P. G. Sem. II CC-7, Unit-I

Submit-1.3.

Mitochondrial Electron Transport chain and Oxidative Phosphorylation

(Part-II)

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Characteristics of Respiratory chain Complexes and Transfer of Electrons:—

Characteristics of protein subunits Constituting different respiratory chain Complexes differ remarkably from each other. The interactive of rid chains of proteins with cofactors, hemes and Fe-S centers determine redox potential of redox centers or complexes.

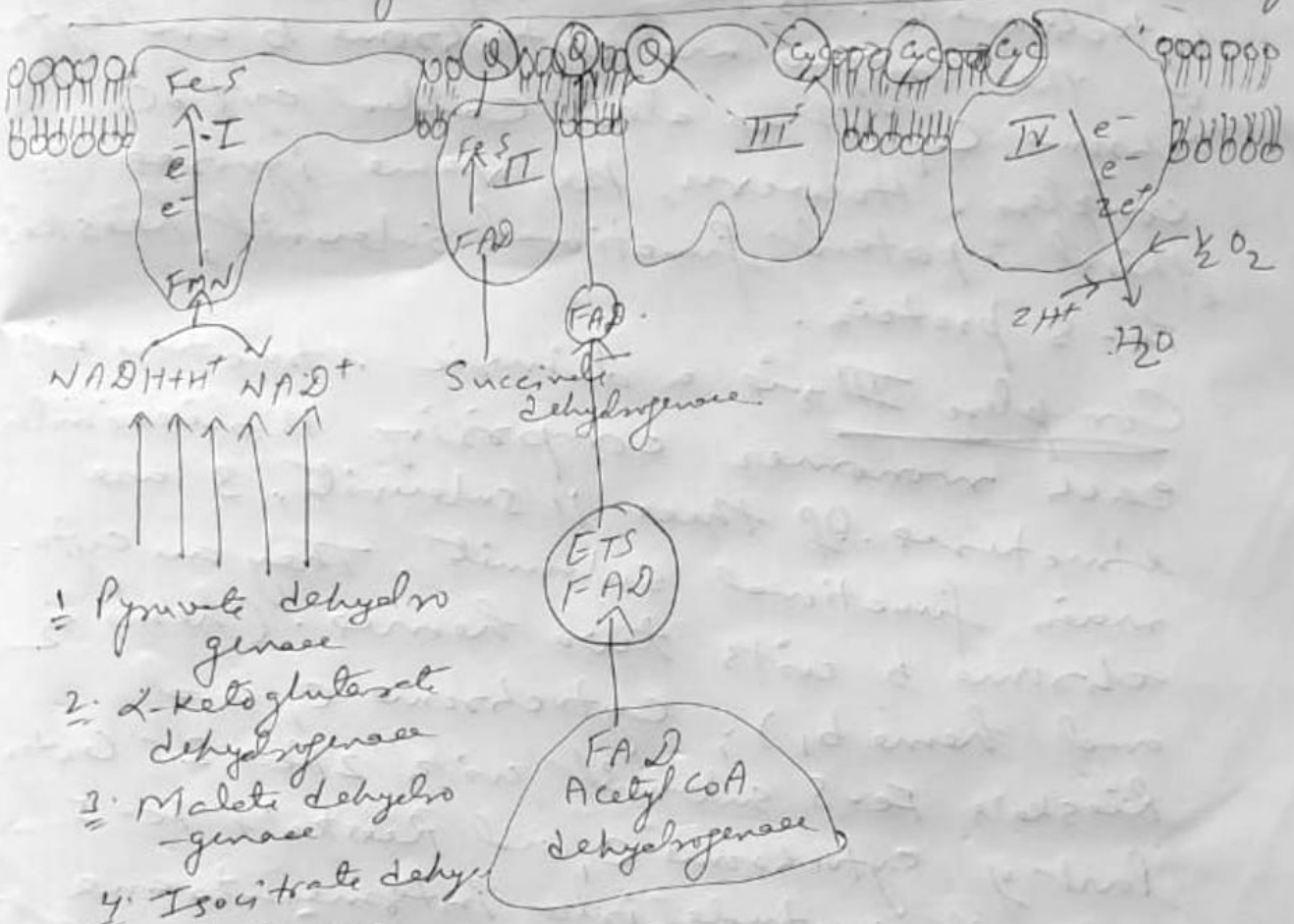
Complex-I:— The Complex I of respiratory chain is also named NADH dehydrogenase or NADH: ubiquinone Oxido reductase. It is a metalloprotein, formed of 41 polypeptide chains, one flavoprotein with flavin mononucleotide (FMN) as coenzyme and six iron-sulfur centers, all linked covalently to cysteinyl sulfur of protein. This Complex is L-shaped with longer arm placed in the lipids of IM and smaller

arm projected in the matrix. The Complex I receives electrons pair as hydride ion from reduced NAD and a proton from mitosol. The FMN receives hydrogen atom as electrons and proton in stages forming semiquinone (FMNH) and dihydro form ($FMNH_2$). From $FMNH_2$ electrons move in single to Fe-S centers and protons to mitosol. Flow of Electrons from Fe-S center to Coenzyme Q and proton from mitosol bring about reduction of coenzyme Q to $CoQH_2$. This flow of electrons and protons from reduced NAD to CoQ generate energy (Exergonic process), which pumps four protons (for every pair of electrons) to the intermembrane space from mitosol. Exact process of this proton pumping is speculative.

Complex II — The Complex II of Res. chain is basically En-bound enzyme succinate dehydrogenase of Kreb's Cycle. The Enzyme comprises four subunit. Two of these subunits C&D are transmembrane in nature and mainly helical, whereas subunits A and B are globular, intruding into mitosol. The subunit A possesses binding site for succinate and coenzyme FAD whereas subunit B possesses three Fe-S centers. The two transmembrane subunit (C&D) possess a heme termed heme

b sandwiched between two subunits, A binding site for CoQ is present mainly in subunit C.

Coenzyme Q (Ubiquinone) – also called Ubiquinone, is a small hydrophobic component of respiratory chain. Being small and hydrophobic, it is easily-



1. Pyruvate dehydrogenase
2. α-Ketoglutarate dehydrogenase
3. Malate dehydrogenase
4. Isocitrate dehydrogenase
5. Glyceraldehyde-3-P dehydrogenase

Diagram showing four ETC Complexes (I, II, III and IV) of respiratory chain with two mobile component cyt c(c) and cytochrome C(C) along with sources reduced NAD and reduced FAD feeding the respiratory chain with electron pair.

- diffusible into lipid bilayer of IM. It acts as a mobile electron carrier between immobile components of Res. chain - Complexes I and III as well as Complexes II and IV.

Complex III : The Complex III (cytochrome bC_2 complex) also called ubiquinone, cytochrome c Oxidoreductase is so called because it acts as an enzyme in the transfer of electrons from Coenzyme Q to cytochrome c. As the main functional subunits of the enzyme are cytochrome b and cytochrome C_1, it is also called cyt bC_1 complex. However, the name ignores the third important functional subunit, Rieske's Fe-S protein.

Complex III is a dimeric structure with each monomer comprising 11 different structures. Of these 11 subunit, 3 are main functional subunit. They are cytochrome b with two hemes. (heme b_2 and heme b_1); cytochrome C_1 and Rieske's Fe-S subunit with 2Fe-2S Center. Part of cytochrome C_1 and Rieske's Fe-S subunit protrude into intermembrane space and thus provide ideal site for interaction of cytochrome c. The cytochrome c is not a component of complex III but is a mobile and soluble component present in interaction with outer surface of IM. It acts as an electron transferring shuttle between complex III and IV. Two molecules of CoQ, participate in single is the transfer of electrons through heme centers present in all the three subunits. The electrons (2e) from each $CoQH_2$

are transferred in single through two different electron transfer circuits. Loss of electrons from QH_2 is coupled to loss of protons to intermembrane space. One electron transfer circuit comprises QH_2 forming a reduced cyt c. The other electron transfer circuit comprises QH_2 with four reduced electrons. Two electrons go to cyt c forming two reduced cyt c and two other electrons go to CoQ picking up two protons from mitosol to generate QH_2. The second CoQ is left in oxidised form (CoQ).

Cytochrome c :- Like other cytochromes, cytochrome c is also a hemoprotein, but unlike them is a soluble protein and is present not as integral protein of IMS but is associated with outer surface of IMS by electrostatic interaction. This makes it a mobile component of respiratory chain, hence it act as a shuttle carrying electrons between Complex III and IV. Quite unlike other cytochromes where heme is non-covalently bound to protein, heme is ~~non~~ covalently bound to protein is cyt c through S of cysteinyl residues. Cytochrome c receives electron singly from cyt c_1 of complex III and shuttles to complex IV. donating electron in single to binuclear copper center of complex IV

Contd Part III