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Research Article

HISTOGENESIS OF LIVER IN HUMAN FOETUSES

***Aradhyula Himabindu and Battam Narasinga Rao**
Department of Anatomy, GITAM institute of Medical Sciences &Research (GIMSR), Rushikonda, Visakhapatnam, India
**Author for Correspondence*

ABSTRACT
Liver is an important gland of gastrointestinal tract having both exocrine and endocrine functions and it is having the extensive power of regeneration. Its main function is to store excess of glucose in the form of glycogen. Not only the adult liver, the foetal liver is an important organ with synthetic and haemopoietic functions. The present study on histogenesis of liver in human fetuses is to unravel the sequence of events in different weeks of gestation. In the liver, the hepatocytes are arranged around the central vein in the form of radiating cords giving a lobular pattern, efferent and afferent structures are present at the periphery of the lobule in the form of portal triad and it shows an extensive haemopoiesis in mid gestation. So the present study confirmed the lobular pattern, portal triad structures and primitive blood vessels within the sinusoids showing foetal haemopoietic function which regress towards the term, at which the hepatocytes are occupied by plentiful glycogen deposits.

Keywords: *Liver, Portal Triad, Haemopoiesis, Glycogen Deposits*

INTRODUCTION
The liver is the largest gland of the human body present in the abdominal cavity. The importance of liver as a gland is in its cell hepatocyte, most versatile cell in the body. It is a cell with both exocrine and endocrine function. It is the metabolic centre of vertebrates and expresses various metabolic enzymes for carbohydrate metabolism and detoxification. In order to perform its functions efficiently, the liver possesses a highly organized and complex tissue structure composed of hepatic parenchymal cells, biliary epithelial cells, and sinusoidal endothelial cells (Kenjiro, 2010). The dominance of liver over other glands is its extraordinary capacity for regeneration. In foetal life, it arises as a glandular bud from the primitive gut at 4 weeks of intrauterine life. The primary hepatic diverticulum rapidly invades the mesenchyme of the septum transversum. The forepart of the diverticular cells rapidly proliferates to form the parenchyma of the gland. The hind part of the diverticulum persists as the bile duct. The mesenchyme of the septum transversum form the Glisson's capsule and connective tissue framework of the gland, forming hexagonal hepatic lobule. The foetal vessels while converging into sinusvenosus divide the liver parenchyma in the form of strands around these vessels. Due to continuous proliferation of cells, the course of these vessels is completely interrupted and capillary like vessels, sinusoids are formed. The thick trabeculae of the early stages are gradually reduced to a single layer of cells after birth. In the meantime, primitive blood cells make their appearance in the perivascular mesenchyme between endothelium and liver cells which indicates foetal haemopoiesis (Sophie *et al.*, 2008). As it is the important gland in prenatal and postnatal life, the present study of histogenesis of liver was taken to know the sequence of events that happens in the human foetal liver in different gestational weeks.

MATERIALS AND METHODS
Fifty human destitute foetuses of different gestations obtained from the local hospitals of Vizianagaram and from the hospital of MIMS constituted the material for this study. Depending on CRL they are divided into different gestational weeks. The abdominal cavity was opened and liver was taken out and preserved in 10% formalin. Foetal liver was subjected to the protocol for the study with H&E staining.

RESULTS AND DISCUSSION
Observations
At 10 Weeks
Section shows mesenchymal cells having an irregular anastomosis with sinusoids entrapped between the anastomosing cords (figure 1). The anastomosing cords are so compact that sinusoids are seen as small

linear spaces in contrast to what is traditionally described as sinusoid. At places with in sinusoids clusters of dark nuclei are seen abundantly that shows haematopoiesis (figure 1).

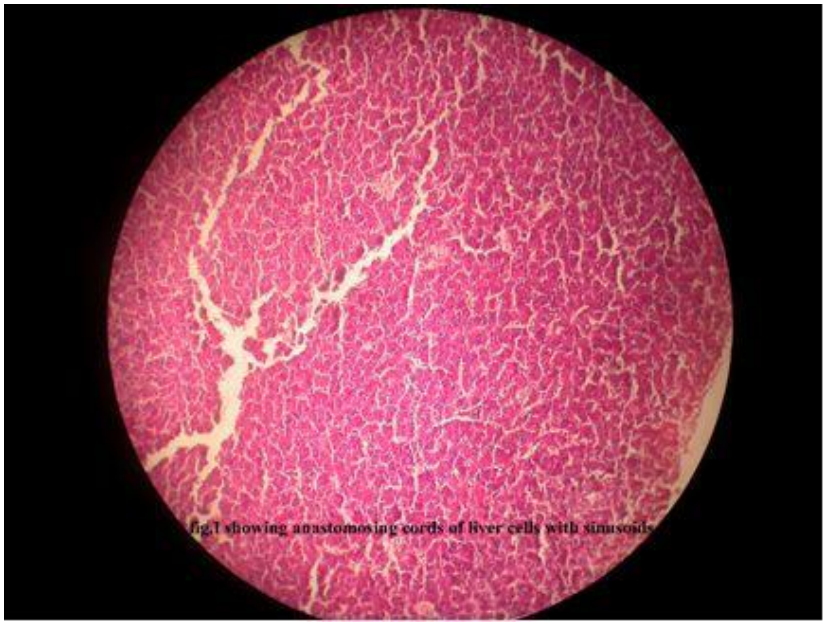

Figure 1: Showing anastomosing cords of hepatocytes with sinusoids

12 Weeks

Lobular pattern of liver started along with appearance of portal triad structures. At 12 weeks a central vein is clearly seen and hepatic laminae are radiating in a centripetal direction. Portal triad surrounded by connective tissue is observed during this gestational period (figure 2).

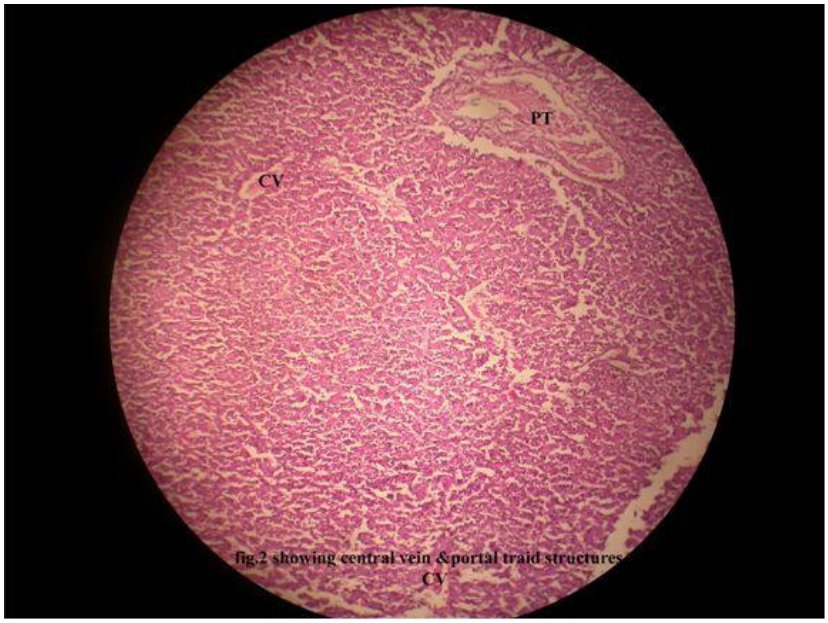

Figure 2: Showing central vein and portal traid structures

16 Weeks

Lobular pattern is very much defined .Primitive blood cells were identified in the sinusoids (figure 3).

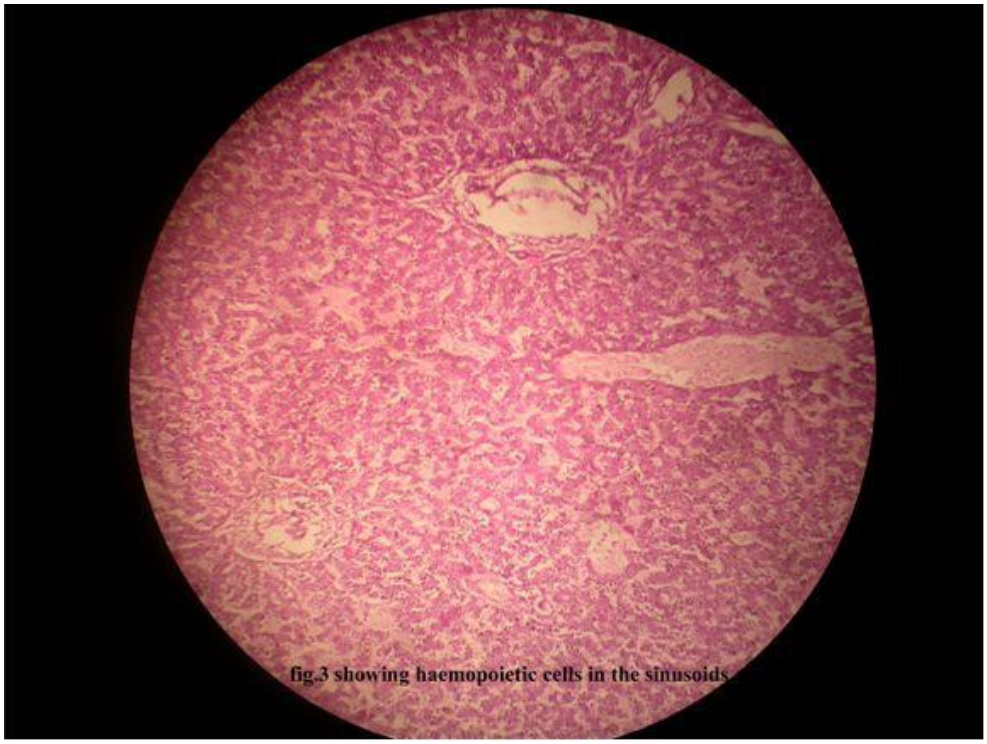

Figure 3: Showing haemopoietic cells in the sinusoids

22 Weeks-24 Weeks

Haemapoiesis is still dominating, showing the haemapoietic function of liver during fetal life. The black specks, which are seen, are the nuclei of cells derived from haemopoietic system (figure 4, figure 5, figure 6).

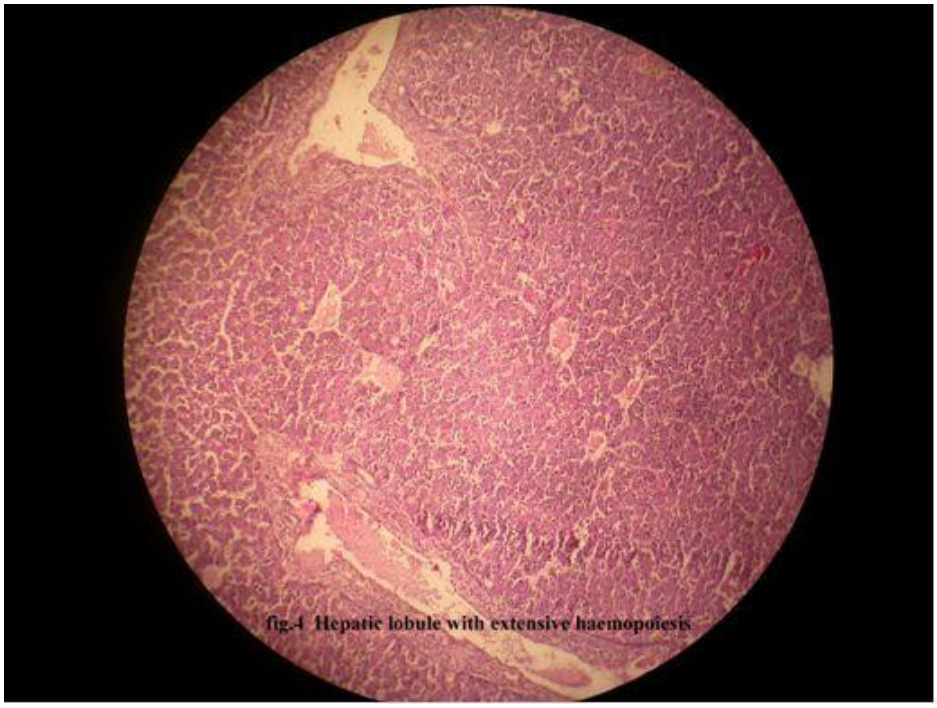

Figure 4: Hepatic lobule with extensive haemopoiesis

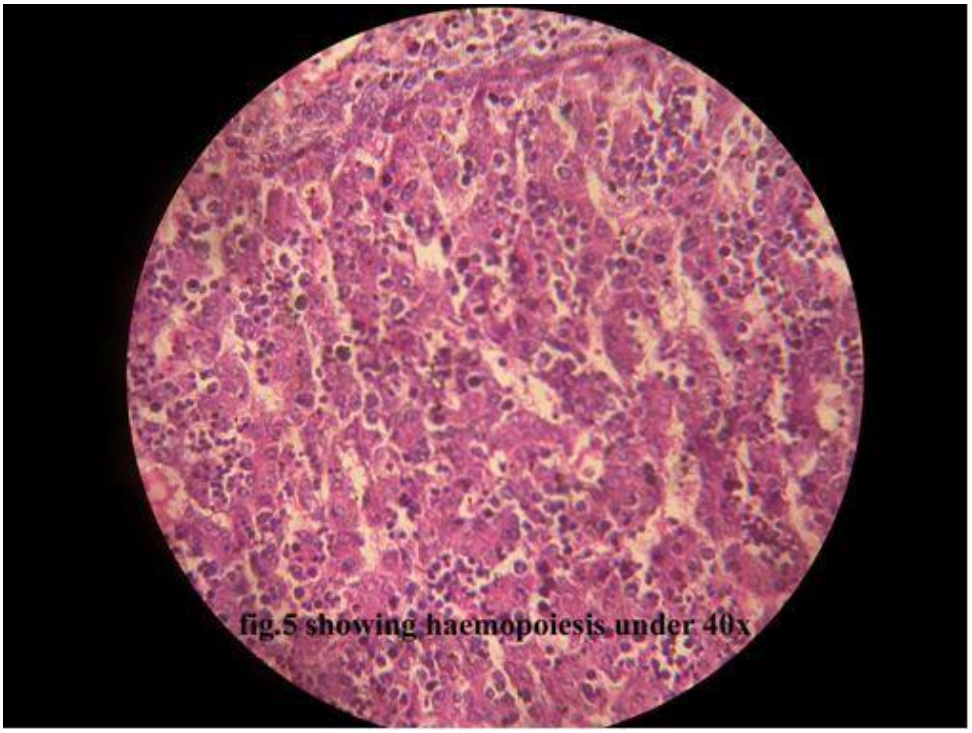

Figure 5: Haemopoietic cells under 40x

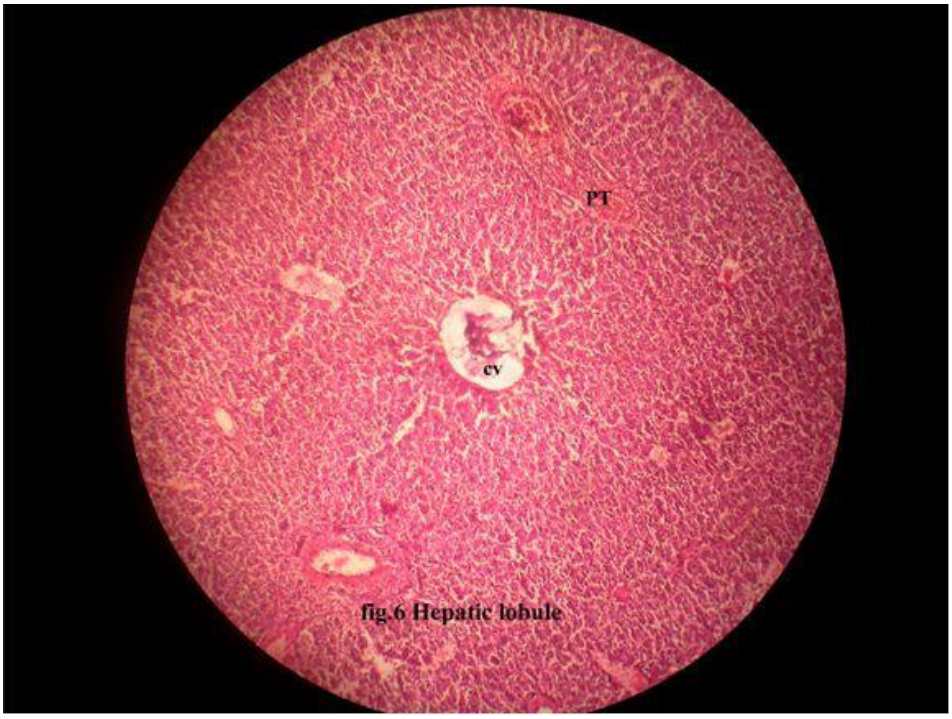

Figure 6: Hepatic lobule

26 Weeks

The dominating haemapoiesis has become focal, most probably because of bone marrow haemapoiesis may have started by this time. There are areas showing vacuoles that represent glycogen deposits. So glycogen deposition started (figure 7).

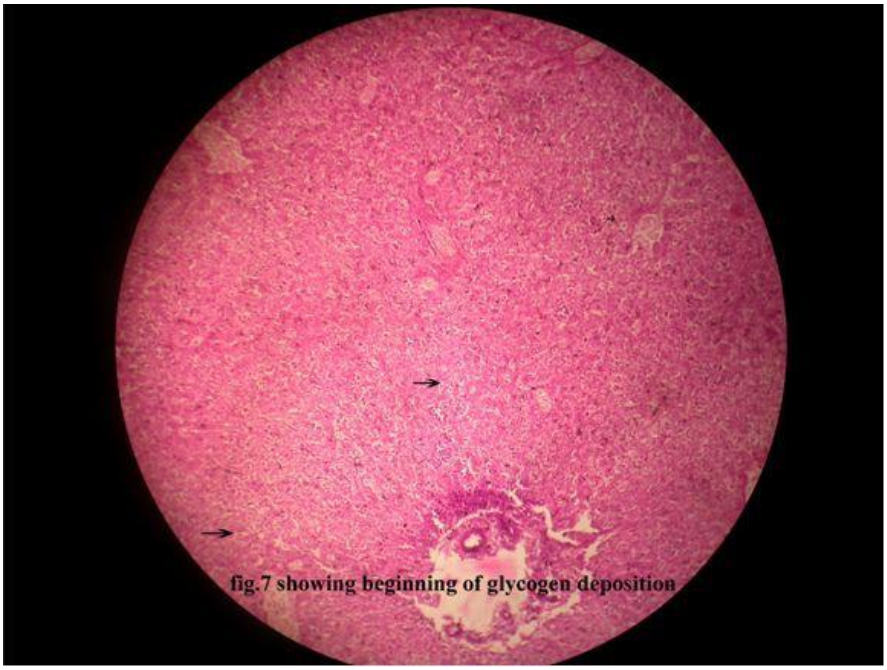

Figure 7: Showing beginning of glycogen deposits

34 Weeks

Lobular pattern is further sharpened.

Haemopoietic activity is very much reduced by the absence of dark stained nuclei.

Glycogen vacuolization is seen as fine white speckling round spaces in most of the field indicate a high glycogen activity, which is the feature of developing liver towards term (figure 8, figure 9).

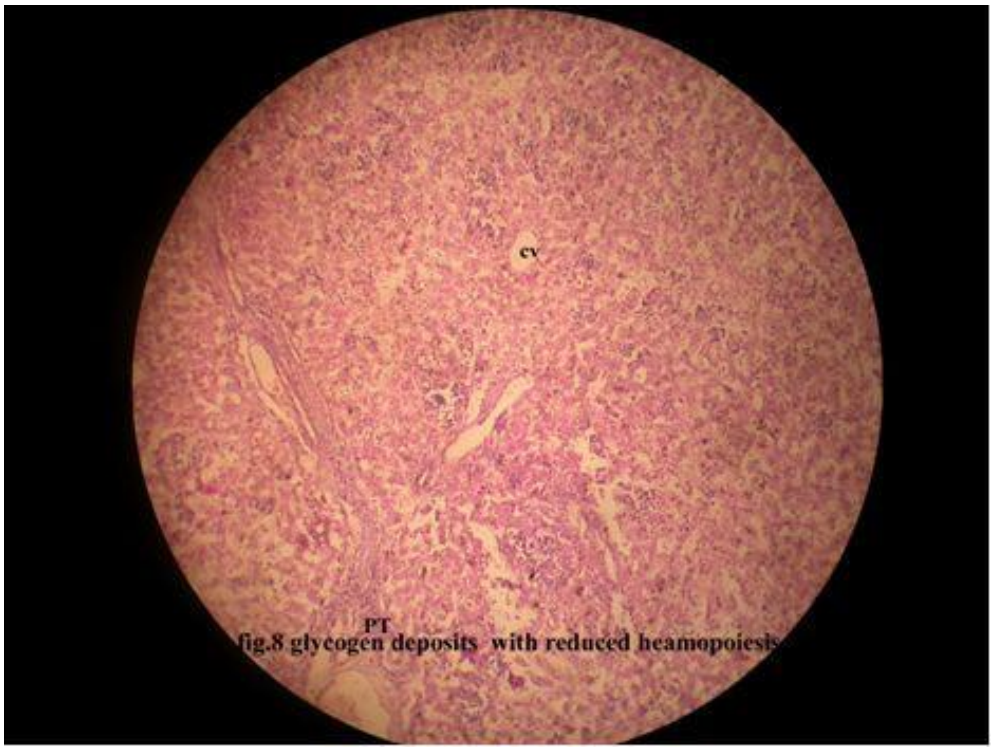

Figure 8: Glycogen deposits with reduced haemopoiesis

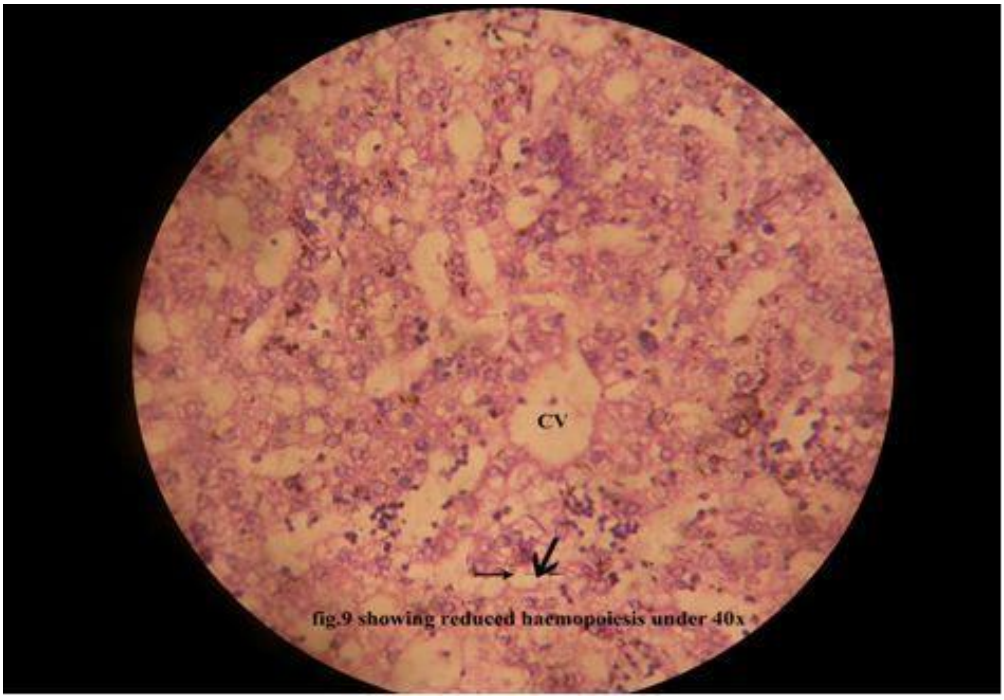

Figure 9: Reduced haemopoiesis under 40x

Full Term

Glycogen deposits have been increased enormously.

Clear differentiation of hepatocytes & hepatic lamellae are observed. Haematopoiesis is further reduced by the absence of primitive blood cells in hepatic sinusoids (figure 10, figure 11).

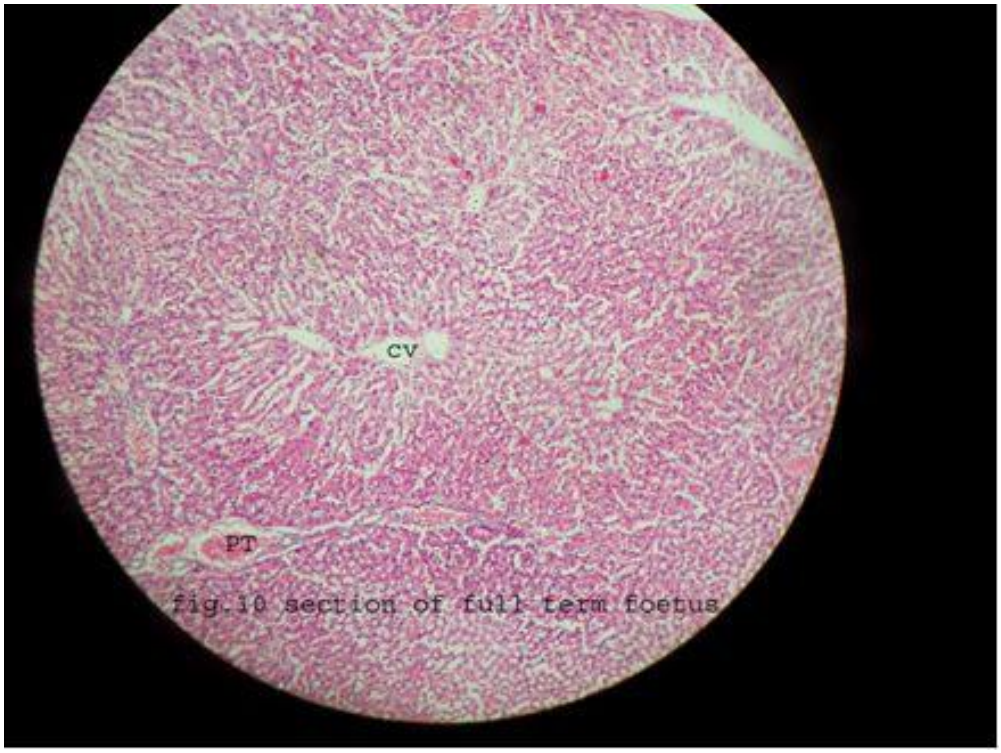

Figure 10: Section of full term foetal liver

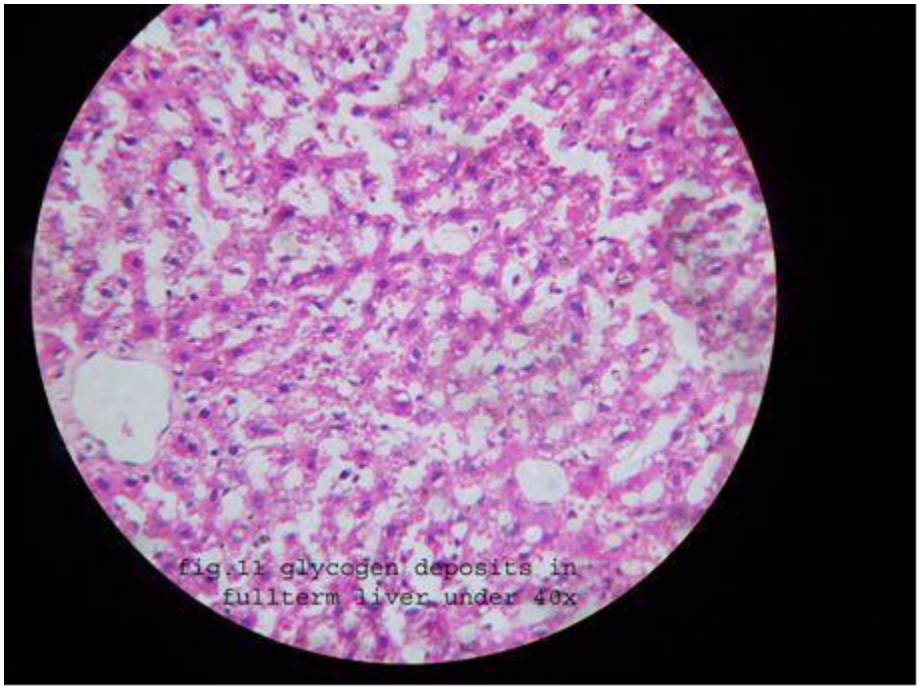

Figure 11: Glycogen deposits at full term under 40x

Discussion

The structural units of liver, hepatic lobule were first reported by wepfer (1664), later by Malphigi (1666). Kierman (1833) defined the hepatic lobule as hexagonal structure that has central vein in its centre. He also that the boundaries are clearly defined by connective tissue only in few species like pig and it is sparse in humans except in the portal traids.

Elias (1949) described the cord like arrangement of hepatocytes that branch and anastomose enclosing sinusoids between them.

He Suyan (1983) described that the lobular formation in the liver starts between 9-12 weeks of gestation.

Anne *et al.*, (1996) described different stages of liver development. The first stage which extends between 5 to7 weeks of gestation, consists of hepatoblasts arranged in thick, anastomosing cords separated by irregular vascular spaces containing intravascular blood cells, mostly of the erythroid lineage

The second stage corresponds to 8to 10 weeks of gestation, during which the definitive vascular architecture of the fetal liver becomes established. Afferent portal veins surrounded by a mesenchymal tissue and efferent vessels in the form of terminal suprahepatic veins are observed within the fetal liver. Hepatic cords are separated by sinusoid-like vessels containing haematopoietic islands. The third stage corresponds with 10 to 12 weeks of gestation is characterised by the maximum intensity of haematopoiesis. The last trimester of gestation was the last stage of his study, during that period the fetal haematopoiesis progressively stops. The early hepatic cords remain thick throughout intrauterine period of life and fetal hepatocytes are filled with glycogen until birth. Hepatic haemopoiesis starts from 7 or 8 weeks of gestation and reaches maximum at 20 weeks .By the time bone marrow haemopoietic function starts liver haemopoisis regresses by 28-32 weeks of gestation (Linda *et al.*, 2011).

The intrahepatic arterial radicles and branches of portal vein appear within the liver parenchyma at 10 weeks of gestation (Sophie *et al.*, 2008). Initially they are located in the centre of fetal liver, later they reach the periphery of liver at 15 weeks (Gouysee *et al.*, 2002). The intrahepatic capillaries which are developed from embryonic vessels are lined by continuous endothelium at 8 weeks of gestation, later they are differentiated into sinusoids with fenestrated endothelium at 17 weeks (Marchiarelli *et al.*, 1988). The hepatocytes of foetal liver at the time of birth show glycogen vacuolization of the epithelial cells, which is the characteristic feature of foetal liver in the last weeks of gestation (Marie *et al.*, 1957).

In the present study hepatocytes are identified as anastomosing cords at10 weeks of gestation and lobular pattern from 12 weeks onwards. The portal triad is observed at 12 weeks of intrauterine life. According to the literature, foetal haemopoiesis starts at 2 months, attains maximum by 24 to 28 weeks and the present study confirms the same.

The glycogen deposits were observed in the foetal liver during last trimester.

Conclusion

The present study of "The histogenesis of liver in human foetuses" is characterized by the cellular differentiation of septum transversum giving raise to the stromal cells of the liver and the hepatic diverticulum, the hepatic trabeculae.

The epithelial cords were enmeshed with stromal capillaries simultaneously. The hepatic gland and its vascular channels showed considerable enlargement because of its haemopoietic function.In the later weeks of gestation there is a slow reversal of haemopoietic function most probably because of taking up of haemopoietic function by bone marrow. This is followed by appearance of glycogen deposits in the foetal liver which are plenty near the term.

REFERENCES

Anne Couverald, Jeans-Yves Scoazec, Marie-Christine Dauge, Annie-France Bringuier, Francois Potet and Gerard Feldmann (1996). Structural and Functional Differentiation of sinusoidal endothelial cells during liver organogenesis in humans. *Blood Journal*, hematologylibray.org **87**(11) 4568-4580.

Elias H (1949). A reexamination of the structure of the mammalian liver I, parenchymal architecture II, The hepatic lobule & biliary system. *American Journal of Anatomy* **84** 311- 333 85.379-456.

Gouysee G, Couverald A, Frachon S, Bouvier R, Nejjari M, Dauge MC, Feldman G, Hein D and Scoazec JY (2002). Relationship between vascular development and vascular differentiation during liver organogenesis in humans. *Journal of Hepatology* **37** 730-740.

He Suyan (1983). Histogenesis of the human liver. *Acta Anatomica Sinica* 02.

Kenjiro Katsu (2010). Histogenesis of developing chick liver, (project) Department of pattern formation (Division of organogenesis) Institute of molecular embryology and genetics, Kumamoto University.

Kierman F (1833). The anatomy and physiology of the liver. *Philosophical Transactions of Roy Society London Biological Science* **123** 711-770.

Linda M. Ernest, Edurado D Ruchelli and Dale S Huff (2011). Colour atlas of fetal and neonatal histology chapter 4 liver 66-77 [Pierre Russo].

Macchiarelli G, Makabe S and Motta PM (1988). Scanning electron microscopy of adult and fetal liver sinusoids. In: *Sinusoids in Human Liver: Health and Disease*, edited by Bioulac-Sage P, Balabaud C and Rijswijk Kupffer (Cell Foundation) 63-85.

Malpighi M (1666). De viscerum structura exercitation anatomica Bononiae.

Marie A Valdes-Dapena (1957). An Atlas of foetal and neonatal histology, copyright, Liver 75-87.

Sophie Collardeau-Frachon and Jeans-Yves Scoazec (2008). Vascular development and differentiation during human liver organogenesis. *The Anatomical Record* **291** 614-627.

Wepfer HE (1664). De dubiis anatomicis, epistula ad Jacob. Hen. Paulum, Nürnberg.