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Roles of Sodium-Calcium Exchanger in Lens Development and Cataractogenesis

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Summary

Although intracellular calcium homeostasis is essential to the control of lens fiber cell differentiation to maintain the special properties of lens, i.e., transparency and high refractivity, the molecular mechanism of calcium regulation in lens remains unclear. To keep high gradient across the plasma membrane (10 times higher in aqueous humor than lens cytoplasm), lens needs to export calcium continuously.

To assess the role of Na-Ca exchanger (NCX) that catalyzes reversible exchange of Na for Ca across the plasma membrane in lens, we characterized NCX isoforms expressed in developing rat lens and investigated the changes in cataractous lens. NCX 1 antibody recognized the molecule of 120 kD, which is mature NCX 1, in both neonatal and adult lens, while anti-NCX2 and 3 antibodies did not detect any band. NCX1 expression was prominent in younger lens and was decreased with rat development. In human cataract lenses, mature NCX 1 was decreased and degraded products were observed. Similar changes were observed in calcium ionophore (A23187, 10 μM)-induced cataractous excised and culcured lenses. Streptozocin-treated (70 mg/kgBW, i.p.) rats showed NCX1 degradation in lenses before getting turbidity. These results indicated that the dysfunction of calcium efflux due to degradation of NCX1 can be a cause of cataractogenesis. Moreover, we visualized lens protein concentration gradient by phase-contrast X-ray CT to evaluate the protein distribution in whole lens.