

ANALYSIS OF BLOOD FLOW INTO THE MAIN ARTERY VIA MITRAL VALVE

MOHD AZRUL HISHAM BIN HJ. MOHD ADIB

UNIVERSITI TEKNOLOGI MALAYSIA

**ANALYSIS OF BLOOD FLOW INTO THE MAIN ARTERY VIA
MITRAL VALVE**

MOHD AZRUL HISHAM BIN HJ. MOHD ADIB

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DEDICATION

Specially dedicated to my beloved and important person in my life :

My Wife

Nur Hazreen Binti Hasni

My Father

Hj. Mohd Adib Bin Hj. Mat Yacob

My Mother

Hjh. Zawiyah Binti Hj. Md. Ariff

My Brother

Mohd Aidinniza Bin Hj. Mohd Adib

Mohd Sanusi Bin Hj. Abdul Fatah

My Sister

Noor Azliza Binti Hj. Mohd Adib

Noriza Binti Mohd Noor

and others for all their love, support and understanding.

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ABSTRACT

Mitral Valve failure causes death if it is not corrected surgically. Such surgical repair can be improved by understanding mitral biomechanics. A two-dimensional FSI model of the Mitral Valve was generated using the ADINA simulation. A simple approximation of the heart geometry was used, the valve dimensions were based on measurements made. The viscosity of blood and the elastic properties of the valve leaflets were obtained from the literature. In this study, numerical modeling was used to determine the correlation between the degeneration of the Mitral Valves rigidity and backflow problem based on several critical parameters of blood. Two stages of Mitral Valve simulation, systolic and diastolic stage and also with ventricle and without ventricle are investigated. Finally, conclude that rigidity of Mitral Valve antipodes to the backflow and Degeneration causing backflow will reach a constant value and agreed with results from experimental.

ABSTRAK

Injap Mitral yang gagal akan menyebabkan kematian jika tidak menjalankan pembedahan dengan cara yang betul. Seperti pembedahan pemuliahan boleh diperbaiki dengan memahami Mitral Biomekanik. Model injap Mitral dua dimensi telah dihasil menggunakan simulasi ADINA. Anggaran untuk geometri jantung dan injap adalah berdasarkan pengukuran. Kepekatan darah dan kekenyalan injap diperolehi melalui bahan bacaan. Dalam kajian ini, model simulasi telah digunakan untuk menentukan hubungan diantara kekuatan injap Mitral dengan masalah aliran balik darah berdasarkan kepada beberapa parameter kritikal pada darah. Dua keadaan injap Mitral iaitu ketika mengembang dan mengecut dan juga model dengan ventricle dan tanpa ventricle telah dikaji. Akhirnya, dapat disimpulkan bahawa keputusan kekuatan injap Mitral adalah berlawanan dengan aliran balik darah dan pengurangan kekuatan injap Mitral menyebabkan aliran balik darah akan mencapai nilai tetap dan sangat bersesuaian dengan keputusan daripada ujikaji.

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LIST OF SYMBOLS**SYMBOLS**

A	Area
E	Young's Modulus
Re	Reynolds Number
Q	Volume flow rate
T	Temperature
t	Time
U	Mean Velocity
ρ	Density
f	Friction Factor
μ	Viscosity
Ω	Voracity Vector
P	Pressure
η	Vortices Component normal to Streamline
ξ	Vortices Component tangent to Streamline\
ν	Kinematic Viscosity

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CHAPTER 1

INTRODUCTION

1.1 Background

In heart anatomy, flow into the arteries depends on the condition of the valves located inside the heart. The valves in the heart maintain the unidirectional flow of blood in the heart into the arteries by opening and closing, depending on the difference in pressure on each side. The valves are mechanically similar to reed valves. Basically there are four types of valves in the heart. The first one is two Atria Ventricular (AV) valves between the atrium and the ventricles. These are small Tricuspid Valve (TV) and Mitral Valve (MV) that prevent backflow from the ventricles into the atrium during systole. Second one is two Semi Lunar (SL) valves in the arteries leaving the heart. These Pulmonary Valve (PV) and Aortic Valve (AV) are located at the base of both the pulmonary artery and the two arteries taking blood out of the ventricles. These valves permit blood to be forced into the arteries but prevent backflow of blood from the atrium into the ventricles. During each heartbeat both of the atrium contract first to pump blood into the ventricles. Then both ventricles contract to pump blood out of the heart into the arteries. There are one way valves between the atrium and ventricles and also between the ventricles and the large arteries that take blood from the heart.

This project will focus only on Mitral Valve (MV). We will investigate the correlation between the degeneration of Mitral Valve rigidity and percentage of backflow. When the rigidity of the Mitral Valves degenerates, the one-way flow is very difficult to be maintained. Thus some backflow will occur. For this investigation, samples of 10 Asian people were selected to study and will validate with simulation using ADINA-FSI. The degeneration of their mitral valves and backflow is the main focus of investigation.

1.2 Statement of Problem

Mitral Valve is very important because it only valve that controls the blood through pulmonary vein from lung into the arteries and prevents backflow from the left atrium to the left ventricle. But today in medical practices they still don't have the specific method to know the percentage of backflow from their patient and just assume or base on their experience before.

Biomedical Journal entitles "*Mitral Valve Repair with the Colvin-Galloway Future Band*". Regenerate the value of rigidity for support the repair techniques of the mitral valve and not replacement with artificial prostheses and to repair the mitral valve is considered to know the value of Mitral Valve rigidity [3].

1.3 Objective

The intention of this project is to determine the correlation between the degeneration of the Mitral Valves rigidity and backflow problem, based on critical parameter of blood via numerical modeling.

1.4 Scope

The scopes of this project had been established as :

- (a). Actual diseased data mitral valves will be used.
- (b). Correlation will be determined using numerical modeling.
- (c). Model will be limited to two-dimensional (2D).