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Changing rates for the induction of labor over the last five decades in a tertiary center

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ABSTRACT

The aim of this study is to evaluate the changing rates for induction of labor, induction failure and obstetric characteristics of patients over the decades in a tertiary center. The data on labor inductions were retrospectively evaluated. The cases were divided into five groups: Group 1 (1976, n = 62), group 2 (1986, n = 104), group 3 (1996, n = 81), group 4 (2006, n=120) and group 5 (2016, n = 379). The rates of the induction cases, deliveries with labor induction among deliveries at ≥37th gestational week, primiparous induction cases, induction failure, the mean maternal age, gestational week at birth and birth weight were compared between the groups. The percentages of induction cases among the total number of deliveries for each year were 2.3% in group 1, 4.3% in group 2, 4.6% in group 3, 6.9% in group 4 and 20.2% in group 5, respectively (p<0.001). The rates of labor induction for deliveries at ≥ 37th gestational week were 2.4% in group 1, 4.7% in group 2, 5.4% in group 3, 8.5% in group 4 and 22.1% in group 5, respectively (p<0.001). Statistically significant differences were found between the groups for the number of primiparous induction cases, the rate of induction failure, mean maternal age, gestational week at birth and birth weight (p values were <0.001 for all). The frequency of labor induction has increased at our clinic with application at earlier gestational weeks and there have been higher induction failure rates over the decades.

1. Introduction

Induction of labor refers to techniques for stimulating uterine contractions to accomplish delivery prior to the onset of spontaneous labor (ACOG, 2009). The purpose of this practice is to achieve birth in a short time and in a controlled manner in cases where the continuation of the pregnancy is likely to constitute a high risk for the mother and the baby. Examples of high-risk conditions that require induction of labor include postterm pregnancy, premature rupture of membranes, hypertensive diseases of pregnancy, fetal death, maternal diabetes, fetal growth restriction, chorioamnionitis, oligohydroamnios and cholestasis of pregnancy (ACOG, 2009; Caughey et al., 2009). In addition, the elective induction of labor without any medical indication has increased in recent years in the world (Grobman, 2007; Caughey et al., 2009). On the other hand, giving birth with a classical caesarean incision, having undergone gynecologic surgery requiring a complete insicion in the uterus fundus, transmural myomectomy reaching the uterus cavity, history of uterine rupture, presence of active genital herpes infection, placenta / vasa previa, cord prolapse, fetal transverse

posture, invasive cervical cancer and advanced fetal stress conditions are considered as contraindications for labor induction (Caughey et al., 2009).

While the frequency of labor induction varies between countries, its prevalence was found to be 23.3% in the United States (USA) according to a recent study (Osterman and Martin, 2014). In addition to reducing complications such as stillbirth and macrosomia, induction of labor at term also has the advantages of giving opportunity for a timely and controlled delivery (Ehrenthal et al., 2011; Rosenstein et al., 2012; Mishanina et al., 2014). However, it is more widely accepted to expect spontaneous delivery in the absence of medical indications whenever possible as induction of labor may cause increased cesarean section rates, procedure related complications and higher cost (Grobman, 2014).

The Bishop score is the most commonly used method for predicting induction success (Crane, 2006). In this scoring system, the clinician evaluates the cervical dilatation, effacement, consistency, position, and the station for the presenting part of the fetus (Crane, 2006). In most of the studies, the probability of vaginal delivery increased at scores of 6 and above, while scores of 3 and below were shown to increase the likelihood of cesarean delivery (Teixeira et al., 2012; Kolkman et al., 2013; Gibson and Waters, 2015). The use of cervical ripeners (such as prostaglandin analogues, laminar japonicum, osmotic dilators, foley catheters and cervical balloons) in patients with a low probability of vaginal delivery increases the success of induction (ACOG, 2009). Following ripening of the cervix, uterine contractions are induced by oxytocin administration (Alfirevic et al., 2017). In addition, methods such as membrane stripping, amniotomy and nipple stimulation are also used with or without induction of pharmacological agents (ACOG, 2009). Tachysystole, decelerations during intrapartum fetal heart rate monitoring, maternal hyponatremia and hypotension, uterine rupture and less commonly amniotic fluid embolism are reported as side effects of labor induction (Battista et al., 2007).

Factors such as changing socioeconomic conditions, increasing medicolegal events, the limited time physicians can devote to patients, and the decreasing tolerance of the patient and the healthcare system to obstetric complications have led to radical changes in obstetric practice (Queenan, 2011; Betrán et al., 2016; Beksac et al., 2018). These changes have caused increased cesarean rates and delivery induction (Osterman and Martin, 2014; Betrán et al., 2016). Furthermore, in some studies it has been shown that delivery induction may increase the risk of cesarean delivery by approximately two fold (Luthy et al., 2004; Vahratian et al., 2005). On the other hand, increased cesarean delivery also brings increased maternal / neonatal complications and cost (Molina et al., 2015; Mylonas and Friese, 2015). Thus, Turkey also aims to increase the rate of vaginal delivery, like other countries with increased cesarean rates. One of the most important steps to be taken for this purpose is to perform appropriate induction of labor protocols and to utilize the experience of past years when cesarean rates were within reasonable limits (Beksac et al., 2018).

Our aim in this study was to evaluate the changing rates for induction of labor, induction failure and obstetric characteristics of patients over the decades in a tertiary center.

2. Materials and method

We retrospectively evaluated the data of labor inductions performed for various indications at the 37th gestational week or later in singleton, live births with vertex presentation for the years 1976, 1986, 1996, 2006 and 2016. Induction of labor procedures performed in pregnancies with fetal congenital anomalies were excluded from the study. The data of 10.477 births, which took place in the mentioned years, were examined retrospectively through patient records in the archive, and 746 patients who met the required criteria were considered as the study group. The cases were divided into five groups according to the years of labor induction: The cases were divided into five groups: Group 1 (1976, n = 62), group 2 (1986, n = 104), group 3 (1996, n = 81), group 4 (2006, n=120) and group 5 (2016, n = 379). The percentages of induction cases in the total number of deliveries for each year, the rates of deliveries with labor induction in the total number of deliveries at the 37th gestational week or later, the number of primiparous induction cases, the rate of induction failure, mean maternal age, gestational week at birth and birth weight were compared between the groups.

The method of labor induction was determined by the experience of the clinicians, the clinical characteristics of the cases, and the findings of vaginal examination. The labor induction protocol of our institution is oxytocin infusion (ACOG, 2009). In this study, induction failure was defined as the absence of vaginal delivery in spite of the applied induction methods and consequent delivery with caesarean section (ACOG, 2009).

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS, version 22.0, for Windows, Armonk, NY: IBM Corp). The Kolmogorov-Smirnov test was used to evaluate the normal distribution of the data. Normally distributed data are presented as mean and standard deviation. Since maternal age, gestational age at birth and birth weight values were found to be normally distributed, these parameters were compared using one-way ANOVA test among the groups. The homogeneity of the variances was assessed by the Levene test. Independent-samples t test was used to compare parametric variables between the groups. Categorical variables were compared using chi-square test. The significance level with a p value of <0.05 was determined. Written informed consent was obtained from all the patients, and the study was approved by the institutional ethics committee of Hacettepe University. No funding was used for this study.

Table 1. The comparision of study groups in terms of mean maternal age, gestational week at birth, birth weight and induction characteristics.

	1976 (n=62)	1986 (n=104)	1996 (n=81)	2006 (n=120)	2016 (n=379)	P value
Maternal age (years) (mean±SD)	24.94±3.94	27.50±4.54	27.10±5.39	30.30±5.30	29.40±5.61	<0.001a
Gestational week at birth (mean±SD)	39.90±2.42	39.02±2.30	38.33±1.62	37.55±2.85	37.09±3.53	<0.001a
Birth weight (g) (mean±SD)	3251.94±535.42	3366.92±453.28	3140.74±490.62	3129.00±42.84	3018.30±714.64	<0.001a
Percentages of the induction cases in the total number of deliveries (%)	2.3%	4.3%	4.6%	6.9%	20.2%	<0.001b
Rates of deliveries with labor induction in the total number of deliveries at 37th gestational week or later	2.4%	4.7%	5.4%	8.5%	22.1%	<0.001b
Percentage of primiparous induction cases (n,%)	42 (67.7%)	38 (36.5%)	52 (64.2%)	49 (40.8%)	207 (54.6%)	<0.001b
Rate of induction failure (n,%)	5 (8.1%)	17 (16.3%)	28 (34.5%)	55 (45.8%)	194 (51.2%)	<0.001b

3. Results

The mean maternal age of all patients included in the study was 28.66 ± 5.48 years. In addition, the mean gestational week at birth and mean birth weight of all the patients in the study were 37.80 ± 3.15 weeks and 3313.46 ± 646.92 g, respectively.

The percentages of induction cases in the total number of deliveries for each year were 2.3% in group 1, 4.3% in group 2, 4.6% in group 3, 6.9% in group 4 and 20.2% in group 5, respectively. Additionally, there were a total of 8827 deliveries at the 37th gestational week or later and the rates of labor induction in these deliveries were 2.4% in group 1, 4.7% in group 2, 5.4% in group 3, 8.5% in group 4 and 22.1% in group 5, respectively (Fig. 1 and Table 1).

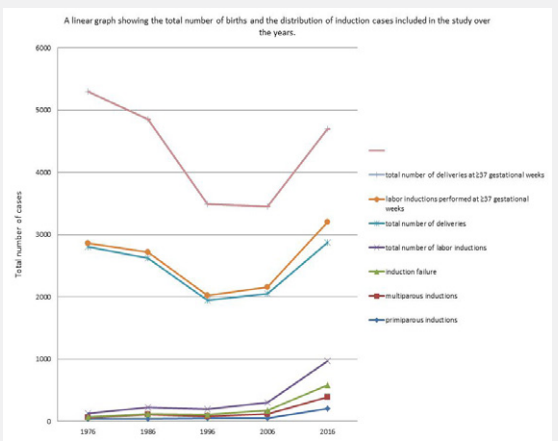

Fig. 1. A linear graph showing the total number of births and the distribution of induction cases included in the study over the years.

A total of 2671 deliveries were performed at our institution in the year 1976. Of the 62 total induction procedures in group 1, 42 (67.7%) were applied to primiparous patients and 5 of these inductions failed (8.1%). When we evaluated the year 1986 (group 2), 38 induction procedures (36.5%) were applied to primiparous patients and 17 induction failures (16.3%) were reported in a total of 2396 deliveries. In the year 1996 (group 3), 52 of the 81 total induction procedures (64.2%) were applied to primiparous women and 28 (34.5%) of them had induction failure in a total of 1752 deliveries. Additionally, in the year 2006 (group 4), 49 of the 120 total induction procedures (40.8%) were applied to primaparous women and 55 (45.8%) of them had induction failure in a total of 1754 deliveries. Finally, in 2016 (group 5), 207 of the total 379 induction applications among 1904 deliveries were applied to primiparous pregnancies (54.6%) and 194 (51.2%) induction failures were reported (Fig. 1 and Table 1).

Statistically significant differences were found between the groups for the percentages of induction cases in the total number of deliveries for each year, the rates of deliveries with labor induction in the total number of deliveries at the 37th gestational week or later, the number of primiparous induction cases, the rate of induction failure, mean maternal age, gestational week at birth and birth weight (p values were <0.001 for all).

Mean maternal age was 24.94 ± 3.94 years for group 1. Statistically significant differences were found between group 1 and the other groups when pairwise comparisons were conducted (p values were 0.003, 0.016, <0.001 and <0.001 for group 2, group 3, group 4 and group 5, respectively). In addition, mean maternal age was 27.50 ± 4.54 years for group 2. There was no statistically significant difference between groups 2 and 3 (p=0.609), although statistically significant differences were found between groups 2, 4 and 5 (p<0.001 for both). Mean maternal age in group 3 was 27.10 ± 5.39 and there were statistically significant differences between groups 3, 4 and 5 (p <0.001 for both values). Finally, the mean maternal age values in groups 4 and 5 were 30.30 ± 5.30 and 29.40 ± 5.61 years, respectively, and there was no statistically significant difference between the two groups (p = 0.154).

The mean gestational week at birth was 39.90 ± 2.42 weeks in group 1. When pairwise comparisions were performed, statistically significant differences were found between groups 1, 3, 4 and 5 (p values were 0.002, <0.001 and <0.001, respectively). However, there was no

statistically significant difference between groups 1 and 2 (p=0.069). The mean gestational week at birth in group 2 was 39.02 ± 2.30 weeks. There was no statistically significant difference between groups 2 and 3 (p = 0.126). On the other hand, statistically significant differences were found between groups 2, 4 and 5 (p <0.001 for both). Furthermore, the mean gestational week at birth in group 3 was 38.33 ± 1.62 weeks and there was no statistically significant difference between groups 3 and 4 (p = 0.076). However, there was a statistically significant difference between groups 3 and 5 (p = 0.001). For groups 4 and 5, the mean gestational week at birth was 37.55 ± 2.85 and 37.09 ± 3.53 weeks, respectively, and there was no statistically significant difference between the two groups (p = 0.137).

The mean birth weight was 3251.94 ± 535.42 g for group 1, and when pairwise comparisions were performed, a statistically significant difference was present only between groups 1 and 5 (p values were 0.260, 0.301, 0.214 and 0.006 for groups 2, 3, 4 and 5, respectively). The mean birth weight for group 2 was 3366.92 ± 453.28 g, and there were statistically significant differences between groups 2, 3, 4 and 5 (p values were 0.017, 0.005 and 0.001, respectively). On the other hand, the mean birth weight for group 3 was 3140.74 ± 490.62 g, and no statistically significant differences were found between groups 3, 4 and 5 (p values were 0.892 and 0.098, respectively). Finally, the mean birth weight values for groups 4 and 5 were 3129.00 ± 642.84 g and 3018.30 ± 714.64 g, respectively, and there was no statistically significant difference between the two groups (p = 0.08).

4. Discussion

The incidence of labor induction has gradually increased from the end of the 1980s to the 2000s (Osterman and Martin, 2014). According to the results of a study conducted in the USA, the frequency of induction, which was 9.5% in 1990, reached the highest level of 23.8% in 2010, and then slightly decreased to 23.3% in 2012 (Osterman and Martin, 2014). The groups most contributing to the decline observed in recent years are the patients within weeks 36, 37 and 38 of gestation (Osterman and Martin, 2014). Recent studies have shown that newborns delivered between 370 and 386 gestational weeks, defined as early term, also carry increased risk of neonatal morbidity (Clark et al., 2009; Dietz et al., 2012). In this regard, the American College of Obstetricians and Gynecologists (ACOG) recommends avoiding elective induction of labor before the 39th gestational week (ACOG, 2013).

In this study, the frequency for induction of labor increased from 2.3% in 1976 to 20.2% in 2016, over these years. This finding is consistent with the current literature (Osterman and Martin, 2014). On the other hand, the important point is that the rate of 6.9% in 2006 increased dramatically in a decade to 20.2%. Our data are dissociated from the USA study at this stage. The frequency for induction of labor, which was at its highest value in the same years, showed a slight decline in recent years. On the contrary, a significant increase was reported in our study. Many factors may be taken into consideration with regard to this tendency. First of all, cesarean section rates, which have risen rapidly in our country, especially at the beginning of the 2000s, should be held responsible for the low rate of inductions in 2006 (Töre et al., 2009). On the other hand, elective cesarean section applications were prohibited by law in 2012 (Ozyuncu et al., 2019). This law has probably led to an increase in labor induction procedures in the following years. The presence of such a law for caesarean section is unique to Turkey.

This study demonstrated that the mean gestational week for induction of labor and birthweight has decreased over the years. The mean gestational week at birth, which was 39.90±2.42 in 1976, decreased to 37.09 ± 3.53 in 2016. Physicians were waiting until further weeks of gestation for induction of labor in the past in our clinic. However, earlier gestational weeks were preferred for labor induction in the last decades. Mean birthweight values also decreased over the years among the labor induction patients, which was consistent with the changes in obstetrics practice worldwide. The mean birthweight, which was 3251.94 ± 535.42 g in 1976, declined to the lowest value of 3018.30 ± 714.64 g in 2016. When we interpret these findings, we can conclude that there is a tendency for induction of labor at earlier gestational weeks in our clinic in the last decades, contrary to some other countries (ACOG, 2009; Osterman and Martin, 2014).

Mean maternal age also increased over the years. While it was 24.94±3.94 in 1976, the values increased to 30.30±5.30 and 29.40±5.61 in 2006 and 2016, respectively. This shows us that there is an increasing trend in the maternal age of labor induction patients. When the parity of the patients were compared, the primiparous induction rate was highest in 1976 (67.7%) and lowest in 1986 (36.5%). The distribution of primiparas in groups did not show any particular pattern. Presumably, this distribution was influenced by changing clinical practices and physicians' preferences.

The most striking finding of our study is that induction failure has increased significantly over the years. This rate, which was 8.1% in 1976, increased to 51.2% in 2016, increasing every decade step by step. In addition to the status of the cervix in predicting induction failure, parity, gestational week, rupture of membranes, body mass index, maternal height, baby's weight and placental insufficiency are also important factors (Crane, 2006; Canda et al., 2010; Gibson and Waters, 2015). Studies in the literature did not indicate such high failure rates despite the increase in induction of labor frequency (Yeast et al., 1999; Heffner et al., 2003; Wolfe et al., 2011). We believe that this high rate is due to the intense social and

legal pressure on physicians. The physicians probably prefer cesarean section with the smallest suspicious condition encountered during the induction of labor in order to protect themselves from medicolegal problems. The main strength of our study was the inclusion of data consisting of five decades experience in the same clinic. On the other hand, the limitations of our study were that it did not contain induction of labor indications and neonatal results, especially due to the limitations of data in the past decades.

In conclusion, the frequency of labor induction has increased at our clinic with application at earlier gestational weeks and there have been higher induction failure rates over the decades.

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