possible and aggressively is paramount due to their dire morbidity and mortality. We concluded our study with a management plan and outcomes for different types of sternal wounds. We advocated a multi-stage management approach, including debridement in conjunction with NPWT, appropriate antibiotic therapy, and reconstruction according to the size of the defect. Our preferred method for reconstruction was eliminating the dead space using pedicled muscle flaps. This not only improved the wounding quality but had a proportional impact on the quality of life of these patients.

## ACKNOWLEDGEMENT

We thank Allah Almighty for showing us the determination and strength to compose this manuscript. Deepest gratitude to all the teachers and colleagues for helping out with their kind words of encouragement and helpful criticism. We are highly indebted to our family and friends who supported us through this journey.

## CONCLUSION

A positive prognosis can be obtained by this treatment protocol.

**Conflict of Interest:** None

**Author's Contribution**

Following authors have made substantial contributions to the manuscript as under:

FS & SR: Concept, data acquisition, critical review, approval of the final version to be published.

MR & HR: Study design, drafting the manuscript, data interpretation, data analysis, critical review, approval of the final version to be published.

MG & SK: Critical review, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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