2.1 **Factors associated with successful induction**

The importance of cervical assessment in labour induction has been recognized for more than 68 years. At present, the most widely accepted method of cervical evaluation are several variants of a system originally offered by Bishop. In Bishop's original study he showed that there was a clear inverse relationship between the cervical score and the time programmed for spontaneous onset of labour. Stated simply, a high Bishop score indicates that spontaneous labour is imminent, while a low BS denotes that it is a distant prospect. More importantly, a high BS predicts a good response to labour induction, while a low score presages difficulties.

The success of induction depends largely on the cervical status at the start of the induction process. Induction of labour in the presence of an unripe cervix (cervical score <3) results in a longer labour and a higher incidence of CS and fetal asphyxia. The cervical scores give a good prediction of the type of labour and the outcome to be expected. If the cervix is ripe a short easy labour which carries little additional stress to the fetus may be anticipated while in case of a very unripe cervix the converse will apply. The influence of parity and the cervical score on the success of induction was well demonstrated in a study done in Singapore. Nulliparous women with a poor cervical score had a high rate of failed induction, and nulliparas with a score of 3 or less had a higher CS rate for failed induction than multiparas with a score of 3 or less. (45% Vs 7.7%) The parity and cervical score not only influenced CS rate but also influenced the other characteristics of labour and their outcome. Women with poor cervical score had longer labours, required higher doses of oxytocin and had a poorer neonatal outcome. A study carried out by Gibb DMF et al showed that low parity and poor cervical score have an adverse effect on obstetric outcome.

An unripe cervix is less of a problem among multiparas requiring induction, the collagen of the cervix may be permanently modified by pregnancy and dilatation so that the process is more readily accomplished in the next pregnancy, even in the absence of obvious ripening. It has been shown that pre-labour occupies several weeks in late pregnancy and it is important to emphasize that the point occupied by the mother within that evolutionary phase has a crucial bearing on her response to labour induction. Thus if she is still in very early pre-labour she has a very different induction prospect from someone in late pre-labour. The closer the onset of spontaneous labour, the easier and more successful will labour induction prove. Thus with the advancing gestational age, the cervix becomes softer and compliant because of various endocrinal and biochemical changes and the uterus becomes fully sensitive to exogenous oxytocin only in late pregnancy resulting in a better outcome of induction. The oxytocin sensitivity of the pregnant uterus varies widely between individuals and at differing stages of pregnancy. From this evolved the principal of oxytocin titration against uterine response.

Successful induction was associated with increased parity and slightly greater gestational age in a study performed by Williams MC et al.

Calder et al have shown that there is an increase in duration of labour, maternal pyrexia, caesarean section and birth asphyxia in primigravidae, who were induced by oxytocin and amniotomy with an unprepared cervix as compared to those, who first underwent cervical ripening.
2.2 Incidence and indications of induction of labour

The reported incidence of induction of labour varies greatly between different countries, population groups and hospitals within the same country. In the 1980’s the reported incidence varies ranging from 4% to 40% in teaching hospitals of the U.K. and figures as high as 55% in non-teaching institutions. In National Maternity hospital Dublin, it has declined from 31% in 1971 to 12.1% in the year 1979, in Royal Maternity hospital, Belfast, it has declined from 56.5% in the year 1971 to 36.9% in the year 1977, and in Simpson Pavilian hospital, Edinburgh, the incidence has similarly declined from 54% in 1974 to 26% in 1980. In an analysis of induction of labour in Simpson Pavilian hospital, Edinburgh, post-maturity was the commonest indication (54%) followed by pre-eclampsia/hypertension (28%), accidental haemorrhage (5%), rhesus isoimmunisation (3%) and others (10%).

In a study performed in Singapore, the induction rate was 9.8%. The leading indications were static weight or weight loss at term (33.6%), pre-eclampsia (22.7%) and prolonged pregnancy (9.5%).

In a recent survey from Finland, Jarvelin et al showed that the practice of induction of labour is not consistent in different hospitals within the same country. The overall rate of inductions was 19.5%. The rate in the University hospital was only 13.4%. Hypertensive disease was the most common indication of induction followed by postdate pregnancy (27.5%), growth retardation (11.5%), fetal deaths (5.0%) and others.

In the study carried out in J.L. Nehru hospital and research centre, India in 1994, the incidence of IOL was 11.4% the indications were mainly postterm pregnancy (72%) and uncontrolled hypertension (25%).

2.3 Outcome of induction of labour

The greatest maternal risk of induction of labour is the risk of morbidity associated with CS for failed induction and for other obstetric indications like non-progress of labour and fetal distress. Prolonged IDI may result in pyrexia, poor neonatal outcome and others. IOL in presence of an unripe cervix results in a longer labour and a higher incidence of CS and birth asphyxia.

The main problem associated with oxytocin administration are hyperstimulation and neonatal hyperbilirubinemia. The latter side effect is more pronounced when the total amount of oxytocin given to the mother is high, such as happens in prolonged inductions.

Primigravida, especially those with an unripe cervix at induction show an unacceptably high rate of complications. Such patients are likely to require more uterine contractility and their labour tends to be long and unproductive with fetal compromise appearing long before vaginal delivery is in sight. Longer IDI, higher incidence of CS and instrumental delivery, higher incidence of pyrexia in labour and higher incidence of birth asphyxia are associated with induction in individuals with an unripe cervix at induction.

In a collaborative study, failures of attempted induction exceeded 20% among individuals with a very low BS (0-3) and a BS of 8 being associated with only 3% failure of induction. Failed induction is essentially a result of poor cervical score and low parity. This was shown in a study
by Arulkumaran et al nulliparas with a cervical score of 3 or less had nearly a 1 in 2 chance of failed induction which was reduced to 1 in 10 if the cervical score was 4 to 6.10

2.3 a. Maternal outcome
In a study carried out in Sweden, the duration of labour decreased with increasing Bishop’s score (degree of cervical ripeness).24 In another study the mean IDI was found to be 11.4 hours in patients whose labour was induced with traditional oxytocin protocol.25

Subjects with lower BS at first inductions had a lower IDI. Parity had a more distinct influence in reducing the IDI when the initial BS was low (4 or less).26

In a study of 125 primigravidae whose labour was induced by amniotomy and intravenous oxytocin it was found that with a low cervical score (0-3) the mean IDI was high (14.9 hours) whereas with a score of 4-7, the mean IDI was low (8.9 hours)9.

Pant et al found that the initial BS was directly related to the IDI and the response was good when the score was above 9, the mean IDI being 8 hours. Women with a low BS (0-4) had a mean IDI of 12.30 hours and those with a score between 5 to 8 had a mean IDI of 9.5 hours.27

Calder and Embrey found that the mean IDI in women with modified BS of four or less induced by oxytocin was 13.1 hours.28

In an Indian study by Mukherjee K et al the mean IDI in women with BS of less than 5 was 22.5 hours and 12.4 hours in primigravida and multigravida respectively.29 Misra M et al found the IDI to be 11.35 hours in primigravidae and 7.99 hours in multigravidae who had pre-induction BS of less than 3.21

In a study carried out in Singapore during 1982/83, the IDI was related to the pre-induction cervical score and parity. Patients with low score had higher mean IDI and multiparous patients had a lower mean IDI. The mean lengths of labour in women with a low cervical score (0-3) was 10.8 hours and 7.1 hours in primigravidas and multigravidas respectively. Similarly, in the group with 4-6 scores it was 8.6 hours and 5.2 hours in primigravidas and multigravidas respectively.10

The risk of CS is greater in the induction of labours group than in the spontaneous labour group. The risk was 2.9 times greater in the indicative induction group than in the spontaneous group in a recent Finnish study.20

The CS rate was high especially in primigravidae whose labour was induced. The emergency CS rate in induced labour was high (16.5%) compared with 6.1% in spontaneous labour.21 When labour is induced by amniotomy and oxytocin infusion in presence of an unripe cervix, the outcome is often unfavourable.17 In a study of 125 primigravidae whose labour was induced by amniotomy and intravenous oxytocin it was found that the CS rate in women with a low cervical score of 0-3 was 32%, whereas it was only 4% in women with a cervical score of 4-7.6
In a study carried out in Singapore the CS rate in multiparas and nulliparas with a good cervical scores (7-10) was not high. However nulliparas with a cervical score of 3 or less had a CS rate of 45.8% for failed induction and 65% for all indications. Multiparas with the same cervical score (<3) had a CS rate of 7.7% only. In the same study, nulliparas with a cervical score of 4-6 had a CS rate of 10.3%, whereas multiparas with cervical score of 4-6 had a CS rate of 3.9%. Obviously, nulliparas had a higher CS rate than multiparas and women with low score had higher CS rate.10

Macer JA et al found that the BS did not appear to affect the CS rate for multiparous women. However nulliparous women with a BS of ≤ 5 had a higher CS rate than those with BS >5, 50% compared with 26.4% (P=0.12).30 Kurup et al showed that multiparas with cervical score of ≤6 induced with oxytocin infusion and artificial rupture of membranes have high CS rate of 43.5%.31 Misra M et al in an Indian study of induced labour with a modified BS of 0-3 found CS rate of 47.2% and 14.6% in primigravidae and multigravidae respectively.21 In an another Indian study, Pant et al found a CS rate of 40% in induced labour with a low BS (0-4) and a CS rate of 15% in women with a BS of 5-8. This study showed almost 3 times higher CS rate in women with a low BS than with a high BS.27

A study by Kurup A et al reaffirmed that induction of labour by amniotomy and oxytocin infusion, in nulliparas with an unfavourable cervix is likely to result in CS, in 43.5% in the previous study10 and 48.6% in the present subgroup. The CS rate was 48.6% in those with a poor cervical score (<5) compared with 8.8% in those who had a good score (> 6).31

In a study of induced labour using an integrative approach (prostaglandin, amniotomy & oxytocin) it was found that the women who had a BS at entry of 3 or less had significantly higher rates of failed induction (9.4 versus 0.7%) and of CS (29% Vs 15.4%), than those with a BS above 3.32

Calder, in a study of primigravidae found that the vaginal delivery rate was 68% (spontaneous-16% and forceps 52%) in women with low pre-induction cervical score (0-3) and 96% (spontaneous 41% and forceps delivery 55%) in women with a score of 4-7.9, 17 Pant L et al in a study of induction of labour by oxytocin infusion in women with a low BS (0-4) showed that the rate of vaginal delivery was 60%, and 20% had instrumental delivery (1/3 of the vaginal delivery). In the same study, the vaginal delivery rate in women with a high BS (5-8) was higher (84%) and instrumental delivery was lower (22% only about ¼ of the vaginal delivery).27

In an Indian study of 40 women with low BS of less than 5 induced with oxytocin infusion the vaginal delivery rate was found to be 60%.29 Another study of oxytocin induced labour in women with a low modified BS (0-3) showed a total vaginal delivery rate of 52.8% and 85.4% in primigravidae and multigravidae respectively. Among vaginal deliveries, instrumental deliveries were 5.8% and 3.6% in primigravidae and multigravidae respectively.21

In a study of induced labour by Xenakis EMJ et al complications of induction were infrequent, regardless of BS. Maternal complications associated with induction of labour and delivery were infrequent and did not differ by Bishop category. Chorioamnionitis was the most common complication occurring in 3.5% of the 0-3 Bishop group and 4% of the 4 and above Bishop
group. All other complications (hyperstimulation, PPH, hysterectomy) occurred in 2% or less population. Overall, 93% of the women experienced no complication.\textsuperscript{32} Vomiting was observed in 4.8% (1/21) and hyperstimulation in 9.5% women with a low BS (<5) induced by oxytocin infusion in an Indian study.\textsuperscript{33} Various studies showed the side effects of oxytocin in induced labour are rare.\textsuperscript{9, 29} In a study, uterine hyperstimulation occurred in 3.6% patients in the continuous oxytocin induction group with a mean BS of 5.4.\textsuperscript{35}

### 2.3 b. Fetal outcome

From the fetal point of view induction appeared to have no serious consequences as fetal asphyxia or placental abruption were no more common as indications for CS in induced than in spontaneous onset group.\textsuperscript{26} In an Indian study, the fetal outcome in induced labour was similar to that of spontaneous labours, and there were no perinatal deaths following induction.\textsuperscript{27} In a study of induced labour with aniotomy and oxytocin infusion, no important effect on neonatal outcome was observed.\textsuperscript{34}

The neonatal outcome was found to be good with 5 min Apgar score <7 only in 3.2% in women induced by traditional oxytocin protocol.\textsuperscript{25} In a study of induction of labour with continuous oxytocin infusion in women with mean BS of 5.4, 16% babies had hyperbilirubinemia and 10.7% had Apgar score <7 at 1 minute.\textsuperscript{35}

Macer JA et al in their study, found that all babies were born alive and there were no neonatal death in the induction group. Neonatal intensive care unit admission was only in 0.8% babies.\textsuperscript{30}

In a study of 125 primigravidae, one-minute Apgar score <5 was found in 23% and 6% of patients with cervical score of 0-3 and 4-7 groups respectively.\textsuperscript{9} Misra M et al in a study of induced labour in women with a modified BS of less than 3, found a five minutes Apgar score of 4-6 in 2.8% primigravidae and 7-10 in 97% of primigravidae and 100% of multigravidae.\textsuperscript{22}

In a study of induced labour, neonatal complications included neonatal sepsis (1.5%), 5-minutes Apgar score <7 (2%) and few neonatal deaths mainly in extremely premature babies.\textsuperscript{24}

Women with poor cervical score had a poor neonatal outcome in a Singaporean study in which the neonatal condition assessed by one-minute and five-minutes Apgar score, it was slightly but not significantly lower in those with poor cervical scores, especially in multigravidae.\textsuperscript{10} Among the neonates, 6.3% had one-minute Apgar score of 6 or less and 93.7% had above 6. Similarly 1.5% had one minute Apgar score of 6 or less and 98.5% had above 6.\textsuperscript{10} Only 4.7% neonates were admitted to the SCBU.