Development of the circulatory system in the chicken embryo

Haider ali naser

Khairi.iraq2009@gamil.com
Department of Biology, College of Education for Pure Science,
Wasit University, Iraq

ABSTRACT

This research was in Laboratory No. 3 in the Department of Life Sciences / College of Education for Pure Sciences at Wasit University to track the development of the blood vessels of chicken embryos in different growth periods as well as to study the rates of egg weights of different ages and this research included chicken embryos due to the ease of Where the samples (eggs) were .access and ease of entry and follow-up. Persistent collected 150 locally fertilized eggs from Al-Kut market and placed in the incubator at a temperature of 37 ° for a period of 14 days and weighed during the first day and examined by a photodetector, then the samples were divided into three groups for the purpose of histological study, knowledge of changes and follow-up of embryonic development And through the study of the .(According to the way the dye works (Hematoxlyn-Eosin histological sections, it became clear that the blood vessels at the beginning of their development appear in the form of blood islands and then develop into a blood vessel whose wall consists of one region of cells in the wings of the mesoderm at the stage of 24-22 incubation hours. Part of the opaque area near the transparent area was observed. It is more opaque and has a speckled appearance due to the invasion of the lateral mesoderm as a result of its peripheral growth and access to it. As for the endoderm, its cells have its peripheral part adherent to the yolk, and this part of the yard is called the vascular area, which suffers a rapid expansion, is in the form of a blood network on the seventh day and then this network connects with each other To form a blood circulation (outgoing and afferent). On day 14, the vitelline blood vessel appears in a large and clear way, and the vitelline vein is observed, due to the increased consumption of the fetus In terms of studying the averages, egg weights during the first and second week, the weight loss of those eggs is observed during this period and is consistent with the development of blood vessels, and it may be the reason for the loss of egg weight with the effect of temperature on the egg and the growth of the fetus inside the egg.

Keywords: Development , circulatory system, chick, embry

Introduction

The circulatory system in the chicken embryo develops from the mesoderm. (1)

At the ends of the mesoderm, scattered mesodermal cells appear, as it is the first indicator of the formation of the first blood islands and is called the area vasculos. (2)

In the head region, the psyllum enlarges and there is a large vesicle on each side called the cardiac thalamic vesicle, and as the growth progresses, the two vesicles unite with each other to form a large space, which is the cavity around the heart. (3)

They arise from localized enlargements in the thickness of the visceral mesoderm. As the growth continues, internal cavities are created that separate central and peripheral cells for each group of enlarged cells. Central cells give blood cells, and peripheral cells give root islets. (4)

❋ In a chicken embryo 24 hours of brooding, the cavity between the visceral side and the somatic side expands on both sides of the anterior intestinal pylorus, as the visceral mesoderm thickens at the edge of the anterior intestinal pylorus, as well as cells separate from the inner surface of the epidermis. Visceral medium to be the primacy of craving(5)

In a fetus of 25 hours of incubation, in the anterior intestinal pylorus, a bending of the visceral crystal occurs and an increase in the .visceral mesoderm thickness is observed (6).

In an embryo of 26 hours of incubation, these two groups of cells are arranged to take the form of a tube with an extreme precision on .each side of the intestinal portal

The tube structure is with a wall consisting of one row of the vacuole called the tube endocardial, from which the endocardium or the inner layer of the heart arises (8). Thick In this muscle. (9

period of growth the lateral edges of the anterior intestinal portal fuse close to the left and right endocardial tubes of each other. (10)

In a fetus for 28 hours of incubation, the two endocardial tubes become close together, as the two parts of the muscle-outer layer close together on the ventral side, consisting of a double-walled membrane, the ventral mesangium (11). Mesocardium and then approaching it from the dorsal side, forming another double support membrane, the mesocardium do. (12)

A fetus at the age of 29 hours of incubation, the tubes of the heart are completely attached and merged into one tube surrounded by the muscular heart, thus forming the tubular heart. (13)

In Jenin, 29-30 hours of incubation, the heart • appears straight (14), and is hidden under the posterior brain in the dorsal view (15). Veins omphalomesenteric. (16)

In a fetus of 33 hours of embrace, the heart enlarges and protrudes from the right side of the fetus (17) and is bounded on the anterior side by the trunk or arterial cone that branches into a right abdominal aortic root and a left and posterior right and left mesenteric vein. (18)

Central cells differentiate into blood cells containing hemoclobin. (19)

Peripheral cell differentiation and islet wall formation. (20)

The vascular space has become a real network of islets connected to each other in forming a network of blood vessels on the surface of the blood vessel, whose function will be to absorb and transport the yolk after it is digested to the fetus. (21)

While the heart is distinguished, we notice that the blood cells also began to distinguish within the islets of blood, where these islands connect to each other, forming a network of vitelline blood vessels that spread far from the fetus in the part of the dark space known as the vascular space and thus there is an open path for blood cells to It reaches the heart. (22)

The mesenteric umbilical veins have been distinguished as a posterior extension of the cardiac tube (23) as well as the vascular network. The yolk began to approach the fetus little by little until the vitelline blood vessels met one of the umbilical mesenteric veins, so that each umbilical mesenteric vein transports blood from the vitelline circulation to the heart. (24)

In a fetus for 48 incubation hours, the two mesenteric arteries are clearly visible, which represent an extension of the dorsal aorta from the front of the fetus to the end of approximately the thirteenth mesodermal segment. (25)

They expand and each one of them bends outward in the direction of the additional embryonic region, and connects to the vitelline blood network, and each artery transports blood from one of the dorsal aorta to the vitelline network. (26)

Thus, the fetal circulation would have completed and became in direct contact with the fetal circulation, which began to appear in the additional embryonic region away from the fetus. (27)

The circulatory system consists of the heart and blood vessel :

A – The heart: It is a twisted tube consisting of four main chambers (the venous sinus, the atrium, the ventricle and the arterial bulb that extends from it forward to the arterial trunk). (28)

B. – Major blood vessels: Four pairs of aortic arches emerge from the arterial trunk, and extend. The dorsal aorta on the dorsal side of the body below the notch cord, and near the 23rd mesodermal segment, two mesenteric arteries extend from the dorsal aorta, each heading to the yolk. Two major anterior while blood collects from the posterior region of the body and two major veins posterior, and the major veins open on each side into a channel called the Cuvier duct. (30)

The size or weight of an egg varies in a flock of chickens due to several circumstances, and the exact reason for some of these differences is not yet known. But many of them have proven to be related to some factors:

Some of these differences in egg size (31) are as follows:

1- Some chicks lay eggs larger than other chicks, and the reason is clearly hereditary, which has an effect on the length of time (time) of ovarian follicle growth (ova) and in turn, large yolks produce large eggs, and vice versa.
2- The first eggs of the chick are smaller than the eggs laid later, the size of the eggs increases with the progress of the chick in production, but the increasing increase in size is not uniform, as the size increases rapidly in the first part of the egg production period, but later on it increases slowly.
3- The sequence of an egg in the chain affects its size. In most cases, the first egg in the chain is the heaviest, and each subsequent egg in the chain is smaller.
4- In such cases, the size of the yolk decreases with the successive egg production, but the decrease in the size of the following eggs is also due to the decrease in the amount of egg white secreted (albumin).
5- Some food components affect the egg s measurement, for example the egg measurement increases with the increase in the protein content in the feed.
6- Hot weather affects the herd, causing a decrease in the size of eggs. (32)

From the table, it is clear that the weight of a medium-shell chicken egg is 60 grams. But in culinary recipes the third row is often used, since one piece has an average weight of 40 grams. A package of 12 pieces of class C2, which are found most often, weighs about 600-700 grams. And a kilogram, depending on the variety, can be from 12 to 25 pieces. (35)

Other country standards may differ from ours. Therefore, in the UK, products weighing 50-60 grams are considered average. And Australia recognizes them as very large, because for them the middle class is only 43 grams. (36

Regardless of the class of eggs, the proportions in which the weight is distributed between shell, shellfish and protein are almost the same:

The ratio of shell to the total weight of chicken eggs is 12%;

The weight of the yolk is about one third of the total egg weight (32%);

Protein accounts for the largest percentage of weight – 56%.

Accordingly, the weight of eggs without the shell is 88% of the total weight. And because cooking acts as a protective cocoon, the water does not penetrate, and the nutrients are not digested – the weight of the egg remains unchanged. (37) .The weight of a boiled egg is almost the same as that of a raw egg, but will be slightly less than that of a roasted one in the skillet. But the caloric content of a fried egg is always higher – if it is fresh it contains 50 to 80 calories, then cooking in the skillet is about twice as large. (38) .Thus, the approximate weight of a hard-boiled egg without taking into account the shell will be:

★ Class 3 – 35 grams.
★Class 2 – 44 grams;
★ 1 class – 53 grams;
★ Selected – 62 grams,
★ The highest category is 70 grams.

The mass of raw chicken eggs can vary from 40 to 80 grams. The largest of them will be the higher class eggs denoted by the letter "B" – they usually weigh between 75 and 80 grams. The price of this product, of course, is always more expensive. Slightly less weight in the selected eggs – 65-75 grams. The remaining eggs are divided into three categories. The first ones are those whose weight is kept between 55-65 grams. The second – eggs weighing from 45 to 55 grams, and the third category includes products in 40 grams. (39) .

At the same time, the mass of whiteness does not always depend only on size. Also of importance is the weight of the protein, as it accounts for more than half of the mass of the product. The share of yolk accounts for about 36% of the total weight, and the crust – the remaining 12-13%. Thus, we can safely say that eggs of the highest class contain the largest amount of protein, which, by the way, is almost completely absorbed into the human body. The weight of the largest chicken eggs in the world, listed in the Guinness Book of Records, is 136 grams. (40)

Since protein is the most important part of the egg, it is especially important to take the class into account when calculating its weight, because the largest egg chosen will have twice the protein compared to the product of the third class. Accordingly, if the dish requires specific proportions, and the diet – strict compliance with calories, the error may be very large. (41)

The average weight of chicken protein is:

★ 23 grams – for the third category,
★ 29 grams – the second time.
★ 34 grams – for the first time,
★ 40 grams – for selectivity,
★ 46 grams – up.

Material and Method

Sample collection and sample dividing method :

A-Sample collection:

150 eggs were collected (fertilized) locally from Al-Kut market, and they were placed in the incubator at a temperature of 37 °. Then the eggs were examined under a light detector and weighed during the first day for a period of 14 days.

B-Sample dividing method:

After collecting the sample, the samples were divided into three groups:

1- The first group was 50 fertilized eggs, which represented a control group.

2. The second group, which contains 50 fertilized eggs, is for weight study.

3. The third group of 50 fertilized eggs is for studying the development of the circulatory system.

This research was done in Laboratory No. 3 in the Life Sciences Department at the Faculty of Education for Pure Sciences at the University of Wasit during the period (29/12/2020) to (10/ 3 /2021)

The histological study :

As confirmed by the researcher (42), the method was followed for the purposes of the histological study by (42)

The Hematoxylen-Eosin methodt, where the formative solutions used in the current study in particular, were prepared. Power (X, 10X, 40, X^4) to determine the histological changes in embryo samples and to follow the embryonic .development in chicken embryo samples

The embryo samples were measured and their length using the oculatar and stuge micrometer to inspect the microscope and take the required measurements. (43)

Results and discussion

The study (44) of the development of blood vessels showed that they appear in the form of blood islands in the mesoderm (wings of the mesoderm) at the stage of 22-24 incubation hours (45), where the part of the hallmark near the transparent area appears more. Dark and mottled appearance (46) somewhat unlike its distant part, and this is confirmed by the researcher (47) and that the reason for the darkness of this part is the invasion of the lateral mesoderm as a result of its peripheral growth (48) and its access to it, while the endoderm whose cells are its peripheral part stuck on the yard. As confirmed by the researcher (49)

As for the part of the opaque area close to the transparent area (50), to which the growth of the mesoderm has reached, it is known as the area opaca vasculasa, because blood vessels originate from the mesoderm (51). The mottled

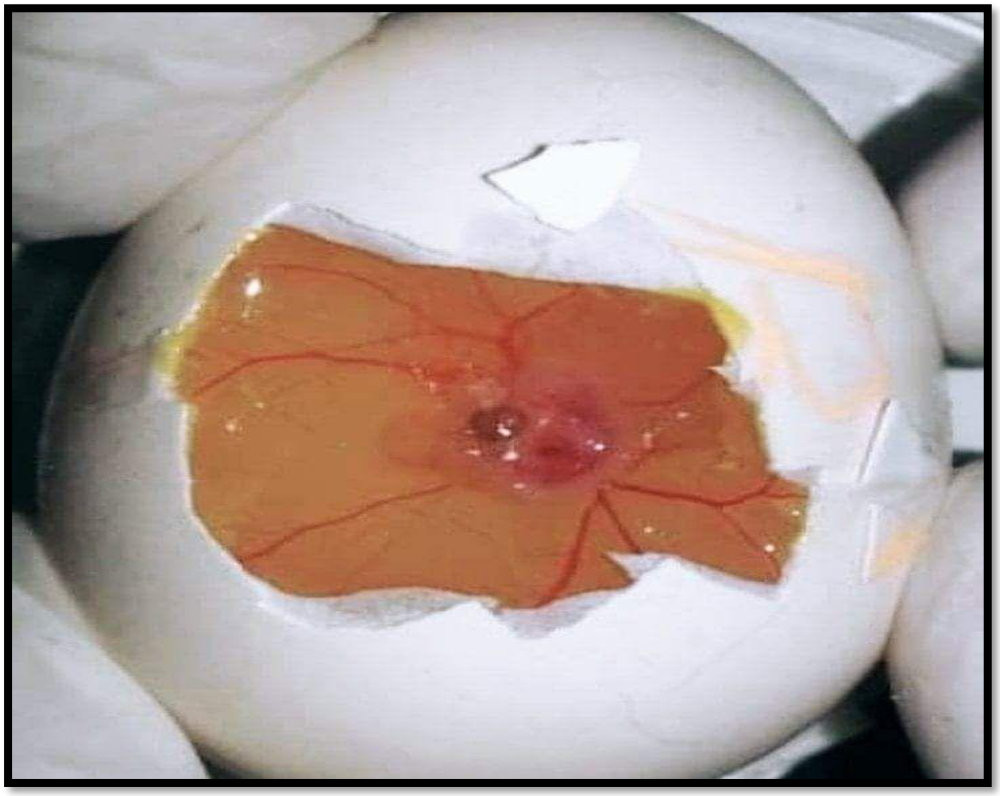
appearance of the pia area, the vessel in the mesoderm, is attributed to the form of cellular aggregates called islets, which form the beginning of the formation of blood vessels and blood corpuscles, and this agrees with the researcher (52)

Image showing blood islands in a chicken embryo.
Image number 1

The area vasculasa outside the fetus after 24 hours of incubation suffers rapidly expanding and its appearance is in the form of a grid as the fetus ages. (53)

The boundaries surrounding the vascular area are indicated by a dark stripe (54) which is the beginning of the formation of a blood vessel, which is an extension and convergence of blood islands (55) and that its formation is a step in organizing the vascular network of the fetus on the surface of the yolk (56) which will in the future become a medium for the absorption and transport of nutrients. To the fetus (57)

And when the formation of the vascular network is complete and its connection with each other, there will be a blood circulation (outgoing and incoming) and this is what the researcher confirmed (58)



.A picture showing the formation of blood vessels in Jenin, aged 48 hours
Image number 2

The blood circulation, especially the veins, appears clearly as the fetus gets older (59), such as the vitelline vein, which appears at this stage very clearly (60) and the reason for an increase in the fetus's need for nutrients coming from the yolk. Agrees with the researcher (61).

The course of blood circulation during the second week (the fetus at the age of 14 days) is very similar to the course of blood circulation in the first week (62) (the fetus at the age of 7 days), but the blood vessels of a wider and larger diameter (63) are noticed the expansion of the vitelline during the second week It is fast and large (64) and the reason why the organs are fully formed and looks forward to an increase in their size and this is what the researcher confirmed (65)

Image showing the development of a vitelline vein in a chicken embryo.
Image number 3

The blood vessel develops in the mesoderm, and at the beginning of its development it is noticed that its wall consists of a single layer of cells, and this is what the researcher said (66).

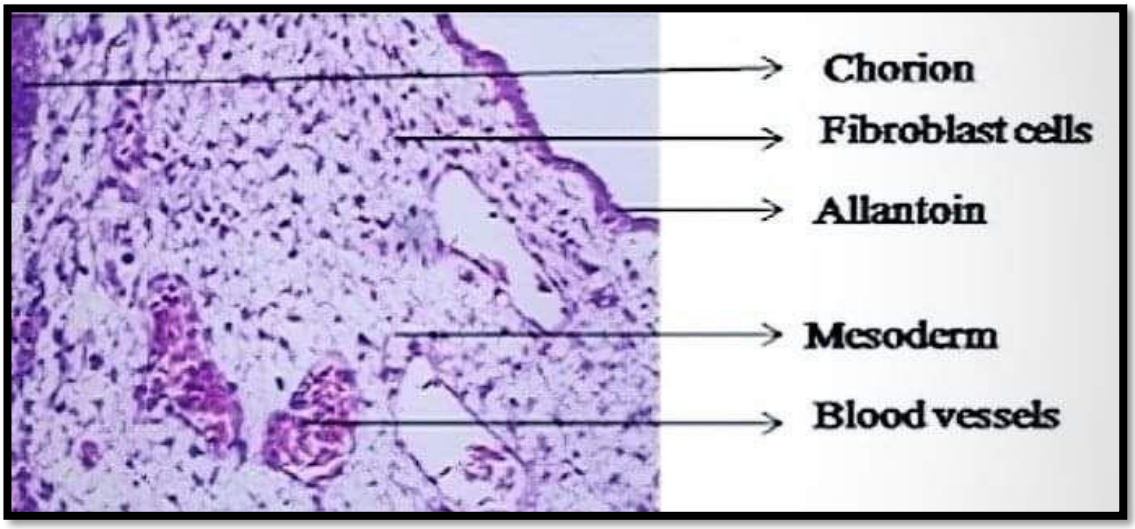


Image showing the blood vessel formation in the mesoderm of chicken embryo
Image number 4

Results and Discussion of Eggs Weight in Chicken:

The current study was conducted to track the embryonic stages of vascular growth and development by selecting the embryos of chickens in order to facilitate access to embryos according to the research study, Loganetal (2002) explained.

That much of the traditional research that was conducted to track the development of blood vessels, included chicken embryos due to obtaining them, ease of entry and continuous follow-up of vascular development, as confirmed by the researcher (68). Days (1, 7, 14) were chosen due to the presence of clear differences and the ease of viewing the vascular network.

Part of the dark courtyard appears at the age of 22 incubation hours. On the seventh day, in the form of a network of blood vessels, and on day 14, the vitelline blood vessel, as shown in the picture on day 14, appears in a large and clear way, and the vitelline vein is observed due to the increased consumption of yolk by the fetus.

In terms of weight and its effect, through a study by Lourens et al. (2006) on two classes of large and small-weight eggs, they observed an insignificant increase in favor of large-weight eggs in the percentage of hatching, which reached 84.1%. 2%. (70)

As Hargit et al. (2006) showed the high level of illiterate immunity in large goose eggs, and this explains the mechanism of the efficiency of illiterate immunity in competition, survival and resistance of hatched chicks of large eggs compared to small eggs. (71)

And as shown in Table One, which represents a sample of samples and weights used,

The weights at the age of one day appear higher than the seventh day, and the seventh day is higher than the fourteenth day, (72)

The rates are shown as follows:

Average of the first day is 46,473

- Average of the seventh day is 44,775
- Fourteenth day rate 43,019

Table No. 2 shows that the egg s weight has decreased due to the effect of temperature on the eggs inside the incubator and the growth of the embryo. (71)

During the study of egg weights averages on days (1; 7; 14), it is noticed that there are significant differences in egg weight, as confirmed by the researcher (72) through the study of the research as shown in Table 1, which represents a sample for samples .

The average weight of eggs on the first day has the highest value of 56,377 and the lowest value of 36,609 (73), so we have the average weight of the first day. Thus, for days 7 and 14, the weights

of eggs cannot be studied individually, the first in large numbers, so the averages of weights are taken to facilitate the study and find differences (74). The 14th, as confirmed by the researcher (75)

As shown in Table 1, which represents the highest and lowest weight and average weights for days (1, 7, 14)

	Weight of egg in first day	Weight of egg in 7 days	Weight of egg in 14 days
Highly weight	56.337	54.221	52.044
Lower weight	36.609	35.329	33.995
Average weight	46.473	44.775	43.019

Which represents the average weights of eggs of different ages
Table 1

Recommendations

1-The use of special tissue cultures in which the development of blood vessels of 7-day-old chicken embryos is tracked.

2-Conducting the study at the level of a light microscope to track the embryonic development accurately.

3-Opening the field to a wide range of conducting various research on avian embryos and establishing advanced laboratories in which to conduct histological and physiological studies related to embryology.

4-Paying more attention to embryology and trying to produce chimeras, which are the result of merging embryos by mixing cells of more than one embryo in early stages of embryonic development.

Conclusions

Through studying the research, we note the following:

1-There are clear differences in growth. After a 22-hour incubation, vascular formation begins, and on day 7 the vascular network appears as a simple network. On day 14 the blood vessels are similar to day 7 but clearer and wider.

2-A decrease in egg weight at a rate of (1-2) grams between the weight of day 1 and day 7, and between day 7 and day 14. Where the first day is the highest weight.

3-Weight loss may be due to:

A-The effect of temperature on the egg.

B -The growth of the fetus inside the eggs.

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