Class 5:

Red blood cell metabolism

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Objectives for this lecture

- Discuss the RBC different type of metabolic pathway.
- understand the how some enzyme may affect RBC metabolic pathway.

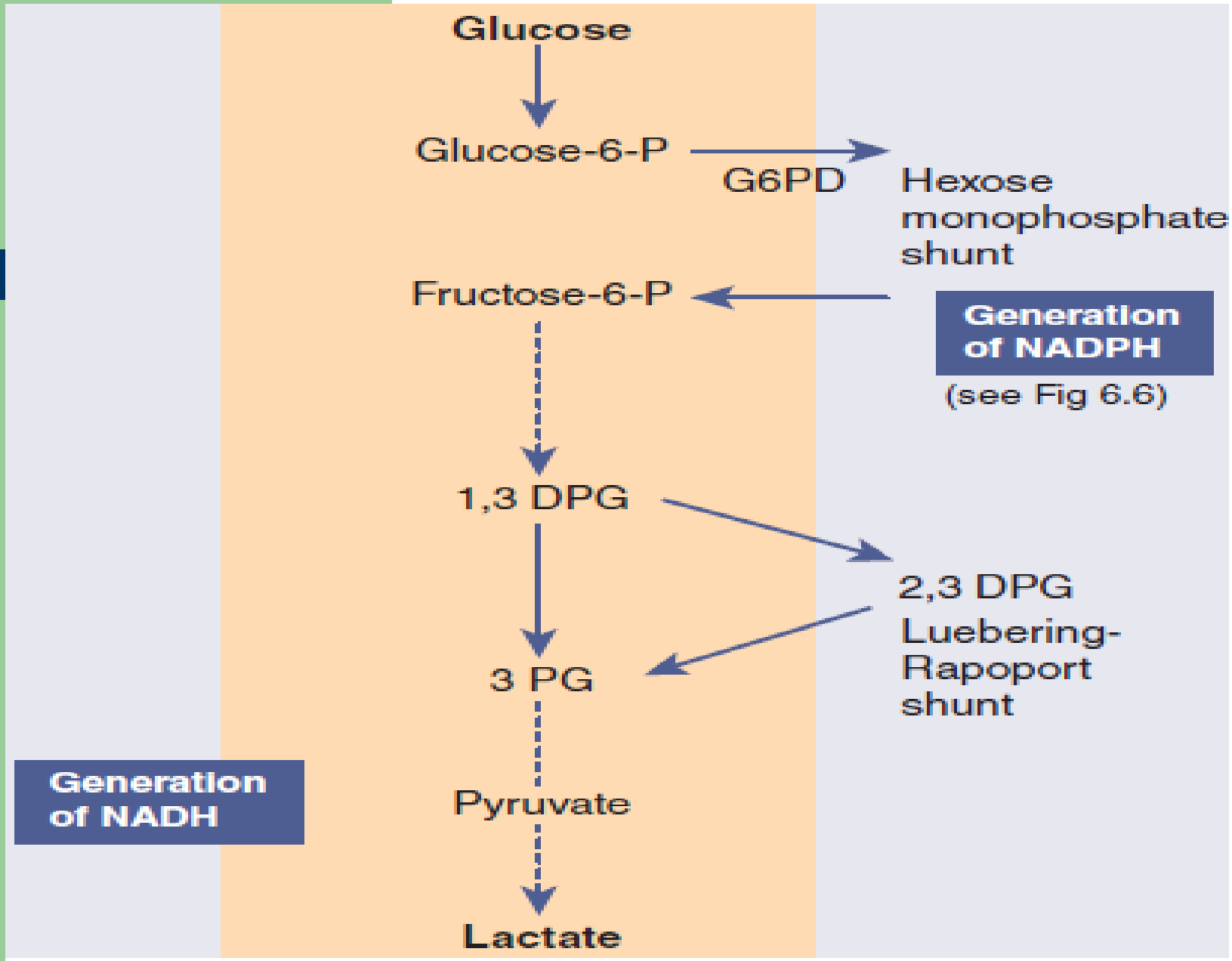
Red blood cell metabolism
Glycolysis

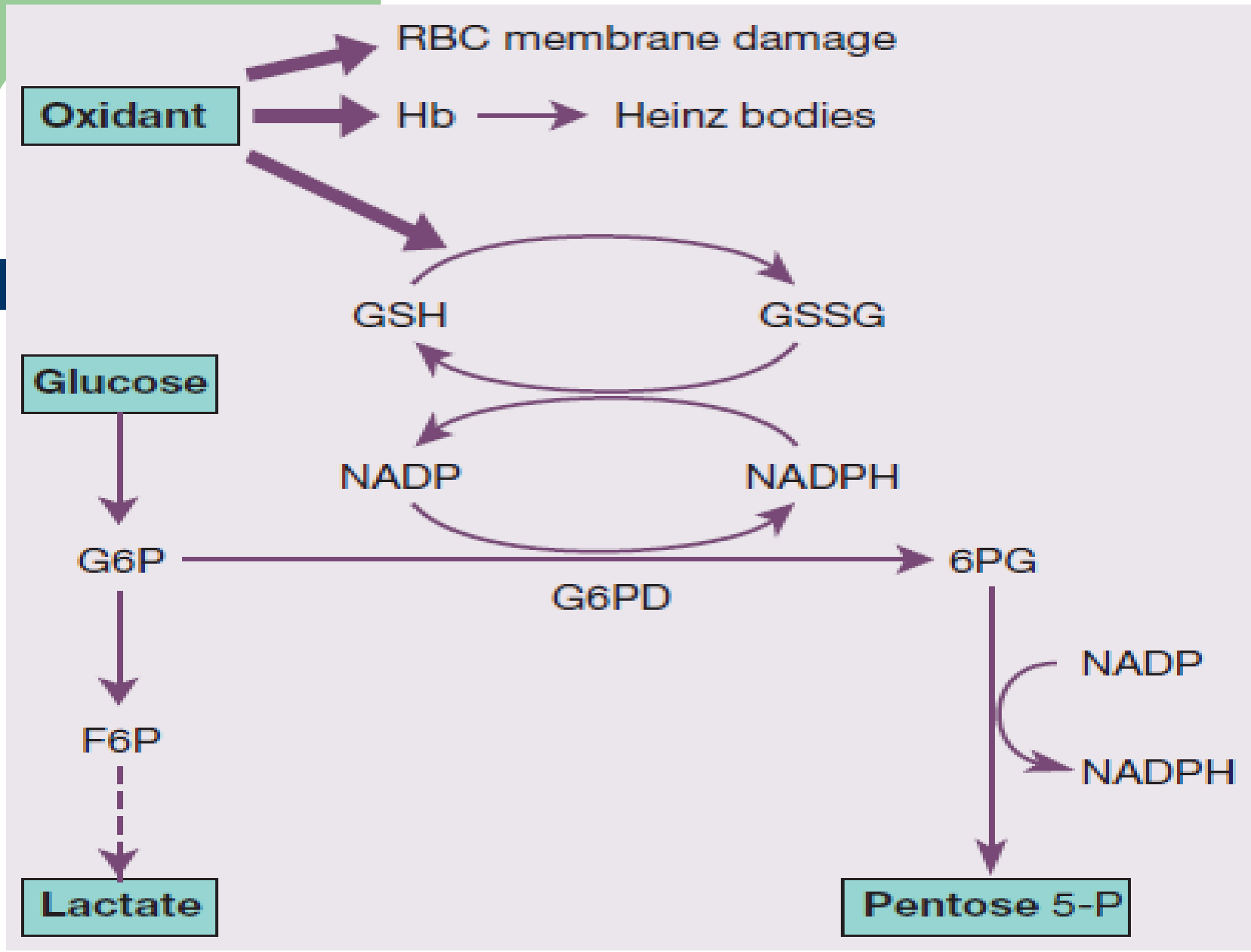
- Mature red blood cells **lack** the mitochondria:
  - *No enzymes for TCA, electron transport chain, and β-oxidation pathway.*
  - *No Utilization for fatty acids or ketone bodies.*

- RBC depend of glycolysis to generate ATP.
- Glucose enter by facilitated diffusion through glucose transporter 1 (GLUT1) in cell membrane.

RBCs Glycolysis

- Glucose is metabolized to lactate.
- 1 glucose molecule give two ATP (energy).
- energy used to maintain RBC volume, shape and flexibility.
- glycolytic pathway in RBC also possesses a branch, or shunt (side arm) to generates 2,3-DPG (2,3-Diphosphoglycerate).
- 2,3-DPG used to regulate the ability of haemoglobin's to transport O_2.


Glucose
Glucose-6-P
G6PD
Hexose monophosphate shunt
Fructose-6-P
Generation of NADPH
(see Fig 6.6)
1,3 DPG
2,3 DPG
Luebering-Rapoport shunt
3 PG
Generation of NADH
Pyruvate
Lactate


RBC membrane damage
Oxidant
Hb
Heinz bodies
GSH
GSSG
Glucose
NADP
NADPH
G6P
6PG
G6PD
NADP
F6P
NADPH
Lactate
Pentose 5-P

Hexose monophosphate (pentose phosphate) shunt

- 10% of glycolysis occurs by this oxidative pathway.
- *NADPH* is generated and is linked with glutathione which maintains sulphydril (-SH) groups intact in the cell.
- *abnormalities RBC* have glucose-6-phosphate dehydrogenase (G6PD) deficiency, the RBC is susceptible to oxidant stress *(hemolytic anemia).*

Hexose monophosphate (pentose phosphate) shunt

- Reduced glutathione (GSH) is used in potentially toxic peroxides.
- NADPH required to return oxidized glutathione (GS-SG) to reduced state GSH.

- Ferric iron is reduced to the ferrous state by *NADH*.

References

- Victor A Hoffbrand, Paul Moss, J Pettit; ***Essential Haematology***. Essentials Series Blackwell Science, New York; 2008.
- Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil. Harper's Illustrated Biochemistry. McGraw-Hill Ed, 31 ed, 2018.