Chapter

Labor Induction

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Abstract

Introduction: Induction of labor is the process of artificially stimulating uterine contraction after the fetus has reached viability and before the spontaneous onset of labor for accomplishing vaginal delivery. It is a common obstetric procedure that is primarily indicated in the presence of complications that put continuing of pregnancy at risk. Its global rate is around 20% with great variation across regions. The most common indications are: postterm pregnancy, hypertensive disorders during pregnancy, pre-labor rupture of membrane, intrauterine growth restriction, intrauterine fetal death, abruption placenta, fetal congenital anomalies, and other medical disorders. Despite its huge significance in preventing neonatal and maternal mortality and morbidity, induction of labor by itself has its own risks and complications compared to spontaneous labor, including a potential of failure to progress, leading to cesarean birth and its complications. When deciding undertaking induction of labor and after fulfilling the requirements for induction, the next step will be deciding which methods will be used to achieve it. Induction could be done medically, surgically, or both depending on the indication and other conditions.

Keywords: labor induction, induction outcome, methods of induction, failed induction, oxytocin

1. Introduction

Labor induction is the stimulation of uterine contraction artificially after the fetus has reached viability (after the 28th week of gestation) and before the spontaneous onset of labor for accomplishing vaginal delivery [1]. It is a common obstetric procedure primarily employed in the presence of obstetrics and medical conditions that threaten pregnancy continuation [2, 3]. Induction of labor has its indications that could be can be elective (planned) or emergency. Elective induction is usually done with prior planning by the health- provider and the mother when continuing the pregnancy beyond certain weeks has risk for the mother or the fetus, like in the case of PROM, DM, moderate hypertension postdate pregnancy, small or large for date baby. Emergency induction is done when there is an emergency maternal and fetal condition that necessities induction of labor immediately such as prolonged PROM, severe IUGR, intrauterine infection, pregnancy beyond 42 week, and preeclampsia and eclampsia [4].

Unfortunately, despite its undisputed importance for ending risky pregnancy, compared with the spontaneous onset of labor, induction has a potential risk of increased rate of cesarean birth and its complication along with different maternal and neonatal complications [5, 6]. Due to this, the World Health Organization (WHO) recommends induction to be performed only with a clear medical indication when expected benefits outweigh potential harms [2].

Although oxytocin is an effective means of labor induction, in women with a favorable cervix, as noted earlier, it is less effective as a cervical ripening agent. Many RCTs that have compared oxytocin with various prostaglandin (PG) formulations and other methods of cervical ripening confirm this observation.

2. Prevalence

Nowadays, the prevalence of induction of labor in the field of obstetrics is increasing. According to a WHO report, up to 25% of all term deliveries in developed countries were following labor induction for different reasons. In the United States and England, labor induction accounts for 29% [4] of deliveries, while 12.1% and 4.4% of deliveries are induced in Asian and African regions, respectively [5].

However, even if induction of labor is practiced widely in the field of obstetrics, it has variations from setting to setting, with studies showing that facilities in developing countries tend to have lower rates of induction of labor than in developed countries. One systematic study shows that the average induction rate was 4.4% in African, 12.1% in Asian, and 11.4% in Latin American countries, which has a huge difference from that in developed countries [5, 6].

3. Indications and contraindications of induction of labor

The decision to induce labor was never an easy task and requires a complex clinical judgment. It usually constitutes a choice between three options, allowing the pregnancy to continue, inducing labor, or performing cesarean section, and needs the consideration of a number of factors [2]. Some of the factors are the condition of the baby, gestational age and the level of certainty about the baby's age (rarely, preterm induction may have to be done.), history of previous cesarean section, the preference of the mother, and the likelihood that induction of labor will be efficient and vaginal delivery could be achieved, which in turn is dependent on the state of the uterine cervix and birth canal [3, 7].

Taking the above conditions in to consideration, there are various indications that might require labor induction. These factors could be maternal or fetal and sometimes both.

3.1 Maternal indications

Maternal conditions that necessitate labor induction could be medical conditions or discomforts that have been caused or aggravated by pregnancy [8, 9]. These indications include:

- Preeclampsia/eclampsia

- Gestational hypertension ≥38 weeks
- Diabetes mellitus
- Renal disease
- Chronic pulmonary disease
- Cholestasis of pregnancy
- Abruptio placentae

3.2 Fetal indications

- Prolonged pregnancy
- Suboptimal intrauterine growth
- Chorioamnionitis
- Multiple pregnancy
- Polyhydramnios
- Uncomplicated twin pregnancy ≥38 weeks
- Pre-labor ruptured membranes
- Alloimmune disease at or near term
- Oligohydramnios
- Nonreassuring antepartum fetal testing
- Intrauterine fetal death

In addition to the abovementioned maternal and fetal indications, labor induction can be done for allowing the essential treatment to be commenced, such as for cervical cancer, relieving emotional distress after intrauterine death in previous pregnancy, or alleviating anxiety about the baby's well-being [10]. Likewise, although currently available guidelines do not recommend it, induction of labor is being used more and more at the request of pregnant women to shorten the duration of pregnancy or to time the birth of the baby according to the convenience of the mother and/or health-care workers [3, 5, 11, 12].

In general, the reason for induction varies from area to area. According to a study done in Latin America, premature rupture of membranes was the single most frequent medical indication accounting for 25.3% of the indications, while post-term pregnancy was the second most common. Another systematic study done in Africa shows that PROM was the most common (27.3%) reason for artificial initiation of labor [2]. In another study done in Saudi Arabia, the most common indication for IOL was post-

term pregnancy accounting for (31%) cases followed by gestational and preexisting diabetes mellitus, together 23.2%, while PROM was the third most common indication accounting for 15% [12].

In conclusion, induction of labor is recommended when the risk of continuation of pregnancy either to the mother or to the fetus is more than that of continuing the pregnancy. However, sometimes induction for maternal interest may compel ignoring the fetus.

3.3 Unacceptable indications

- Care provider or patient convenience
- Impending macrosomia
- Patients considered to be at an increased risk for preeclampsia (such as having a prior history of preeclampsia)
- Concerns about intrauterine growth restriction
- Additionally, preterm or early-term induction is not medically indicated for maternal anxiety or discomfort related to normal pregnancy
- Previous pregnancy with labor abnormalities such as rapid labor or shoulder dystocia
- Simply because the mother lives far from the hospital
- Suspected fetal macrosomia (estimated fetal weight > 4000 gm) in a nondiabetic women is also an unacceptable indication because there is no reduction in the incidence of shoulder dystocia but twice the risk of CS [13, 14].

3.4 Contraindications

Induction should be avoided if there is any fetal or maternal condition that contraindicates labor or vaginal delivery. These conditions could be grouped as absolute and relative contraindications.

3.4.1 Absolute contraindications

Absolute contraindicates are any gynecological, obstetrical, or medical conditions that preclude safe vaginal delivery, which include but are not limited to the following [3, 15, 16]:

- Cephalopelvic disproportion more than borderline (macrosomia or contracted pelvis)
- Abnormal fetal lie or presentation (e.g., transverse or oblique lie, footling breech)
- Diagnosed major placenta or vasa previa

- Extensive vaginal plastic operations like repaired fistulas.
- Pelvic tumors obstructing delivery like cervical cancer and tumor previa
- Pelvic structural deformities
- Umbilical cord presentation and prolapse
- Abnormal fetal heart rate pattern (Category III fetal heart rate tracing)
- Absence of cesarean section facility
- Extensive genital wart, cervical cancer, and active genital herpes
- Previous history of uterine surgery like classical cesarean section or inverted T uterine incision, two or more lower segment cesarean sections, myomectomy entering the endometrial cavity, ruptured uterus, and so on.

3.4.2 Relative contraindications

- Elderly primigravida or grand multiparty
- Uterine over distention from polyhydramnios or multiple pregnancy
- One lower segment cesarean section
- Frank breech
- Bad obstetric history
- Unfavorable cervix, especially for elective induction.

N.B. These conditions require internal or external continuous monitoring of uterine contractions and the fetal heartbeat. In the absence of such monitoring, they become absolute contraindications [17].

4. Outcome of labor induction

Induction of labor (IOL) is done with the main aim of initiating labor without its true time to save the health of the mother and unborn fetus and minimizing severe obstetric complications related to unnecessary cesarean section [2]. However, this artificial initiation of labor is not without its own risks and is associated with adverse maternal and perinatal outcomes such as postpartum hemorrhage [18], hyperstimulation of the uterus that can result in uterine rupture, chorioamnionitis, endometritis [9], fetal hypoxia, maternal fluid intoxication [19], stillbirth [5], severe birth asphyxia [20], increased medical interventions, increased hospital costs [3], abnormal fetal heart rate patterns, maternal water intoxication if oxytocin is used, delivery of a preterm infant due to incorrect estimation of dates, and cord prolapse [8, 21]. Induction of labor also influences the woman's childbirth experience, and it has more

discomfort and pain. For these abovementioned reasons before starting IOL, all pregnant women should have consented to the process and understand all benefits, maternal and fetal risks, and alternatives to IOL. Furthermore, reviewing indications for cesarean section, operative vaginal delivery should be discussed prior to offering IOL.

Furthermore, even after induction is done knowing all these risks, it might not achieve the intended labor and vaginal birth, and it may result in failed induction. However, while there is a well-accepted definition of IOL, the definition of a successful or failed induction of labor (FIOL) is less certain [22–24]. Most studies define FIOL as an inability to achieve vaginal delivery or birth through cesarean section (CS) [25–27]. Nevertheless, others suggest a variety of criteria such as mode of delivery (vaginal versus cesarean) and certain time intervals within which active phase of labor is achieved or adequate number of uterine contractions is achieved for diagnosing FIOL [3, 28, 29]. Some protocols also define it as failure to achieve regular (e.g., every 3 min) uterine contractions and cervical change after at least 6–8 h of the maintenance dose of oxytocin administration, with artificial rupture of membranes [30]. American College of Obstetricians and Gynecologists (ACOG) recommends diagnosing and doing cesarean section for a failed IOL if vaginal delivery is not achieved for 12–18 hours after administrating oxytocin and performing amniotomy [16].

5. Pre-induction assessment

As mentioned before, although the goal of labor induction is to achieve a successful vaginal delivery, induction exposes women to a higher risk of a CS and other complications than spontaneous labor. To minimize these risks and complications, thorough examination of the maternal and fetal condition is required before undertaking labor induction [31]. Indications and contraindications for induction should be well reviewed and discussed with the patient along with the alternatives, risks, and benefits of labor induction. Confirmation of gestational age and evaluation of fetal lung maturity should also be performed. Labor induction should be performed at a location where personnel who are familiar with the process and its potential complications are available. Availability of uterine activity and electronic fetal monitoring (EFM) is also recommended for any mothers receiving uterotonic medications [2, 32].

In spite of this, existing evidence points out that the failure rate of IOL is increasing worldwide [33, 34]. As a result, a variety of maternal and fetal factors as well as screening tests have been suggested to predict labor induction success. Maternal factors include: parity (prior vaginal delivery), body mass index (BMI), and maternal age. Fetal factors include: estimated fetal weight, gestational age, and fetal presentation. Clinical pelvimetry, transvaginal ultrasound (TVUS) assessment of the cervix, and biochemical markers [including fetal fibronectin (fFN) and insulin-like growth factor binding protein-1 (IGFBP-1) [31, 35, 36]]. The other main factor that determines the success of induction is the status of the cervix (Bishop score) before induction is commenced. For this reason, before undertaking induction of labor, pre-induction assessment for the fulfillment of the prerequisites, particularly bishop score, is required.

5.1 Cervical ripening and Bishop score

One of the main factor that needs to be examined and documented before labor induction is cervical status using Bishop score, which is one of the most important

factors for predicting the likelihood of success in labor induction [31, 37]. The Bishop score is a pre-labor pelvic scoring system that is commonly used in clinical practice as a predictor of the success for induction [38].

It was first developed in the 1960s by Dr. Edward Bishop. Initially, the system tabulates a score based on 5 determinants (the station of the presenting part and four characteristics of the cervix) [39]:

1. Dilation,
2. Effacement,
3. Consistency, and
4. Position.

Each component attributes a value from 0 to 2 or 3 points each (for a maximum score of 13). However, in 1966, Burnett modified the scoring scheme so that each variable was assigned a maximum value of 2 points (for a maximum score of 10) [40].

If the Bishop score is high, which is often considered to be a score of 8 or above, the likelihood of vaginal delivery is similar whether labor is spontaneous or induced [41]. In contrast, a low Bishop score, which is a score of 5 or less, is considered to be unfavorable, and if an induction is indicated, cervical ripening agents may be utilized [37, 38, 41]. A score from 6 to 7 is considered to be intermediate [30, 32].

Several studies have shown an increased rate of failed induction and CS when women are induced with an unfavorable cervix (12–16). Xenakis's prospective study of 597 pregnancies stratified found the highest risk of CS and failed induction in those with low Bishop scores [25].

6. Method of induction and cervical ripening

When deciding undertaking induction of labor after fulfilling the requirements for induction, the next step will be deciding which methods will be used to achieve it. Depending on different conditions, there are different types of induction methods that could be utilized. These methods are grouped as medical and surgical. Medical method of induction are methods that use pharmacological products to achieve artificial labor initiation, while surgical methods use non-pharmacological methods [2, 3, 31, 32].

6.1 Medical method

6.1.1 Prostaglandins

Prostaglandins are a group of physiologically active endogenous compounds found in the myometrium, decidua, and fetal membranes during pregnancy. Its administration results in the dissolution of collagen bundles and an increase in submucosal water content of the cervix, resulting in changes of cervical connective tissue that are similar to those observed in early labor [2, 3, 31, 42]. It also causes direct stimulation of myometrial contraction by stimulating receptors in the uterus [38].

PG formulations analogues were have been used since they were first synthesized in the laboratory in 1968. They could be used for both induction and as a cervical ripening agent, but they are more effective when used for cervical ripening with increased success of vaginal delivery rates within 24. However, the overall risk of cesarean section will not change, and they have an increased risk of uterine hyperstimulation and FHR changes [43].

Although they can be given intravenously and by oral routes, local administration of PGs in the vagina or the endocervix is the route of choice because of fewer side effects and acceptable clinical response [31].

There are different types and preparations of PG available for both induction of labor and cervical ripening.

Prostaglandin E2 (PGE2): Also known by the name dinoprostone, it is a naturally occurring compound involved in promoting labor, by causing contractions in the myometrium via direct stimulation and softening and dilatation in the cervix, dissolving the collagen structural network of the cervix [38, 42].

Prostaglandin E2 is available in 3 different preparations as a cervical ripening agent:

- Intravaginal 1 mg and 2 mg gel (Prostin), and

A. **Intravaginal Cervidil**

- It is a vaginal insert form of PGE2 that contains 10 mg of dinoprostone in a timed-release formulation.
- It releases the medication at 0.3 mg/hr. that could be left in place for up to 12 hours, and oxytocin may be initiated from 30 to 60 minutes after its removal [31].

B. **Intracervical gel (Prepidil) [31].**

- It contains dinoprostone, 0.5 mg per 3 g syringe (2.5 mL gel), for intracervical administration.
- Its dose can be repeated in 6–12 hours if cervical change is inadequate and uterine activity is minimal following the first dose. However, drug administration should cease if there are no contractions within twenty-four hours or if there are severe adverse effects, including membrane rupture or uterine hyperstimulation [32, 44].
- The recommended maximum cumulative dose of dinoprostone should not exceed 1.5 mg (three doses) within a 24-hour period.
- Because of the potential for uterine tachsystole with concurrent oxytocin and prostaglandin administration, oxytocin should not be initiated until 6–12 hours after the last dose of dinoprostone [44].

C. **Intravaginal gel (Prostin),**

- It is a translucent triacetin-based thixotropic gel formulation that contains either 1 mg or 2 mg of dinoprostone, as the active ingredient in each unit dose of 3 grams (2.5 mL).

- It is inserted high into the posterior fornix of the vagina, and patient should be instructed to remain recumbent for at least 30 minutes.

- For women with favorable cervix, the initial dose is 1 mg of PROSTIN E2 Vaginal Gel.

The advantage of the controlled-release vaginal insert (Cervidil) over the intracervical one is that it easier to administrate than intracervical (Prepidil) preparations, and it allows easier removal in the case of onset of active labor, rupture of membranes, or with the development of uterine tachsystole. It also requires only a 30 minute delay before the initiation of oxytocin upon its removal compared with an interval of 6 hours for the latter [32, 42].

In conclusion, as other methods, the use of PGE2 has its own advantages and limitations.

Advantages:

- Good patient acceptance,

- A lower operative rate than oxytocin and less need for oxytocin augmentation when used with an unfavorable cervix (Bishop <7) [32]

- It is a bronchodilator and is not contraindicated in women who suffer from asthma.

Limitations:

- Relatively expensive,

- Requires refrigerated storage and is unstable at room temperature,

- Has more chorioamnionitis or endometritis and admissions to NICU than oxytocin [31].

Prostaglandin E1 (Misoprostol): It is another form of synthetic prostaglandine1 analogue that has uterotonic properties, by contracting smooth muscle fibers in the myometrium and facilitation of cervical opening by relaxing of the cervix [45]. It is considered as a safe and effective off-label use for induction of labor or cervical ripening by ACOG [46]. It is available as 100 μg and 200 μg tablets that could be divided to provide 25 or 50 μg doses.

Due to higher dosing (50 μg every 6 hours), it may be associated with uterine tachsystole and fetal heart rate decelerations; ACOG recommends using 25 μg dosing every 3–6 hours with vaginally applied misoprostol and suggests that the higher doses should be used only in select circumstances [47]. If necessary, oxytocin may be initiated 4 hours after the final misoprostol dose in using 25 μg.

A meta-analysis that compared 25 μg with 50 μg dosing reported that 50 μg dosing resulted in a higher rate of vaginal delivery within 24 hours with higher rates of uterine tachsystole meconium passage and higher frequency of fetal acidosis with an umbilical arterial pH of less than 7.16 but without compromising the neonatal outcomes [48].

Advantages of misoprostol are that it is inexpensive, stable at room temperature, and can be administered orally or placed vaginally with few systemic side effects. However, compared with vaginal misoprostol, administration of misoprostol by the buccal or sublingual route increases uterine tachsystole [31].

Mode of administration: Misoprostol can be administered orally or placed vaginally with few systemic side effects, with studies reporting that misoprostol tablets placed vaginally are either superior to or equivalent in efficacy compared with intracervical PGE2 gel [49]. Although no difference in clinical outcomes are apparent when comparing intravaginal or intracervical PGE2 preparations, for ease of administration and patient satisfaction, vaginal administration is recommended [48, 50, 51].

NOTE: PG formulations of any kind should be avoided in women with a prior uterine scar, such as a prior cesarean delivery or myomectomy, because their use has been associated with an increased risk of uterine rupture.

6.1.2 Oxytocin

Oxytocin is the most potent uterotonic and common pharmacologic agent used to induce labor. It stimulates the smooth muscles of the uterus in similar fashion with the natural hormone that secretes from the posterior lobe of the pituitary gland in a pulsatile fashion. It also causes contraction of the myoepithelial cells surrounding the mammary alveoli leading to milk ejection during lactation [31, 52].

It has been used either alone or with other drugs and methods. Its administration produces periodic uterine contractions first demonstrable at approximately 20 weeks' gestation, with increasing responsiveness with advancing gestational age primarily due to the upregulation of oxytocin receptor MRNA levels and strong increase in the density of myometrial oxytocin receptors, reaching a peak during early labor [31, 53]. **Once spontaneous labor begins, the uterine sensitivity to oxytocin increases rapidly.** This physiologic mechanism makes oxytocin less effective as a cervical ripening agent [31].

Although oxytocin is an effective means of labor induction, in women with a favorable cervix, as noted earlier, it is less effective as a cervical ripening agent and commonly used in combination with other cervical ripening methods. It could also be used alone given the cervix is favorable [54].

Oxytocin protocols and mode of administration: Oxytocin is most often given intravenously and cannot be given orally because the polypeptide could be degraded to small, inactive forms by gastrointestinal enzymes. Its plasma half-life is short, estimated at 3–6 minutes, and steady-state concentrations are reached within 30–40 minutes of initiation or dose change.

It is generally diluted by placing 10 units in 1000 mL of an isotonic solution, such as normal saline, yielding an oxytocin concentration of 10 mU/mL. And given by infusion pump to allow continuous, precise control of the dose is administered [31, 32]. The dosage can be divided into high-dose and low-dose protocols depending on the initial dose and the amount and rate of sequential increase in dose [47, 52].

However, despite the frequent use of oxytocin in clinical practice, and suggestion of several experts for the implementation of a standardized protocol in oxytocin administration [47, 55]. There is little consensus regarding which protocol is most appropriate. And oxytocin protocols in induction of labor remain one of the challenges in the field of obstetrics. Protocols differ as to the initial dose, incremental time period, and steady-state dose [47].

Low-dose oxytocin protocols

- They mimic endogenous maternal physiology and are associated with lower rates of uterine tachsystole
- They are initiated at 0.5–1 mU and increased by 1 mU/min at 30- to 40-minute intervals.
- An alternative low dose begins at 1 to 2 mU/min that is increased by 2 mU/ min with shorter incremental time intervals of 15–30 minutes.

High-dose oxytocin protocols

- They often start with an initial oxytocin dose of 6 mU/min that is increased by 6 mU/min at 15- to 40-minute intervals or start at 4 mU/ min with 4 mU/min incremental increases every 15 minutes [31, 56].
- A maximum oxytocin dose has not been established, but most protocols do not exceed 42 mU/min [31].
- These regimens are largely used in active management of labor protocols and for labor augmentation, rather than for labor induction.

6.2 Mechanical and surgical methods

6.2.1 Stripping or sweeping of the fetal membranes

Stripping or sweeping of the fetal membranes refers to the digital separation of the chorioamniotic membrane from the wall of the cervix and lower uterine segment by inserting the examiner's finger beyond the internal cervical os and then rotating the finger circumferentially along the lower uterine segment [31]. Sweeping of the membranes is simple, safe procedure and could be used as both labor induction and cervix ripening method. It is thought to cause ripening of the cervix and eventually labor by inducing the release of endogenous prostaglandins from the membranes and decidua. It also triggers Ferguson reflex, which promotes oxytocin release from maternal pituitary. It is usually done prior to ARM as a preliminary step or could also be used as an isolated procedure for induction, provided the cervical score is favorable [38].

Compared with oxytocin induction, recent trial studies have suggested that membrane stripping increased the rate of spontaneous vaginal delivery and shortened the induction to delivery interval [57].

Giving the potential risks of membrane rupture and associated maternal and neonatal infection, undertaking membrane stripping should be carefully weighed before performing the procedure in known GBS carriers [58, 59].

Prerequisite for membrane stripping: In order to use membrane stripping for induction or as a cervical ripening agent, there are criteria that need to be fulfilled. These are:

a. The fetal head must be well applied to the cervix.

b. The cervix should be dilated so as to allow the introduction of the examiner's finger [38].

Advantage and limitation of membrane stripping

- It has low cost than other pharmacological methods [60].
- It has an increased risk of vaginal bleeding and discomfort during vaginal examination compared with expectant management.

6.2.2 Balloon devices: Foley Catheter

Another non-pharmacological option for labor induction is the insertion of balloon catheter, which includes the introduction of a single or a double balloon catheter under sterile technique into the intracervical canal past the internal os. The bulb is then inflated with 30–60 cc of water, and it applies pressure on the internal os of the cervix to stretch the lower uterine segment and increase the release of local PG [32].

The catheter is left in place until either it falls out spontaneously or 24 hours have elapsed. Some practitioners apply a small degree of traction on the catheter by taping it to the inside of the leg [61].

Limitation of balloon device

- The insertion of balloon devices is contradicted in the presence of low-lying placenta
- Its use is relative contraindicated in the presence of antepartum hemorrhage, rupture of membranes, and evidence of lower tract genital infection [32].

6.2.3 Artificial rupture of membranes (AROM)

Amniotomy, also known as artificial rupture of membranes (AROM), is the intentional rupture of this amniotic sac by an obstetrical provider. This procedure is common during labor management and has been performed by obstetrical providers for quite a long time. The principal reasons for artificial rupture of membranes are to ripen the cervix, induce or augment the labor process, and assist in the placement of internal fetal monitoring devices to provide the direct assessment of fetal status [32, 62–64].

Rupture of the membranes causes cervical ripening and labor onset by different mechanisms, which include stretching of the cervix, separation of the membranes (liberation of prostaglandins), and reduction of amniotic fluid volume.

The effectiveness of ARM depends on the state of the cervix, station of the presenting part, and use of other methods, with shorter induction delivery interval when amniotomy is combined with oxytocin than used singly [38].

Advantages of amniotomy

- High success rate
- Chance to observe the amniotic fluid for blood or meconium

- Access to use fetal scalp electrode or intrauterine pressure catheter or for fetal scalp blood sampling

- Furthermore, other than causing cervical ripening and inducing labor, artificial rupture of membranes has other immediate benefits [38], such as lowering of the blood pressure in preeclampsia and relief of maternal distress in hydramnios.

Limitations

- Once the procedure is adopted, there is no scope of retreating from the decision of delivery.

- It cannot be employed in closed cervix. The cervix should be at least one finger dilated.

Contraindications

Use of ARM for labor induction and cervical ripening is contraindicated in the presence of the following conditions:

- Closed cervix

- Presenting part not engaged: if the presenting part is not engaged doing ARM may increase the risk of cord prolapse.

- Intrauterine fetal death

- Complete placenta previa

- Transverse lie: it increases the risk of cord prolapse

- Breech presentation prior to full dilation

- Maternal AIDS and active genital herpes infection: to reduce the risk of mother-to-child transmission

- It is also preferably avoided in chronic hydramnios, as there is risk of sudden massive liquor drainage and uterine decompression that may lead to early placental separation. In such a case, if necessary, controlled ARM should be done.

Risks and Complications of ARM

The most common complication of artificial rupture of membranes is prolapse of the umbilical cord. This invariably occurs if artificial rupture of membranes is performed before the head is engaged in the maternal pelvis [38]. Additional ARM have the following risks and complications:

- Uncontrolled escape of amniotic fluid and placental abruption

- Injury to the cervix or the presenting part

- Rupture of vasa praevia leading to fetal blood loss

- Amnionitis
- Accidental injury to the placenta, cervix or uterus, fetal parts, or vasa previa
- Liquor amni embolism (rare).

6.3 Combined Methods

Having a lack of most established single effective method for inducing labor in the obstetrics literatures, combined methods have been implemented to increase the success rate of induction [65, 66]. Combined method could be using either more than one medical methods or medical methods with mechanical methods. The most commonly used combined methods for induction are the use of oxytocin infusion that could be started either prior to or following prostaglandins or rupture of the membranes depending mainly upon the state of the cervix and head brim relation [38]. The advantages of the combined methods are:

1. More effective than any single procedure
2. Shortens the induction-delivery interval and thereby minimizes
    - The risk of infection and
    - The period of observation.

Conflict of interest

The authors declare no conflict of interest.

Acronyms and abbreviations

APGAR	appearance, pulse, grace, activity, reflex
ARM	artificial rupture of membranes
CEMOC	comprehensive emergency obstetric care
CS	cesarean section
FIOL	failed induction of labor
ICU	intensive care unit
IOL	induction of labor
IUFD	intrauterine fetal death
IUGR	intrauterine growth restriction
NICU	neonatal intensive care unit
PG	prostaglandin
PIH	pregnancy-induced hypertension
PPH	postpartum hemorrhage
PPROM	preterm premature rupture of the membranes
PROM	premature rupture of the membranes
SDG	sustainable development goal

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