

Chapter 23

Ventricular Assist Device and Its Necessity for Elderly Population

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ABSTRACT

Ventricular Assist Device (VAD) is considered to be the part and parcel to those people who have cardiac complications or heart failure especially the aged patients. Although VADs have contributed remarkably for the past few years, yet these devices possess some limitations, mainly the driveline infections. Due to these conditions, researchers are aiming to improve its functionality as well as other necessary/additional features and hence there is a need to develop the 'next generation' wireless VAD system which could be very effective to reduce the risk of this infection. In this chapter, the necessity of the VAD and different kinds of VADs are presented and discussed. These features incorporate hemodynamic states after receiving the VADs, selection of biomaterials for the VAD system, VAD pumps and its classifications. Finally, a brief discussion is also provided based on the recent advancement of the VAD system and the scope for the future research.

INTRODUCTION

Ventricular Assist Devices (VADs) are considered as lifesaving systems. It is well known that a lack of usual blood flow can develop different heart diseases. These diseases indubitably influence the natural operational activities of the heart and a prime factor for causing death. To be precise, left ventricle (LV) of the cardiac system is the most important chamber which helps in the circulation of blood to the entire body. On the other hand, when usual functionalities of left ventricle are hindered because of aging or weakened cardiac muscles then it is vulnerable to various cardiac diseases primary treatments for these

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diseases are utilization of ventricular assist devices (VADs), which are basically implanted/set-up inside the patients. To date, researches have produced substantial advancements in development of the VADs including sizes and shapes but still various limitations exist which cause various cardiovascular diseases (CVD) and/or infections for the VAD-patients (Arefin, 2015). The cardiovascular system comprises of a pumping-organ, (the heart) blood and blood-vessels which act as a branching network throughout the whole body. The heart is a conically formed pumping organ which serves the total requirement of blood needed by the whole body and it is constructed from the muscle tissues (Bronzino, 2006). Cardiac diseases itself are one of the main factors for human morbidity. Precisely, a significant knowledge is necessary based on the general and diseased hearts to attain suitable results for the general and clinical cardiac analysis (Vadakkumpadan et al., 2010). Utilization of the VADs substantially minimize mortality rate especially for those people who are on the heart transplant waiting record (Garbade, Bittner, Barten, & Mohr, 2011; Moazami, Sun, & Feldman, 2011). Also, people with CVD, weakened heart muscle and/ or elderly people are in need of VAD systems. Although there are various cardiovascular diseases named-valvular heart diseases (Bender, 1992; Morsi, 2011) and coronary artery diseases/coronary heart diseases (Arefin, 2015; Başçiftçi & Incekara, 2011; Channel, 2014), but special attention has been given towards the heart failure diseases and its treatments, especially which are highly suitable for the elderly people.

Cardiovascular Disease (CVD)

In general, Cardiovascular Diseases (CVDs) refer to every possible disorder of the cardiac system (the heart and blood vessel), which is not functioning properly. This disease is responsible for causing impairment to the blood circulation tracks, such as the veins and arteries where the blood is flowing to and from the heart. In statistics of NHMRC (National Health and Medical Research Council) it is mentioned that total expenditure for research of CVD was \$439.5 million in year of 2000 to 2007 in Australia (Arefin, 2015; Council, 2014).

Moreover, it is also stated that CVD is the main cause of death in Australia including approximately 45,600 people died in year of 2011. Specifically due to this disease, in every 720 seconds one person dies in Australia (Council, 2014). Subsequently, in the under developed countries 80% of people was found to be affected and ultimately died because of this disease and the percentage is still elevating at an alarming rate. In contrast, in developed countries during years from 1960 to 2010 CVD-deaths for the aging population have been found to decrease by 50%. Moreover, in the most cases CVD related disorders are often checked at advanced stages and hence this disease is perilous. Consequently, because of this specific reason, apposite drug therapies need to be prescribed at the very beginning of the condition so that it can help blocking the advancement of the disease (Emeto, Moxon, Rush, Woodward, & Golledge, 2011). Furthermore, CVD also acts as the main source of mortality for the people with Hemodialysis (HD). It occurs because of blood pressure, unstable lipid metabolism, oxidative stress, micro inflammation, hyperhomocysteinemia, anaemia, secondary hyperparathyroidism and vascular shunt flow (Petrovi, Obrenovi, Trbojevi-Stankovi, Majki-Singh, & Stojimirovi, 2011). Additionally, when high blood pressure is responsible for the causing the heart disease, it is characterized as the *hypertensive heart disease* (Badii, 2012). Largely, CVDs affect the cardiac system over extended time frame and this often develop much higher risk of heart attacks and strokes. Also, the blocked blood vessel is unable to circulate the blood into the cardiac system and/or in the brain (Online, 2013). Subsequently, various factors can influence the enhancement of the cardiac system, which is termed as the congenital cardiac disease. Moreover, different infections can affect the general functionalities of the heart valve, which

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