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Offline Doppler Signals Analysis as the Initial Study of Non-Invasive Blood Pressure Measurement for Patients With Continuous Flow Heart Support



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INTRO

RESULTS

Project RH-ROT

METHODS

CONCLUSIONS



A prototype automatic blood pressure monitoring system

Project objectives:

- Introduction to pilot production and to clinical practice of innovative long term heart support rotary pump – originally developed in Poland the implantable ReligaHeart ROT system;
- Development and introduction to clinical practice of long distance remote monitoring system for patients supported with implantable rotary left ventricle assist devices (LVAD) at home (developed for different foreign devices. and completely integrated with ReligaHeart ROT system);
- Development and introduction to clinical practice of novel hybrid cardiac rehabilitation model for patients supported with implantable rotary LVAD. including hospital as well as long distance remote controlled patient rehabilitation at home (tele-rehabilitation supported with long distance remote pump monitoring).

OBJECTIVES

The accurate, non-invasive blood pressure measurement (NIBP) as well as recognition and management of hypertension in patients supported by continuous flow VADs (CF-VAD) is an essential component of optimal clinical care. Limited understanding of the distinct hemodynamics of these pumps makes measurement and medical management of NIBP quite challenging. One of possible solution may be utilization of Doppler detector in NIBP measurement.

METHODS

The Doppler blood flow signal vs pressure in cuff curves in N=16 CF-VAD supported patients (HVAD, HeartMate2, HeartMate3) were registered and analyzed off-line. Patients were diversified regarding age, supporting time, physical activity etc. The MD4 pocket-size Doppler together with UD48V ultrasound Doppler designed for bilateral diagnostics of peripheral vessels (SONOMED, Warsaw, Poland) were used for radial artery Doppler signal detection. Signals were registered during the manual blood pressure measurement at arm or forearm (above Doppler probe).

RESULTS

Performed study have shown a significant variability of blood flow morphology regarding CF-VAD type and patient's status. The simple Doppler detector gave a satisfying signals for analyses of artery blood flow vs artery compression pressure dependence. The periodic pump flow changes were clearly observed in signals. The systolic pressure was determined in every one case. However, diastolic pressure determination seems to be complex, due ambiguity of flow signal changes in this area.

DISCUSSION

Blood flow in peripheral arteries in CF-VAD supported patient is complex and quasi-physiological. A prototype ultrasonic Doppler-based semi-automatic NIBP measurement system for patients supported by CF-VADs was developed. It confirmed good quality of blood flow signal detection for whole range of flow, related with artery obstruction caused by precisely controlled cuff pressure. Advanced offline Doppler signals analysis will be performed, including simultaneous catheter-based pressure monitoring, to validate specific blood pressure values determination algorithm.



A prototype of Polish rotary blood pump.

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