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Chapter

Induction of Labour

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Abstract

Induction of labour is one of the common obstetric interventions in the world with varied incidence rates between developed and developing countries. It is generally employed by obstetricians and physicians managing pregnant women when the risk of continuing such pregnancy is far greater than delivery at that said point. A detailed evaluation and indications for induction of labour should be done for every single woman. Methods of induction of labour could be pharmacological, mechanical or both; taking care to reduce or eliminate complications associated with this intervention. Decision for induction of labour should involve the most senior member of the team with a woman centered approach to care. Induction of labour carries multiple risks and complications compared with spontaneous onset of uterine contractions with increase tendency of operative vaginal delivery and caesarean section.

Keywords: pre-inductive cervical state, induction of labour, onset of labour, postdate, augmentation, misoprostol

1. Introduction

Induction of Labour (IOL) is one of the common obstetric procedures and or intervention encountered in maternity unit(s) all over the world [1]. Usually, the risk of continued pregnancy is far more detrimental to the mother or her unborn baby or both [1, 2]. Therefore, a balance in favour delivery is anticipated and planned with the anticipating mother using a woman centered approach [3, 4]. Decision for induction of labour should be led by the most experienced obstetrician on ground in consultation with the team managing such pregnancy. IOL will set up a cascade of events cumulating to the delivery of the baby and automatically elevates that pregnancy state to high risk [2]. These processes are important that they are closely monitored to end point and beyond.

2. Epidemiology

The incidence of induction of labour varies between different settings and appears to be on the rise especially in developed countries. In the United States the rate of IOL is quoted to be approximately 30 percent [5]. While in the United Kingdom (UK) the recent maternity figures show an increase rate of 2.1% from the 29.4% in 2016–2017 to 31.6% in 2017–2018 [6] according to the Hospital Episode Statistics. This increase in induction rates in developed countries and particularly in the UK is attributed to improved diagnostic tools and better understanding of maternal medicine, advanced

maternal age, and socioeconomic class variation [7–9]. The incidence of induction in Africa has been found to be below 10 percent in most settings. In a recent cross-sectional study to assess the prevalence, outcome and associated factors among women delivered at public hospitals in Ethiopia, Lueth et al. [10] reported a prevalence of 9% and failed IOL was responsible for 3.3% increase in caesarean section rates. Vogel et al. [11] in a secondary analysis of data for World Health Organization (WHO) global survey on maternal and neonatal health found that the unmet needs of IOL were between 60% and 80% with an average rate of IOL of 4.4%. In resource-constrained settings there is less capacity due to inadequate facilities, lack of trained staff and limited centers where safe caesarean sections can be performed on a 24 h basis.

3. Definition of terms

In order to understand the concept of induction of labour, some key terms need to be clearly understood:

Induction of Labour (IOL): This refers to the artificial initiation of uterine contractions before their spontaneous onset at or beyond the age of viability with the sole aim of delivery of the fetoplacental unit where the benefit of pregnancy termination exceeds its prolongation [1, 2, 7, 10, 11].

Successful IOL: Is said to occur when vaginal delivery is achieved usually within 24–48 h [12].

Failed IOL: In recent National Institute for Health and Care Excellence (NICE) guideline, unsuccessful IOL is considered when once cycle of treatment has failed to initiate uterine contractions [13]. Some authors refer to failed induction as the inability to achieved adequate uterine contractions after 6–8 h of oxytocin administration and at ceiling doses for at least an hour [14]. It is important to understand that failed IOL should not always results in emergency caesarean section as studies have shown that considerable number of women will delivery beyond such set points [15].

Cervical ripening: Is the change of cervical physical and chemical (intrinsic) morphology as a result of realignment of collagen fibres and extracellular matrix from firm to a compliant structure with gradual softening, effacement and dilatation which increases the likelihood of vaginal delivery. It can be from a natural process, chemically or mechanically induced [12, 13, 16].

Tachysystole: Is said to occur when there are greater than 5 contractions in 10 min in a period of approximately 30 min. Uterine tachysystole is further subdivided into two categories: with or without fetal heart rate changes [13, 17–19]. This could be spontaneous or induced.

Hypertonus: When uterine contractions duration is more than 2 min without fetal heart rate changes. This is also considered as increase in uterine tonus, which is intrauterine pressure between contractions [13, 19].

Hyperstimulation: Refers to tachysystole or hypertonus with abnormal fetal heart rate changes. This term is largely abandoned, and it is replaced with tachysystole with fetal heart abnormalities. [13, 18].

4. Understanding onset of labour

Labour diagnosis is one of the most important clinical judgements in maternity care and is much more important to understand its onset. However, the mechanisms

involved in the onset of labour still remains blurred and why some women will reach postdate or post term without spontaneous onset of labour is elusive. Our narrow understanding of the mechanism of onset of labour makes IOL difficult [19]. Usually, a cascade of biochemical events heralds the onset of a complex well-regulated process that results in cervical ripening, occasional membrane rupture and high frequency myometrial contraction that result in the expulsion of the fetoplacental unit [20].

The mechanism of spontaneous onset of labour has a fetal, placental/fetal membranes and maternal components that contribute to its onset via series of paracrine/autocrine hormones. Uterine quiescence that is maintained throughout pregnancy is switched off by the withdrawal of the functional inhibitory effect of progesterone via progesterone receptor (PR). There is an increase unbalance ratio of progesterone receptor key isoforms with more expression of progesterone receptor A (PR-A) compared with progesterone receptor B (PR-B) that increases with advancing gestational age and might also inhibit the PR-B genes. The overwhelming increased ratio of PR-A to PR-B may promote transcription of contractile protein CX43 [20, 21] and increase gap junctions' formation in the myometrium [22]. Oxytocin receptors (OXTR) gradually increase with advancing gestational age which may directly increase intracellular calcium concentrations [23].

Prostaglandins (PG) play major roles in initiation and maintenance of uterine contraction via prostaglandin receptors. The prostaglandins that play major role in inducing myometrial contractility are prostaglandin E2 (PGE2) and prostaglandin F2α (PGF2α) which induces intracellular calcium by opening calcium gated channels. Spontaneous labour is also associated with sterile inflammation with increase infiltration of leucocytes and upregulation of inflammatory cytokines and chemokines, particularly interleukin 1B which increases expression of calcium transport protein. Though there are plethora of literatures toward the physiology of the onset of labour, its exact pathway remains elusive [20–23].

5. Indications and contraindications of IOL

The indication(s) for induction of labour should be weighed on the scale of clinical judgement to ascertain that the benefit(s) of delivery outweighs continuation or prolongation of such pregnancy. This decision should be taken seriously, and there should be shared decision between the managing clinicians and the woman as well as appropriate informed consent taken. Prior to informed consent there should be a dialogue on the primary indication for IOL and other contributory factors, risks and benefits, methods and rationale, and realistic expectations [24].

6. Preinduction cervical state

The Bishop's score is used to assess the pre-inductive state of the cervix and to forecast the favorability of the cervix to comply during IOL. IOL is highly likely to fail if it is embarked upon without a proper assessment of the woman and consideration of the bishop score. The cervix retains its firm rigidity throughout pregnancy. As the uterus enlarges, the cervix becomes softer and distensible in preparation for labour and delivery by ripening. Ripening is a complex series of biochemical processes that results in softening of the cervix, effacement, and dilation. This usually occurs prior to uterine contractions for both spontaneous and iatrogenic labour. The cervix is composed of fibroid connective tissue, collagen (type I, III predominately and a small amount of type IV), elastin, vasculature, fibroblast, and smooth muscle [25, 26].

Indications [13, 25]	Contraindications [13, 25]] confirmed
Post term >42 weeks	Maternal refusal
Late term pregnancy/postdate 41 0–41 6 weeks	Prior classical, De Lee or inverted T incision
Preeclampsia >37 weeks	Significant prior uterine surgery (e.g. full thickness
Eclampsia	myomectomy)
Chronic hypertension	Previous hysterotomy
Gestational hypertension >38 weeks	Two or more previous caesarean sections
Twin gestation	
• Uncomplicated dichorionic twin pregnancy > 38 weeks	Previous uterine rupture
• Uncomplicated monochorionic twin pregnancy > 36/37 weeks	Fetal malpresentation (e.g. transverse lie, footling
Diabetes in pregnancy or gestational diabetes	breech)
Alloimmune disease near term or at term	Placenta previa
IUGR	Vasa previa
IUFD	Cord presentation
Intrahepatic cholestasis of pregnancy	Active genital herpes
Prelabour rupture of membrane at term or near term	Invasive cervical cancer
Preterm Prelabour rupture of membrane with GBS colonisation	
Oligohydramnios	
Chorioamnionitis	
Significant but stable antepartum haemorrhage	
Obstetric Cholestasis	
Controversial	
Prior IUFD	Previous vesicovaginal fistula
Care giver or maternal request	Previous OASIS
Suspected fetal macrosomia	
One previous caesarean section	

Table 1.
Indication for induction of labour (Table 1).

Cervical remodelling is associated with increase vascularity, stromal and glandular hypertrophy. There is concomitant increase in inflammatory activities with production of cytokines which leads to the release of metalloproteases (2 and 9) that degrades cervical collagens. The extracellular matrix which is strengthened by proteoglycans is gradually reduced with an unbalanced increase in glycosaminoglycans. The remodelling of the cervix is associated with decreased cross-linkages between collagen helices which cumulates to increased compliance to softening, effacement, and dilation [26].

Various hormones are responsible for this complex interaction that leads to cervical ripening. Increase in cyclooxygenase −2 lead to rise in the level of local PGE2 and PGF2α. PGE2 will activate a series of reactions: increase dilatation of small vessels in the cervix, increase collagen degradation, increase in hyaluronic acid, increase chemotaxis for leucocytes and increase release of Interleukin −8. PGF2α stimulate an increase in glycosaminoglycans. The role of Nitric Oxide (NO) has been the focus on recent studies on its contribution to cervical ripening. Increased levels of induced Nitric Oxide Synthase (iNOS) activity by resident and migrating inflammatory cells is associated with cervical ripening by dramatic increase in NO. NO might play a role by increased activities of metalloproteases [27–29].

Dr. Edward Bishop in 1964 proposed a Prelabour scoring system to assess the likelihood of going into spontaneous labour [30]. It has now undergone several

Cervical features	Score			
	0	1	2	3
Cervical dilatation (cm)	0	1–2	3–4	>4
Length (cm)	>4	3–4	1–2	<1
Station of the presenting part (cm)	−3	−2	−1/0	+1/+2
Consistency	Firm	Average	Soft	—
Position	Posterior	Mid/Anterior	—	—

Table 2.
Modified Bishop's (Calder) score [31, 32] confirmed (Table 2).

modifications to assess the favourability prior to IOL. The score is an aggregate sum of the cervical dilatation, consistency, effacement, position and fetal station [31]. A total score of 6 and above is considered favourable and score below that is deemed unfavourable. The Calder Modification replaces cervical effacement with cervical length with a total score of 12 [31, 32]. In a retrospective study [33] done recently to closely look at the relationship between bishop score and successful induction, a higher bishop score (8–10) at the beginning of IOL is directly proportional to the higher rates of successful IOL compared with bishop score between 6 and 7. There is recent evidence to show that the cervical length assessment by transvaginal ultrasound appear to be superior to the bishop score, however this is not a routine practice [34].

7. IOL check list

An induction check list is good clinical practice to ensure women are properly prepared, improve IOL success and prevent complications. Every maternity setting should have an IOL check list tailored to meet their local standard. A check list should have the patient's biodata, informed consent, gestational age, indication for IOL, patient routine booking investigations, associated comorbidity, previous surgeries, and the bishop score. A recent ultrasound with estimated fetal weight - which also rules out any contraindication for vaginal delivery, an admission CTG and the method of cervical ripening and IOL with the responsible doctor's name and signature should be clearly documented [35].

8. Cervical ripening and IOL agents

Cervical ripening and induction agents can be group into pharmacological, mechanical and combination of both. While some agents are intended to ripen the cervix before initiation of induction of labour, majority will progress to initiate uterine contractions. See **Table 3**.

8.1 Prostaglandins

Prostaglandins have gained wide acceptance as a cervical ripening and induction agent over the decade and is now considered a preferred agent for both. However, they are said to be associated with a small risk for tachysystole and fetal heart rate changes [36]. Misoprostol—a synthetic prostaglandin E1 analogue—is heat stable and low cost

Pharmacological	Mechanical	Combination
Prostaglandins • Prostaglandin E2 (Dinoprostone) • Prostaglandin E1 (Misoprostol) Oxytocin	Transcervical catheters • Foley • Cook Extra-amniotic saline infusion Stripping membrane Laminaria Cervical hygroscopic dilators Extra-amniotic saline infusion	Transcervical catheter + Prostaglandins Transcervical catheter + Oxytocin

Table 3.
Cervical ripening and induction agents.

compared to Dinoprostone. This has seen its wide usage especially in low resource setting. Misoprostol availability is said to bring equity in the disparity of induction of labour between developed and resource constrained regions of the world and recently a low dose misoprostol preparation was approved for IOL in Nordic countries [37, 38]. The dosing and timing of misoprostol ranges 25–50 mcg every 2–6 h. However, in a study of balancing efficacy and safety, the minimum efficacious dose associated with less complication is 25 mcg [38], while the vaginal compared with the oral route appears to offer significant clinical advantage in successful vaginal delivery [39].

Dinoprostone is prostaglandin E2 that comes in two popular preparations as Cervidil, a control release hydrogel suppository 10 mg vaginal inserted every 12 h at 0.3 mg/h. and Prepidil administered as an intracervical gel of 0.5 mg/2.5 ml or 1 or 2 mg for intravaginal insertion every 4–6 h with a maximum of 3 doses in 24 h. Dinoprostone needs to be refrigerated and is relatively expensive for resource constrained settings [40, 41]. The International Federation of Obstetrics and Gynaecology (FIGO) recently established an expanded chart on the dosage of misoprostol in variety of Obstetric and Gynaecologic conditions in the light of new evidence and through expert contributions which has been endorsed by FIGO safe motherhood and newborn health committee (**Table 4**) [42].

8.2 Oxytocin

Oxytocin is a neuropeptide hormone produced by the hypothalamus via the paraventricular nuclei and stored in the posterior pituitary gland. It is secreted when triggered by labour, lactation, social interaction, and stressors. Oxytocin acts on the myometrium to induce uterine contractions via G-proteins with the subsequent release of intracellular calcium stores through a complex interplay on its activity on phospholipase C. Its potency is directly proportional with advancing gestational age when there are sufficient oxytocin receptors [43]. The synthetic oxytocin is a cyclic nonapeptide which is identical to the natural oxytocin obtained via chemical synthesis. Oxytocin acts within a minute of intravenous injection and 2–4 min via the intramuscular route. In a low dose infusion, it causes rhythmic uterine contractions with a repetitive pattern. It can cause sustained uterine contraction at high dose infusion. It reaches its steady state between 20 and 40 min during continuous infusion, and it is metabolised and cleared by the liver and kidneys with about 1 percent unchanged in the urine [43, 44].

Oxytocin might have plausible synergistic effect in cervical ripening, however its role as a cervical ripening agent is not well established [45]. There are still controversies on its optimal regimen for induction of labour with varied protocols in different settings. However, a low dose regimen initiated between 0.5 and 1 mU, and increased

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<13 weeks' gestation	13–26 weeks' gestation	>26 weeks' gestation[8]	Postpartum use
Pregnancy termination[a,b,1] 800μg sl every 3 hours *or* pv*/bucc every 3–12 hours (2–3 doses)	**Pregnancy termination**[1,5,6] 13–24 weeks: 400μg pv*/sl/bucc every 3 hours[a,e] 25–26 weeks: 200μg pv*/sl/bucc every 4 hours[f]	**Pregnancy termination**[1,5,9] 27–28 weeks: 200μg pv*/sl/bucc every 4 hours[f,g] >28 weeks: 100μg pv*/sl/bucc every 6 hours	**Postpartum hemorrhage (PPH) prophylaxis**[i,2,10] 600μg po (x1) *or* **PPH secondary prevention**[j,11] (approx. ≥350ml blood loss) 800μg sl (x1)
Missed abortion[c,2] 800μg pv* every 3 hours (x2) *or* 600μg sl every 3 hours (x2)	**Fetal death**[f,g,1,5,8] 200μg pv*/sl/bucc every 4–6 hours	**Fetal death**[2,9] 27–28 weeks: 100μg pv*/sl/bucc every 4 hours[f] >28 weeks: 25μg pv* every 6 hours *or* 25μg po every 2 hours[h]	**PPH treatment**[k,2,10] 800μg sl (x1)
Incomplete abortion[a,2,3,4] 600μg po (x1) *or* 400μg sl (x1) *or* 400–800μg pv* (x1)	**Inevitable abortion**[a,2,3,5,6,7] 200μg pv*/sl/bucc every 6 hours	**Induction of labor**[h,2,9] 25μg pv* every 6 hours *or* 25μg po every 2 hours	
Cervical preparation for surgical abortion[d] 400μg sl 1 hour before procedure *or* pv* 3 hours before procedure	**Cervical preparation for surgical abortion**[e] 13–19 weeks: 400μg pv 3–4 hours before procedure >19 weeks: needs to be combined with other modalities		

References
a WHO Clinical practice handbook for safe abortion, 2014
b von Hertzen et al. Lancet, 2007; Sheldon et al. 2016 FIAPAC abstract
c Genzell-Danielsson et al. IJGO, 2007
d Sääv et al. Human Reproduction, 2015; Kapp et al. Cochrane Database of Systematic Reviews, 2010
e Dabash et al. IJGO, 2015
f Perritt et al. Contraception, 2013
g Mark et al. IJGO, 2015
h WHO recommendations for induction of labour, 2011
i FIGO Guidelines: Prevention of PPH with misoprostol, 2012
j Raghavan et al. BJOG, 2015
k FIGO Guidelines: Treatment of PPH with misoprostol, 2012

Notes
1 If mifepristone is available (preferable), follow the regimen prescribed for mifepristone + misoprostol[b]
2 Included in the WHO Model List of Essential Medicines
3 For incomplete/inevitable abortion women should be treated based on their uterine size rather than last menstrual period (LMP) dating
4 Leave to take effect over 1–2 weeks unless excessive bleeding or infection
5 An additional dose can be offered if the placenta has not been expelled 30 minutes after fetal expulsion
6 Several studies limited dosing to 5 times; most women have complete expulsion before use of 5 doses, but other studies continued beyond 5 and achieved a higher total success rate with no safety issues
7 Including ruptured membranes where delivery indicated
8 Follow local protocol if previous cesarean or transmural uterine scar
9 If only 200μg tablets are available, smaller doses can be made by dissolving in water (see www.misoprostol.org)
10 Where oxytocin is not available or storage conditions are inadequate
11 Option for community based programs

Route of Administration
pv – vaginal administration
sl – sublingual (under the tongue)
po – oral
bucc – buccal (in the cheek)
* Avoid pv (vaginal route) if bleeding and/or signs of infection
Rectal route is not included as a recommended route because the pharmacokinetic profile is not associated with the best efficacy

Table 4.
FIGO misoprostol-only recommended regimens 2017 [42] confirmed.

by 1 mU/min every 30–40 min interval is preferred over high dose regimen of 4–6 mU [44].

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A. Dosage

The dose of oxytocin is calculated using the formula: 10 units of oxytocin in 1000 ml of normal saline or ringers' lactate is equivalent to 10,000 mU. Therefore, each ml (1 ml) of fluid mix is 10 mU. In 1000 ml give 6 ml/h (60 mU/h.)

Starting dose at 1 mU/min oxytocin infusion should be escalated at 30 min interval until adequate and strong contractions (3–4 lasting 40–50 s in 10 min) is established.

The 2 IU in 200 ml is recommended because it is cost effective with less water intoxication in resource constrained settings. Oxytocin dose of greater than 20 mU/min highlighted in red is to be administered only by a senior resident doctor or a specialist. Low dose oxytocin infusion should be administered by infusion pump, however in settings where there are no infusion pumps, a senior doctor should closely monitor the infusion at a rate of 10 drops/min in a diluent of concentration of 10 IU in 1000 ml escalated every 30 min maximum of 60 drops/min.

B. Preparation

1. Obtain informed consent for oxytocin induction and or augmentation of labour

2. Do a pre induction and or augmentation CTG before the onset of oxytocin

3. Continuous CTG is advised for all patients

4. Do haemoglobin and obtain blood for blood group and save serum

5. Do not administer oxytocin on a previous uterine scar except by a specialist instruction (such specialist should monitor the patient)

6. Clearly document the indication for oxytocin use in the labour care guide

7. Inform all the managing/incoming team/theatre staff/Anaesthetist

8. For induction of labour: use oxytocin only in patients with bishop score >6 and perform artificial rupture of membrane if the membranes are intact

9. Do not give oxytocin within 6 h of prostaglandin use

C. Monitoring

1. Continuous CTG

2. Escalate the dosage every 30 min after assessment of maternal condition, fetal condition, and uterine contraction

3. Maintain, reduce, or stop dose when adequate uterine contractions are achieved (3–4 contractions in 10 min lasting 40–50 s)

4. Use the labour care guide in monitoring all patients on oxytocin infusion

5. STOP oxytocin and give plain normal saline whenever there is uterine hyperactivity:

   a. Tachysystole

   b. Hypertonus

   c. Hyperstimulation

The woman should adopt a left lateral position.

Consider supplemental oxygen, especially when there are signs of maternal hypoxia or category III CTG changes characterised by absent baseline variability with any of the following: recurrent late decelerations, recurrent variable decelerations, bradycardia, or sinusoidal pattern. Consider delivery if fetal heart rate abnormality persists.

6. Fetal rate abnormality may be the earliest sign of uterine rupture especially in patients on oxytocin infusion

7. After 4 h, stop infusion to reassess if there is any benefit of further infusion

8.3 Transcervical catheters

The transcervical extra-amniotic catheters have been one of the oldest methods of cervical ripening and induction of labour [46]. The Foley catheter has a single balloon with a capacity between 30 and 80 ml that is inserted into the extra-amniotic space compared to the more recent Cook's catheter with double balloons with one inserted into the extra-amniotic space as the uterine balloon and another below the cervix as the vaginal balloon with capacity of 80 ml for both [47]. In a Cochrane data base of systematic review of 23 studies [48], there were no statistically significant difference in comparing Foley catheter and prostaglandins in achieving vaginal delivery within 24 h with similar incidence of caesarean section rates. However, the transcervical Foley's catheter had lower incidence of tachysystole and or fetal heart rate abnormalities [48].

In a randomised controlled trial comparing a 30 and 80 ml Foley catheter balloon for preinduction cervical ripening, 80 ml provided faster labour, more dilatation and decrease need for oxytocin [49]. However, no significant difference was found between 12- and 24-h duration in induction delivery interval [46]. Other additives like applying traction and weight to the catheter has demonstrated faster expulsion of the Foley without any effect on the induction delivery interval (**Figure 1**) [50].

A single transcervical Foley catheter without extra-amniotic saline has better patient satisfaction with less discomfort compared with the double balloon catheter and it is cost effective especially in resource constrained settings [51]. Recent evidence is suggesting that highly motivated women can use transcervical Foley balloon in an outpatient setting with no increase in morbidity and or adverse outcome [52].

One of the major concerns of transcervical balloon catheters is theoretical risk of infection. This risk has not been validated and the rates of puerperal and neonatal infection appear similar to other methods of induction [53–55].

Combination of mechanical and pharmacologic methods has been one of the recent advances in labour induction to increase efficiency and efficacy, reduce cost and reduce adverse effects of induction agents to the mother and her baby. The BIGIN trial was a randomised control trial that compared buccal versus vaginal misoprostol
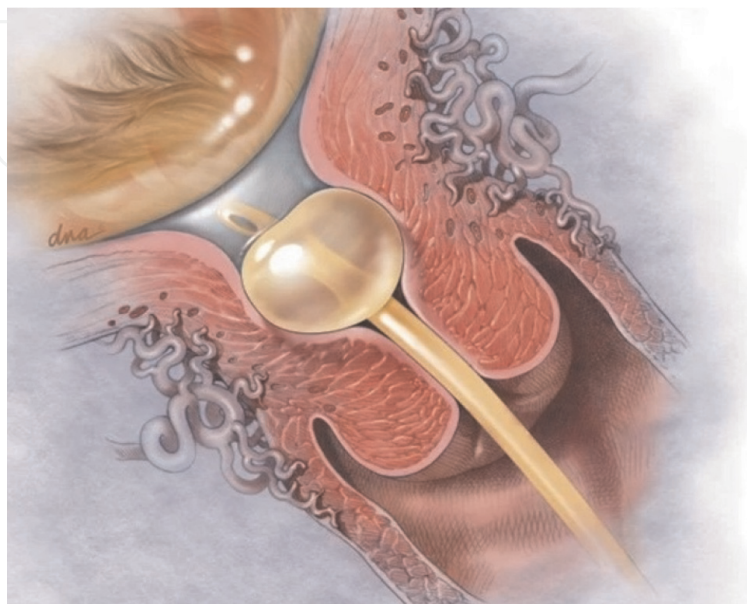

Figure 1.
Transcervical extra-amniotic Foley's catheter [46].

with Foley catheter. The vaginal misoprostol with Foley catheter resulted in a shorter induction delivery time with similar caesarean section rates, perinatal and maternal morbidity among both arms of the study. Therefore, vaginal misoprostol combination is recommended as the preferred method for combination method [56].

8.4 Stripping membrane

This is an old but reliable method of inducing cervical remodelling to comply with induction of labour. It is a mechanical method that involves a digital vaginal examination with the aim of placing one or two gloved fingers -usually the index and the middle - into the cervix and thereafter performing a circular sweeping motion. This is an artificial separation of the membrane that increases the activity of PGF2 and phospholipase which induces the complex cascade of cervical ripening [57]. In a recent Cochrane review [58], there is more likelihood to have spontaneous vaginal delivery among women who had their membranes swept. NICE guidelines on IOL recognised sweeping of membrane as an adjunct to formal induction [13]. Membrane sweeping can be offered to women from 39 weeks of gestation and thereafter additional membrane sweep could be offered at 40 and 41 weeks if there is no onset of spontaneous labour after the first membrane sweep [13]. There are concerns on the possibility of large doses of bacteria pushed above the internal os resulting in increased risk of maternal and fetal infection especially when there is a prolonged delay between membrane sweep and the onset of labour [57]. The role of cervical massage as an alternative method to membrane sweeping appears promising with significant effect on bishop score and can be considered as a reasonable option; especially if the cervical os is closed [59].

8.5 Laminaria and cervical hygroscopic dilators

Laminaria are dried seaweed stems (Laminaria japonica or Laminaria digitalis) that can be placed in the cervix to induce cervical ripening by absorbing water and expanding to cause cervical dilation and provoke endogenous prostaglandin release [60, 61]. Dilapan-S (MEDICEM, the Netherlands) is a sterile hygroscopic cervical dilator that has demonstrated no increased risk of infection like the laminaria tents. They are polymer rods which consist of the dilating part made of hydrogel and a polypropylene handle. An international observation study has revealed that Dilapan-S has not increased the risk of hyperstimulation and may be used in an outpatient setting [61, 62].

8.6 Artificial rupture of membranes (AROM)

Amniotomy can be used as an adjunct to induction of labour in a woman whose cervix is accessible and favourable. It is usually a prelude to oxytocin induction. However, in recent NICE guideline, it is not recommended as a sole method of induction with or without oxytocin except where prostaglandins are contraindicated [13, 61]. A recent randomised controlled trial has found that immediate oxytocin administration after AROM was not associated with shorter AROM to delivery time compared to delay of 4 h. Therefore, the decision to use any method should follow local protocols based on resources and maternal choice [63]. It is important to remember that there is a major risk of the cord prolapse with an unengaged presenting part.

Other methods of cervical ripening and induction of labour are yet to be clinically validated. Therefore, the use of mifepristone, acupuncture, homoeopathy, hypnotic relaxation, baths, enema, sexual intercourse, breast stimulation, intracervical hyaluronidase, relaxin, corticosteroids, and oestrogen need further research [64].

9. IOL in special clinical scenarios

Certain obstetric conditions occur more commonly, therefore a brief overview of IOL in these conditions are highlighted.

9.1 Prolonged pregnancy

Prolonged pregnancy is a loose term that applies to all pregnancy beyond estimated due date which comprises of postdate and post term pregnancy. It occurs in about 5–10% of all pregnancy and the rate is reduced to incidence of 2–5% with ultrasound dating in the first trimester. A better classification of term pregnancy underscores the importance of late term (41 0/7–41 6/7 and post term (42 0/7 and beyond) on uteroplacental insufficiency with increase perinatal morbidity and mortality. The risk of still birth, macrosomia, shoulder dystocia, birth injury, postpartum haemorrhage and meconium aspiration syndrome are higher at late term and post term compared with early term (37 0/7–38 6/7) and full term (39 0/7–40 6/7) [13, 65]. Therefore, NICE guidelines and WHO recommends IOL at 41 weeks and beyond. In the rare circumstances when the woman declines IOL beyond 42 weeks, she should have twice weekly CTG and ultrasound and be counselled based on findings [1, 13]. Neonatal outcome did not improve following IOL at 39 weeks compared with expectant management in a multicenter trial (ARRIVE) in the United States, however the rate of caesarean section was lower in the intervention arm [66].

9.2 Hypertensive disorders of pregnancy

Hypertension complicates about 10% of pregnancies and remains one of the major causes of perinatal and maternal morbidity and mortality [67, 68]. Preeclampsia is considered a severe form of hypertension in pregnancy with an incidence of 2–5% of all hypertensions in pregnancy. Early onset (<34 weeks) and preterm preeclampsia (<37 weeks) could present with severe disease to prompt immediate delivery [68]. Following the HYPITAT Trial I, women with gestational hypertension or preeclampsia at term should be offered delivery. While HYPITAT II trial, recommends that non severe hypertension between 34 and 37 weeks should be delivered at 37 weeks [69, 70].

9.3 Prelabour rupture of membrane

The rupture of amniotic sac before the onset of labour is termed as prelabour rupture of membrane which can occur before (preterm prelabour rupture of membrane) or after 37 weeks of gestation (term prelabour rupture of membrane) [71]. Preterm (24/0–36/6) prelabour rupture of membrane (PPROM) complicates about 3% of pregnancies and is responsible for about 30–40% of preterm births. The Royal College of Obstetricians and Gynaecologists recommend conservative management for uncomplicated PPROM to 37 weeks. Prelabour rupture of membrane should be

offered delivery after 37 weeks if it occurs and there is no onset of labour within 24 h or when PPROM is complicated by infection [72]. The induction method can either be by prostaglandin or oxytocin, however, the Bishop Score should be made favourable before such induction is embarked upon.

9.4 Hyperglycaemia in pregnancy

Hyperglycaemia is considered as one of the most common medical conditions in pregnancy with one in every 6 live births occurring in women with some degree of hyperglycaemia. Gestational Diabetes Mellitus is the most common type, and it is responsible for 84% of hyperglycaemia in pregnancy. There are higher incidences of perinatal and maternal morbidities and mortalities among pregnant women with any form of hyperglycaemia. A balance of glycaemic control and fetal maturity should be weighed to consider the timing of delivery. FIGO recommends delivery for women at 40–41 weeks for a well-controlled hyperglycaemia with fetal weight of <3800 g while delivery via induction is recommended at 38–39 weeks for poorly controlled hyperglycaemia with babies that are between 3800 and 4000 g. Elective caesarean section is the preferred delivery mode for babies weighing 4000 g and above [73].

9.5 IOL in previous caesarean section

The high rates of uterine rupture in patients with previous caesarean section is well established. There is a 2–3 times higher risk of uterine rupture in patient induced or augmented with previous caesarean section. This risk should be understood by both the physician preferably, a senior obstetrician, and the patient before undergoing induction or augmentation of labour in women with previous caesarean section. The risk of uterine rupture is lower with mechanical methods (Foley catheter and amniotomy) compared with prostaglandins [74].

10. Augmentation of labour (AOL)

Improving the efficiency of uterine contractions by increasing the frequency, duration, and intensity in women with inadequate or uncoordinated uterine contractions of spontaneous onset to reduce or prevent adverse outcome for the babies and their mother associated with prolonged labour is best describe as augmentation [75, 76]. The term AOL is loosely applied to women undergoing induction of labour, but this is a misnomer because contractions in induction of labour are not of spontaneous onset. The decision to augment the labour process should be carefully and meticulously evaluated after a thorough history and examination excluding any cephalopelvic disproportion and establishing that the cause of unsatisfactory progress of cervical dilatation and descent of the presenting part is solely the problems of power. Every local maternity setting should have a protocol of AOL using oxytocin infusion which is usually the same strength and frequency with induction protocol (see **Table 5**). Low dose oxytocin regimen is favoured because of less complications related to augmentation [76]. AROM can be considered as a sole method AOL because it enhances uterine contractions by increasing plasma prostaglandins, however the effectiveness of AROM appears to be debatable [77, 78].

Prior to preforming AROM, an informed consent is necessary, and patient should be informed of the benefits of AROM and the possible complications therein and the

Oxytocin regimens					
Time from start (min)	Oxytocin dose (mU/min)	Volume of infusion (ml/h)			
		10 IU in 500 ml	10 IU in 1000 ml	2 IU in 200 ml	10 IU in 1000 ml Without infusion set
0	1	3	6	6	10 drops
30	2	6	12	12	20 drops
60	4	12	24	24	30 drops
90	8	24	48	48	40 drops
120	12	36	72	72	50 drops
150	16	48	96	96	60 drops
180	20	60	120	120	
210	24	72	144	144	
240	28	84	168	168	
270	32	96	192	192	

Oxytocin dose of greater than 20 mU/min highlighted in red can only be administer by a specialist or a senior resident doctor.

Table 5.
Low dose oxytocin infusion for induction and augmentation of labour. Version (1.0) 2021.

fetal heart rate is checked. AROM can be performed with an Amniotomy finger cot (Amnicot) or Amniotomy hook (AmniHook) or a spinal needle for control release of amniotic fluid. The woman adopts a supine position and flexes her hips and knees (frog legged), or it can be done in the lithotomy position. A sterile glove finger is introduced using the dominant hand to performed vaginal examination and noting the cervical dilatation, effacement, position, station and to exclude cord presentation and possible vasa previa is noted. During the vaginal examination the amniotic perforator can be introduced with the non-dominant hand and the tip of the amniotomy hook is pushed against the sac with the index and middle finger guiding it and pull back. With successful rupture of membrane, the examining fingers should be held back to exclude cord prolapse and the amniotic fluid should be assessed for volume, colour, smell or particle within. It is good practice to recheck fetal heart and observe the woman closely for any vaginal bleeding [75, 76, 79]. For control release with spinal needle a bivalved speculum is required.

11. Complications of IOL and AOL

Artificial contractions are said to be more painful than spontaneous ones, more so the intensity and the duration might be more exaggerated than natural contractions. Therefore, the rates of complications associated with artificial uterine contractions are multiple folds compared with contractions from spontaneous onset [13]. The complications of IOL and AOL could range from tachysystole, hypertonus or an outright tachysystole with fetal heart rate abnormalities, placenta abruption or uterine rupture [80, 81] which occur in about 1–5% of women undergoing IOL. It is estimated that

IOL could fail in 15% of patient with unfavourable cervix [81]. Both IOL and AOL could result in cord prolapse following AROM. There is a tendency of increasing the risk of infection, operative vaginal delivery and increased caesarean section rate [80] in women undergoing IOL. Poor childbirth experience was encountered in about 4.5% of patient undergoing IOL in a recent study to assess maternal childbirth experience [82]. The risk of primary post-partum haemorrhage in patients undergoing IOL is well documented [83]. Fetal complications can be in the form of fetal distress, meconium stained liquor and neonatal jaundice. Litigation from the abuse of oxytocin has been enormous in the past decade globally [84].

12. Conclusion

There is an increased rate of IOL especially across developed countries, however the unmet need for IOL in developing countries is bridged by the availability of misoprostol and Foley's catheter at cost effective rates. Timely and appropriate IOL can lead to reduction in perinatal and maternal morbidity and mortality. Therefore, there is need for obstetricians and physicians that provide care in women's health to keep abreast with the best external available evidence on the subject matter. It is important to employ the concept of respectful maternity in the pre-induction, induction, and post induction phase to improve outcomes, reduce litigations and enhance women satisfaction. A diagnosis of failed induction does not translate to automatic caesarean section if the fetal and maternal conditions are adjudged to be normal and stable; a pause and restart can be initiated after 24–48 h with lower threshold for intervention in the second cycle.

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References

[1] World Health Organization (WHO). Recommendations: Induction of Labour at or Beyond Term. Geneva: World Health Organization; 2018 http://apps.who.int/iris/bitstream/handle/10665/44531/9789241501156_eng.pdf?sequence=1

[2] Marconi AM. Recent advances in the induction of labor. F1000Research. 2019;**8**(F1000 Faculty Rev):1829. DOI: 10.12688/f1000research.17587.1

[3] World Health Organization (WHO). Recommendations: Intrapartum Care for a Positive Childbirth Experience. Geneva: World Health Organization; 2018 Licence: CC BY-NC-SA 3.0 IGO

[4] Akuamoah-Boateng J, Spencer R. Woman-centered care: Women's experiences and perceptions of induction of labor for uncomplicated post-term pregnancy: A systematic review of qualitative evidence. Midwifery. 2018;**67**:46-56. DOI: 10.1016/j.midw.2018.08.018 Epub 5 September 2018. PMID: 30232052

[5] Gomez HB, Hoffman MK, Caplan R, Ruhsta K, Young MHH, Sciscione DOAC. Buccal vs vaginal misoprostol combined with Foley catheter for cervical ripening at term (the BIGIN trial): A randomized controlled trial. American Journal of Obstetrics and Gynecology. 2021;**224**(524):e1-e8

[6] National Health Service. Rise in proportion of induced labours, new maternity figure shows. 2018. NHS Maternity statistics 2017-2018. Published on 25 October 2081 by NHS Digital. https://digital.nhs.uk/news/2018/nhs-maternity-statistics-2017-18

[7] Carter S, Channon A, Berrington. Socioeconomic risk factors for labour induction in the United Kingdom. BMC Pregnancy and Childbirth. 2020;**20**(146). DOI: 10.1186/s12884-020-2840-3

[8] Wilson BL. Assessing the effects of age, gestation, socioeconomic status, and ethnicity on labor inductions. Journal of Nursing Scholarship. 2007;**39**:208-213

[9] Rydahl E, Declercq E, Juhl M, Maimburg RD. Routine induction in late-term pregnancies: follow-up of a Danish induction of labour paradigm. BMJ Open. 2019;**9**:e032815. DOI: 10.1136/bmjopen-2019-032815 https://bmjopen.bmj.com/content/9/12/e032815

[10] Lueth GD, Kebede A, Medhanyie AA. Prevalence, outcomes and associated factors of labour induction among women delivered at public hospitals at MEKELLE town-(a hospital based cross sectional study). BMC Pregnancy and Childbirth. 2020;**20**:203. DOI: 10.1186/s12884-020-02862-7

[11] Vogel JP, Souza JP, Gulmezoglu AM. Patterns and outcomes of induction of labour in Africa and Asia: A secondary analysis of the WHO global survey on maternal and neonatal health. PLoS One. 2013;**8**(6):11. https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0065612&type=printable

[12] Society of Obstetrician and Gynaecology of Canada (SOGC). Induction of labour. SOGC Clinical Practice Guideline. No 296. Journal of Obstetrics and Gynaecology Canada. 2013;**35**(9):840-857

[13] National Institute for Health and Care Excellence (NICE). Inducing Labour. 2021. www.nice.org.uk/guidance/ng207

[14] Melkie A, Addisu D, Mekie M, Dagnew E. Failed inductionmof labour and its associated factors in Ethopia: A systematic review and metaanlysis. Heilyon. 2021:7(3);e06415. https://www.cell.com/heliyon/pdf/S2405-8440(21)00520-X.pdf

[15] Banos N, Migliorelli F, Posadas E, Ferreri J, Palacio M. Definition of failed induction of labour and its predictive factors: Two unsolved issues of everyday clinical situation. Fetal Diagnosis and Therapy. 2015;**38**:161-169. DOI: 10.1159/000433429

[16] Pierce S, Bakker R, Myers DA, Edwards RK. Clinical insight for cervical ripening and labour induction using prostaglandins. The American Journal of Perinatology. 2018;**8**:e307-e314

[17] Macones GA, Hankins GD, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development workshop report on electronic fetal monitoring: Update on definitions, interpretation, and research guidelines. Obstetrics and Gynecology. 2008;**112**:661-666

[18] Sukumaran S, Jia YJ, Chandraharan E. Uterine tachysystole, hypertonus and hyperstimulation: An urgent need to get the definitions right to avoid intrapartum hypoxic-ischaemic brain injury. Global Journal of Reproductive Medicine. 2021;**8**(2):5556735. DOI: 10.19080/GJORM.2021.08.5556735

[19] Mealing NM, Roberts CL, Ford JB, Simpson JM, Morris JM. Trends in induction of labour, 1998–2007: A population-based study. The Australian and New Zealand Journal of Obstetrics and Gynaecology. 2009;**49**:599-605

[20] Nguyen-Ngo C, Lappas M. Mechanism of normal labour. Current Opinion in Physiology. 2020;**13**:27-32. DOI: 10.1016/j.cophys.2019.09.008

[21] Nadeem L, Shynlova O, Matysiak-Zablocki E, Mesiano S, Dong X, Lye S. Molecular evidence of functional progesterone withdrawal in human myometrium. Nature Communications. 2016;7:11565. DOI: 10.1038/ncomms11565

[22] Nadeem L, Shynlova O, Mesiano S, Lye S. Progesterone via its type-A receptor promotes myometrial gap junction coupling. Scientific Reports. 2017;7:13357. DOI: 10.1038/s41598-017-13488-9

[23] Shmigol AV, Eisner DA, Wray S. Simultaneous measurements of changes in sarcoplasmic reticulum and cytosolic. The Journal of Physiology. 2001;**531**:707-713. DOI: 10.1111/j.1469-7793.2001.0707h.x

[24] New Zealand College of Midwives. Helping Women Make Decisions about Induction of Labour. https://www.midwife.org.nz/wp-content/uploads/2020/01/ARRIVE-Infographic-amended.pdf.

[25] The Federation of Obstetricians and Gynaecologist of India, Indian College of Obstetrician and Gynaecologist (FOGSI-ICOG). Induction of Labour: Good Clinical Practice Recommendation. 2018. https://www.fogsi.org/wp-content/uploads/2018/09/XGCPR-IOL-26July.pdf.

[26] Bishop EH. Pelvic scoring for elective induction of elective induction. Obstetrics and Gynecology. 1988;**24**:266-268

[27] Leppert PC. Anatomy and physiology of cervical ripening. Clinical Obstetrics and Gynecology. 1995;**38**(2):267-279. DOI: 10.1097/00003081-199506000-00009 PMID: 7554594

[28] Schmitz T, Fuchs F, Closset E, et al. Outpatient cervical ripening by nitric oxide donors for prolonged pregnancy: A randomized controlled trial. Obstetrics and Gynecology. 2014;**124**(6):1089-1097

[29] Promsonthi P, Preechapornprasert D, Chanrachakul B. Nitric oxide donors for cervical ripening in first-trimester surgical abortion. Cochrane Database Syst Rev. 2011;**7**(12):CD007444. DOI: 10.1002/14651858.CD007444.pub3

[30] Bishop EH. Pelvic Scoring for Elective Induction. International Journal of Gynecology & Obstetrics. 1964;**24**: 266-8

[31] Calder AA, Embrey MP, Hillier K. Extra-amniotic prostaglandin E2 for induction of labour at term. The Journal of Obstetrics and Gynaecology of the British Commonwealth. 1974;**81**:39-46

[32] Galzie SK, Rao SB. Cervical effacement, as an independent parameter versus modified bishop score, for predicting the favourability of vaginal delivery in a primigravida at 40 weeks of gestation and beyond. Iternational Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2020;**9**(5):1-7

[33] Ikeotuonye AC, Anikwe CC, Obuna JA, Okorochukwu BC, Eijkeme BN, Ifemelumma CC, et al. Relationship between Bishop score and success of induction of labour in Federal Teaching Hospital, Abakaliki, Ebonyi state. Open Journal of Obstetrics and Gynecology. 2018;**8**:980-992. DOI: 10.4236/ojog.2018.811099

[34] Kehila M, Bougmiza I, Ben Hmid R, Abdelfatteh W, Mahjoub S, Channoufi MB. Bishop score vs ultrasound cervical length in the preinduction of cervical ripening success and vaginal delivery in nulliparous

women. Minerva Ginecologica. 2015; **67**(6):499-505

[35] American College of Obstetricians and Gynaecologists (ACOG). ACOG Patient Safety Checklist No 2. Inpatient Induction of Labor Committee Opinion, No.560, 2013; December 2011, reaffirmed 2014, Available from: https://obgynriskalliance.com/globalassets/ob-gyn-tool-kit/acog-patient-safety-checklists/acog-patient-safety-checklist-inpatient-induction-of-labor.pdf

[36] Thomas J, Fairclough A, Kavanagh J, Kelly AJ. Vaginal prostaglandin (PGE2 and PGF2a) for induction of labour at term. Cochrane Database of Systematic Reviews. 2014;**6**:CD003101

[37] Kwawukume EY, Ayertey RP. Misoprostol for induction of labour in a low-resource setting. Tropical Journal of Obstetrics and Gynaecology. 2002;**19**(2): 78-81

[38] Helmig RB, Hildman LE. An audit of oral administration of Angusta® (misoprostol) 25 µg for induction of labor in 976 consecutive women with a singleton pregnancy in a university hospital in Denmark. Acta Obstetricia et Gynecologica Scandinavica. 2020;**99**: 1396-1402

[39] DebBarma AM, Baidya JL, Ray D. A comparative study of misoprostol oral versus vaginal route for induction of labour. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2020;**9**(5): 1907-1913

[40] Tseng J-Y, Lin I-C, Chang W-H, Yeh C-C, Horng H-C, Wang PH. Using dinoprostone vaginal insert for induction of labor: A single institute experience. Taiwanese Journal of Obstetrics & Gynecology. 2020;**59**:723-727

[41] Reinhard J, Rosler R, Yuan J, Schiermeier S, Herrmann E, Eichbaum MH, et al. Prostaglandin E2 labour induction with intravaginal (Minprostin) versus intracervical (Prepidil) administration at term: Randomized study of maternal and neonatal outcome and patient's perception using the Osgood semantic differential scales. BioMed Research International. 2014;**2014**:682919. DOI: 10.1155/2014/682919

[42] Morris JL, Winikoff B, Dabash R, Weeks A, Faundes A, Gemzell-Danielson K, et al. FIGO updated recommendation for misoprostol used alone in gynecology and obstetrics. International Journal of Gynecology & Obstetrics. 2017; **138**: 363-366

[43] Baranowska B, Kajdy A, Kiersnowska I, et al. Oxytocin administration for induction and augmentation of labour in polish maternity units—An observational study. BMC Pregnancy and Childbirth. 2021:**21**: 764. DOI: 10.1186/s12884-021-04190-w

[44] Kenyon S, Tokumasu H, Dowswell T, Pledge D, Mori R. High-dose versus low-dose oxytocin for augmentation of delayed labour. Cochrane pregnancy and childbirth group, editor. Cochrane Database of Systematic Reviews [Internet]. 2013;**13** [cited 13 February 2021]; Available from: http://dpo.wiley.com/10.1002/14651858. CD007201.pub3

[45] Ferguson JE II, Head BH, Frank FH, Singer JS, Stefos T, Mari G. Misoprostol versus low-dose oxytocin for cervical ripening: A prospective, randomized, double-mask trial. American Journal of Obstetrics and Gynecology. 2002;**187**(2): 273-280

[46] Esakoff TF, Kilpatrick SJ. The transcervical foley balloon.

Contemporary obstetrics and gynaecology. 2013. https://www.contemporaryobgyn.net/view/transcervical-foley-balloon

[47] Liu X, Wang Y, Zhang F, et al. Double-versus single-balloon catheters for labour induction and cervical ripening: A meta-analysis. BMC Pregnancy and Childbirth. 2019;**19**:358. DOI: 10.1186/s12884-019-2491-4

[48] Jozwiak M, Bloemenkamp KW, Kelly AJ, Mol BW, Irion O, Boulvain M. Mechanical methods for induction of labour. The Cochrane Database of Systematic Reviews. 2012;**14**(3): CD001233. DOI: 10.1002/14651858. CD001233.pub2. PMID: 22419277

[49] Levy R, Kanengiser B, Furman B, Arie AB, Brown D, Hagay ZJ. A randomized trial comparing a 30 ml and an 80 ml Foley catheter balloon for preinduction cervical ripening. American Journal of Obstetrics and Gynecology. 2004;**191**(5):1632-1636

[50] Cherian AG, Marcus TA, Sebastine T, Rathore S, Mathews JE. Induction of labour using Foley catheter with weight attached versus without weight attached: A randomized control trial. The International Journal of Gynecology. 2022;**157**(1):159-164

[51] Pennell CE, Henderson JJ, O'Neill MJ, McChlery S, Doherty DA, Dickinson JE. Induction of labour in nulliparous women with an unfavourable cervix; a randomized controlled trial comparing double and single balloon catheters and PGE2 gel. BJOG : An International Journal of Obstetrics and Gynaecology. 2009;**116**(11): 1443-1452

[52] Sciscione AC, Muench M, Pollock M, Jenkins TM, Tildon-Burton J, Colmorgen GHC. Transcervical Foley catheter for preinduction cervical

ripening in an outpatient versus inpatient setting. Obstetrics and Gynecology. 2001;**98**(5.1):751-756

[53] Sullivan CA, Benton LW, Roach H, Smith LG Jr, Martin RW, Morrison JC. Combining medical and mechanical methods of cervical ripening. Does it increase the likelihood of successful induction of labor? The Journal of Reproductive Medicine. 1996;**41**(11): 823-828

[54] Dalui R, Suri V, Ray P, Gupta I. Comparison of extraamniotic Foley catheter and intracervical prostaglandin E gel for preinduction cervical ripening. Acta Obstetricia et Gynecologica Scandinavica. 2005;**84**(4):362-367

[55] Moraes Filho OB, Albuquerque RM, Cecatti JG. A randomized controlled trial comparing vaginal misoprostol versus Foley catheter plus oxytocin for labor induction. Acta Obstetricia et Gynecologica Scandinavica. 2010;**89**(8): 1045-1052

[56] Gomez HB, Hoffman MK, Caplan R, Ruhstaller K, Young MHH, Sciscione AC. Buccal vs vaginal misoprostol combined with Foley catheter for cervical ripening at term: A randomized controlled trial. American Journal of Obstetrics and Gynecology. 2021;**224**(524):e1-e8

[57] Sukumaran S, Chandraharan E. The historical practice of "membrane sweep" to initiate labour: Does it have a role in contemporary obstetric practice? Global Journal of Reproductive Medicine. 2021;**8**(2):5556733. DOI: 10.19080/GJORM.2021.08.5556733

[58] Finucane EM, Murphy DJ, Biesty LM, Gyte GML, Cotter AM, et al. Membrane sweeping for induction of6labour. Cochrane Database of Systematic Reviews. 2020;**2**(1): CD000451

[59] Yaddehige SS, Kalansooriya HD, Rameez MFM. Comparison of cervical massage with membrane sweeping for pre-induction cervical ripening at term: A randomized control trial. Sri Lanka Journal of Obstetrics and Gynaecology. 2019;**41**:66-74. DOI: 10.4038/sljog. v41i3.7883

[60] Jeeva MA, Dommisse J. Laminaria tents or vaginal prostaglandins for cervical ripening: A comparative trial. South African Medical Journal. 1982;**61**: 402-403

[61] Chodankar R, Sood A, Gupta J. An overview of the past, current and future trends for cervical ripening in induction of labour. The Obstetrician and Gynaecologist. 2017;**19**:219-226. DOI: 10.1111/tog.12395

[62] ClinicalTrials.gov. Dilapan-S/ Dilasoft E-Registry in Induction of Labor (DSREGISTRYIL) https://clinical trials.gov/ct2/show/NCT02318173

[63] Tan PC, Soe MZ, Sulaiman S, Omar SZ. Immediate compared with delayed oxytocin after amniotomy labor induction in parous women: A randomized controlled trial. Obstetrics and Gynecology. 2013;**121**:253-259

[64] Mozurkewich EL, Chilimigras JL, Berman DR, Perni UC, Romero VC, Valerie JK, et al. Methods of induction of labour: A systematic review. BMC Pregnancy and Childbirth. 2011;**11**:84 http://www.biomedcentral.com/1471-2393/11/84

[65] Hellmeyer L, Bahlman F, Janku P, Zahumensky J, Baev O, Saad A, Murthy A. ClinicalTrials.gov. Dilapan-S/Dilasoft E-Registry in Induction of Labor (DSREGISTRYIL). https://clinicaltrials.g ov/ct2/show/NCT02318173

[66] Grobman WA, Rice MM, Reddy UM, Tita AT, Silver RM, Mallett G, et al. Labor induction versus expectant management in low-risk nulliparous women. The New England Journal of Medicine. 2018;**379**: 513-523

[67] National Institute for Health and Care Excellence (NICE). Hypertension in pregnancy: diagnosis and management. NICE guideline [NG133]. 2019 www.nice.org.uk/guidance/ng133

[68] Poon LC, Shennan A, Hyett JA, Kapur A. Hadar E, Divakar H et al. The International Federation of Gynecology and Obstetrics (FIGO) initiative on pre-eclampsia: A pragmatic guide for first-trimester screening and prevention. International Journal of Gynaecology and Obstetrics 2019;**145**(Suppl. 1):1-33

[69] Koopmans CM, Bijlenga D, Groen H, MC Vijgen S, Aarnoudse JG, Bekedem DJ et al. HYPITAT study group. Induction of labour versus expectant monitoring for gestational hypertension or mild pre-eclampsia after 36 weeks' gestation (HYPITAT): A multicentre, open-label randomised controlled trial. Lancet 2009;**374**(9694):979-988

[70] Broekhuijsen K, van Baaren G-J, van Pampus MG, Ganzevoort W, Sikkema JM, Woiski M, et al. Immediate delivery versus expectant monitoring for hypertensive disorders of pregnancy between 34 and 37 weeks of gestation (HYPITAT II): An open -label, randomized controlled trial. Lancet. 2015;**385**(9986):2492-2501

[71] Tiruye G, Shiferaw K, Tura AK, Debella A, Musa A. Prevalence of premature rupture of membrane and its associated factors among pregnant women in Ethiopia: A systematic review and meta-analysis. SAGE Open Medicine. 2021;**9**:1-9

[72] Thomson AJ, On behalf of the Royal College of Obstetricians and Gynaecologists. Care of Women Presenting with suspected preterm prelabour rupture of membranes from 24+0 weeks of gestation. BJOG. 2019; **126**:e152-e166

[73] Hod M, Kapur A, Sacks DA, Hadar E, Agarwal M, Di Renzo GC. The International Federation of Gynecology and Obstetrics (FIGO) initiative on gestational diabetes mellitus: A pragmatic guide for diagnosis, management, and care. International Journal of Gynecology & Obstetrics. 2015;**131**:S173-S211

[74] Royal College of Obstetricians and Gynaecologists. Green-top guideline No. 45 Birth after previous caesarean section. October 2015 London: RCOG; Available at: www.rcog.org.uk

[75] Nabhan A, Boulvain M. Augmentation of labour. Best Practice. 2020;**67**:80-89

[76] World Health Organization (WHO). WHO recommendation for augmentation of labour. 2014. https://apps.who.int/iris/bitstream/10665/112825/1/9789241507363_eng.pdf

[77] Mitchell MD, Flint AP, Bibby J, Brunt J, Arnold JM, Anderson AB. Rapid increases in plasma prostaglandin concentrations after vaginal examination and amniotomy. British Medical Journal. 1977;**2**(6096):1183-1185

[78] Wei S, Wo BL, Qi HP, Xu H, Luo ZC, Roy C, Fraser WD. Early amniotomy and early oxytocin for prevention of, or therapy for, delay in first stage spontaneous labour compared with routine care. Cochrane Database Syst Rev. 2012;9(9):CD006794. DOI: 10.1002/14651858.CD006794.pub3

[79] Mahdy H, Glowacki C, Eruo FU. Amniotomy. [Updated 25 August 2021]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Available from: https://www.ncbi.nlm. nih.gov/books/NBK470167/

[80] Devarasetty S, Habeebullah S. Induction of labor: A review. Journal of Basic, Clinical and Applied Health Science. 2019;**2**(4):128-133

[81] National Collaborating Centre for Women's and Children's Health (UK). Induction of Labour. London: RCOG Press; 2008. https://pubmed.ncbi.nlm. nih.gov/21510026/ PMID: 21510026

[82] Adler K, Rahkonen L, Kruit H. Maternal childbirth experience in induced and spontaneous labour measured in a visual analog scale and the factors influencing it; a two-year cohort study. BMC Pregnancy and Childbirth. 2020;**20**:415. DOI: 10.1186/s12884-020-03106-4

[83] Kumar B, Kumari S, Hughes S, Savill S. Prospective cohort study of induction of labor: Indications, outcome and postpartum hemorrhage. The European Journal of Midwifery. 2021;**5**: 53. DOI: 10.18332/ejm/142782

[84] Olah KDJ, Steer P. The use and abuse of oxytocin. Obstetrics and Gynecology. 2015;**17**:265-271