

The Effects of Fetal Gender on Indications of Cesarean Section

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Abstract: The purpose of this study was to evaluate the effect of fetal gender to indications of cesarean section (C-section). Clinical and demographical data of 5858 (53.3%) women carrying male fetuses (group 1) and 5132 (46.7%) women carrying female fetuses (group 2) were screened retrospectively. Demographic data, neonatal complications and C-section indications were used to compare the participants according to fetal gender. Median gestational age at delivery was 38 (24-41) weeks in group 1 and 39 (24-41) weeks in group 2. Mean birthweight was determined 3193 ± 796.9 in group 1 and 3063 ± 744 in group 2. These differences were determined statistically significant too ($p < 0.001$ and $p < 0.001$ respectively). Similarly, frequencies of macrosomia, preterm birth and NICU admission were determined statistically higher in Group 1 ($p = 0.05$, $p < 0.001$ and $p < 0.001$). Severe intrauterine growth restriction (IUGR) and failure to progress during labor relative risks were determined significantly lower in Group 1 (RR 0.95 (0.88-1.22) and RR 0.85 (0.75-0.97)), and suspected macrosomia relative risk was found statistically higher in group 1 (cRR 1.59 (1.40-1.80), ARR 1.14 (1.12-1.16)). Male gender has an effect on the C-section rate, but most C-section indications are not affected by fetal gender. Further studies are currently required in order to determine the relation between C-section indications and fetal gender.

Keywords: Gender, C-section, Male, Female, Labor

Introduction

In the last 20 years, several studies have detected an association between adverse pregnancy outcomes and fetal gender; especially risk of preterm delivery (PTB), macrosomia and cord complications increased in pregnant women carrying a male fetus (1–6). Likewise pregnancy complications, cesarean section (C-section) rate is increased in pregnant women carrying male fetuses (7,8). Association between increased complication in pregnancy and fetal gender is not clarified yet.

Some authors suggested that gestational complications are increased owing to the fact that male fetuses are bigger and heavier than female fetuses (6,9). But recently, Challis et al. have stated that the genomic effect of fetal gender on fetal-placental-maternal unit may be the cause of fetal gender-associated pregnancy complications(10). C-section is a lifesaving delivery method when it is performed appropriately and with proper medical indications.

According to World Health Organization (WHO), C-section rates have increased especially in developing countries (11). Also, some authors determined that C-section rates are more frequent in women carrying male fetuses than women carrying female fetuses (6,9). There are very few studies showing the effect of fetal gender on cesarean indications in the literature (12–14). However, there is no consensus for the relationship between fetal gender and C-section indications, either. In this study, we aimed to evaluate the effect of fetal gender on indications of C-section.

Materials and Methods

Patients undergo C-section in between January 2013 and June 2017 were retrospectively screened. Primary C-section deliveries after 24 weeks of gestation were included in the study. Patients with maternal causes for C-section such as preeclampsia, eclampsia, maternal systemic disease (cardiovascular disease, etc.) were excluded from the study.

Indications of C-section for male (group 1) and female (group 2) fetuses was compared. The differences between the groups were examined in terms of demographic data and neonatal characteristics. The delivery

mode, indications of primary C-section and fetal gender were screened from patient files and newborn unit patient cards at delivery room.

Cesarean indications were divided into subgroups as; failure to progress during labor, non-reassuring fetal status, fetal malpresentation, abnormal placentation (placental invasion anomalies and placental abruption), funic presentation or cord prolapse, suspected macrosomia, severe intrauterine growth retardation and cephalopelvic disproportion except caused by maternal pelvic dimensions. Gestational ages were determined according to the last menstrual date or first trimester crown rump length. Delivery before gestational week 37 was considered as preterm birth and with a birthweight less than 2500 g were considered as low birthweight. Stillbirth and need of newborn intensive care unit (NICU) rates were retrospectively screened based on the delivery room records.

When the maternal or fetal health outweighed the risk of prolonging pregnancy, our primary approach was to perform cervical ripening by utilization of oxytocin intravenous or dinoprostone vaginal insert for induction of labor, according to Bishop score. C-section was performed in the presence of prolonged latent phase or arrest of active phase or second stage of labor. Estimated fetal birthweight (EFBW) was calculated by Hadlock formulas. Patients with > 4500 g EFBW were considered as suspicious macrosomia, and C-section was planned.

Placental pathologies, such as placental invasion anomalies and placental abruption, were diagnosed by radiological methods (ultrasonography, magnetic resonance imaging). Late deceleration and severe late decelerations at continuous fetal cardiotocography were considered as an indicator of fetal stress and non-reassuring fetal condition. In the severe IUGR group, delivery time and mode were planned by a perinatologist according to the causes of growth retardation.

Statistical Analysis

The results were presented in frequencies and percentages. Normality tests were selected in accordance with the number of pregnancies, and a normal distribution pattern was accepted if $p > 0.05$. The results were presented as mean \pm standard deviation (SD) for normally distributed data and median (range) for non-normally distributed data. The chi-square test was used for intergroup differences of categorical variables based on the number of data.

In univariate analyses, independent sample T-test was used for parametric variables, and the Mann-Whitney U test was used for non-parametric variables. A generalized mixed model was planned to determine the relative risk (95% CI) (crude and adjusted) between fetal gender and C-section indications. $p < 0.05$ was considered statistically significant. Statistical analyses were performed by using SPSS 22.0 for Windows (SPSS Inc., Chicago, IL) and SAS (version 9, SAS Institute Inc, Cary, NC).

Results

In total, 17808 pregnant women who submitted to our hospital and gave birth with primary C-section were retrospectively evaluated. After excluding 6818 pregnant women as they did not meet the inclusion criteria, the population of the study finally consisted of 5858 (53.3%) women carrying male fetuses and 5132 (46.7%) women carrying female fetuses. The maternal demographic information and neonatal characteristics of newborns are summarized in Table 1.

There was no significant relationship between fetal gender and maternal age, parity and stillbirth. Gestational age at delivery was significantly lower and birthweight was significantly higher in Group 1 ($p < 0.001$ and $p < 0.001$, respectively). Macrosomia, preterm birth and NICU admission frequencies were determined statistically higher in Group 1 ($p < 0.001$, $p = 0.05$ and $p < 0.001$, respectively).

Indications of C-section according to gender of fetus and relative risks are summarized in Table 2. Relative risk of severe intrauterine growth restriction (IUGR) (cRR 0.85, 95% CI 0.75 to 0.97, $p < 0.05$) and failure to progress during labor (cRR 0.95, 95% CI 0.88 to 1.02, $p < 0.05$) were determined to be lower in Group 1.

Table 1. Maternal Demographic and Neonatal Characteristics according to Fetal Gender Study Groups

	Group 1, 5858 (53.3%)	Group 2, 5132 (46.7%)	p-value*
Maternal age, median (min, max)	26 (13-49)	26 (13-51)	0.465
Nulliparity, n (%)	3608 (61.6%)	3238 (63.1%)	0.103
Maternal BMI			
Gestational age at delivery, median (min, max)	38 (24-41)	39 (24-41)	<0.001
Preterm birth (<37 weeks), n (%)	1095 (18.7%)	872 (17%)	0.05
Birthweight, mean±std	3193 ±796.9	3063 ± 744	<0.001
Low birth weight (<2500 gr), n (%)	945 (16.2%)	903 (17.6%)	0.08
Macrosomia, n (%)	679 (11.6%)	376 (6.6%)	<0.001
NICU admission, n (%)	767 (13.1%)	563 (11%)	<0.001
Stillbirth, n (%)	52 (0.8%)	41 (0.7%)	0.140

Group 1; male fetuses and Group 2; female fetuses

*Bold text indicates a statistically significant difference with a p-value less than 0.05

However, when relative risk was adjusted for birthweight and gestational age at delivery and NICU admission, only severe IUGR (aRR 0.56, 95% CI 0.33 to 0.96, p<0.05) adjusted relative risk was determined to be statistically significant. Suspected macrosomia crude relative risk (cRR 1.59, 95% CI 1.40 to 1.80, p<0.05) and adjusted relative risk (aRR 1.14, 95% CI 1.12 to 1.16, p<0.005) were found statistically significant higher in Group 1.

Table 2. Indications for Cesarean Section according to Gender of Fetus

	Group 1 5858 (53.3%)	Group 1 5132 (46.7%)	Crude relative risk*	Adjusted relative risk**
Failure to progress during labor, n (%)	1270 (21.6%)	1180 (22.9%)	0.95 (0.88-1.22)	0.92 (0.76-1.11)
Suspected macrosomia, n (%)	631 (10.8%)	334 (6.5%)	1.59 (1.40-1.80)	1.14 (1.12-1.16)
Cephalopelvic disproportion, n (%)	1030 (17.6%)	878 (17.1%)	1.02 (0.94-1.11)	0.91 (0.76-1.10)
Non-reassuring fetal status, n (%)	1858 (31.7%)	1696 (33%)	0.96 (0.91-1.02)	0.87 (0.72-1.03)
Funic presentation or cord prolapse, n(%)	30 (0.5%)	15 (0.3%)	1.74 (0.94-3.24)	1.26 (0.63-2.50)
Fetal malpresentation, n(%)	459 (7.8%)	445 (9.1%)	0.91 (0.80-1.03)	1.08 (0.80-1.46)
Severe IUGR, n(%)	431 (6.9%)	404 (7.9%)	0.85 (0.75-0.97)	0.56 (0.33-0.96)
Abnormal placentation				
Placenta previa, n(%)	102 (1.7%)	103 (2%)	0.86 (0.66-1.08)	0.84 (0.69-1.04)
Plecenta abroption, n(%)	67 (1.1%)	57 (1.1%)	1.02 (0.72-1.46)	0.89 (0.62-1.24)

Group 1; male fetuses and Group 2; female fetuses

* Relative risks and adjusted relative risks were calculated for male fetus and bold text indicates a statistically significant difference with a p-value less than 0.05

Relative risks were adjusted for birthweight and gestational age at delivery and NICU admission

Discussion

Fetal sexual differentiation is a result of a complex process of interactions of gonadal, hormonal and genetic factors. The effect of fetal hormonal factors have a major impact on obstetrical outcomes and fetal gender (9).

According to authors, male gender during pregnancy was associated with poor pregnancy outcomes. Risk of PTB, macrosomia, cord complication and C-section rates were determined to be higher in the male gender than the female gender (1–6,15). Similar to the literature, in our study, PTB, macrosomia and NICU admission rates and birthweight were determined to be higher in the male gender (6,16,17) and in addition to this, gestational age at birth was determined to be higher in the female gender group (17,18).

When C-section rates are higher than 10% at the population level, C-section is not associated with reductions in maternal and newborn mortality rates according to WHO (19). In our country, C-section rate is approximately %48, and with this ratio, our country has become one of the countries with the highest C-section rate (20). Similar to our results, fetal distress is the most common indication for C-section in our country according to an analysis published recently and there are also studies from other countries consistent with our results (3,13,14,21). The second most frequent indication for C-section in our study was failure to progress labor, similar to the literature (3,14).

In our study, failure to progress during birth relative risk was determined to be significantly lower in Group 1 (95% CI, cRR 0.88). Malemed et al. (12) and Lieberman et al. (22) determined that arrest of dilatation and prolonged second stage rates were higher in the male gender groups, but Hadar et al. (23) and Ashwal et al. (24) could not find a relationship between fetal gender and failure to progress during labor. Patient selection criteria, different geographical locations and different genetic backgrounds may have played a role in these different outcomes. In this study, suspected macrosomia relative risk (95% CI RR 1.80) and adjusted relative risk (%95 CI aRR 1.60) were found to be significantly higher in Group 1, similar to Melemed et al. (12). Similar to suspected macrosomia, only severe IUGR indication relative risk (95% CI RR 0.75) and adjusted relative risk (95% CI aRR 0.33) were determined to be significantly lower in Group 1. According to the literature, IUGR was found to be more frequent in the female gender than in the male gender, similar to our results. (9,10). Growth-restricted fetuses may exist in a state of mild-to-moderate chronic oxygen and substrate deprivation and as a result, late and variable deceleration rates are increased in fetal monitoring.

There are only a few studies in the literature about C-section indications and fetal gender that are detailed as much. To our knowledge this study is more comprehensive than most studies in the literature as single center data in terms of number of patients who giving birth with primary C-section.

In conclusion, in developing countries, the C-section rate is becoming a public health problem. It should be kept in mind that fetal gender has an effect on pregnancy outcomes as well as on C-section rates. However, according to our study, most of the indications for C-section are not affected by fetal gender. In case of suspected macrosomia is detected in male gender or severe IUGR is detected in female gender, C-section rates may be increased. Further studies are required in order to determine the relation between C-section indications and fetal gender.

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