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Using evidence-based medicine to achieve successful induction of labor.

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ABSTRACT

Induction of labour is a two-step process involving cervical ripening and the initiation of uterine contractions, with the goal of achieving vaginal birth. To optimize the chance of a safe and timely vaginal birth, the process of induction of labour should be evidence based and individualized to the given person and situation. In this study, we lay out a framework for how this should be done, emphasizing on careful clinical assessment and planning, flexibility in the strategy of induction, patience during the ripening andmlatent phases of labour, and thoughtful consideration regarding changing the strategy if active labour is not initially achieved. The goal of this review is to present the current evidence on this topic in the form of a user-friendly protocol that can be easily adapted to institutional practice.

Introduction

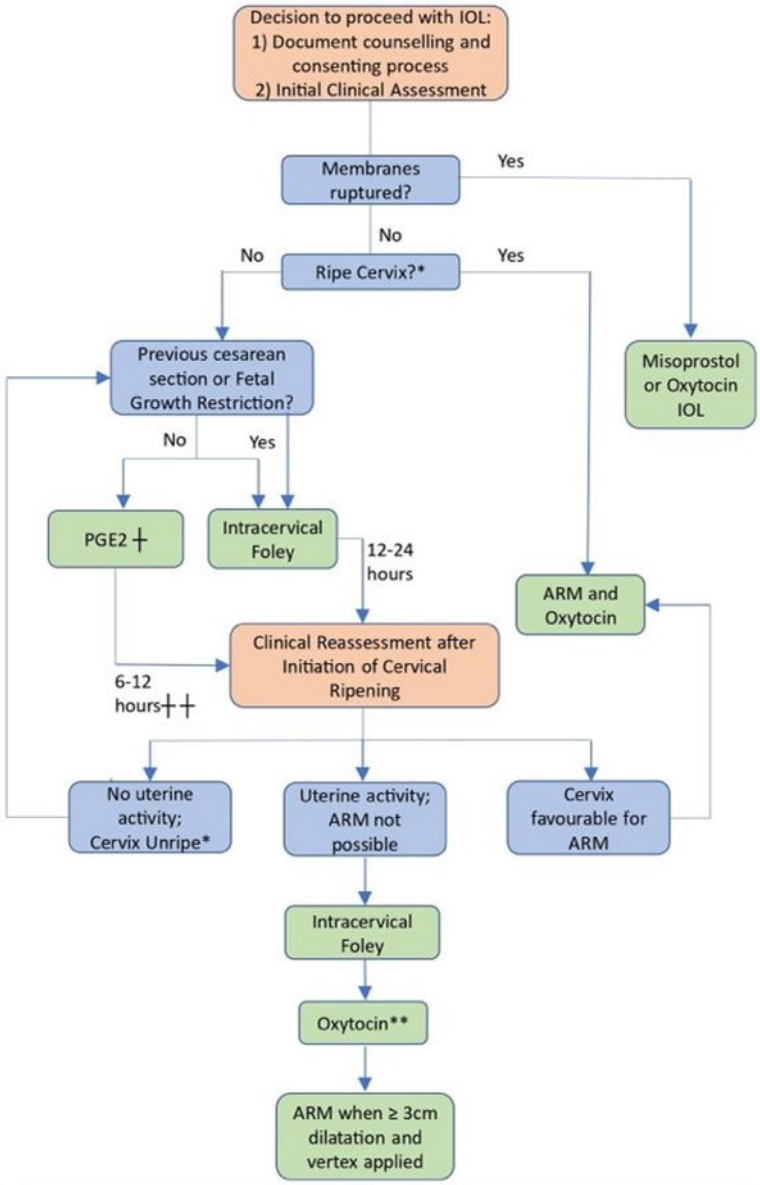
Induction of labor involves the artificial initiation of contractions, with the goal of achieving vaginal delivery in a safe and timely manner. An optimal induction plan involves two distinct phases:

1. cervical ripening: the process of softening, flattening or dilation of the cervix prior to active labor, if active labor has not already occurred.

2. onset of contractions: the process of stimulating uterine activity to achieve full dilation and fetal descent.

How this is achieved should be identified after considering the clinical history of the pregnant person, results of the objective examination, and various circumstances. Several international guidelines have previously provided frameworks for the management of labor induction [1-4] (Figure 1).

Figure 1 - Pathway to optimize induction of labor.



┼Dosage of dinoprostone gel depends on parity; for 2mg starting dose if nulliparous, 1mg starting dose if multiparous
┼┼Re-assessment timing after PGE2 depends on formulation used:
6 hours for dinoprostone gel vs 12 hours for dinoprostone insert
* A "ripe" cervix may be defined as a modified Bishop's score ≥ 7
**Oxytocin may be started prior to or after Foley expulsion depending on clinical urgency

Shared decision making on induction of labor in contemporary clinical practice

Traditionally, induction of labor was thought to be indicated when the risk of continuing the pregnancy for the mother and fetus outweighed the risks associated with induced labor [1-4,6]. However, new evidence continues to emerge in favor of induction of labor in the absence of medical indications. For example, a multicenter study in the United States (U.S.) recently demonstrated lower rates of cesarean section and hy-

pertensive disorders of pregnancy with no increase in neonatal adverse effects when nullipara, with no clinical indication for induction of labor, were induced at 39 weeks compared with those who were managed with expectancy [7]. Following the publication of this study, the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine suggested that it is reasonable to offer labor induction to low-risk nulliparous women at 39 weeks, after considering resource implications [6,8].

It is important to note that induction of labor should be considered only when there is a recognized, evidence-based indication, following appropriate shared decision-making through discussions between the health care provider and the pregnant person. Such discussions should assess and incorporate the woman's specific needs and preferences.

Pregnant women should be given time to consider options and make an informed decision regarding the timing and method of induction of labor. Once the decision to proceed with induction of labor is made, this shared decision-making process should be properly documented in the medical record along with the reason and planned method of induction. Gradual planning and management of labor induction are of utmost importance to optimize the chances of success.

Role of membrane disconnection in avoiding a formal process of labor induction

Membrane disconnection is a process in which, after obtaining consent, a health care provider during a vaginal examination inserts one or two fingers into the cervix and detaches the lower pole of the membranes from the lower uterine segment in a circular motion [9]. This causes a localized release of prostaglandin F2a, phospholipase A2 and cytokines from intrauterine tissues, while cervical stretching can help initiate the Ferguson reflex by releasing oxytocin and thus increasing uterine activity [10]. Membrane dislodgement is a simple technique that can be performed on an outpatient basis, with the goal of softening the cervix, increasing cervical flattening, and promoting uterine contractions, leading to the spontaneous onset of labor without the need for a formal labor induction process.

A recent Cochrane systematic review and meta-analysis, which included 44 randomized and quasi-randomized controlled trials reporting data for 6940 pregnant individuals, showed that compared with the no-intervention group, randomized individuals who underwent membrane disconnection were more likely to have a spontaneous onset of labor (average hazard ratio (aRR), 1.21; 95% confidence interval (CI), 1. 08-1.34) and less likely to need induction of labor (aRR, 0.73; 95% CI 0.56-0.94), with no difference for any adverse maternal or fetal/neonatal outcomes [11].

Furthermore, based on a small number of included studies, membrane disconnection has been associated with health care cost savings and a positive patient experience, with benefits outweighing risks, despite being perceived as an inconvenience [11].

Based on current evidence and when induction of labor is not urgent or hospital care is not required, membrane unbundling may be considered as an alternative or in addition to formal induction of labor.

Induction planning

The process of labor induction is optimized when individualized care and planning are provided, based on the specific characteristics of the pregnant person's history and physical examination. The following factors should be considered when planning the method of induction of labor to optimize the possibility of successful induction of labor (see Table 1).

Table 1 – Factors to be considered in the initial assessment for labor induction planning.

Medical history:
Is the pregnant person nulliparous or multiparous?
Are there maternal risk factors or considerations for induction failure (e.g., high Body Mass Index)?
Are there fetal considerations that should influence the choice of cervical maturation or induction agent (e.g., fetal growth restriction)?
Are there maternal risk factors for uterine rupture that influence the choice of ripening or induction agent (e.g., cesarean section)?
Clinical examination.
Are the membranes ruptured or intact?
Is there any uterine activity?
Is the cervix "mature" (i.e., what is the Bishop score)?

Parity

Nulliparous women are more likely to require cervical ripening and have a higher risk of induction failure than individuals who have had a previous vaginal delivery [12]. A patient and gradual approach to cervical preparation in nulliparous women is critical to optimize the likelihood of successful induction. Large multiparity is a relative contraindication to the use of prostaglandins [2] for cervical preparation because of the increased risk of hyperstimulation and uterine rupture. If cervical ripening is required in these patients, mechanical methods should be considered.

Prior uterine surgery including cesarean section

The risk of uterine rupture during labor is increased for those with a history of previous uterine surgery, including cesarean section surgery, open fetal surgery, and full-thickness myomectomy. Ultrasound assessment of scar thickness, although promising, has not shown reliability in predicting the risk of uterine rupture, and there are currently no cut-off values for clinical practice outside of research protocols [13]. For women with a previous cesarean section, the use of oxytocin is considered safe when used with appropriate monitoring and when the required health care personnel are available to proceed with a timely cesarean sec-

tion if necessary. Although there is a lack of reliable data, the addition of oxytocin is believed to approximately double the risk of uterine rupture compared with spontaneous labor after cesarean section [14]. Since prostaglandin E1 (PGE1) and prostaglandin E2 (PGE2) have a higher risk of uterine rupture than oxytocin [1,14], their use should be avoided in the setting of previous uterine surgery for individuals undergoing induction at term with a viable fetus. In these cases, for cervical maturation, it would be a more appropriate choice to use a balloon catheter, followed by oxytocin administration in a monitored setting.

Body mass index

Induction of labor in individuals with a high body mass index (BMI) requires special consideration [15]. These individue may require a longer time to achieve a favorable Bishop score [16] and progress to full dilation during spontaneous dilation [17] and induced labor [18], which has a higher risk of unplanned cesarean sections, mainly because of the lack of progression in labor [19-21]. This occurs due to biologically related factors (e.g., a relative inhibition of myometrial activity by adipocytokines secreted by adipose tissue) and behavioral factors (e.g., an inability on the part of health care providers to assess cases of prolonged labor and monitor uterine activity and fetal heart rate activity adequately and continuously) [15].

Fetal growth and well-being

Before administering any agent or performing any procedure related to cervical ripening or induction, an assessment of fetal well-being, such as by nonstress testing, should be performed and documented. If available, a bedside ultrasound may be used to confirm presentation and normal amniotic fluid volume before proceeding.

Fetal growth restriction, particularly if secondary to placental insufficiency, has traditionally been considered a risk factor for adverse intrapartum outcomes, including cesarean section. This is likely related to decreased fetal reserves to resist the stress of labor.

Current evidence suggests that the probability of vaginal delivery is still high in this population and that induction versus expectant management does not result in a significant difference in perinatal outcomes [22]. The mode of cervical maturation may help optimize fetal outcome, particularly if there is clinical concern regarding fetal well-being.

In the case of fetal growth restriction, although mechanical maturation with a balloon catheter seems to be associated, overall, with adverse perinatal outcomes, including cesarean sections for nonreassuring fetal status, compared with those observed with PGE1 or PGE2 [23], the use of prostaglandins with close monitoring may be effective [24]. In this case, maturation in a hospital setting may be preferred over outpatient protocols, as closer monitoring of fetal status may be desirable.

Membrane status

In the context of ruptured membranes at term, although oral, buccal, or sublingual misoprostol has a theoretical advantage over oxytocin in promoting both ripening of the cervix and stimulation of contractions, published evidence suggests that maternal and fetal/neonatal outcomes are comparable regard-

less of whether labor is induced with oxytocin infusion, vaginal prostaglandins, or oral misoprostol [5]. Cervical ripening with a balloon catheter has not been shown to reduce the time to delivery compared with oxytocin administration [25]. A randomized trial is underway to determine whether the use of a double balloon catheter with simultaneous oxytocin results in a shorter duration of labor and time until delivery, compared with 24 hours of vaginal prostaglandin followed by oxytocin [26].

Uterine activity

The presence of pre-existing regular uterine activity at the time of evaluation for induction of labor may help determine the optimal choice of ripening agent. Regular painful uterine contractions are considered a relative contraindication to the use of irreversible, long-acting prostaglandins in the form of vaginal preparations such as PGE2 gels and tablets because of the risk of causing tachysystole. For women who experience two or more painful contractions every 10-minute interval, consideration should be given to delaying the use of a second dose of a maturing agent because of the possibility of a cumulative uterotonic effect. In these patients, a slow-release PGE2 insert or reversible mechanical maturation by a method such as an intracervical balloon catheter may be a better choice.

Cervical status

The modified Bishop score represents the best cervical assessment method for an optimal approach to induction of labor. Other methods have been used to predict induction with positive results, including the fetal fibronectin test and transvaginal ultrasonography for an assessment of cervical maturity, but none of these assessment methods have been found to be better than the Bishop score [27-29].

Initiation of labor induction: cervical maturation

Induction of labor is more likely to result in vaginal delivery when the cervix is adequately prepared for labor labor or "matured." The maturation process includes initial dilation, cervical softening, flattening, anteriorly directed position change, and decreased station and is often assessed using standardized scoring systems [30].

Bishop first published his scoring system (score) in 1964 [31], and this has since been modified several times. The modified Bishop score [32] includes five determinants that can be obtained through a vaginal examination that ascertains cervical dilatation, flattening, position, cervical consistency, and fetal station, presenting the various determinants with points from 0 to 2 assigned to each variable. When the Bishop score is six or less, cervical maturation is recommended to improve the likelihood of successful induction [33-35].

Options for cervical maturation include both pharmacological agents such as prostaglandins and non-pharmacological modalities such as intracervical balloon catheters. Prostaglandin PGE2, also called dinoprostone, consists of a 10-mg slow-release insert, a 1-mg or 2-mg intravaginal gel, or a 0.5-mg vaginal tablet. The 10-mg dinoprostone insert is recommended for all individuals regardless of parity because it is designed to release a fixed amount of dinoprostone (0.3 mg/h over a 12-hour period) and can be removed in case of hyperstimulation with rapid reversal of effect [36]. The dinoprostone insert

should be removed at the beginning of active labor or 12 h after insertion; however, it continues to release dinoprostone consistently up to 26 h. More current recommendations, therefore, call for reevaluation 12-24 h after insertion.

Regarding prostaglandin gel, it is recommended that nulliparous women receive an initial dose of 2 mg, while multiparous persons should receive an initial dose of 1 mg. Reevaluation every 6 h is recommended unless clinical circumstances require earlier evaluation. Repeated dosing at 1 mg or 2 mg may be given if further cervical maturation is indicated at that time [37].

Prostaglandin tablets, used both for cervical maturation and to stimulate contractions throughout the induction process, are taken orally at an initial dose of 0.5 mg per hour. If sufficient labor labor does not occur after two doses, the dose may be increased in 0.5 mg increments at each hourly interval to a maximum dose of 1.5 mg. Once active labor is achieved, the maintenance dose is recommended to be reduced to 0.5 mg every hour [38].

PGE1, also called misoprostol, can be administered orally, buccally, sublingually, or vaginally, and dosing intervals and timing vary by protocol. For term inductions, a dose of 25-50 mcg orally is often considered a reasonable starting dose, with repeated doses at two-, four- or 6-hour intervals, depending on the specific protocol being used. In some cases, misoprostol administration can be repeated until delivery without the need to use oxytocin, as PGE1 functions both as a cervical maturation agent and to induce uterine contractions [39].

Intracervical balloon catheters are a means of maturing the cervix without the use of synthetic pharmacological agents. Inflation of the balloon causes elongation of the lower uterine segment, thereby stimulating the release of endogenous prostaglandins. Double balloon catheters do not appear to offer significant advantages over less expensive single balloon catheters [40,41]. Contraindications to the use of balloon catheters include low placenta, antepartum hemorrhage, and evidence of lower genital tract infections. There is evidence on the safety of using balloon catheters to induce labor even in the presence of group B streptococcal colonization when antibiotics are administered as prophylaxis at the onset of labor or at rupture of membranes [42].

Meta-analyses comparing various methods of cervical ripening and labor induction found that vaginal misoprostol, especially at doses of 50 mg, was associated with the highest probability of achieving vaginal delivery within 24 h. The same analysis suggested that misoprostol might also be associated with the highest probability of uterine hyperstimulation. Balloon catheters, on the other hand, were associated with the lowest chance of encountering uterine hyperstimulation with alterations in fetal heart rate [43,44]. There is considerable uncertainty regarding the most advantageous method for reducing the likelihood of cesarean section [43,44] and insufficient data to recommend one method over another in terms of pregnant women's liking [44]. Based on cost-utility analyses, most agents used for labor induction exhibited similar efficacy and differed mainly in cost, with the greatest cost-effectiveness demonstrated for low-dose misoprostol and buccal/

sublingual misoprostol solutions [44].

This means that dinoprostone inserts, gels, and tablets, misoprostol, and balloon catheters possess comparable safety, as well as clinical and cost-effectiveness,and the choice of strategy should be individualized, based on the relevant clinical history and examination findings at the time of induction.

Cervical maturation in inpatient versus outpatient settings

Outpatient labor induction refers to the process in which the cervix is evaluated, cervical maturation is initiated, and the fetus is monitored for a short period in a hospital setting, after which the woman is discharged, returned home, with a plan to return to the beginning of labor or for reevaluation and hospitalization for induction/acceleration of labor.

Several studies and a recent meta-analysis [45] have demonstrated the safety of ambulatory cervical ripening using both mechanical ripening [46] and prostaglandins [47]. Although inpatient ripening allows for closer monitoring of fetal status, it has not necessarily been shown to be safer [48]. Cost-effectiveness studies suggest that outpatient maturation may result in total cost savings compared with hospital management during this phase [49,50], such as reduced total time spent in the hospital. We recognize that outpatient labor induction is not universally practiced and that some agents are used off-label in the outpatient setting. Where outpatient induction of labor is practiced, it is imperative that a decision on the right agent in each individual circumstance be determined first, followed by the feasibility of using that agent on an outpatient basis, rather than first deciding on induction on an outpatient basis and then choosing the method deemed suitable for induction on an outpatient basis.

Monitoring and evaluation after the onset of cervical maturation

Fetal heart rate monitoring is recommended immediately before and after the use of any maturation agent. For prostaglandins, at least 1 hour of monitoring is generally recommended if the intention is to continue with outpatient cervical preparation.

Depending on the ripening agent used, the patient should be reassessed in a timely manner following inpatient or outpatient ripening. Reevaluation should include assessment of the mother's and baby's general condition, changes in uterine activity, and a cervical examination using the Bishop score. Recent literature supports the importance of cervical reassessment prior to planning the next stage of the induction process, as the results of the cervical examination after the first agent of maturation correlates better with the time of birth than the initial cervical assessment [51]. For patients receiving intravaginal PGE2 gel, reevaluation is recommended every 6 h. For patients receiving intravaginal PGE2 inserts or balloon catheters, reevaluation is recommended every 12 h, even if there is no or minimal cervical change and if the clinical condition of the mother and fetus is stable, further evaluation after 24 h is not unreasonable. For those who present with regular uterine activity and in whom artificial rupture of membranes is possible, amniotomy would be the preferred next step. If amniotomy is not possible and the Bishop score remains six or less, repeat ripening is indicated, either with the same agent or a different agent. No studies have been published evaluating the benefits of switching from one ripening agent to another.

If the cervix is still not mature after a second attempt, an alternative agent should be considered. Alternatively, intracervical balloon catheter and oxytocin may be used.

For patients presenting with uterine activity and a closed cervix for reevaluation after prostaglandins, we suggest placing a balloon catheter for further maturation rather than a repeat dose of prostaglandin, although the use of PGE2 gel repeated every 6 hours is not unreasonable. For patients with cervical change but no appreciable uterine activity, repeating prostaglandin may be a more appropriate choice if amniotomy and administration of oxytocin or misoprostol are not feasible.

Decision making at the time of the first reevaluation is critical to the success of labor induction. Reevaluation after misoprostol administration is complex and depends on the dose and route used [39]. For PGE2 gel/compresses, most health care providers recommend using a second dose of the same agent if rupture of membranes is not feasible after the first dose. If there is minimal cervical change and no uterine activity after 12-24 h of PGE2 insert, it may be appropriate to consider another method such as the use of PGE1 or PGE2 gel or a balloon catheter with or without oxytocin. Similarly, if there is minimal change and no uterine activity 12-24 h after the use of a balloon catheter, the use of the more appropriate prostaglandin should be considered. It is especially important NOT to perform an amniotomy too early during cervical maturation and/or induction of labor, especially in women with high BMI. Facilitating good cervical smoothing prior to amniotomy will reduce the incidence of prolonged rupture of membranes and its consequences, including cesarean section.

Sequential versus simultaneous cervical maturation and induction of labor

Traditionally, ripening of the cervix was performed before starting oxytocin for induction of uterine contractions. Some have questioned whether these steps should be completely sequential, a process that could take several days to complete. The 'simultaneous use of intracervical balloon catheters and oxytocin has been shown to increase the chances of delivery within 24 h compared with a sequential strategy of a balloon catheter followed by oxytocin in nulliparous and multiparous women, with no significant differences in the incidence of cesarean sections or other maternal or neonatal complications [52]. A recent meta-analysis demonstrated a reduced time to vaginal delivery when simultaneous use of intracervical balloon catheters with prostaglandins or oxytocin was compared with sequential use of a catheter followed by oxytocin. No significant differences in maternal or neonatal adverse events were observed in this study, except for a higher incidence of postpartum endometritis in the simultaneous group [53]. It is worth noting that these studies were conducted in an inpatient setting, and the results may not be generalizable to centers performing cervical ripening on an outpatient basis. Simultaneous use of balloon catheters with oxytocin may be a useful strategy for patients with an indication for rapid delivery when hospital monitoring is required, for example, those with atypical fetal heart rate, significant fetal growth restriction, or preeclampsia.

Choice of agent for the onset phase of contractions

Traditionally, intravenous oxytocin has been the agent of choice for pharmacological induction of labor. By simulating the release of oxytocin during the labor process, intravenous oxytocin activates its receptors on uterine myocytes to encourage contractile activity. Several studies have been published showing that oral misoprostol can be as effective as oxytocin in achieving vaginal delivery, with fewer overall cesarean sections, but increased rates of meconium-stained amniotic fluid compared to that observed in patients undergoing induction with oxytocin [54]. One disadvantage of misoprostol compared with oxytocin is that the dosing regimen does not allow for tight titration based on contraction or fetal heart rate, and misoprostol is not rapidly reversible once administered.

Misoprostol may be particularly useful in cases of ruptured membranes prior to term labor, and it can be used for both cervical maturation and as a primary induction agent; one study shows that sublingual misoprostol was associated with a similar total time to delivery as oxytocin, but with a decrease in the duration of the second stage of labor and improvement in the Apgar score at 5 minutes [55].

Initiation of induction of labor

Once the cervix has adequately matured, options for management of ongoing labor include pharmacological initiation of induction with misoprostol or oxytocin with or without concomitant amniotomy. With a favorable cervix, many would advocate starting oxytocin at the same time as performing amniotomy, rather than performing amniotomy and then waiting before starting oxytocin [1,56]. Delayed initiation of oxytocin has been associated with a longer interval to delivery in both nulliparas [57,58] and multiparas [59], with no maternal or neonatal benefit. A recent meta-analysis showed that an early amniotomy following balloon catheter expulsion or adequate ripening but before the onset of active labor compared with a late amniotomy in the active phase is indeed associated with decreased time from induction to delivery without increased cesarean section rates [60]. Although there is variability in practice regarding concurrent versus sequential use of oxytocin after amniotomy, current evidence would favor concomitant administration of oxytocin and amniotomy.

Oxytocin protocol

There is no oxytocin dosing protocol that has clearly been shown to be superior to others. A review of the literature suggests no difference in the risk of cesarean section, delivery within 24 hours, or any neonatal outcome, between low-dose and high-dose oxytocin regimens, although the definition of "low " and "high" dose protocols differ among studies [61]. Each institution is encouraged to establish its own protocol, as having a standard approach for all practitioners at a given site will likely minimize treatment errors and adverse outcomes.

The goal of oxytocin induction is to achieve 3-4 contractions in a 10-minute period with a duration of 40-60 seconds each. The rest period between contractions should be at least 60 seconds. The oxytocin dosage should be titrated up until this pattern of labor is established. The value of repeat cervical examinations before this contraction pattern is achieved is questionable, as the likelihood of signifi-

cant cervical change is low and the use of repeat examinations can theoretically increase the overall risk of infection. Once the desired contraction pattern is reached, the dose of oxytocin can be maintained at that level, provided an adequate cervical change is made. The main risk of labor induction by oxytocin is hyperstimulation. This can result in changes in fetal heart rate, which may reflect a compromised fetal state. Most guidelines recommend continuous fetal heart rate monitoring during oxytocin administration once contractions are established in a regular pattern [3,4]. For patients in whom the contraction pattern cannot be adequately assessed with an external tocometer, for example, in those with a high BMI, an intrauterine pressure catheter offers a more reliable and accurate means of assessment. In the event of hyperstimulation with alterations in fetal heart rate, oxytocin infusion should be immediately reduced or discontinued, and intrauterine resuscitation initiated, with the patient positioned in left lateral decubitus. The half-life of oxytocin is 1-6 min, and sufficient time should be allowed for the baseline value of uterine tone to return to normal before an emergency cesarean section is performed.

Managing the latent phase of labor after induction of labor

The latent phase of labor in the context of induction is the period from the onset of uterine activity to the transition to active labor. Definitions of latent and active labor differ in literature publications. Some sources define latent labor as uterine activity with dilation of 0-3 cm in nulliparous patients, and dilation of 0-4 or 5 cm in multiparous patients, with the phase of active labor appearing after this limit. More recently, there has been a push to define the onset of active labor as dilation of at least 6 cm, as this is when the maximum slope in the rate of change of cervical dilation occurs [62]. The preoccupation with defining active labor before a 6-cm dilation constitutes an attempt to expect a time when labor progresses at a predictable rate and to consider labor as "failed" when normal cervical change does not occur. This is one of the greatest dangers in labor induction, as physicians expect laboring women to follow the same pattern of cervical change described by Friedman, consisting of the eponymous curve based on data from a homogeneous group of women in spontaneous labor [63]. Friedman's work was instrumental in the development of the World Health Organization's partogram, which is widely used globally, but, has, perhaps, outgrown its broad applicability in the current era of routine induction. The standards set by Friedman's curve have directly contributed to the increase in the number of cesarean sections performed for "failure to progress," many of which are performed before patients have truly entered the active phase of labor [64].

In more recent studies of women undergoing spontaneous labor at term, Zhang et al. ascertained that the cervix dilated, substantially, more slowly in the active phase than had been previously described by Friedman [65,66]. The pattern of progress may be even slower with induction of labor, particularly during the period before true active labor. Patients undergoing cesarean section for "failure to progress" before 6 cm dilation in the context of induction may alternatively be considered to have "failure to induce labor." In this situation, with normal fetal and maternal status, we recommend considering

whether everything has been done to optimize the induction process before considering it failed.

Management of prolonged latent labor

The time from the start of induction with oxytocin to active labor and delivery is highly variable. Many institutions have set upper limits for the dose of oxytocin to be used, at which point further escalation must be reevaluated. It may be reasonable at this point to increase the dose further with continued monitoring of the contraction pattern if active labor is not yet achieved. If contractions are deemed adequate, or are uncertain, but labor is not progressing to the active phase, then it is often helpful to place an intrauterine pressure catheter to allow objective monitoring of contraction strength, using Montevideo units to further titrate oxytocin dosage.

For individuals in whom an appropriate contraction pattern is not achieved during the latent phase, a strategy that has been tried consists of a rest period from oxytocin. The motivation for this behavior has the biological plausibility of allowing oxytocin receptors on uterine myocytes to restore themselves after they have become saturated and begin to degrade due to continued exposure to oxytocin. A recent retrospective cohort study showed no change in the odds of cesarean section with or without oxytocin rest except in the group without oxytocin for a period of at least 8 hours [67].

This would suggest that a long period of rest is necessary, which could theoretically increase the risk of chorioamnionitis in the case of previously ruptured membranes. Rest from oxytocin may be a viable option for patients who experience a prolonged latent phase and where immediate delivery is not necessary, as it may optimize their chances of having a vaginal delivery. A long period of rest from oxytocin may save time in the long term compared with continuous persistence of oxytocin if the uterus does not respond appropriately.

Another option for patients who do not achieve an adequate contraction pattern despite a high level of oxytocin doses would be to change strategies completely, such as proceeding with the administration of misoprostol instead of oxytocin. In this case, we recommend deactivating oxytocin and administering the first dose of 25-50 mcg of misoprostol after a rest period of at least 1 hour. Institutions should have a protocol for induction of labor using misoprostol in term patients if this strategy is to be used safely, as there are different dosage regimens [39].

We would like to emphasize that, failure to achieve active labor should not be considered an indication for cesarean section in the absence of adequate contractions. With patience, most patients will achieve active labor. A protocol for managing a prolonged latent phase of labor is outlined in Figure 2.

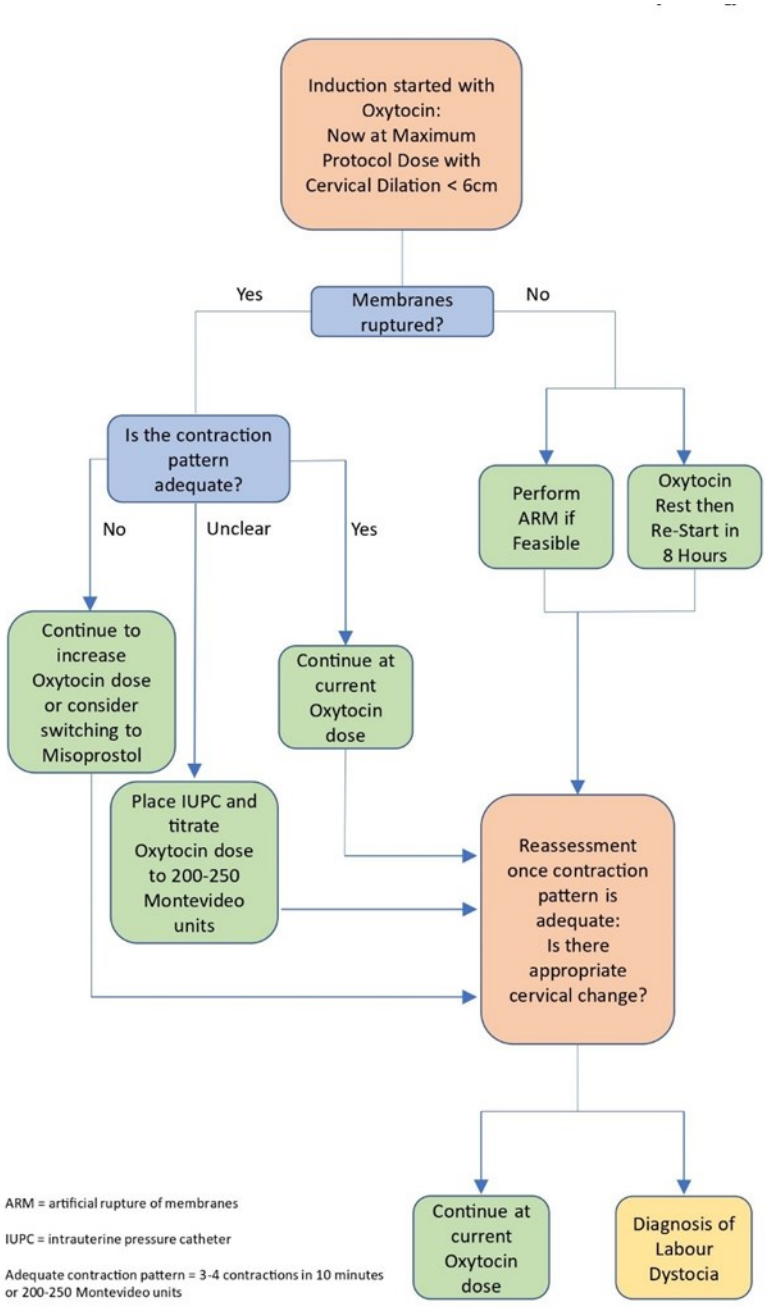
Management of active labor

Once regular contractions are established with cervical dilation of 6 or more centimeters, the management of labor is very similar to that of women experiencing spontaneous labor.

There are some literature studies that suggest that complete cessation of oxytocin during the active labor period has no effect on the final mode of delivery and that this may be an option in some cases [68]. Since some individuals will experience spacing out of their contractions or even stalling their labor,

we generally continue oxytocin at the lowest effective dose used to achieve a normal contraction pattern with cervical changes. Once in the active phase of labor, the rate of cervical changes with induced labor is similar to that in spontaneous labor.

Figure 2 - Options for managing slow progress in the latent phase of labor induction with oxytocin



Management of the second stage of labor

The second phase of induced labor is managed similarly to that of women who labor spontaneously. Labor generally proceeds similarly during this stage whether induced or spontaneous, with no significant differ-

ences in the overall duration of this stage of labor [69], provided contractions remain adequate. Many physicians have previously argued for a period of rest and spontaneous descent, prior to the onset of active pushing in the second phase of the fetal head, particularly for women with epidural anesthesia. Recent evidence, however, has not shown a difference in the risk of cesarean section with rest in the second stage. Individuals who started pushing immediately at full dilation spent less total time in the second stage of labor and had a reduced risk of chorioamnionitis compared with individuals in whom pushing was delayed by 1 hour [70]. There may be a subset of laboring individuals with a fetal head in a high position, or with a baby in a nonoccipital anterior position that may benefit from a period of passive descent to allow spontaneous rotation.

In conclusion, to optimize the success of induction of labor and reduce cesarean section rates, institutional protocols in labor management are needed and there should be clear criteria for cesarean sections undertaken for labor dystocia and failed induction. If done well, the induction process is safe and does not increase the risk of cesarean section compared with waiting-to-expect management.

The use of a standardized, evidence-based protocol for induction of labor and a commitment to the goal of achieving a safe vaginal delivery by the health care provider ensures the best chance of successful induction for the pregnant woman.

We propose some general principles for optimizing the chances of successful induction of labor (Table 2)

Table 2-General principles for optimizing the chances of successful induction of labor

1. Individualized assessment and care in planning cervical ripening and detailed collection of history and objective examination to select the best ripening agent, place of ripening, and timing of reevaluation.
2. Meticulous use of repeated assessment and flexibility in strategy during the maturation process- are there characteristics of the maternal/fetal state that have changed from the initial plan?
3. The use of written and consistent protocols within a health care institution to provide consistency among clinicians and safety for patients.
4. Patience during the latent phase of labor. Active labor begins with a 6-cm dilation. A cesarean section done before this time should be considered a "failure to induce."
5. Use of additional strategies, such as intrauterine pressure catheters to titrate to higher doses of oxytocin, suspension of oxytocin in case of inadequate contractions and intact membranes, and the use of alternative pharmacologic agents such as misoprostol if the contraction pattern is inadequate.

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