Abstract

Preterm neonate is exposed to significant hemodynamic changes after delivery. Cardiac and extracardiac shunts, especially ductus arteriosus, play an important role in this process. Failure of postnatal adaptation and persistent patent ductus arteriosus (PDA) may lead to cardiac overload and circulatory failure with hypoperfusion of vital organs and in turn adversely affect the short-term and long-term morbidity and mortality of these patients. Newborns with very low birth weight are at highest risk, however the possibilities for diagnosing circulatory failure in this patient group are limited. Clinical presentation and physical examination are nonspecific and involve subjective measures. Functional echocardiography provides information on systolic and diastolic heart function as well as the possibility to measure cardiac output and superior vena cava flow (SVC flow). Much of what is known about ventricular function pertains to systole rather than diastole. Near infrared spectroscopy provides another noninvasive method, enabling the measurement of tissue oxygenation including that of the brain. Cerebral oxygenation can be measured by placing the probe on the head of the neonate. Further possibility to help diagnose circulatory system failure are biochemical markers, commonly used in diagnosing myocardial failure in adults. Their importance in neonatology is increasing.

The thesis comprises of four separate studies. Aim of the first study was to describe the diastolic function of the left and right ventricle during the first 48 hours of life. These data have not been published in existing literature. Values measured in the studied group of preterm newborns as compared to fetal measurements and mesurements in term neonates are equivalent to values of impaired myocardial function. During the first 48 hours of life however, the values of ventricular function change significantly, representing a progressive improvement of the diastolic ventricular function.

In the second study, we have shown the changes that occur in cardiac output and superior vena cava flow and their relationship to cerebral tissue oxygenation as measured by near infrared spectroscopy. Both left and right cardiac output increased significantly during the study period. SVC flow, a parameter of perfusion of the upper half of the body, in particular of the brain, has also increased but the change was not statistically significant. 41% of studied neonates had low SVC flow during at least one of the performed measurements, mostly during the ones taken at 6 and 12 hours. The relatively high percentage of babies with low SVC flow compared to other published studies is explainable by the high number of neonates with extremely low birth weight in our group of patients (mean birth weeight was 850 grams). Cerebral oxygenation, as represented by cerebral tissue oxygenation index (cTOI), decreased at 12 hours of life followed by an increase at 24 hours. This was accompanied by reciprocal changes in cerebral tissue oxygen extraction (cFTOE) with the maximum

value being reached at 12 hours and with decreasing values thereafter. On the contrary to our expectation, an increase of SVC flow was not accompanied by higher values of cTOI, moreover the correlation between SVC flow and cTOI was negative at 6 hours of age. Low cerebral oxygenation with higher value of oxygen extraction from blood is a known risk factor of hypoxic-reperfusion cerebral injury.

The third study investigated the correlation between NT-proBNP, a biochemical parameter of cardiac overload, and the size of patent ductus arteriosus in newborns with birth weight below 1500 grams. Measured values of NT-proBNP were significantly higher in neonates with PDA during the first two weeks of life. During the third week, the results were significantly different only in patients with PDA of more than 2mm in diameter. This may have been due to the very small proportion of patients with PDA after the third week of life. NT-proBNP value correlated well with the diameter of PDA and its use as a diagnostic tool for patent ductus arteriosus in newborns after the first week of life looks promising.

Last study aims to give a review of existing biochemical markers used to aid diagnosis of myocardial dysfunction in critically ill neonates.