Development of the foundations of the vascular system, development of hematopoiesis, primitive blood circulation

Blood vessel development

The circulatory system is formed as the first system in the 3rd week of embryo development. Primitive blood vessels are formed that connect the embryoblast to the trophoblast, thanks to which the embryo obtains oxygen and nutrients from the trophoblast and transfers there waste products it does not need. Blood vessels are formed in two successive events:

Vasculogenesis

🔎 *For more information see Arterial Development.*

- first in the extraembryonic mesoderme, later also in the intraembryonic mesoderm
- this is a series of events that are controlled by growth factors
- FGR2 first acts on the cells of the extraembryonic mesoderm, later also on the intraembryonic mesoderm; under its influence, mesenchymal cells differentiate into hemangioblasts (FGR2 binds to a receptor on the surface of mesenchymal cells)
- hemangioblasts form groups = blood islets that are exposed to another factor that is produced by the surrounding mesenchymal cells; it is VEGF (vascular endothelial growth factor)

Vasculogenesis and angiogenesis.jpg

- VEGF acts via two different receptors - first it acts on the 2nd receptor; this action leads to the differentiation of hemangioblasts into cells that remained on the surface of the blood island and turn into endothelial cells (angioblasts) and into cells that are in the middle of the islet, do not have contact with the surrounding mesenchymal cells and turn into primitive blood cells (blood stem cells)
- under the influence of the factor on the 1st receptor, angioblasts join together, intercellular connections are formed, mainly zonulae occludentes, and this is how the first blood vessels with the appearance of capillaries are formed, in which primitive blood cells are located, which begin to form hemoglobin, but do not lose nucleus (they remain in the form of erythroblasts)

Angiogenesis

- also regulated by VEGF (tentoraz acts on both receptors at the same time), which stimulates the proliferation of endothelial cells in places where new blood vessels sprout from vessels that are already formed
- TGFβ and PDFG (platelet growth factor) also play an important role here
- growth of already formed primitive vessels, formation of branches, entire networks, vascular channels
- connection of vascular channels, which arise first in the extraembryonic splanchnopleure of the yolk sac (vasa vitelline = yolk = omphalomesenteric vessels), then in the extraembryonic somatopleure of the chorion and the germinal stem (vasa umbilicalia = umbilical vessels) and finally in the cardiogenic zone, which is the area of the future heart

By connecting and differentiating the blood islets in the embryo, the main vessels of the embryo are formed: paired ascending and descending aortas, paired precardial and postcardial veins.

Primitive Blood Circulation

- primitive circulation includes heart, intraembryonic, omphalomesenteric and umbilical vessels
- **arterial circulation** - the right and left aorta ascendens (emerging from the truncus aorticus) are very short, they form the aortic sac - they are divided into six aortic arches that connect to the dorsal aorta - their caudal continuation is the aa.umbilicales , which enter the tortuous chorium through the germinal shaft
- dorsal aortas merge caudally into one unpaired aorta descendens

- **venous circulation** – paired precardial veins bring blood from the cranial regions of the embryo; paired postcardial veins from the remaining regions of the embryo
- precardial and postcardial veins merge into a common trunk = vena cardinallis communis dextra et sinistra (ductus Cuvieri) which opens into the sinus venosus
- sinus venosus also collects blood from the veins of extraembryonic areas – the omphalomesenteric veins and the left umbilical vein

Development of hematopoiesis

Hematopoietic areas During embryonic development, hematopoiesis is first localized in the yolk sac region, later the liver, spleen and finally the bone marrow take over this role.

- hematopoiesis takes place in the wall of the yolk sac from approximately the 14th - 20th day of embryonic development
- definitive stem cells originate from the AGM (aortic-gonad-mesonephros region/mesoderm surrounding the aorta at the level of the plica urogenitalis)
- AGM cells colonize the liver and spleen (after the 6th week of development) and finally the bone marrow (from the 20th week of development)
- the bone marrow becomes the definitive hemopoietic organ

Links

Related Articles

- Development of arteries
- Development of veins

References

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