

RESEARCH THESIS

**Types and Locations of ST-Segment Changes and Impact on Mortality of
COVID-19 Patients in Referral Hospitals in East Java**



Author

Aurelia Regina

012011133072

CLASS OF MEDICAL PROGRAMME

FACULTY OF MEDICINE

UNIVERSITAS AIRLANGGA

SURABAYA

2022

RESEARCH THESIS

**Types and Locations of ST-Segment Changes and Impact on Mortality of
COVID-19 Patients in Referral Hospitals in East Java**



Author

Aurelia Regina

012011133072

**CLASS OF MEDICAL PROGRAMME
FACULTY OF MEDICINE
UNIVERSITAS AIRLANGGA
SURABAYA
2022**

**TYPES AND LOCATIONS OF ST-SEGMENT CHANGES AND IMPACT ON
MORTALITY OF COVID-19 PATIENTS IN REFERRAL HOSPITALS IN
EAST JAVA**

Research Paper

This statement is to fulfil the requirement of the research module

Medical Faculty of Universitas Airlangga

Author

Aurelia Regina

012011133072

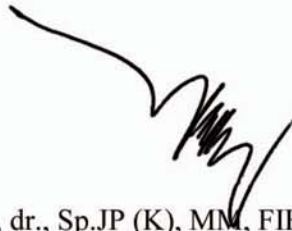
**CLASS OF MEDICAL PROGRAMME
FACULTY OF MEDICINE
UNIVERSITAS AIRLANGGA
SURABAYA
2022**

APPROVAL SHEET

This research paper has been approved for testing

Date: May 30, 2023

First Supervisor



(Prof. Dr. Yudi Her Oktaviono, dr., Sp.JP (K), MM, FIHA, FICA, FASCC, FSCAI)

NIP. 196510081990011001

Second Supervisor



(Prof. Dr. Bambang Purwanto, dr., M.Kes)

NIP. 198008282006041002

Plh Coordinator of Medicine Study Program



(Sakina, dr., M.Si)

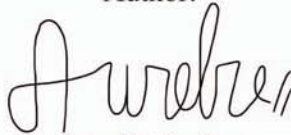
NIP. 1984042920091220003

EXAMINER DECISION FORM

TYPES AND LOCATIONS OF ST-SEGMENT CHANGES AND IMPACT ON
MORTALITY OF COVID-19 PATIENTS IN REFERRAL HOSPITALS IN
EAST JAVA

THESIS

Author:



Aurelia Regina

NIM 012011133072

Approved and accepted after being assessed by the Examiner Team of the Medical
Program, Faculty of Medicine, Universitas Airlangga

Surabaya, June 12, 2023

Approved by,
Chief Examiner



Dr. Johanes Nugroho Eko Putranto, dr., Sp.JP (K)

NIP. 196801102016016101

First Supervisor



Prof. Dr. Yudi Her Oktaviono, dr., Sp.JP
(K), MM, FIHA, FICA, FASCC, FSCAI

NIP. 196510081990011001

Second Supervisor



Prof. Dr. Bambang Purwanto, dr.,

M.Kes

NIP. 198008282006041002

STATEMENT OF ORIGINALITY

The undersigned, I

Name : Aurelia Regina
NIM : 012011133072
Study Program : Medical Program
Faculty : Medicine
Stage : Bachelor

Stating that I have not committed plagiarism in the writing of my thesis with the title of,

**TYPES AND LOCATIONS OF ST-SEGMENT CHANGES AND IMPACT ON
MORTALITY OF COVID-19 PATIENTS IN REFERRAL HOSPITALS IN
EAST JAVA**

If one day it is proven to have committed plagiarism, then I will receive the sanctions that have been set.

Thus, this statement letter I made in real terms.

Surabaya, June 12, 2023

A 10,000 Rupiah Indonesian postage stamp with a signature over it. The stamp features the Garuda Pancasila emblem and the text '10000', 'METERA', and 'TEMPEL'. The serial number '293AKX798065837' is visible at the bottom.

Aurelia Regina

NIM 012011133072

ACKNOWLEDGEMENT

Praise be to God Almighty for all his grace and guidance so that the author is able to complete the research paper titled, “Types and Locations of ST-Segment Changes and Impact on Mortality of COVID-19 Patients in Referral Hospitals in East Java”. This paper wouldn’t be able to be completed without the supervision, advices, help, and support from various parties. Therefore, the author would like to express gratitude to all the following people generously.

1. Prof. Dr. Muhammad Nasih S. E., M. T., Ak., CMA, as the Chancellor of Universitas Airlangga, who allowed the author to study and conduct the research at Universitas Airlangga.
2. Prof. Dr. Budi Santoso, dr., Sp. OG (K) as the Dean of Faculty of Medicine, Universitas Airlangga, who allowed the author to pursue education and complete the author’s research paper at Universitas Airlangga.
3. Dr. Purwo Sri Rejeki, dr., M.Kes as the Program Coordinator of the Faculty of Medicine, Universitas Airlangga who has facilitated the process in the completion of this research paper.
4. Dr. Pudji Lestari, dr., M.Kes as the Head Coordinator of the Research Module who has guided, facilitated, and permitted the author to complete this research paper.
5. Prof. Dr. Yudi Her Oktaviono, dr., Sp.JP (K), MM, FIHA, FICA, FASCC, FSCAI as the first supervisor who has given continuous guidance, mentorship, and support, which allowed the author to complete this research paper.

6. Prof. Dr. Bambang Purwanto, dr., M.Kes as the second supervisor who has mentored and given advices that has been very helpful for the completion of this research paper.
7. Makhyan Jibril Al-Farabi, dr., M.Sc., M.Biomed, Yusuf Azmi, dr, and Ariikah Dyah Lamara, dr, as the author's seniors who have given guidance, advices, and mentored the completion of this research paper.
8. Yoppie Prim Avidar, dr., M.Kes., Sp.An as the guardian lecturer who has given guidance and encouragement during the completion of this research paper.
9. The author's family who has given their time, encouragement, and endless support which has allowed the author to complete this research paper.
10. The author's colleagues and friends that has given the author their full support and encouragement throughout the completion process of this research paper.

Surabaya, June 12, 2023



Aurelia Regina

ABSTRACT**TYPES AND LOCATIONS OF ST-SEGMENT CHANGES AND IMPACT ON MORTALITY OF COVID-19 PATIENTS IN REFERRAL HOSPITALS IN EAST JAVA**

Myocardial injury is one of the most common complications in COVID-19 patients, indicated by ST-segment changes in ECG findings. ST-segment changes were shown to have higher association with severe prognosis and higher mortality rate. With significant association between ST-segment changes and possible prognostic factors in COVID-19 patients, a comprehensive approach is needed to enhance the survival rate through a better understanding of the aforementioned association. We identified 562 confirmed COVID-19 data in East Java between March 2020 to April 2021. Electrocardiograph (ECG) findings of each patient were examined to find which type and location of ST-segment changes were most significantly correlated to mortality. After multivariable adjustment and stepwise elimination, six of 22 variables: gender ($p = 0.02$), age ($p = <0.01$), anterior ST elevation ($p = <0.01$), anteroseptal ST elevation ($p = <0.01$), upsloping ST depression ($p = <0.01$), and coronary heart disease ($p = 0.04$) were found significant towards mortality. We concluded that anterior and anteroseptal ST elevation and upsloping ST depression have worse prognosis thus higher mortality rate in COVID-19 patients compared to other types and locations of ST changes. Further studies are required to enhance the improvement of care coordination.

Keywords: COVID-19, ECG, ST-segment changes, Mortality

TABLE OF CONTENTS

INSIDE COVER.....	ii
APPROVAL SHEET.....	iv
EXAMINER DECISION FORM	v
STATEMENT OF ORIGINALITY.....	vi
ACKNOWLEDGEMENT	vii
TABLE OF CONTENTS.....	x
LIST OF TABLES.....	xiv
LIST OF FIGURES	xv
CHAPTER 1 INTRODUCTION	1
1.1. Background.....	1
1.2. Formulation of the Problem.....	3
1.3. Aim of Research	3
1.3.1. General aim.....	3
1.3.2. Specific aim	3
1.4. Benefit of Research.....	4
1.4.1. Theoretical benefit	4
1.4.2. Practical benefit	4
CHAPTER 2 LITERATURE REVIEW	5
2.1. COVID-19.....	5
2.1.1. Definition of COVID-19.....	5
2.1.2. Pathophysiology of COVID-19	5
2.1.3. Clinical manifestations of COVID-19	6
2.1.4. Possible complications of COVID-19	8
2.2. Electrocardiogram.....	14
2.2.1. Normal electrocardiogram findings	14
2.2.2. Definition of ST segment.....	18

2.2.3. Types of ST changes.....	19
2.2.4. Location of ST changes	21
2.2.5. Electrocardiogram abnormalities and pathophysiology in COVID-19 patients	22
2.3. Mortality	25
2.3.1. Definition of mortality	25
2.3.2. Mortality in COVID-19 patients related to cardiovascular complications	25
CHAPTER 3 RESEARCH CONCEPTUAL FRAMEWORK	26
3.1. Research Conceptual Framework	26
3.2. Hypothesis of Research.....	27
CHAPTER 4 RESEARCH METHODOLOGY	28
4.1. Research Method and Design	28
4.2. Population, Sample Size, and Sample Gathering Technique.....	28
4.2.1. Population	28
4.2.2. Sample size	28
4.2.3. Inclusion criteria	28
4.2.4. Exclusion criteria	29
4.2.5. Sample gathering technique	29
4.3. Research Variables and Operational Definition	29
4.3.1. Dependent variables.....	29
4.3.2. Independent variables	29
4.3.3. Operational definition	30
4.4. Research Material	34
4.5. Research Instrument.....	34
4.6. Location and Time of Research	34
4.6.1. Location of research.....	34
4.6.2. Time of research	34
4.7. Data Gathering Procedure.....	35
4.8. Research Operational Framework.....	35

4.9.	Data Processing and Analysis Procedure.....	35
4.9.1.	Data processing	35
4.9.2.	Data analysis	36
4.10.	Ethical Aspect of Research	36
4.10.1.	Anonymity aspect	36
4.10.2.	Beneficiary aspect	36
4.10.3.	Confidentiality Aspect	36
CHAPTER 5 RESEARCH RESULTS AND ANALYSIS.....		37
5.1.	Subject Characteristics.....	37
5.1.1.	Demographic of Subjects.....	37
5.1.2.	Comorbid Conditions of Subjects.....	38
5.2.	ST-Segment Changes in Subjects	39
5.3.	Correlation between Variables towards Mortality.....	41
5.3.1.	Correlation between Demographic Characteristics of Subjects towards Mortality	44
5.3.2.	Correlation between the Comorbidities of Subjects towards Mortality..	45
5.3.3.	Correlation between Types and Locations of ST-Segment Changes towards Mortality.....	45
CHAPTER 6 DISCUSSION.....		46
6.1.	General Characteristics	46
6.1.1.	Demographic.....	46
6.1.2.	Comorbid Conditions.....	49
6.2.	Electrocardiographic Characteristics of Subjects	51
6.2.1.	ST-Elevation Findings	51
6.2.2.	ST-Depression Findings.....	54
6.3.	Correlation between ST-Segment Changes and Mortality in Subjects.....	55
6.4.	Risk Factors and Prevention of ST-Segment Abnormalities in COVID-19 Patients.....	57
6.5.	Management in COVID-19 Patients with ST-Segment Abnormalities.....	58
CHAPTER 7 CONCLUSION AND SUGGESTIONS.....		61

7.1.	Conclusion	61
7.2.	Suggestions	61
REFERENCES		63

LIST OF TABLES

Table 2.1 ECG Patterns of STEMI Locations and Threshold Values	21
Table 2.2 Location of Ischemia or Infarction in STEMI	22
Table 4.1 Study Variables and Operational Definition.....	34
Table 5.1 Demographic of Subjects.....	37
Table 5.2 Clinical Characteristics and Univariate Analysis	43
Table 5.3 Logistic Regression.....	43

LIST OF FIGURES

Figure 2.1 Entrance Mechanism of SARS-CoV-2.....	10
Figure 2.2 Renin-Angiotensin Pathway	11
Figure 2.3 Normal ECG Findings.....	16
Figure 2.4 Inferior STEMI with Focal ST Segment Elevation in Leads II, III, and aVF, ST Segment Depression in Lead aVL.....	24
Figure 3.1 Research Conceptual Framework.....	26
Figure 4.1 Types of ST Depression	31
Figure 4.2 Research Operational Framework	35
Figure 5.1 Graphic of Age Distribution.....	38
Figure 5.2 Comorbid Condition of Subjects	38
Figure 5.3 Types of ST Elevation Findings in Subjects	39
Figure 5.4 Types of ST Depression Findings in Subjects.....	40
Figure 5.5 Location of ST Depression Findings in Subjects	41