Coronary –Circulation
Under normal conditions cardiac muscle metabolism is almost exclusively aerobic depending on oxidative phosphorylation to resynthesis the ATP continuously utilized by repetitive, excitation, contraction relaxation. Myocardial oxygen requirements may increase and therefore high and unremitting even under resting conditions.
During stress or exercise oxygen requirements may increase abruptly by three to four folds. Unlike skeletal muscle, cardiac muscle cannot obtain more oxygen by extracting greater percentage of the oxygen delivered to it. Myocardial oxygen extraction is near maximal at rest. So the major mechanism by which oxygen delivery to myocardium can be augmented is by an increase in the amount of coronary artery blood flow.
Capillary density is very high in heart muscle commensurate with the high oxygen requirements of myocardial cells. Collectively the coronary vasculature and the blood it contain account for approximately 15% of the total mass of the heart.
The pattern of blood flow to the left ventricle [which receives the greatest proportion of coronary flow] is unique in that arterial flow is markedly decreased during systole since the intramyocardial pressure generated by contracting myocardial fibers effectively shuts off flow from the epicardial to the intramural arteries most of the coronary flow to the left ventricle occurs during diastole.
Coronary autoregulation

If there is a sudden change in aortic pressure [within certain limits] coronary vascular resistance will adjust itself proportionally within 8 to 12 seconds so that a constant blood flow is maintained. The level to which coronary flow is autoregulated at any given time is determined by the instantaneous oxygen requirement of the heart.
Autoregulatory reserve
Refers to the maximal degree of vasodilatation possible in the coronary vascular bed.

Autoregulation in localized area
When partial obstruction of an artery causes a decrease in the coronary perfusion pressure the vessel distal the obstruction will dilate thus normalizing flow by decreasing coronary vascular resistance.
Coronary blood flow must be modulated continuously so that a sufficient supply of oxygen is delivered to the myocardium to support oxidative energy production at rate that match energy utilization, the most likely mediator is adenosine.

An increase rate of ATP hydrolysis leads to an increase in the rate of production of adenosine this leads to a decrease in smooth muscle tone which leads to increase in the rate of oxygen delivery.
Epicardial versus subendocardial blood flow: Several factors affecting blood flow in the subendocardial layer of the myocardium.

1. Systolic compression is much higher in the subendocardial layers than in the subepicardial of the heart such that subendocardial blood flow is virtually absent in systole.

2. There may be some degree of mechanical interference with flow in the subendocardial vessels in late diastole as pressure is exerted on the inner layers of the heart by blood filling and distending the ventricular chamber. This may account for the fact that flow in the subendocardial layers rises rapidly in early diastole but falls of in the late diastole.
3. Flow to the midwall of the heart is approximately equal in systole and diastole.

4. In the outer layers of the subepicardial flow is slightly higher in systole than in diastole.

5. The arrangement of intramural vessels partially compensate for the almost complete absence of blood flow to the endocardium during systole in that vascular density is increased in the endocardium arteries so that the net flow is augment.
6. Subendocardial arteries have lower intrinsic vascular resistance such that blood flow is normally higher in the subendocardial to superepicardial flow in a ratio about 1.1:1 this is consistent with the fact that oxygen requirements are higher in the subendocardium because it develops higher wall stress and shortens more than the subepicardial layers.

7. However because of the lower resting coronary resistance of the subendocardial vessels the capacity to further augment flow in response to increased metabolic demands [i.e the coronary reserve of the subendocardial vessels] is inherently less in the midwall and epicardial vessels.
8. Some oxygen does diffuse directly into subendocardium from the arterial blood that fills the left ventricular chambers but it reaches only the most superficial layers.