The Use of Human Cells for the Evaluation of Risk from Physical and Chemical Agents

NATO Advanced Science Institutes Series

A series of edited volumes comprising multifaceted studies of contemporary scientific issues by some of the best scientific minds in the world, assembled in cooperation with NATO Scientific Affairs Division.

This series is published by an international board of publishers in conjunction with NATO Scientific Affairs Division

A Life Sciences	Plenum Publishing Corporation
B Physics	New York and London
C Mathematical and Physical Sciences	D. Reidel Publishing Company Dordrecht, Boston, and London
D Behavioral and Social Sciences	Martinus Nijhoff Publishers The Hague, Boston, and London
E Applied Sciences	
F Computer and Systems Sciences	Springer Verlag Heidelberg, Berlin, and New York
G Ecological Sciences	

Recent Volumes in Series A: Life Sciences

Volume 54—Leukotrienes and Prostacyclin
edited by F. Berti, G. Folco, and G. Velo

Volume 55—Durable Resistance in Crops
edited by F. Lamberti, J. M. Waller, and N. A. Van der Graaff

Volume 56—Advances in Vertebrate Neuroethology
edited by Jörg-Peter Ewert, Robert R. Capranica, and David J. Ingle

Volume 57—Biochemical and Biological Markers of Neoplastic Transformation
edited by Prakash P. Chandra

Volume 58—Arterial Pollution: An Integrated View on Atherosclerosis
edited by H. Peeters, G. A. Gresham, and R. Paoletti

Volume 59—The Applications of Laser Light Scattering to the Study of Biological Motion
edited by J. C. Earnshaw and M. W. Steer

Volume 60—The Use of Human Cells for the Evaluation of Risk from Physical
and Chemical Agents
edited by Amleto Castellani

Volume 61—Genetic Engineering in Eukaryotes
edited by Paul F. Lurquin and Andris Kleinhofs

Volume 62—Heart Perfusion, Energetics, and Ischemia
edited by Leopold Dintenfass, Desmond G. Julian, and
Geoffrey V. F. Seaman

The Use of Human Cells for the Evaluation of Risk from Physical and Chemical Agents

Edited by

Amleto Castellani

Casaccia Center for Nuclear Studies
Rome, Italy

Springer Science+Business Media, LLC

Proceedings of a NATO Advanced Study Institute on
the Use of Human Cells for the Assessment of
Risk from Physical and Chemical Agents,
held August 24–September 5, 1981,
in Pisa, Italy

Library of Congress Cataloging in Publication Data

Main entry under title:

The Use of human cells for the evaluation of risk from physical and chemical agents.

(NATO advanced science institutes series. Series A, Life sciences; v. 60)

“Published in cooperation with NATO Scientific Affairs Division.”

“Proceedings of a NATO Advanced Study Institute on the Use of Human Cells for the Assessment of Risk from Physical and Chemical Agents, held August 24–September 5, 1981, in Pisa, Italy.”

Bibliography: p.

1. Carcinogenicity testing—Congresses. 2. Mutagenicity testing—Congresses. I. Castellani, Amleto. II. NATO Advanced Study Institute on the Use of Human Cells for the Assessment of Risk from Physical and Chemical Agents (1981: Pisa, Italy) III. North Atlantic Treaty Organization. Scientific Affairs Division. IV. Series. [DNLN: 1. Mutagenicity tests—Methods—Congresses. 2. Carcinogens—Analysis—Congresses. 3. Radiation effects—Congresses. 4. Cytological technics—Congresses. QY 95 N279u 1981]

RC268.65.U83 1983

616.99'4071'0287

83-2429

ISBN 978-1-4757-1119-6

ISBN 978-1-4757-1117-2 (eBook)

DOI 10.1007/978-1-4757-1117-2

© 1983 Springer Science+Business Media New York
Originally published by Plenum Press New York in 1983
Softcover reprint of the hardcover 1st edition 1983

All rights reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise, without written permission from the Publisher

PREFACE

In this volume are collected 30 papers, 9 round table discussions and 11 communications presented at the ASI Course on "The use of human cells for the evaluation of risk from physical and chemical agents", sponsored by NATO and organized by ENEA.

The aim of the Course was to present different scientific approaches and technical advices in order to get dose-effect relationships which are the basis for risk evaluation. The scientific background which is behind this approach was extensively discussed.

Emphasis has been given to the use of human cells or human data in order to attempt to have a correct and realistic evaluation of the damage in humans.

There are many criticisms on the use of animal data for human risk evaluation because of differences between species and between strains within the same species: differences in metabolism, activation processes and DNA repair ability makes uncertain the extrapolation of animal data to humans.

Also data obtained using specific strains or highly inbred strains in order to reduce the variance are not applicable due to the heterogeneity of the human population connected with individual responses. In this respect only the use of human cells enable us to detect the individual variability and to identify sensitive subpopulations that would be at greater risk.

My appreciation to Pieranita and Alberto Castellani for the assistance during the meeting and to Giuseppe Biondi for his help in some of the editorial work.

Ameleto Castellani
Department of Health and
Environment Protection
ENEA, CRE, Casaccia
Rome, Italy

CONTENTS

LECTURES

What do We Mean by the Expression Risk Assessment?..... J.D. Jansen	1
The Search for Criteria to Assess the Risks Resulting from Exposure to Carcinogenic Agents U. Saffiotti	13
Some Comments on the Use of Human Cells for Estimates of Risk C.F. Arlett	23
The Strauss-Albertini Test for Direct Enumeration of Drug-Resistant Peripheral Blood Lymphocytes G.H.S. Strauss	31
Induction of Sister Chromatid Exchange by Chemical Mutagens P.E. Perry	49
Dose-Response Relation of Chromosome Aberrations J.D. Jansen	63
Mutagen-Induced Chromosome Damage in Man P.E. Perry	77
Repair of Radiation Damage in Mammalian Cells R.B. Setlow	91
Repair and Expression of Aflatoxin B ₁ -induced DNA Damage S.A. Leadon, P.A. Amstad and P.A. Cerutti	105
Parvoviral Probe for Assessing the Mutagenic Risk of Low Doses of Radiation and Chemicals Administered to Human Cells J.J. Cornelis, C. Dinsart, Z.Z. Su and J. Rommelaere	119

Assessment of Human Lymphoid Cell Damage Induced by Therapeutic Levels of 8-Methoxypsoralen and Long Wavelength Ultraviolet Radiation <i>In Vitro</i>	141
K.H. Kraemer	
The Mutagen Sensitivity Response of Cells from Individuals Heterozygous for DNA Repair Deficiency Genes	155
C.F. Arlett and S.A. Harcourt	
Repair of Chemical Damage in Mammalian Cells	169
R.B. Setlow	
Effects of Various Promoters on Cell Transformation by Simian Virus 40 Mutants	179
L. Daya-Grosjean, R. Monier and A. Sarasin	
Repair of Ultraviolet-Light-Induced Damage in Human Skin	197
B.M. Sutherland	
Dosimetry by Means of Measurement of Hemoglobin Alkylation and Risk Estimation Based on the rad-Equivalent Approach	205
S. Osterman-Golkar	
PUVA Therapy: Immunologic and Genotoxic Approaches to Risk Evaluation	219
G.H.S. Strauss	
Parvoviral Probe of DNA Replication in Mammalian Cells Exposed to Genotoxic Agents	237
J. Rommelaere, J.-M. Vos and D.C. Ward	
Ultraviolet-Light-Induced Transformation of Human Primary Cells	263
B.M. Sutherland	
Use of Human Lymphoblastoid Cell Lines to Determine Cellular Hypersensitivity to Physical and Chemical Agents	275
K.H. Kraemer	
Cellular Studies on Patients with an Unusual Clinical Sensitivity to Ionizing Radiation	285
A.M.R. Taylor	

CONTENTS

ix

Electrophilic Reactivity as a Measure of Genotoxic Potency	295
L. Ehrenburg and S. Osterman-Golkar	
SOS Functions Induced in Carcinogen-Treated Mammalian Cells	301
A. Sarasin and M. Mezzina	
Radiation-Induced Transformation in Rodent and Human Cells: Assay Systems and Uses in Risk Estimates	315
C. Borek	
Correlation of NCI and IARC Carcinogens with Their Mutagenicity in Salmonella	353
B.L. Harper, S.J. Rinkus, M. Scott, M. Ammenhauser, K.M. Bang, M. Lowery and M.S. Legator	
A Review and Evaluation of Human Genetic Bioassay Data for Some Known or Suspected Human Carcinogens ...	425
M.D. Waters, N.E. Garrett, C.M. Covone-de Serres, B.E. Howard and H.F. Stack	
From Bacteria to Man, the Evolution of Mutagenicity Testing	467
M.S. Legator and B.L. Harper	
Genetic Bioassay Data on Some Known or Suspected Human Carcinogens	495
M.D. Waters, N.E. Garrett, C.M. Covone-de Serres, B.E. Howard and H.F. Stack	
The Search for Biological Models to Investigate Human Carcinogenic Risks: Human Pathology and Experimental Carcinogenesis Correlations at the Organ, Tissue and Cellular Level, <i>In Vivo</i> and <i>In Vitro</i>	571
U. Saffiotti	
The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today	587
R. Peto	

ROUND TABLES

Reasons for Distrusting Human Risk Assessment Based Solely on <i>In Vitro</i> or Animal Test Results	595
Leader: R. Peto	
Quantitative Relationships, if Any, Between Human and Animal Carcinogenesis: Biological Aspects	603
Leader: J.D. Jansen	
Qualitative and Quantitative Problems in the Extrapolation of Risk to Humans from Animal Data	623
Leader: U. Saffiotti	
Risks from Ambient Chemicals and Radiations	635
Leader: M.D. Waters	
Human and Other Mammalian Cells: Their Role in Risk Assessment	647
Leader: C. Borek	
Measurements of DNA Repair Activity in Human Cells	663
Leader: P.A. Cerutti	
Risk Assessment for Low-Dose and Low-Dose-Rate Radiation	675
Leader: R.B. Setlow	
Difference in Cancer Susceptibility among Individuals and What Determines the Differences	689
Leader: A.M.R. Taylor	
Calibration and Monitoring of Human Population: Biological Aspects, Hemoglobin Alkylation and Radiation Equivalent Approach	701
Leader: M.S. Legator and S. Osterman-Golkar	

COMMUNICATIONS

Relaxation of Supercoiled DNA by DNA Modifying Agents: Detection by Gel Electrophoresis	725
G. Ciarrocchi, M. Ciomei and M.A. Pedrini	
The <i>MER</i> Phenotype: Human Tumor Cell Strains Defective in Repair of Alkylation Damage	731
D.B. Yarosh, M.R. Mattern, D.A. Scudiero and R.S. Day III	

CONTENTS

xi

Growth-Dependent and Age-Related Changes in the Free Amino Acid Pool of Human Diploid Fibroblasts	735
Y. Sambuy and A.H. Bittles	
DNA Fragmentation and Sister Chromatid Exchanges Induced by Commercial Auramine O, Purified Auramine, and Michler's Ketone	745
D. Vecchio, M. Pala, P. Russo, L. Ottaggio, A. Albini, S. Parodi and L. Santi	
An Attempt to Determine the Origin of DNA Single-Strand Breaks Observed after Treatment of Mammalian Cells with Alkylating Agents	755
A. Abbondandolo, E. Dogliotti, P.H.M. Lohman and F. Berends	
Localization of Genes Involved in DNA Repair on Human Chromosomes by Using Cell Fusion	761
M. Stefanini, W. Keijzer, A.J.J. Reuser, A. Geurts Van Kessel, T. Verkerk, A. Westerveld, J.F. Jongkind and D. Bootsma	
<i>In Vitro</i> Studies on Chemical Carcinogenesis in Balb/c 3T3 Cells	767
E. Cortesi	
The Chemical Hazard of Anto-Implantation Assessed and Analyzed Both <i>In Vitro</i> and <i>In Vivo</i>	773
D.M. Pugh and H.S. Sumano	
Cellular Specificity in DNA Damage, Repair, and Replication during Chronic Carcinogen Exposure	781
J.G. Lewis, M.A. Bedell, K.C. Billins and J.A. Swenberg	
The Problem of Specificity in the Assessment of Risk from Chemicals and Radiation-Breast Cancer Models	793
M.N. Gould	
Author index	799
Subject index	801