Non-invasive procedure to calculate Fractional Flow Reserve in patients with coronary artery disease and its comparison with the gold standard

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Cardiovascular diseases are the leading cause of death in developing countries. The most common cause of cardiovascular disease is coronary artery disease. These are formed by the deposition of plaque on the walls of the endothelium, which produce a reduction in the blood supply and thus oxygen, increasing the risk of ischemia [1]. Fractional flow reserve (FFR) is a physiological measure that expresses the severity of a lesion caused by stenosis. It is an invasive procedure in which a pressure guidewire is introduced inside the arteries under hyperemic conditions. Numerous studies have been carried out comparing FFR, the gold standard procedure, with other procedures such as PCI (percutaneous coronary intervention). These conclude that the use of the FFR technique reduces the mortality rate and myocardial infarction [2].

Thanks to advances in technology, it is now possible to perform an FFR using CFD (computational fluid dynamics)[3]. This tool makes it feasible to simulate, in a virtual environment, the dynamics of the blood inside the heart. To do this, CT (computed Tomographic) cardiac images of individual patients and accurate boundary conditions, that simulate the normal functioning of the heart, are required [4]. This technique has been validated in studies comparing it against the invasive procedure (FFR) [5].

The main advantage of performing a FFR using CFD technology, is that it is a non-invasive test. In addition, it allows multiple variables to be measured, such as Wall Shear Stress (WSS). In particular, this variable is related to the appearance and growth of atherosclerosis plaque. Studies have shown how measuring the levels of WSS can help prevent the detachment of atherosclerosis plaques[6, 7].

In conclusion, the use of CFD techniques applied to the heart provides multiple advantages, including the elimination of the risks associated with invasive procedures, as well as broadening the spectrum of parameters that can be measured.

A comparison of the FFR calculation procedure between a coronary CFD model and its invasive counterparty will be presented.

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