The correlation between Myocardial Function and Cerebral Hemodynamics in term infants with Hypoxic Ischemic Encephalopathy

Thesis

Submitted for Partial Fulfillment of the Master Degree in Pediatrics

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2009

Dedication

To my father and
mother
who supported me in
my whole life

Acknowledgment

I would like to begin by thanking Allah for his guidance and protection, may this blessing always guide us.

Moreover I would like to express my sincere and profound gratitude to Professor Doctor/ ***Mohamed Samy El Shimi,*** Professor of Pediatrics, Faculty of Medicine, Ain Shams University for his meticulous supervision, loyal encouragement and valuable advises throughout the work.

I wish to express deep appreciation to Professor Doctor/ ***Hanan Mohamed Eisa***, Professor of Radiology, Faculty of Medicine, Ain Shams University for her continuous encouragement, supervision and kind care.

I am also grateful to Doctor/***Soha Mohamed Khafagy***, Lecturer of Pediatrics, Faculty of Medicine, Ain Shams University for her unique effort, continuous guidance, assistance and knowledge she offered me throughout the performance of this work.

My special thanks for Doctor/ ***Samia Hassan Sobhy***, for her support, guidance and for dedicating much of her time to accomplish this work.

Last but not least, I convey my thanks to my patients, their parents and to anyone who helped me to complete this work.

Appendices

No	GA	Mode of delivery	Fetal distress	Body wt.	Sex	Apgar score			Use of inotropes	Convulsions	Sarnat			Oliguria	Start of feeding
						1st min	5th min	10th min			I	II	III		
1	38	Vag.	Yes	3.5	Female	3	5	6	Yes	Yes		III		Yes	0
2	37	Css.	Yes	3	Female	3	6	7	Yes	Yes		III		Yes	0
3	37	Css.	No	2.5	Male	3	6	8	No	No		II		No	7th
4	38	Css.	Yes	2.5	Male	3	5	7	Yes	Yes		III		Yes	0
5	37	Css.	Yes	3	Male	3	6	7	Yes	No		II		No	8th
6	38	Css.	Yes	3.3	Female	3	6	8	Yes	No		I		No	2nd
7	37	Css.	No	3.7	Male	3	6	8	No	No		I		No	3rd
8	42	Vag.	Yes	3.6	Male	3	5	7	No	No		I		No	3rd
9	41	Css.	Yes	3.5	Male	3	5	6	Yes	Yes		II		Yes	10th
10	38	Css.	Yes	3	Male	3	5	6	Yes	Yes		III		Yes	0
11	37	Css.	Yes	3.5	Female	3	5	8	No	No		II		No	4th
12	38	Vag.	No	3.7	Female	3	5	7	No	No		I		No	5th
13	39	Vag.	Yes	3.5	Male	2	4	8	No	No		I		No	5th
14	37	Vag.	Yes	3	Male	2	4	6	Yes	Yes		III		Yes	0
15	37	Css.	No	3	Female	3	5	6	No	Yes		II		Yes	11th

No	GA	Mode of delivery	Fetal distress	Body wt.	Sex	Apgar score			Use of inotropes	Convulsions	Sarnat	Oliguria	Start of feeding
17	38	Css.	No	3	Male	6	7	8	No	No	0	No	1st
18	37	Css.	No	3.3	Male	7	8	9	No	No	0	No	1st
19	37	Css.	Yes	3.5	Female	6	7	7	No	No	0	No	1st
20	37	Vag.	No	3.9	Female	7	8	8	No	No	0	No	1st
21	38	Vag.	No	3.2	Male	5	7	7	No	No	0	No	1st
22	37	Vag.	No	3	Female	6	8	9	No	No	0	No	1st
23	39	Css.	No	3.5	Male	7	8	8	No	No	0	No	1st
24	38	Css.	No	3.6	Female	6	7	8	No	No	0	No	1st
25	39	Vag.	No	3.4	Female	6	8	8	No	No	0	No	1st
26	40	Vag.	No	3.9	Male	6	7	8	No	No	0	No	1st
27	39	Css.	No	3.5	Male	5	6	7	No	No	0	No	1st
28	37	Vag.	No	3	Male	6	7	8	No	No	0	No	1st
29	38	Vag.	No	3.6	Female	7	8	8	No	No	0	No	1st
30	39	Css.	No	3.7	Female	6	8	8	No	No	0	No	1st

N	CRP with titre			CBC				Cr	Na	K	Transcranial Sonar					
	1st	2nd	3rd	TLC	Hb	Plat	N.				RI 1	PI 1	RI 2	PI 2	RI 3	PI 3
1	6	12	14	11	14	130	4	1.3	130	5	0.8	1.5	0.84	1.56	0.83	1.6
2	6	6		10	16	192	5	1.2	124	4.8	0.56	0.9	0.75	1.2		
3	6	12	6	8	17	180	3.5	0.9	125	4.5	0.7	1.3	0.58	1.1	0.6	1.1
4	6	12	24	39	16	205	7	1.2	126	5.1	0.71	1.4	0.73	1.2	o.8	1.5
5	6	12	6	10	17	190	4.5	1.1	129	4.9	0.55	0.8	0.62	1	0.66	1.2
6	6	12	6	9	15	160	3.9	1	124	4.3	0.52	0.78	o.6	1.2	0.65	1
7	6	6	6	10	16	170	4.1	0.2	125	4	0.78	1.6	0.74	1.4	0.7	1.4
8	6	12	6	8	17	200	5.5	1.1	128	4.2	0.51	0.8	0.6	1.1	0.64	1.2
9	6	12	48	11	18	180	6	0.9	125	5.2	0.52	0.9	0.57	1	0.74	1
10	6	6		9	13	110	5.5	0.7	123	5.1	0.73	1.4	1	1.7		
11	6	6	12	10	18	160	5	1.1	125	5.2	0.53	0.9	0.6	1	0.65	1.1
12	6	12	6	11	17	150	6.5	1	127	4.3	0.8	1	0.68	1	0.59	1.2
13	0	6	6	12	18	180	5.4	0.3	126	3.9	0.72	1.3	0.57	1.2	0.56	1
14	0	6	48	13	10	90	6.5	1.1	125	3.8	0.71	1.4	0.8	1.5	0.9	1.6
15	0	6	6	11	17	160	6	0.8	124	4.1	0.76	1.3	0.77	1.5	0.77	1.4

No	CRP with titre			CBC				Cr	Na	K	Transcranial Sonar					
	1st	2nd	3rd	TLC	Hb	Plat.	N				RI 1	PI 1	RI 2	PI 2	RI 3	PI 3
16	0	6		8	17	190	4.5	0.3	137	3.9	0.65	1.15	0.7	1		
17	0	0		10	18	200	4.6	0.5	133	4	0.54	0.9	0.6	1.1		
18	0	6		11	18.5	180	5	0.6	135	4.2	0.59	0.95	0.62	1		
19	6	6		10	17	170	3.5	0.4	137	3.6	0.62	1	0.72	1.3		
20	0	6		10	16.5	160	4.2	0.5	142	4	0.65	1.2	0.68	1.3		
21	0	0		9	18	210	5.3	0.6	136	3.6	0.79	0.85	0.73	1.1		
22	o	0		12	19	192	5.5	0.4	145	4	0.66	0.79	0.71	1.2		
23	0	6		10	18	180	5	0.6	134	3.6	0.61	1.1	0.65	1.3		
24	0	6		11	17	170	4.8	0.5	143	3.4	0.56	0.82	0.6	1		
25	0	0		12	19	190	5.5	0.5	144	4.2	0.55	0.79	0.59	1.2		
26	0	6		13	18	200	4.9	0.7	135	3.9	0.78	1.1	0.75	1.1		
27	0	0		11	17	180	5.1	0.3	142	3.7	0.55	0.8	0.61	1.1		
28	0	0		10	18	190	5.5	0.2	134	4.1	0.6	1	0.65	1.2		
29	0	0		12	19	190	5.2	0.4	136	4.5	0.7	1.4	0.69	1		
30	0	0		9	16	200	5.3	0.3	142	3.8	0.65	1.2	0.62	1		

No	Echo 1					Echo 2					Echo 3					Mortal. Yes/No	D. 0f H. Admis.	D. of Ventil.
	LPEP/ LVET 1	EF% 1	SF% 1	CO 1	A/E 1	LPEP/ LVET 2	EF% 2	SF% 2	CO 2	A/E 2	LPEP/ LVET 3	EF% 3	SF% 3	CO 3	A/E 3			
1	0.5	41	24	0.3	0.8	0.53	37	22	0.25	0.76	0.6	36	20	0.21	0.73	yes	20	20
2	0.45	38	26	0.4	0.9	0.51	35	23	0.3	0.6						yes	3	3
3	0.44	50	23	0.16	1.1	0.4	52	25	0.2	1.3	0.33	65	28	1	1.4	no	18	7
4	0.5	42	32	0.32	0.6	0.5	39	26	0.3	0.7	0.52	35	24	0.5	0.8	yes	15	15
5	0.4	60	27	0.4	0.7	0.3	61	28	0.5	1	0.25	65	33	0.8	1.2	no	23	10
6	0.45	49	20	0.6	0.7	0.4	50	23	0.45	1	0.28	53	26	0.7	1	no	25	4
7	0.9	32	14	0.5	0.8	0.8	35	15	0.12	0.8	0.75	36	16	0.17	0.9	no	15	0
8	0.7	50	24	0.4	0.6	0.66	55	26	0.7	0.9	0.6	59	28	0.55	1.2	no	10	0
9	0.75	59	29	0.29	1.3	0.78	40	26	0.25	1	0.8	35	23	0.2	0.7	yes	50	40
10	0.76	39	21	0.4	0.8	0.8	35	19	0.2	0.6						yes	3	3
11	0.6	45	24	0.54	0.56	0.5	55	28	0.6	1	0.35	60	30	1	1.1	no	30	4
12	0.7	47	23	0.6	0.6	0.45	56	27	0.4	0.7	0.4	55	31	0.8	1	no	11	0
13	0.8	52	28	0.5	0.7	0.7	54	29	0.43	1	0.6	69	36	0.52	1.2	no	12	3
14	0.7	39	22	0.45	0.8	0.75	32	24	0.3	0.6	0.4	32	18	0.1	0.5	yes	60	55
15	0.6	38	24	0.32	0.6	0.5	41	26	0.6	0.7	0.8	53	27	0.7	0.8	no	30	15

NO	Echo 1					Echo 2					Mortal.	D. of H. Admiss.	D. of ventil.
	LVPP/ LVET 1	EF% 1	SF% 1	CO 1	A/E 1	LPEP/ LVET 2	EF% 2	SF% 2	CO 2	A/E 2			
16	0.57	69	36	0.14	0.86	0.45	70	38	0.6	0.9	No	30	0
17	0.4	71	37	1.2	1.4	0.31	72	39	1.1	1.5	No	0	0
18	0.4	67	34	1.3	1.2	0.3	70	36	1.3	1.3	No	0	0
19	0.39	70	30	0.9	0.9	0.33	73	32	1.2	0.94	No	17	0
20	0.75	72	38	1.37	1.37	0.34	73	41	1.3	1.4	No	0	0
21	0.5	67	34	1.1	1.1	0.41	71	37	1.1	1.2	No	0	0
22	0.8	82	47	1	1	0.42	81	50	0.9	1.3	No	0	0
23	0.5	68	35	1.3	1.3	0.43	70	38	0.7	1.5	No	0	0
24	0.5	57	35	1.5	1.5	0.42	71	36	0.6	1.3	No	0	0
25	0.5	62	28	0.9	0.9	0.35	62	30	0.6	1.2	No	0	0
26	0.45	72	32	1.2	1.2	0.41	73	36	1	1.5	No	0	0
27	0.5	65	38	1	1	0.42	75	40	0.8	1.3	No	0	0
28	0.4	61	33	1.2	1.2	0.42	71	34	1	1.4	No	0	0
29	0.6	62	30	1	1	0.42	67	35	0.9	1.2	No	0	0
30	0.4	61	35	1	1	0.32	64	37	1	1.3	No	0	0

Contents

List of Abbreviations

AAP : American Association of Paediatrics

ABP : Arterial blood pressure

ACOG : American College of Obstetrics and Gynecology

a-EEG : Amplitude-Integrated electroencephalography

ALT : Alanine transaminase

AR : Aortic regurgitation

AST : Aspartate transaminase

ATPase : Adenosine triphophatase

BAEPs : Brainstem auditory evoked potentials

BP : Blood pressure

CBF : Cerebral blood flow

CBFV : Cerebral blood flow velocity

Cl : Chloride

CNS : Central nervous system.

CP : Cerebral palsy

Cr : Creatinine

CSF : Cerebrospinal fluid

CT : Computed Tomography

CVO : Combined ventricular output

DIC : Disseminated intravascular coagulopathy

DT : Deceleration time

ECG : Electrocardiogram

ECMO : Extracorporeal membrane oxygenation

EDV : End-diastolic velocity

EEG : Electroencephalogram

EF : Ejection fraction

EFM : Electronic fetal monitoring

FHR : Fetal heart rate

FS : Fractional shortening = **SF** : Shortening fraction

FVEPs : Flash visual evoked potentials

GABA : G-aminobutyric acid

GI : Gastrointestinal

GLUT : Glucose transporter protein

Hb : Hemoglobin

HIE : Hypoxic ischemic encephalopathy

HIE-NE : Hypoxic ischemic encephalopathy neonatal encephalopathy

HOCM : Hypertrophic obstructive cardiomyopathy

I L : Interleukin

ICP : Intracranial pressure

ICT : Isovolumic contraction time

IGF-1 : Insulin-like growth factor-1

IVRT : Isovolumic relaxation time

K : Potassium

LPEP/LVET : left ventricular pre-ejection period/ left ventricular ejection time

LVH : left ventricular hypertrophy

MAP : Mean arterial pressure

MCA : Middle cerebral artery

$MgSO_4$: Magnesium sulfate

MR : Mitral regurgitation

MRI : Magnetic resonance imaging

MRI : Magnitic Resonance Imaging

Na : Sodium

NEC : Necrotizing enterocolitis

NICHD : Neonatal Research Network

NIRS : Near infrared spectroscopy

NMDA : N-methyl-D-aspartate receptor

NOS : Nitric oxide synthetase

PA : Pulmonary artery

PCA : Postconceptional age

PCA : Posterior cerebral artery

PCr/Pi : Phosphocreatine to inorganic phosphate

PDA : patent ductus arteriosus

PI : Pulsatility index

PROM : Premature rupture of membrane

PSV : Peak systolic velocity

PT : Prothrombin time

PTT : Partial thromboplastin time

PVL : Periventricular leukomalacia

PVR : Pulmonary vascular resistance

RI : Resistive index

RPEP/RVET : Right ventricular pre-ejection period/ right ventricular ejection time

SEPs : Somatosensory evoked potentials

SIADH : Syndrome of inappropriate antidiuretic hormone

T3 : Tissue thyroid hormone

T4 : Blood thyroid hormone

Tei index : Myocarial performance index

TGFβ-1 : Transforming growth factor beta-1

TLC : Total leucocytic count

TSH : Thyroid stimulating hormone

VEPs : Visual evoked potentials

VSD : Ventricular septal defect

List of Tables