Coronary Blood Flow

Coronary Circulation is from the coronary Arteries and veins which lie superficially on the heart surface and penetrate the muscular heart layer, myocardium. The arteries branch from the aorta and surround the heart surface like a crown. These arteries and veins make up the coronary heart circulation. The left coronary artery supplies the anterior and left lateral portions of the left ventricle. The right coronary artery supplies most of the right ventricle and the posterior side of the left ventricle. This is true in majority of people.

Normal Coronary Blood Flow

Resting coronary blood flow is roughly 225 ml/min which results in 4- 5% of the total cardiac output. The coronary circulation is in place as only 1/10 mm of the endocardial heart layer is supplied by blood from the chambers. The rest of the heart needs its own nutrition therefore, coronary circulation is important for this function. Due to the fact that the blood is supplied directly from the aorta, the blood is highly oxygenated.

Systole and Diastole

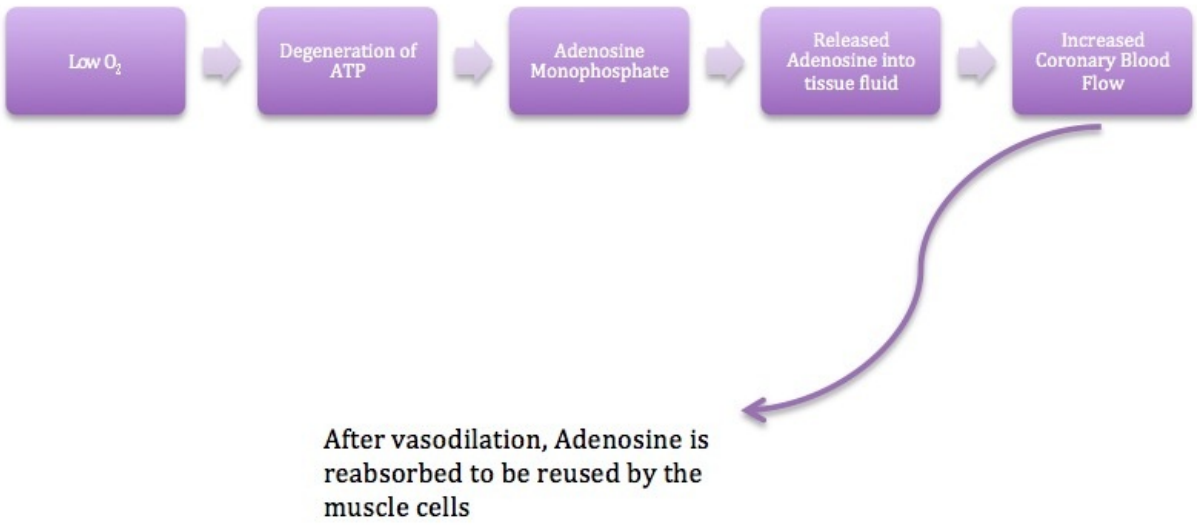
During systole the heart muscle contracts, constricting the coronary heart vessels. This is due to a strong contraction particularly from the left ventricle which compresses the intramuscular vessels. During Diastole the cardiac muscle relaxes, enabling blood to flow through the capillaries with no obstruction. In diastole the blood flows rapidly through the capillaries, providing the heart with nutrition. The right ventricle has far less force of contraction compared to the left ventricle therefore the right side ha less phasic changes to the blood flow compared to the left side.

Control of Coronary Blood Flow

Local arteriolar vasodilation is the main controller of coronary blood flow. Whenever the heart activity is increased, the rate of coronary flow is also increased. This also applies to decreased activity, the blood flow is slowed down. It responds to the local need of nutrition for the heart. This is also known as local muscle metabolism.

Oxygen

Coronary blood flow is regulated almost in exact proportion of oxygen demand for the cardiac muscle. If the heart needs more oxygen, then coronary blood flow must be increased. If there is a decrease in oxygen supply to the heart it is speculated that the heart causes vasodilator substances from the muscle cells to be released so the arterioles dilate. It is thought one of these substances is Adenosine, which is a good vasodilator. See diagram below for the Adenosine mechanism.



- Adenosine is not the only Vasodilator, there are others such as Potassium ions, Carbon dioxide, Hydrogen Ions, and Bradykinin, nitric oxide.

Nervous Control

There are *direct and indirect effects* which are stimulated by the Autonomic nervous system to the heart that control the coronary blood flow as well. **Direct Effects** result from stimulation of the Vagus nerve which in turn releases acetylcholine and norepinephrine and epinephrine from the sympathetic nerves of the coronary vessels. The sympathetic stimulation increases heart rate, activity as well as the metabolic rate, in turn sets off local blood flow regulators which dilate the vessels. The Vagal stimulation functions the opposite way, it slows the heart by depressing the cardiac oxygen consumption and indirectly constricting the coronary arteries. **Indirect Effects** are more important for normal coronary flow conditions as they result from secondary changes of the heart by increased or decreased activity which changes the coronary blood flow.

References

- GUYTON, Arthur C. – HALL, John E.. *Textbook of medical physiology.* 11th edition. Philadelphia : Elsevier Saunders, 2006. Chapter 21: Coronary Circulation. ISBN 0-8089-2317-X.