

Cardio Care 2021: Non Invasive Intra-Cardiac Pressure Monitoring (ICPM)

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We present a system based on a revolutionary technological concept allowing noninvasive measurement and calculation of pressures in cardiac chambers and assess the left ventricular systolic and left ventricular end diastolic pressure (LVEDP) and the right ventricular systolic and right ventricular end diastolic pressure (RVEDP). LVRDP and RVEDP being the major markers for congestive heart failure (CHF) and predictors of myocardial dysfunction. Intra-cardiac pressure changes preside the development of many symptomatic events, thus the ability to provide an advantageous monitoring of intra-cardiac blood pressure is critical.

The system is capable to process ultrasound data (as well as other imaging modalities) recorded from the heart chambers, analyze it and calculate the pressure changes in left ventricle (LV), right ventricle (RV), left atrium (LA) and pulmonary capillary wedge pressure (PAW), right atrium (RA), pulmonary artery (PA) and assess LVEDP and RVEDP in real time with great accuracy.

Furthermore, the system can be calibrated to a specific patient by simultaneous recording of imaging device and catheter based pressure recording of the relevant heart chamber with precise presentation of the absolute pressure values to the imaging data.

This procedure can be performed during any cardiac catheterization for any cardiac indication/diagnosis/morphology.

This system allows to create a patient-specific model for calculation of the absolute pressure within the calibrated heart chamber using only an imaging device at any time in the outpatient clinic and in the near future it will be used even at home (operated by the patient) with cumulative data transition, elaboration and graphic presentation for the use of the medical team.

Initial model for this research was tested on a laboratory model followed by an animal trial in sheep (BJSTR.2018.07.001466), carried out under the approval of the Helsinki ethical research committee.

The system proved capable to assess the LA/PAW, RA, LV, RV and PA pressures in sheep following calibration for 6 months and with up to 40% weight gain.

The results were confirmed during ongoing human experiments which are also conducted under the approval of an ethical committee and by obtaining an informed consent from the patients involved, who undergo cardiac catheterization for their individual medical/clinical indications, and agreed to participate in a complementary echocardiography research of ICPM.

The system has proved to be capable to precisely assess LVEDP and RVEDP from ultrasound recordings calibrated to the pressure meter data gathered from the catheters placed either in LA, LV, RA or RV respectively.

Following the initial calibration during the catheterization, the system is capable to calculate the pressures in the heart chambers previously calibrated and assess LVEDP and RVEDP after a minute of imaging which may be performed by the medical team or by the patient anytime and everywhere.

In the production setting the system will be able to transmit the data from the imaging device through a smartphone or a computer to a cloud system where the data would be processed and transmitted to the relevant medical personnel who will instruct the patient for medical adjustments if needed - based on the cumulative data of the patient.

The major goal of the current system development is to provide accurate information that will help to control heart failure of any medical cause, with reduction of hospitalization rate and therapeutic costs, hence improving life quality and life expectancy.

Foot Note: This work is partly presented at Joint Event on 29th International conference on Cardiology and Cardiovascular Diseases & 36th World Cardiology Conference, September 27, 2021 as Webinar