

UNIVERSITI TEKNOLOGI MARA

**ANALYSIS ON THE EFFECTS OF
PULSATION INDUCED FLOW IN
MECHANICAL CIRCULATORY
SUPPORT SYSTEM**

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ABSTRACT

Impedance pump is a valve less pump emerging from the blood circulatory system of human that function without blade or propeller to transfer fluid. The impedance pump offers good characteristics as valve less pump to overcome clinical issues such as blood cell damaged by the rotational blades used in mechanical circulatory support system. Thus, this research is to analyse the flow rate performance in valve less impedance pumps which generates a unidirectional flow of fluid around closed loop of soft viscoelastic tubing inspired by Liebau phenomenon. An experimental setup was prepared that consist of rigid and elastic tube with outer compression mechanism to generate wave flow at various frequencies. Parameters such as frequency, elastic tube diameter, pinching position and fluid viscosity were analysed to describe the influence on the flow rate throughout the experiment. Then, double compression on elastic tube section was performed to compare with single compression experiment. The difference on the flow rate was discussed further. To provide uniform and sequence compression, a DC electric motor was utilized as to convert rotational to vertical pinching. A long elastic balloon was used for elastic section with various diameter (32 mm, 16 mm, and 10 mm). Experiment had been tested on the frequency range of 1.8 Hz to 7.3 Hz. Different types of fluids were tested for viscosity variation. The viscosities were 8.9×10^{-4} kg/m.s for water, 2.68×10^{-3} kg/m.s for 35% glycerine-water, and 3.42×10^{-3} kg/m.s for 45% glycerine-water. The viscosity difference does not affect much of the flow rate, however high viscosity of fluid showed some reduction on the flow. Larger diameter of elastic tube caused volumetric difference in system and stable flow rate was achieved in larger tube diameter. For double pinching, there is an aggressive increment of flow in the system which revealed higher flow rate occurred at low frequency. The pinching position that is far from centre of the system, experienced slightly higher flow rate compared to the position that is near to the centre. From the result, it can be concluded that impedance pump can be used as a valve less pump to transport sensitive fluid without damage, however a lot of improvement can be done for future study.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Heart disease or coronary heart disease can be mentioned as number one, world top killer where contribute to a higher mortality each year plus with high cost of treatment and medication [1]. According to Malaysia's mortality statistic profile, death cause due to coronary heart disease was forty-two percent which almost quarter of the country population and that become the first cause of death in Malaysia as shown in Figure 1.1.

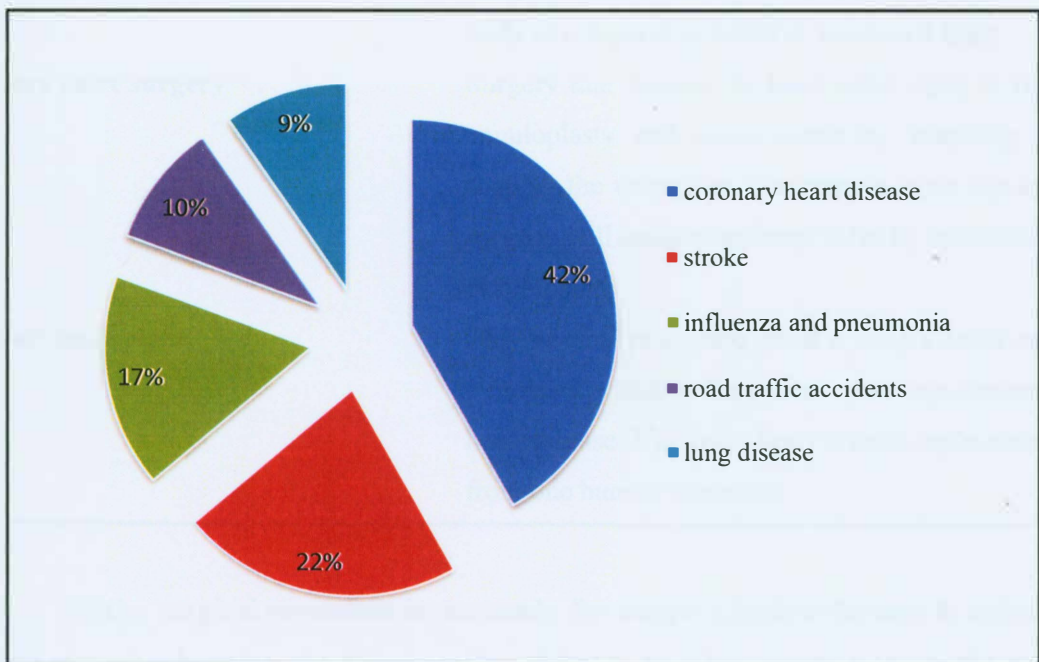


Figure 1.1 Among Tops Causes of Death in Malaysia [2]

Other than typical medical case there are many factors that can lead to coronary heart disease that influence by individual lifestyle such as smoking, physical inactivity, stress and diet quality can expose a person to a high risk patient [1, 3, 4]. A small number of hereditary disease that refer to family health history and genetic also contribute to heart disease in adulthood [3, 4]. Aging tend to incur become high potentials of coronary heart disease victims as the aging process change the ability of heart to maintain sufficient cardiac output due to elasticity reduction of blood vessels [5]. It can affect