
PHYSIOLOGY OF SHOCK

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NEW YORK

THE COMMONWEALTH FUND

1950

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THE COMMONWEALTH FUND

PUBLISHED BY THE COMMONWEALTH FUND
41 EAST 57TH STREET, NEW YORK 22, N. Y.

*Printed in the United States of America
By Case, Lockwood & Brainard
Hartford, Connecticut*

PHYSIOLOGY
OF SHOCK

LONDON
GEOFFREY CUMBERLEGE
OXFORD UNIVERSITY PRESS

DEDICATED TO
MY COWORKERS — PAST AND PRESENT

FOREWORD

FROM JULY, 1940, to September, 1946, the research program of the Department of Physiology in the School of Medicine of Western Reserve University was chiefly centered around studies of the peripheral circulation and shock. This program, under the general direction of the author, proceeded with no preconceived theories or blueprints; suggestions for successive steps in the investigations were allowed to grow out of preceding experiments or a group of these. During most of the time three teams, each composed of an experienced investigator and one or two research trainees, were continuously active. In difficult problems several experienced investigators combined their talents. The results of these studies and the interpretations that appeared valid were published in current journals.

This monograph has evolved from these researches. Through daily contact with the investigations, and particularly through experiments in which the author participated, certain opinions were gradually crystallized regarding the factors and mechanisms concerned in the circulatory failure of shock. When the data were again considered after the lapse of a few years, during which time additional discoveries had been published, it was found that, while most of the conclusions remained valid, a few required amendment or revision in order to fit all of the known facts. Furthermore, it became obvious that the significance of our studies could only be evaluated when viewed in proper perspective with other investigations, past and present. It, accordingly, proved desirable to review the important experimental and clinical data that had accumulated and to assess, on the basis of personal experiences, the probable validity of the conclusions that had been drawn at various periods.

The reader, therefore, will discover that, although this monograph conscientiously attempts to assemble and critically analyze the vast amount of experimental work pertaining to shock, the researches of the Western Reserve University group and the conceptions to which they gave rise will be heavily stressed. However, he may be assured

that this is not intended to minimize the importance of many significant contributions by other investigators.

The monograph begins with a general analysis of the many pathways over which scientific progress has been made in the solution of the shock problem. It next describes the patterns of laboratory studies and the ends that each type of study has sought to attain. The following chapter deals with a survey of the clinical signs and symptoms, which the laboratory investigator must always consider in deciding whether nature's experiment is merely simulated or duplicated. The criteria of experimental shock are next discussed critically; then the advances that have been made during the current era in the experimental production of various types of shock.

Since our conclusions were derived largely from the study of experimental hemorrhagic shock, the methods for its standardization in our own and other laboratories are presented in detail, and their relative merits evaluated. Moreover, since our hemodynamic studies involved newer methods of pressure recording, the advantages and limitations of which are still not generally appreciated, a chapter is intercalated which reviews the principles for their construction and use as well as the inferences that may and may not be drawn from recorded pressure curves. A procedure is described by which the progressive shock developing as a result of low blood volumes may be compared to that developing when blood volume is not reduced. The reasons are given why a concept of oligemic and normovolemic forms of shock was evolved. Succeeding chapters contain a detailed exposition of the hemodynamics of shock, the possible mechanisms of peripheral circulatory failure, and the role that default of the myocardium may play. The concluding four chapters are more largely concerned with the work of other investigators, evaluated to the author's best ability and integrated with our dynamic studies. They include discussions of the abnormalities of respiratory, oxidative, and metabolic functions; a recapitulation of how important organs are affected; and a discussion of the role of toxemic and nervous factors. The final chapter summarizes the sequential events and reactions that occur during the development of oligemic and normovolemic shock.

The author is indebted to many associates, who contributed to the experimental work and offered their frank, friendly criticisms throughout their respective periods of association. Special mention must be made of Harold D. Green, who served as co-director of the project for

four years, and of Harold C. Wiggers, David F. Opdyke, Ewald E. Selkurt, and Robert S. Alexander. To these and many others, too numerous to name individually, his appreciation and thanks are due. His secretary, Miss Jeanette Ingersoll, deserves praise and thanks for many types of service connected with the preparation of the manuscript.

Finally, the author wishes to express his appreciation of the financial support given by The Commonwealth Fund, and no less of the many forms of encouragement received from its officers and staff.

C. J. W.

October, 1950

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