



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكرو فيلم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



MONA MAGHRABY



Sternal Closure Using Steel Wires by Figure of Eight versus Interrupted Simple Sutures in Adult Cardiac Surgeries

Thesis

*Submitted for Partial Fulfilment of Master Degree in
Cardiothoracic Surgery*

By

Mahmoud Mohamed Abu-Emma Mohamed

(M.B., B.Ch.)

Supervised by

Prof. Dr. Walaa Ahmed Saber Abd El Hameed

*Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University*

Prof. Dr. Hossam El Din Ashour Abd El Hameed

*Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University*

Prof. Dr. Faisal Amr Mourad

*Associate Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University*

Faculty of Medicine - Ain Shams University

2021

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سُبْحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**, the Most Kind and Most Merciful.*

*I am deeply grateful to **Prof. Dr. Walaa Ahmed Saber Abd El Hameed**, professor of Cardio-thoracic Surgery – Faculty of medicine, Ain Shams University, who gave me his experience, advice and guidance during performing this work.*

*I would like to thank **Prof. Dr. Hossam El Din Ashour Abd El Hameed**, Professor of Cardio-thoracic Surgery - Faculty of medicine, Ain Shams University, for his marked effort while performing the practical part of this work, and for continuous professional advice and support during writing this work.*

*I also thank **Prof. Dr. Faisal Amr Mourad**, Associate professor of Cardio-thoracic Surgery- Faculty of medicine, Ain Shams University, for his tremendous efforts in performing this work, and for his support and guidance.*

I would like also to thank all the staff members of the Cardiothoracic Surgery department Ain Shams University, and all my colleagues.

Mahmoud Mohamed Abu-Emma

List of Contents

Title	Page No.
List of Tables	i
List of Figures	iii
List of Abbreviations.....	v
Introduction.....	1
Aim of the Work.....	4
Review of Literature	
A- Anatomy of the Sternum	5
B- Impact of Sternal Instability on Mediastinitis.....	13
C- Pathology of Sternal Wound Infection and Mediastinitis	27
D- Microbial Etiology of Mediastinitis	32
E- Diagnosis of Mediastinitis.....	37
F- Clinical Presentation.....	40
G- Management of Mediastinitis	51
H- Techniques for wire Closure	58
Patients and Methods	71
Results	79
Discussion	101
Summary	118
Conclusion	122
Recommendations.....	123
References	124
Arabic Summary	1

List of Tables

Table No.	Title	Page No.
Table (1):	Classification scheme of mediastinitis introduced by El Oakley and Wright based on the time at which the patient presents with mediastinitis relative to the initial surgical procedure	29
Table (2):	Age distribution in both groups:	79
Table (3):	Relation between sex and stability of the sternum:	81
Table (4):	Relation between EF and stability of the sternum:	83
Table (5):	BMI distribution in both groups:	83
Table (6):	Relation between DM and instability of sternum:	84
Table (7):	Intra-operative variables between groups:	85
Table (8):	Duration of mechanical ventilation in groups:	87
Table (9):	Relation between duration of mechanical ventilation and stability of sternum:	88
Table (10):	Length of ICU stay in both groups:	89
Table (11):	Relation between length of ICU stay and stability of sternum:	90
Table (12):	Comparison between 2 groups regarding early serous discharge:	92
Table (13):	Comparison between 2 groups regarding positive culture:	93
Table (14):	Relation between technique and stability of the sternum:	94
Table (15):	Relation between CXR and instability of sternum:	95

List of Tables (Cont...)

Table No.	Title	Page No.
Table (16):	Relation between CT and instability of sternum: .	96
Table (17):	Relation between technique and superficial wound infection (SWI):.....	97
Table (18):	Duration of post-operative hospital stay in both groups:	98
Table (19):	Relation between stability and post-operative hospital stay:	99
Table (20):	Variables of sternum instability:	100

List of Figures

Fig. No.	Title	Page No.
Figure (1):	Anatomy of the sternum	5
Figure (2):	Anatomic study of the collateral blood supply of the sternum	8
Figure (3):	Morphologic variants of the sternal blood supply	12
Figure (4):	Bimanual alternating chest compressions are used for diagnosing sternal stability.....	42
Figure (5):	Chest x-ray lateral view showing disrupted stainless-steel wire	46
Figure (6):	Axial CT images of Sternal Dehiscence.....	48
Figure (7):	3D construction sternum bone	49
Figure (8):	Schematic drawing illustrating the principles sternotomy wiring techniques used in the study.....	60
Figure (9):	Lasnoff device	66
Figure (10):	Visual comparison of wire (a), (c) and plate (b), (d) sternal fixation in the unloaded state (a), (b), at 180N (c) and 360N (d) later load.....	68
Figure (11):	Surgical technique for 1ry closure by plates	69
Figure (12):	Figure of 8 wire technique	73
Figure (13):	Simple wire technique	74
Figure (14):	Age distribution in groups.....	80
Figure (15):	Sex distribution in both groups	81
Figure (16):	EF in both groups	82
Figure (17):	Intra-operative data.....	86

List of Figures (cont...)

Fig. No.	Title	Page No.
Figure (18):	Duration of mechanical ventilation in both groups	87
Figure (19):	Relation between duration of mechanical ventilation and stability of sternum.	88
Figure (20):	Length of ICU stay in both groups	90
Figure (21):	Relation between length of ICU stay and stability of sternum	91
Figure (22):	Comparison between 2 groups regarding early serous discharge	92
Figure (23):	Comparison between 2 groups regarding culture positivity.....	93
Figure (24):	Relation between technique and stability of the sternum.....	94
Figure (25):	Relation between CXR, CT and instability of sternum.....	96
Figure (26):	Duration of post-operative hospital stay in both groups.....	98
Figure (27):	Relation between stability and post-operative hospital stay.....	99

List of Abbreviations

Abb.	Full term
<i>BMI</i>	Body mass index
<i>CPB</i>	Cardio-pulmonary bypass
<i>CXR</i>	Chest X-ray
<i>COPD</i>	Chronic kidney Disease
<i>CKD</i>	Chronic Kidney Disease.
<i>CoNS</i>	Coagulase Negative Staphylococcus
<i>C.T</i>	Computed Tomography
<i>CABG</i>	Coronary artery bypass graft
<i>CCT</i>	Cross Clamp Time
<i>DSWI</i>	Deep Sternal Wound Infection
<i>DM</i>	Diabetes Mellites
<i>ECHO</i>	Echocardiography
<i>EF</i>	Ejection Fraction
<i>ECG</i>	Electrocardiogram
<i>HF</i>	Heart Failure
<i>HBO</i>	Hyperbaric Oxygen Therapy
<i>HTN</i>	Hypertension
<i>ICU</i>	Intensive Care Unit
<i>IMA</i>	Internal Mammary Artery
<i>NYHA</i>	New-York Heart Association
<i>PTFE</i>	Polytetra Fluro-eythelene
<i>SWI</i>	Sternal Wound Infection
<i>S/I</i>	Sternal/Intercostal branch
<i>S/P</i>	Sternal/Perforating branch
<i>SSWI</i>	Superficial Sternal Wound Infection
<i>TLC</i>	Total Leucocytic Count
<i>TEE</i>	Transesophageal Echocardiography
<i>TTE</i>	Transthoracic Echocardiography
<i>VAC</i>	Vacuum-Assisted Closure

INTRODUCTION

Median sternotomy is a commonly performed incision with distinct advantages for exposure of mediastinal and pulmonary hilar structures (*Dürreleman and Massard, 2006*).

Median sternotomy was originally introduced by Milton in 1897 and was performed infrequently for various conditions of the mediastinum until cardiac surgery as a field developed in the 1950s (*Milton, 1897*).

Median sternotomy for cardiac surgery was advocated in 1957 by Julian and colleagues. Since then, it has been the standard approach for many open-heart operations (*Julian et al., 1957*).

Wiring, interlocking, plate-screw, and cementation techniques have been examined for sternotomy closure. All techniques have their advantages and disadvantages. The ideal sternal closure should ensure stability, reduced rate of post-operative complications, and a short hospitalization period, alongside cost-effectiveness (*Alhalawani and Towler, 2013*).

The stainless-steel encircling wire used as either interrupted simple sutures or as figure of eight sutures is the current standard method of median sternotomy closure in cardiothoracic operations (*Goodman et al., 1986*).

It is assumed that little or no significant lung injury is sustained during sternotomy and that post-sternotomy changes in pulmonary functions are related to changes in the mechanics of the thoracic cavity itself (*Güler et al., 2001*).

A well-defined incidence of wound complications is associated with sternotomy, which are costly and potentially lethal in cases of deep sternal wound infection (DSWI) or mediastinitis (*Hollenbeak et al., 2000*).

Not only DSWI is associated with significant perioperative mortality, but historically even successfully treated DSWI is associated with reduced mid and long-term survival compared with matched cardiac surgical patients without this devastating postoperative complication (*Karra et al., 2006*).

Resuming sternal integrity following sternotomy for open heart surgery remains one of the main stays for an expeditious recovery. Sternal split remains today a significant risk factor with an incidence of dehiscence and infection (*Kotnis-Gaska et al., 2018*).

Although sternotomy closure is straight forward, it is not without complications. The reported incidence of sternal dehiscence varies from 20%– 25%. If not recognized early, instability of the bone fragments interferes with healing and can lead to complete sternal breakdown, sternal wound infection,

and mediastinitis, which are major causes of morbidity and mortality after open- heart surgery (*Dell'Amore et al., 2018*).

Various studies have shown mediastinitis rates of 1%–2.5% and mortality rates of 15%–50%. Other risk factors for sternal dehiscence include chronic obstructive pulmonary disease (COPD), redo surgery, renal failure, diabetes mellitus, chronic steroid use, obesity, concurrent infection and immunosuppression. Intraoperative risk factors such as off-midline sternotomy, osteoporosis, prolonged cardiopulmonary bypass, transverse fractures of the sternum, and bilateral internal mammary artery harvest have been identified (*Olbrecht et al., 2006*).