Visita Laboratorio – Esercitazione corso Fluidodinamica per la Bioingegneria – 24/25 Maggio 2016

Test Valvola Aortica Meccanica (25 mm, On-X Valve, Bileaflet Mechanical Aortic Valve, *On-X Life Technologies, Inc.*)

Test Valvola Aortica Biologica (23 mm, Epic™ Supra Aortica Valve, *St. Jude Medical, Inc.*)

**Valvola Meccanica: 25 mm, On-X Valve**

**Valvola Biologica: 23 mm, Epic™ SupraValve**

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### Geometrical description:

The HER PD consists of 8 main components. The linear electromagnetic Pump feeds the Ventricle Chamber, which is regulated by a mitral valve at the inlet, whilst a flow meter is located at the outlet. The Aortic Chamber is located downstream of the flow meter and it includes the valve housing, two pressure transducers (upstream and downstream of the aortic valve, respectively) and a pipe mimicking the aortic root and arch. The Aortic Compliance chamber, (the fluid heater) and the Peripheral Resistance complete the system before the flow gets into the Atrial Tank. The electromagnetic linear pump is a Parker PRA3810S (*Parker Hannifin Corp, Cleveland, OH, USA*), aortic and ventricular pressure are measured using PCB Piezotronics series 1500 (*PCB Group, Depew, NY, USA*), and the flow measure is monitored with an ultrasonic flow-meter probe ME-PXN-Series (*Transonic Systems Inc., Ithaca NY, USA*).

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### Averaged data over 10 consecutive cycles were used to extract the following quantities:

- the *TransAortic Pressure Drop* ($\Delta P$) defined as the average of the difference between ventricular and aortic pressure during the ejection phase;
- the *TransAortic Maximum Pressure drop* ($\Delta P_{\text{max}}$);
- the *Aortic Mean Pressure* ($P_{\text{AO}}^\text{mean}$) defined as the average of Aortic Pressure ($p_{\text{AO}}$) during the cycle;
- the *Aortic Minimum Pressure* ($P_{\text{AO}}_{\text{min}}$);
- the *Aortic Maximum Pressure* ($P_{\text{AO}}_{\text{max}}$);
- the *Ventricular Maximum Pressure* ($P_{\text{LV}}_{\text{max}}$);
- the *Pumped Stroke Volume* ($SV_{\text{pump}}$), i.e. the maximum displacement of the piston multiplied by its cross-sectional area;
- the *Stroke Volume* ($SV$) defined as forward flow that occurs through the aortic valve substitute;
- the Aortic Closing Volume (CV), corresponding to the backflow as the valve leaflets move from the open to the closed configuration;
- the Aortic Leakage Volume (LV), corresponding to backflow occurring when the valve is fully closed;
- the Aortic Regurgitant Fraction (RF [%]) given by the ratio between the sum of the total regurgitant volume (CV+LV) and SV;
- the Aortic Peak Flow (PF), i.e. the maximum forward flow during ejection phase;
- the Effective Orifice Area (EOA), i.e. the minimum flow area (cm$^2$) downstream the valve during the ejection phase, defined as:

$$EOA = \frac{Q_{RMS}}{51.6 \sqrt{\Delta P \rho}}$$  \hspace{1cm} (1)$$

where $\rho$ (g/cm$^3$) is the fluid density and $Q_{RMS}$ (ml/s) is the root mean square forward flow.

**Software LabView: (pannello di controllo LabView)**

![Software LabView](image)

**Croce sperimentale: (blackboard)**
Results: Esempio HR = 70 bpm, CO = 4 l/min Valvola meccanica 25 mm

Esempio Output LabView: