Disordered Labor: Objective Evaluation and Management

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Simplified techniques for analyzing the graphic patterns of dilatation and descent allow the practitioner to define aberrant labor using objective criteria for diagnosis. Six major disorders of labor are readily characterized. Once diagnosed, details concerning etiologic factors, efficacy of modalities of treatment, and prognostic outlook can be readily evolved. Programs of management are presented for each group of dysfunctional patterns based on such data. Introduction of the graphic analytic technique for diagnosing and managing labor adds a significant new dimension to our diagnostic potential and therapeutic capabilities.

In order to discuss the detection of abnormal labor progression intelligently, it is essential to be able to characterize normal labor on a clinical basis. The clinical patterns of labor vary so widely that the practitioner's skills are taxed to their utmost in his attempts to determine which are normal and which are abnormal. Unfortunately, many of our clinical concepts of labor and its abnormalities are rather poorly founded and many of the currently used approaches to obstetrical pathology are based on collected personal experiences only. It is imperative for every physician, both veteran and novice, to introduce objectivity into his practice so that he will be better equipped to diagnose disorders of labor early and definitively, thereby to avoid imposing hazards on his patients and their fetuses.

The usual diagnostic criteria in use nowadays to define labor abnormalities generally invoke arbitrary standards of total duration of labor beyond which an abnormality may be considered to exist. These tend to be of very limited usefulness because many serious abnormalities may arise well before the normal limit of duration has been exceeded, and many labors that extend beyond the normal duration may actually be entirely normal. The single guideline of duration must, therefore, be considered as much too coarse and insufficiently definitive to permit us to specify precisely which patients are at risk by virtue of the presence of an aberrant labor.

Relevant clinical data are available to the practitioner for interpretation not in terms of the patterns of uterine contractility, but rather in progression of cervical dilatation and descent of the fetal presenting part. These may be studied in detail without sophisticated physiologic measuring equipment.

In order to follow individual labors in progress as objectively as possible we need merely utilize the important relationships between dilatation and elapsed time in labor, on the one hand, and between descent and time on the other. These readily grasped relationships provide the practitioner with utilitarian means for assessing progression and for uncovering aberrations of labor. This method has not only been found useful for the study of individual labors in progress, but it has proved valuable for both the investigation and the teaching of the management of labor and for the evaluation of the effects of various factors that influence the course of labor.

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Graphic Analysis of Labor Progression

When isolated observations of cervical dilatation in any given labor are plotted against the time elapsed from the onset of labor, using a vertical axis of cervical dilatation in centimeters and a horizontal axis of hours in labor (Figure 1), a characteristic S-shaped curve is generated. This pattern is seen in all normal labors without exception. Similarly, a characteristic hyperbolic curve is traced in all normal labors when the station is plotted against time. By station we refer to the plane of the forward leading edge of the fetal presenting part as it relates to the plane of the ischial spines, designating the number of centimeters (stations) above the midpelvic plane with negative digits and the levels below the midpelvis with positive digits. These rather simple visual patterns allow for quick interpretation and evaluation of the labor in progress. Each patient constructs her own unique clinical picture, offering a reliable means for following the course of the normal labor and for distinguishing it objectively from abnormal varieties. The characteristic normal patterns of dilatation and of descent are common to all patients and are independent of the more variable and less reliable characteristics of labor, including contractility patterns and soft-part resistance.

The method entails a technique for recording simple data that the physician would ordinarily gather in any event. Except for graph paper, it requires no special equipment and no specialized knowledge. Inasmuch as the shape of the pattern is the chief evaluative factor, inaccuracies of digital estimates are relatively unimportant provided they are consistent. Easily communicated, the method is readily learned by the uninitiated, and often rapidly becomes more reliable than the accumulated intuition and clinical impressions of some physicians who have many years of obstetrical experience.

Any square-ruled graph paper will do for the construction of these patterns. Many institutions prefer to devise their own graph so as to incorporate the record into the hospital chart. Horizontal coordinates are numbered by hours of labor. The onset of labor is arbitrarily defined as the onset of

regular uterine contractions as perceived by the patient. The vertical coordinates on the left are numbered in ascending order to represent centimeters of cervical dilatation. At the right, the same vertical coordinates are keyed in descending order with the familiar measurements which denote the station of descent in centimeters. For convenience in identification, an estimate of cervical dilatation is entered by a small circle and that of station by an *X*. Each subsequent observation is joined to the preceding notation by a straight line. The resulting graph furnishes a simple visual pattern for quick assessment of labor in progress.

The characteristic pattern allows us to measure the durations of the various distinctive portions of the labor and to study the change in cervical dilatation and in descent per unit time. The slope of the curve is an accurate measure of the specific rate of change for a given labor. This measurement of slope proves to be very useful in clinical practice for identifying specific disorders.

Arbitrary subdivisions of the first stage of labor (Figure 2) have been done to facilitate analytic study.[1] One can divide the first stage into a *latent phase,* extending from the onset of labor to a point in time when the dilatation curve begins to change sharply, and the *active phase,* which begins with the upswing of the dilatation curve and terminates at full dilatation and retraction of the cervix at the onset of the second stage. The active phase is further subdivided into an initial *acceleration phase,* a linear *phase of maximum slope,* and a terminal *deceleration phase.* The latent phase is the interval during which uterine contractions undergo orientation, polarization and coordination while the cervix is being prepared for later active dilatation by softening and effacement. The phase of maximum slope is that interval during which cervical dilatation proceeds at its most rapid rate in a constant, linear manner. The deceleration phase represents the cephalad retraction of the cervix around the fetal presenting part that occurs at the end of the first stage; not only is there no "slowing down" actually taking place during the deceleration phase, but myometrial contractility may actually be increasing sharply about this time.

The corresponding descent curve bears certain constant relationships to the dilatation pattern, retaining its latent aspects until the dilatation curve has entered the phase of maximum slope; at this time descent usually begins its active phase. Descent reaches its maximum slope at the same time that the dilatation curve enters the deceleration phase.

Disorders of Labor

The technique of graphing labors has made it possible for us to analyze labor progression and to define abnormal patterns. This in turn has permitted us to spell out diagnostic criteria, assess etiologic factors, determine the relative efficacy of treatment programs and elucidate prognosis. In all six major disorders of labor progression aberrations have been discovered to exist. They are each different and objectively identifiable. Based on studies of large numbers of labors, statistical limits for each of the several components of the dilatation and descent patterns have been determined. For example, it has been shown that most nulliparas have latent phases less than 20 hours in duration; the latent phase in most multiparas, by contrast, rarely exceeds 14 hours. Gravidas that exceed these limits of latent phase duration may be considered to have a labor aberration, termed simply *prolonged latent phase* (Figure 3). This disorder constitutes the most commonly encountered labor dysfunction and is by far the most innocuous by virtue of the fact that when properly managed most patients fare very well indeed.

A second variety of disorder can be defined by abnormally slow progress in the active phase of dilatation. When the maximum slope of dilatation is less than 1.2 cm/hr in nulliparas, a *protracted active-phase dilatation pattern* may be said to exist (Figure 4). Similarly, in multiparas maximum slopes below 1.5 cm/hr constitute this characteristic abnormality of labor. Somewhat related to this problem is the disorder of *protracted descent,* which is defined by a maximum slope of descent less than 1.0 cm/hr in nulliparas or 2.0 cm/hr in multiparas. The relationship between these two disorders centers around common etiologic factors, treatment responses and outcome prognoses.

Prolonged deceleration phase is a fourth variety of labor disorder readily defined by finding the deceleration phase in a nullipara exceeding three hours or in a multipara beyond one hour (Figure 5). This is a potentially very serious problem closely related to two other ominous arrest-type aberrations: *secondary arrest of dilatation* and *arrest of descent.* Secondary arrest of dilatation is recognized by a pattern showing cessation of the expected progression in the active phase for at least two hours. It usually requires two vaginal examinations done by the same individual spaced at least two hours apart to make the diagnosis. Analo-

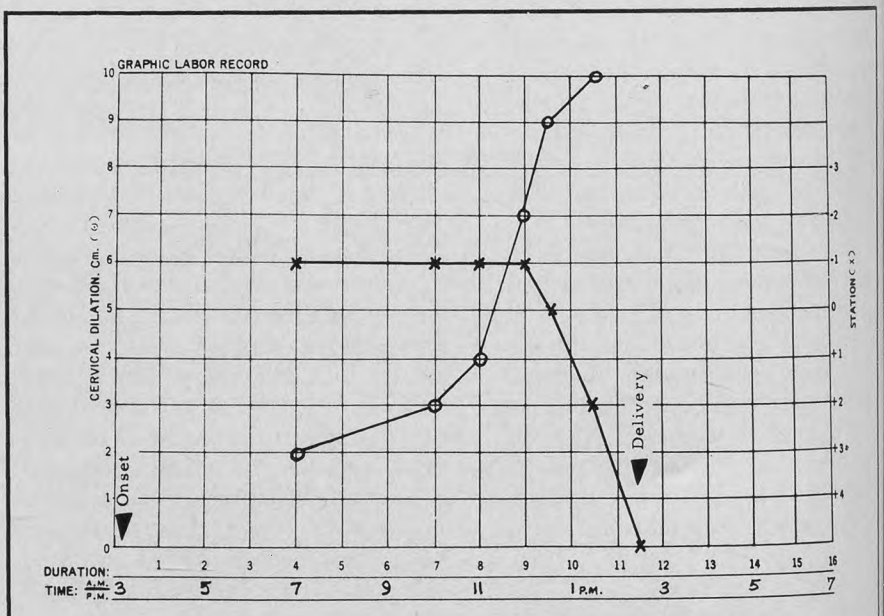

Figure 1. Example of actual graphic recording of patient evolving normal labor pattern leading to vaginal delivery. Cervical dilatation (0) and station (X) are plotted against elapsed time in labor to yield typical normal tracings.

gously, arrest of descent can be recognized by interruption of the progressive descent pattern, usually in the second stage, for at least one hour. The serious nature of these three labor aberrations is due to their common association with cephalopelvic disproportion.

While each of these six disorders is an independent entity, any or all may appear in labor simultaneously in various combinations in a given patient. The theoretical possibility of 63 different permutations suggests why there has been so much confusion in the past with regard to the clinical characterization of abnormal labor in practice. Recognizing them as they arise, therefore, will prove very useful for purposes of simplifying patient management, optimizing one's approach to specific problems and improving outcome as a consequence.

The six labor aberrations can be grouped into three categories by virtue of certain similarities alluded to earlier. First, prolonged latent phase stands alone as an independent entity unrelated to the others. Second, the two protraction disorders, protracted active-phase dilatation and protracted descent, are clearly related and can be considered together as a group. Third, the three arrest-type disorders are comparable and can be discussed together, including prolonged deceleration phase, secondary arrest of dilatation, and arrest of descent. These groupings are based on those similarities of the abnormal patterns relating to etiology, response to treatment, and prognosis, as well as their propensity to occur together and in sequence during the course of any given abnormal labor. The clinical features of each of these three groups of labor aberrations are summarized in Table 1.

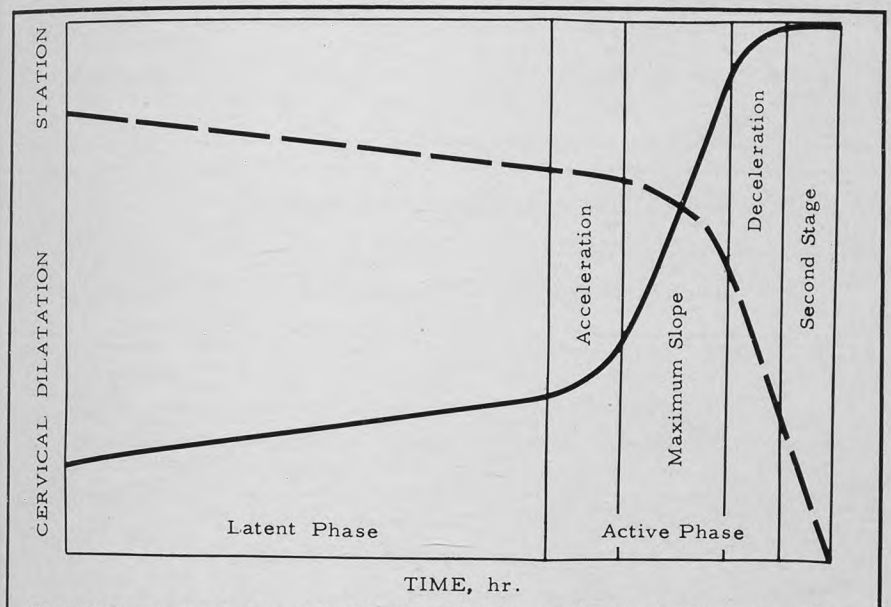

Figure 2. Composite of dilatation (solid line) and descent (broken line) patterns against time, showing distinctive phases of the first stage as well as usual interrelation between cervical dilatation and fetal descent.

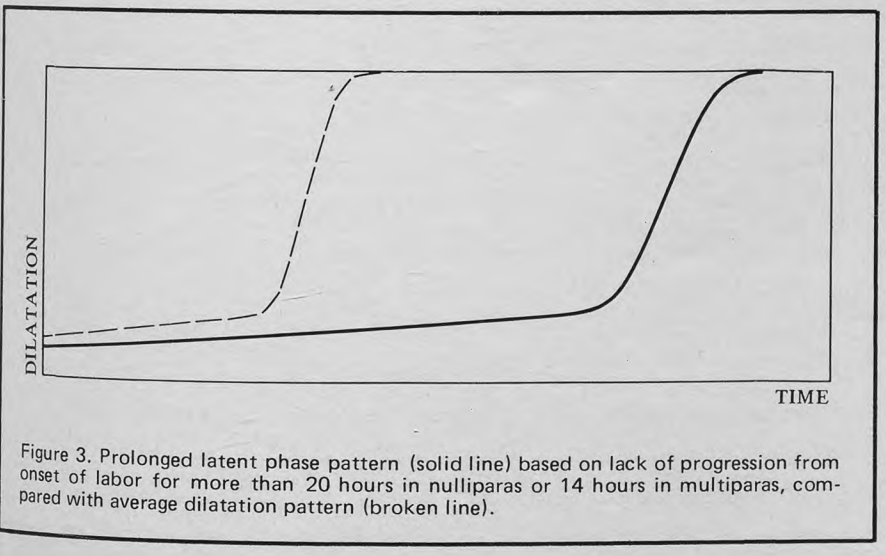

Figure 3. Prolonged latent phase pattern (solid line) based on lack of progression from onset of labor for more than 20 hours in nulliparas or 14 hours in multiparas, compared with average dilatation pattern (broken line).

Prolonged Latent Phase

Patients with prolonged latent phase (Figure 3) lasting longer than 20 hours in nulliparas or 14 hours in multiparas are frequently found to have been subjected to the inhibitory effects of excessive sedation or anesthesia during the latent phase. There can be little doubt that sedation and anesthesia given too early in labor, that is, before the latent phase is completed, will prolong labor unnecessarily. It is important to recognize that the latent phase is particularly sensitive to narcotic and analgesic medications. Moreover, patients who begin labor with a cervix that is unprepared for subsequent labor, that is, thick, uneffaced, undilated, and unyielding, can be expected to have a prolonged latent phase. Other patients with abnormally prolonged latent phase will later be found to have been in false labor so that when the contractions finally stop, the diagnosis becomes apparent in retrospect. Others will go on into the active phase in one of the protraction disorders, revealing that the latent phase prolongation was probably based on some underlying dysfunctional process.

Patients with prolonged latent phase tend to be exhausted and discouraged. These patients have been shown to benefit considerably by rest (Figure 6). Such rest can be accomplished by the use of a narcotic agent, such as morphine, given in sufficient amounts to stop the labor temporarily. An effective regimen is 15 mg morphine sulfate (20 mg for a large patient), repeating the medication only if necessary in 20 minutes if contractions are still occurring (10 mg average second dose, 15 mg for a large woman). About 85 percent of patients treated in this way will respond in six to ten hours, after a well-deserved rest interval, by entering the active phase and progressing normally thereafter to delivery. The effectiveness of this treatment approach is about the same as that of oxytocin stimulation for this disorder, but rest is preferable because of the frequency of unrecognized false labor in these patients and the overriding consideration of their emotional

and physical needs. No form of therapy other than rest or oxytocin has been shown to be consistently effective in correcting this disorder. Oxytocin is reserved for those patients in whom the additional six to ten hours of delay in evolving the labor progression would be unacceptable, for example, in those with amnionitis or severe preeclampsia or other conditions urgently requiring the pregnancy to be terminated.

With this conservative method of treating prolonged latent phase by means of therapeutic rest, the prognosis is very good with regard to both delivery and fetal outcome. As mentioned, most will respond later with normal active dilatation and descent, followed by vaginal delivery. Concerns about the potentially depressing action of narcotics on the respiratory center of the infant are allayed in that these patients do not progress to delivery while the drug is present in active amounts; the depressant effects will have abated long before the infant is born. Following rest therapy, about ten percent of patients will awaken out of labor, indicating in retrospect that their problem was false labor. In the remaining five percent thus treated, the original condition will recur in which contractions are ineffective in producing dilatation. Here further active therapy by oxytocin infusion, unless contraindicated, is in order and the latent phase can be expected to be ended promptly to yield a normal active-phase progressive pattern culminating in normal delivery.

Needless to say, patients with prolonged latent phase are not immune to further problems subsequently. They are not, however, particularly prone to develop other problems either. This program of management for them has been shown to be very useful in reducing the need for cesarean section for such dubious conditions as cervical dystocia or primary dysfunctional labor. Prolongation of the latent phase does not appear to influence fetal or maternal morbidity or mortality adversely, provided it is handled expeditiously when the diagnosis is made, as outlined above. There is no justifiable reason to resort to cesarean section as a primary therapy for this innocuous condition. The prognosis for vaginal delivery is excellent and abdominal delivery is not warranted merely because the condition has been diagnosed.

Protraction Disorders

As stated earlier, the disorders of protracted active-phase dilatation and protracted descent are analogous to one another in many ways and, therefore, will be discussed together (Figure 4). The underlying pathogenesis is unknown as yet, but many common factors appear to be associated or perhaps contributory, including minor malpositions (such as persistent occiput posterior or transverse), excessive sedation, and improperly administered conduction anesthesia. By the latter we mean an epidural or caudal anesthetic that is given to too high a level (above dermatome T-10), too early (before the onset of the active phase), or in conjunction with other inhibitory factors such as excessive sedation.

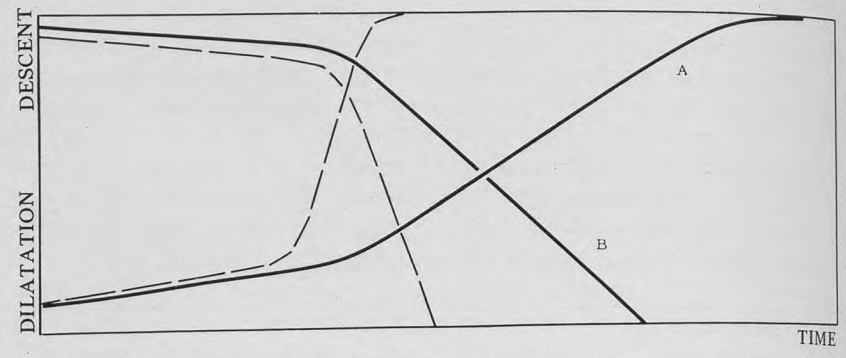

Figure 4. Characteristic protracted active-phase dilatation (*A*) and protracted descent patterns (*B*), contrasted with expected patterns of progression of dilatation and descent.

Table 1. Dysfunctional Patterns of Labor

	Prolonged latent phase	Protraction disorders	Arrest disorders
Diagnosis	Nulliparas > 20 hr Multiparas > 14 hr	Dilatation Nulliparas < 1.2 cm/hr Multiparas < 1.5 cm/hr Descent Nulliparas < 1.0 cm/hr Multiparas < 2.0 cm/hr	Deceleration Nulliparas > 3 hr Multiparas > 1 hr Dilation Arrest > 2 hr Descent Arrest > 1 hr
Etiology	Excess sedation Unprepared cervix False labor Anesthesia Uterine dysfunction	Unknown CPD 28% Malposition Excess sedation Anesthesia	CPD* 45% Malposition Excess sedation Anesthesia
Therapy	Rest	Support Avoid inhibition	Cesarean for CPD Oxytocin if no CPD
Response	85% "cure" 10% out of labor	90% progress	94% "cure"
Delivery	Vaginal	Vaginal Cesarean for CPD	Cesarean for CPD Vaginal (by response)
Fetal risk	Not increased	Slightly increased	Threefold increase

*CPD, Cephalopelvic disproportion

Of greatest importance in association with protraction disorders is the occurrence of cephalopelvic disproportion in more than one fourth of the patients. There is obvious need for definitive evaluation of fetopelvic relationships by digital and x-ray examinations whenever protraction disorders are encountered.

The treatment for protraction disorders is uniformly ineffective. These rare problems do not appear to be correctable by any of the stimulatory methods presently available for our use. At the same time, however, it is quite easy to inhibit further progress or even to produce arrest of dilatation or of descent in these patients, by such potentially deleterious measures as excessive sedation or regional block anesthesia. If intractable bony dystocia is encountered in these patients, one may justifiably elect cesarean section because it avoids the necessity for a long, tedious labor. In the absence of disproportion, labor should be allowed to progress while the physician provides all necessary support for the patient's emotional and physical needs, paying special attention to fluid and electrolyte imbalances. Thus, it is most important for the practitioner to recognize these abnormalities so that he can offer these essential supportive measures, while taking care to avoid anything that will tend even remotely to impede progress or to jeopardize the outcome.

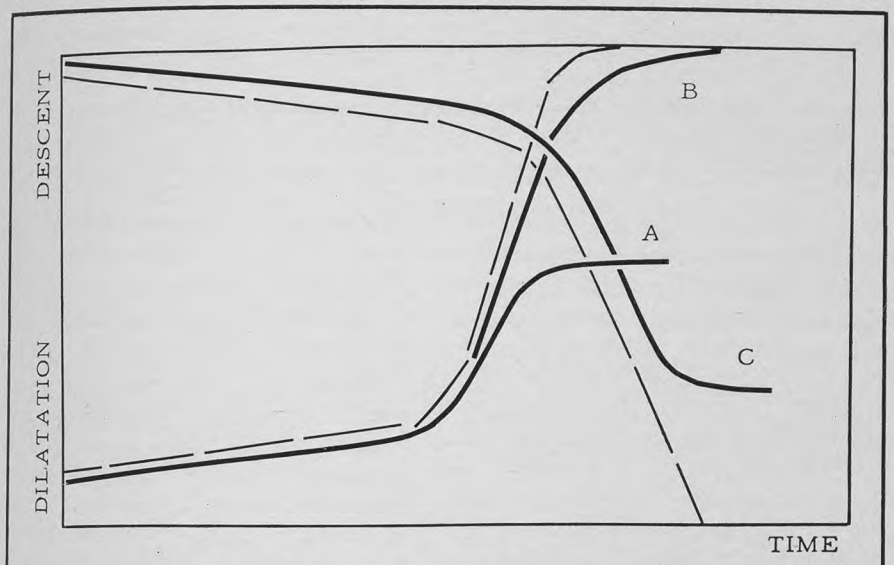

Figure 5. Arrest patterns of abnormal labor, including secondary arrest of dilatation (*A*), prolonged deceleration phase (*B*) and arrest of descent (*C*). Broken lines represent normal patterns of dilatation and descent.

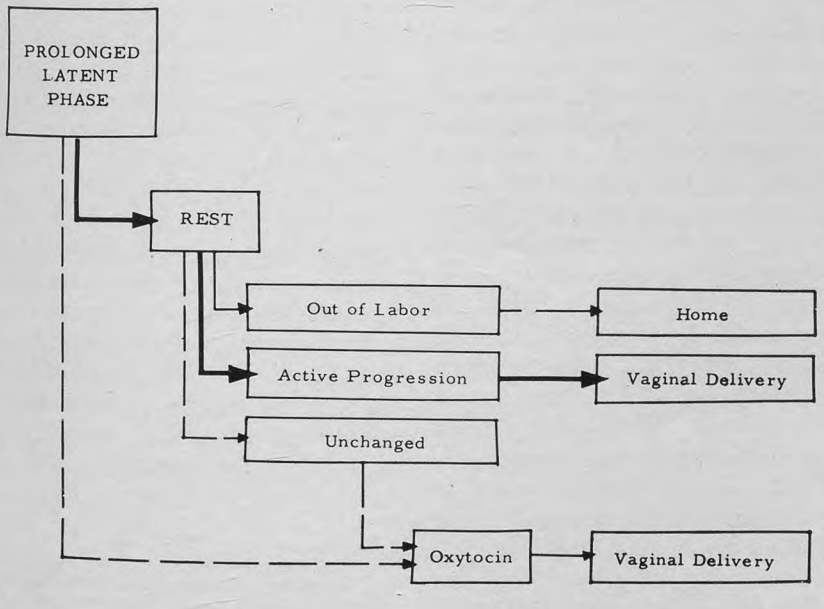

Figure 6. Program of management for prolonged latent phase, consisting primarily of therapeutic rest for most patients.

Continued progress is expected in patients with protraction disorders, if they are properly managed in a conservative manner by expectancy. The prognosis remains good as long as progress continues. There appears to be only a very small increase in risk to mother or infant from these conditions, especially if no ill-advised measures for stimulation or for traumatic vaginal delivery are undertaken.

When the patient with a protraction disorder develops the further complication of an arrest pattern, the outlook becomes much worse. Cesarean section now is more likely and fetal risks increase greatly. The risk to the fetus in association with protraction disorders is primarily related to the type of delivery which is undertaken subsequently. Midforceps procedures, for example, are especially hazardous under these circumstances and this must be borne in mind when these critical conditions are encountered. Conservative management must be carried to its ultimate in this regard, and techniques of delivery should be limited to easy outlet forceps or spontaneous delivery; cesarean section is not indicated for the labor per se, but may have to be done for cephalopelvic disproportion or other clearly defined fetal or maternal problem.

Arrest Disorders

The most ominous labor disorders encountered in practice are those arrest-type problems (Figure 5) characterized by prolonged deceleration phase, secondary arrest of dilatation, or arrest of descent. The reason these are such critical aberrations is their common association with cephalopelvic disproportion in nearly half these cases. Since the probability of an atraumatic vaginal delivery in the presence of disproportion is negligible, patients with an arrest disorder in which cephalopelvic disproportion can be documented warrant cesarean section without further trial of labor. Patients frequently present with a pattern of arrest as the very first sign of disproportion. Under these circumstances the abnormal pattern of dilatation or of descent serves as a useful prognostic

index to forewarn the physician that the patient may have an insurmountable bony dystocia. Patients who present this combination of arrest pattern and disproportion should be treated by cesarean section as the safest and most conservative approach.

Whenever arrest patterns are diagnosed, it is vital that an intensive search be carried out to uncover problems in fetopelvic relationships. Accurate digital and x-ray pelvimetry should be performed promptly. No form of treatment for arrest should be instituted before the pelvic relations are investigated thoroughly. Disproportion in association with a pattern of arrest does not deserve a further trial of labor, since safe vaginal delivery is very unlikely to occur under these circumstances.

If disproportion can be ruled out in the presence of an arrest pattern, therapy can be selected according to the condition of the patient. Where arrest has resulted from excessive sedation or from improperly administered conduction anesthesia, expectancy alone may suffice to allow the offending agent to abate. For the remaining patients, stimulation with oxytocin infusion (Figure 7) should be undertaken if there are no contraindications. Most such patients will respond well to uterotonic stimulation if it is administered cautiously and in sufficient doses to simulate strong, normal labor. It must be reemphasized that no form of uterotonic stimulation should ever be instituted in these cases until the bony relationships have been investigated thoroughly and disproportion has been ruled out with certainty. To do otherwise would signify that one may be stimulating the uterus to drive a fetus through a pelvis that is not adequate enough in size to accommodate it; the resulting trauma to both mother and baby would be unacceptable.

Arrest patterns constitute the most serious abnormalities and carry especially poor prognoses for vaginal delivery. Many patients with these patterns ultimately require cesarean section because of the associated disproportion. Where pelvic relations are adequate, the prognostic outlook for vaginal delivery is much better. One can determine the prognosis more carefully by means of a therapeutic trial if one compares the rate of progression in the slope of dilatation or descent *before* the arrest with the rate that occurs *after* treatment for the arrest. The prognosis for delivery improves with the increment of slope. The more rapid the postarrest slope, the more likely is vaginal delivery to occur. Patients whose postarrest slope is more than 2 cm/hr greater than the prearrest slope should all be expected to delivery vaginally; none should require cesarean section unless it is indicated for some other reason, such as fetal distress. The clinician should bear in mind, however, that this test of stimulation should not be undertaken in the presence of documented disproportion.

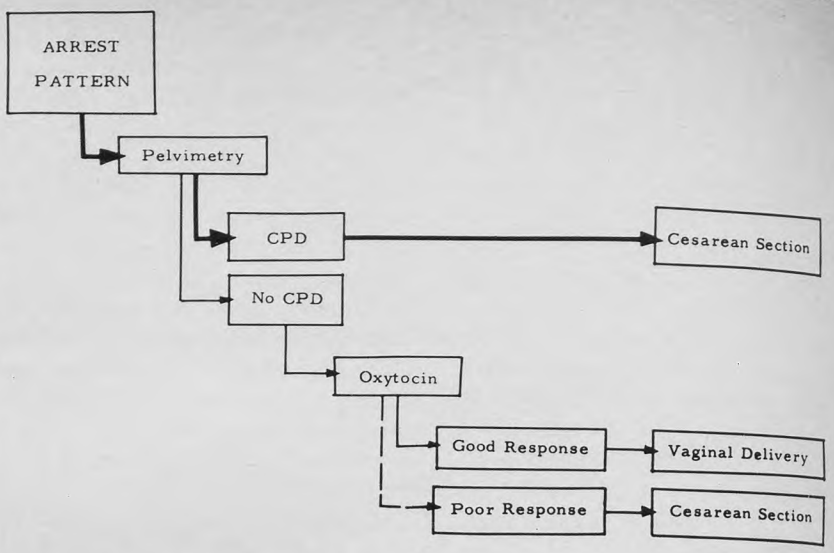

Figure 7. Recommended program for managing patients with an arrest pattern, involving assessment for fetopelvic disproportion first.

As to fetal prognosis, the specific risk factor for arrest patterns appears to be greater than that which is expected for comparable normal labors.[2,3] On this basis, arrest of dilatation or of descent must be considered to be a pattern of labor that is inherently deleterious to the fetus. Therefore, it requires early diagnosis, prompt evaluation for disproportion, and careful definitive and conservative management. Since most arrest patterns are easily diagnosed within a short time after dilatation or descent stops, it should be relatively easy to uncover these high-risk situations expediently. This applies especially to clinicians who graph the progress of ongoing labor, because they can detect the arrest as it is occurring. If one were to wait for some arbitrary total duration of labor to pass before becoming aware of the possible presence of such abnormalities, one would regularly miss patterns of arrest until it was perhaps too late to correct them or to avert serious fetal damage.

Conclusions

We have reviewed the standards of clinical definition of aberrant labor as defined by simplified techniques of analyzing the graphic patterns of dilatation and descent as they relate to the time elapsed in labor. Objective criteria for diagnosis of specific labor aberrations have been evolved, helping to clarify some of the confusion that pervades this field. We have characterized the six major aberrations of labor that become readily apparent by this approach, grouping them into three major categories for purposes of detailing programs of management. Each set has its own preferred management options. Briefly, therapeutic rest is ideal for prolonged latent phase; support and expectancy are best for protraction disorders; cesarean section is clearly warranted in arrest disorders complicated by disproportion; and oxytocin stimulation is reserved for arrest disorders occurring without disproportion. Early diagnosis by graphic means and expeditious therapy appropriate for the condition will benefit all.

References

1. Friedman EA: Labor: Clinical Evaluation and Management. New York, Appleton-Century-Crofts, 1967
2. Friedman EA, Sachtleben MR: High risk labor. J Reprod Med 7:28-32, 1971
3. Friedman EA, Sachtleben MR: Patterns of labor as indicators of risk. Clin Obstet Gynecol 16:172-183, 1973