The Effect of Positive End Expiratory Pressure (PEEP) on the Pulmonary to Systemic Blood Flow Ratio (QP/QS) in Neonates with Hypoplastic Left Heart Syndrome (HLHS)

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BACKGROUND: Neonates with single ventricle physiology require critical balance of pulmonary (QP) and systemic circulation (QS). High QP/QS is indicative of pulmonary overcirculation, a high saturation > 85% and systemic underperfusion.

OBJECTIVE: The use of non-conventional PEEP (> 8 or <4 cm H20) to induce pulmonary hypertension in neonates with HLHS and QP/QS >1 will result in improved systemic perfusion and decrease use of inotropes.

DESIGN/METHODS: Neonates with HLHS and arterial saturation >85% were randomized in a cross-over design to low (4-0 cm H20) or high (8-14 cm H20) PEEP to achieve sat 75 85% and maintaining same tidal volume. Vessel diameter and flow velocity integral in the main pulmonary artery (QMPA) and ductus arteriosus (QPDA) were obtained using 2D Echo before and 1 hour after PEEP changes. Doppler flow velocity were performed in Celiac (CA), superior mesenteric (SMA) and anterior cerebral arteries (ACA). Other data collected inotropic score (INS), lactate (L), urine output (UO), systolic BP (SBP) and gases.
Calculation: QP = QMPA - QPDA, QPDA = QS. Average velocity (AV) was calculated in CA, SMA, ACA. All measurements were recorded and later analyzed blindly by an independent investigator.

RESULTS: 8 and 9 neonates were randomized to high and low peep respectively. 1 neonate in low and 3 in high group were crossed over to other group.

	High PEEP (n = 9)		**Low PEEP (n=12)**	
	Before	**After**	**Before**	**After**
QP/QS	3.6 ±1.1	2.1 ±0.5 *	3.2 ±0.8	2.0 ±1.1 *
INS	6.5 ±7.2	3.5 ±2.5	4.9 ±1.6	1.3 ±1.0 *
SBP (mmHg)	58 ±7.3	61 ±9.3	59 ±9.6	64 ±7.1 *
UO (ml/kg/hr)	2.8 ±1.1	3.2 ±0.9	2.3 ±1.0	4.7 ±1.0 *
L (mmol/L)	1.8 ±0.4	1.6 ±0.4	1.8 ±0.5	1.4 ±0.5 *
Sat (%)	88 ±3.0	86 ±3.1	90 ±4.8	78 ±6.0 *
CA	33 ±11	33 ±14	30 ±13	48 ±26 *
SMA	11 ±2	12 ±5	15 ±6	18 ±8
ACA	17± 5	22 ±7	20 ±6	26 ±6 *

Results are mean ±SD, *P<0.05 before and after

CONCLUSIONS: The use of low PEEP in babies with HLHS and high QP/QS results in decreased shunt fraction, decreased inotropic use and improved systemic perfusion with increased blood flow velocity in anterior cerebral artery and celiac axis. Although high PEEP resulted in significant decrease in shunt fraction, there was no associated significant changes to systemic perfusion.