Lens Ageing and Development of Senile Cataracts

Interdisciplinary Topics in Gerontology
Vol. 12

Series Editor
KP. von Hahn, Basel

S. Karger · Basel · München · Paris · London · New York · Sydney

Workshop on Ageing of the Lens, held after the 18th Meeting of the Association for Eye Research, Bonn, July 14–16, 1977

Lens Ageing
and Development of Senile Cataracts

Volume Editor
O. Hockwin, Bonn

In cooperation with
H. Bloemendal, Nijmegen; G. Duncan, Norwich; S. Lerman, Atlanta, Ga.; Phillips, Edinburgh, and H Rink, Bonn

170 figures and 47 tables, 1978

S. Karger · Basel · München · Paris · London · New York · Sydney

Interdisciplinary Topics in Gerontology

Vol. 9: Cellular Ageing: Concepts and Mechanisms
Part I: General Concepts, Mechanisms I: Fidelity and Information Flow
Editor: R.G. Cutler, Richardson, Tex.

Vol. 10: Cellular Ageing: Concepts and Mechanisms
Part II: Mechanisms II: Translation, Transcription and Structural Properties
Editor: R.G. Cutler, Richardson, Tex.

Vol. 11: Multidisciplinary Gerontology: A Structure for Research in Gerontology in a Developed Country
Editor: LR. Mackay, Melbourne
Lens Ageing and Development of Senile Cataracts

This volume contains 30 papers presented at the Workshop on Ageing of the Lens, held after the 18th Meeting of the Association for Eye Research, Bonn 1977. Selected papers from the Meeting are published as 'Gerontological Aspects of Eye Research', forming Vol. 13 in the series Interdisciplinary Topics in Gerontology (for contents see pages VII and VIII).

Contents

Preface IX
Nordmann, J. (Strasbourg): Opening Remarks 1
Courtois, Y.; Counts, M. F.; Laurent, M.; Simonneau, L., and Treton, J. (Paris): In vitro Cultivation of Bovine, Chick and Human Epithelial Lens Cells in Ageing Studies 2
Rink, H. (Bonn): Lens Epithelial Cells in vitro 24
François, J.; Victoria-Troncoso, V.; Cansu, K, and Victoria-Ihler, A. (Ghent): Culture of the Lens Epithelium in Senile Cataract 34
Bloemendal, H and Vermorken, A.J.M. (Nijmegen): Protein Synthesis in Isolated and Cultured Epithelia from Calf Lenses 41
Rink, H; Twenhoeven, H, and Hockwin, O. (Bonn): Antero-Posterior Cation Gradients in Bovine Lenses during Aging 80
Koch, -R.; Fischer, ., and Kaufmann, (Bonn): The Spontaneously Hypertensive Rat: An Animal Model for Presenile Cataract Development 90
Giblin, F.J. and Ready, V.N. (Rochester, Mich.): High Molecular Weight Protein Aggregates in X-Ray-Induced Cataract: Evidence for the Involvement of Disulfide Bonds 94

Contents VI

Liem-The, K.N.; Ringens, P.J.; Holtslag, J.C.W.M., and Hoenders, HJ. (Nijmegen): Changes in the Proportion and Composition of Structural Proteins during the Development of X-Ray Cataract in Rabbit Lens 105
Kremer, F. and Koch, -R. (Bonn): Effect of X-Rays and Carotid Ligature on Lens Transparency and on Various Biochemical Parameters in Rat Lenses 119
Boms, J.; Gruber, L.; Hockwin, Q., and Harris, J. (Bonn): The Crystalline of the Rat Lens with Triparanol-Induced Cataracts, also Related to Ageing 127
Rathbun, W.B.; Hough, M.; Gruber, L., and Harris, J.E. (Minneapolis, Minn.): The Reversal of Triparanol-Induced Cataract in the Rat. V. Activity Levels of ATPase and Three Enzymes of Glutathione Metabolism 132
Keller, HW. and Koch, -R. (Bonn): Experimental Arabinose Cataracts 141
Ohrloff, (Bonn): Age Changes of Enzyme Properties in Crystalline Lens 158
Banroques, J.; Skala, H; Schapira, F., and Dreyfus, J.C. (Paris): The Aging of Enzymes in Eye Lens 180
Korte, I. and Hockwin, O. (Bonn): In vitro Adaptation to Environmental Changes of Young and Old Bovine Lenses 187
Bours, J. (Bonn): Isoelectric Focusing and Isotachophoresis of Rat Lens Crystalline in Dependence on Age 196
Bours, J.; Week, ., and Hockwin, O. (Bonn): Gel Filtration Chromatography of Cristallins and Nucleic Acids from Different Parts of the Bovine Lens in Dependence

Downloaded by: 54.70.40.11 - 10/3/2017 8:16:28 AM
Gerontological Aspects of Eye Research

27 selected papers presented at the 18th Meeting of the Association for Eye Research, Bonn 1977. Published as Vol. 13 in the series Interdisciplinary Topics in Gerontology.

Contents

Preface IX
Introduction XI

Weale, R.A. (London): The Eye and Aging 1


Perkins, E.S. (London): Uveitis in Older Age Groups 21

Wurster, U. and Hoffmann (Hannover): Influence of Age and Species on Retinal Lactate Dehydrogenase Isoenzymes 26

Haeringen, N.J. van and Glasius, E. (Amsterdam): Erythrocyte Aggregation in Relation to Thrombotic Disorders of the Retina 40

Cremer-Bartels, G. (Münster): Age Dependence of Melatonin Biosynthesis in Rat Retina 46

Chioralia, G.; Baermann, H.; Kremer, F., and Dragomirescu, V. (Bonn): Permeability Study on Aging Rat Eye Tissues by Fluorescence Methods 51

Schlüter, G. (Bonn): Ultrastructural Investigations of the Embryonic Mouse Eye under Normal and Experimental Conditions 57

Deerberg, F.; Pittermann, W., and Rapp, K. (Hannover): Longevity Study in Han:Wistar Rats: Experience in Maintaining Aging Rats for Gerontological Investigations 66

Murawski, U. and Egge, H. (Bonn): Longevity Study of Age Changes in Serum Lipids
in Rats 75
Egge, H. and Murawski, U. (Bonn): Cyclic Modulations in Age-Dependent Variations of Rat Liver Lipids 81
Hockwin, O. (Bonn): Experimental Design in the Longevity Project on Eye Changes in Wistar Rats 88

Contents VIII

Koch, H.-R.; Hockwin, O., and Kremer, F. (Bonn): Life-Long Follow-Up for Senile Cataract Development in Wistar Rats 95
Hockwin, O.; Rast, F.; Rink, H.; Münnichoff, J., and Twenhöven, H. (Bonn): Water Content of Lenses of Different Species 102
Klethi, J. and Nordmann, J. (Strasbourg): Problems Concerning Aging of the Lens - Bovine and Human - and Senile Cataract 143
Lerman, S. and Borkman, R.F. (Atlanta, Ga.): Photochemistry and Lens Aging (Discussion induced) 154
Bando, M.; Nakajima, ., and Satoh, K. (Tokyo): Association of Sugar with Human Lens Protein 231
Bracchi, P.G.; Campanini, G., and Marami, G. (Parma): Calcium Content and Distribution in the Normal Human Lens and in Senile Cataract 239
Bushell, A.R. and Duncan, G. (Norwich): Calcium and High Molecular Weight Aggregates in the Human Lens 247
Satoh, K. and Morishita, R. (Noda, Chiba): Involvement of Uronic Acid in Calcium-Induced Aggregation of Deaggregated Water-Insoluble Protein of Human Lens 251
Subject Index 255
Preface

With ageing, the crystalline lens is subjected to two different kinds of changes which affect its functional capacity. These changes have been realized by the ophthalmologist for centuries:

(a) Loss of accommodation ability. This means a reduced capability to change the lens shape according to distance for exact focusing.

(b) Morphological lens changes which each ageing individual develops. In this respect it is remarkable that only in some patients do circumscribed opacities progress to mature cataracts, the time of occurrence with respect to the patients’ age varying widely.

Age-related changes show different morphological manifestations. In some patients the opacification of the normally transparent lens is more intense in the anterior cortex or periphery, while with others it is in the nucleus or the posterior subcapsular region. Changes in the nucleus leading to decrease or loss of vision are more often due to intensified coloration than to opacification.

There is no doubt that senile cataracts are the result of multifactorial events. Among the many influences possibly leading to the different types of senile opacities the ageing of the lens is the most important and most serious factor. For a long time lens research has been involved with changes induced by increasing age. Recent results obtained from human and animal material in longitudinal studies or investigations on certain age groups showed that the ageing of the lens leads to changes in: cell physiology; protein synthesis; protein composition; electrolyte balance with disturbances in water content; carbohydrate and energy metabolism in quantity and quality.

At the Workshop on 'Ageing of Lens Metabolism' in Bonn in July 1977, scientists in the various fields of lens research have reported their latest findings and have discussed their effects on future research projects. Thus the present volume represents an all-time review on age problems of the lens. Its publication coincides with a new phase of research in this field. In 1978, a cooperative research programme on 'Cellular ageing and decreased functional capacities of organs' was started in the EC member states, which is supported by the European Community. Ageing of the lens and senile cataract formation is one of the three key programmes. In the United States, too, a special project on senile cataract research has been started, and the exchange of experiences on an intercontinental level has already been agreed on.

Considering that in the United States, for instance, only 5 other surgical operations are performed more frequently than cataract extraction, and that in
the year 1958 in England and Wales about 24,000 cataract extractions were
performed, and further that in countries like India (Punjab district) 22.5% of the
population between 50 and 59 years of age and 31% of the age group over 60
suffer from lens opacities, the benefit lying in the advance in our knowledge of
the ageing processes of the crystalline lens is evident. If we succeed in elucidating
the mechanisms responsible for age-related opacities, as has already been possible
with certain experimental cataract models, we shall probably find the means to
slow down or even prevent the rate of cataract formation.

The final scope in this field of age research is not a question of restoring
transparency to already opacified lenses, which we know is impossible despite
the promising statements of certain pharmaceutical firms. The aim should rather
be to stop in time certain initiating factors before they start off the multifactorial
processes leading to opacification, which slowly but surely causes the
loss of vision. All over the world, scientists in the field of lens research have this
goal in mind. It may be assumed that their results on the cellular, molecular and
organ level hold also true for ageing problems of other cells and organs. For
several basic problems such as the posttranslational protein changes, the lens
represents the ideal model, and more and more teams in other fields than eye
research take advantage of its properties. Let us hope that the progress in
research on lens ageing and development of senile cataract, as demonstrated at
the Congress in Bonn, will be widely propagated through this book and will
invite scientists to cooperate in this fascinating project.

The Workshop, held at the Congress Centre of the German Red Cross in
Meckenheim-Merl, has been made possible through grants from Bayropharm,
Cologne, Boehringer, Ingelheim, Chauvin-Blache, Montpellier, Grünenthal,
Stolberg, Janssen, Düsseldorf, Knoll, Ludwigshafen, Dr. Mann, Berlin, Martinistiftung
der Medizinisch-Pharmazeutischen Studiengesellschaft e.V., Frankfurt,
Rodenstock, Munich, Sharp & Dohme, Munich, Schwind, Aschaffenburg,
Titmus-Eurocon, Aschaffenburg, Dr. Thiemann, Lünen, Dr. Thilo, Sauerlach,
Topcon-Europe, Rotterdam, Dr. Winzer, Constance, Zeiss, Oberkochen, Zyma-Blaes,
Munich, whose liberal support is gratefully acknowledged.

Preface XI

The staff of the Division Biochemistry of the Eye, Institute of Experimental
Ophthalmology, University of Bonn, was glad to learn that the participants of
the Workshop have appreciated their efforts to make their stay agreeable, and
that a repetition of the meeting would be welcome.

On behalf of the organizers I want to express our thanks to S. Karger
Publishers, Basel, and to Priv. Doz. Dr. von Hahn, Basel, Editor of the series
Interdisciplinary Topics in Gerontology for accepting the papers of the International
Workshop on Ageing of the Lens for the present volume.
0. Hockwin