Risk Factors and Maternal and Neonatal Outcomes of Pregnancy (Postprint)

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Abstract

Background Standardizing labor management is crucial for ensuring maternal and neonatal safety. Since the publication of the new labor stage guidelines, the definition of prolonged labor has not been emphasized, and minimizing interventions during labor is recommended; consequently, the number of pregnant women with labor duration exceeding 24 hours has increased compared with previous periods.

Objective To analyze the risk factors and maternal and neonatal outcomes in pregnant women with labor exceeding 24 hours and to discuss labor management under the new labor stage guidelines.

Methods In this retrospective study, clinical data were collected from pregnant women who received prenatal care and delivered at the Department of Obstetrics, the First Affiliated Hospital of Nanjing Medical University, from January to December 2022. A total of 40 singleton pregnant women with normal fetal position and prolonged total labor (exceeding 24 hours) were selected as the observational group, and 95 singleton pregnant women with normal fetal position and normal total labor (less than 24 hours) were selected as the control group. The age, BMI, gestational age at delivery, gestational diabetes, gestational hypertension, neonatal birth weight, labor conditions, labor analgesia rate, and labor intervention rate were compared between the two groups. Multivariate Logistic regression analysis was used to explore the risk factors for total labor exceeding 24 hours. Maternal and neonatal outcomes, including intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, postpartum hemorrhage, manual removal of placenta, fetal distress, neonatal asphyxia, and referral to the neonatal intensive care unit (NICU), were compared to identify risk factors and analyze maternal and neonatal outcomes in pregnant women with labor exceeding 24 hours.

Results There were no significant differences in age, BMI, gestational age at delivery, gestational hypertension, gestational diabetes mellitus, or neonatal birth weight between the two groups (P>0.05). The first stage of labor, second stage of labor, and total labor were longer, and the rates of labor analgesia and labor intervention were higher in the observational group than in the control group (P<0.05). Multivariate Logistic regression analysis showed that labor analgesia and intervention were not risk factors for total labor exceeding 24 hours (P>0.05). There were no significant differences in the incidence of postpartum hemorrhage, vaginal instrumental delivery, or fetal distress between the two groups (P>0.05). The incidence of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, and NICU referral was higher in the observational group than in the control group (P<0.05). No neonatal asphyxia occurred in either group.

Conclusion The rates of labor analgesia and labor intervention were significantly increased in pregnant women with total labor exceeding 24 hours due to prolonged labor. Although prolonged labor does not increase the incidence of postpartum hemorrhage, manual removal of placenta, or neonatal asphyxia, it does increase the incidence of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, and fetal distress. Obstetricians and gynecologists should pay attention to the adverse maternal and neonatal outcomes caused by prolonged labor and provide individualized labor management.

Full Text

Risk Factors and Maternal and Neonatal Outcomes of Pregnant Women with Total Labor Duration Exceeding 24 Hours

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Abstract

Background: Standardized labor management is crucial for ensuring maternal and neonatal safety. Since the implementation of new labor standards, the definition of dystocia has been de-emphasized and interventions during labor

have been minimized, resulting in an increased number of pregnant women experiencing labor exceeding 24 hours compared to previous periods.

Objective: To analyze the risk factors and maternal/neonatal outcomes associated with total labor duration exceeding 24 hours and discuss labor management under the new labor standards.

Methods: This retrospective study collected clinical data from pregnant women who received maternity care and delivered vaginally at the Department of Obstetrics, the First Affiliated Hospital of Nanjing Medical University from January to December 2022. A total of 40 singleton pregnant women with normal fetal position and prolonged total labor (>24 h) were selected as the observation group, while 95 singleton pregnant women with normal fetal position and normal total labor (<24 h) served as the control group. The two groups were compared regarding maternal age, BMI, gestational age at delivery, gestational diabetes, gestational hypertension, neonatal birth weight, labor characteristics, labor analgesia rate, and delivery intervention rate. Multivariate logistic regression analysis was used to explore risk factors for total labor exceeding 24 hours. Maternal and neonatal outcomes—including intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, postpartum hemorrhage, manual removal of placenta, fetal distress, neonatal asphyxia, and NICU admission—were compared to identify risk factors and analyze outcomes.

Results: No significant differences were observed between the two groups in age, BMI, gestational age at delivery, gestational hypertension, gestational diabetes mellitus, or neonatal birth weight ($P>0.05$). The observation group had longer first stage, second stage, and total labor duration, as well as higher rates of labor analgesia and labor intervention compared to the control group ($P<0.05$). Multivariate logistic regression analysis showed that labor analgesia and intervention were not risk factors for total labor exceeding 24 hours ($P>0.05$). No significant differences were found in the incidence of postpartum hemorrhage, manual removal of placenta, or fetal distress between the two groups ($P>0.05$). However, the observation group exhibited higher incidences of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, and NICU admission ($P<0.05$). No neonatal asphyxia occurred in either group.

Conclusion: Prolonged labor significantly increases the rates of labor analgesia and labor intervention. Although prolonged labor does not increase the incidence of postpartum hemorrhage, manual removal of placenta, or neonatal asphyxia, it does increase the incidence of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, and fetal distress. Obstetricians should pay close attention to adverse maternal and neonatal outcomes caused by prolonged labor and implement individualized labor management.

Keywords: Parturition; Obstetric labor; Pregnancy outcome; Fetal distress;

Management of labor stage; Labor analgesia; Labor intervention; Risk factors

Introduction

The total labor process encompasses the entire duration from the onset of regular contractions through delivery of the fetus and placenta, divided into three stages: the first stage (cervical dilation), the second stage (fetal delivery), and the third stage (placental delivery). Labor process management is essential for ensuring maternal and infant safety, with standardized and individualized management serving as the primary approach to improving outcomes.

In China, the early labor management model was proposed by Friedman in 1954 and gained worldwide recognition. However, recent clinical practice has revealed that this model is no longer suitable due to increased maternal age at delivery, reduced physical labor, and widespread application of labor analgesia. In 2014, the Obstetrics and Gynecology Group of the Obstetrics and Gynecology Branch of the Chinese Medical Association conducted a comprehensive review of domestic and international literature, referencing guidelines from the National Institute of Child Health and Human Development (NICHD), the American College of Obstetricians and Gynecologists (ACOG), and the Society for Maternal-Fetal Medicine (SMFM), and issued the "Expert Consensus on Criteria and Management of New Labor (2014)" to guide clinical practice in China.

Previously, a total labor duration exceeding 24 hours was diagnosed as dystocia, which was believed to lead to adverse pregnancy outcomes. However, the Expert Consensus on Criteria and Management of New Labor (2014) de-emphasized the definition of dystocia. The new labor model advocates minimizing labor interventions and significantly relaxes the time limits for labor progression, resulting in an increased number of women with total labor duration exceeding 24 hours compared to previous periods. This study analyzed the prevalence, risk factors, and maternal-infant outcomes associated with total labor duration exceeding 24 hours to provide better guidance for clinical practice, individualized labor management, and reduction of adverse maternal and neonatal outcomes.

Materials and Methods

Study Subjects

A total of 135 women who underwent regular prenatal examination and delivered vaginally at the Department of Obstetrics, the First Affiliated Hospital of Nanjing Medical University in 2022 were retrospectively selected. Based on whether total labor duration exceeded 24 hours, participants were divided into an observation group (total labor >24 h, n=40) and a control group (total labor $ $24 h, n=95). Inclusion criteria were: (1) singleton pregnancy; (2) full-term delivery; (3) primigravida; and (4) labor management according to the "Expert

Consensus on Criteria and Management of New Labor (2014)" . The sole exclusion criterion was cesarean delivery. The study was approved by the Ethics Committee of the First Affiliated Hospital of Nanjing Medical University (Luncheon Review No. 2023-SR-362), and all patients provided informed consent.

Data Collection

Clinical data were collected and recorded, with relevant indicators compared between the control and observation groups. General information included maternal age, BMI, gestational week at delivery, gestational hypertension, gestational diabetes mellitus, and neonatal birth weight. Labor characteristics comprised duration of the first, second, and third stages of labor; total labor duration; use of labor analgesia; and labor interventions (including diazepam intravenous injection, pethidine intramuscular injection, resorcinol, oxytocin for augmentation of contractions, and artificial rupture of membranes). Maternal and neonatal outcomes assessed included intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, postpartum hemorrhage, manual removal of placenta, fetal distress, neonatal asphyxia, and NICU admission.

Statistical Analysis

SPSS 23.0 software was used for statistical analysis. Measurement data were tested for normality; normally distributed data were expressed as mean ± standard deviation and compared between groups using independent samples t-test, while non-normally distributed data were expressed as median (P25, P75) and compared using rank-sum test. Categorical data were expressed as frequencies and percentages and compared between groups using ^{2} test. Multivariate logistic regression analysis was employed to investigate factors associated with total labor duration exceeding 24 hours. Statistical significance was defined as $P<0.05$.

Results

General Characteristics

Comparison of maternal age, BMI, gestational week at delivery, gestational hypertension, gestational diabetes mellitus, and neonatal birth weight between the two groups revealed no statistically significant differences ($P>0.05$), as shown in Table 1.

Table 1 Comparison of general maternal and neonatal characteristics between groups

Group	Cases	Age (years)	BMI (kg/m^2)	Gestational week of delivery	Gestational hypertension n (%)	Gestational diabetes mellitus n (%)	Neonatal birth weight (kg)
Control group	95	28.9$±3.0	26.3±2.9	39.7±1.0	5(5.3)	11(11.6)	3.45±0.26
Observation group	40	29.1±3.2	27.3±2.5	40.			

Labor Characteristics

Comparison of the third stage of labor duration between groups showed no statistically significant difference (P>0.05). However, the observation group exhibited significantly longer first stage, second stage, and total labor duration, as well as higher rates of labor analgesia and labor intervention compared to the control group (P<0.05), as shown in Table 2.

Table 2 Comparison of labor characteristics between groups

Group	Cases	First stage duration (h)	Second stage duration (h)	Third stage duration (h)	Total labor duration (h)	Labor analgesia n (%)	Labor intervention n (%)
Control group	95	10.00 (7.50, 13.20)	1.00 (0.63, 1.52)	0.10 (0.07, 0.15)	11.40 (8.20, 14.30)	79 (83.2)	51 (53.7)
Observation group	40	24.00 (22.50, 25.70)	1.80 (0.98, 2.42)	0.10 (0.08, 0.16)	25.80 (24.60, 27.20)	39 (97.5)	40 (100.0)

Multivariate Logistic Regression Analysis

Multivariate logistic regression analysis was performed with total labor duration >24 h as the dependent variable (assigned value: >24 h=1, $ $24 h=0) and independent variables including BMI, gestational week at delivery, neonatal birth weight, and labor analgesia (assigned values: measured values for continuous variables; no=0, yes=1 for analgesia), which were clinical high-risk indicators with P<0.1 in univariate analysis. Results showed that none of these indicators were significant influencing factors for total labor duration >24 h (P>0.05), as shown in Table 3.

Table 3 Multivariate logistic regression analysis of factors influencing labor >24 hours

Variables	Wald ^{2} value	P value	Odds Ratio (95% CI)
BMI	-	>0.05	1.146 (0.987, 1.330)

Variables	Wald ^{2} value	P value	Odds Ratio (95% CI)
Gestational week of delivery	-	>0.05	1.453 (0.943, 2.237)
Neonatal birth weight	-	>0.05	1.001 (1.000, 1.003)
Labor analgesia	-	>0.05	4.376 (0.535, 35.800)

Maternal and Neonatal Outcomes

No statistically significant differences were observed between the two groups in the incidence of postpartum hemorrhage, manual removal of placenta, or neonatal asphyxia (P>0.05). However, the observation group showed significantly higher incidences of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, fetal distress, and NICU admission compared to the control group (P<0.05), as shown in Table 4. Among the 9 neonates admitted to NICU in the observation group, 4 had low oxygen saturation and 5 had tachypnea, all of whom achieved good prognosis.

Table 4 Comparison of maternal and neonatal outcomes between groups

Groups	Cases	Intrapartum fever n (%)	Mediolateral episiotomy n (%)	Vaginal instrumental delivery n (%)	Manual removal of placenta n (%)	Amniotic fluid contamination n (%)	Cervical laceration n (%)	Postpartum hemorrhage n (%)	Fetal distress n (%)	Neonatal asphyxia n (%)	NICU admission n (%)
Control group	95	13 (13.7)	9 (9.5)	1 (1.1)	1 (1.1)	14 (14.7)	4 (4.2)	3 (3.2)	2 (2.1)	0 (0)	11 (11.6)
Observation group	40	19 (47.5)	20 (50.0)	5 (12.5)	5 (12.5)	7 (17.5)	4 (10.0)	9 (22.5)	9 (22.5)	0 (0)	12 (30.0)

Discussion

In 2014, the Obstetrics and Gynecology Group of the Obstetrics and Gynecology Branch of the Chinese Medical Association issued guidelines that de-emphasized the definition of dystocia and advocated minimizing labor process interventions when maternal and fetal conditions permitted, leading to an increased number of mothers with total labor duration exceeding 24 hours compared to previous periods. Although the definition of dystocia is no longer emphasized, prolonged labor may still lead to adverse maternal and infant outcomes. To assess this impact, the present study analyzed influencing factors and outcomes in women with total labor duration exceeding 24 hours to further standardize and guide labor management.

This study compared general conditions between groups, including maternal age, BMI, gestational week at delivery, gestational hypertension, gestational diabetes mellitus, and neonatal birth weight, finding no statistically significant differences. Logistic regression analysis indicated these factors were not high-risk factors for prolonged total labor duration exceeding 24 hours. Khalifa et al. compared 174 women with normal BMI and 164 women with high BMI, finding that among high-BMI women with successful vaginal delivery, neonatal birth weight was significantly increased and both first and second stages of labor were significantly prolonged, resulting in increased risks of chorioamnionitis, cervical laceration, incisional infections, and higher NICU transfer rates. These results differed from those of Shen Nan et al., who found no statistically significant differences in maternal age, gestational week at delivery, BMI, gestational diabetes mellitus, gestational hypertension, preterm rupture of membranes, or labor induction between groups with total labor duration exceeding 24 hours versus $ $24 hours. The present study' s findings were consistent with the latter.

Previous studies have demonstrated that although labor analgesia significantly relieves maternal pain, it substantially increases the incidence of prolonged second stage of labor, leading to adverse maternal and infant outcomes such as chorioamnionitis, cervical laceration, postpartum hemorrhage, and increased NICU admission rates with high short-term adverse neonatal outcome rates. Shen Nan et al.' s study confirmed that labor analgesia is a risk factor for total labor duration exceeding 24 hours. In this study, although the observation group had a higher rate of labor analgesia, it was not identified as a significant risk factor for total labor duration exceeding 24 hours, possibly due to selection bias from the small sample size requiring further investigation. Management of labor following analgesia, particularly during the second stage, should remain a high priority in clinical practice. Additionally, this study found that the rate of labor intervention in the observation group was significantly higher than in the control group, which aligns with previous findings that clinicians often implement active interventions during actual labor management to reduce potential risks of prolonged labor to mother and baby.

This study investigated perinatal outcomes in primiparous women with total labor duration exceeding 24 hours. Results showed no statistically significant differences in postpartum hemorrhage or manual removal of placenta between groups ($P>0.05$), while the observation group exhibited higher incidences of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, and cervical laceration ($P<0.05$). When abnormalities occur, active intervention should be implemented, often resulting in increased rates of labor intervention, vaginal instrumental delivery, and mediolateral episiotomy, consistent with Matta et al.' s findings. Yan Sisi et al.' s 2016 study demonstrated that prolonged labor did not increase postpartum hemorrhage incidence, and similarly, the present study found no significant differences in postpartum hemorrhage or manual removal of placenta, possibly because prolongation of labor and prophylactic use of procoagulant drugs immediately after fetal delivery substantially reduced these complications. Research has also

found that under the new labor model, none of the postpartum complication rates were significantly altered in women with total labor duration exceeding 24 hours. This study found no neonatal asphyxia in either group, but the incidence of fetal distress and NICU admission was higher in the observation group ($P<0.05$). Among the 9 neonates admitted to NICU, 4 had low oxygen saturation and 5 had tachypnea, all achieving good prognosis and discharged within one week. Therefore, although prolonged labor leads to amniotic fluid contamination and increased fetal distress incidence, it does not affect perinatal prognosis or outcomes, consistent with previous studies.

In conclusion, this study demonstrated that under the new labor management model, increased labor duration raised the incidence of maternal fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, fetal distress, and neonatal NICU admission, while showing no statistically significant differences in postpartum hemorrhage, manual removal of placenta, or neonatal asphyxia. These findings suggest that obstetricians and gynecologists, under the new labor management model, should closely monitor labor progress when duration exceeds 24 hours, strengthen interventions, actively promote labor progression, provide symptomatic treatment, ensure maternal psychological well-being, and prepare adequately for assisted delivery and neonatal resuscitation to reduce adverse maternal and neonatal outcomes.

Authors' Contributions

Lu Yihan proposed the research objectives, designed the study, implemented the research, and wrote the manuscript; Wang Jiwen and Sun Yue created and formatted the tables; Feng Runrun, Han Yufei, and Song Zhenzhen collected and organized data and performed statistical analysis; Sun Ying and Dai Huihua revised the manuscript; Chen Xing was responsible for quality control, article review, and overall supervision.

Conflict of Interest

The authors declare no conflict of interest.

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Note: Figure translations are in progress. See original paper for figures.