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Study of Liver Development in Laboratory Mice Embryos mus musculus

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ABSTRACT: The current study aimed to follow up some embryonic developments in the Swiss white mice Mus musculus to identify the nature of these developments in order to increase scientific knowledge from this aspect as well as the importance of mice as a model for experimental studies.The liver is the largest internal organ that provides essential metabolic and endocrine functions, these include the production of bile, metabolism of nutritional compounds, detoxification, regulation of glucose levels through glycogen storage and control of blood balance by secreting clotting factors and serum proteins.Hepatocytes are the main cell type in the liver, accounting for about 70% of adult organ mass, hepatocytes and biliary epithelial cells are derived from the embryonic endoderm while visceral cells, astrocytes, kupffer cells and vascular cells are of mesoderm origin.After the occurrence of internal fertilization, the fertilized egg begins to divide until the blastomeres divide into the trophectoderm, which forms the placenta in the future, and the mass of internal cells that later form the embryo.

KEYWORDS: liver development. Embryos. mus musculus. Embryonic development.

INTRODUCTION

Mice are considered one of the important laboratory animals being a standard model because they summarize the evolution of disease and genetic development in a high and rapid manner that suits many studies and because they are small in size and fast reproduction as well as their prices are appropriate and easy to raise, obtain and deal with (Wong et aI, 2015). as they are amenable to manipulation of genetics and have similar aspects with humans in terms of pathophysiology and therapeutic nature, which made them the most widely used models in studies. Pritchett, 2007).).

Mice embryos are important in scientific experiments, as the cellular organization of the mice liver is exactly similar to that of other mammals, confirming that the mice provides a useful animal model for studying liver structure and function (Baratta et al., 2009).

The study of liver development in mice has garnered great attention from embryology researchers for more than 60 years, encouraging scientists to investigate the important roles played by the liver in storing and releasing nutrients and its important role in removing toxic substances (Sigal et al., 1999).

The fetal liver is responsible for the production of red blood cells during embryonic development, and the liver goes through two stages characterized by the maturation of hepatocytes and the increase of connective tissue through several stages of morphological changes (Khanna, 2014).

The liver, bile duct system, and pancreas share a common origin from the definitive ventral endoderm forming the foregut in human. Cardinale et al.,(2012)

The liver is the largest internal organe, providing a site for hematopoiesis during gestational development and critical metabolic, synthetic, and detoxification in adulthoodi. Liver development is regulated by a finely balanced and progressive series of cellular and molecular interactions. Ader et al .,(2006), Liver development begins when a diverticulumi of the caudal fore-gut and it part of the splanchnic mesenchymee unit, after that immature hepatic cells (hepatoblasts) begin to form as the liver bud following interactions between the epithelial cells of the endoderm with cardiogenic cells of the mesoderm , Critical to the early development of the liver is the epithelial-mesenchymal interactions,. Bossard and Zaret, (2000).

Hepatoblasts proliferate from the endoderm to form a tissue bud and then proliferate further into the adjacent septum transversum, intermingling with endothelial cells. liver morphogenesis requires an interaction between hepatoblasts and blood vessel endothelium. Asahina et al.,(2006).

the liver extends to its unique capacity to regenerate in response to the loss of liver mass or injuries. As a biochemical defense against toxic chemicals and reprocess or of absorbed substrates, the liver may be periodically exposed to harmful factors . Mao et al.,(2014).

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Exposure to certain chemicals such as antibiotics during pregnancy also has adverse effects on the liver growth of rat embryos, leading to abnormalities in liver weight and cellular structure (Ayres-Silva et al., 2011).

MATERIAL AND METHODS

Laboratory animals:

The current study was conducted on 20 females and 10 males of the Swiss white mice, which were obtained from the Faculty of Veterinary Medicine / University of Al-Qadisiyah at the age of 9-11 weeks, the mice were placed in cages with all the requirements for the mating process from temperatures of 20-25 ° C, lighting for 12 hours a day, and appropriate ventilation.Al-ibrahimi et al.,(2020)

Mating

Females were placed with males by (2 females + 1 male) in each cage during the night hours for the purpose of mating, and it was confirmed that the pregnancy occurred by examining the vaginal plug the next morning as in the picture (1) and the pregnancy is considered zero (0) and the next day is the first day of pregnancy (Bayat et al, 2013.)

The vaginal plug serves two purposes: it closes the female mouse's vagina, preventing the escape of sperm from the male mouse, and it prevents other male and female mice from mating again. Sometimes, the vaginal plug of a mouse may fall off inside the cage, Li and Winuthayanon, (2017). so we look for it inside the cage.

Fig (1) Copulatory plug at the vaginal opening.

Animal Dissection The pregnant mice were immolates by placing a cotton swab saturated with chloroform, and after anesthesia it was transferred to the autopsy dish and fixed with pins Female pregnant mice in the 15th and 18th days as in picture (2) and the embryos were kept in a formalin solution of 10% concentration as in picture (3).

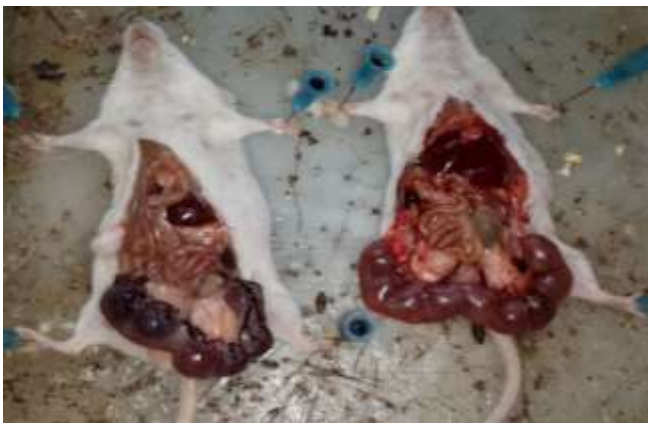

Fig (2) pregnant female on day 15 observe uterine horns and embryos inside.

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Fig (3) mice embryos in formalin solution 10%.

Histological Sections the histological sections of the organs included in the study were prepared following the steps described by Bancroft and Steven, 2002).).

From the first step of fixation to the last step, which is the dyeing of the prepared sections using hematoxlin-eosin dye following the study, Woods and Ellis (1994) as in the picture (4).

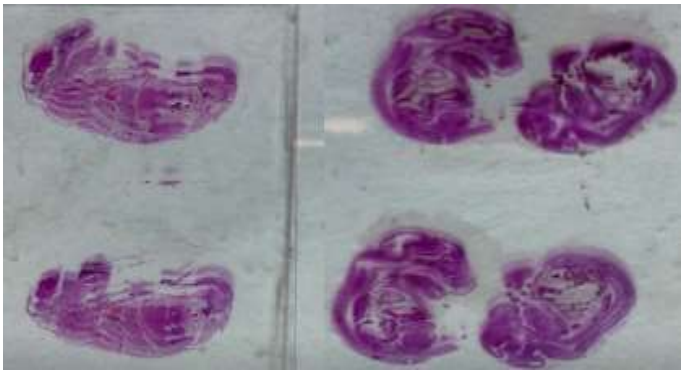

Fig (4) Histological sections of mice embryos.

RESULTS & DISCUSSION

Histological changes in the liver of embryos.`

liver being a vascular connection between the developing placental vessels to the heart, and haemopoietic, as a special tissue where blood stem cells dwell before bone marrow development. Giancotti et al.,(2019).

Histological examination of sections taken from the liver of mice embryos aged 15 days of gestation showed clear liver development and hepatocytes form less regulation of blood vessels and sinusoidal dilation and the appearance of red blood cells as in Figure (5, 6), the study agreed with what was mentioned by Rappaport et al., (1954) The cells that make up the liver acinus are three areas, an area surrounding the central vein and another surrounding the portal area with The appearance of a copious median area with erythrocytes

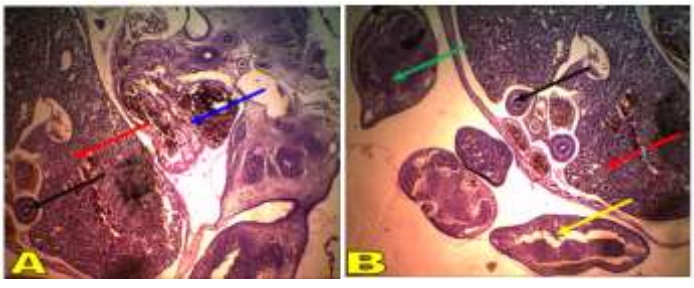

Fig (5) (A and B) represents a transverse section in the mouse embryo (15) days of pregnancy where we observe the heart (blue arrow), liver (red arrow), intestine (black arrow), lungs (yellow arrow) and kidney (green arrow) (H&E,10X).

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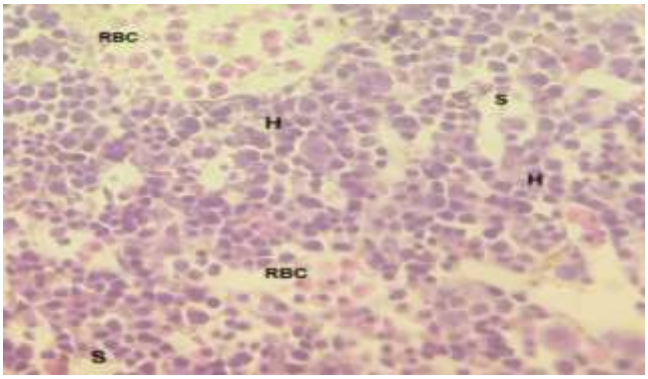

Fig (6) mouse embryo liver aged 15 days of pregnancy, showing hepatocytes(H), sinusoids(S) and many red blood cells Corpuscles (RBC) Vitelline veins are paired structures connected by three anastomotic channels interrupted by developing hepatic trabeculae (H&E,40X).

The histological sections taken from the liver of mice embryos showed the age of 18 days of gestation, the regularity of the cytoarchitecture of the liver tissue was observed more regularly and in order than the previous age stage, as in the picture (7and 8) the development of blood vessels and the development of the cellular engineering structure of the parenchymal tissue Tissue, and the study was consistent with what the study found (Baratta et al., (2009, which stated that astrocytes can be identified by the presence of fat droplets located between endothelial cells and liver cells, while endothelial cells have a long, flat nucleus and mouse liver have the same cellular components and traits as other mammalian species (Riccalton-Banks et al., (2003).

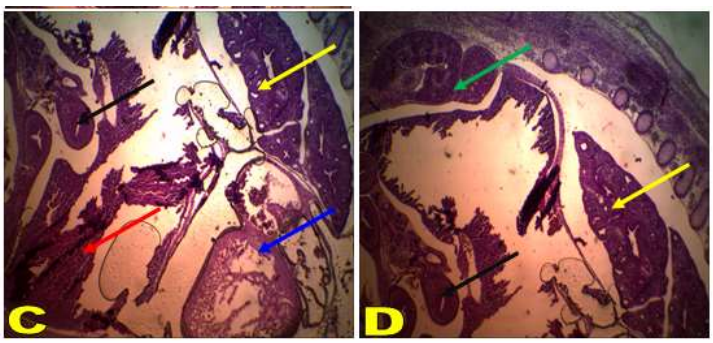

Fig (7) (C and D) A mouse embryo (18) days of pregnancy,the heart (blue arrow), liver (red arrow), intestines (black arrow), lungs (yellow arrow) and kidney (green arrow) (H&E,10X).

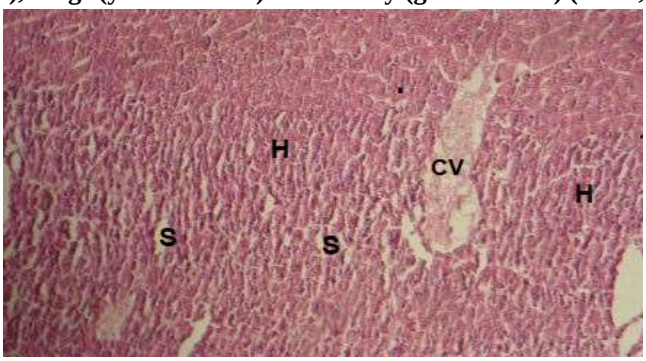

Fig (8) Mouse embryo liver 18 days of pregnancy in which the central vein (CV) is surrounded by hepatocytes (H) Hepatocytes and sinusoids (S) , vitelline veins are largely incorporated into the developing liver as hepatic sinusoids (H&E,40X).

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Histological sections taken from the liver of mice embryos showed the age of 19 days of gestation, the regularity of the cytoarchitecture of the liver tissue was observed more regularly and in order than the previous age stage, Several hematopoietic cells are seen interspersed among hepatoblasts which display large nuclei and scanty cytoplasm as in the picture (9 and 10) .

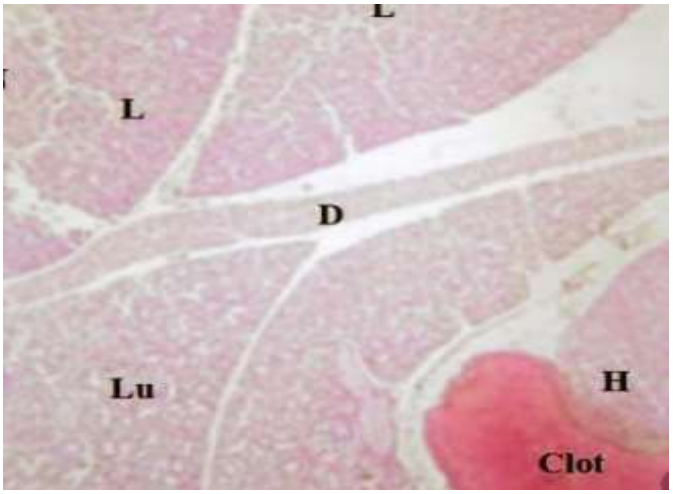

Fig (9) This histological section of mouse embryo shwoing : The heart (H), the lung (Lu), the diaphragm (D) and the liver (L). The heart has a big blood clot resulting from tissue preperation. The lobes of the lung ara clear.

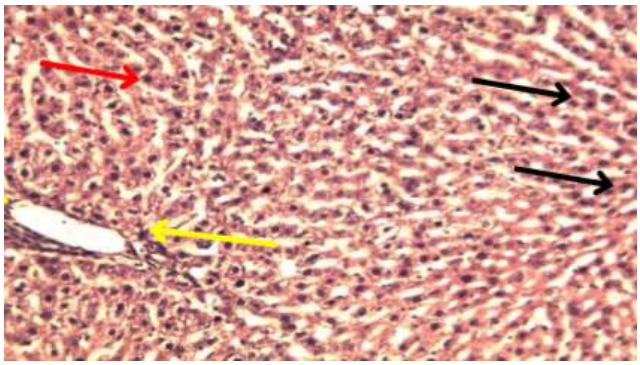

Fig (10) Section of mouse liver shows tissues of the liver and bile duct (yellow arrow) and hematopoietic cells are observed among the hepatocytes which begin to show cuboidal morphology and large clear cytoplasm (H&E,10X).

Modern studies showed that human fetal liver organoids mimic human liver development, including of hepato-biliary organogenesis, and can differentiate toward hepatocyte and cholangiocyte structures with improved function.
Vyas et al.,(2018).
Ability to proliferation and differentiation of the hepatic progenitor cells to form hepatocytes, that human HpSCs can be effective in treating patients with liver disease. Khan et al., (2010).

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