Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

FUNCTIONAL ECHOCARDIOGRAPHIC PARAMETERS IN PERINATAL ASPHYXIATED TERM NEONATES

Dr Suman kumawat,[1] Dr Laxman siddh,[2] Dr Abhimanyu tiwari[3], Dr Neha Thakur[4*]

[1]Senior Resident, Department of Pediatrics, SPMC Bikaner
[2,3]Assistant professor, Department of paediatrics, SP medical college, Bikaner
[4]Assistant professor, Saraswathi medical college, hapur, Uttar Pradesh

Corresponding Author: Dr Neha Thakur, Assistant professor, Saraswathi medical college, hapur, Uttar Pradesh. Email: Laxmansiddh@gmail.com.

ABSTRACT

Introduction: Perinatal asphyxia is defined as the failure to initiate and sustain breathing at birth. **Aim:** compare functional echocardiographic parameters of perinatal asphyxiated term neonates with non asphyxiated term neonates. **Methodology:** This observational study, conducted at the Division of Pediatric Cardiology in M.D.M Hospital under the Department of Pediatrics, Dr. S.N. Medical College, Jodhpur, focused on perinatal asphyxia and hypoxic ischemic encephalopathy (HIE). Perinatal asphyxia severity was classified as moderate or severe based on breathing patterns and APGAR scores at 1 minute after birth. HIE diagnosis relied on physical examination, utilizing the modified Sarnat & Sarnat staging system to determine severity. **Result:** our observational study compared functional echocardiographic parameters between perinatal asphyxiated term neonates and non-asphyxiated term neonates. The findings revealed significant differences in certain parameters between the two groups: La and Ao did not differ significantly between the study and control groups.The ratio of La to Ao was significantly higher in the study group. LVES was significantly larger in the study group. EF and FS were significantly lower in the study group, indicating impaired cardiac function. Other parameters such as LVMPI, MAPSE and mitral E/A and E/e' ratios did not show significant differences between the two groups. However, the diastolic diameter of the tricuspid annulus was significantly larger in the study group compared to the control group. **Conclusion:** The perinatal asphyxia may impact specific echocardiographic parameters indicative of cardiac dysfunction, particularly in terms of left ventricular systolic function.Early recognition and management of cardiac involvement may improve outcomes in this vulnerable population.

Keywords- Perinatal asphyxia, Neonates, Echocardiographic.

INTRODUCTION

Perinatal asphyxia is defined as the failure to initiate and sustain breathing at birth (Basic Newborn Resuscitation Practical Guideline from WHO) and usually refers to the condition of impaired gas exchange during the first and second stage of labour, that if persist leads to fetal hypoxemia and hypercarbia[1].Perinatal asphyxia is a common problem with the incidence varying from 0.5 – 2% of live births[2]. The incidence for perinatal asphyxia ranges from as low as 3.6/1000 live birth in Canada to as high as 26.5/1000 in Nigeria. Incidence of birth asphyxia in India is 9.2/1000 live birth[3] The National Neonatal Perinatal Database (NNPD) 2000 defined moderate asphyxia as slow gasping breathing or an APGAR score of 4-6 at 1 minute of age. Severe asphyxia was defined as absent breathing or an APGAR score of 0-3 at 1 minute of age[4] .It is an important cause of admission to neonatal intensive care units (NICU) with multi organ dysfunction[5]. When an hypoxic event occurs, it

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

leads to a series of physiological mechanisms in order to preserve the function of vital organs (especially brain and heart) ,whereas other organs such as the kidneys, gastrointestinal tract, and skin are affected to a varying degree based on the duration of the episode[6]. However, despite of compensatory mechanisms, it may progress to hypoxic- ischemic encephalopathy (HIE) involving the brain and heart[7].The various clinical features related to cardiac dysfunction are increase in respiratory rate, hepatomegaly , hypotension due myocardial dysfunction and systolic murmur (usually pan-systolic murmur of tricuspid regurgitation and/or mitral regurgitation) because of annulus dilatation of papillary muscle necrosis[8]. Respiratory distress is the most important clinical feature of hypoxic heart damage.The clinical evaluation, cardiac enzymes – LDH, CPK-MB and troponin, electrocardiography (ECG), echocardiogram- M mode, 2D ECHO, Doppler and tissue doppler are means for cardiac function evaluation are the different modalities to evaluate neonate with birth asphyxia. In the present study We want to evaluate the value of Functional ECHO cardio-graphy for assessing cardiac dysfunction in neonates with asphyxia and to find out if it has any correlation with different serum enzymes- CPK-MB.

Aim

To compare functional echocardiographicparameters of perinatal asphyxiated term neonates with non asphyxiated term neonates.Correlation of functional echocardiographic parameters with CKMB.

METHEDOLOGY

The current study was an observational study, was conducted in Division of Pediatric cardiology in M.D.M Hospital under Department of Paediatrics, Dr. S. N. Medical College, Jodhpur. The study was conducted after Institutional Ethical Committee approval. The study focused on perinatal asphyxia and hypoxic ischemic encephalopathy (HIE). Perinatal asphyxia was classified as moderate if there was slow or gasping breathing, or if the APGAR score was between 4 and 6 at 1 minute after birth. It was classified as severe if there was no breathing or if the APGAR score was between 0 and 3 at 1 minute.HIE was diagnosed based on physical examination, assessing various factors including consciousness level, neuromuscular control, reflexes, pupil response, heart rate, and other physiological indicators. The severity of HIE was categorized using the modified Sarnat & Sarnat staging system, which evaluates the extent of encephalopathy.The inclusion criteria for the study included term babies with specific APGAR scores or breathing patterns at 1 minute after birth, delivered either intramurally or extramurally. Control subjects were healthy term babies with APGAR scores above 7 at 1 minute, also delivered intramurally or extramurally.Exclusion criteria comprised neonates with major congenital malformations, positive perinatal septic scoring, or congenital heart defects excluding PDA and PFO. Parents of eligible neonates were briefed about the study and verbal consent was obtained for participation.

Sample size

The sample size was calculated to be 60 using a formula based on a 95% confidence interval and 80% power.After resuscitation according to neonatal resuscitation guidelines, asphyxiated neonates were admitted to the NICU. Data including Apgar score, gestational age, sex, and weight were recorded. Gestational age was assessed using the last menstrual period and the Expanded New Ballard score. The severity of HIE was graded using the Sarnat & Sarnat staging within six hours of birth.Blood chemistry tests, including CPK-MB and Troponin I, were conducted within six hours of birth. A comprehensive clinical and neurological examination was performed.so we calculated sample size by a formula with 95% confidence interval and and 80% power.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

$n= 2\times(Z(1-\alpha/2 +Z\beta)2/\delta2$
$Z(1-\alpha/2= 1.96$(At 95% confidence interval)
Δ =effective size(0.5)
$Z\beta= 0.84$(At 80% power)

Myocardial Performance Index (MPI/Tei Index) :
The MPI was calculated by formula $(a - b)/b$.
LV MPI = IVCT + IVRT/ LVET = MCOT – LVET/ LVET,
MCOT (a)- Mitral Valve Closure to Opening Time (ms), LVET (b) - LV Ejection time (ms)48
In non -asphyxiated group Apgar score, sex of baby and weight of baby,gestational age was recorded in a predesigned proforma for this study.

Statistical methods:
Data from the study was analyzed using Microsoft Excel 2010 with SPSS version 20.0. Results were presented as mean values ± standard deviation. Categorical data were expressed as number (%). Statistical analysis employed Student's t-test and Chi-square test to determine the significance of differences in means between variables. Anova test was utilized to assess significance between groups. A p-value < 0.05 was deemed significant, indicating either negative or positive correlation. Regression analysis was conducted to evaluate the correlation between CPKMB and functional echocardiographic parameter

RESULT

Table(1): Gender and weight wise distribution of cohort:

Gender	Control group (n=65)	Study group (n=45)
Male	32 (49.23%)	22 (48.89%)
Female	33 (50.77)	23 (51.11%)
Total	65	45
Weight (in kg)		
< 2.5 kg	03	06
>2.5	62	39
Total	65 (2.98±0.32)	45 (2.82±0.31)

The male to female ratio were in control and study group were 0.96:1 and 0.95:1 respectively.The mean birth weight of the neonates in control group and study group were 2.98 ± 0.32 kg and 2.82±0.31 kg respectively.

Table (2) :Biomarker level with severity of HIE grading:

HIE Grading	CPKMB	TROP I (+)	Serum LDH
I [n=9]	124.33±93.47	-	579.0±163.58
II [n=25]	264.28±179.72	05	772.0±440.66

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

III [n=11]	439.54±156.73	10	1382.12±367.37

In a study group comparing biochemical parameters among different degrees of hypoxic-ischemic encephalopathy (HIE) groups:
- HIE I group: Mean CPKMB level was 124.33±93.47, mean LDH level was 579.0±163.58. None of the cases were positive for troponin I.
- HIE II group: Mean CPKMB level was 264.28±179.72, mean LDH level was 772.0±440. 5 out of 25 cases were positive for troponin I.
- HIE III group: Mean CPKMB level was 439.54±156.73, mean LDH level was 1382.12±367.37. 10 out of 11 cases were positive for troponin I.

COMPARISON BETWEEN STUDY AND CONTROL GROUP:

Table(3): Left ventricular systolic and diastolic functions:

Parameters	**Control group**	**Study group**
La	10.52±1.73	10.99±2.19
Ao	9.49±1.00	8.93±1.03
La/Ao	1.11±0.22	1.23±0.27
LVED	15.63±2.11	14.99±2.89
LVES	9.94±2.08	11.14±2.59
EF	64.95±10.08	45.24±13.14
FS	36.43±8.07	24.93±7.57
LVMPI	0.48±0.32	0.53±0.51
Mvcf	1.69±0.59	1.50±0.68
MAPSE	4.65±1.04	4.56±0.92
Diastolic functions		
Mitral E/A	1.14±0.29	1.14±0.33
E/e'Medial	8.34±2.73	9.18±2.10

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

E/e'Lateral	8.72±1.98	9.34±1.5

In this study comparing neonates with birth asphyxia to a control group, several cardiac parameters were evaluated.
neonates with birth asphyxia showed significant differences in Ao diameter, La/Ao ratio, LVES, EF, and FS compared to the control group, indicating cardiac impairment. Other parameters such as LVED, LV MPI, mVCF, MAPSE, and mitral E/A and E/e' were not significantly different between the two groups.

Table(4): Right ventricular systolic and diastolic functions:

Parameters	**Control group**	**Study group**
RVDD	8.83±1.80	9.49±1.73
RVDs	4.92±1.54	5.36±1.73
TAPSE	6.05±1.61	5.76±1.32
Diastolic functions		
Tricuspid E/A	0.92±0.34	1.09±0.41
E/e'medial	8.72±2.30	9.70±1.37
E/e'Lateral	8.37±2.02	9.28±1.18

Among neonates with birth asphyxia, the study did not find significant differences in RVED, RVES, TAPSE, or parameters related to tricuspid valve function when compared to the control group.

Table(5): Diastolic Annular diameter of AV valve

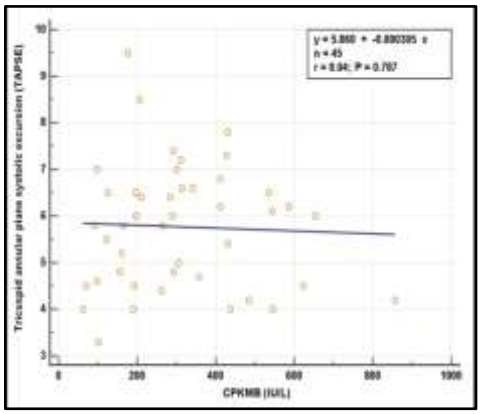
Parameters	**Control group**	**Study group**
Tricuspid annulus	12.43±1.53	13.8±2.06
Mitral annulus	9.62±1.31	11.26±1.37

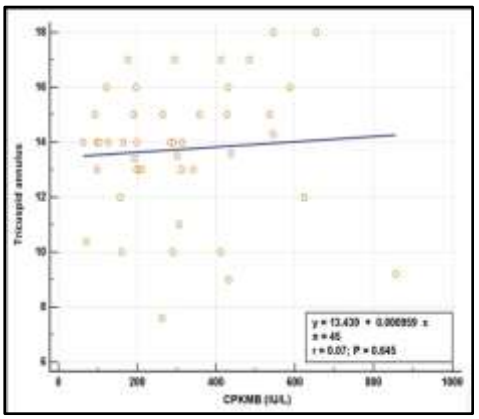
Among neonates with birth asphyxia, the study found a significant difference in the mean diastolic diameter of the tricuspid annulus compared to the control group, while no significant difference was observed in the mitral annulus diameter.The mean value of tricuspid and mitral annulus in study group were 13.8±2.06mm and 11.26±1.37mm respectively while in control group were 12.43±1.53mm and 9.62±1.31mm respectively.It means among neonates

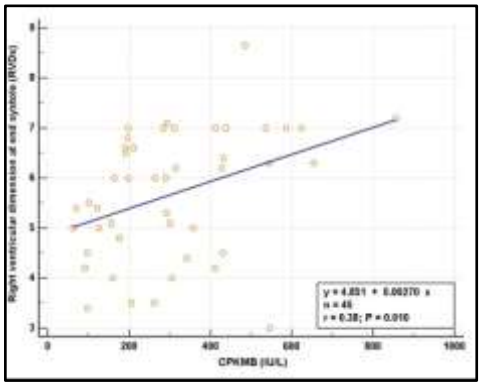
ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

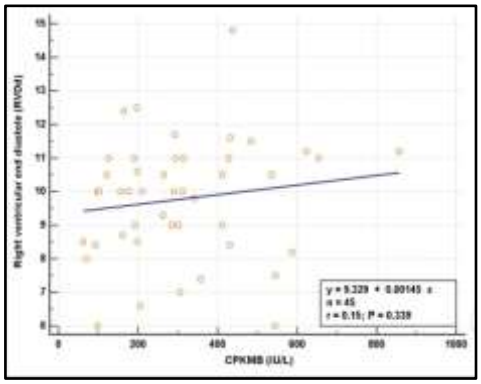
with birth asphyxia the mean value of diastolic diameter of tricuspid annulus was influenced, which was confirmed statically also, as P value was <0.005.which was significant

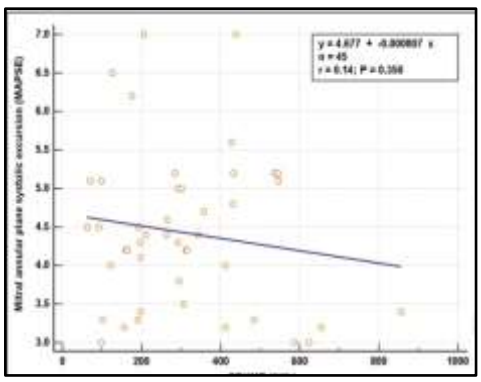
Scattered diagram showing Correlation of functional echocardiographic parameters with CKMB:

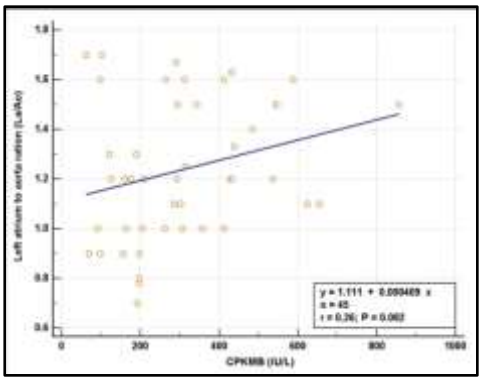




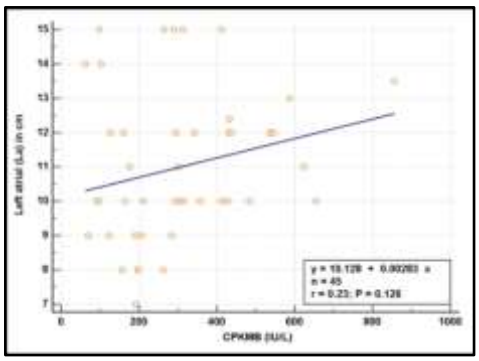


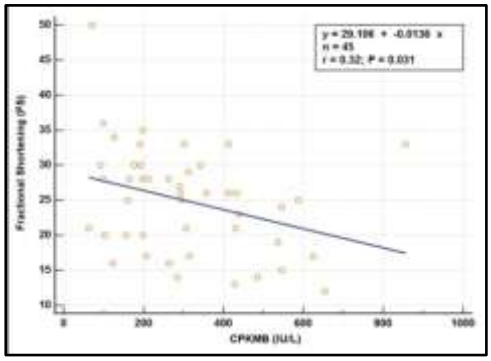


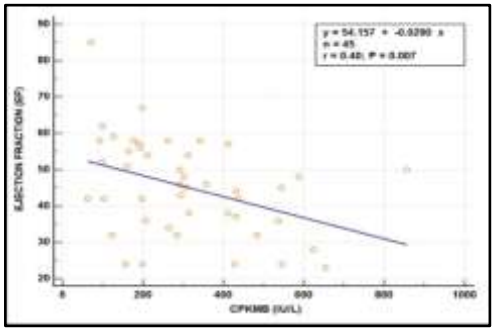




ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024







DISCUSSION

The male to female ratio were in control and study group were 0.96:1 and 0.95:1 respectively.The mean birth weight of the neonates in control and study group were 2.98 ± 0.32 kg and 2.82±0.31 kg respectively.In the Study group male female ratio in HIE I, HIE II, HIE III were 0.5:1, 1.08:1 and 1.2 :1 respectively.

In our study out of total 45 cases in study group, 12(26.66%) cases were expired and 33(73.33%) survived. Among expired cases 8.3% and 91.66 % cases were in HIE II group and HIE III group respectively.In survived cases 27.27% and 72.72% cases were belongs to HIE I and HIE II group respectively.The mean value of La in control group was 10.52±1.73mm. Solinger et al[9] from their study reported the normal range of La between 8–13.5 mm. A recent study was done by TaksandeAM et al (2018)[10]reported the mean value of La in healthy term neonates to be 9.6 ± 2.12 mm.

Discussion on comparison between study and control group:

In our study there was no significant difference in La diameter between the study and control groups, there was a significant difference in Ao diameter and La/Ao ratio, suggesting left atrial enlargement possibly due to mitral regurgitation in neonates with birth asphyxia.

In our study while there was no significant difference in LVED between the study and control groups, there was a significant difference in LVES, indicating potential alterations in left ventricular function among neonates with birth asphyxia.Tsivya oBan Vasenina AD et al[11] reported from their study value of LVED and LVES in control group as 17.7±1.5mm and 10.2±1.2mm respectively while in study group as 18.9±1.6mm and 12.5±1.4mm which was statically significant(<0.05).

The mean value of EF and FS in study group was 45.24±13.14 and 24.93±7.57 respectively while in control group was 64.95±10.08 and 36.43±8.07. It suggest among neonates with

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

birth asphyxia EF and FS were affected, which was confirmed statically also, as P value was <0.0001.Tsivyan PB and VaseninaAD et al[11] reported from their study value of fractional shortening (LVFS) in study group was 33.8±5.2% while in control group was 41.0±6.9% which was statically significant(<0.001).

The mean value of LVMPI and mvcf in study group were 0.53±0.51 and 1.50±0.68 while in control group were 0.48±0.32 and 1.69±0.59. It means among neonates with birth asphyxia LV MPI and mVCFwere not influenced, which was confirmed statically also, as P value was >0.05 which were not significant.

The mean value of mitral E/A,medial and lateral E/e' among study and control group were1.14±0.33,9.18±2.10 & 9.34±1.5 and 1.14±0.29,8.34±2.73 & 8.72±1.98 respectively.It means among neonates with birth asphyxia The mean value of mitral E/A,medial and lateral E/E' were are not influenced, which was confirmed statically also, as P value was >0.05 were not significant.

In the study group, the mean RVED was 9.49±1.73mm, and the mean RVES was 5.36±1.73mm. In the control group, these values were 8.83±1.80mm and 4.92±1.54mm, respectively. Statistical analysis showed that there was no significant difference between the study and control groups for both RVED and RVES (p value > 0.05).

In both the study and control groups,MAPSE: Study group: 4.56±0.92mm, Control group: 4.65±1.04mm,TAPSE: Study group: 5.76±1.32mm, Control group: 6.05±1.61mm.The comparison between the study and control groups showed no significant difference in these parameters. The (p-values >0.05), confirming that there was no statistically significant influence of birth asphyxia on the mean values of MAPSE and TAPSE.

In both the study and control groups, the mean values of tricuspid E/A ratio, medial tricuspid E/e', and lateral tricuspid E/e' were not significantly different. The (p-values> 0.05), confirming that there was no statistically significant influence of birth asphyxia on these parameters.

In the study group, the mean diastolic diameter of the tricuspid annulus was 13.8±2.06mm, while in the control group, it was 12.43±1.53mm. Statistical analysis showed a significant difference with a p-value of less than 0.005.

Conclusion

The study provided valuable insights into cardiac function in neonates with birth asphyxia, highlighting differences in various cardiac parameters compared to healthy controls. These findings contribute to our understanding of the impact of birth asphyxia on cardiac health in neonates and underscore the importance of early detection and management of cardiac issues in this population.

REFRENCE

1. John P. Cloherty , Eric C. Eichenwald, Anne R.Hansen. Manual of neonatal care; seventh edition.Philadelphia:Lippincott Williams & Wilkins, 2010.Chapter 55:Perinatal asphyxia and Hypoxic ischemic Encephalopathy p711-27.
2. Lawn J, Shibuya K, Stein C. No cry at birth: global estimates of intrapartum stillbirths and intrapartum related neonatal deaths. Bull World Health Organ. 2005; 83: 409-417.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

3. Levene ML. Kornberg J , Williams TH .The incidence and severity of post asphyxia encephalopathy in term infant. Early Hum Dev 1985;11:21-26.
4. Committee on Obstetric practice,American College of Obstetrician and gynaecologist ACOG Committee opinion. Number 326, December 2005. Inappropriate use of the terms fetal distress and birth asphyxia. ObstetGynaecol 2005; 106: 1469- 1470.
5. Shah P, Riphagen S, Beyene J, Perlman M: Multiorgan dysfunction in infants with post-asphyxial hypoxic-ischaemic encephalopathy. Arch Dis Child Fetal Neonatal Ed 2004, 89:F152–F155. [PubMed]
6. Pasternak JF: Hypoxic-ischemic brain damage in the term infant. Pediatr Clin North Am 1993, 40:1061–1071. [PubMed]
7. Tapia-Rombo CA, Carpio-Hernandez JC, Salazar-Acuna AH, AlvarezVazquez E,Mendoza-Zanella RM, Perez-Olea V, et al: Detection of transitory myocardial ischemia secondary to perinatal asphyxia. Arch Med Res 2000,31:377–383.
8. P.S. Rajakumar, B. Vishnu Bhat, M.G. Sridhar1, J. Balachander2, B.C. Konar1, P. Narayanan and G. Chetan. Electrocardiographic and Echocardiographic Changes in Perinatal Asphyxia. Indian journal of pediatrics.2009;76(3):261-64. [PubMed]
9. Solinger R, Elbl F, Minhas K. Echocardiography in the normal neonate. Circulation 1973; 47: 108–118.
10. Mohanrao Taksande A. Tissue Doppler Echocardiography: Assessment of the CardiacFunctions in Infant'S of Dia-betic Mothers. Journal of Cardiology and Therapy. 2018;5(1):738-741.
11. P.B.Tsivyan and A.D Vasenina, Left ventricular systolic and diastolic function in term neonates after mild perinatal asphyxia European Journal of Obstetrics & Gynecology and Reproductive Biology, 40 (1991) 105-110 0 1991 Elsevier Science Publishers B.V. 0028-2243/91/$03.50