



GESTATIONAL AGE-RELATED CORRELATION OF EXTERNAL CARDIAC MORPHOMETRY IN ABORTED FETUSES

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ABSTRACT

Introduction: Growth rate of organs in fetal stage were very high in bringing out dynamic changes in morphologic and morphometric appearance of organs. Evaluation of cardiac structure is essential for definitive diagnosis of cardiac anomalies in planning and implementing prenatal therapy. **Aims and Objectives:** Assessing gestational age related dynamic changes in fetal hearts by autopsy study of aborted fetuses and interpretation of dimensions of hearts. **Materials and Methods:** Dead and spontaneously aborted fetuses of various gestational age groups were collected and utilized for this study by dissecting hearts and taking measurements. The results were analyzed using Karl Pearson's correlation coefficient, ANOVA – f test and linear regression analysis. **Results:** The mean values of all external measurements of hearts are increasing significantly with gestational age in trimester wise groups whereas they are differing significantly in week wise groups except heart width. **Conclusion:** Morphometric data and their innovative interpretation had immediate applications in both morphological and functional areas of cardiology and helpful in permanent clinical evaluation of fetal heart development.

KEYWORDS : Aborted fetus, External fetal heart dimensions, heart width, Trimester-wise distribution, week-wise distribution.

INTRODUCTION

The growth rate of organs in fetal stage is very high in bringing out changes in morphologic and morphometric appearance of vital organs. Knowledge of these dynamic changes is helpful in evaluation of good pregnancy outcome by doing prenatal diagnosis by measuring certain vital organs like heart, brain, kidneys, etc. in addition to external body dimensions of fetus. Evaluation of cardiac structure is essential for definitive diagnosis of cardiac anomalies in planning and implementing prenatal therapy. Congenital cardiac malformations are the most common anomalies encountered in pediatric clinics in terms of frequency and severity with an incidence of 3-9 per 1000 live births¹.

Early diagnosis of cardiac malformations involves permanent clinical evaluations of fetal heart development. The morphometric data and their innovative interpretation have applications in both morphological and functional areas of cardiology. Correct assessment of fetal heart dimensions and their evaluation through study of aborted fetuses would offer useful dimensional landmarks in interpretation of echocardiographic studies and performing surgical techniques in situ. Thereby decreasing incidence of mortality rate in fetuses.

AIMS AND OBJECTIVES

The present study aimed at assessing gestational age related changes in fetal hearts by autopsy study of dead and spontaneously aborted fetuses and interpretation of exterior dimensions of hearts and correlating them with each other.

MATERIALS AND METHODS

A total of 60 apparently dead and spontaneously aborted fetuses of both sexes or 10 to 40 weeks of gestational age groups were utilized for this study. These were collected from the Dept. of Obstetrics and Gynaecology, Govt. Maternity Hospital, Tirupati after obtaining informed consent from the relatives as per ethical clearance certificate from Institutional

Ethics Committee. The study was conducted in Dept. of Anatomy, S.V. Medical College, Tirupati by following dissection method. The fetuses were transferred in 10% formalin solution. After observing congenital malformations if any, the fetuses were embalmed using multiple injection technique. Fetal thoracic cavity was opened and the contents of thorax were explored in situ for any congenital abnormality. The heart is separated from the surrounding structures after cutting the great vessels at the level of their entry. The heart is weighed with blood clots in situ after its removal using simple physical balance, in an attempt to restore the normal contour of chambers. The morphometric parameters were observed and recorded using measuring tape, thread (for heart circumference) and digital calipers in millimeters.

The measurements observed were – Heart height (Hrt.Ht), Heart weight (Hrt.Wt), Heart diameter (Hrt. D), Heart width (Hrt. Wd) and Heart circumference (Hrt. C). Total fetuses studied are categorized into three trimester groups viz., 0-12 weeks; 13-28 weeks & 29 weeks – term based on gestational age. Each group was again categorized into month wise (4 week period) subgroups. The data collected were analyzed and subjected to the following statistical tests - Student t test, Karl Pearson's Correlation coefficient, ANOVA -f test and linear regression analysis.

RESULTS

A total of 37 male and 23 female fetuses were observed. Most of fetuses are from third trimester age group. The location of heart and its relations are normal in all fetuses.

Table.1. Morphology of fetal hearts

S.No.	Morphological parameter	No.of cases	Percentage
1	Rounded contour	6	10
2	Prominent vasculature	4	6.67
3	Increased cardio thoracic ratio	1	1.67

Among 60 fetuses, rounded contour of heart was observed in 6

cases (10%), prominent vasculature in 4 cases (6.67%) and increased cardio-thoracic ratio in 1 case (1.67%).

Table.2: External cardiac parameters - Gestational age (trimester-wise)

Parameters	Gestational age	N	Mean	Std. deviation	F-value	p-value
Hrt.H (mm)	I Trimester	4	25.6700	5.43876	6.625**	0.003
	II Trimester	15	30.3260	5.46292		
	III Trimester	41	35.3344	6.69166		
Hrt.D (mm)	I Trimester	4	13.745	4.6795	8.860**	0.000
	II Trimester	15	18.909	4.2990		
	III Trimester	41	23.482	5.6666		
Hrt.Wd (mm)	I Trimester	4	18.0325	5.88497	4.951*	0.010
	II Trimester	15	25.5347	6.66854		
	III Trimester	41	29.0885	7.52698		
Hrt.Wt (gms)	I Trimester	4	4.5500	2.87634	5.468**	0.007
	II Trimester	15	9.8933	4.14668		
	III Trimester	40	14.0225	7.19158		
Hrt.C (cm)	I Trimester	4	5.25	1.443	7.975**	0.001
	II Trimester	15	7.70	1.850		
	III Trimester	40	8.68	1.704		

*significant at p<0.05; **significant at p<0.01.

Heart height (Hrt.H), Heart depth (Hrt.D), Heart width (Hrt.Wd), and Heart weight (Hrt.Wt), Heart circumference (Hrt.C).

Table.3: Gestational age (week-wise) averages of external cardiac parameters.

Parameters	Gestational age	N	Mean	Std. deviation	F-value	p-value
Hrt.H (mm)	9 - 12 weeks	4	25.6700	5.43876	2.646*	0.026
	13 - 16 weeks	3	31.3133	6.93601		
	17 - 20 weeks	2	26.5450	8.98733		
	21 - 24 weeks	10	30.7860	4.79800		
	25 - 28 weeks	14	33.4250	7.50164		
	29 - 32 weeks	7	35.4286	6.24299		
Hrt.D (mm)	9 - 12 weeks	4	13.745	4.6795	2.807*	0.019
	13 - 16 weeks	3	19.577	3.3088		
	17 - 20 weeks	2	17.360	9.7722		
	21 - 24 weeks	10	19.019	3.8743		
	25 - 28 weeks	14	23.273	7.5882		
	29 - 32 weeks	7	23.224	5.8213		
Hrt.Wd (mm)	9 - 12 weeks	4	18.0325	5.88497	2.228	0.054
	13 - 16 weeks	3	28.2667	9.22327		
	17 - 20 weeks	2	17.2700	3.40825		
	21 - 24 weeks	10	26.3680	5.52643		
	25 - 28 weeks	14	28.7207	10.93910		
	29 - 32 weeks	7	27.8643	6.29476		
Hrt.Wt (gms)	9 - 12 weeks	4	4.5500	2.87634	2.295*	0.049
	13 - 16 weeks	3	8.7000	2.99040		
	17 - 20 weeks	2	10.1250	9.01561		
	21 - 24 weeks	10	10.2050	3.89033		
	25 - 28 weeks	13	11.5308	6.62415		
	29 - 32 weeks	7	14.9786	7.21335		
Hrt.C (cm)	9 - 12 weeks	4	5.25	1.443	3.173*	0.010
	13 - 16 weeks	3	8.50	2.291		
	17 - 20 weeks	2	6.25	2.475		
	21 - 24 weeks	10	7.75	1.671		
	25 - 28 weeks	13	8.24	1.857		
	29 - 32 weeks	7	8.79	1.822		
	32 wks-term	20	8.93	1.592		

*significant at p<0.05; **significant at p<0.01.

Heart height (Hrt.H), Heart depth (Hrt.D), Heart width (Hrt.Wd), Heart weight (Hrt.Wt), Heart circumference (Hrt.C).

Gestational age wise and Week-wise distribution of external cardiac parameters of aborted fetuses were presented in Tables. 2 & 3 which are showing one way ANOVA carried out in the sample studied and revealing that the mean values of all parameters are increasing significantly with the gestational

age in trimester wise groups whereas in week-wise groups they are differing significantly. The statistical analysis of these parameters indicate that all parameters are varying significantly in week-wise groups except heart width which did not show significant difference in week-wise.

Table.4: Correlation matrices for external cardiac parameters in aborted fetuses

	Hrt. Ht(mm)	Hrt. Dt(mm)	Hrt. Wd(mm)	Hrt. Wt.(g)	Hrt. C(cm)
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Hrt.Ht(mm)					
Hrt.Dt(mm)	.850(**)				
Hrt.Wd(mm)	.779(**)	.840(**)			
Hrt.Wt(g)	.844(**)	.833(**)	.740(**)		
Hrt.C(cm)	.866(**)	.883(**)	.909(**)	.817(**)	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Hrt.Ht(Heart height); Hrt.Dt(heart depth); Hrt.Wd(heart width); Hrt.Wt(heart weight); Hrt.C(heart circumference).

A correlation matrix for external cardiac parameters in Table.4 shows that all the external cardiac parameters are having significant strong positive correlation among each other. Independent sample 't' tests for gender showed no significant difference between genders of different gestational ages with regard to all given parameters.

DISCUSSION

Most of the specimens collected were of 2nd and 3rd trimester only. The present study did not reveal gender differences in aborted fetuses contrary to the reports of Elizabeth Hurlock², Schultz et.al.³, Brenner et.al.⁴, and Pederson⁵.

The present study did not reveal gender differences of external cardiac parameters in aborted fetuses contrary to that reported in literature^{3,4}. Most of the literature was focused on number of chambers, length and width of heart. In addition to those reported in literature heart depth and heart circumference were also included in the present study. Limited literature is available on cardiac morphometric parameters of fetuses and these are mostly based on reports on western population. The reported studies were based on either ultrasonographic or on autopsy findings. In the present study observations were on autopsied fetuses.

The present study established that the size of heart increases with gestational age agreeing with those reported in literature⁶⁻¹¹.

CONCLUSION

The morphometric data and their innovative interpretation had immediate applications in both morphological and functional areas of cardiology and helpful in permanent clinical evaluation of fetal heart development during gestational period. Correct assessment of fetal heart dimensions and their evaluation through the study of aborted fetuses in ontogenesis could offer useful dimensional landmarks during gestational period for better analysis.

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