The normal parturient’s admission temperature

David B. Acker, M.D., Erica B. Schulman, M.A., Bernard J. Ransil, M.D.,
Benjamin P. Sachs, M.B., B.S., D.P.H., and Emanuel A. Friedman, M.D., Sc.D.
Boston, Massachusetts

The relationship between oral temperature taken at the time of admission and the duration of elapsed labor was evaluated. Onset of labor data revealed a diurnal distribution with an apogee at midnight to 2 AM and a nadir at 11 AM to noon. Temperature data ranged from 94.3° to 99.7° F (34.6° to 37.6° C). The mean temperature of 97.8° ± 0.8° F (36.6° ± 0.44° C) is significantly lower (p < 0.001) than the clinical reference temperature of 98.6° F (37.0° C). A likely explanation is the coincidental admission time (early to late morning) and the nadir of the diurnal variation in temperature. Linear regression fitted to the data (after deletion of six hypothermic outliers) yielded the relationship: temperature = 97.8° F + 0.0115 x duration of elapsed labor (temperature = 36.6° C + 0.0064 x duration of elapsed labor) for which the correlation coefficient is not statistically significant. (Am J Obstet Gynecol 1987;157:308-11.)

Key words: Febrile morbidity, labor, normal parturient, temperature

Fever is a sign of considerable clinical significance. It is generally defined in medicine as an elevation of body temperature above normal daily variation. Although frequently associated with infection, it may be associated with other conditions or states, including dehydration or prolonged exertion. Difficult or long labors are said to be associated with an increase (rarely above 100.4° F or 38.0° C) in the core temperature.1,2

A parturient's moderately elevated or slightly rising temperature presents the clinician with a diagnostic dilemma. The ability to distinguish between an early infectious process and a variation in the elevation of normal intrapartum temperature has obvious practical importance. Recent obstetric publications have not provided guidelines for interpreting this common finding.3,5

The purpose of this article is to provide a reliable measure of the admission temperature of a group of normal parturients and to determine the variation, if any, of temperature with respect to the duration of labor, thereby providing data to help define both the limits of normal temperature and the level at which fever can be said to exist and warrant investigation and care.

From the Charles A. Dana Research Institute and the Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology and Medicine, Beth Israel Hospital and Harvard Medical School. Supported in part by Grant RR-01032 from the General Clinical Research Centers Program of the Division of Research Resources, National Institutes of Health.

Received for publication October 22, 1986; revised March 12, 1987; accepted April 16, 1987.

Reprint requests: David B. Acker, M.D., Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Beth Israel Hospital, 330 Brookline Ave., Boston, MA 02215.

Material and methods

All patients and their singleton babies delivered at Beth Israel Hospital during the calendar year 1982, numbering 2746 pairs, were available for study. Data were abstracted from the patients' charts, collated, edited, verified, and stored on computer tapes by specially trained staff. The data base consisted of demographic and medical characteristics, obstetric complications, labor and delivery events, and neonatal outcome.

From this population, a subset was selected that fulfilled, on retrospective chart review, the following criteria: the gestational age was 37 to 41 weeks (dating from the last menstrual period); the onset of labor was spontaneous; the membranes were intact (specifically, there was no history of ruptured membranes, no evidence of amniotic fluid was noted in the vagina during the physical examination on admission, and there was subsequent documentation of either spontaneous or artificial rupture of membranes); the gravida delivered spontaneously; and there was no evidence of any antepartum, intrapartum, or postpartum infection or inflammatory disease. In all 502 patients satisfied all criteria and served as the sample population for this study.

The patient's statement concerning the onset of regular uterine contractions, as documented in the admission history, was taken as the time of onset of labor. The parturient's time of admission and concomitant vital signs, which included an oral temperature obtained with an IVAC temperature measuring system (IVAC Corp., San Diego, Calif., accuracy ± 0.2° F or 0.11° C) were recorded by the primary nurse. The difference between the two recorded times was used to define the duration of elapsed labor for the purposes of this investigation. Although additional temperature
readings were made periodically over the course of the labor, usually at 4-hour intervals, only the first recording was used in this study.

The onset of labor, temperature on admission, and duration of elapsed labor data were evaluated for the distribution properties by means of D'Agostino's statistic, histograms, skewness (degree of asymmetry), and kurtosis (degree of peakedness) and plotted to evaluate the relationship, if any, between temperature and duration of elapsed labor. The resulting observed linear relationship was evaluated by linear least squares regression.

**Results**

The relationship between the percentage of gravidas perceiving the onset of regular contractions and the time of day of that perception is displayed in Fig. 1. A definite diurnal distribution is evident with an apogee between midnight to 2 AM and a nadir between 11 AM to noon.

The temperature readings obtained on admission are displayed in Fig. 2. The range for the 502 normal gravidas was 94.5° to 99.7° F (34.6° to 37.6° C). The average temperature was 97.8° ± 0.8° F (36.6° ± 0.44° C) (mean ± SD). These data were not normally distributed by D'Agostino's statistic (p < 0.01). A histogram showed both significant kurtosis (p < 0.01) and significant negative skewness (p < 0.01).

The duration of elapsed labor data exhibited a Poisson distribution, with a range of 0.25 to 32 hours (Fig. 3). More than half (56.4%) of the patients were admitted within 5 hours of the onset of labor. The nonnormal character of the distribution is further illustrated by the low median value, 4.25 hours, compared with an arithmetic mean of 5.89 hours, and the large coefficient of variation (84%). Distribution typing established that the duration of elapsed labor data were log normal in character with a geometric mean of 4.31 hours.

To evaluate the relationship between temperature and the duration of elapsed labor, a correlation scatterplot (Fig. 4) was made, which yielded a wedge-shaped distribution about a temperature of 97.8° F (36.6° C). A linear regression fitted to the data yielded the relationship: temperature = 97.8° + 0.0148 × duration of elapsed labor (temperature = 36.6° C + 0.0082 × duration of elapsed labor). The correlation (r = 0.09) and linear behavior were statistically significant at the p = 0.04 level.

**Comment**

The onset of labor data of these 502 normal parturients reveal a diurnal distribution rhythmicity that has previously been noted by Kaiser and Halberg and by Shettles. For a disproportionate number of patients and for reasons that remain unexplained, the initiation or the perception of the initiation of spontaneous labor
(in the presence of intact membranes) occurs during periods of rest or sleep.

The temperature data exhibit two interesting features. First, the mean temperature of 97.8° ± 0.8° F (36.6° ± 0.44° C) is significantly lower (p < 0.001) than the clinical reference temperature of 98.6° F (37.0° C); indeed, 79% of the patients have a temperature less than 98.6° F (37.0° C). Furthermore, the temperature distribution is skewed significantly toward lower temperatures.

The elapsed duration of labor data offers a clue to a likely explanation. Most of the patients experienced the onset of regular contractions in the very late evening or early morning hours. The median time from the onset of labor to admission was 4.25 hours. Therefore it is likely that most of the patients were admitted (and had their temperature taken) during just that period of the morning when the diurnal variation of temperature in pregnancy was at its nadir.*

However, several other factors might account for the findings: the accuracy of the measuring system (varies ± 0.2° F or 0.11° C), an error in the clinical use of the digital thermometer, an error in the acceptance of the clinical norm (obtained in the days when mercury thermometers were the standard measurement device), or a bias toward hypothermia in this sample population (as suggested by the negative skewness in the histogram).

However, the inaccuracy of ± 0.2° F (0.11° C) does not explain a difference of four times that value.

The digital thermometer may not be properly standardized or used, or it may detect temperature correctly, or the older mercury thermometers consistently were overread. Alternatively, both measurement devices could be in error and contribute to the relatively small difference of 0.8° F (0.44° C). These are important technologic issues that the design of this study does not address.

Turning to the remaining factor, the possibility of bias, we note that the histogram of this population (Fig. 2) shows a small group of six patients at the extreme low end of the temperature scale. The mean of these cases represent a hypothermic subpopulation and that the parent distribution is bimodal and nonhomogeneous.

Acting on this assumption and deleting these six possible outliers yields a sample population of 496 gravidas that is normally distributed by D’Agostino’s statistic and does not differ significantly in mean ± SD from the unedited sample (97.9° ± 0.7° F versus 97.8° ± 0.8° F) (36.6° ± 0.39° C versus 36.6° ± 0.44° C). Skewness (p = 0.02) and kurtosis (p = 0.05) are still statistically significant (but borderline). The range of temperatures decreases from 5.4° to 3.8° F (3.0° to 2.1° C).

A correlation scatterplot of the edited distributions (not shown) yields a linear regression of the form: temperature = 97.8° F + 0.0115 × duration ofelapsed labor (temperature = 36.6° C + 0.0064 × duration of elapsed labor) for which the correlation coefficient (r = 0.076) is not statistically significant.

Therefore the outcome of analysis is a sample distribution of 496 individual gravidas who were admitted
with a mean temperature of 97.9° ± 0.7° F (95% confidence limits ± 0.07%) or 36.6° ± 0.39° C (95% confidence limits ± 0.04%) after a mean (arithmetic) duration of elapsed labor of 5.9 ± 2.6 hours (95% confidence limits ± 0.4%). The more precise (but less clinically familiar) geometric mean duration of elapsed labor was 4.31 hours (almost identical to the median). Therefore these cases may be regarded as a reference population from which the following clinical inferences may be drawn.

The diurnal variation in the onset of labor and a gravida's normal temperature is well established but not frequently emphasized clinical concepts. The clinician should be alert to the significance of the time of day of a gravida's admission and the resulting admission temperature.

An admission temperature of 99.4° F (37.4° C), which represents the mean ± 2 SD, in a normal parturient with intact membranes is uncommon (especially in the morning hours). It can be expected to occur, with use of a one-tail value, on the basis of our distribution, once in 50 cases. Values of 100.2° F (37.9° C), which represent the mean ± 3 SD, should not occur but once in 1000. The reasonableness of these frequencies can be tested against the current data base. Six of 496 patients have a temperature >99.4° F (37.4° C) whereas 10 are expected due to chance. There are no patients whose temperature exceeds 99.7° F (37.6° C), whereas two are expected due to chance.

Therefore in the absence of a history of ruptured membranes, a temperature elevation >99.4° F (37.4° C) may be indication of an abnormality such as unsuspected leakage of amniotic fluid (although not found in this series). A careful examination to confirm the presence of intact membranes should be initiated. This should include at the least visualization of the vaginal vault and fornices for amniotic fluid and the performance of a fern or Nitrazine paper test on suspected secretions. An ultrasonographic evaluation of amniotic fluid volume should be considered. Whether the membranes have ruptured, other sources of inflammation or infection should be considered. If the cause for the temperature elevation cannot be found, prudent management should include close observation and a well monitored in-hospital labor. Regardless of the duration of labor at the time of admission, the parturient should not be sent home.

Presently, the difference between the lower temperatures observed in this study and the more conventionally accepted reference temperature (98.6° F or 37.0° C) and the lack of any observed relationship between duration of elapsed labor and the admission temperature should not be taken to be in disagreement with the classic clinical teaching. Previous works related prolonged or difficult labors (inevitably associated with ruptured membranes and multiple pelvic examinations) to a slight rise in temperature. Our results are applicable only for the clinical conditions specified within this study. It would be inappropriate to generalize these data to other situations.

The data needed for correct interpretation of temperature in association with other than intact membranes are not available; a suitably designed prospective study is needed.

We thank Dr. Irwin H. Kaiser for his review of this manuscript and wise suggestions for its improvement. Data analysis was performed with the Core Laboratory Computer facilities.

REFERENCES