

## Developmental Physiology of the Fetal Cardiovascular System

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### DESCRIPTION

The anatomy of fetal circulation is a fascinating topic that involves understanding the unique adaptations necessary for the developing fetus to receive sufficient oxygen and nutrients from the mother's blood supply. The human fetus is dependent on the placenta for oxygen and nutrients, and the circulatory system of the fetus must be adapted to support this dependence. The fetal circulation is characterized by a number of unique features that allow for the efficient exchange of gases and nutrients across the placenta while protecting the developing fetus from harmful substances. This study provides a detailed anatomy of the fetal circulation, focusing on the structure and function of the fetal heart, pulmonary and systemic circulations, and the ductus arteriosus.

#### Fetal heart

The fetal heart is a critical component of fetal circulation, and it undergoes several adaptations to meet the demands of the developing fetus. Unlike the adult heart, the fetal heart has two unique structures, the foramen ovale and the ductus arteriosus, which allow blood to bypass the lungs.

The foramen ovale is a small hole located in the septum between the two atria of the fetal heart. This hole allows oxygenated blood from the placenta to flow from the right atrium to the left atrium and bypass the lungs, which are not yet functional. The foramen ovale closes shortly after birth when the pressure in the left atrium increases, closing the valve.

The ductus arteriosus is a small blood vessel that connects the pulmonary artery to the aorta. It allows blood to bypass the lungs and flow directly to the body. The ductus arteriosus also closes shortly after birth as the pressure in the pulmonary artery decreases, causing the valve to close.

#### Placenta

The placenta is an essential component of fetal circulation, acting as the interface between the fetal and maternal blood supplies. It allows for the exchange of oxygen, nutrients, and waste products between the mother and the fetus.

The placenta is composed of two layers: the maternal layer and the fetal layer. The maternal layer contains the maternal blood supply, which flows into the placenta through the uterine arteries. The fetal layer contains the fetal blood supply, which flows into the placenta through the umbilical arteries.

The exchange of gases and nutrients occurs across the placenta through diffusion, facilitated diffusion, and active transport. Oxygen and nutrients, such as glucose, amino acids, and lipids, move from the maternal blood supply to the fetal blood supply. Waste products, such as carbon dioxide and urea, move from the fetal blood supply to the maternal blood supply.

#### Fetal circulatory system

The fetal circulatory system is unique and complex, with several adaptations necessary for the developing fetus to receive sufficient oxygen and nutrients. The fetal circulatory system consists of three major components: the umbilical vein, the ductus venosus, and the umbilical arteries.

The umbilical vein is the largest vessel in the umbilical cord, carrying oxygenated blood from the placenta to the fetus. It enters the fetal circulation through the liver, where it is partially shunted through the ductus venosus and into the inferior vena cava. The rest of the blood flows into the right atrium of the fetal heart.

The ductus venosus is a small blood vessel that connects the umbilical vein to the inferior vena cava, allowing oxygenated blood to bypass the liver. This shunting is necessary because the liver is not yet fully functional in the fetus.

The umbilical arteries are two small blood vessels that carry deoxygenated blood from the fetus to the placenta. They arise from the internal iliac arteries in the fetus and branch out to form a network of capillaries in the placenta, where gas and nutrient exchange occurs.

### CONCLUSION

The fetal circulation is a complex system that is adapted to meet the unique physiological needs of the developing fetus. The fetal heart is responsible for pumping oxygenated blood from the

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**Received:** 02-Jan-2023, Manuscript No. APCR-23-23267; **Editor assigned:** 06-Jan-2023, Pre QC No. APCR-23-23267(PQ); **Reviewed:** 20-Jan-2023, QC No. APCR-23-23267; **Revised:** 27-Jan-2023, Manuscript No. APCR-23-23267(R); **Published:** 03-Feb-2023, DOI: 10.35248/2161-0940.23.13.411

**Citation:** Giussani A (2023) Developmental Physiology of the Fetal Cardiovascular System. *Anat Physiol.* 13:411.

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placenta to the developing tissues, and the pulmonary and systemic circulations are designed to allow for efficient gas and nutrient exchange. The ductus arteriosus is a critical fetal blood

vessel that is essential for shunting blood away from the lungs and into the systemic circulation, but it must close after birth to prevent the development of certain medical conditions.