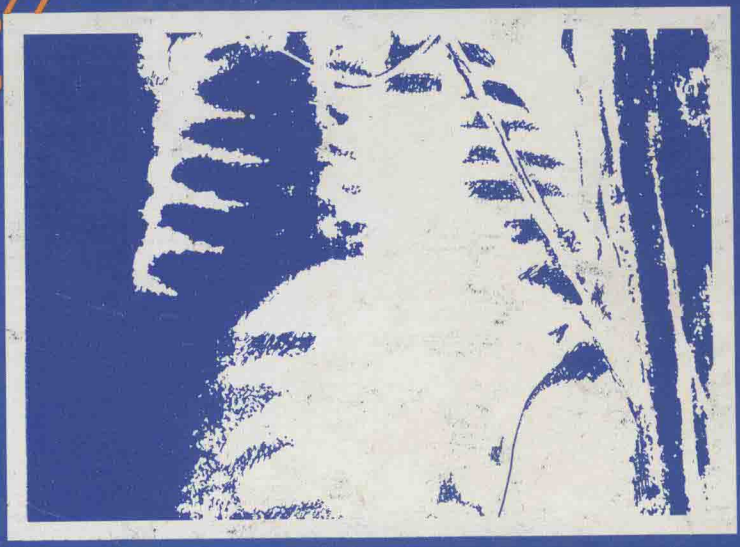
Gertie E. Marx

Clinical Management of Mother and Newborn



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Gertie F. Marx, Editor

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Clinical Management of Mother and Newborn

Preface

The birth of a baby is the culmination of months of anticipation and planning. Most often, mother and infant are healthy and readily able to establish close contact—a bond. However, in some situations either mother or baby or both present complications. The more prompt and rational the treatment, the sooner the normal parent–infant relationship will commence.

This book is devoted exclusively to the first days following birth. In its 15 chapters, postpartum and postnatal physiology and pathophysiology are reviewed by 18 specialists. Normal and abnormal development of mother and child is correlated with proven means of clinical management.

Chapters 1 through 3 cover maternal postpartum developments and complications. Chapter 4 stresses the importance of a normal parent–newborn relationship, a concept of increasing concern in modern society. The following ten chapters discuss neonatal physiology and pathophysiology; the effects of obstetric anesthesia on infant behavior, pulmonary function measurements in the postnatal period and treatment of the sick newborn are discussed in detail. The final chapter reviews maternal and perinatal mortality; the data, based on extensive surveys in New York City, indicate that current management is effecting an overall decline in mortality.

I wish to thank my collaborators and our publisher for their help in this endeavor to enhance the care given to mothers and their newly born infants —for the benefit both of the young family and of society in general.

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Postpartum Uterine Activity and Anesthesia

Gerard M. Bassell, Prasanta Chandra, and Gertie F. Marx

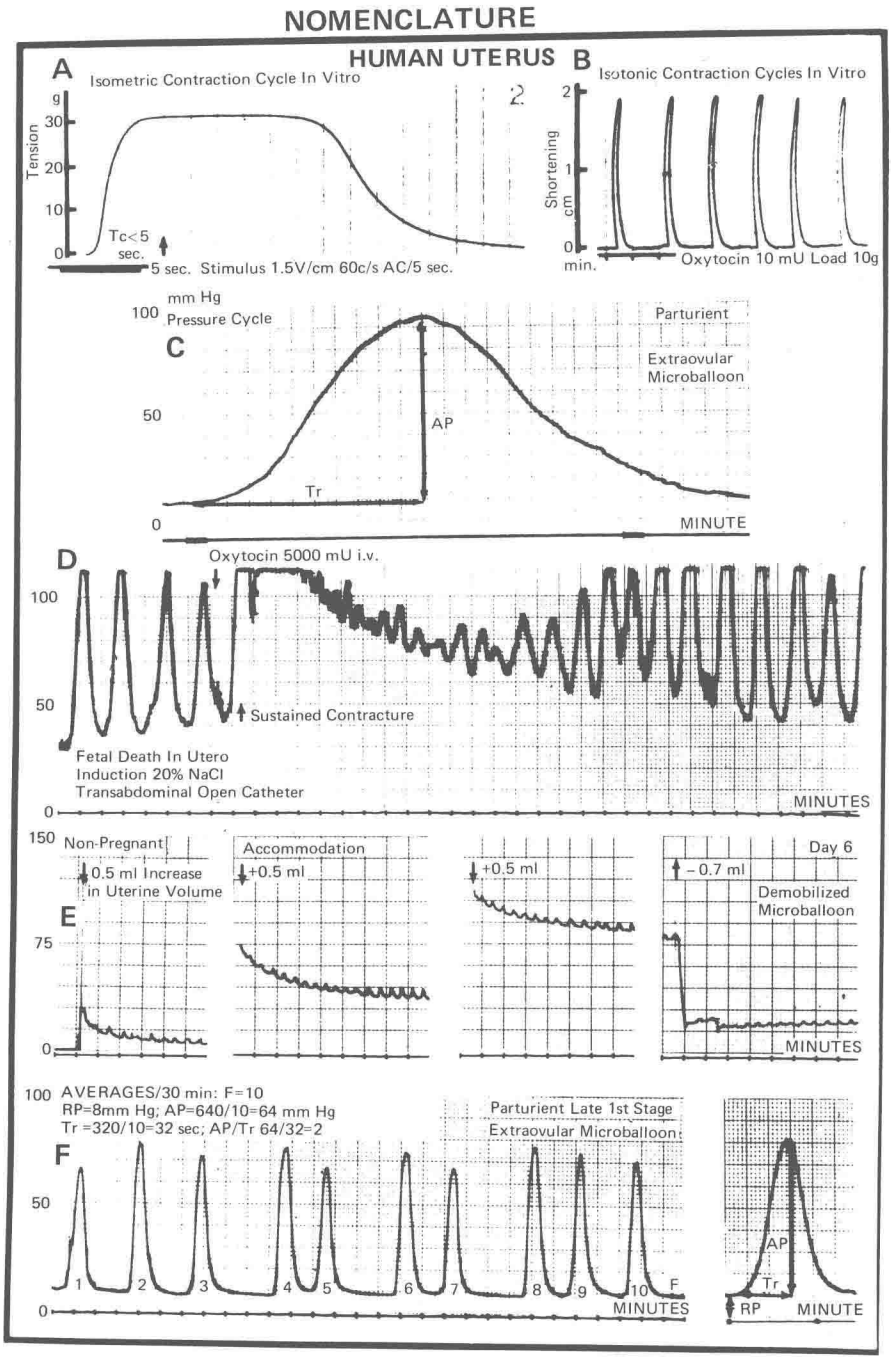
Immediately following delivery of the placenta, uterine congestion decreases rapidly as the vigorous contractions of the uterine musculature squeeze blood out of the myometrium. The anterior and posterior walls come into apposition and the cavity becomes quite smooth except at the former site of placental attachment; the uterine cavity is then almost obliterated (28). Thus, the postpartum uterus is well suited for *in vivo* studies of the effect of anesthetic agents on activity of the term-pregnant uterus, as concern for fetal well-being is no longer present.

Uterine Muscle Physiology

Uterine musculature exhibits the same physiologic function as other smooth muscle or striated and cardiac muscle. Any differences occur mainly as a result of hormonal influences, but the cellular behavior of all muscles is similar.

The normal function of muscles is described by the term "contraction cycle" (2, 3, 4, 11, 17), during which the muscle undergoes various changes in tension and length enabling it to perform its required task efficiently. A "contracture," on the other hand, is a rare and unphysiologic state of sustained muscular activity, in which all cells are activated to contract tetanically, with profound loss of mechanical efficiency.

The two phases of the contraction cycle are the "isometric" and the "isotonic" periods. During the isometric portion of the cycle both ends of the muscle are fixed during the development of tension; no external shortening occurs. Once external shortening does occur, the muscle has entered


NOMENCLATURE
HUMAN UTERUS
A
Isometric Contraction Cycle In Vitro
Tension
g
30
20
10
0
Tc<5 sec.
5 sec. Stimulus 1.5V/cm 60c/s AC/5 sec.
B
Isotonic Contraction Cycles In Vitro
Shortening
cm
2
1
0
min.
Oxytocin 10 mU Load 10g
C
mm Hg
100
Pressure Cycle
Parturient
Extraovular Microballoon
50
AP
Tr
0
MINUTE
D
Oxytocin 5000 mU i.v.
100
50
Sustained Contracture
Fetal Death In Utero
Induction 20% NaCl
Transabdominal Open Catheter
0
MINUTES
E
150
Non-Pregnant
0.5 ml Increase in Uterine Volume
Accommodation
+0.5 ml
+0.5 ml
Day 6
- 0.7 ml
Demobilized Microballoon
75
0
MINUTES
F
100
AVERAGES/30 min: F=10
RP=8mm Hg; AP=640/10=64 mm Hg
Tr =320/10=32 sec; AP/Tr 64/32=2
Parturient Late 1st Stage
Extraovular Microballoon
50
1
2
3
4
5
6
7
8
9
10
F
0
MINUTES
AP
Tr
RP
MINUTE

the isotonic phase regardless of whether a load has been moved. The muscle can only move a load during the phase of isotonic shortening, and only a loaded muscle can perform external work (= load × distance). During the isometric period, if an unstimulated muscle undergoes a constant stretch, it develops a "resting tension" to which is added the "active tension" of the isotonic period of the contraction cycle. If moderate stretch is sustained for an appreciable length of time, the muscle "accommodates" by decreasing its resting tension.

These terms are used to describe the situation in the uterus as well as in other muscles. The resting uterus has a measureable "resting tension" (or "resting pressure") and undergoes both isometric and isotonic contraction cycles as well as pressure cycles (9) (Fig. 1.1). Thus, intrauterine pressure measurements reveal a resting pressure during the period between two contractions (pressure cycles), onto which is added the active pressure produced during the uterine contraction. As with other muscles, the uterus accommodates to sustained external stretch with a decrease in resting pressure. In a normal contraction cycle, only discrete areas of muscle cells are involved, with the resultant contractile rhythmicity ensuring that fatigue does not occur too readily and that a high level of efficiency is maintained over extended periods of time.

Methods of Intrauterine Pressure Measurement

For almost 80 years, investigators attempted to delineate uterine function by inserting various measuring devices into the human uterus. Reflecting

Fig. 1.1 Intrauterine pressure (original tracings, human uterus) for *in vitro* and *in vivo* experiments. **A.** Isometric tension in the electrically "tetanized" uterus, when all myometrial cells are simultaneously activated. Note that activity manifests after 1.5 seconds latency period and the contraction time (T_c) is less than 5 seconds. **B.** Isotonic shortening. Note the work performed in a "steady state." **C.** Pressure cycles during parturition. **D.** Contracture. Note the high resting pressure (over 30 mm Hg) sustained by the osmotic effect of intra-amniotic hypertonic saline in a patient with fetal death *in utero*. Note the "contracture," superimposed on the high resting pressure by an overdose of oxytocin. **E.** Accommodation of the nonpregnant human uterus to sustained stretch. Stretch is induced by stepwise increase in uterine (balloon) volume. Note the gradual decrease in resting pressure after the stretch-induced initial increase. Note the sudden drop in resting pressure after the reduction in uterine volume. **F.** The quantitation of the averages in frequency (F), resting pressure (RP), active pressure (AP), time of pressure rise (T_r) and AP/T_r of the parturient uterus in a 30-minute tracing. The "total averages" of clinical labor are measured by averaging the various parameters for the entire process. [From Csapo (9), with permission of the author.]

available technology, balloons connected to pressure-measuring instruments and filled with fluid or air have been inserted, x-ray with radiocontrast has been used, gas has been introduced into the uterine cavity, and open-ended catheter recordings of pressure waveform have been taken. In contrast to the nonpregnant uterus, the gravid uterus is closed and fluid filled, so that pressures are transmitted with minimal distortion to an internal pressure recording device, be it balloon or open-ended catheter, provided that insertion of the instrument does not create a large fluid leak. Open-ended catheters have been placed transabdominally into the amniotic sac, creating a bridge between the amniotic fluid and an external pressure transducer. Such procedures are not without hazard, however, and puncture of maternal blood vessels or fetal parts can occur during insertion of the pressure catheter.

Far safer is the use of the extraovular microballoon technique of Csapo (8, 12, 14), in which a catheter, closed by a microballoon of appropriate size and wall characteristics, is inserted transcervically into the extraovular space. This method can be used prior to rupture of membranes, as the balloon is placed without entering the amniotic sac. Provided that the volume of the balloon is between 0.5 to 0.8 ml, maximum pressure will be recorded during uterine activity. The problems associated with the transabdominal open catheter approach are thus circumvented and both methods have been shown to provide identical data (9). The recording system is air free and fluid filled, and has a short Teflon catheter, closed at one end by the microballoon and connected at the other end to a pressure transducer.

Among the advantages of the extraovular microballoon technique are lack of leakage from the amniotic cavity and absence of air introduction. As the microballoon is inserted per vaginam, puncture of maternal blood vessels or fetal parts cannot occur. Some inaccuracies can be introduced, however, if air is not properly purged from the catheter, if the balloon is over- or underdistended, or if the presenting fetal part is allowed to compress the balloon. Strict adherence to the recommended methods of insertion (30), together with careful removal of air from the system and filling the balloon to the correct volume, will ensure that pressure recordings will be accurate and reproducible. The presence of the microballoon within the uterine cavity has been shown not to affect normal uterine physiology (13). Therefore, the tracings obtained are an accurate representation of uterine activity during the period of measurement.

Although the extraovular microballoon method is used safely during labor, the effect of drugs and anesthetic agents on uterine function is studied more easily after expulsion of the products of conception. Consequently, the "demobilized microballoon technique," in which the lower portion of the recording catheter is fixed to the patient's thigh, is used following expulsion of the placenta, thereby preventing descent of the balloon toward the cervical canal. As the internal uterine walls are soon apposed after