STUDIES ON AN INHERITED CATARACT OF SHEEP

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ABSTRACT

The findings presented in this thesis comprise the first report and description of an inherited cataract in sheep. The condition was first diagnosed in a number of related New Zealand Romney sheep, from a high performance Romney stud.

Clinically, cataracts which are always bilateral, are usually first visible at 2 months of age as characteristic focal opacities, confined to either the central or peripheral anterior and posterior cortex of the lens. By 8 to 10 months of age, there is more generalised lenticular opacity and total opacity usually occurs by 10 to 12 months. Two lambs born with congenital bilateral mature cataracts, showed partial lens absorption, which was obvious clinically by 8 months of age.

Controlled breeding studies, show that cataracts are inherited as a simple autosomal dominant trait. The two congenitally affected lambs, which resulted from matings between affected parents, are assumed to be homozygous for the defective gene.

Histologically, ovine cataract is characterised by the progressive degenerative swelling and lysis of lenticular fibres, beginning initially within localised areas of the anterior and posterior cortex. The distribution of early lesions correlates with the clinical appearance of early stage cataracts. With cataract progression, more of the cortical and eventually the nuclear fibres are affected and in the mature state, only a small number of attenuated equatorial fibres remain. The anterior epithelial cells become vacuolated apparently in response to cortical degeneration, and they also undergo proliferation, metaplasia to a spindle shaped cell and they migrate posteriorly beneath the posterior capsule. Beneath the posterior capsule, epithelial cells form either a single layer of flattened cells, or aggregations of large 'bladder' cells. The formation of new lens fibres at the equator continues relatively normally, throughout all stages of cataract.

Ultrastructurally, anterior epithelial cells contain two types of vacuole. Small circular vacuoles which are not membrane bound are present in small groups within the cytoplasm. These are also present and are more numerous within spindle shaped cells. The large irregular shaped vacuoles noted by light microscopy are usually membrane bound and often contain membranous or granular material. These vacuoles are interpreted as being dilated and damaged endoplasmic reticulum. Both spindle shaped and vacuolated anterior epithelial cells have increased amounts of endoplasmic reticulum and in spindle shaped cells, fibrillar material and electrondense deposits are present. Capsular material, though observed surrounding some spindle shaped cells histologically, could not be demonstrated ultrastructurally. The profound breakdown of the cellular architecture of the lens is readily demonstrated by scanning electronmicroscopy.

Water and electrolyte analyses of cataractous lenses, show that water and sodium content increases and potassium is lost, during cataractogenesis.

The objectives of this study, were to define the inherited cataract of New Zealand Romney sheep in clinical, genetic and pathological terms, to examine water and electrolyte shifts in cataractous lenses, and to compare the condition with other inherited cataracts of man and other animals. It is concluded, that this ovine cataract though apparently clinically unique, does in pathological and biochemical terms resemble many cataracts of man and animals of different causes. These changes are not aetiologically significant, but merely reflect the limited range of stereotyped reactions which are possible in the cataractous lens. For this reason, it is proposed that this ovine cataract would provide a useful model for fundamental studies on the pathogenesis of cataract.

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INTRODUCTION

Inherited cataracts have been recorded in man and several animal species. The objectives of this study, were to define a previously unreported ovine inherited cataract in clinical, genetic and pathological terms and to compare these findings with those reported in man and other animals.