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Minimally Invasive, Fully Implantable Left Ventricular Assist Device: Concept, Design, and Early Prototyping

F. A. Pleșoianu[1], C.E. Pleșoianu[2,3], A. Țăruș[4] and G. Tinică[2,4]
[1] *"Grigore T Popa" University of Medicine and Pharmacy, Faculty of Biomedical Engineering, Iași, Romania*
[2] *"Grigore T Popa" University of Medicine and Pharmacy, Faculty of Medicine, Iași, Romania*
[3] *Institute of Cardiovascular Diseases "Prof. Dr. George I.M. Georgescu", Department of Clinical Cardiology, Iași, Romania*
[4] *Institute of Cardiovascular Diseases "Prof. Dr. George I.M. Georgescu", Department of Cardiovascular Surgery, Iași, Romania*

Advanced heart failure is an increasing prevalent pathology with important socio-economic impact, justifying the tremendous worldwide effort to develop and improve valuable alternatives to heart transplantation. Mechanically circulatory support is now into the spotlight with evidence showing improved survival and quality of life in an extremely fragile population. However, severe side effects such as thrombosis, bleeding or infection still limit its clinical use. Against this background, our multidisciplinary team (bioengineer, cardiologist, and cardiovascular surgeons) designed an innovative left ventricular assist device suitable for patients with advanced heart failure as bridge to cardiac transplant, temporary support when myocardial recovery is possible or as destination therapy for patient not eligible for heart transplantation. The device consists of an electronic circuit, internal battery, wireless energy receiving antenna and an axial flow pump that mobilizes blood from the heart to the arterial system, unloading the failing heart. The device is designed to provide multiple features: flow of blood with minimal turbulence and without areas of mechanical stress, energy autonomy and wireless power supply, possibility of fully implantation by minimally invasive techniques, and biocompatible amorphous tetrahedral carbon coating that may provide the premises to reduce the negative effects of known devices.