Early Diastolic Dysfunction and Respiratory Morbidity in Premature Infants: An Observational Study

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Introduction

Premature infants often require respiratory support during the early neonatal period; with some requiring prolonged ventilation. The relationship between diastolic function assessed over the first 12 hours following birth and early respiratory morbidity remains unexplored. We hypothesise that diastolic dysfunction measured over the first 12 hours of age is associated with the need for ventilation in preterm infants.

Study Aims

We aim to define left ventricular diastolic function using Tissue Doppler Imaging (TDI) and assess its association with invasive ventilation requirements in this population. We also aim to show the association between left ventricular diastolic function and the risk of pulmonary hemorrhage (PH) in the first week of life.

Methods

- Retrospective Observational Study
 - Infants < 32 weeks gestation
 - Survived beyond the first week
 - Excluded if:
 - Congenital anomalies
 - Chromosomal anomalies
 - CHD except PDA/PFO/ASD
- Echo performed @ 10 [7 – 12] hours
 - PDA diameter
 - Ejection fraction
 - LA: Ao & E: A
 - TDI velocities
 - LV, Septum, R
 - s', e', a', ea'
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The cohort was divided into two groups based on the ventilation status at the time of the echocardiogram; all infants were invasively ventilated or on non-invasive CPAP. The independent effect of diastolic function on the outcomes of interest were assessed using logistic regression and adjusted odds ratios (OR) with 95% CI.

Results

	CPAP (n=87)	Invasive ventilation (n=96)	p
Gestation (weeks)	27.9 ± 1.8	26.4 ± 1.8	<0.01
Birthweight (grams)	1113 ± 286	896 ± 266	<0.01
Caesarean section	57 (66)	64 (67)	0.88
Male	49 (56)	59 (62)	0.55
SGA(<10 th centile)	10 (12)	12 (13)	1.0
Apgar score at 5 minutes	9 [8 – 9]	7 [6 – 9]	<0.01
Surfactant at birth	53 (61)	94 (98)	<0.01
Chorioamnionitis	8 (9)	10 (10)	0.81
Pre-eclampsia	5 (6)	6 (6)	1.0
Magnesium sulphate	65 (77)	69 (73)	0.74
Antenatal steroids			
Partial	25 (29)	17 (18)	0.03
Complete	57 (66)	63 (66)	

	CPAP (n=87)	Invasive ventilation (n=96)	p
Ventilation at 48 hours of age	23 (28)	62 (79)	<0.01
Ventilation at 1 week of age	16 (19)	53 (67)	<0.01
Pulmonary haemorrhage	1 (1)	10 (10)	0.01
Severe IVH	5 (6)	16 (17)	0.04
Inotropes on Day 1	2 (2)	29 (30)	<0.01
PDA treatment (medical & surgical)	19 (22)	50 (52)	<0.01
PDA ligation	4 (5)	7 (7)	0.54
Periventricular leukomalacia	3 (4)	8 (10)	0.13
Chronic lung disease	23 (28)	49 (62)	<0.01
Death before discharge	4 (5)	17 (18)	<0.01

Results

	CPAP (n=87)	IPPV (n=96)	p
Left Ventricle free wall			
s' (cm/s)	3.1 ± 0.8	3.0 ± 0.9	0.80
e' (cm/s)	4.1 ± 1.5	3.4 ± 1.0	<0.01
a' (cm/s)	4.5 ± 1.8	4.5 ± 1.7	0.92
ea'	1.0 ± 0.4	0.8 ± 0.2	<0.01
Septum			
s' (cm/s)	2.6 ± 1.0	2.5 ± 0.7	0.26
e' (cm/s)	2.9 ± 1.0	2.9 ± 0.9	0.73
a' (cm/s)	4.1 ± 1.4	4.0 ± 1.3	0.44
ea'	0.8 ± 0.2	8.0 ± 0.2	0.61
Right Ventricle free wall			
s' (cm/s)	4.0 ± 1.0	3.8 ± 1.1	0.14
e' (cm/s)	4.4 ± 1.4	4.1 ± 1.4	0.22
a' (cm/s)	7.4 ± 1.9	6.8 ± 2.1	0.04
ea'	0.6 ± 0.2	0.7 ± 0.2	0.69

Tissue Doppler Velocities in the two groups
Data is presented as means ± SD

Diastolic function and Morbidity

Eleven infants developed Pulmonary Haemorrhage:
Lower LV e': **2.9 ± 1.2 vs. 3.8 ± 1.3 cm/s, p=0.04**
Lower LV ea': **0.68 ± 0.10 vs. 0.93 ± 0.32, <0.01**

Conclusion

This study highlights the **multifactorial nature** of common disease states during the early neonatal period and emphasizes the **relevance of myocardial performance** in the evolution of early respiratory morbidity.

Future research should now **focus on therapies targeted to improve diastolic performance** in this population in an attempt to mitigate morbidity and **improve short-term outcomes**.

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