1972

Year Book OF ANESTHESIA

ECKENHOFF
BRUNNER
BRUCE
DITZLER
LINDE

THE YEAR BOOK *of* ANESTHESIA 1972

YEAR BOOK MEDICAL PUBLISHERS

INCORPORATED

35 EAST WACKER DRIVE

CHICAGO

THE PRACTICAL MEDICINE YEAR BOOKS

Medicine: DAVID E. ROGERS, M.D.; ROGER M. DES PREZ, M.D.; PAUL HELLER, M.D.; T. JOSEPH REEVES, M.D.; NORTON J. GREENBERGER, M.D.; PHILIP K. BONDY, M.D.; FRANKLIN H. EPSTEIN, M.D.

Surgery: SEYMOUR I. SCHWARTZ, M.D.; JOHN S. NAJARIAN, M.D.; ERLE E. PEACOCK, JR., M.D.; G. TOM SHIRES, M.D.; WILLIAM SILEN, M.D.; FRANK C. SPENCER, M.D.

Anesthesia: JAMES E. ECKENHOFF, M.D.

Drug Therapy: DALE G. FRIEND, M.D.

Obstetrics & Gynecology: J. P. GREENHILL, M.D.

Pediatrics: SYDNEY S. GELLIS, M.D.

Radiology: *Diagnosis*—WALTER M. WHITEHOUSE, M.D.; JOSEPH J. BOOKSTEIN, M.D.; TRYGVE O. GABRIELSEN, M.D.; JOHN F. HOLT, M.D.; WILLIAM MARTEL, M.D.; JOHN R. THORNBURY, M.D. *Therapy*—HOWARD B. LATOURETTE, M.D.; ROBERT T. GUTHRIE, M.D.; A. CURTIS HASS, M.D.

Ophthalmology: WILLIAM F. HUGHES, M.D.

Ear, Nose & Throat: JOHN A. KIRCHNER, M.D.; MICHAEL M. PAPARELLA, M.D.

Neurology & Neurosurgery: RUSSELL N. DE JONG, M.D.; OSCAR SUGAR, M.D.

Psychiatry & Applied Mental Health: FRANCIS J. BRACELAND, M.D.; DOUGLAS D. BOND, M.D.; DANIEL X. FREEDMAN, M.D.; ARNOLD J. FRIEDHOFF, M.D.; LAWRENCE C. KOLB, M.D.; REGINALD S. LOURIE, M.D.

Dermatology: FREDERICK D. MALKINSON, M.D.; ROGER W. PEARSON, M.D.

Urology: JOHN T. GRAYHACK, M.D.

Orthopedics & Traumatic Surgery: H. HERMAN YOUNG, M.D.

Plastic & Reconstructive Surgery: KATHRYN L. STEPHENSON, M.D.; REED O. DINGMAN, M.D.; JOHN C. GAISFORD, M.D.; BOYD W. HAINES, JR., M.D.; ROBERT J. HOEHN, M.D.; FREDERICK J. MCCOY, M.D.; GREER RICKETSON, M.D.

Endocrinology: THEODORE B. SCHWARTZ, M.D.; FRANK O. BECKER, M.D.; WILL G. RYAN, M.D.

Pathology & Clinical Pathology: WILLIAM B. WARTMAN, M.D.

Nuclear Medicine: JAMES L. QUINN, III, M.D.

Cancer: RANDOLPH LEE CLARK, M.D.; RUSSELL W. CUMLEY, PH.D.

Cardiovascular Medicine & Surgery: EUGENE BRAUNWALD, M.D.; W. PROCTOR HARVEY, M.D.; WALTER M. KIRKENDALL, M.D.; JOHN W. KIRKLIN, M.D.; ALEXANDER S. NADAS, M.D.; OGLESBY PAUL, M.D.; IRVING S. WRIGHT, M.D.

Printed in U.S.A.

Library of Congress Catalog Card Number: 63-25215

There are twenty YEAR BOOKS in various fields of medicine and one in dentistry. Publication of these annual volumes has been continuous since 1900. The YEAR BOOKS make available in detailed abstract form the working essence of the cream of recent international medicoscientific literature. Selection of the material is made by distinguished editors who critically review each year more than 500,000 articles published in the world's foremost journals.

TABLE OF CONTENTS

The material covered in this volume represents literature reviewed up to March, 1972.

THE YEAR BOOK *of* ANESTHESIA 1972

YEAR BOOK MEDICAL PUBLISHERS

INCORPORATED

35 EAST WACKER DRIVE

CHICAGO

THE PRACTICAL MEDICINE YEAR BOOKS

Medicine: DAVID E. ROGERS, M.D.; ROGER M. DES PREZ, M.D.; PAUL HELLER, M.D.; T. JOSEPH REEVES, M.D.; NORTON J. GREENBERGER, M.D.; PHILIP K. BONDY, M.D.; FRANKLIN H. EPSTEIN, M.D.

Surgery: SEYMOUR I. SCHWARTZ, M.D.; JOHN S. NAJARIAN, M.D.; ERLE E. PEACOCK, JR., M.D.; G. TOM SHIRES, M.D.; WILLIAM SILEN, M.D.; FRANK C. SPENCER, M.D.

Anesthesia: JAMES E. ECKENHOFF, M.D.

Drug Therapy: DALE G. FRIEND, M.D.

Obstetrics & Gynecology: J. P. GREENHILL, M.D.

Pediatrics: SYDNEY S. GELLIS, M.D.

Radiology: *Diagnosis*—WALTER M. WHITEHOUSE, M.D.; JOSEPH J. BOOKSTEIN, M.D.; TRYGVE O. GABRIELSEN, M.D.; JOHN F. HOLT, M.D.; WILLIAM MARTEL, M.D.; JOHN R. THORNBURY, M.D. *Therapy*—HOWARD B. LATOURETTE, M.D.; ROBERT T. GUTHRIE, M.D.; A. CURTIS HASS, M.D.

Ophthalmology: WILLIAM F. HUGHES, M.D.

Ear, Nose & Throat: JOHN A. KIRCHNER, M.D.; MICHAEL M. PAPARELLA, M.D.

Neurology & Neurosurgery: RUSSELL N. DE JONG, M.D.; OSCAR SUGAR, M.D.

Psychiatry & Applied Mental Health: FRANCIS J. BRACELAND, M.D.; DOUGLAS D. BOND, M.D.; DANIEL X. FREEDMAN, M.D.; ARNOLD J. FRIEDHOFF, M.D.; LAWRENCE C. KOLB, M.D.; REGINALD S. LOURIE, M.D.

Dermatology: FREDERICK D. MALKINSON, M.D.; ROGER W. PEARSON, M.D.

Urology: JOHN T. GRAYHACK, M.D.

Orthopedics & Traumatic Surgery: H. HERMAN YOUNG, M.D.

Plastic & Reconstructive Surgery: KATHRYN L. STEPHENSON, M.D.; REED O. DINGMAN, M.D.; JOHN C. GAISFORD, M.D.; BOYD W. HAINES, JR., M.D.; ROBERT J. HOEHN, M.D.; FREDERICK J. MCCOY, M.D.; GREER RICKETSON, M.D.

Endocrinology: THEODORE B. SCHWARTZ, M.D.; FRANK O. BECKER, M.D.; WILL G. RYAN, M.D.

Pathology & Clinical Pathology: WILLIAM B. WARTMAN, M.D.

Nuclear Medicine: JAMES L. QUINN, III, M.D.

Cancer: RANDOLPH LEE CLARK, M.D.; RUSSELL W. CUMLEY, PH.D.

Cardiovascular Medicine & Surgery: EUGENE BRAUNWALD, M.D.; W. PROCTOR HARVEY, M.D.; WALTER M. KIRKENDALL, M.D.; JOHN W. KIRKLIN, M.D.; ALEXANDER S. NADAS, M.D.; OGLESBY PAUL, M.D.; IRVING S. WRIGHT, M.D.

Printed in U.S.A.

Library of Congress Catalog Card Number: 63-25215

There are twenty YEAR BOOKS in various fields of medicine and one in dentistry. Publication of these annual volumes has been continuous since 1900. The YEAR BOOKS make available in detailed abstract form the working essence of the cream of recent international medicoscientific literature. Selection of the material is made by distinguished editors who critically review each year more than 500,000 articles published in the world's foremost journals.

TABLE OF CONTENTS

The material covered in this volume represents literature reviewed up to March, 1972.

INTRODUCTION

How to keep up with the literature—an enormous job! Anesthesiologists have, perhaps, a more difficult time than do most other specialists because pertinent articles appear in so many journals. No one person could hope to scan regularly every journal for articles of significance to anesthesiology. It is relatively easy to follow the anesthesia journals because their number is small, but it is the hundreds of other journals that are of concern. The problem has become even more acute with the extension of the anesthesiologists' activities into intensive care and resuscitation areas.

For the YEAR BOOK OF ANESTHESIA, 5 editors scan appropriate journals as well as articles selected from basic science and clinical journals. Important articles are abstracted and most are commented on. Some are abstracted in order to make what the editors believe is a pertinent point in the editorial comment. Most, however, are selected because the article is a significant contribution to anesthesia or intensive care practice, emphasizes a fundamental point or suggests a new approach to a problem.

JAMES E. ECKENHOFF

BIOCHEMISTRY AND PHYSICAL CHEMISTRY

Cyclic 3′,5′-Nucleotide Phosphodiesterase: Cytochemical Localization in Cerebral Cortex. Increasing evidence suggests that adenosine 3′,5′-monophosphate (cyclic AMP) may be involved in regulation of metabolism and function in nervous tissue. Cyclic AMP may be intimately associated with molecular events underlying synaptic transmission. The rate of enzymatic destruction of nucleotide by cyclic 3′,5′-nucleotide phosphodiesterase is an important factor limiting the magnitude and duration of action of cyclic AMP in tissues. Noel T. Florendo, Russell J. Barrnett and Paul Greengard[1] (Yale Univ.) studied cytochemically the localization of phosphodiesterase in brain, which of all mammalian tissues has the highest phosphodiesterase activity. Cerebral cortex from the parietal lobe of the adult male albino rat was examined. The hydrolytic product 5′-AMP was converted to adenosine and inorganic phosphate with an excess of 5′-nucleotidase and the phosphate was precipitated with lead ion.

Sections incubated in medium containing 3 mM. cyclic AMP showed localization of reaction product almost exclusively in postsynaptic nerve endings. Most appeared in the immediate vicinity of the synaptic membrane, particularly on or near the area of thickening of the postsynaptic membrane. The little remaining product was usually found close to smooth endoplasmic reticulum, possibly microtubules. Reaction product was found within about 85% of identifiable postsynaptic nerve endings. Little or no product was seen in association with axonal structures. Little or no product was found in sections incubated in medium containing 3 mM. cyclic AMP and 50 mM. theophylline. A variety of control experiments was carried out.

The postsynaptic membrane is the site at which neural transmitter substances alter permeability and thereby initiate or inhibit the generation of propagated responses in postsynaptic neurons. The authors believe that the effects of neurotransmitters on cyclic AMP are brought about through an action on postsynaptic membranes. If cyclic AMP mediates the physiologic action of certain neurotransmitters on neurons, then termi-

(1) Science 173:745-747, Aug. 20, 1971.

nation of the action of the transmitters would require removal of the cyclic AMP formed in response to action of the neurotransmitter as well as of the transmitter itself. The presence of phosphodiesterase in the immediate vicinity of the postsynaptic membrane would provide for such a function and its finding there provides further evidence for a role of cyclic AMP in the physiology of synaptic transmission.

► [Can the presence of anesthetics in the brain affect action of phosphodiesterase? Can this be related to the mechanism of anesthesia?—Eds.]

Clinical Implications of Gas-Induced Osmosis are discussed by Brian A. Hills[2] (Duke Univ.). Gases behave like other solutes of comparable molecular structure in vitro, but the effects are transient because of their rapid diffusion across membranes not truly semipermeable. Significant osmotic pressures have been induced across excised sections of such tissues as bladder and peritoneum by steady-state gas concentration gradients.

Boundaries across which osmotic movement of water could be particularly clinically significant are the extravascular cell membrane and the capillary wall. Previous studies (Hills, 1971) indicated that gases can induce osmosis across these boundaries. In the present study, experiments on peritoneum from rabbits showed that a gas partial pressure gradient produced a higher osmotic pressure than previously estimated. Experiments on articular cartilage from steers showed this tissue also to be semipermeable to gases. Gas-induced osmosis is clinically relevant to any situation where appreciable gas concentration gradients are likely to arise and to induce significant displacement of water. These are likely to become manifest in tissues where undesirable effects can be produced by small water movements.

A differential concentration of gas between joint fluid and the blood in the head of a bone can induce osmosis. A rapid rise in gas concentration in blood due to a change in inspired partial pressures would tend to move water from the joint into bone. An example is hyperbaric arthralgia ("dry joints"), which occurs during and soon after rapid compression. Movement of water within bone may cause sequestration or further concentration of certain solutes such as hydroxyapatite. Sudden increases in blood-gas concentration during anesthesia will tend to dehydrate nerve tissue. Gas-induced osmosis has been postulated

(2) Arch. Int. Med. 129:356-362, February, 1972.

as a possible mechanism of inert gas narcosis and possibly gaseous anesthesia, or at least for the components of those effects known to be transient.

Tissue detachments may occur when an osmotic pressure drives water across a barrier composed of two mediums of widely differing permeabilities, for example, aqueous and lipid tissue or epithelium and endothelium. Movement of water from cortical bone toward marrow could cause lipid detachment at interfaces such as endosteum. Gas-induced osmosis across bone could explain fat emboli found in blood on hyperbaric exposure. Gas-induced osmosis could also account for skin eruptions in patients during nitrous oxide anesthesia, retinal detachment in the newborn and oxygen toxicity in the lung manifest as pulmonary edema.

Demonstration of preferential water retention by subcutaneous fluid pockets saturated with more soluble gases indicates that gas-induced osmosis is an additional factor to be considered in fluid homeostasis.

► [This article brings up an interesting phenomenon long ignored by anesthetists. Although the author, a biophysicist, is mainly interested in problems other than anesthesia, there is obvious implication. We regularly make rapid changes in the patient's gaseous environment. Are some of the untoward effects of anesthesia related to osmotic pressure changes and water movement across membranes? Are these water movements related to the mechanism of anesthesia?—Eds.]

Synaptic Transmission in the Brain. K. Krnjević[3] (McGill Univ.) points out that nerve cells in the mammalian brain generate all-or-none impulses which are conducted along various branches of the cells in the usual manner. An effect of the presynaptic electric current on the excitability of the postsynaptic cell is unlikely to be very important except when many endings discharge synchronously or perhaps at a special synapse whose structure favors electric transmission ("gap" junctions). Further transmission of a signal generally depends on the transient release of a specific chemical from nerve endings whenever an impulse arrives, the transmitter interacting with specific receptor chemical groups in the membrane of the postsynaptic cell, thus altering its electrochemical properties and excitability. A given cell can apparently make only excitatory or inhibitory synapses with other cells. Any factor making the membrane potential more positive facilitates excitation, whereas any factor preventing such a change is inhibitory.

(3) Klin. Wchnschr. 49:519-523, May, 1971.

Most central excitatory nerve endings cannot alone initiate a postsynaptic spike. All synapses are not equipotent. Inhibitory nerve endings initiate corresponding inhibitory postsynaptic potentials. Inhibitory synapses situated at a remote dendritic site could block remote excitatory effects without their action being otherwise clearly reflected in changes in potential, resistance or even excitability of the soma. No compelling evidence for direct interneuronal communication through dendrodendritic synapses has been suggested. Good evidence has been obtained that γ-aminobutyric acid is an inhibitory transmitter in cortex and other areas of the brain. Monoamines (noradrenaline, dopamine and 5 hydroxytryptamine) may be released by nerve endings, but the evidence on effects exerted on any particular group of nerve cells is not conclusive. Glutamate and possibly aspartic acid have been tentatively identified as excitatory transmitters in brain. Acetylcholine excites a certain fraction of cerebral neurons and its central effects are often slow and prolonged. The depolarizing effect of acetylcholine is associated with an increase in membrane resistance, presumably because it reduces the potassium permeability of the membrane.

► [As information continues to accumulate, the mechanisms of synaptic transmission in mammalian brain become more clear. Our knowledge of peripheral neurohumoral mechanisms serves as a good model in our understanding of the more complicated design of central transmission. This article offers a brief and authoritative summary of current knowledge.—Eds.]

Kinetics of Acetylcholine Synthesis and Hydrolysis in Myasthenia Gravis. The weakness of myasthenia may be related to a defect in neuromuscular transmission, but no systematic evaluation of acetylcholine metabolism in myasthenic tissue has been reported. Symptoms of the disease could result from a deficiency in acetylcholine synthesis, increased hydrolysis of acetylcholine, binding inactivation of acetylcholine, blockade of the receptor site or the synthesis of a false transmitter. Roger N. Rosenberg, Donald J. Dalessio, Jacque Tremblay and David Woodman[4] performed enzyme kinetic studies on choline-O-acetyltransferase (CAT) and acetylcholinesterase (AchE) in serum, skin fibroblast cultures and sartorius muscle biopsies from normal and myasthetic subjects. Choline-O-acetyltransferase was assayed by an isotopic technic with 1-^{14}C-acetyl coenzyme A, and AchE with 1-^{14}C-acetylcholine. Muscle biopsies from myasthenics were obtained under propoxycaine local anes-

(4) Science 173:644-645, Aug. 13, 1971.

KINETICS OF ACETYLCHOLINE SYNTHESIS AND HYDROLYSIS IN SARTORIUS MUSCLE IN NORMAL AND MYASTHENIC SUBJECTS (NANOMOLES OF ^{14}C PRODUCT FORMED PER MILLIGRAM OF PROTEIN PER 20 MINUTES, pH 6.8, 37 C., I.E., UNITS OF ACTIVITY)

	CAT		AchE	
	Units of activity	Mean ± S.D.	Units of activity	Mean ± S.D.
General anesthesia controls $n = 2$	22.6 ± 1.9 21.3 ± 1.2	22.0 ± 2.3	182 ± 23 180 ± 11	181 ± 24
Propoxycaine controls $n = 4$	12.3 ± 2.2 11.7 ± 0.8 11.2 ± 0.8 11.4 ± 1.5	11.6 ± 0.4	195 ± 7 228 ± 1 253 ± 23 161 ± 9	209 ± 42
Myasthenics* $n = 3$	9.7 ± 1.8 8.2 ± 1.3 8.0 ± 0.1	8.6 ± 0.8	229 ± 9 245 ± 18 330 ± 32	268 ± 55

* $P < .005$ between propoxycaine controls and myasthenics for CAT specific activity.

thesia and from normals during general anesthesia. Biopsies were obtained 12 hours after the last dose of pyridostigmine. Fibroblast cultures were prepared from upper arm skin.

A significant decrease in CAT activity per milligram of protein was found in myasthenic skeletal muscle compared with that found in muscle. No significant difference in AchE activity was found (table), and serum and skin fibroblast CAT activities in normal and myasthenic tissues were similar. An average 26% reduction in myasthenic muscle CAT activity was documented. The enzyme activities found in muscle most likely reflect metabolism at the nerve terminal.

A noncompetitive endogenous inhibitor may be present in myasthenic muscle. If so, the autoimmune features of myasthenia gravis may be related to the defect in neuromuscular transmission. Impaired acetylcholine synthesis with a normal hydrolytic rate, however, represents only one factor causing the clinical symptoms of this disease. Other factors to be considered include hypoplastic motor end-plates with a reduced nerve terminal surface area, antibodies to muscle and postjunctional membrane insensitivity to acetylcholine.

Effect of Hypoxia on Substrate Levels in the Brain of the Adult Mouse. Proper functioning of the adult mammalian brain is completely dependent on the oxidative metabolism of carbohydrates. The high-energy phosphate content is quickly depleted under anaerobic ischemic conditions due to relatively inef-