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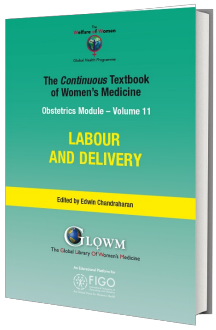

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Chapter

Induction and Augmentation of Labor

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INTRODUCTION

Induction of labor is defined as the artificial process of initiating labor before spontaneous onset, using mechanical or pharmacological methods. Augmentation of labor, however, is the stimulation of uterine contractions once the woman has spontaneously initiated labor, but the progress is considered inadequate.

The rates of induction of labor have been progressively increasing over past decades, especially in developed countries. This is the result of better diagnostic tools and understanding of maternal and fetal medical complications. There is still a significant difference in the rates of induction of labor between countries. From the highest rates observed in Asian and Latin American countries (highest Sri Lanka 35.5%)[1] to the lowest in African countries (Niger 1.4%) going through intermediary rates in developed countries such as the UK and USA (20 and 22%, respectively).[2,3]

INDICATIONS AND CONTRAINDICATIONS

As a general rule, induction of labor is indicated when the benefits of delivery to the mother or the fetus outweigh the risks associated with induction of labor. That is to say that induction of labor is indicated when the continuation of pregnancy poses a risk to maternal and/or fetal health.

The most common reasons for induction of labor are postdate pregnancy and maternal disease such as hypertension/pre-eclampsia or gestational or pre-existing diabetes. However, more recently, the indications have been continuously increasing due to a better understanding of the pathophysiology and of maternal and fetal conditions such as intrahepatic cholestasis of pregnancy (ICP), fetal growth restriction and placental insufficiency. Furthermore, there has been an increase in the number of women with pre-existing chronic medical problems including maternal cardiac disease and autoimmune amongst others, who are now supported through pregnancy, but may previously have been advised to avoid pregnancy or even to terminate. The indications for induction of labor are summarized in Table 1.

Table 1 Indications for induction of labor.

- Post-dates pregnancy
- Pregnancy induced hypertension
- Pre-eclampsia
- Intrauterine growth restriction
- Diabetes/gestational diabetes
- Isoimmunization
- Maternal medical conditions (cardiac, renal disease, lupus)
- Intrahepatic cholestasis of pregnancy
- Oligohydramnios
- Chorioamnionitis
- Prelabor rupture of membranes
- Fetal structural defects
- Fetal demise

Maternal considerations when inducing labor are mostly the risk of failure of induction, the need for operative delivery and the length of the process requiring more analgesia and more medical intervention. One of the most important fetal considerations is that of prematurity. Despite the best attempts to postpone induction of labor until after term (>37 weeks), some clinical situations will require it earlier due to maternal (cardiac pre-existing condition, severe pre-eclampsia, severe intrahepatic cholestasis of pregnancy) or fetal reasons (fetal growth restriction with redistribution, fetal malformation). In these cases, it has to be clear that the benefits outweigh the risks as the fetuses will be at increased risk of neonatal complications including, but not limited to, respiratory distress syndrome, jaundice and feeding difficulties.

Maternal request induction of labor after 39 weeks (most commonly due to the discomfort of pregnancy or social reasons) is increasing and still controversial. These cases need to be discussed on a case-by-case basis considering the specific circumstances.

The main relative contraindications to induction of labor are previous cesarean section, breech presentation, grand multiparity, unstable lie, polyhydramnios, twin pregnancy and non-reassuring cardiotocography not requiring emergency delivery. In these cases, senior input with consideration to the specific clinical circumstances should be sought. Absolute contraindications are detailed in Table 2.

Table 2 Contraindications for induction of labor.

- Placenta previa
- Transverse fetal lie
- Umbilical cord prolapse
- Prior classical uterine incision
- Previous myomectomy breaching cavity
- Active genital herpes infection

ASSESSMENT OF THE CERVIX

The success of induction of labor is related to the state of the cervix prior to induction,[4] parity,[5,6] body mass index (BMI)[7] and position of the vertex (occipito-anterior higher success compared to occipito-posterior).[8]

In 1955, Bishop[9] described a method to assess the cervix in multiparous women prior to the start of induction of labor through a digital vaginal examination. The length of the cervix, consistency, position and dilatation are considered, and a score is given depending on each parameter. He concluded that a score of 9 or more resulted in a success rate of

induction of labor similar to that in women with spontaneous onset of labor. The Bishop score used currently is similar to the one described in the 1950s, but it is now applied to nulliparous women as well. Nulliparous women with a Bishop score of 3 or less have a 23-fold increased risk of induction of labor failure and multiparous women a 6-fold increase risk.[10]

Some studies[11,12] have evaluated the use of ultrasound to assess the cervix prior to induction, however, the last systematic review concluded that ultrasound assessment of cervical length was not an effective predictor of successful induction of labor.[13]

METHODS OF INDUCTION OF LABOR

It is strongly recommended that any process of induction starts with the ripening of the cervix. This is to achieve the softening and distensibility of the cervix to facilitate labor and delivery but does not necessarily involve the achievement of regular uterine contractions.

There are two methods of induction of labor:

1. **Mechanical methods**
   The main advantages of the mechanical methods are a low risk of inducing fetal heart rate (FHR) changes, uterine hyperstimulation and, allergic reactions, as well as easy storage as they do not require refrigeration. The disadvantage is the discomfort during insertion and the need for the cervix to be at least 1 cm dilated. These methods can be beneficial in cases where there is a higher risk of fetal compromise (i.e. fetal growth restriction) or uterine rupture (i.e. previous cesarean section, grand multiparity).
   a. **Membrane sweeping**
      It is performed via a digital vaginal examination and stripping the membranes from the lower uterine segment, by sweeping the finger through the internal os. This releases prostaglandins and it is mostly used to avoid formal induction of labor. In the UK, it is routinely offered from 40 weeks in the antenatal clinic to reduce the number of inductions required for post-term pregnancy.
   b. **Intracervical balloon**
      Several devices have been used such as the Cooks balloon and a Foley catheter. The catheter is introduced through the cervix into the uterine cavity and a balloon inflated with saline to apply pressure on the lower segment and the internal os. This can also lead to the release of prostaglandins. Some of the devices have a second balloon that is inflated in the vagina applying pressure on the external os.
      There is no consensus to recommend the routine use of these devices. A Cochrane review concluded that the use of this method resulted in similar rates of cesarean section as the use of prostaglandins or oxytocin with less risk of hyperstimulation.[14] WHO recommends its use in combination with oxytocin especially when prostaglandins are not available or are contraindicated.[1] However, NICE guidelines do not recommend its use routinely as there is insufficient evidence on their efficacy or the risk of neonatal infection.[2]
   c. **Laminaria tents**
      They can be natural or synthetic and are placed in the cervix where they dilate secondary to water absorption. They have been used routinely for pregnancy termination. There is little evidence of their use for third trimester induction of labor,[15] although they have recently has started to be used in the UK, so more evidence will become available in the near future.
2. **Pharmacological methods**
   a. **Prostaglandins**
      Dinoprostone (PGE_2) is the prostaglandin most commonly used for cervical ripening. The PGE_2 acts through three different mechanisms: it alters the extracellular matrix of the cervix, increases the activity of the smooth muscle in the uterus and, finally, it leads to gap junction formation necessary to coordinate the uterine contractions.
      There are different commercial devices available including a slow-release pessary containing 10 mg, a vaginal tablet containing 3 mg or a gel containing 1 or 2 mg of dinoprostone. The choice will depend on individual circumstances and risks. In cases where the risk of hyperstimulation is higher, the first choice will be the pessary as it can be removed if hyperstimulation occurs. In cases where there is a favorable cervix, it might be more appropriate to use a

tablet or gel as it will reduce the length of the induction process. NICE guidelines recommend the use of one cycle of PGE_2 tablets or gel followed by a second dose if labor is not established or the use of one slow-release pessary over 24 hours.[2]

A Cochrane review comparing the use of PGE_2 with placebo or other prostaglandins concluded that the use of PGE_2 probably increased the likelihood of vaginal delivery within 24 hours and whilst there was an increase in hyperstimulation, this did not affect the rate of cesarean section.[16] Another review in 2008 concluded that intracervical prostaglandins were effective compared to placebo but inferior when compared to intravaginal prostaglandins.[17]

b. **Oxytocin**

Oxytocin was first used by intravenous drip for labor induction back in 1948 by Theobald *et al*.[18] Later, in 1953, it was the first polypeptide synthesized by Du Vigneaud *et al*.[19] The half-life of oxytocin is 10–12 minutes. It has been shown that it takes 40 minutes to achieve a steady-state plasma concentration.[20] It is known that there is a variable response of the uterus to oxytocin but, in general, it is believed that the sensitivity increases with advanced gestational age. It is generally used as an intravenous infusion of a dilute solution (10 mU/ml). There are different regimens, it can be administered as a dilution of 10 IU in 500 ml of saline or a more concentrated regimen of 10 IU of oxytocin in 50 ml of saline. This dilution is especially recommended in patients that require fluid restriction (i.e. pre-eclampsia, renal disease). The dose is titrated and increased every 20–30 min until regular contractions are achieved (3–4 every 10 minutes).

Although there is consensus on the use of oxytocin for augmentation of labor, its use for induction of labor is still controversial. WHO recommends its use when prostaglandins are not available;[1] however, NICE guidelines do not support the use of oxytocin alone for induction unless in specific circumstances where there is a risk of hyperstimulation.[2]

The most common complication with the use of oxytocin is hyperstimulation. This can result in fetal compromise and hence, prior to the use of oxytocin, continuous fetal monitoring is required. If this occurs, the oxytocin infusion should be immediately reduced or stopped and routine measures for resuscitation should be initiated (position patient in left lateral decubitus).

A Cochrane review comparing the use of oxytocin alone for induction of labor compared with vaginal prostaglandins concluded that the latter probably increases the chances of vaginal delivery within 24 hours.[21]

c. **Misoprostol**

Misoprostol is a synthetic PGE_1 analog, in the form of a tablet that can be administered via oral, vaginal or rectal routes. It was initially used as a gastric protective agent, but it was found that it caused uterine contractions in early pregnancy. It is currently commercially available in the form of a 200 µg tablet.

A Cochrane review in 2010 of 121 trials concluded that in comparison with placebo, misoprostol achieved more vaginal deliveries within 24 hours. However, uterine hyperstimulation, was increased. In comparison with PGE_2 and oxytocin, misoprostol was associated with less need for epidural analgesia, more vaginal deliveries and more uterine hyperstimulation and meconium stained liquor. The need for subsequent oxytocin augmentation after induction with misoprostol was lower.[22]

There is no general consensus on the dose that should be used, although NICE guidelines recommend not to exceed 50 µg. The final general recommendations in view of the lack of evidence and the risks associated with the use of misoprostol, are that misoprostol should only be used in women undergoing induction of labor due to intrauterine fetal death or in the context of a trial.

INDUCTION OF LABOR IN SPECIFIC CIRCUMSTANCES

1. **Prolonged pregnancy**

Post-term pregnancy is the most common indication for induction of labor. It complicates 5–10% of all pregnancies and has been associated with maternal and fetal complications including higher risk of stillbirth (5 times higher at 43 weeks compared to 37 weeks), macrosomia leading to higher risk of operative delivery, shoulder dystocia and postpartum

hemorrhage, higher rates of meconium aspiration syndrome and birth injury.

NICE guidelines recommend induction of labor between 41 and 42 weeks' gestation. If the woman declines induction of labor at 42 weeks, at least twice weekly cardiotocography and ultrasound assessment should be offered.[2] Similarly, WHO recommends induction of labor after 41 weeks.[1]

2. **Prelabor rupture of membranes at term**

   About 6–19% of pregnancies at term will present with spontaneous rupture of membranes before the onset of labor. Induction of labor in this setting, reduces the risk of chorioamnionitis, endometritis and NICU admissions without increasing the rate of cesarean section.[23] NICE guidelines state that the risk of serious neonatal infection is 1% compared to 0.5% in women with intact membranes and that 60% of women with premature rupture of membranes (PROM) will go into labor spontaneously within 24 hours. The recommendation is to offer induction of labor after 24 hours of ruptured membranes if labor has not been established.[2] The method of induction can be either prostaglandins or oxytocin, although oxytocin is preferred if there are signs or higher risk of infection. In women with known group B streptococcus, immediate induction of labor should be offered following PROM at term.

3. **Hypertension/pre-eclampsia**

   The management of severe hypertensive disease is specific to the case. In general, provided there are no fetal concerns, the decision for delivery is dependent upon adequate control of blood pressure using multiagent oral therapy. The degree of control and decision for delivery will be a balance between the gestation and associated morbidity, versus the acute danger to maternal health.

   The management of more mild and usually late disease has greater consensus since the HYPITAT trial. [24] The recommendation that these women are offered delivery after 37 weeks is supported by NICE.[2] In doing so, there is an improvement in maternal outcome measured by a composite score.

4. **Intrauterine growth restriction**

   This indication has progressively become more frequent as the understanding of fetal growth and the tools to detect it improve. Large population studies have shown that fetal size is related to perinatal survival,[25] and that planned delivery at term is related to improved neonatal outcomes.[26] When opting for induction of labor, it is important to bear in mind that a fetus with growth restriction has less metabolic reserves and, therefore, is less capable of tolerating the stress posed by the induction process. Especially in fetuses with abnormal fetal Dopplers, a case-by-case analysis is required before taking a final decision to proceed with an induction as these fetuses have a higher likelihood of needing delivery by emergency cesarean section. Parity, gestational age, degree of redistribution, parents wishes and likelihood of a successful induction need to be carefully considered before deciding to proceed with an induction as opposed to an elective cesarean section.

5. **Vaginal birth after cesarean section**

   There are established data showing that patients with a previous cesarean section are at increased risk of uterine rupture during both induction with prostaglandins (2–3 times higher) and augmentation with oxytocin (1–2 times higher) compared to women with spontaneous onset of labor. These risks should be explained to patients and clearly documented before attempting a vaginal birth after cesarean section (VBAC). If the cervix is favorable, artificial rupture of membranes should be the method of choice to induce these women as it does not increase the risk of uterine rupture. Mechanical methods can also be considered as a first-line option in these cases. NICE guidelines recommend the use of prostaglandins for induction of labor in women with a previous cesarean section if the patient wishes to do so. However, there is absolute consensus that misoprostol should not be used as the risk of rupture is unacceptably high. The prostaglandin of choice should be a vaginal pessary of dinoprostone 10 mg as it is the safest pharmacological method in these cohort of women.

6. **Twin pregnancies**

   Twin pregnancies invariably require earlier delivery, even uncomplicated dichorionic-diamniotic twins, delivery is usually recommended between 37 and 38 weeks. There is very limited evidence on the use of PGE_2 and/or oxytocin for induction and augmentation of labor in twin pregnancies.

INDICATIONS FOR AUGMENTATION OF LABOR

Augmentation of labor is defined as the use of medical interventions to stimulate uterine contractions when the woman is in established labor but the progress is considered inadequate.

One of the main issues is the lack of consensus on the definition of adequate progress in active labor.

1. **Primary arrest**
   This is defined as a progression of <1 cm/h in multiparas and 0.5 cm/h in nulliparas during the active phase slope (between 3 and 7 cm of dilatation). About 80% of nulliparas and 90% of multiparas respond to augmentation with oxytocin at this stage, suggesting that poor uterine activity is an important factor on primary arrest, although there is always a degree of accumulative obstacles including malposition, deflexion and malrotation.
2. **Secondary arrest**
   It is defined as a slow or lack of progress between 7 and 10 cm dilatation. Even if full dilatation is eventually reached, there is an increased risk of difficult instrumental delivery in these women. Although in this type of arrest, mechanical problems have an important role, still 60% of nulliparas and 70% of multiparas respond to oxytocin augmentation. This is most likely due to the fact that adequate uterine contractions facilitate the correction of malposition, malrotation of deflexion.

METHODS

1. **Amniotomy**
   It is the artificial rupture of membranes and it is known to increase the uterine contractions, although the evidence is weak. Amniotomy is recommended prior to commencing oxytocin augmentation and can help detect meconium earlier.
2. **Oxytocin augmentation**
   It can be considered when lack of adequate contractions is identified as the main cause for lack or slow progress. However, if there is poor progress despite good uterine activity, consideration should be given to other possible causes such as malposition, deflexion and cephalopelvic disproportion. If any of these are identified, the risks of oxytocin augmentation should be carefully outweighed against the potential benefits.
   Oxytocin augmentation is contraindicated if there is abnormal fetal heart rate monitoring or other concerns such as maternal sepsis.

CONCLUSIONS

Induction of labor is becoming more frequent. In some cases, this earlier intervention has improved maternal and neonatal morbidity and mortality, such as when undertaken for pregnancy-induced hypertension and pre-eclampsia, growth restriction and intrahepatic cholestasis of pregnancy. The success rates have improved due to the use of prostaglandins and mechanical methods for cervical ripening prior to amniotomy and oxytocin infusion. Despite this, still around 20% of inductions fail and require a cesarean section. The process of induction of labor has some associated risks, the most common are uterine hyperstimulation and increased need for operative delivery and, much less frequently, uterine rupture. The indications and the benefits and risks should be discussed with the patient, and it is essential to involve them in the decision-making process. Appropriate analgesia and support should be provided to women undergoing induction of labor. Failed induction of labor does not necessarily warrant a cesarean section. Provided there are no maternal or fetal concerns, postponement and restarting the process after 24–48 hours should be considered in an attempt to achieve a vaginal birth.

PRACTICE RECOMMENDATIONS

1. Induction of labor should be offered to women with uncomplicated pregnancies from 41 weeks onwards

due to the increased risk of stillbirth.

2. **Induction of labor in preterm pregnancies (<37 weeks) should be carefully assessed and the benefits must to clearly outweigh the risks of prematurity.**
3. **Women should be informed of the indication for induction, the risks involved and the benefits. The process and the plan of management if induction fails should be explained.**
4. **Cervical ripening with prostaglandins or a mechanical agent is strongly recommended as it improves the success rates of induction.**
5. **The use of oxytocin for induction or augmentation requires continuous fetal heart rate monitoring due to the risk of hyperstimulation that can cause fetal compromise.**

CONFLICTS OF INTEREST

The authors of this chapter declare that they have no interests that conflict with the contents of the chapter.

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