THE PATHOGENESIS OF SUBCAPSULAR OPACITIES OF THE LENS (PERMEABILITY - C ATARACT)

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ABSTRACT

The colloid–osmotic pressure gradient between lens protein and the surrounding fluid amounts to approximately 1000 mm H₂O. When there is a disturbance of the function of the cation pump there occurs initially an egress of the smaller potassium molecule plus water out of the lens leading to a loss of weight. Subsequently, through increasing intake of sodium and water a Donnan equilibrium is established accompanied by swelling of the lens. The physiological (active) permeability changes into physical (passive) permeability resulting in permeability cataract (cataracta subcapsularis). In the early stages of permeability cataract the lesion of the cation pump (the 'leak') is confined to a place centrally beneath the posterior capsule with loss of K and intake of Na. The rest of the cation pump – initially still intact – tries to maintain the normal contents of electrolytes through increased activity (of the enzymes, by intake of K) which in turn leads to a migration of K towards the leak situated centrally beneath the posterior capsule. The cation pump is disturbed only in cases of permeability cataract (cataract subcapsularis, cataracta matura, cataracta intumescentia). It remains largely intact in cases of typical senile cataract (cataracta supranuclearis) and in cases of grey or brown nuclear cataract (cataracta nuclearis).

Cataract is caused by a great variety of disturbances of the lens metabolism. The question whether the opacification of lens protein involves a direct or an indirect disturbance of metabolism is easily answered:

1. The hard nucleus of the lens in very old patients shows practically no signs of any metabolism, nevertheless it is often clear and transparent to a large extent.

2. An isolated lens – in spite of much loss of weight through desiccation –
Above: clear lenses of cattle dried in air for 8 days.
Below: In drying chamber dried lenses of cattle showing lamellar separation.

Clear lenses of cattle kept in saccharose solution for 3 days.

remains clear and transparent until lamellar separation of the dried up protein layers occurs. (Fig. 1)

3. Lenses which are put in high molecular hypertonic solutions, e.g. 50% saccharose (Fig. 2) remain clear and transparent or show only a slight degree of opacification on the protein surface for an extended period after the disappearance of the subcapsular droplets (Salz Cataract). There is much protein shrinkage (on removing the lens from the solution the capsule is slack and wrinkled).