생화학 2학기 후반부: 강의내용

1. 비타민
2. 지질/지질대사
3. 단백질 및 아미노산 대사
4. 핵산 대사
5. 대사의 조절기전: Signaling/ 유전자발현 조절 기전
6. 대사의 overview
7. 질병의 분자기전

<평가방법>

- 기말시험/Quiz/report : 40 점
- 출석, 강의태도, 강의참여도 : 10 점

생명현상의 Overview : 생명현상의 분자기전

Information

생체정보 : hormone, cytokines, neurotransmitter→세포→유전

O_2/영양분 cytokines neurotransmitters Hormones

1st messenger

당질
(당뇨병)

지질→저장
(비만, 동맥경화)

Signaling

Epigenome

-omics

°Physiome

Transcriptome

2nd messenger

·Southern blot
· Northern blot

AAA

mRNA

Vt B

·Genome=gene+chromosome
-sequencing
-SNP

·Transcriptome

DNA chip

Proteomme

· Western blot

Protein
(생리기능)

TCA

Vt C, E

NADH

themogenin

ATP

Cell homeostasis

·Proteome
-2D/Mass

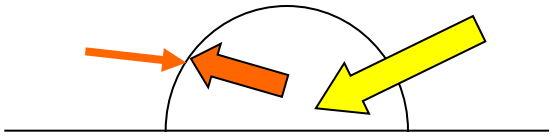
a.a

Metabolome

Lipidome

열

단백질



Hormesis

Maintenance

Cell proliferation (replication)

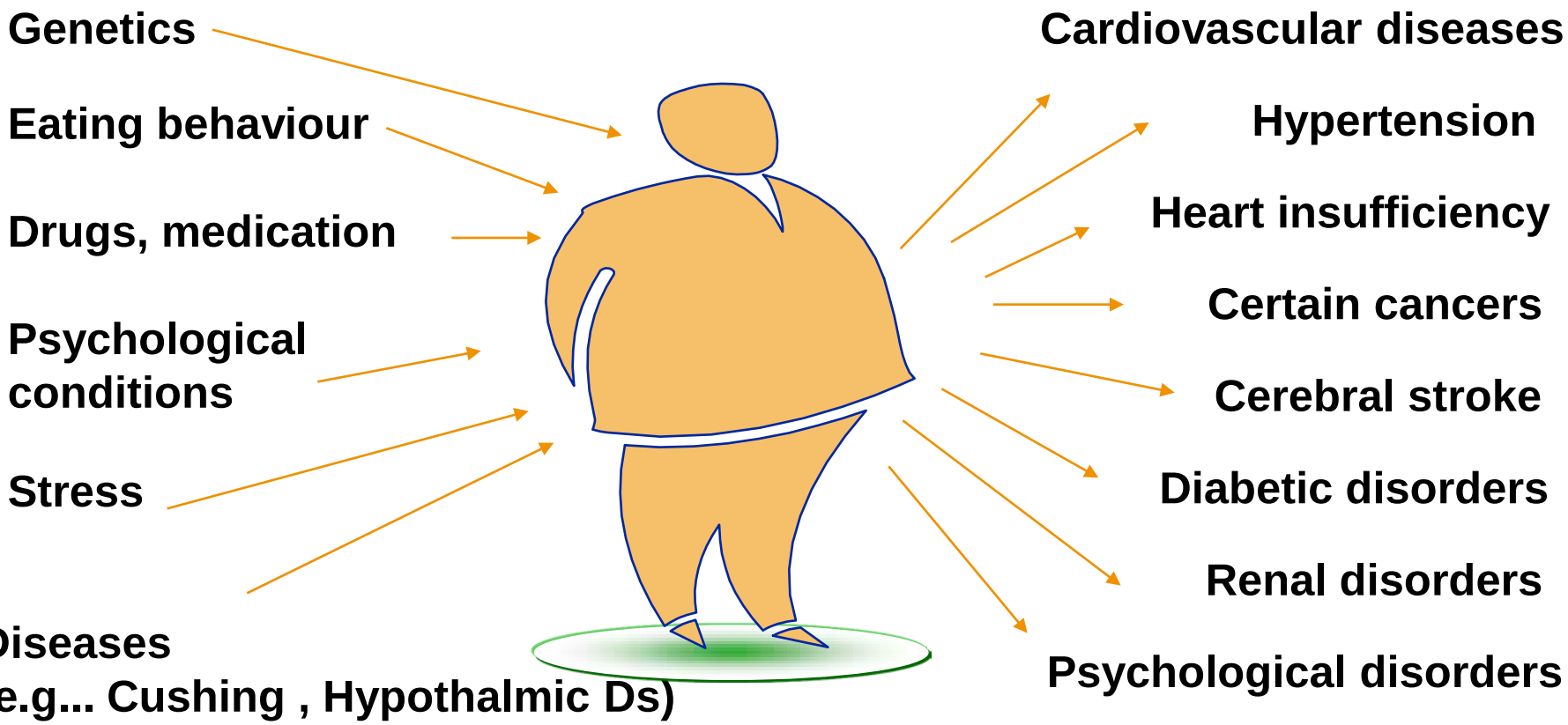
E小

E多

Gerontome

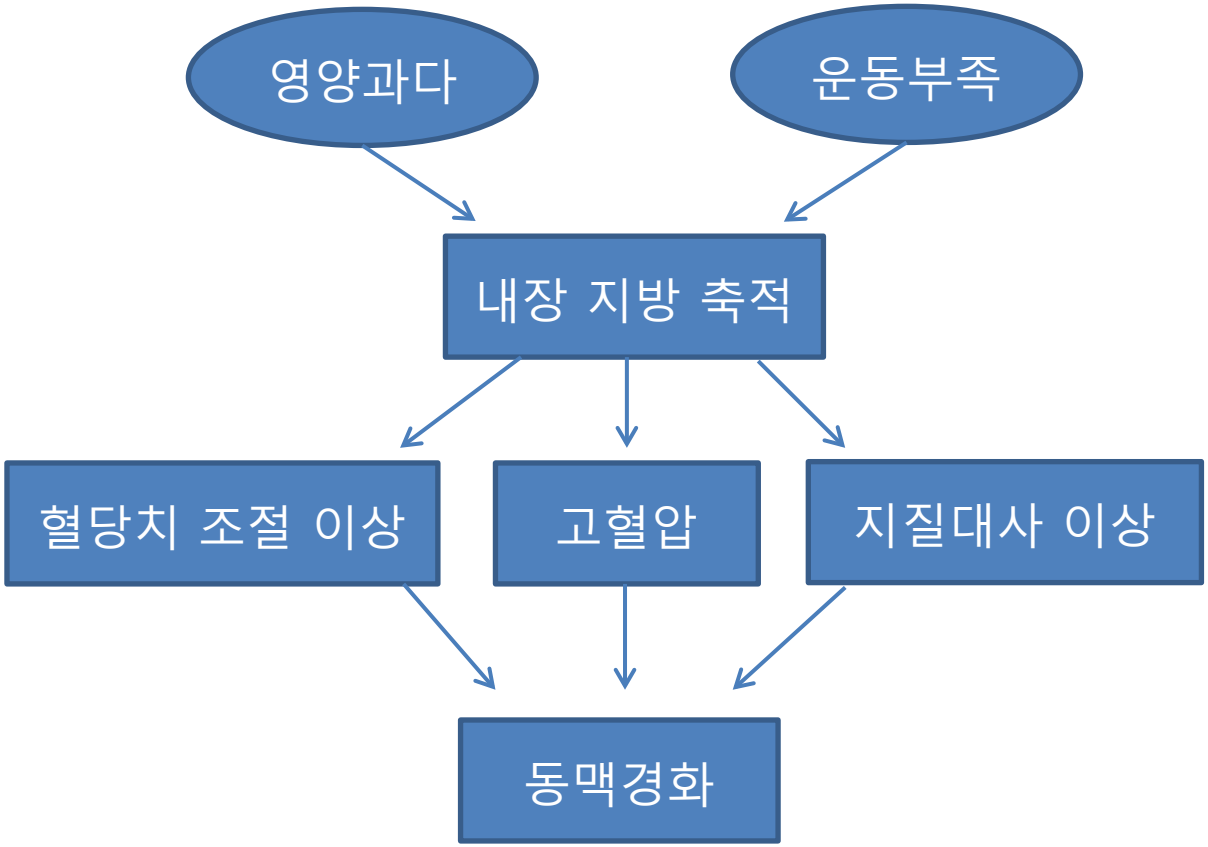
비만의 합병증

Causes → Obesity → Medical complications



Factors leading to obesity and related co-morbidities

Metabolic Syndrome 개념



Metabolic syndrome 이란?

Central obesity

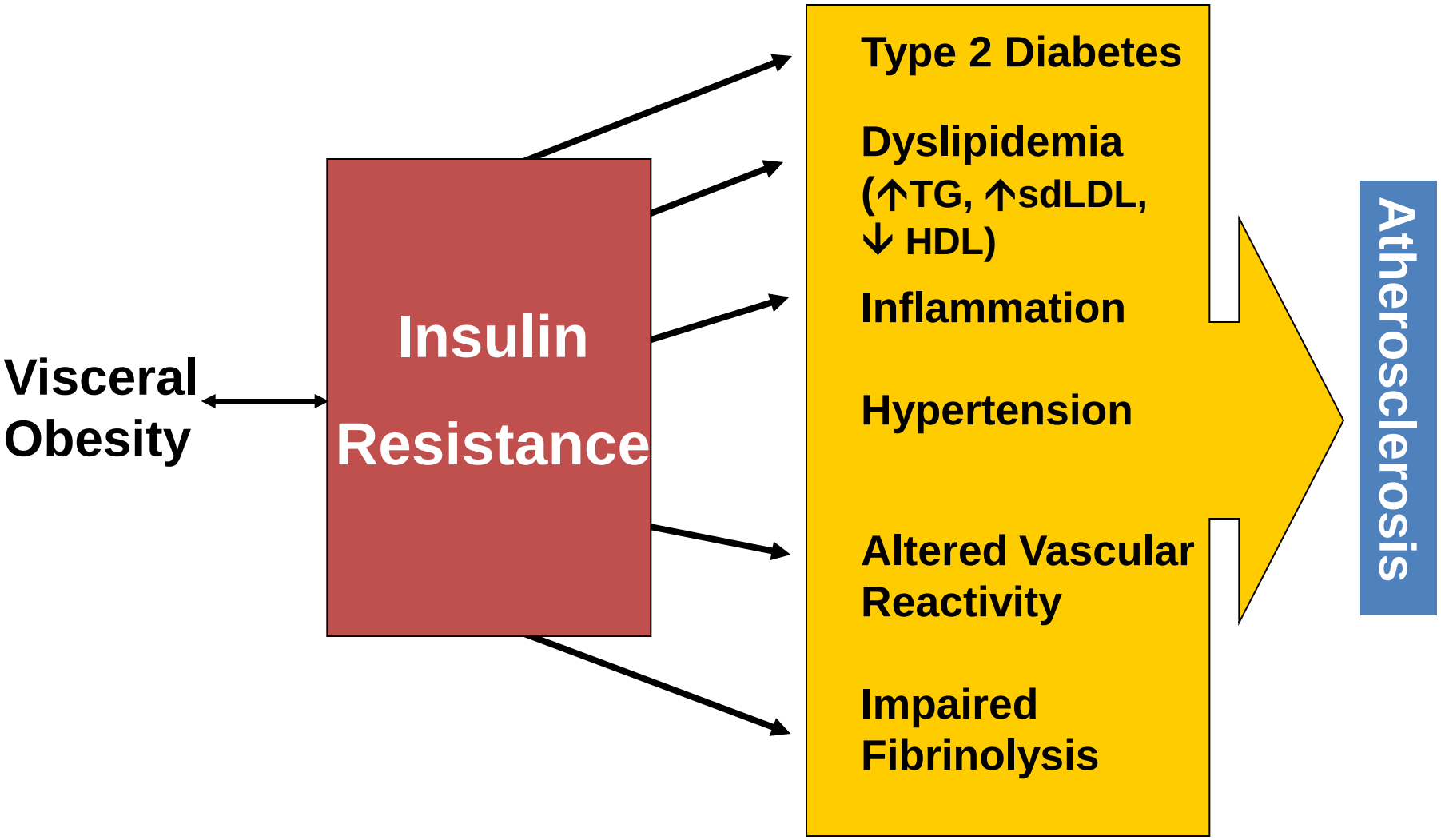
Glucose intolerance

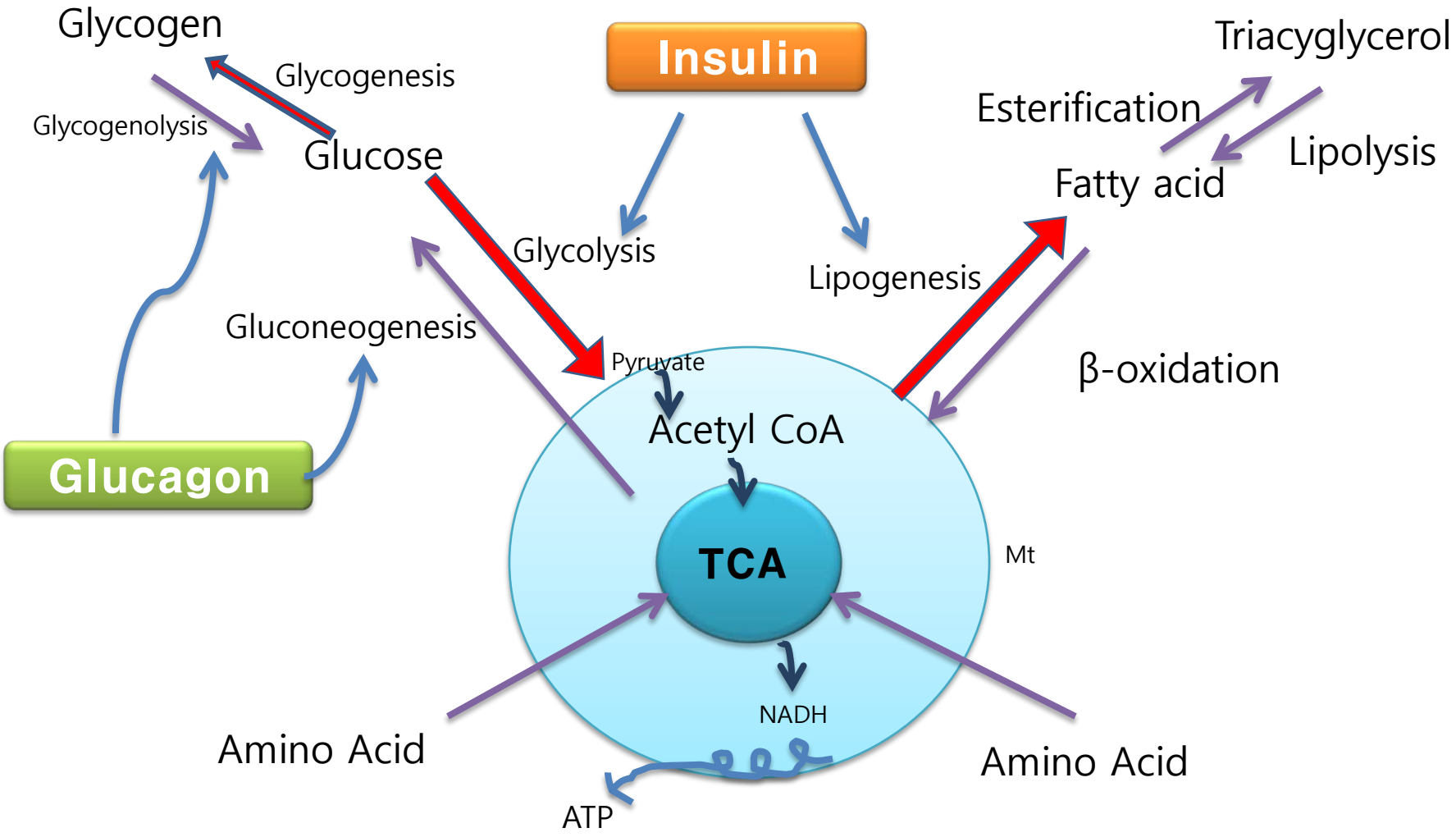
Hypertension

Dyslipidemia

Vascular dysfunction and atherosclerosis

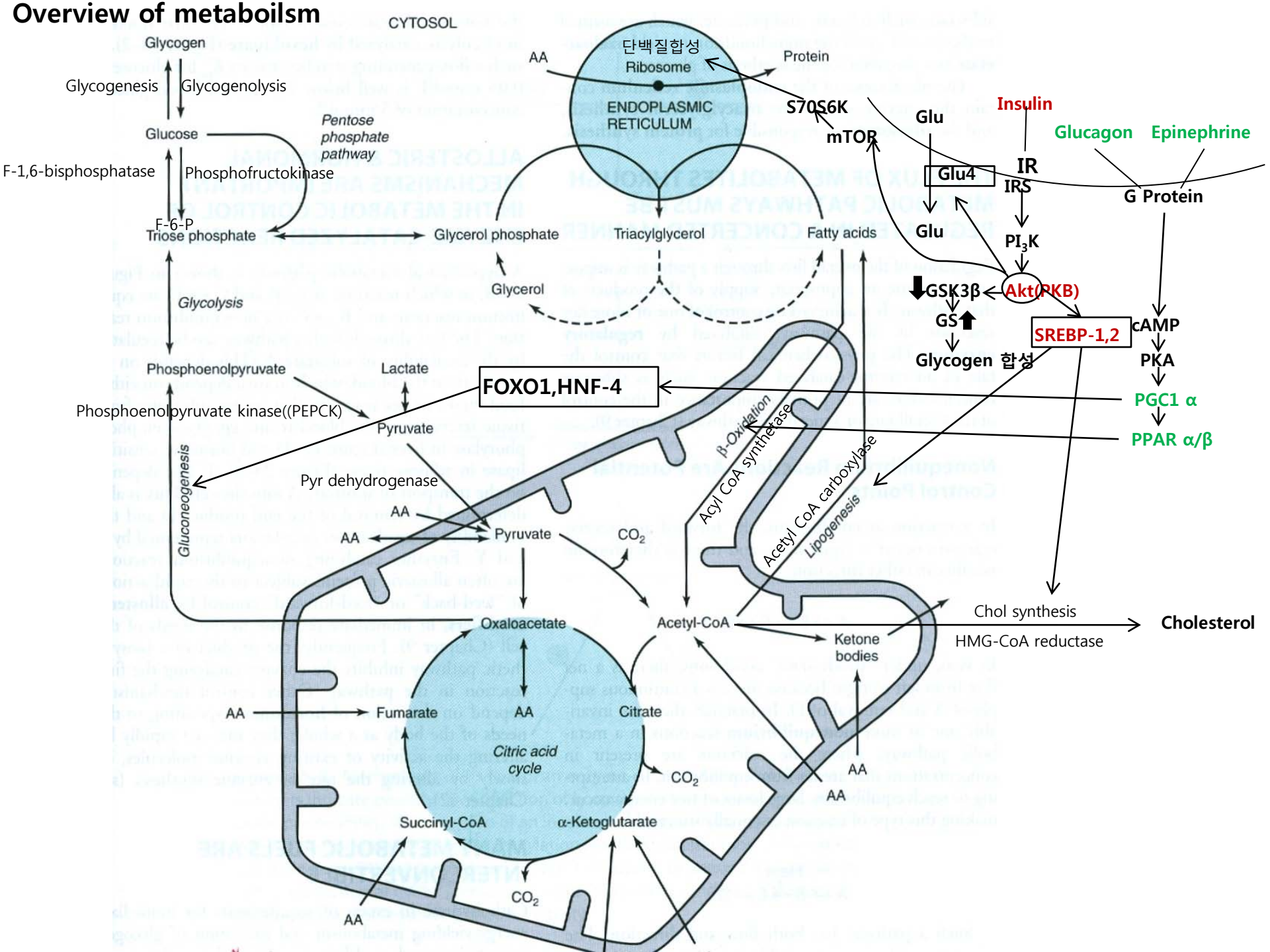
The Metabolic Syndrome





Overview of Metabolic Map

Overview of metaboilsm



Importance of blood vessel

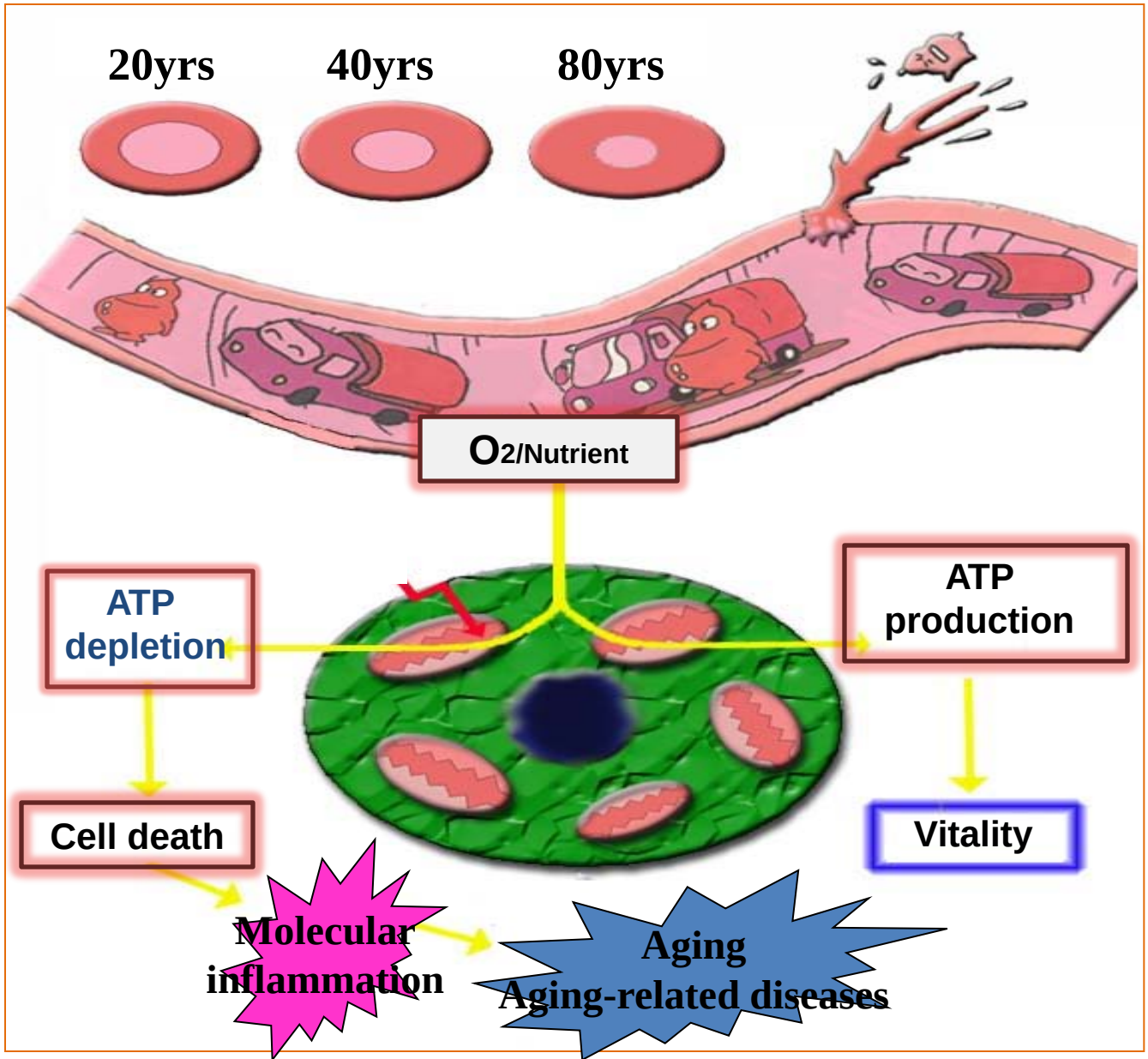


Table 21–1. Regulatory and adaptive enzymes of the rat (mainly liver).

	Activity in					
	Carbohydrate Feeding	Starvation and Diabetes	Inducer	Repressor	Activator	Inhibitor
Enzymes of glycogenesis, glycolysis and pyruvate oxidation						
Glycogen synthase system	↑	↓	Insulin		Insulin Glucose 6-phosphate[1]	Glucagon (cAMP), phosphorylase, glycogen
Hexokinase						Glucose 6-phosphate[1]
Glucokinase	↑	↓	Insulin	Glucagon (cAMP)		
Phosphofructokinase-1	↑	↓	Insulin	Glucagon (cAMP)	AMP, fructose 6-phosphate, P_i, fructose 2,6-bisphosphate[1]	Citrate (fatty acids, ketone bodies),[1] ATP,[1] glucagon (cAMP)
Pyruvate kinase	↑	↓	Insulin, fructose	Glucagon (cAMP)	Fructose 1,6-bisphosphate[1], insulin	ATP, alanine, glucagon (cAMP), epinephrine
Pyruvate dehydrogenase	↑	↓			CoA, NAD^+, insulin,[2] ADP, pyruvate	Acetyl-CoA, NADH, ATP, (fatty acids, ketone bodies)
Enzymes of gluconeogenesis						
Pyruvate carboxylase	↓	↑	Glucocorticoids, glucagon, epinephrine (cAMP)	Insulin	Acetyl-CoA[1]	ADP[1]
Phosphoenolpyruvate carboxykinase	↓	↑	Glucocorticoids, glucagon, epinephrine (cAMP)	Insulin	Glucagon?	
Fructose-1,6-bisphosphatase	↓	↑	Glucocorticoids, glucagon, epinephrine (cAMP)	Insulin	Glucagon (cAMP)	Fructose 1,6-bisphosphate, AMP, fructose 2,6-bisphosphate[1]
Glucose-6-phosphatase	↓	↑	Glucocorticoids, glucagon, epinephrine (cAMP)	Insulin		
Enzymes of the pentose phosphate pathway and lipogenesis						
Glucose-6-phosphate dehydrogenase	↑	↓	Insulin			
6-Phosphogluconate dehydrogenase	↑	↓	Insulin			
"Malic enzyme"	↑	↓	Insulin			
ATP-citrate lyase	↑	↓	Insulin			ADP
Acetyl-CoA carboxylase	↑	↓	Insulin?		Citrate,[1] insulin	Long-chain acyl-CoA, cAMP, glucagon
Fatty acid synthase	↑	↓	Insulin?			

[1]Allosteric.
[2]In adipose tissue but not in liver.

nesis is to supply ATP required in the pyruvate carboxylase and phosphoenolpyruvate carboxykinase reactions as well as reversing the phosphoglycerate kinase reaction in glycolysis.

Another enzyme that is subject to feedback control is **phosphofructokinase (phosphofructokinase-1).** It occupies a key position in regulating glycolysis. Phosphofructokinase-1 is inhibited by citrate and by ATP and is activated by AMP. AMP acts as an indicator of the energy status of the cell. The presence of **adenylyl kinase** in liver and many other tissues allows rapid equilibration of the reaction:

$$ATP + AMP \leftrightarrow 2ADP$$

Thus, when ATP is used in energy-requiring processes resulting in formation of ADP, [AMP] rises. As [ATP] may be 50 times [AMP] at equilibrium, a small fractional decrease in [ATP] will cause a sever-

Table 29–1. Summary of the major regulators of metabolic pathways.

Pathway	Major Regulatory Enzymes	Activator	Inhibitor	Effector Hormone	Remarks
Citric acid cycle	Citrate synthase		ATP, long-chain acyl-CoA		Regulated mainly by the need for ATP and therefore by the supply of NAD^+
Glycolysis	Phosphofructokinase	AMP, fructose 2,6-bisphosphate in liver, fructose 1,6-bisphosphate in muscle	Citrate (fatty acids, ketone bodies), ATP, cAMP	Glucagon ↓	Induced by insulin
Pyruvate oxidation	Pyruvate dehydrogenase	CoA, NAD, ADP, pyruvate	Acetyl-CoA, NADH, ATP (fatty acids, ketone bodies)	Insulin ↑ (in adipose tissue)	Also important in regulating the citric acid cycle
Gluconeogenesis	Pyruvate carboxylase	Acetyl-CoA	ADP	Glucagon?	Induced by glucocorticoids, glucagon, cAMP. Repressed by insulin
	Phosphoenolpyruvate carboxykinase	cAMP?			
	Fructose-1,6-bisphosphatase	cAMP	AMP, fructose 2,6-bisphosphate in liver, fructose 1,6-bisphosphate in muscle	Glucagon	
Glycogenesis	Glycogen synthase		Phosphorylase (in liver). cAMP, Ca^{2+} (in muscle)	Insulin ↑ Glucagon (liver) ↓ Epinephrine ↓	Induced by insulin
Glycogenolysis	Phosphorylase	cAMP, Ca^{2+} (muscle)		Insulin ↓ Glucagon (liver) ↑ Epinephrine ↑	
Pentose phosphate pathway	Glucose-6-phosphate dehydrogenase	$NADP^+$	NADPH		Induced by insulin
Lipogenesis	Acetyl-CoA carboxylase	Citrate	Long-chain acyl-CoA, cAMP	Insulin ↑ Glucagon (liver) ↓	Induced by insulin
Cholesterol synthesis	HMG-CoA reductase		Cholesterol, cAMP, mevalonate, bile acids	Insulin ↑ Glucagon (liver) ↓	Inhibited by certain drugs, eg, lovastatin

insulin