The Effect of Oxytocin in Labor Induction and Augmentation in Obese Women in an Eastern Coastal City of China

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Abstract: Background: The problem of obesity during pregnancy is becoming more and more prominent in China. In the past, little attention was paid to the induced labor of obese parturients. Aim: To explore the dose difference of oxytocin and delivery outcome in different BMI parturients. Methods: A retrospective cohort study was conducted in a third-class hospital in Wenzhou from January to October 2019. A total of 644 parturients were divided into normal group (n=130), overweight group (n=316), and obese group (n=197), and were compared on the dosage and continuous infusion time of oxytocin, duration of delivery, and birth outcome. Results: Maternal BMI was positively correlated with the dose and duration of oxytocin infusion. Obese women required a higher dose and longer drip time than women with normal BMI. In comparison with the normal group and overweight group, the obese group had significantly longer duration of first-stage and total stages of labor, and a significantly higher rate of postpartum hemorrhage and intermediate cesarean delivery, and the incidence of large babies. Conclusions: Obese women needed more oxytocin and longer time to achieve vaginal delivery. Obesity is an independent risk factor for adverse pregnancy outcomes in oxytocin-induced labor.

Keywords: Oxytocin; Obese; Labor Induction; Augmentation; Delivery Outcome

1. Introduction

Oxytocin is the first-line drug for clinical labor induction and augmentation as it can increase tone of the uterine smooth muscle and increase the frequency of contractions, but still maintain the rhythm, symmetry and polarity. It has been noted that labor inductions apply to women with different BMIs have different results. Hu et al [1-2] suggested that the factors influencing the effectiveness of oxytocin in inducing labor in obese women might be related to their suppressed uterine contractility. Excessive weight gain during pregnancy also increases the risk of gestational diabetes, preterm birth and pre-eclampsia. Studies has found that obese women tend to fail in labor induction, and have a higher risk of caesarean section, postpartum hemorrhage, giant babies, fetal distress and physical abnormalities in newborns [3-4]. Study on the effect of oxytocin induction and augmentation in obese population is scarce[4]. This study explored the differences in the use of oxytocin and the outcome of delivery in pregnant women with different BMI, so as to provide insight for the management of oxytocin in obese pregnant women.

2. Methods

2.1 Participants

Six hundred and forty-four singleton primiparous mothers who met the inclusion criteria and delivered in a third-class hospital in Wenzhou, China, from January to October 2019 were selected. Data collected included :① maternal data: age, height, weight, gestational week, fetal membrane status at admission, uterine dilation; ② fetal data: fetal biparietal diameter,

fetal birth weight; (3) labor outcome: caesarean section rate, postpartum hemorrhage rate; (4) labor process data: first, second, third and total stage labor duration, rate of epidural anesthesia; ⑤ total amount of oxytocin used and duration of continuous intravenous drip. Inclusion criteria: ①labor with oxytocin infusion; ②primiparous women; ③singleton, head position; ④ no contraindications of vaginal delivery; ⑤ has indications for induction of labor with oxytocin; ⑥ no other uterine contraction-promoting drugs. Exclusion criteria: ① fetal abnormalities such as fetal malformation; ② presence of serious disease; ③ incomplete clinical data.

2.2 Settings

After admission, the women who met the inclusion criteria, were recruited in this study. Maternal BMI was calculated based on height and weight at admission and three groups were divided according to BMI. $18.5 \text{ kg/m}^2 \leq \text{BMI} < 24 \text{ kg/m}^2$ was considered normal; $24 \text{ kg/m}^2 \leq \text{BMI} < 28 \text{ kg/m}^2$ was considered overweight; and $\text{BMI} \geq 28 \text{ kg/m}^2$ was considered obese[2]. Use of oxytocin: The low-dose oxytocin regimen recommended by the Obstetrics and Gynaecology Group of the Chinese Medical Association was used to labor induction and augmentation[5]. The speed was controlled by the Shenzhen Shengnuo SN-1500H infusion pump and the fetal heart monitor was a Philips FM-20 model from Germany.

2.3 Statistical analysis

Data analysis were performed in IBM SPSS Statistics version22.0. Count data were expressed in (%) using the χ^2 test. Measurement data conformed to a normal distribution (K-S test) was expressed as mean±standard deviation (±S), and group comparisons were performed using one-way ANOVA, with P<0.05 being considered a statistically significant difference.

2.4 Ethical considerations

This study has been approved by the Ethics Committee of the First Affiliated Hospital of Wenzhou Medical University (No. 2019089). Informed consent was sought from participants. Data regarding maternal delivery were collected and analysed anonymously.

3. Results

A total of 644 women were included, 130 in the normal group, 316 in the overweight group and 197 in the obese group. See Table 1 for general information. The differences in general information were not statistically significant (P>0.05) in the three groups.

Table 1 General maternal information (±S) (%)

Item	Normal group n=130	Overweight group n=316	Obese group n= 198	F-value	χ^2	P-value
Age	27.84±3.81	28.87±4.09	28.37±4.54	2.951	-	0.053
Gestational week	39.30±1.62	39.48±1.62	39.43±1.22	1.033	-	0.356
Height	159.3±5.15	160.6±3.84	161.13±5.06	0.654	-	0.524
Biparietal diameter	91.82±4.55	93.13±3.82	98.04±64.52	1.548	-	0.213
Painless delivery	75（57.59%）	189（62.66%）	115（58.08%）	-	0.241	0.887
Dilation of the uterus on admission	0.64±0.97	0.40±1.01	0.29±0.88	0.975	-	0.887

The total dose of oxytocin used in the obese group was significantly higher than that in the overweight and normal groups (P<0.05). In the duration of oxytocin drip, there was a significant difference between the three groups, and by LSD

test, the obese group was higher than the normal group (P<0.05), and the difference between the overweight and obese groups was not statistically significant (P>0.05), see Table 2.

Table 2 Total dose of oxytocin used, duration of continuous titration (±S)

Item	Number of cases	Total dose of oxytocin (mIU/min)	Duration of oxytocin titration (min)
Normal group	130	5.15±3.06	296.76±272.37
Overweight group	317	6.03±3.57	377.06±311.19
Obese group	198	9.01±4.31	405.84±329.21
F-value		54.304	5.047
P-value		0.000	0.007

In the comparison of the duration of labor stages (table 3), the first stage was longer in the obese group than in the normal group and the overweight group, and the difference between the normal group and the overweight group was not statistically significant (P>0.05). The difference between the duration of the second and third stage of the three groups was not statistically significant (P>0.05). In the total stage duration, the obese group was significantly higher than the normal group and the overweight group(P<0.05), and the difference between the overweight group and the obese group was not statistically significant (P>0.05). The differences between the overweight and obese groups were not statistically significant(P>0.05).

Table 3 Time of first, second, third and total stage of labor (min) (±S)

Group	Number of cases	First stage	Second stage	Third stage	Total stage
Normal group	130	687.39±363.95	74.52±47.81	7.90±2.94	769.81±367.81
Overweight group	316	710.58±369.97	74.03±48.32	8.19±3.23	791.45±376.74
Obese group	197	783.68±375.08	85.72±70.85	13.38±73.58	880.41±380.85
F-Value		3.368	2.907	1.145	4.548
P-value		0.0351	0.055	0.319	0.011

As shown in Table 4, after Z-test, the rate of postpartum hemorrhage in the obese group was significantly higher than that in the normal group and the overweight group (P<0.05), while the difference between the normal group and the overweight group was not statistically significant (P>0.05). And the difference in caesarean section rate between the three groups was not statistically significant (P>0.05). The incidence of huge babies in the obese group was significantly higher than that in the normal group and the overweight group (P<0.05).

Table 4 Comparison of postpartum haemorrhage rates, birth outcomes and incidence of large babies [n (%)]

Group	Number of cases	Postpartum haemorrhage (%)	Normal birth (%)	Caesarean section (%)	Giant baby (%)
Normal group	130	4 (3.08%)	113 (86.92%)	17 (13.08%)	2 (1.54%)
Overweight group	316	11 (3.48%)	271 (85.76%)	44 (13.92%)	18 (5.70%)
Obese group	197	17 (8.63%)	164 (83.25%）	34 (17.26%)	24 (12.18%)
χ^2value		7.953	1.364	1.364	15.065
P-value		0.019	0.506	0.506	0.001

4. Discussion

One of the main findings of this study was that the amount of oxytocin used and the duration of the drip were significantly higher in the obese group than in the normal group, with an increase in oxytocin dose of approximately 57% and an increase in duration of the drip of approximately 73% compared to the normal group. This is consistent with the majority of scholarly reports[6]. The reasons for this may be: ① Obese pregnant women are affected by estrogen, and the oxytocin receptors in the myometrium increases. In order to achieve effective uterine contraction, more oxytocin should be

combined with them. ②Studies have shown that uterine contractility is negatively correlated with endocrine factors such as cholesterol, leptin and growth hormone-releasing peptide. These factors are significantly higher in the serum of obese women, whose uterine contractility is inhibited. ③The total volume of intravenous oxytocin is absorbed by the extracellular fluid, and obese women have more extracellular fluid space than normal women. Because of this physiological difference, obese women require more oxytocin to facilitate effective labor [6-8]. The total dose of oxytocin in this study was lower than those reported in the United States, Australia, and the United Kingdom, which may be due to the fact that the Chinese diagnostic criteria for obesity were lower than international standards. Asian women are generally small in size compared with European and American women. For the latter more oxytocin are needed to achieve a vaginal delivery.

The duration of labor was not accelerated in obese women despite receiving a higher dose and longer duration of induction of labor with oxytocin. In this study, the duration of the first stage of labor was significantly longer in the obese group than in the normal group. In a Swedish study involving 15,259 women, the first stage of labor is longer in obese women, especially when the cervix is between 4 and 10 cm. [8]. This is thought to be related to the suppression of uterine contractility during the first stage of labor in obese women. In the second and third stage, the differences between the three groups were not statistically significant, consistent with that reported by Roloff et al[6].

The rate of postpartum hemorrhage and incidence of macrosomia were higher in the obese group than in the normal and overweight groups in the results of this study, and there was no statistically significant difference in the rate of caesarean section when comparing the three groups, which is consistent with Zhang's study[9]. The study showed that BMI was significantly correlated with cesarean delivery, macrosomia and postpartum hemorrhage rate. And the risk of cesarean delivery rate and incidence of macrosomia were 2.5 times and 2 times higher in obese women respectively compared to normal women. And the rate of postpartum hemorrhage also increased with the increase in BMI [10-11]. The reason why there was no statistical difference between the three groups in this study in terms of the rate of caesarean section after induction of labor with oxytocin may be due to the fact that obese women and their families did not have a strong desire to have a normal delivery and the choice of delivery method was mostly caesarean section, which was not included in this study. Obese women who chose to have a normal birth had a better chance of having a normal birth as they had been fully assessed by the doctor and had better perineal and cervical conditions. The reasons for the high rate of hemorrhage and giant babies in obese women are considered to be related to the accumulation of excess adipose tissue in the abdominal cavity, the relative narrowing of the soft birth canal, which does not facilitate the descent of the fetal head and the lack of abdominal pressure accompanied by weak contractions, leading to an increased rate of postpartum hemorrhage. Also, obese women are prone to giant babies, leading to cephalopelvic disproportion, causing difficulties in labor and increasing the rate of caesarean section and postpartum hemorrhage [12-13].

5. Conclusion

The results of this study show that obese women require more oxytocin and longer induction of labor to achieve vaginal delivery, longer duration of the first and total stage, and higher risk of postpartum hemorrhage and macrosomia. And besity is an independent risk factor for adverse outcomes of induced abortion. Management of obese women should be strengthened with contractions to induce labor, and maternal weight management, fetal monitoring and neonatal monitoring should be strengthened.

Funding

Acknowledgements

effort.

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