

A judiciously op.
outlook concerning the
future THERAPY OF
PARKINSONISM, and
other hyperkinetic
diseases-- supported
by documented
evidence.

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The NEUROSURGICAL ALLEVIATION of PARKINSONISM

TWO NEW TECHNIQUES By THE AUTHOR

Presenting in detail two new techniques which have been developed by the author and used successfully in this disease-- including indications for these operations, surgical technique, complications, results and follow up data.

It includes a synopsis of earlier neurosurgical approaches, as well as the principal contemporary techniques.

Summarizing the results of 125 cases

Case histories and follow-up experience with various types of Parkinsonian patients, including both salutary results and complications.

Physiologic and psychologic implications.

FOR THE NEUROSURGEON, NEUROLOGIST GENERAL PRACTITIONER AND INTERNIST

ILLUSTRATIVE CASE REPORTS

WHAT NEUROSURGICAL THERAPY HAS TO OFFER

FOR THE NEUROSURGEON: This book will contain information regarding what type of case best suited for operation and explicit instructions on how to study the patient pre-operatively, detailed instructions on the operative technique and an explanation of all details necessary for post-operative care.

FOR THE NEUROLOGIST: Factual follow-up data which are aimed to show the following things:

a) that neurosurgical therapy is capable of alleviating tremor and rigidity of Parkinsonism without producing paralysis.

b) that considerable physiologic data are being gathered by neurosurgical investigators which will aid the neurologist in understanding the physiology of diseases of the basal ganglia.

(continued on front flap)

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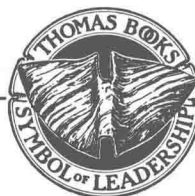
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of PARKINSONISM

To My Wife
Cherrie Frost Cooper

Preface

IT IS THE PURPOSE of this book to summarize the present status of the neurosurgical therapy of parkinsonism. Recent developments in surgical approaches to the therapy of this disease justify a judiciously optimistic outlook concerning the future therapy of parkinsonism, and indeed, other hyperkinetic diseases as well. It is my aim in this volume to present documented evidence that such a judiciously hopeful attitude regarding the neurosurgical therapy of parkinsonism is warranted. Further, it is my hope to provide detailed instructions for the selection of patients for neurosurgical therapy, the technique of operation, and the postoperative care and management of such patients.

In brief, there are six principal objectives which I have tried to fulfill in the preparation of the monograph. These objectives are: 1) The presentation of documented evidence that certain neurosurgical procedures are now capable of alleviating many cases of advanced parkinsonism — cases which heretofore have been assigned a hopeless prognosis. 2) A synopsis of earlier neurosurgical approaches to the therapy of parkinsonism, as well as the principal contemporary techniques. 3) The detailed description of the operative techniques which have been developed on our own service. An attempt has been made to present these techniques in such an explicit manner that any interested neurosurgeon would be supplied with sufficient information to enable him to perform these operations in properly selected cases. 4) To summarize the results up to the present time in a personal series of more than 125 cases. 5) To inform members of the medical profession, aside from neurosurgical colleagues, of the therapeutic possibilities inherent in the present neurosurgical approaches to parkinsonism. By describing in some detail the case histories and follow-up experience with various types of parkinsonian patients, including both salutary results and complications, I have tried to set forth the present possibilities of benefit, as well as the present risks of surgical therapy. I have also attempted to indicate the patients who appear to constitute the most favorable type of case for operation. 6) Finally, an attempt has been made to indicate new avenues of investigation for neurosurgical approaches to the hyperkinetic disorders. Moreover, it is important to note that there are many profitable scientific side streets which have been encountered during the current investigation. The physiologic and psychologic implications of some of the findings in our own cases have been mentioned.

In order to make crystal-clear the technical details described in the text, it was my aim to include artistic reproduction of these technical details, which, by themselves, would be self-explanatory. Miss Mary Lorenc has admirably supplied such drawings. Working from rough sketches by the author and from personal observation in the operating room, she has produced all of the drawings for this monograph. These could profitably be studied even without reference to the text. Miss Rose Marie Spitaleri and Mrs. Helen Onufrechuk O'Brien have during the past three years made motion picture records before and after operation of every case in the series. The photographic reproductions presented in this book are from the cinematographic records which they have made. Mrs. Janice Condon supplied the painstaking secretarial assistance which is so essential to the preparation of any literary effort. I should like to acknowledge the contributions of these co-workers to the present volume.

During the course of the three years that the investigation which has contributed to this monograph was being conducted, I have received support and encouragement from many persons. It is impossible to acknowledge here all to whom I am indebted. However, it is likewise impossible not to acknowledge some of the sources of professional and moral support without which this work might not have reached its present stage. The early anterior choroidal artery operations were carried out on the neurosurgical services of Bellevue Hospital and Central Islip State Hospital. It was due to the support and cooperation of Professor Thomas I. Hoen, Chief of Neurologic Surgery of New York University-Bellevue Medical Center and Dr. Francis O'Neill, Director of Central Islip State Hospital that this investigation could be initiated. From the inception of this study and up to the present time, Dr. Howard A. Rusk, Director of the New York University Institute of Physical Medicine, and Rehabilitation, has provided moral support, physical facilities and generous assistance to all aspects of the work which is summarized in this book. Dr. Rusk's enduring interest not only in our specific surgical techniques but more particularly in restoring dignity and usefulness to the chronically ill has become an important part of the moral structure of this study.

During a critical phase of our personal investigations, a distinguished group of senior colleagues kindly consented to personally review the results which had been obtained up to that time and to examine many of the patients who had been operated previously. Among those who were kind enough to come personally to review our results and techniques and who offered encouragement that has meant much to my colleagues and myself were Dr. Francis Grant, Professor of Neurologic Surgery at the University of Pennsylvania, Dr. Percival Bailey, Professor of Neurologic Surgery at the University of Illinois and Dr. James C. White, Professor of Surgery at Harvard. Dr. Robert S. Schwab, Director of the Parkinson Disease Clinic at Massachusetts General Hospital, has also been kind enough to review

the results which have been obtained during our investigation of neurosurgical therapy of parkinsonism. In addition, Dr. Schwab has contributed much of the knowledge gained by his extensive experience with this disease and has become an important collaborator in the present study. I wish to acknowledge my indebtedness and my gratitude to all of these distinguished colleagues.

I have been particularly fortunate in having the assistance of two outstanding, young neurosurgeons during these investigations. Dr. Aldo Morello of Italy, a Fellow in Neurologic Surgery at the New York University-Bellevue Medical Center has contributed much to the development of the anterior choroidal artery operation. In particular, his interest in the arteriographic visualization of the anterior choroidal artery has been an important factor in perfection of this technique. Dr. Nicolas Poloukhine of Paris, Fellow in Neurologic Surgery at St. Barnabas Hospital, has also made significant contributions to this study since joining our group one year ago. Dr. Poloukhine's anatomical and technical studies have contributed much to the perfection of the technique of chemopallidectomy. I wish to acknowledge the devoted and enthusiastic assistance which each of these men has contributed to the clinical aspects of our investigations.

Finally, I should like to acknowledge my indebtedness to Dr. A. P. Merrill, Superintendent of St. Barnabas Hospital for Chronic Diseases and to the Board of Managers of this institution. As part of their program in developing St. Barnabas Hospital as a center for dynamic treatment and rehabilitation of the chronically ill, they have established a neurosurgical service and provided it with facilities which provide an opportunity to carry out the further development and improvement of neurosurgery of parkinsonism and other hyperkinetic disorders. This effort is also indebted to the generous support of the Allen P. and Josephine Green Foundation and the William Hale Harkness Foundation.

IRVING S. COOPER, M.D.

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**The NEUROSURGICAL ALLEVIATION
of PARKINSONISM**

Chapter I

The Problem

SINCE 1817, when James Parkinson¹ described the syndrome which now bears his name, there has been a sustained interest in developing new methods of therapy for this affliction. This interest has thus far resulted in very little concrete progress toward the development of a specific pharmaceutical agent which will either permanently alleviate the disabling symptoms of parkinsonism or halt its inexorable course, once the first sign of the shaking palsy has made its appearance.

A clinical diagnosis of parkinsonism can now be made solely from the failure of an arm to swing during ambulation. Unfortunately, early recognition of the disease does not as yet presuppose an alleviation of the patient's distress. Paradoxically enough, informing the patient of the onset of parkinsonism creates anxiety which in turn often hastens the aggravation of symptoms. Thus, the need for therapeutic measures to alleviate some or all of the symptoms of parkinsonism is probably even more acute now than it was in 1817 when Parkinson said that he would think himself "... fully rewarded by having excited the attention of those who may point out the most appropriate means of relieving a tedious and most distressing malady."

The many excellent historical and descriptive accounts of the parkinson syndrome obviate the necessity for going into minute detail on this phase of the subject in the present brief volume. Practical help toward diagnosing the early insidious manifestations can be gained from the accounts of Wilson² and others. However, a brief picture of moderately advanced parkinsonism may be germane, for at this stage of the disease, the possibility of surgical therapy should be considered.

The classical presenting symptoms of a typ-

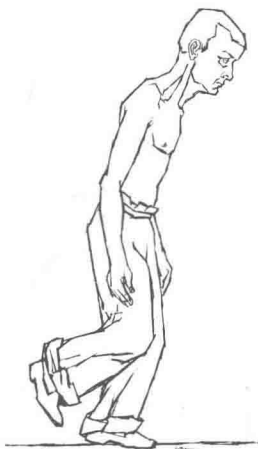


ical case of moderately advanced parkinsonism are tremor, rigidity and abnormal gait.

The tremor, usually present at rest, consists of alternating contractions of antagonistic muscle groups and is most marked in the distal parts of the extremities. Although commonly referred to as a *tremor at rest*, it often appears during motion, and may eventually spread to the proximal parts of the extremities as well as the truncal and nuchal musculature. Intensified by emotional stress it almost always disappears during sleep. The usual course of tremor is to increase in violence as the disease progresses. However, in some instances, as rigidity increases and the patient becomes relatively immobile, the tremor may become less notable.

The *stiffness or inflexibility of somatic musculature* present in practically every case of parkinsonism varies from a subjective stiffness which interferes with fine voluntary movements to board-like rigidity of the entire body which renders the patient immobile. This rigidity usually results in the familiar cogwheel phenomenon when the extremity is moved passively. Rigidity is the most common and significant factor leading to incapacitation.

Abnormalities of gait usually appear early in the course of the disease and, in most instances, progress to such a degree that the patient can no longer walk unaided. Characteristic manifestations are the dragging of one leg, *marche à petit pas*, or actual festination. Both propulsion and retropulsion are observed, and occasionally there is an imbalance suggestive of ataxia, with a falling toward one side. Rigidity, of course, contributes greatly to the gait abnormalities which usually develop simultaneously with muscular stiffness and a general flexion attitude of the body.



This triad: tremor, rigidity and abnormal gait, has become virtually synonymous with the syndrome and present-day surgery is directed toward the relief of these principal symptoms. There are, however, many other varied and protean manifestations which assume major importance in certain cases and which may or may not be relieved by surgery. In evaluating a patient's disability, all of the components of the syndrome must be considered. In some cases, one or more so-called minor elements of the complex may be contributing in greater degree to the patient's incapacitation than the classical triad described above.

Bradykinesia, extreme slowness of movement, is a common symptom. It is usually a reflection of rigidity, although in some instances the lack of spontaneous movement appears to be out of proportion to the demonstrable rigidity. Masked facies, oculogyric crisis, spontaneous crying or



laughing, respiratory difficulties in the form of uncontrollable overbreathing, as well as vegetative phenomena, such as spontaneous hyperthermia, and excessive sweating are common manifestations. Dysphagia and dysphonia are almost invariably present in the advanced case. Inasmuch as they usually reflect stiffness and weakness of the pharyngeal musculature and vocal cords, great care must be exercised in evaluating these signs in a potential candidate for surgery.

One other area of symptomatology invariably observed in parkinsonians — psychological disturbances — has not as yet received sufficient attention. Although Parkinson stated that the intellect is not impaired by the shaking palsy, he neglected to emphasize the frequent incidence of psychologic abnormality in such cases. Actually, psychiatric disturbances in many instances play an important role in the course of this illness.

Moderate to severe depression is the most frequent psychic symptom encountered in parkinsonians. However, paranoid manifestations with fixed delusions and, in some instances, actual hallucinations may occur in the advanced case. Excessive anxiety, obsessive-compulsive behavior, negativism, stereotyped activity and personality deterioration are among the common psychologic stigmata encountered in patients undergoing investigation on our service. Although many of these psychologic abnormalities are undoubtedly secondary to a chronic disabling disease, others appear to be due to organic brain involvement. It is impossible to

overemphasize the importance of a careful psychiatric and psychologic evaluation of all patients suffering from parkinsonism—particularly those under consideration as potential candidates for brain surgery.

During the clinical evaluation of a moderately advanced parkinsonian candidate for surgical therapy, it must be borne in mind that in practically every instance the foregoing symptoms are progressive. The average patient will finally reach a lingering stage of almost total helplessness; speechless, expressionless, unable to move at will but constantly shaking from involuntary motions, held in a prison of his own rigid musculature.

The symptomatology and course of the disease may be modified by the etiology, i.e., postencephalitic, idiopathic or senile. The rapidity and eventual degree of incapacitation will depend partly on the patient's psychologic and emotional structure and partly on the care and understanding he receives from the physician. But, in view of our present knowledge, the relentless progress of the illness is almost inevitable. It is this invariably pessimistic prognosis that has led some patients to submit to brain surgery with full awareness of the risks involved, in the hope of a degree of alleviation, and has led some neurosurgeons to attempt procedures for such alleviation.

It has been generally held that neurosurgery could make little or no material contribution to an eventual solution of the problem of therapy in parkinsonism. Nevertheless, during the past century many neurosurgeons have attempted to alleviate one or more of its intractable symptoms by surgical intervention. More often than not, the plea of a patient desperate enough to "try anything" for some measure of relief has been the deciding factor in the surgeon's decision to take up his scalpel.

In addition to seeking a means of alleviation for the immediate patient the surgeons stimulated by this problem have also sought to obtain clinical-physiologic data which might contribute to a better understanding of the mechanisms underlying the disease. These physiologic contributions have been particularly important to

an understanding of parkinsonism, since investigators were, until recently, unable to transmit the disease to experimental animals. Fortunately, recent reports indicate that one or more of the manifestations of the syndrome can be reproduced in the laboratory animal so that a new avenue for therapeutic investigations appears to be opening.

In our present state of knowledge, the interest of any neurosurgeon who attempts to alleviate parkinsonism should be directed not only toward perfection of a particular surgical technique but also toward perfection of the general understanding of this symptom complex and its underlying mechanisms. *The surgeon should become attached neither to any particular technique nor to his own proposed solution to the problem, but rather to the problem itself.* This attitude of neurosurgical investigators has, in the past, guided their interest in many physiologic operations. It would be unreasonable to approach the problem of neurosurgical intervention in parkinsonism with any other justification.

It is to the neurosurgeon who has a dual role — as surgical therapist and clinical investigator — that this monograph is directed. Investigations of the therapy of parkinsonism, both surgical and medical, appear to be entering a new phase, in a philosophical as well as a scientific sense. It is now evident that several manifestations of advanced parkinsonism are reversible and that, in selected patients, lasting alleviation of tremor, rigidity and disability can be achieved in a degree previously considered to be impossible. The results of neurosurgical studies have held enough promise to stimulate many neurosurgeons to duplicate and improve upon current techniques, similarly, medical investigators have been stimulated to reconsider the pathologic physiology of the problem and it is hoped that they will eventually come up with a medical solution.

This volume dealing with the neurosurgical alleviation of parkinsonism is dedicated to the proposition that neurosurgical investigations can make a definite contribution toward an increased knowledge of this disease and conse-

quently toward better medical therapy. Indeed, in what appears to be an era of revived interest in parkinsonism, there could be no greater reward than the early appearance of a new and better medical therapy that would render obsolete the data offered here.

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Chapter II

A Review of Surgical Approaches to the Treatment of Parkinsonism

ALTHOUGH NEUROSURGERY for the treatment of the symptoms of parkinsonism has been seriously attempted only in the past two decades, operations have already been devised which attack all levels of the nervous system (Figure 1). These operations include destructive lesions of the pyramidal tract at the level of cerebral cortex, cerebral peduncle and spinal cord. The dorsal nerve roots and dorsal columns of the

spinal cord as well as the cerebellum have also been subjected to surgery. During the past decade, surgery of the basal ganglia has received increasing attention.

An evaluation of the positive and negative aspects of these surgical experiences, which have extended from the radicular to the cortical level, may help to clarify the present status of the surgical therapy of parkinsonism.

THE PYRAMIDAL ERA OF SURGICAL THERAPY

Neurosurgical attack on the pyramidal tract originated with operations devised to resect either the premotor cerebral cortex (area 6), the motor cerebral cortex (area 4), or both. According to Klemme,¹ "the premotor cortical removal for the treatment of this condition (paralysis agitans) was introduced by me in 1937." However, Bucy^{2, 3, 4} also performed cortical excision of the cerebral cortex for tremor in the same year, following his earlier studies of cortical excision for choreo-athetosis. In this regard, it should be noted that Horsley⁵ excised the precentral cortex for athetosis as early as 1890.

Klemme advocates resection of the premotor cortex, corresponding to Brodmann's area 6, for relief of tremor in the contralateral extremities. The reports of Klemme's surgical technique are lacking in detail, and his early reports substantiating successful results lack both documentation and follow-up studies. A 1940 report states that of 100 operations performed, thirty-nine had relieved contralateral involuntary movements without causing any neurologic deficit. These patients were said to be completely rehabilitated. The mortality rate in this series was 17 per cent. Inasmuch as there has been no confirmation of these salutary results, a final

evaluation of this procedure will have to await a documented follow-up study of Klemme's cases. It cannot be doubted, however, that this operation frequently produces a contralateral spastic hemiparesis and may be followed by convulsive seizures.

Contrasted with Klemme's scanty published data covering his large series of cases are Bucy's many detailed analyses and conclusions based on his experience with a limited series of cortical excisions for parkinsonian tremor. Bucy states that cortical extirpation is most effective when it includes both areas 4 and 6 of Brodmann (Figure 2). After exposure of the precentral cortex he identifies the arm and leg areas respectively by stimulating the cortex with a 60 cycle sinusoidal current. He then employs a wide resection of either the arm or leg area or both. This produces a contralateral hemiplegia which subsequently lessens in severity, leaving the patient with a residual hemiparesis but without tremor. Epileptiform seizures may develop following this operation. Rigidity and incapacitation are not decreased and may, in fact, be increased by cortical extirpation.

His results led Bucy to conclude that this operation which could be considered a palliative