

DIAGNOSIS AND
MANAGEMENT
OF THE FETUS
AND
NEONATE
AT RISK

a guide for team care

FIFTH EDITION

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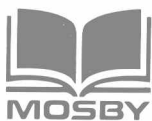
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Preface

The *Primer on Prematurity and High-Risk Pregnancy*, the first edition of this series, was prefaced with comments indicating that the objective of the book was to provide a concise source of information for physicians and nurses who care for the high-risk pregnant mother and the premature infant. Evolutionary changes in subsequent editions broadened that objective to include all risk infants. However, the basic intent to furnish a concise source of information for the health care providers caring for the risk pregnancy and risk fetus-neonate remains the motivation for undertaking this edition (the fifth). Central to this objective is our continued dedication to the concepts of team care and regionalization of care for those individuals negotiating (hopefully unscathed) that most hazardous period of life, the perinatal interval.

Vast changes have occurred in possibilities for perinatal health care during the two decades since the first edition was published (1966). Technological advances in maternal, fetal, and neonatal care have occurred at an unprecedented rate, and there has been a marked decline in perinatal mortality. Save for those perinates below 26 weeks of gestational age, the likelihood of intact survival has materially increased for each weight group. Nearly all disease states exhibit similar decreases in ability to place the perinate at jeopardy. Nonetheless, the most important ingredients in care remain human concern, communication, interpretation, and organization.

In the United States, unfortunately, the health teams necessary to provide these vital

services are faced with external constraints that threaten their current ability to function, while limiting their ability to achieve scientific progress at the rate at which we have all become accustomed. Three of the more serious constraints are economic restrictions, a hostile medicolegal climate, and a decline in research funding.

The first problem particularly threatens health care provided to the poor. A deprived population may require more care to achieve the same results, but efforts ensuring that this care is provided are cost-effective in our areas of concern. Denying adequate funding for perinatal care to this segment of the population will increase rather than decrease health care expenditures, in addition to causing a staggering loss of human potential.

The medicolegal crisis threatens everyone's health care and has become evident in those regions of the United States that are experiencing a dearth of obstetrician-gynecologists because of overwhelming malpractice insurance premiums. While no easy answers to this phenomenon exist, the problem is expanding into alarming issues of cost and access to health care.

Research, mentioned last but no less important, is the lifeblood of progress. Indeed, there is direct correlation between the rapid progress of the last decades and the substantial research support that was extended. With proposed major cutbacks in funding, the converse situation is likely to emerge.

These problems are not dealt with in our text, since solutions lie in disciplines beyond the

scope of our current efforts; however, the public must be made aware of these issues, and resolutions must be sought at every level. Indeed, health care providers may necessarily have to increase their involvement in local and national efforts to this effect.

The text's direction retains its firm roots in obstetric and neonatal medical information, with focus on an ever-widening bridge of perinatal information. To accommodate new data and yet remain concise, nearly every chapter has been extensively rewritten, although the format remains unchanged. This fifth edition also witnesses further evolutionary change among its authors. Although less involved in technical details, Dr. S. Gorham Babson, neonatologist, has provided his usual superb editorial efforts, and while not an extensive participant in this edition, Dr. Ralph C. Benson, obstetrician, has provided valuable consultation for several of the presented issues.

Although both would modestly object, we dedicate our efforts in the continuation of this series to these two remarkable gentlemen who wrote the first edition. Both Drs. Benson and Babson have been a constant source of inspiration to the many generations of those in all medical disciplines who have been fortunate enough to come into contact with them. Their unselfish efforts and concern for the continuity of care for the perinate have been well matched by their dedication, knowledge, intellectual expertise, and total commitment to give of themselves to others. Their gentility, courtesy, and ability to work together constitute a model worthy of emulation. Thus it is with gratitude, admiration, and a great deal of love that this book is dedicated to them.

**M. L. Pernoll
Gerda I. Benda**

**DIAGNOSIS AND MANAGEMENT OF THE
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Section I DIAGNOSIS AND MANAGEMENT OF THE HIGH-RISK FETUS AND NEONATE

1

What is a risk perinate?

Between 5 and 10 million conceptions occur yearly in the United States. Of these, 2 to 3 million are early spontaneous abortions. This loss may be fortuitous because as many as half of these conceptuses demonstrate on study aberrations of chromosome structure or number. Others may suffer from fetal viremia such as rubella or from damage by unidentified pathogens. Nearly 1 million pregnancies are legally or illegally terminated each year.

Of the more than 3.7 million pregnancies each year that reach 20 weeks of gestation, nearly 30,000 result in fetuses that die before delivery. Almost the same number of neonates succumb in the first month of life after birth. Another 30,000 have severe (but often correctable) congenital malformations, although one quarter of these lesions are ultimately lethal. Complications of pregnancy and delivery will contribute heavily to the conditions of at least 90,000 who will be mentally retarded (IQ of 70 or below) and another 150,000 who will have great difficulty in school because they are "poor learners." These handicapped individuals will be unable to compete fully in our increasingly complex society.

Once viability is reached, perinatal death and permanent damage measured in terms of years of loss of life and productive living exceeds death and serious damage caused by other major catastrophes, for example, cardiovascular disease, cancer, or accidents. Indeed, yearly perinatal deaths exceed all other causes of death combined until 55 years of age. Despite marked improvement in perinatal care, prevention of morbidity during this interval remains an urgent problem.

Other factors also contribute to making perinatal safety more pressing at present. For example, sweeping social changes have altered the size of families. Until recently, large families were in vogue, and death or perinatal wastage was unfortunate but not considered a major tragedy. Today, the majority of families consist of one to three children, and current concepts stress quality of life. Deliberate family planning is increasing, and abortion is being used to terminate unintended pregnancies. Every child is increasingly becoming a wanted child. Consequently, the health care worker is asked, with intensified urgency, to protect the individual from damage before, during, and after birth. Moreover, advances along many scientific fronts have afforded knowledge for the achievement of perinatal health care far beyond what was previously available. Indeed, the last two decades have witnessed the introduction and acceptance of risk assessment, clinical ultrasonography, antenatal diagnosis, electronic fetal monitoring, and physiologic maturity testing, to mention just a few of the advances. Why, then, have we not made more progress in decreasing the human suffering and disability that have their genesis in fetal or neonatal life?

Part of the answer may lie in our lack of an educational approach to preventing perinatal health problems. Indeed, the responsibility for reproductive education in the United States is not clearly spelled out, and young adults continue to have little valid information on which to base important reproductive decisions. The increased rate of very low birth weight infants born to younger mothers causes the neonatal mortality to be higher in this than other mater-

nal age groups. While social and economic, as well as educational, factors sharply affect pregnancy health and the utilization of available health care, much of the morbidity and mortality that occurs in the perinatal period could be prevented if current knowledge were promptly applied.

The purpose of this book may be stated simply. We propose to review modern management of commonly encountered perinatal problems in continuity (maternal, fetal, and neonatal) to help the reader acquire practical information necessary for patient care. The comments are directed to the health care team involved in direct patient care, primarily the medical practitioner, the house officer, and the involved nursing staff. We hope that this effort encourages greater application of current knowledge by the various professions to benefit the patient. To provide perinatal safety, it is mandatory to identify those at risk and provide the specific care necessary to prevent death or damage.

DEFINITION OF PERINATAL JEOPARDY

Perinatal jeopardy is the hazard of death or disability that occurs during human growth and development from viability until 28 days after birth. The risk may be subdivided into general influences and specific factors. This division allows better delineation of those factors related to perinatal risk.

GENERAL FACTORS INIMICAL TO PREGNANCY (WHICH MAY REQUIRE SPECIAL GUIDANCE)

Malnutrition

Increased nutritional requirements during pregnancy are multiple. The stress of pregnancy, as well as other intrinsic and extrinsic factors, can be only roughly appraised. Unfortunately, extrapolation from animal studies is in most instances merely suggestive, and therefore much is still unknown about nutrition in pregnancy. However a review of what is known provides a practical basis for recommendations or actions.

WEIGHT GAIN

Pregnancy accounts for about 24 lb of weight gain during gestation. A steady weight gain of 0.5 to 1 lb/wk is recommended. Obviously, one should not attempt corrections on a crash basis,

especially during the first or last trimesters, to avoid harm to the fetus. A considerably underweight gravida may do well to gain more than 24 lb, and even in the obese, it may be wise to allow a 20 to 30 lb weight gain. If attempts are made to help the patient reach her ideal weight for height, they should be conducted postpartum and preferably not while the patient is lactating.

More than one third of the total weight gain of 24 lb (11 kg) during a term pregnancy represents fetal weight: approximately 7.7 lb (3,500 gm). The placenta, amniotic fluid, and uterine weight each account for between 1.4 and 2 lb (650 and 900 gm). Increased interstitial fluid and blood volume contribute approximately 2.7 and 4 lb (1,200 and 1,800 gm), respectively. Breast enlargement adds at least 0.9 lb (400 gm). The remaining 3.5 lb (1,640 gm), otherwise unspecified, represents fat and other maternal stores.

Standard weight for height is given in Table 1-1, which applies to women of small, medium, and large body builds who are 25 years of age or older. For patients less than 25 years old, deduct 1 lb for each year. For the young adolescent, however, individualized assessment is necessary, especially if maximal growth has not yet been achieved.

Proper weight gain does not guarantee optimal nutrition. In general, about 4 lb of weight

Table 1-1. Standard weight for height of women

Height feet inches		Small frame	Medium frame	Large frame
4	10	102-111	109-121	118-131
4	11	103-113	111-123	120-134
5	0	104-115	113-126	122-137
5	1	106-118	115-129	125-140
5	2	108-121	118-132	128-143
5	3	111-124	121-135	131-147
5	4	114-127	124-138	134-151
5	5	117-130	127-141	137-155
5	6	120-133	130-144	140-159
5	7	123-136	133-147	143-163
5	8	126-139	136-150	146-167
5	9	129-142	139-153	149-170
5	10	132-145	142-156	152-173
5	11	135-148	145-159	155-176
6	0	138-151	148-162	158-179

Source of basic data: 1979 Build Study, Society of Actuaries and Association of Life Insurance Medical Directors of America, 1980.

gain in the first trimester, 10 to 12 lb in the second, and 8 to 10 lb in the last are reasonable. Nevertheless, a gain of more than 2 to 3 lb/mo in the last 3 to 4 months suggests fluid retention and may presage a developing toxemia of pregnancy.

ENERGY

The suggested optimal caloric (more than 36 kcal/kg body weight) intake is listed in Table 1-2. Few individuals are capable of counting calories consistently, nor are they generally willing to be specific. Nonetheless, caloric intake and weight gain or loss are rough correlates. Hence adequacy of caloric intake can be estimated by trends in body weight. However, a number of other variables influence trends in body weight, including the basal metabolic rate, lean body mass, and physical activity of the individual, as well as the stage of pregnancy.

Poor maternal nutrition may be a contributing cause of abnormal bleeding and spontaneous premature labor and delivery. The underweight gravida is more likely to deliver early. Moreover, preeclampsia and eclampsia are prob-

ably the result, at least in part, of nutritional (most likely protein) deficiency.

The popular belief that intrauterine growth can be satisfactorily maintained despite maternal deprivation is no longer tenable as a generality. The mother's health and that of her offspring depend in large measure on the quality and, to a lesser degree, the quantity of her food. It is known that the fetus normally doubles its weight during the last 8 weeks of pregnancy; this fetal weight gain may be reduced significantly by a starvation regimen.

NUTRIENTS

At least 50 nutrients are believed to be essential nutritional needs of the gravid woman. These needs vary with each individual patient's requirements during the numerous phases of pregnancy and puerperium. If pregnancy is complicated by colitis, for example, amounts and types of food have to be modified accordingly. Fetal growth and maintenance are a greater nutritional challenge than normal recovery postnatally. Lactation naturally adds another dimension.

Table 1-2. Recommended daily dietary allowances for nonpregnant, pregnant, and lactating women

	Recommended daily allowances for women						
	Nonpregnant (age in years)					Preg- nant	Lac- tating
	11-14	15-18	19-22	23-50	51+		
Energy (kcal)	2,400	2,100	2,100	2,000	1,800	+ 300	+ 500
Protein (gm)	44	48	46	46	46	+ 30	+ 20
Fat-soluble vitamins							
Vitamin A activity (RE)	800	800	800	800	800	1,000	1,200
(IU)	4,000	4,000	4,000	4,000	4,000	5,000	6,000
Vitamin D (IU)	400	400	400			400	400
Vitamin E activity (IU)	12	12	12	12	12	15	15
Water-soluble vitamins							
Ascorbic acid (mg)	45	45	45	45	45	60	80
Folacin (μ g)	400	400	400	400	400	800	600
Niacin (mg)	16	14	14	13	12	+ 2	+ 4
Riboflavin (mg)	1.3	1.4	1.4	1.2	1.1	+ 0.3	+ 0.5
Thiamin (mg)	1.2	1.1	1.1	1.0	1.0	+ 0.3	+ 0.3
Vitamin B ₆ (mg)	1.6	2.0	2.0	2.0	2.0	2.5	2.5
Vitamin B ₁₂ (μ g)	3.0	3.0	3.0	3.0	3.0	4.0	4.0
Minerals							
Calcium (mg)	1,200	1,200	800	800	800	1,200	1,200
Phosphorus (mg)	1,200	1,200	800	800	800	1,200	1,200
Iodine (μ g)	115	115	100	100	80	125	150
Iron (mg)	18	18	18	18	10	+ 18	18
Magnesium (mg)	300	300	300	300	300	450	450
Zinc (mg)	15	15	15	15	15	20	25

The National Academy of Sciences-National Research Council (Table 1-2) has suggested the optimal nutritional requirements of proteins, together with 16 other food requirements of the pregnant woman.

The importance of protein in the anabolism of pregnancy always is emphasized, but the implication that carbohydrates and fats are of little importance, especially since patients may reduce intake of these to reduce excess weight, is unfortunate. Protein insufficiency can develop, even with adequate protein ingestion, if insufficient calories are available because a large portion of the amino acids in the protein will be deaminated for energy needs. Brief semistarvation (less than 1,500 calories) may reduce body proteins, enzymes, and even hormones. If starvation is extended for weeks or months, fluid retention and weight gain will be noted. Misinterpretations by the obstetrician may lead to an even stricter diet. By and large, reduction of the caloric intake below 1,500 calories for any length of time is unwise during pregnancy because of probable fetal deprivation.

SAMPLE DIET

A good pregnancy diet is deceptively simple. Mores or lack of knowledge, money, or motivation are a few of the reasons the pregnant woman does not receive a well-balanced, high-protein, high-vitamin, high-mineral diet. Excessive carbohydrates, especially sweets, should be limited. Following are the *daily* basic food requirements in pregnancy and lactation:

1. One quart (4 glasses) or more of milk (any kind: whole milk, buttermilk, low fat, skim, or powdered skim milk)
2. Two eggs
3. One or two servings of fish, liver, chicken, lean beef, lamb, or pork, or any kind of cheese
4. One or two good servings of fresh, green, leafy vegetables: mustard, collard, or turnip greens or spinach, lettuce, or cabbage
5. Two or three slices of whole wheat bread
6. A piece of citrus fruit or a glass of lemon, lime, orange, or grapefruit juice
7. One pat of margarine, vitamin A enriched

The pregnant woman should also include the following in her diet:

1. A serving of whole-grain cereal: Wheatena, Cream of Wheat, farina, oatmeal, or granola, four times a week

2. A yellow or red vegetable five times a week
3. Liver once a week
4. Whole baked potato three times a week

For years the notion has persisted that too much table salt or sodium-containing preparations are at least a contributory cause of toxemia. Granted that the preeclamptic patient may not efficiently excrete sodium once the disorder has developed, there is no convincing evidence that the sodium ion is the culprit. "Everything in moderation" still is an excellent maxim. With good diet, especially one with ample protein, the sodium problem usually will take care of itself.

Indeed, patients will fare better if the health care provider stresses good diet rather than total weight gain. Many women become so self-conscious and self critical of poundage that they go on harmful crash diets, take drastic purges, or exhaust themselves in exercise fads. The positive approach of stressing essential foods in reasonable portions rarely has to be critical or accusatory, and patients are more relaxed and cooperative.

Edema is also a bogey during pregnancy. Dependent or physiologic edema occurs in well-nourished, healthy women because of mild circulatory stasis. It is especially common in warm weather, and rest periods and elevation of legs suffice for relief. This type of edema is a sign of neither cardiac nor renal disease nor toxemia of pregnancy. It is not an indication for diuretic therapy. In contrast, generalized or pathologic edema reflects a disease process. This abnormality, often attributable to heart or kidney failure or toxemia of pregnancy, cannot be prevented by diuretics, which may be indicated, however, in the treatment of selected patients. Be this as it may, thiazide diuretics are extremely potent and may cause serious maternal or fetal complications, even when used discriminately.

MATERNAL NUTRITIONAL RISK IDENTIFICATION

High-risk obstetric patients needing special dietary (and medical) counseling include women with the following:

1. Anemia (hemoglobin level of less than 9.5 gm, hematocrit reading of 30% and other chronic metabolic disorders, i.e., diabetes