Intrapartum Foetal Monitoring

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Electronic foetal heart-rate monitoring and foetal scalp-blood sampling are two commonly used diagnostic procedures for assessing foetal condition during labour. This review describes the techniques employed, and the interpretation of the information provided by these procedures.

Electronic foetal heart-rate monitoring

In current practice, electronic foetal heart-rate monitoring is performed by either the internal or the external method. With the internal method, an ECG electrode is applied directly to the foetus, and the monitor separates the foetal electrocardiogram from the maternal, amplifies the foetal signal and measures the intervals between consecutive foetal heart beats. The external method depends on detection of ultrasound reflected off moving heart structures. In both methods the intervals between consecutive heart beats are converted into displayed instantaneous heart rates. The calculated heart rates are recorded continuously on a strip chart along with a measure of uterine activity, provided either by an external tocodynamometer or an internal intrauterine pressure catheter (IUPC).

Heart-rate tracings are evaluated for the baseline heart rate, heart-rate variability, and periodic changes in rate. The normal baseline rate is between 120 and 160 beats per minute. By convention, baseline rate is measured at a time when no uterine activity is present.

Variability may be described as either short-term (beat to beat), or long-term variability. In clinical practice, more significance is assigned to long-term variability. Long-term variability is more easily measured and provides a more accurate indication of foetal oxygen reserve than does beat-to-beat variability. Normal long-term variability has an amplitude of at least five beats per minute, occurring at a frequency of three to five cycles per minute. Periodic changes in the foetal heart rate, by definition, are those which occur during and immediately following a uterine contraction. Increases in rate, or accelerations, are for the most part innocu-

ous, and when associated with foetal movements are a good indication of adequate foetal oxygen reserve.

Decreases in rate, or decelerations, may be either early, late or variable. Early decelerations begin within five to ten seconds of the onset of contractions, have a uniform shape, and return to the baseline by the end of the contraction. This pattern may be caused by foetal head compression. Early decelerations have no clinical significance and require no intervention.

Late decelerations begin late in the contraction phase, the nadir usually occurs more than 20 seconds after the peak of the contraction, and the return to baseline occurs after the end of the contraction.

Variable decelerations are the most frequently observed deceleration pattern. They are variable in shape and time of onset. The onset and return to the baseline is usually abrupt and the descent from the baseline frequently reaches below 100 beats per minute.

Proper interpretation of alterations in the foetal heart-rate tracings must take into consideration the presence or absence of antepartum conditions detrimental to maternal or foetal health, maternal medications, and intrapartum factors interfering with the normal progress of labour. Changes that occur at any specific time must also be evaluated in terms of previous evidence of a healthy or sick foetus.

The following examples illustrate normal and common abnormal patterns of foetal heart tracings. The distance between vertical lines is one minute. The upper panel is the foetal heart rate tracing, in beats per minute, while the lower panel shows the uterine activity (UA).

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FIGURE 1 Normal: Each division of horizontal axis is one minute (Figures 1–5). The baseline heart rate is 135 beats per minute; long-term variability is present; no periodic changes are noted. This tracing indicates a healthy foetus with a good oxygen reserve.

FIGURE 2 Tachycardia and Reduced Variability: Marked foetal tachycardia with a baseline heart rate of 220 beats per minute. Long-term variability is absent. This tracing strongly suggests foetal compromise and further steps to define the severity and cause of the problem must be taken. Other causes of persistent tachycardia are foetal immaturity, maternal pyrexia, intrauterine sepsis, early foetal hypoxia, or medications such as atropine or vasodilator. Absent variability may also occur during the foetal sleep cycle, which may last from 20 to 30 minutes. Absent variability may also be due to foetal neurological immaturity, or maternal drugs such as atropine, scopolamine, sedatives, and narcotics. However, when long-term variability is absent, foetal hypoxia must always be suspected.

FIGURE 3 Early Decelerations: The baseline heart rate is 155 beats per minute, with good long-term variability, and early decelerations (onset early in contraction, uniform shape, return to baseline by end of contraction). This pattern suggests the presence of a healthy foetus. Early decelerations are the result of increased vagal tone associated with head compression during contractions.

FIGURE 4 Variable Decelerations: The baseline heart rate is 150–160 beats per minute, with the presence of long-term variability, and variable decelerations. Despite the degree of change in foetal heart rate during the deceleration, the long-term variability is reassuring of an adequate foetal oxygen reserve. The double peak in the uterine contraction tracing suggests that this patient may be advancing into the second stage of labour. Variable decelerations commonly accompany the second stage.

Variable decelerations may also be associated with umbilical cord compression. In the presence of persistent variable decelerations, intervention should include stopping an oxytocin infusion, a change of maternal position, ensuring adequate maternal blood volume replacement, and administration of oxygen. If variable decelerations continue to worsen, a pelvic examination must be done, to exclude cord prolapse.

FIGURE 5 Late Decelerations: The baseline heart rate is 145 beats per minute, with absent long-term variability and marked late decelerations. Usually late decelerations are less pronounced than present in this example. Late decelerations may occur with uterine hypertonus, abruptio placenta, and maternal hypoxia or hypotension. A pattern of subtle late decelerations associated with absent long-term variability is ominous. Intervention initially is the same as for persistent variable decelerations. However, if the pattern persists, foetal scalp-blood sampling is indicated.

Foetal Scalp-blood Sampling

To obtain foetal scalp blood, the scalp is visualized through a special endoscope, an incision is made with a specifically designed blade and blood is collected in a capillary tube. The pH (hydrogen ion activity) of the blood is measured. Table 1 summarizes normal and abnormal results. The foetal pH is normally greater than 7.25 during labour. If the pH is less than 7.20, preparation should be made for immediate delivery, maternal pH determined, and scalp sampling repeated. Confirmation of foetal acidosis without maternal acidosis should be followed by immediate delivery, especially if this finding is associated with persistent late decelerations and absent variability.

TABLE 1 Suggested Management Based on Foetal Scalp-Blood analysis

pH	Hydrogen Ion Activity (n mol/Litre)	Management
Greater than 7.25	Less than 56	Continue monitoring
7.20–7.25	63–56	Repeat in 15–20 minutes
Less than 7.20	Greater than 63	If confirmed, deliver immediately

Summary

With the widespread use of electronic foetal heart-rate monitoring and foetal scalp sampling to detect foetal asphyxia during labour, one must be cognizant of the limitations of these procedures. They are only a reflection of foetal status up to the moment of sampling and cannot anticipate all the changes that may still occur before or during delivery. Clinical experiences have shown that about 95 per cent of the foetuses with a normal heart rate tracing have a one-minute Apgar score of seven or more, but about one-third of the foetuses with abnormal heart rates are also vigorous at birth.³

In conclusion, properly performed and interpreted foetal heart-rate monitoring and scalp sampling are valuable aids in assessing the foetus during labour.

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