THE JOURNAL OF OBSTETRICS AND GYNECOLOGY OF INDIA

The Journal of Obstetrics and Gynecology of India (November–December 2018) 68(6):482–486
https://doi.org/10.1007/s13224-017-1083-3

ORIGINAL ARTICLE

Labor Pattern Among Primigravida in Local Population

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Received: 22 March 2017 / Accepted: 5 December 2017 / Published online: 22 December 2017

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Labor pattern in local population Labor pattern in local population described the influence of the demographic and anthropometric characteristics of the population on the labor pattern and the need for the customized labor curve for Indian population to avoid increased cesarean section rate.

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Abstract

Objectives In this study, we tried to make the customized labor curve by studying the labor pattern among the primigravidas and we compared the cervicograph with Zhang's and Suzuki's curves. This study may be a motivator for future research to create own labor norms for our Indian population which may help in reducing the cesarean section rates, principally in primigravidas.

Materials and Methods It was a prospective observational study, which included 156 primigravidas with uncomplicated term singleton pregnancy with spontaneous onset and progression of labor, who had normal vaginal delivery with good maternal and neonatal outcome.

Results The shape of the labor curve of this study was similar to Zhang' and Suzuki–Horiuchi's curves which had slower progression. The active phase started from 5 to

6 cm of cervical dilatation onwards which was similar to Suzuki–Horiuchi's curve. In the present study, the mean rate of cervical dilatation in the active phase was 1.5 cm/hour in contrast to Friedman's study which had a mean rate of cervical dilatation of 3 cm/hour with lower limit of 1.2 cm/hour as 5th centile.

Conclusion In the present study the mean rate of cervical dilatation in active phase in Indian women was approximately equivalent to the lowest acceptable rate of cervical dilatation in Friedman's study. If we continued to follow Friedman's labor norms, it could result in increasing c-sections. Hence, it would be prudent to create a customized labor curve for the local population served based on their individual characteristics features.

Keywords Labor pattern in primigravidas · Customized labor curve · Cervicograph · Labor pattern Indian study · Spontaneous labor

Introduction

The anthropometric and demographic characteristics could vary among population groups. They reflect the characteristics of that specific population. The labor curve was likely to be more representative and clinically more relevant to that specific population when it considered the anthropometric and demographic characteristics also [1]. The labor norms should also consider a woman's race/ethnicity, age, height, weight, gestational age, epidural use and parity. We should consider to modify and to extend the limits for the definitions of normal and the prolonged labor [2]. There was no recent Indian study that represents the pattern of the labor in our population. So we decided to do this study which describes the pattern of the labor in our population.

Materials and Methods

It was a prospective observational study done in Southern Railway Head Quarters Hospital, Aynavaram, Chennai, between 2014 and 2015. This study included only humans. The study population comprised of antenatal patients who had been booked and delivered at Southern Railway Hospital, Chennai, who fulfilled the inclusion criteria. The study was done after clearance from the ethical and scientific committee, and the informed consent was obtained from the patients. The inclusion criteria were primigravidas with age group 18–34 years, BMI 19–25, height > 150 cm, gestational age between 37 weeks 0 days and 41 weeks, singleton pregnancy, spontaneous onset of labor, vertex presentation, estimated fetal weight between 2.5 and 3.5 kg (by Hadlock formula done at term just prior to patient going into the labor), who delivered by normal vaginal delivery with good maternal and neonatal outcome. The exclusion criteria were precipitate labor, preterm, IUGR, patients who had been given epidural analgesia, malposition/malpresentations (confirmed by antenatal ultrasound), c-sections, induced and augmented labors, and medical/obstetric complications.

The labor progress had been plotted in the graph: duration of labor in *X*-axis which had been mentioned in hours (each small box an hour interval) and the cervical dilatation in *Y*-axis in cm (each box one cm).

The general labor protocols were followed.

1. Plotting the partogram from the onset of regular uterine contractions as '0' time similar to Friedman's study.
2. Four hourly per vaginal examination was done in first stage, hourly in second stage and more frequently done if required.
3. In case of PROM, the diagnosis was made by history and clinical examination. If patient was already in labor, she was included in the study.
4. Monitoring of:
   - Fetal heart monitoring: half an hourly in latent phase and continuous CTG (cardiotocogram) monitoring in active phase.
   - Uterine contractions: half an hourly.
   - Maternal pulse rate: half an hourly.
   - Maternal temperature: second hourly.
   - Blood pressure: 4th hourly.
5. Neonatal outcome by APGAR 1 and 5 min and NICU (neonatal intensive care unit) admission details
6. The 4th stage of labor was by monitoring maternal vitals, general condition, uterine size, amount of vaginal bleeding for every 15 min for 1 h, and it was extended if needed.

Outcome measured were

1. Duration of labor for each stage and phases,
2. Deriving the rate of cervical dilatation in active phase,
3. Deriving customized cervicograph for the study population based on the mean rate of the cervical dilatation,
4. Comparing the present study's duration of labor and cervicograph with contemporary labor pattern of various populations.

For statistical analysis

- The data were collected using case record forms and entered on Microsoft Excel spreadsheet.

- Nonlinear regression model was used to plot the labor where the cervical dilatation was plotted against the hours of labor.
- The interval between two cervical dilatations was calculated using IBM®-SPSS®20.2 version for Windows® for statistical analysis.
- Using '*t*' test with IBM®-SPSS®20.2 version for Windows®, the study data were compared considering the pre-existing studies as gold standard. *p* value less than 0.05 was considered for statistical significance.

Results

During this period, 156 antenatal patients fulfilled the inclusion criteria. The demographic characteristics were age in years: mean ± SD (SD—standard deviation) 24.16 ± 2.6, median 24, mode 23, range 19–30; height in cm: mean ± SD 159.3 ± 6.19, median 160, mode 158; body mass index [BMI] of [pre—pregnancy weight]: mean ± SD 21.9 ± 1.59, median 21.9, mode 23; gestational age(GA): mean 38.6 ± 5.86 weeks, median 39.1 weeks, mode 39.2 weeks; the admission cervical dilatation: mean 1.8 cm, median 1 cm; duration of first stage of labor in hours and minutes: mean ± SD 12 h 44 min (min—minutes) ± 5 h 58 min, median 11 h, mode 11 h; the second stage duration in minutes: mean ± SD 34.2 ± 14.05, median 30, mode 30; duration of third stage of labor in minutes: mean ± SD 4.8 ± 0.85, median 5, mode 5. The admission-to-delivery interval, mean ± SD was 12 h 54 min ± 4 h 13 min, median 11 h 13 min, and mode 5 h 30 min; for male babies the admission-to-delivery interval mean ± SD was 13 h 32 min ± 5 h 16 min, and for female babies mean ± SD was 12 h 24 min ± 6 h 38 min. The sex of the baby had no influence on the admission-to-delivery interval ($p > 0.05$), the duration of the first stage and the second stage of the labor ($p > 0.05$).

Birth weight (BW) variables in kg were mean ± SD 2.96 ± 0.28, median 2.95, mode 2.9. The BW correlated positively with the BMI of the mother ($p < 0.01$) and the GA ($p < 0.01$). For male babies, BW in kg was mean ± SD 2.97 ± 0.27, and for female babies, it was mean ± SD 2.95 ± 0.29, and there was no influence of the sex of the baby on BW ($p > 0.05$).

The BMI of the mother correlated positively with the socioeconomic status (SES) ($p < 0.01$) and the GA ($p < 0.01$). The GA correlated positively with the SES ($p < 0.05$) and the duration of the second stage of the labor ($p < 0.01$).

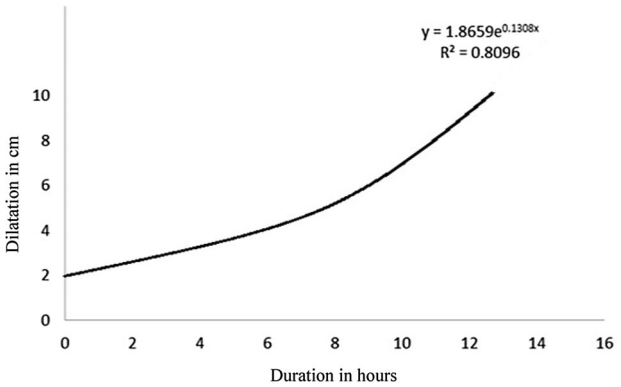

Fig. 1 Labor curve of the present study

Derivation of the Labor Curve of the Present Study

The labor curve was obtained by scatter plotting the time in hours in *X*-axis and the mean cervical dilatation in *Y*-axis (Fig. 1). The curve fitting was done by regression analysis. The better fit to the data was obtained with the exponential form of the function with R^2 value of the function being 0.8096 and F value of the function 110.585** (significant at 99% confidence level [$p < 0.01$]).

The fit form of the exponential curve was $Y = 1.8659e^{0.13086X}$

Y = dilatation in cm

X = duration in hours

The transition time in between each cervical dilatation was more gradual in initial centimeters. There was no definite inflection point in the labor curve. The mean expected time taken for each centimeter cervical dilatation was derived. The rate of dilatation for each hour was obtained from that.

The mean rate of cervical dilatation was 0.885 cm/hr in both latent and active phases. The SD of the rate cervical dilatation was 0.55. The rate of the cervical dilatation doubled in between 5 and 6 cm cervical dilatation onwards (Table 1). So the active phase duration commencement was considered after 5 cm dilation. The mean rate of cervical dilatation in active phase was 1.5 cm/hour with SD of 0.23. The mean duration of the latent phase was 7.37 h and for the active phase 5.1 h respectively. There was a lag in the cervical dilatation in between 8 and 10 cm cervical dilatation. The existence of deceleration phase was observed.

Table 1 The mean expected time for each cm cervical dilatation and the rate of cervical dilatation

Cervical dilatation in cm	Mean duration in hours	Rate of cervical dilatation (cm/hour)
2–3	2.93	0.34
3–4	2.56	0.39
4–5	1.87	0.53
5–6	0.75	1.33
6–7	0.69	1.45
7–8	0.56	1.78
8–9	1.5	0.66
9–10	1.65	0.60

Discussion

From Friedmans work, the lowest acceptable rate of cervical dilatation for the phase of the maximum slope was obtained as 1 cm/hour. This above rule was the base for creating the alert and the action lines by Philpott and Castle for diagnosing labor abnormalities. The WHO [World Health Organization] developed the partogram for labor management which closely resembled the partogram developed by Philpott and Castle. But the risk of misdiagnosing dystocia would be higher if the 1 cm/hour rule was faster than normal progression [3]. By revising the traditional labor curves, the primary cesarean section rate could be lowered [4].

The partogram and the labor norms based on Philpott and Castle study were considered as a standard for labor management. But if the standard partogram did not consider the average labor pattern of a specific population, it could result in untimely intervention in that population [1]. Bogart conducted a retrospective observational study in South Africa. He included 1595 low-risk primigravidas with spontaneous labor onset. In that study, the rate of the cervical dilatation of active phase for entire group was 1.32 ± 0.72 cm. In the present study, the mean rate of the cervical dilatation in active phase was 1.5 ± 0.23 cm which composed of Indian population. By comparing the rate of the cervical dilatation of these two populations, the difference was statistically significant ($p < 0.002$). Every population had a specific character which was unique for them. Bogart concluded that the revised alert line based on the 10th centile of the local population should be created for diagnosing labor abnormalities.

The intrapartum decision making depended on the slowest acceptance limits of labor duration and the rate of cervical dilatation. Neal et al. [5] had done a systemic review which included 18 studies of various populations to assess the mean active phase duration and the rate of cervical dilatation in 7009 low-risk primigravidas with spontaneous onset of labor. The studies with the active labor duration and the rate of the cervical dilatation of primigravidas which had inclusion criteria similar to the present study are mentioned in Table 2. The weighted mean duration of the active labor was 6 h. The weighted mean rate of the cervical dilatation based on the linear calculation was 1.2 cm/hour. They concluded that the active phase duration of the low-risk nulliparous women was longer (6 h) than that of Friedman's study (4.9 h). The slowest acceptable rate of the cervical dilatation was also slower which was 0.6 cm/hour with mean of 1.2 cm/hour instead of Friedman's slowest acceptable rate of 1.2 cm/hour with mean of 3 cm/hour in active phase. The present study results were also similar with the above systemic review.

Laughon et al. [2] compared the labor pattern among 14,791 ancient (CPP—Collaborative Perinatal Project 1959–1966) and 43,576 modern women (CSL—Consortium on Safe Labor 2002–2008) in US population. They concluded that the modern women (CSL) were older with higher BMI which resulted in longer first stage of labor. The second stage duration of labor with spontaneous delivery of CSL women (median 0.9 h) was longer than the duration in the present study (0.3 h). It would be due to differences in the BW of the present study (2.96 ± 0.28) and CSL modern US women (3.19 ± 0.573) which was statistically significant ($p < 0.001$). This finding reinforced that the demographic characters of the specific population would have an influence on the labor duration.

Zhang et al. [6] derived the average labor curve for 27,170 nulliparous women in US population with

Table 2 The active phase duration and the rate of the cervical dilatation of low-risk primigravidas with spontaneous labor onset and progression from Neal et al. systemic review [5]

Studies	Dilatation at active phase onset cervical dilation in cm	Active phase duration mean (in hours)	Rate of active phase dilatation mean (cm/hour)
Alber et al. (1996)	4	7.7	0.8
Alber et al. (1999)	4	7.7	0.8
Gurewitch et al. (2002)	3.1	4.5	1.5
Jones et al. (2003)	4	6.2	1
Present study	5	5.1	1.5

spontaneous labor onset who had normal vaginal delivery and neonatal outcome in the period between 2002 and 2008. That labor curve had slow progression with no definite inflection point. They concluded that the active phase commencement at 6 cm would be more appropriate for that population. Like Zhang's curve, the present study's labor curve also did not have definite inflection point. The active phase commencement of the present study was at 5 cm cervical dilatation. From these evidences, we observed that in the present study modern Indian women also had slower labor progression.

Suzuki et al. [7] studied the labor pattern in 2369 low-risk nulliparous Japanese women with spontaneous labor onset and derived the customized labor curve for that population. The characteristic features of the curve are: the curve had a smooth shape with active phase duration of 5.1 h with slow progression, it was slower than Friedman's curve, the deceleration phase was not observed like Zhang's 2002 curve and the rate of the cervical dilatation started to double at 5–6 cm cervical dilatation onwards. The present study's labor curve also had similar features of Suzuki's curve like slower and gradual progression except existence of phase. Both studies had similar active phase duration. Both study populations belonged to Asian population. This could be the reason behind the above-mentioned findings.

Neal et al. [8] studied the outcome of nulliparous women with spontaneous onset of labor in US population. They included 114 women in pre-active labor. They observed that the commencement of active phase did not occur until 6 cm of cervical dilatation. By comparing the second stage duration (median 79 min) with the present study's duration (30 min), the duration in the present study was shorter. Neal et al. study's US population's mean BW was 3.453 ± 0.466 kg which was heavier than the present study BW ($p < 0.001$). So, we could conclude that the present study Indian babies had lower BW than US babies which resulted in shorter second stage of labor in present study Indian women than in US women. This was another evidence that the demographic characters of a specific population could modify the labor duration of that population.

Conclusion

The duration of the labor was influenced by race, maternal height, weight, BMI and BW. The present study's mean rate of cervical dilatation in the active phase was 1.5 cm/hour which was approximately equivalent to lowest acceptable rate of cervical dilatation of Friedman's study. Therefore, present study population Indian women had longer and slower labor with no inflection point in labor curve and active phase started from 5 to 6 cm cervical dilatation. Hence, continuing to follow Friedman's rate of cervical dilatation and Philpot curve which was adopted from Friedman, there would be more c-sections. This tendency could be effectively curbed by plotting customized labor curves for the local population served.

Acknowledgements The authors express their sincere thanks to Dr. Prasanna Kumar, MD, Medical Director of Southern Railway Headquarters Hospital, Dr. Nirmala Devi, DGO, Senior Divisional Medical Officer, Dr. Kalyani, DGO, DNB, Dr. Rajarajeswari, MD, and Dr. Apernapriya, DNB, Department of Obstetrics and Gynaecology, my father P. Pitchaimuthu, my mother P. Usha, my husband Dr. R. Sathiyanarayanan, my brother P. Kumar, my sister in law R. Ramya and my family members for their immense help in doing this study.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Informed Consent Informed consent was obtained from all the patients for all diagnostic and therapeutic procedures.

Human and Animal Rights This article does not contain any studies with animal subjects.

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