

ORIGINAL RESEARCH ARTICLE

GROWTH AND DEVELOPMENT OF THE LIVER IN HUMAN FOETUSES

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ABSTRACT

Background: Liver is the largest compound gland in the body. Liver is one of the organs of interest for researchers since a long time. Though, detailed study about adult liver is there but liver at different stages in the fetal period is far less available. The present study attempted to find out the relationship between the body weight and liver weight in different gestational weeks of foetuses.

Methods: The study was carried out on 40 spontaneously aborted human foetuses of known gestational age ranging from 10 weeks to 38 weeks. The weight of the foetuses was measured in grams on digital weighing machine. The anterior abdominal wall was dissected and the liver was removed. The weight of the liver was measured in grams on digital weighing machine. Data of the study were statistical analyzed by using the Microsoft Excel 2007 program.

Results: The average body weight of foetuses at 10th week and 38th week was 28 and 3200 gm respectively. The average weight of liver at 10th week and 38th week was 2.2 and 120.1 gm respectively. The relative ratio between liver weight and body weight at 10th week and 38th week are 7.86 and 3.75 respectively.

Conclusions: Evaluating body and liver weights and measurements against known standards is an important part of perinatal pathology. It also provides new insights to the anatomist and clinician for understanding and developing knowledge in both normal and pathological conditions of liver tissue.

INTRODUCTION

The liver is the largest compound gland in the body and, after the skin, the largest single organ. It weighs approximately 1500 grams in adult.¹ From early childhood onward, it occupies right hypochondrium, epigastrium and extends upto the left hypochondrium. It is located below the diaphragm.² The ratio of liver to body weight decreases with growth from infancy to adulthood. The liver weight is 4–5% of body weight in infancy and decreases to approximately 2% in adulthood. The size and weight of the liver also varies according to sex- being smaller in females, age and with the individuals under different conditions.³

The liver primordium arises as a ventral outgrowth of the endoderm, the hepatic diverticulum or liver bud, from the distal part of the foregut early in the fourth week. The liver grows rapidly from the 5th to 10th weeks and fills a large part of the upper abdominal cavity.⁴ Liver secretes bile and performs a numbers of functions which are metabolism, synthesis, storage, excretion and protection. The fetal liver is an active site of hematopoiesis in the second trimester fetuses. It is essential for all the stages of life.⁵

Liver is one of the organs of interest for researchers since a long time. Though, detailed study about adult liver is there in the literature but liver at different stages in the fetal period is far less available. Hence, the present study attempted to find out the relationship between the body weight and liver weight in different gestational weeks foetuses.

METHODS

The present cross-sectional study was conducted from January 2020 to January 2021, in the Department of Anatomy, Manipal College of Medical Sciences. This research was approved by the Institutional research ethical committee of MEMG/IRC/GA. Forty aborted human foetuses, aged between 10th to 38th gestational weeks were obtained from the Department of Obstetrics and Gynaecology and stored in 10 % formalin. The foetuses included the spontaneous abortion and still born foetuses. Foetuses with any anomaly or pathology were excluded in the study. The age of foetuses was calculated from the obstetrical history, crown rump length (CRL) and crown heel length (CHL). The weight of the foetuses was measured in grams on digital weighing machine (Figure 1). The dissection was done according to the Cunningham's manual of practical anatomy 15th edition.⁶ The order of dissection was as follows:

Incisions were taken on anterior abdominal from the xyphoid process to the pubic symphysis, from xyphoid process along the costal margin till midaxillary line on either side, from pubic symphysis to Anterior superior Iliac Spine (ASIA) above inguinal canal on either side. Then the flaps were reflected laterally from the midline. The morphological observations were noted on the liver after opening the abdomen. The liver was detached from all the ligaments, porta hepatis and diaphragm. Care was taken not to cut the liver. The weight of the liver was measured in grams on digital weighing machine (Figure 2). The percentage relative weight of liver was calculated by the formula: % relative weight of liver = Liver weight/Body weightX100. All the data were represented as mean then analyzed with Microsoft Excel 2007 software and represented graphically.



Figure 1: Measuring weight of foetus



Figure 2: Measuring weight of foetal liver

RESULTS

The results of mean body weight, weight of liver and ratio of liver and foetal weight is shown in Table 1.

The average body weight of foetuses at 10th week and 38th week was 28 and 3200 gm respectively. The average weight of liver at 10th week and 38th week was 2.2 and 120.1 gm respectively. The relative ratio between liver weight and body weight at 10th week and 38th week are 7.86 and 3.75 respectively. In the present study the body weight of foetuses and foetal liver weight showed gradual increase from 10th week to 38th weeks of gestation. The present study shows that the liver comprises 7.86% of the body weight in the 10th week and 3.75% in the 38th week foetuses. Scatter graph showing weight of foetuses against gestational age is shown in figure 3. Scatter graph showing mean weight of liver against gestational age is shown in figure 4. Scatter graph showing ratio of liver and body weight against gestational age is shown in figure 5.

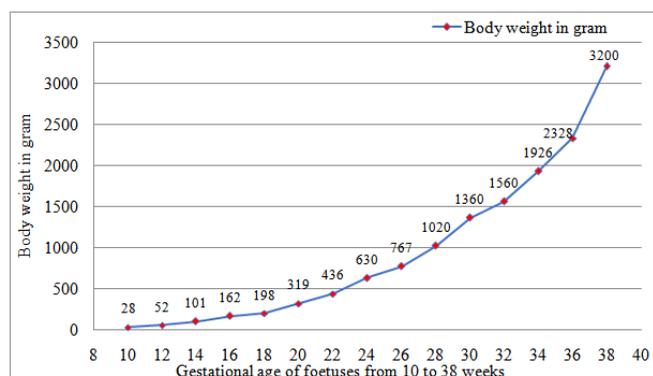


Figure 3: Scatter graph showing weight of foetuses in gram against gestational age

Table 1: Mean body weight, weight of liver and ratio of liver and foetal weight

Gestational age (GA) in weeks	Number of foetuses	Body weight in gm	Weight of liver in gm	% Relative weight of liver
10	2	28	2.2	7.86
12	3	52	2.4	4.62
14	2	101	2.7	2.67
16	3	162	4.6	2.84
18	2	198	8.2	4.14
20	3	319	12.4	3.89
22	4	436	17.3	3.97
24	3	630	26.1	4.14
26	3	767	36.6	4.77
28	2	1020	42.1	4.13
30	3	1360	47.2	3.47
32	2	1560	60.2	3.86
34	2	1926	85.6	4.44
36	3	2328	96.2	4.13
38	3	3200	120.1	3.75

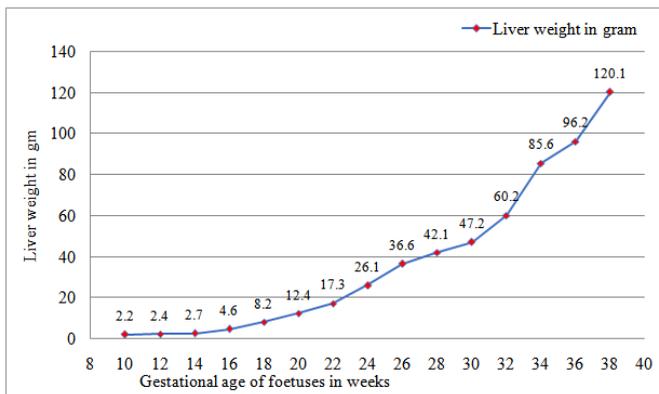


Figure 4: Scatter graph showing weight of liver in gram against gestational age

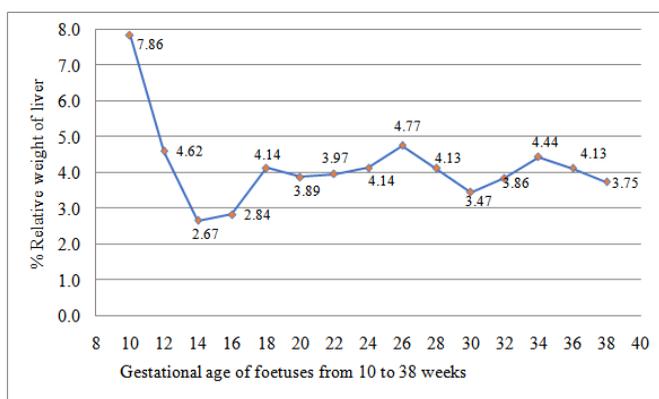


Figure 5: Scatter graph showing ratio of liver and body weight against gestational age

DISCUSSION

Increase in foetal weight as well as organ weight is a good indicator of foetal growth in general. Rate of weight gain during early gestational age differs considerably with late gestational age. In the present study the weight of foetuses showed gradual increase from 10th week to 38th weeks of gestation. These findings were compared with the findings of others researchers and was in agreement well with that of Keith Moore,⁷ while it is less compared to the findings obtained from the study of Hamilton⁸ and Anne Marie Guihard Costa⁹. These differences may be due to racial, genetic, or nutritional differences. Many studies suggest that fetal liver size and weight measurements are valuable tools in detecting intrauterine growth retardation, gestational diabetes, intrauterine infections, isoimmunization, neoplasms, certain metabolic diseases and fetal macrosomias and their follow up.^{10,11}

Gruenwald and Minh had extensively worked on the organ weights of fetuses in relation to body weight. According to them liver weight during 24th week of gestation was 32 gm and during 40 week was 149 gm.¹² In the present study liver weight during 24th week of gestation was 26 gm and during 38 week was 120 gm. Schulz et al have studied organ weight and

body weight in number of fetuses. They conclude that the liver weight increases from 5th month to 10th month of gestation. The average weight in 5th month was 18 gm and in 10th month was 129 gm.¹³ The present study shows the liver weight increases from 12.4 gm to 120 gm from 5th month to 10th month of gestational age respectively. Porter and Craig have given the extensive data to correlate the body weight and organ weight in different periods of gestation. Their study showed that liver weight increases from 0.8 gm to 155 gm from 12th to 40th weeks of gestational age respectively.¹⁴ The present study shows the liver weight increases from 2.4 gm to 120 gm from 12th to 38th weeks of gestational age respectively.

Previous studies with Ultrasonography technique, done by Callen¹⁵ and Gimondo et. al.¹⁶ provided the range of fetal liver weight from 20th to 40th gestational weeks. Their findings on liver weight were slightly lower than the present investigations. In this cadaveric study, we acquired data in the weight of the fetal liver between 10th to 38th weeks. In the present study, the mean liver weight was found to be slightly higher than Soner Albay et al. studies.¹⁷

In comparison of relative weight of liver, it is seen that the findings of Gruenwald and Minh are comparable than the findings of present study.¹² Previous studies report that the liver comprises 10% of the body weight at the 10th week and 2% at birth.¹⁸ The present study show that the liver comprises 7-8% of the body weight in the 10th week and this ratio drops down to 3-4% in the 38th week. Another study which was done by Mitropoulos et al.¹⁹ was that all organ weights/body weights was found almost constant after 30 weeks gestation, which is found to be in conformity with the finding of the present study. These differences may be due to difference in sample size of study, different technique used, genetic and environmental factors which may affects the foetal and liver development.

To the best of our knowledge, this study has attempted to completely investigate the relationship between the growth of foetal liver and body from 10th to 38th gestational age of developing human foetuses. However, the present study cannot determine how the early growth of liver has appeared in the fetuses before 10th weeks of gestation and is the limitation of the study.

CONCLUSION

The present study confirms that in the normally developing foetuses the body and liver weight increases with increase in gestational age. The findings of this study also confirmed the relative weight of liver was more in the early gestational age. Evaluating body and liver weights and measurements against known standards is an important part of perinatal pathology. It also provides new insights to the anatomist and clinician for understanding and developing knowledge in both normal and pathological conditions of liver tissue.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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