Terminal oxidation and phosphorylation in Respiration (Electron Transport System) or Oxidative Production of ATP in Respiration.

The respiratory breakdown of glucose in presence of oxygen is an oxidative process. During this process several intermediates such as phosphoglyceraldehyde, pyruvic acid, iso citric acid, α-ketoglutaric acid, succinic acid and malic acid are oxidized. Eeach oxidation step involves release of 2H which goes to reduce various coenzymes viz. NAD^+ and FAD. Reduced NAD^+ or FAD released in the glycolysis and krebs cycle, finally reduce oxygen to H_2O. This transfer of H^+ and e^- from $NADH + H^+$ or $FADH_2$ to O_2 is not a simple process. To facilitate this transfer, many intermediate cytochromes and other carrier having their intermediate redox potentials are arranged in a series which transport electrons from NADH or $FADH_2$ to O_2.

This ~~variou~~ seqvence of electron carriers constitute the electron transport system [ETS] There are several thousand electron transport system in each mitochondrium located in the inner - mitochondrial membrane.

The various components of electron transport include - cytochrome b, 2 types of cytochrome c, Ubiquinone, flavoprotein (FMN or FAD), Iron - sulphur Protein (Fe-S) and enzyme cytochrome oxidase which is associated with cytochrome a and a_3 these components are arranged in four kinds of complexes-

Complex I (NADH dehydrogenase complex)

complex II (Succinate dehydrogenase complex)

Complex III (Cytochrome bc_1 complex)

Complex IV (Cytochrome oxidase complex).

There is a V^{th} complex, ATP synthase complex, which is evolved in ATP synthesis.

Reduced coenzymes transfer their electrons and protons through the electron transport system in the following manner:

(i) First step involves transfer of hydrogen from $NADH + H^+$ to FMN. The FMN gets reduced to $FMNH_2$ and the co-enzyme $NADH + H^+$ gets oxidized to NAD^+

(2) Reduced FMN (i.e $FMNH_2$) then transfer its electrons to Fe-S protein (Iron-sulphur protein and $2H^+$ into the inner membrane space.

(3) The reduced Fe-S protein then transfers its electrons to ubiquione (UQ). The UQ takes two ēs from Fe-S protein & two protons ($2H^+$) from the matrix to become UQH_2.

(4) Reduced ubiquinone (UQH_2) then transfers its electrons to cyt b and $2H^+$ to the other side Into inter membrane space.

The $FADH_2$ reduced in kreb's cycle also enters through complex II into ETS at this stage by transfering its 2H to UQ. The UQ is reduced to UQH_2.

(5) Reduced cyt b, then transfer its ēs to Fe-S protein. The Fe^{3+}-S is converted to Fe^{2+}-S. This protein then transfers electrons to UQ which also take 2^+H from inner matrix to become UQH_2.

(6) The reduced UQ transfer its ēs to cyto C_1.

(7) Reduced cyt C_1 then reduces cyt c by transferg its electron.

(8) Finally the ēs from cyt c are transferred via cyt a and cyt a_3 to O_2.

This step is also k/a terminal oxidation is catalysed by enzyme cytochrome oxidase

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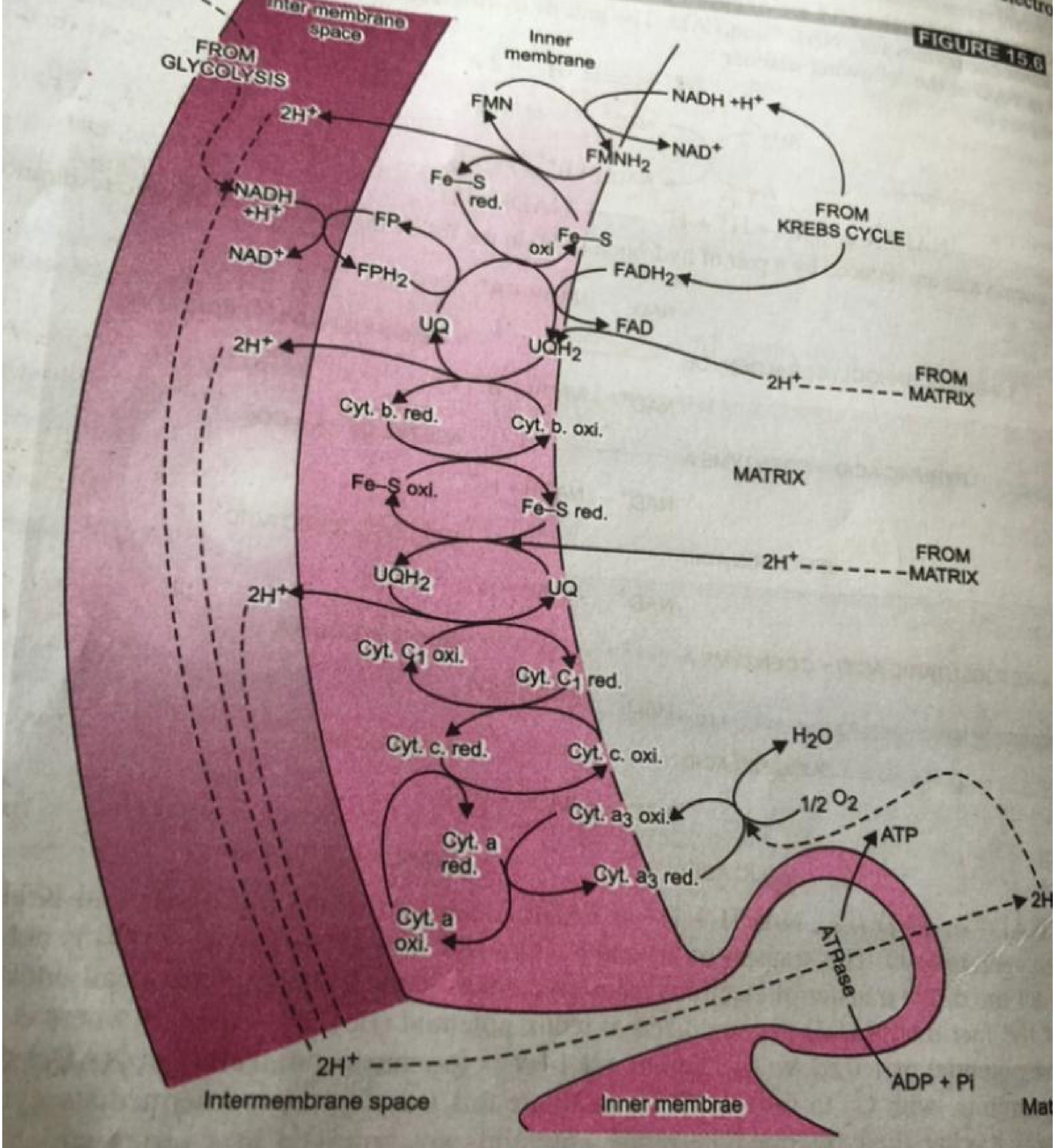

Schematic representation of mitochondrial electron transport and oxidative osphorylation (FMN = Flavin mono nucleotide ; UQ = Ubiquinone ; FP = Flavopro Fe – S = Iron sulpher protein)