Cardiac Disease in Pregnancy:

Medical Care, Cardiovascular Surgery and Obstetric Management as Related to Maternal and Fetal Welfare

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F. A. DAVIS COMPANY, PUBLISHERS

60.8

Library of Congress
Catalog Card No.
60-12257

PRINTED IN THE UNITED STATES OF AMERICA

Obstetrics & Gynecology

. . . *A SERIES OF MONOGRAPHS*

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Foreword

I FIRST MET *the author of this book when he entered Cornell Medical School in 1934, and grew to know him well during his clinical years as a medical student. Our association became even closer during his subsequent years of resident training, when Dr. Mendelson became interested in the problem of pregnancy complicated by cardiac disease. Actually, the concept of making this area his major field of interest and of increasing his knowledge and experience, and eventually writing this book, was born at that time—more than twenty years ago.*

Following completion of his resident training in 1943, Dr. Mendelson was appointed to the attending staff of the Cornell University Medical College Hospital and assumed charge of the Obstetric Cardiac Clinic of the New York Lying-In Hospital, a post he has held continuously until the present.

The Obstetric Cardiac Clinic had been initiated in September, 1932, when the present buildings of the New York Hospital-Cornell University Medical College were completed and the Lying-In Hospital transferred from its old site on Second Avenue. From the outset, the policy of the clinic has been to care for all obstetric patients with heart disease within the Department of Obstetrics and Gynecology, since this plan was felt to serve best the interests of the patients. In addition, both clinic and pavilion patients have provided valuable opportunities for the teaching of medical students, resident physicans, and attending staff, as well as clinical material for the instruction of internists, surgeons, and pediatricians at all levels. The members of other departments of the hospital have become acutely aware of the unique problems involved in the total care of the obstetric cardiac patient, and the best of cooperation from the departments of medicine, pediatrics and surgery, whose consultations are employed both in the Out-Patient Department and on the pavilions, has been enjoyed.

The incidence of cardiac disease in pregnancy in the New York Lying-In Hospital is considerably higher than it is in most comparable university hospitals. One of the reasons for this is the presence of a Pediatric Cardiac Clinic that was initiated some fifty years ago, and which was incorporated in the new Department of Pediatrics of the Cornell University Medical College Hospital in 1932. Some third generation patients from this source are now being cared for.

The source material for this book has been derived from the study of almost 4000 patients treated in the clinic and pavilions of the New York Lying-In Hospital. During the past two decades, Dr. Mendelson has had the opportunity of seeing almost every patient in this large series in the Out-Patient Department and in the pavilions; in many instances he has

been present during labor and delivery of these patients. To the best of my knowledge, no other book has been based on the actual management of such a large number of obstetric patients with heart disease. The clinical experience provided has given the author practical knowledge concerning not only the common conditions, but also rare complications, all of which are documented. For although the majority of obstetric cardiac patients studied had rheumatic heart disease or the sequelae of this disorder, there were many with less common cardiac and circulatory problems, such as coronary artery disease, patent ductus arteriosus (with reverse flow), pulmonary hypertension, coarctation of the aorta, patent septa, kyphoscoliotic heart disease, hyperthyroid heart disease, sickle cell anemia, and many others.

Previous volumes on this subject have been written for the most part by internists. Since the author of the present work is an obstetrician, he has had the great advantage of a long experience in caring for obstetric patients, and is familiar with all the problems that may befall those without heart disease. This knowledge has been invaluable in the interpretation of observations in the patient with heart disease.

Dr. Mendelson was one of the pioneers in the philosophy that the patient with cardiac failure should not be delivered by cesarean section, a practice that was rather generally in vogue at the time he initiated his studies. His experiences have lent valuable support to the policy that cesarean section should be employed mainly for obstetric indications.

It is a great satisfaction to me to know that this accumulated experience has been assembled and made available for those interested in this subject. This book is unique in that it describes the management of the obstetric cardiac patient by a coordinated "team" of obstetrician, internist, and surgeon. It should, therefore, be of great interest and value to surgeons, internists, and obstetricians, as well as to pediatricians and general practitioners who care for patients with heart disease and only rarely encounter the more serious forms of this disorder. In addition, it is a valuable reference work for medical students and residents in training.

Dr. Mendelson is to be commended for the prodigious task that he has accomplished.

R. Gordon Douglas, M.D.
Obstetrician and Gynecologist-in-Chief
New York Lying-In Hospital

Acknowledgments

THE COMPLETION OF A BOOK is followed by a task which is both pleasant and difficult, namely, that of paying homage to all those who have inspired and assisted the author.

Dr. Henricus J. Stander, the late Obstetrician and Gynecologist-in-Chief of the New York Lying-In Hospital, and his successor, Dr. R. Gordon Douglas, have been responsible for development of the antepartum cardiac clinic, and for encouraging various investigative projects under their respective guidances.

Dr. Harold E. B. Pardee, a true pioneer in the contemporary field of obstetric cardiology, gave freely of his wisdom and clinical experience when I embarked on this study.

Members of the New York Hospital "cardiovascular team" have cooperated in the study and treatment of many problem patients. I refer specifically to Dr. Frank Glenn—Department of Surgery; Dr. Harold J. Stewart—Department of Medicine; Drs. Mary Allen Engle and Henry Goldberg—Department of Pediatrics; Dr. Joseph Artusio—Department of Anesthesia; Dr. Dan Lukas—Cardiopulmonary Laboratory; and Dr. Israel Steinberg—Department of Radiology.

Members of the New York Hospital medical and obstetric house staffs have worked with me throughout the years, and have rendered excellent care to the patients. It would take considerable space to list all their names.

My colleagues—Drs. Charles Enselberg and Jack Milowsky—carefully reviewed portions of the text, and made important corrections and suggestions.

Drs. Charles H. Hendricks, John Quincy Adams, Russell de Alvarez, Louis P. Lowenstein, Charles P. McCartney and Hans Popper kindly provided illustrations from their publications.. These contributions are acknowledged where they are reproduced in the text.

Although I do not pose as an authority in obstetrics or cardiology, my formal credentials classify me as an obstetrician. I have had the tremendous good fortune to learn many fine points of this specialty through long association with Drs. Everett M. Hawks and Edward H. Dennen.

I am deeply indebted to the F. A. Davis Company and to Dr. Claude Heaton for cooperation in the completion of this book.

I am grateful to Louise Munsch for preparation of the graphic illustrations, to Sara Brady for typing and proofreading the manuscript, and to Frances Macdonald for supplying statistic information from the New York Lying-In Hospital records.

My wife, Marie Krause Mendelson, an experienced author in her own right, not only exhibited undying indulgence while I devoted many hours to this work, but ably helped me in preparing Chapter 17.

I cannot conclude these acknowledgments without sincere tribute to inspiration provided through the confidence of Mrs. L.—the first New York Lying-In Hospital patient subjected to antepartum mitral commissurotomy.

CURTIS LESTER MENDELSON, M.D.

Introduction

A COMPREHENSIVE, historic review of obstetric cardiology is beyond the scope of this book. The reader interested in this fascinating phase of the subject should refer to "The Heart in Pregnancy" by Julius Jensen, which covers the earlier writings in great detail. However, it is appropriate here to mention the major works which can be classified as monographs or books.

In 1876, August Berthiot published "Grossesse et Maladies du Coeur," in which he drew attention to the seriousness of heart disease in pregnant women, and discussed the complications in terms of anatomic and physiologic alterations. Angus Macdonald's book, "The Bearings of Chronic Disease of the Heart upon Pregnancy, Parturition, and Childbed," which appeared in 1878, emphasized the role of mitral stenosis in maternal mortality. In 1921, "Heart Disease and Pregnancy," by Sir James Mackensie, contained the first clear interpretation of prognosis in relation to cardiac reserve. "The Heart in Pregnancy," published by Julius Jensen in 1938, and mentioned above, gave an exhaustive review of the world literature on the subject. That same year, Crighton Bramwell and Edith Longson published a smaller volume entitled "Heart Disease and Pregnancy." "The Heart in Pregnancy and the Childbearing Age," by Burton Hamilton and Jefferson Thomson, which appeared in 1941, contained a thorough discussion of cardiac disease in relation to hemodynamic changes of pregnancy. In 1951, Morgan Jones published a brief monograph entitled "Heart Disease in Pregnancy." The most recent contribution, "Heart Disease and Pregnancy—Physiology and Management," by Sidney Burwell and James Metcalfe, appeared in 1958, and is a worthy successor to the earlier volume by Hamilton and Thomson.

Contemporary scientific journals contain a prodigious list of contributors whose major interest also lies in the field of obstetric cardiology. These authors are cited in the text and in bibliographic references included at the end of each chapter.

There is ample reason for the expanding interest in this special field. Improvements in prenatal care, plus availability of blood and of antibiotic drugs, have reduced the ravages of toxemia, hemorrhage and infection, so that currently heart disease is the single, greatest cause of maternal mortality at many obstetric clinics throughout the world. This fact is portrayed vividly in Table 1, which shows the changing causes of maternal deaths in order of magnitude at the New York Lying-In Hospital from 1932 through 1957.

The purpose of this book is to discuss the various etiologic types of heart disease encountered during pregnancy, in terms of medical care, cardiovascular surgery and obstetric management.

TABLE 1

New York Lying-In Hospital

Changing Causes of Maternal Deaths in Order of Magnitude

(September 1, 1932 – December 31, 1957)

1932–1937	*1938-1942*	*1943-1947*	*1948-1952*	*1953-1957*
Infection	Infection	Cancer	*Heart disease*	*Heart disease*
Hemorrhage	Embolus	Hemorrhage	Cancer	Cancer
Pneumonia	Hemorrhage	*Heart disease*	Infection	Infection
Heart disease	*Heart disease*	Cerebrovascular accident	Toxemia	Pneumonia
Embolus	Toxemia	Embolus		Embolus
Toxemia	Cerebrovascular accident	Infection		
Cerebrovascular accident		Pneumonia		
Cancer				

The material upon which the study is based includes 3690 cases from the New York Lying-In Hospital—the majority of which have been followed personally by the author—and reports of other experiences gathered from the literature. Where controversial issues are involved, I have attempted to give the opposing points of view together with reasons for my own convictions. If at times the arguments seem belabored, I beg the reader's indulgence, for the primary intention is to shed light upon this great hazard to childbearing. After all, there must be a happier solution to the problem than recommended by Peter: "Fille, pas de marriage; femme, pas d'enfants; mere, pas d'allaitment."

In the past, obstetricians depended almost entirely upon their medical colleagues when confronted with a cardiac problem in pregnancy. Seldom, on the other hand, did cardiologists appreciate fully the obstetric implications of heart disease. This hiatus has been bridged to some extent through development of "obstetric-cardiac" clinics in most maternity centers. These clinics first were established in the early 1920's at the Boston Lying-In Hospital, the Sloane Maternity Hospital in New York and at the New York Lying-In Hospital.

However, the challenge of maternal mortality due to heart disease still exists, and can be met only through a useful integration of the specialties concerned. Accordingly, I have attempted to cover the medical, surgical and obstetric aspects of the subject in considerable detail. Despite the long and frequent periods of frustration and the sense of inadequacy I have felt while collecting and organizing the material over some twenty years, the personal experience has been rewarding, but if in some small way this presentation serves to meet the challenge, my time will have been spent to true advantage.

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CHAPTER 1

Circulatory and Respiratory Changes in Pregnancy

The childbearing state is accompanied by significant alterations in circulatory and respiratory physiology, and a knowledge of these changes is a prerequisite for management of pregnancy complicated by heart disease.

HEART RATE

The heart rate (Figure 1) begins to rise between the eighth to tenth week, gradually increases to a maximum level during the thirty-fourth to thirty-sixth week, and returns subsequently toward normal at term. Although the highest acceleration amounts only to some ten beats per minute, this represents a total of 14,000 extra beats per day.

OXYGEN CONSUMPTION

Oxygen consumption (Figure 2) begins to rise about the second month, and increases progressively, reaching a value between 10 and 20 per cent above normal at term. The rise is due primarily to fetal and uterine metabolism. Calculations of basal metabolic rate based upon the standard Du Bois formula are not entirely accurate because of the pregnant woman's atypic body surface area.

ARTERIOVENOUS OXYGEN DIFFERENCE

The arteriovenous oxygen difference (Figure 3) begins to decrease about the eighth week, falls to an average of 3.4 volume per cent during the fourteenth to thirtieth week, and increases subsequently to normal at term.

ARTERIAL BLOOD PRESSURE AND PERIPHERAL RESISTANCE

The mean blood pressure (Figure 4) tends to decrease in the first and second trimesters. There is a disproportionate fall in the diastolic level

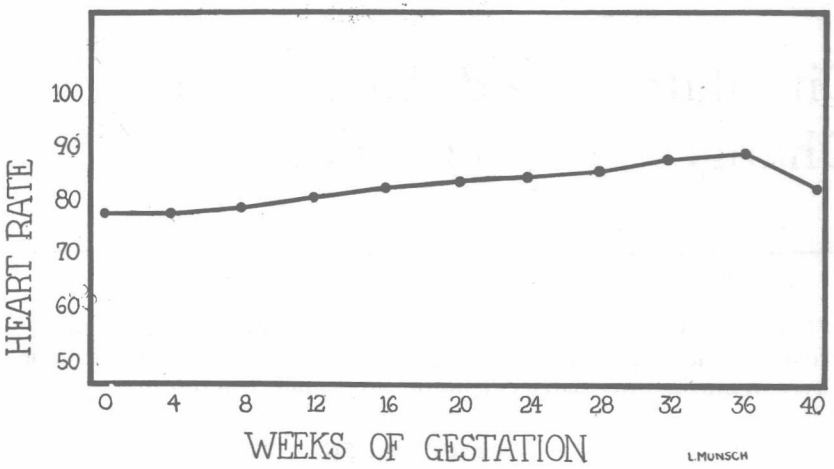

FIG. 1. Heart rate in pregnancy.

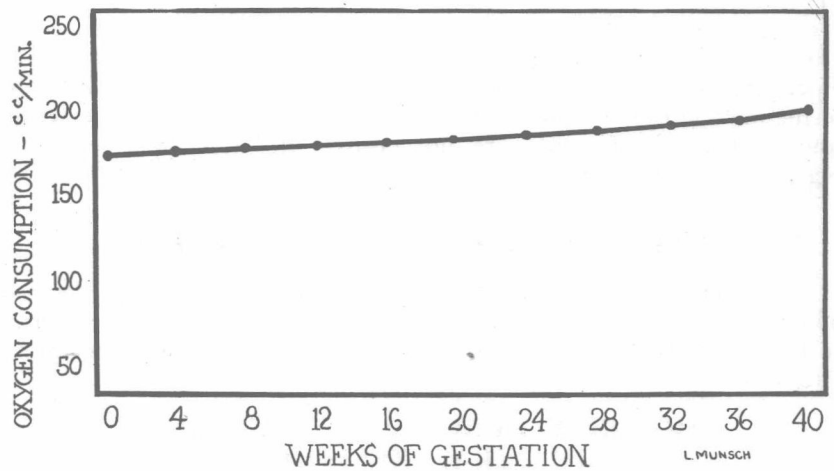

FIG. 2. Oxygen consumption in pregnancy.

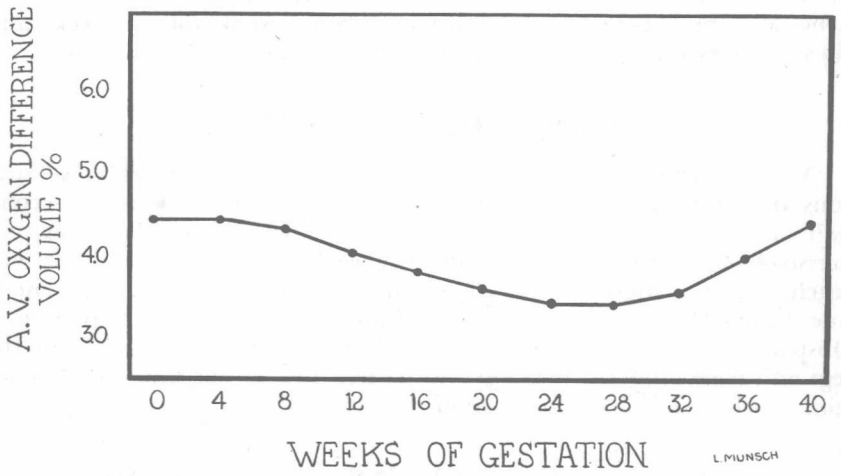

FIG. 3. Arteriovenous oxygen difference in pregnancy.

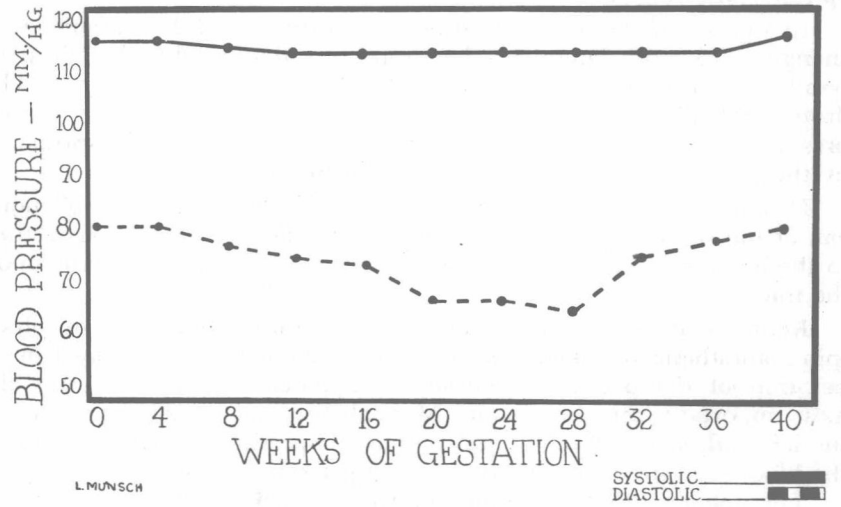

FIG. 4. Systemic blood pressure in pregnancy.

which may produce capillary pulsation. The peripheral resistance (Figure 5) begins to fall in the first trimester, reaches its lowest value of 980 dyne sec. cm.-5 between the fourteenth and twenty-fourth week, and rises progressively to a normal value of 1240 dyne sec. cm.-5 at term.

VENOUS BLOOD PRESSURE

Venous pressure (Figure 6) in the upper extremities remains fairly constant, although there is a tendency for slight decrease in the second half of pregnancy. Venous pressure in the lower extremities rises progressively beginning about the twelfth week, and the term value may reach a level as high as 10 to 20 cm. of water above normal. The rise is due primarily to pressure of the gravid uterus upon adjacent pelvic veins. Obstruction to venous return frequently produces varicose veins of the legs and hemorrhoids. If the gravid patient lies on her side, the obstruction is relieved and femoral venous pressure falls.

THE SUPINE HYPOTENSIVE SYNDROME

In some otherwise normal gravid patients, the assumption of a supine position produces hypotension, tachycardia, and syncope. Occasionally, abdominal pain may develop. These symptoms are relieved promptly by changing to the lateral position, by sitting, or by standing erect. The syndrome is encountered generally during the last trimester, and disappears following delivery.

In a group of 196 near-term subjects, Quilligan and Tyler found that changing from the lateral to the supine position produced a drop in systolic pressure of 30 mm. Hg or more in six cases (3 per cent). The drop in blood pressure was accompanied by a definite rise in venous pressure of the lower extremities, but the cardiac output—as estimated by the pulse pressure method—remained constant.

Howard, Goodson, and Mengert attributed the circulatory phenomena of the supine hypotensive syndrome to a decrease in venous return to the heart, brought about through pressure of the gravid uterus upon the inferior vena cava.

Kennedy and associates studied 600 consecutive deliveries in which spinal anesthesia was used, and found that hypotension developed in 18 per cent of the patients. The supine hypotensive syndrome was the most important causative factor. Manual displacement of the uterus to the left with relief of abdominal venous compression effectively restored the blood pressure to normal in over 90 per cent of the subjects.

The augmentation of venous return, which normally accompanies a uterine contraction (page 36), may prevent these manifestations from developing during labor.