●115 THE EFFECT OF TRANSFUSION ON CARDIAC OUTPUT AND SYSTEMIC OXYGEN TRANSPORT IN PREMATURE INFANTS. Janet E. Larson, John P. Cheatham, Robert M. Nelson Department of Pediatrics, Neonatology and Cardiology, University of Nebraska Medical Center, Omaha, Nebraska

The hemoglobin (Hgb) in a premature infant usually falls to 8-10 gm/dl at 6 weeks of age. Infants 4-6 weeks old are often transfused above this range in the NICU if requiring supplemental oxygen or ventilator support. We measured cardiac output (CO) and calculated systemic oxygen transport (SOT) [CO x O_2 content of arterial blood] in infants to evaluate if maintaining these higher Hgbs actually improved oxygen transport to tissues. CO was measured by pulsed-Doppler echocardiography in the ascending aorta before and within 2 hours following transfusion with 10cc/kg packed cells. 2-3 DPG, % fetal Hgb, and arterial blood gases were measured before and after transfusion. Infants less than 4 weeks of age (n=5) were compared to infants 4-8 weeks old (n=5). In the younger infants the mean Hgb went from 10.3 to 13.3 gm/dl (within normal range for their age) and CO was 186 (±52) cc/kg/min before transfusion and 187 (±35) cc/kg/min after transfusion. SOT rose by 19% in these infants. In the older infants, Hbg went from 11 to 13.3 (above the normal range for age) and CO fell from 204 (±57) cc/kg/min to 141 (±52) cc/kg/min ($p<.01$), and SOT fell by 19%. We conclude that maintaining Hgb in neonates above the normal range for their age may not improve oxygen transport to tissues, but may actually cause a decrease in oxygen delivery.

116 SURGICAL CLOSURE OF PATENT DUCTUS ARTERIOSUS IN CRITICALLY ILL PREMATURE INFANTS. Joseph W. Lewis, Jr. M.D., and Roberta E. Sonnino, M.D. Sponsored by: Lester Weiss, M.D., Henry Ford Hospital, Cardiac and Thoracic Surgery, Detroit, Michigan 48202.

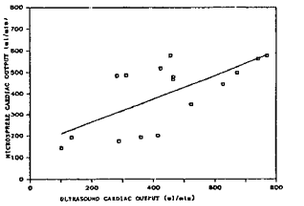
Respiratory distress syndrome(RDS) of prematurity can be complicated by patent ductus arteriosus(PDA) kept open by underlying hypoxia. As RDS clears, a large left to right(L-R) shunt may develop adding pulmonary edema to pre-existing respiratory dysfunction. Since 1978, 27 infants required ductal closure when medical management failed to abolish a significant L-R shunt. The mean birthweight of these infants was 1122 gm with a gestational age of 29 weeks. Most required intubation due to RDS around one hour of life. If the pulmonary edema in these infants could not be controlled medically within 5-7 days, surgical closure was done. The average body weight at surgery was 1034 gm. Two operative deaths (7%) occurred in infants with preexisting renal failure; 3 late deaths (11%) occurred in patients with severe broncho-pulmonary dysplasia(BPD). Postoperative problems were common: BPD-12 cases, hydrocephalus-6, retrolental fibroplasia-5, and necrotizing enterocolitis-2. At mean follow-up of 35 months, 12 were felt to have normal growth and development. Persistent abnormalities were present in the remaining survivors: respiratory dysfunction-5, cerebral palsy-2, deafness-2, and blindness-1. In summary, PDA complicating RDS of prematurity can be closed with low mortality (7%). Although postoperative complications were common, 48% of survivors had normal growth and development at mean follow-up of 35 months.

●117 INCREASED CALCIUM CHANNEL DENSITY IN CARDIAC SARCOPLASMIC RETICULUM FROM FETAL SHEEP Lynn Mahony, Indiana University School of Medicine, Indiana University Hospitals, Dept. Pediatrics, Spon. by J. Lemons.

Decreased active Ca accumulation by vesicles of cardiac sarcoplasmic reticulum (SR) from fetal sheep can in part be attributed to decreased density of Ca pumps. To determine if differences in Ca release channels also contribute to decreased Ca accumulation, we measured the effects of ryanodine on Ca uptake by SR vesicles isolated from fetal and maternal sheep. Ryanodine caused a larger increase in Ca uptake in the fetal (84±10%, mean ±SD, n=4) than in the maternal (52±18%, n=4, $P<0.02$) SR vesicles suggesting that a larger number of channels were open in the fetal SR vesicles before the addition of ryanodine. We then measured the binding of (^{3}H)Nitrendipine, a dihydropyridine drug that is a potent Ca channel antagonist. (^{3}H)Nitrendipine binding sites which purportedly measure Ca channels, have been identified in cardiac SR vesicles. Specific binding measured at 2.5 nM (^{3}H)Nitrendipine was significantly higher in fetal (0.33±0.053 pM/mg protein, n=4) then in maternal (0.19±0.042 pM/mg protein, n=4, $p<0.01$) SR vesicles. The equilibrium constant was not different in fetal (363±111 pM) and maternal (321±26 pM) SR vesicles. However, the density of binding sites was significantly higher in the fetal (0.81±0.13 pM/mg protein) than in the maternal SR(0.50±0.07 pM/mg protein, $P<0.01$). We conclude that decreased Ca accumulation in fetal SR vesicles may be related to a higher density of Ca release channels. This data suggests that the immature myocardium may respond differently to Ca channel antagonists than the adult myocardium.

118 CORRELATION BETWEEN CARDIAC OUTPUT MEASURED BY THE MICROSPHERE METHOD AND DUPLEX DOPPLER ULTRASONOGRAPHY. Thomas Malone, Nancy Hansen, Mohammed Bashiru, and James Menke. (Sponsored by Dwight Powell) Children's Hospital, Ohio State University, College of Medicine, Columbus, Ohio.

Cardiac output can be estimated with Doppler ultrasonography by measuring aortic root diameter and aortic blood velocity: Q (ml/min) = V x A x 60 (sec/min). Q=aortic blood flow, V=mean aortic velocity, and A=aortic cross sectional area. We evaluated the ability of a Diasonics duplex ultrasound scanner to estimate cardiac output in newborn piglets. Aortic diameter and mean peak aortic blood velocity were measured while simultaneously measuring cardiac output with the microsphere technique in six newborn piglets. Comparison of the 16 cardiac output measurements obtained with each technique demonstrated a correlation coefficient of .68. Duplex ultrasonography reliably estimated cardiac output in newborn piglets by measuring aortic diameter and mean peak blood flow velocity ($p<0.05$). However, in our hands, the correlation between these two techniques showed considerable scatter. Further studies to investigate the etiology of these deviations are necessary before utilizing Doppler derived cardiac outputs in the research or clinical setting.



†119 CYTOCHROME c OXIDASE IN THE DEVELOPING HUMAN HEART. CORRELATION WITH MITOCHONDRIAL ULTRASTRUCTURE. J.Marin-Garcia, T.Kosaki, M.E. Dockter. St. Jude Children's Research Hospital, Memphis, TN. and Children's Hospital of New Jersey/New Jersey Medical School, Newark, NJ.

Changes in morphology and cytochromes content of the heart mitochondria (M) have been demonstrated with maturation in animal model systems. To determine if cytochrome c oxidase (CO) content and activity correlates with M development in the human heart we performed electron microscopic (EM) and biochemical studies of ventricular myocardium from samples obtained at autopsy in 6 patients (age range 6 days to 22 yrs, mean 6 yrs). None had evidence of cardiac pathology. Qualitative analysis of mitochondrion number, volume and fine structure was performed by EM of negatively stained, thin sections of fixed cardiac tissue. CO content was assessed by dithionite reduced minus ferricyanide oxidized spectra of isolated M and CO activity was determined by polarographic assay using saturating concentration of horse cytochrome c as substrate. An increase in CO content and activity was observed from the neonatal period (0.3nm heme a/mg protein and 140 nmO_2/min/mg protein) to adulthood (1.0 nm heme a/mg protein and 1104 nmO_2/min/mg protein). The number and structural organization of M was also noted to increase with age mainly from the early neonatal period to infancy. Thus, in human heart development there is a continuing biogenesis of M after birth. Number and size of M increases as well as M with higher CO content and activity.

120 REAL-TIME SPECTRUM ANALYSIS OF BRACHIAL DOPPLER SIGNALS IN NEONATES WITH PATENT DUCTUS ARTERIOSUS (PDA). James Menke, Mohammed Bashiru and Rex Bickers. (Sponsored by Dwight Powell) Children's Hospital, Ohio State University, Columbus, Ohio.

We previously reported a correlation between brachial artery pulsatility index (continuous wave velocitometry) and left atrial enlargement (echocardiographic LA:Ao ratio) in neonates with PDA.

To further define the limitations of neonatal Doppler ultrasound for PDA evaluation, we compared the pulsatility index (PI) obtained by continuous wave (CW) velocitometry with the index obtained from spectral analysis (SA) of the audio Doppler signal in ten patients with suspected PDA. Twenty-one brachial examinations were obtained.

Linear regression of the PI values obtained by CW and SA revealed a highly linear correlation ($r=0.89$, $p<0.001$) but the regression line was not the line of identity. Additionally, the standard deviation of the residuals is greater than that expected for identical measurements. PI values by both methods resolved into two distinct groups, representing normal arterial flow and reverse flow secondary to left-to-right shunt.

Although CW measurements were lower than SA measurements, there was no difference in sensitivity for identifying infants with significant PDA.

We conclude that CW pulsatility index is a satisfactory predictor of PI obtained by the more precise SA technique. Lower CW values may be related to inherent limitations of the zero crossing detector used to produce the CW signal.