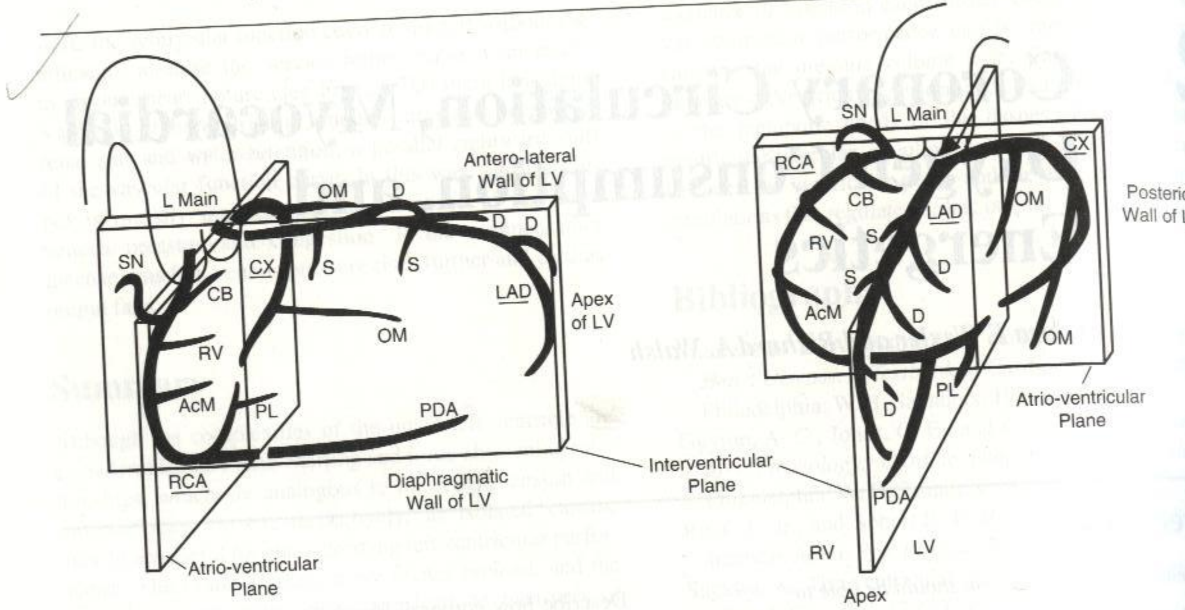
L Main
OM
D
Antero-lateral
Wall of LV
D
D
SN
CX
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CB
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Apex
of LV
RV
OM
AcM
PL
PDA
RCA
Diaphragmatic
Wall of LV
Interventricular
Plane
Atrio-ventricular
Plane
SN
L Main
RCA
CX
CB
LAD
OM
Posterior
Wall of LV
RV
S
D
S
AcM
D
OM
PL
D
Atrio-ventricular
Plane
PDA
RV
LV
Apex

Coronary –Circulation

Under normal conditions cardiac muscle metabolism is almost exclusively aerobic depending on oxidative phosorylation 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.

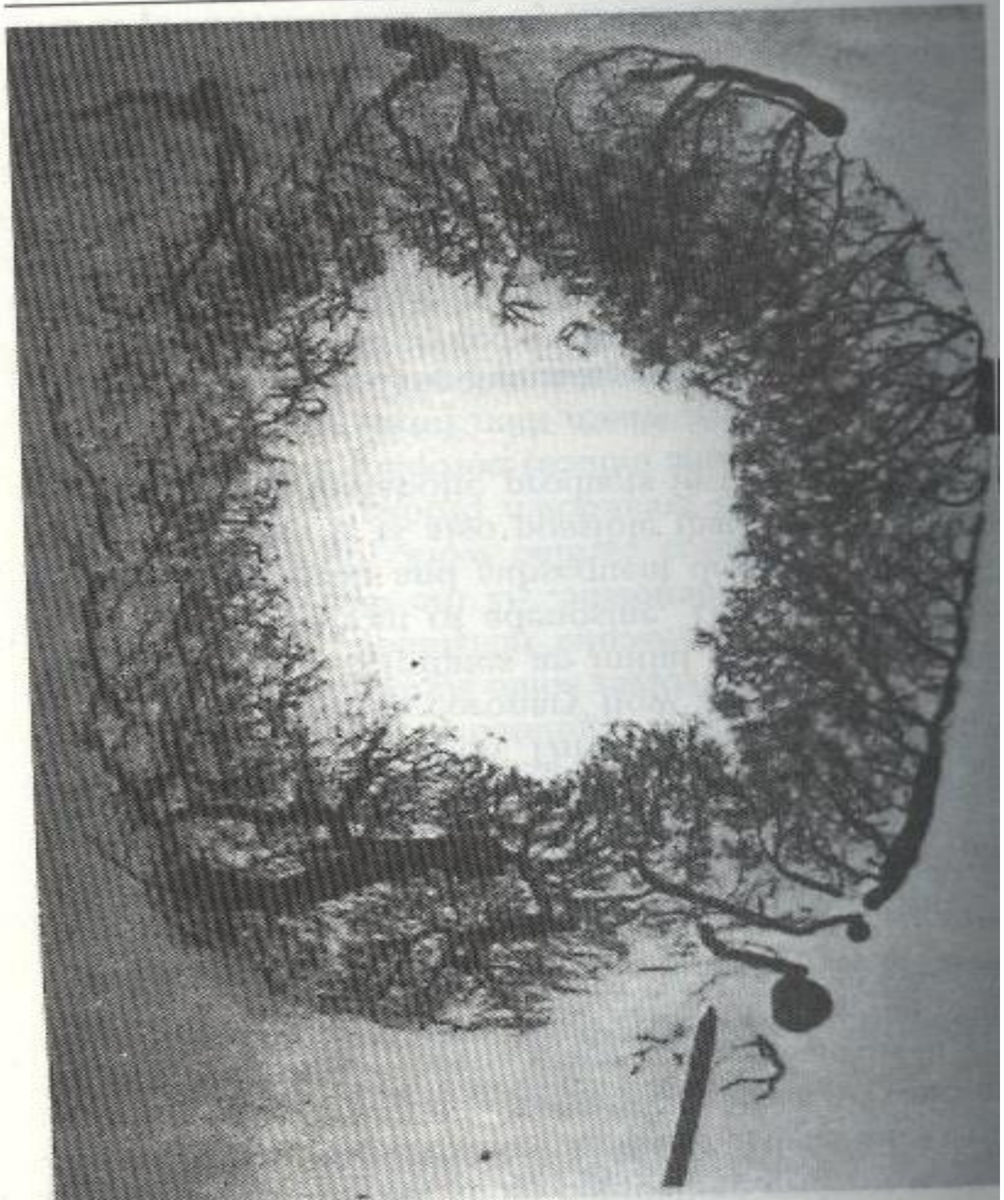
During stress or exercise oxygen requirements may increase abruptly by three to four folds.

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.

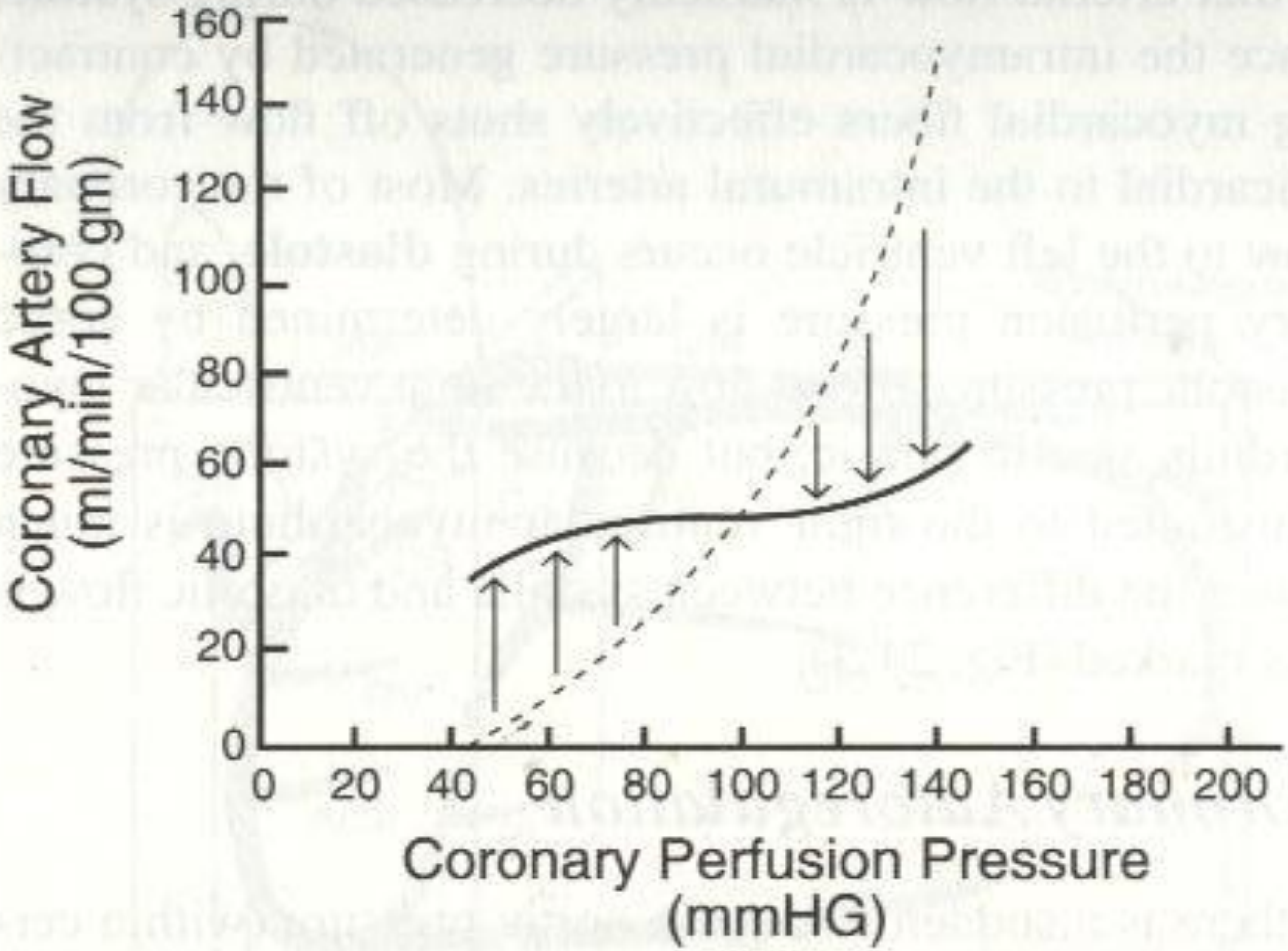
Collectively the coronary vasculature and the blood it contain account for approximately 15% of the total mass of the heart.



- 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 [with in certain limits] coronary vascular resistance will adjusts it self proportionally with in 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.



160
140
120
100
80
60
40
20
0
Coronary Artery Flow
(ml/min/100 gm)
0 20 40 60 80 100 120 140 160 180 200
Coronary Perfusion Pressure
(mmHG)

Autoregulatory reserve

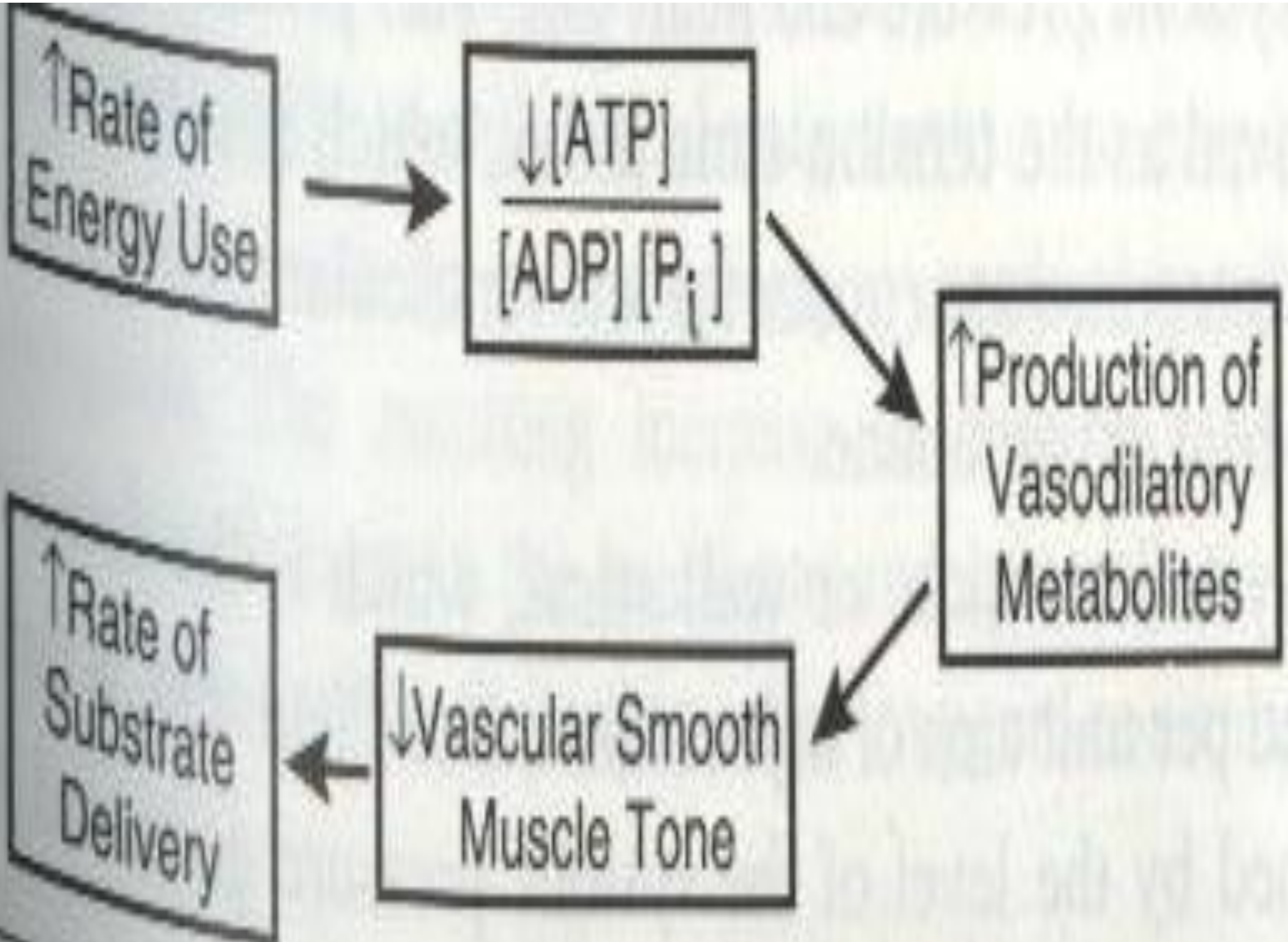
Refers to the maximal degree of vasodilatation possible in the coronary vascular bed .

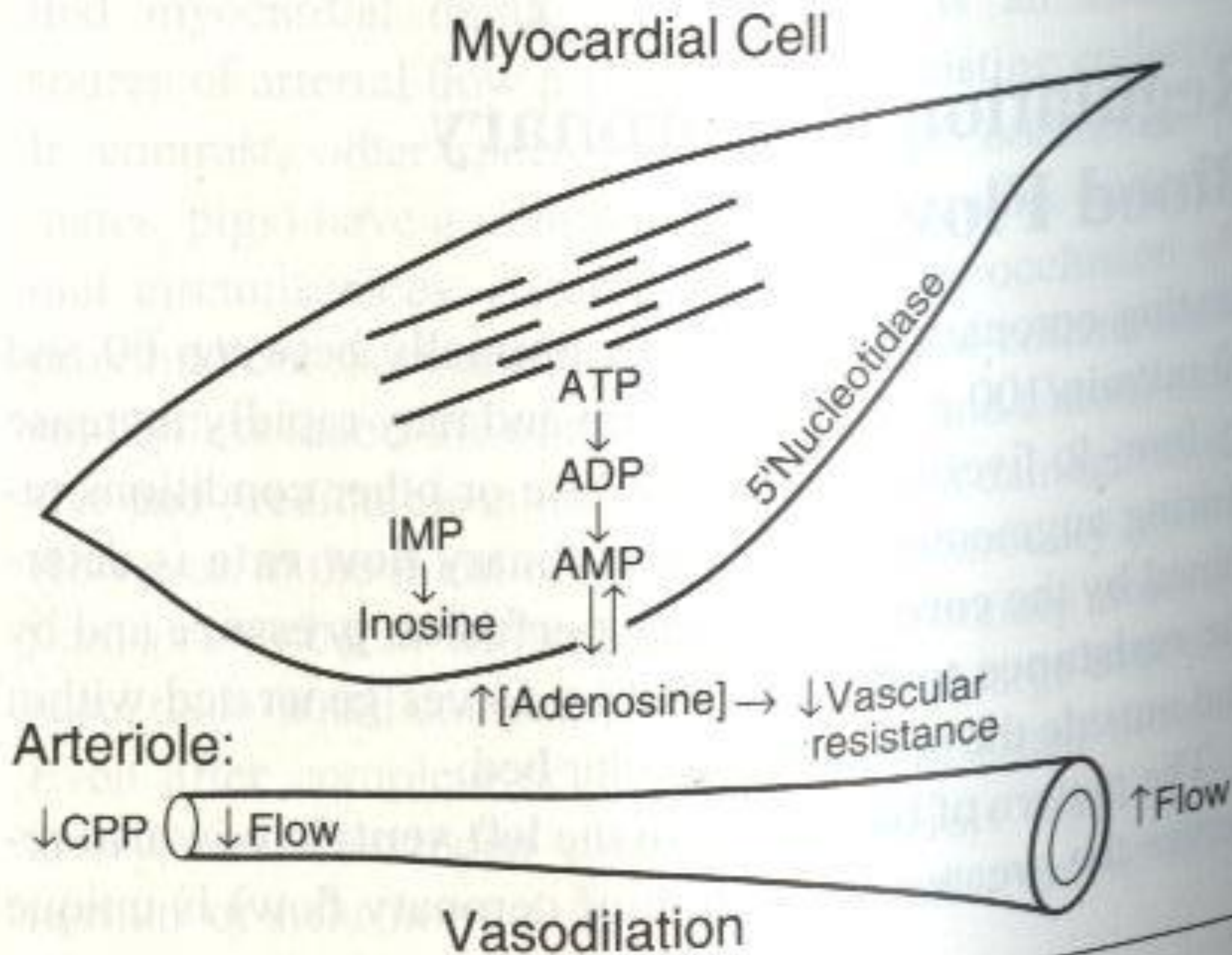
Autoregulation in localized area

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

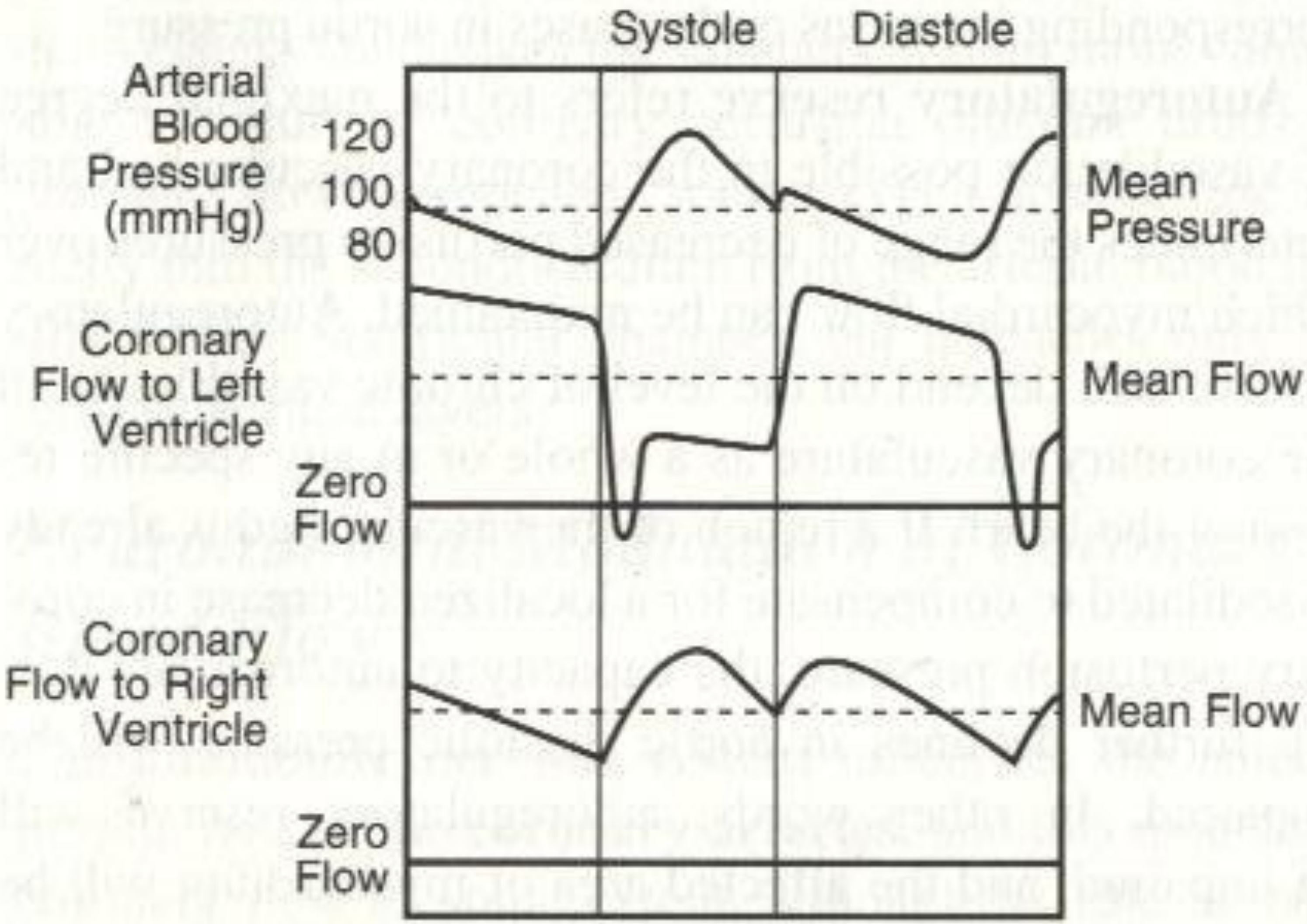

↑Rate of Energy Use
↓[ATP] / [ADP] [P_i]
↑Production of Vasodilatory Metabolites
↓Vascular Smooth Muscle Tone
↑Rate of Substrate Delivery


Myocardial Cell
ATP
ADP
AMP
IMP
Inosine
5'Nucleotidase
↑[Adenosine] → ↓Vascular resistance
Arteriole:
↓CPP
↓Flow
↑Flow
Vasodilation

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.


Systole
Diastole
Arterial Blood Pressure (mmHg)
120
100
80
Mean Pressure
Coronary Flow to Left Ventricle
Mean Flow
Zero Flow
Coronary Flow to Right Ventricle
Mean Flow
Zero Flow

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 supepicardial flow in a ratio about 1.1:1this 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.