

STUDY TO ASSESS THE RELATIONSHIP BETWEEN SUPERIOR VENA CAVA FLOW AND INTRAVENTRICULAR HEMORRHAGE IN PRETERM INFANTS

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Introduction

Germinal matrix hemorrhage–intraventricular hemorrhage (GMH-IVH) is the most common variety of neonatal intracranial hemorrhage and is characteristic of the premature infant. The importance of the lesion relates not only to its high incidence but also to the essential gravity of the larger forms of IVH and their attendant complications. Moreover, the major forms of brain injury of the premature infant occur most commonly in the context of IVH, either as an apparent consequence of the IVH or as an associated finding. Transcranial Doppler (TCD) ultrasonography has been extensively performed in preterm infants to evaluate alterations in cerebral hemodynamics, and studies in the literature have suggested that systolic and diastolic flow velocities of the anterior cerebral artery are related to physio-pathological mechanisms of hemorrhages and hypoxic-ischemic events. Cerebral blood flow (CBF) in unhealthy preterm newborns is not auto-regulated, being therefore correlated to any change in systemic blood flow. During the early transitional period, the use of left or right ventricular output for measurement of systemic blood flow may not be accurate because of blood shunting across the patent ductus arteriosus (PDA) and foramen oval. Consequently, measurement of cardiac input via the superior vena cava (SVC) has been suggested as a proxy for global central blood flow in the transitional period.

Aim of the work

The aim of the study was to evaluate the relationship between superior vena cava (SVC) flow measurements within the first day of life and development of intraventricular hemorrhage in preterm born infants.

Subjects and Methods

This study was conducted on (127) preterm infants that fulfill the eligibility criteria and delivered at Alexandria University Maternity Hospital (AUMH) whose gestational age was ≤ 32 weeks and birth weight ≤ 1500 grams. On day one, the recruited preterm infants were undergone echocardiography to assess the superior vena cava (SVC) flow and transcranial Doppler (TCD) ultrasonography to assess the anterior cerebral artery (ACA) flow velocity. The studied infants were evaluated as regards the occurrence of germinal matrix-intraventricular hemorrhages (GMH-IVH) during the first week of life. Infants were categorized into two main groups: IVH group (n=71) and non-IVH group (n=56). Moreover, the studied infants were categorized into two different groups: low SVC flow group (n=44) and normal SVC flow group (n=83) to test the effect of different variables on SVC flow on the first day of life.

Results

Table 1: Univariate analysis for IVH cases as regards echocardiographic parameters

	Total (n = 127)		IVH				OR (95% C.I)	p
	No.	%	No (n = 56)		Yes (n = 71)			
			No.	%	No.	%		
SVC flow (ml/kg/min)								
Low (<41)	44	34.6	11	19.6	33	46.5	3.553(1.584 – 7.966)	0.002*
Normal (≥ 41)	83	65.4	45	80.4	38	53.5	1.000	
Min. – Max.	5.0 – 174.0		9.0 – 174.0		5.0 – 165.0		0.987 (0.975 – 0.999)	0.034*
Mean \pm SD.	56.99 \pm 31.57		63.91 \pm 31.60		51.53 \pm 30.68			
Median (IQR)	52.0 (36.0 – 70.0)		59.50 (46.50 – 72.50)		44.0 (33.0 – 68.0)			
LVO (ml/kg/min)								
Low (<150)	37	29.1	14	25.0	23	32.4	1.437(0.657 – 3.145)	0.364
Normal (≥ 150)	90	70.9	42	75.0	48	67.6	1.000	
Min. – Max.	62.0 – 445.0		62.0 – 400.0		80.0 – 445.0		0.999 (0.994 – 1.003)	0.626
Mean \pm SD.	194.14 \pm 76.14		197.84 \pm 74.15		191.23 \pm 78.07			
Median (IQR)	185.0 (139.0 – 238.0)		192.0 (148.0 – 248.0)		184.0 (131.0 – 232.0)			
RVO (ml/kg/min)								
Low (<150)	9	7.1	0	0.0	9	12.7	–	0.999
Normal (≥ 150)	118	92.9	56	100.0	62	87.3	1.000	
Min. – Max.	80.0 – 636.0		154.0 – 569.0		80.0 – 636.0		1.000 (0.997 – 1.003)	0.869
Mean \pm SD.	300.09 \pm 119.86		298.13 \pm 97.76		301.65 \pm 135.44			
Median (IQR)	280.0 (214.0 – 368.0)		282.0 (224.0 – 356.5)		280.0 (203.0 – 376.0)			
LA/AO ratio								
Min. – Max.	0.66 – 2.52		0.72 – 1.79		0.66 – 2.52		1.112 (0.317 – 3.898)	0.869
Mean \pm SD.	1.14 \pm 0.28		1.13 \pm 0.26		1.14 \pm 0.30			
Median (IQR)	1.09 (0.94 – 1.30)		1.09 (0.94 – 1.35)		1.10 (0.94 – 1.29)			
PDA Size (mm)								
Min. – Max.	0.0 – 3.79		0.0 – 3.61		0.0 – 3.79		0.995 (0.689 – 1.438)	0.979
Mean \pm SD.	1.23 \pm 0.95		1.23 \pm 0.88		1.23 \pm 1.02			
Median (IQR)	1.40 (0.0 – 1.90)		1.39 (0.68 – 1.81)		1.43 (0.0 – 2.06)			
PDA/weight (mm/kg)								
Min. – Max.	0.0 – 4.08		0.0 – 3.56		0.0 – 4.08		1.144 (0.799 – 1.636)	0.463
Mean \pm SD.	1.22 \pm 0.99		1.15 \pm 0.85		1.28 \pm 1.09			
Median (IQR)	1.32 (0.0 – 1.85)		1.20 (0.73 – 1.54)		1.40 (0.0 – 2.05)			
PFO Size (mm)								
Min. – Max.	0.0 – 3.50		0.0 – 2.72		0.0 – 3.50		0.971 (0.594 – 1.588)	0.907
Mean \pm SD.	1.45 \pm 0.72		1.46 \pm 0.68		1.44 \pm 0.75			
Median (IQR)	1.49 (1.07 – 1.90)		1.52 (1.19 – 1.90)		1.45 (1.00 – 1.90)			

Table 2: Multivariate Logistic regression analysis for the clinical and investigational parameters affecting cranial ultrasound IVH

	P value	OR	Multivariate# 95% C.I. for OR	
			Lower	Upper
			HR (beat/min)	0.680
RR (breath/min)	0.095	1.045	0.992	1.100
CRT (sec)	0.313	1.550	0.662	3.629
PP=Weak	0.960	0.953	0.148	6.141
Diastolic BP (mmHg)	0.382	0.907	0.728	1.129
Mean arterial BP (mmHg)	0.696	1.038	0.863	1.248
SVC=Low (<41)	0.038*	3.148	1.065	9.311
ACA End diastolic velocity	0.854	0.980	0.793	1.211
Resistance index	0.518	1.022	0.956	1.093
PT (sec)	0.143	1.078	0.975	1.191
PTT (sec)	0.229	1.018	0.989	1.047
Initial HCO3	0.212	0.924	0.816	1.046

OR: Odd's ratio C.I: Confidence interval LL: Lower limit UL: Upper Limit
#: All clinical and investigational variables with p<0.05 in univariate was included in the multivariate
*: Statistically significant at p \leq 0.05

Conclusion

- Higher anterior cerebral artery resistance index (ACA RI) within the first day of life is associated with increased risk of IVH development.
- Superior vena cava (SVC) flow is the most important echocardiographic parameter that can be correlated to IVH. Moreover, it is one of the most important independent variables that can predict the development of IVH in premature infants early in life.
- Both lower SVC flow and higher ACA RI early in life are not only associated with IVH, but also catastrophic IVH in prematurely born infants.