The values of mesenteric and celiac arterial blood flow parameters in healthy preterm newborns

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Abstract

Background: Mesenteric and celiac arterial blood flow parameters may be useful in the diagnosis of abdominal complaints. In differential diagnosis necrotizing enterocolitis (NEC) should always be considered, especially in preterms. Incidence of this disease comes to 2.5/1000 live births, but mortality reaches 20-50%. Early diagnosis is of great importance in early stages of NEC, to avoid surgical treatment and peritonitis. It may decrease mortality in this group of patients and improve further quality of life. The aim of the study was to evaluate values of mesenteric and celiac arterial blood flow assessment during abdominal ultrasonography in healthy preterms. Method: Study group consists of 50 healthy preterms. Ultrasound of the abdomen was performed in all newborns and blood flow in superior mesenteric artery (SMA) and celiac artery (CA) was assessed: peak systolic velocity (PSV), pulsation index (PI) and resistance index (RI). Results: Mean values were obtained: SMA PSV = 58 cm/s (range 32.3-84.2 cm/s); CA PSV = 56 cm/s (range 14.3-126.0 cm/s), SMA PI = 2.0 (range 1.21-4.52); CA PI = 1.65 (range 0.66-3.13); SMA RI = 0.86 (range 0.71-1.11); CA RI = 0.79 (range 0.5-1.13). Conclusions: These measurements are physiological values for a group of preterm infants and might become reference values and be useful in the diagnosis of NEC.

Key words: mesenteric blood flow parameters, celiac blood flow parameters, NEC, ultrasound of the abdomen

Background

Ultrasound of the abdomen is a noninvasive and reliable method of diagnosis [1]. Measurements of blood flow in different organs may be useful in clinical practice. Mesenteric and celiac arterial blood flow parameters may be helpful in the diagnosis of abdominal complaints, but there is no normal range estimated. Celiac axis (CA) supplies liver, spleen and stomach, superior mesenteric artery (SMA) supplies small intestine and portion of large intestine. It means that these two arteries supply the region where most common symptoms of inflammation can be found during routine ultrasound performed in newborns with necrotizing enterocolitis (NEC): inflammatory reaction of the gallbladder, intramural intestinal gas, ascites. In the case of inflammation in the abdomen cavity, caused by necrotizing enterocolitis, the blood flow is expected to be abnormal. Although the precise etiology of NEC is unknown, it is generally accepted that the most important etiologic factor is intestinal ischemia or hypoperfusion leading to altered mucosal integrity [1-4]. Newborns with blood flow abnormalities such as high resistance patterns of blood velocity in SMA on first day of life are at increased risk of developing NEC [5, 6]. Also blood flow parameters in SMA and CA were different in newborns with NEC or suspected to have NEC compared to the healthy control group [7-11]. Using blood flow measurements in these arteries as additional examination during diagnosis might be helpful in clinical practice because the decision making process is usually very difficult. Abdominal complaints are often observed in preterm newborns, especially in intensive care units. Symptoms such as elevated residuals in the stomach or mild abdominal distension might be a sign of a functional gastric problem but also a first sign of more severe disease [4]. In differential diagnosis, necrotizing enterocolitis (NEC) should always be considered, especially in preterm infants. Incidence of this disease comes to 2.5/1000 live births, but mortality reaches 20-40% [3]. Early diagnosis is of great importance in early stages of NEC, to avoid surgical treatment and peritonitis. It may decrease mortality in this group of patients and improve further quality of life. Using any possible noninvasive methods of diagnosis is very advantageous. Aim of the study was to evaluate values of mesenteric and celiac arterial blood flow assessment during abdominal ultrasonography as reference values in preterms without any abdominal complaints.

Method

Study group consists of 50 healthy preterms in the age of gestation 24 to 36 weeks (mean 29 weeks), mean birth weight was 1410 g (min. 580 g, max. 3430 g).
All newborns were examined in the Department of Neonatology at Poznań University of Medical Sciences, Poland by the same investigator to avoid individual interobserver variability. The consent of local Bioethics Committee was obtained. Inclusion criteria were prematurity, enteral feeding and lack of any abdominal complaints. Exclusion criteria were unstable condition, oscillative ventilation, catheter in the umbilical artery, abnormal blood flow measurements in aorta during research, congenital abnormalities, metabolic disorders, underwent surgeries in the abdominal cavity. The examination was performed before feeding to avoid increased flow velocities after feeding [4].
Ultrasound of the abdomen was performed using Philips ATL Ultrasound HDI 3500 with 5-8 MHz probe and Doppler option. Angle correction was used when necessary. In all babies blood flow in the superior mesenteric artery (SMA) and celiac artery (CA) was assessed: peak systolic velocity (PSV), pulsation index (PI) and resistance index (RI).

Results

In this group measurements of blood flow were: mean SMA PSV was 58 cm/s (range 22.6-126.0 cm/s); CA PSV = 57 cm/s (range 32.3-128.0 cm/s), mean SMA PI = 2.0 (range 1.21-4.52); CA PI = 1.65 (range 0.77-3.13); mean SMA RI = 0.84 (range 0.69-1.11); CA RI = 0.78 (range 0.55-1.13). Variability of these results are shown in tables (Fig. 1-6). There is statistical significant positive correlation between CA PSV and gestational age ($r^2 = 0.31$ $p < 0.05$). There was no significant correlation between other parameters (SMA PSV, CA RI, CA PI, SMA RI, SMA PI) and the gestational age or birth weight.

Discussion

Ultrasound of the abdomen is a useful, although is not perfect, method in the diagnosis of abdominal complaints. The measurement of blood flow in mesenteric arteries is very difficult. Luminal diameter of these vessels is very small, even less than 2 mm [5], especially in extremely premature newborns. Also, if the patient is in good condition and reactive, every movement may cause loss of signal. Results can vary, depending on conditions such as patent ductus arteriosus, shock, sepsis, stress, hypothermia, hyperviscosity, dehydration and feeding [6]. After feeding, flow velocities may increase up to 100% of the initial values with the peak after 45 minutes [7, 8]. Flow velocities in the SMA corresponds with gestational age and weight, but PI is an independent factor [5]. This study shows a correlation between flow velocity in CA and gestational age. The quantity and quality of meal correlates with the results of measurements [8], even basal flow velocities might be higher in infants who receive larger volumes of milk [7]. However, these findings do not discredit blood flow measurements as reliable method of diagnosis. Deeg proved differences in results between newborns diagnosed with NEC and the control group. Significant increase in peak systolic and time average velocity in splanchnic arteries was observed in patients with NEC [6]. Kempley et al. and Riccabona showed increased SMA velocity in infants who presented symptoms of necrotizing enterocolitis [8, 11]. Also in adults hemodynamic changes in splanchnic arteries were found in patients with inflammatory bowel disease [9]. Because diagnosis of necrotizing enterocolitis is difficult if the newborn who does not manifest symptoms, it is very important to collect as much information as possible.
sible. Confirmation of NEC is related to antibiotic therapy which is not indifferent to the patient, on the other hand any delay in diagnosis and treatment of NEC might worsen the prognosis for the patient or even cause death. This is why it is important to search for new noninvasive diagnostic tools which could be used. One of them might be measurement of blood flow in celiac trunk and superior mesenteric artery, but further investigation are necessary. Especially normal ranges in newborns should be estimated what was done in this study. These measurements are physiological values for a group of preterm infants and might become a reference values and useful in diagnosis of NEC.

References