THE EFFECT OF MANUAL FETAL SCALP STIMULATION ON FETAL HEART RATE DURING LABOR

by

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This thesis has been read by each member of the following supervisory committee and by majority vote has been found to be satisfactory.
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I have read the thesis of [redacted] Seklemian in its final form and have found that (1) its format, citations, and bibliographic style are consistent and acceptable; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the Supervisory Committee and is ready for submission to the graduate school.

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ABSTRACT

Accurate assessment of the state of fetal well-being during labor is a priority and more accurate assessments are obtained if multiple parameters are assessed.

This investigator proposed manual fetal scalp stimulation as an assessment tool that is easily performed, gives immediate results, and is less invasive than other tools. Fetal heart rate accelerations meeting specific criteria are indicative of fetal well-being. In this study, it was hypothesized that manual fetal scalp stimulation would produce fetal heart rate accelerations in the low-risk fetus during labor.

An equivalent time samples design was used to study 28 low risk maternal/fetal dyads. Fetal heart rate patterns were observed, evaluated, and measured 112 times. One-half of these observations were preceded by manual fetal scalp stimulation. Fetal heart rate accelerations were measured by established criteria. Results supported the hypothesis that manual fetal scalp stimulation does produce fetal heart rate accelerations (p < .001).
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- To my four parents, thanks for always being there with love and understanding. Your confidence in me enables me to succeed.

- To my sister, you are my special friend, who always has time to listen and care.
CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

Introduction

A goal of patient care during labor and delivery is to maintain a state of fetal well-being. If fetal well-being can be maintained, then the prognosis for a favorable delivery outcome can be made. Many methods are presently available to evaluate the state of fetal well-being. The most sensitive indicator of fetal status is fetal heart rate. The fetal heart rate is an indirect indicator of fetal health during labor (Bracero, Schullman & Baxi, 1986). Monitoring fetal heart rate patterns is beneficial in assessing fetal well-being because it is an indirect measure of fetal and placental oxygen reserve (Rayburn, Duhring & Donaldson, 1978).

Many different fetal heart rate patterns have been studied in the process of evaluating fetal status. Fetal heart rate accelerations have been shown to be a reflection of fetal well-being (Lee, Di Loreto & O'Lane, 1975; Rayburn et al., 1978). The presence of accelerations has been correlated with good neonatal outcomes and is
considered to be an appropriate fetal response to stimulation (Clark, Gimovsky & Miller, 1984; Harvey, 1987). If fetal heart acceleration patterns can be elicited from a fetus during labor, then it is reasonable to predict a favorable neonatal outcome.

Purpose

The purpose of this study was to investigate the effects of manual fetal scalp stimulation on the fetal heart rate during labor. The study was proposed to add to the body of health knowledge with regard to how a low-risk fetus responds to scalp stimulation, thereby providing a less invasive, easier method to elicit fetal heart rate accelerations during labor. The results of this study could provide expanded nursing knowledge and improved quality of care for the fetus during labor.

Problem Statement

The problem considered in this investigation was to identify the effects of manual fetal scalp stimulation on the fetal heart rate during labor.

Conceptual Framework

When a fetus is stimulated, a variety of responses may be anticipated, including fetal movement and changes in fetal heart and respiratory rates (Timor-Tritsch, Dierker, Hertz & Rosen, 1979). The fetal heart rate is controlled by the autonomic nervous system. The sym-
pathetic branch increases the heart rate and the parasympathetic branch decreases the heart rate (Barrada, Edwards & Hakanson, 1979; Bracero et al., 1986; Freeman, 1987; Harvey, 1987; Martin, 1978; Sampson, Mudaliar & Lele, 1980). The cardioaccelerator center, part of the autonomic nervous system, is believed to control the tachycardic response of the heart rate to stimulation (Gandhi & Gugliucci, 1982; Lee et al., 1975). In 1975, Lee and associates reported that the cardioaccelerator nerves were responsible for the normal cardiac response in adults to accommodate the change from rest to work. Lee then applied this same concept to explain the fetal heart rate accelerations that he found frequently accompanied fetal movement.

In 1982, Gandhi and Gugliucci reported that excitation of the fetal central or peripheral nervous system may cause a reflex acceleration of the fetal heart rate. Authorities agree that the appropriate response of a healthy fetus to stimulation, whether it is sound, movement, or touch, is acceleration of the fetal heart rate (Lee et al., 1975; Clark et al., 1984).

Fetal heart rate accelerations have been shown to reflect an intact fetal nervous system, thus indicating a state of fetal well-being (Clark et al., 1984; Freeman, 1987; Gross, Sokol & Rosen, 1979; Krebs, Petres, Dunn & Smith, 1982; Lee et al., 1975, 1976). Fetal heart rate
accelerations, in response to stimulation during labor, have been correlated with good neonatal outcomes (Harvey, 1987; Krebs et al., 1982; Lee et al., 1975; Patrick, Carmichael, Chess & Staples, 1984; Sampson et al., 1980). Evaluating the fetal heart monitor strip for the presence of fetal heart rate accelerations is an efficient, readily available, and inexpensive way of assessing the state of fetal well-being (Krebs & Petres, 1978).

Review of the Literature

History of Fetal Monitoring

The fetal heart rate is one of the most important vital signs of the fetus in utero. Historians report that in 1821, Kergaradec was the first to attribute clinical importance to the auscultation of the fetal heart rate (Goodlin, 1979; Gross et al., 1979; Miller & West, 1986). During the mid 1800s, Kennedy studied and wrote about the clinical importance of various fetal heart rate patterns (Goodlin, 1979). In 1848, Kilian first suggested that the fetal heart rate might be used to diagnose fetal distress (Miller & West, 1986). These studies encouraged physicians to auscultate the fetal heart rate for 30 seconds after a uterine contraction. However, the focus of the physician's attention was on the extremely high maternal morbidity and mortality rates around the turn of the century (Goodlin, 1979).

During the mid 1950s, with greatly reduced maternal
mortality rates, obstetricians began to concentrate upon the welfare of the fetus (Goodlin, 1979). Auscultation of the fetal heart rate with an obstetrical head stethoscope (fetascope) became the accepted standard of care (Goodlin, 1979; Miller & West, 1986). While auscultation was shown to have merit in establishing the presence of a fetal heart rate, there were reported problems in the assessment of fetal status. Documented problems included inability to hear due to a thick maternal abdomen or uterine wall, the position of the placenta, the fetal position, and the amount of amniotic fluid (Fox & Druzin, 1983). Another complaint was that intermittent auscultation only sampled a portion of the fetal cardiac cycle and, therefore, was not an accurate indicator of fetal status (Fox & Druzin, 1983; Miller & West, 1986). In 1968, Benson and associates reported that auscultation was not a reliable indicator of fetal distress (Goodlin, 1979; Miller & West, 1986).

Electronic fetal monitoring was developed in the 1960s. Hon first reported a technique of electronic fetal monitoring in 1958, and by 1969 an apparatus for electronic fetal monitoring was commercially available (Miller & West, 1986; Shy, Larson & Luthy, 1987). In 1972, an international conference established nomenclature and developed standards for fetal heart rate monitoring (Miller & West, 1986).
The ability to continuously record and auscultate the fetal heart rate has dramatically changed modern obstetrical practice. Continuous electronic fetal monitoring provides valuable information about fetal status. Changes in fetal blood acid-base balance, which influence fetal heart rate and the respiratory component of the placenta's function, can be assessed by electronic fetal monitoring (Duhring, 1979). Currently, it is the accepted standard of care to provide laboring women with continuous electronic fetal monitoring (Duhring, 1979; Miller & West, 1986; Shy et al., 1987).

Patient safety is an important consideration during electronic fetal monitoring. Any electrical device operated at the bedside must meet strict regulations as set by the individual hospital and the Association for the Advancement of Medical Instrumentation (Pillay, Chik, Sokol & Zador, 1979). Concerns about increased risk to the patient have been considered. It has been reported that in patients with electronic fetal monitoring, there were no differences in the maternal postpartum infection rate or the neonatal infection rate (Haverkamp et al., 1979).

**Fetal Monitoring Equipment**

Determination of the fetal heart rate has been accomplished by many different modes. Currently two methods are most frequently used during labor. Ultrasound
of the fetal heart rate was proposed by Doppler in 1842 (Goodlin, 1979). By 1964, the ultrasonic doppler transducer had been refined and became a very successful external instrument used in detecting the fetal heart rate antenatally and during labor. This ultrasound transducer detects the shift of the sound waves as they are reflected from the moving fetal heart (Miller & West, 1986). Internal fetal heart monitoring can also be accomplished. In 1963, Hon's modification of a Michelle skin clip allowed a direct pickup of the fetal electrocardiogram (Goodlin, 1979). Today, the spiral fetal scalp electrode is frequently used to determine the fetal heart rate during labor.

Monitoring uterine contractions is also an important part of electronic fetal monitoring. This may be accomplished by either an external or an internal method. The external method requires placement of a tocotransducer on the maternal abdomen. It is a pressure sensor that records the frequency and duration of uterine contractions (Fox & Druzin, 1983; Goodlin, 1979). The internal method requires the placement of a fluid-filled plastic catheter through the cervix into the uterine cavity. The intrauterine pressure is transmitted through the catheter to a strain gauge where the pressure is measured in millimeters of mercury (Miller & West, 1986). The internal method has the advantage of allowing the health care
provider to record the intrauterine pressure in conjunction with the frequency and duration of contractions.

The electronic fetal monitor records the information received pertaining to fetal heart rate and uterine contractions. This record is a timed moving strip chart that shows the fetal heart rate pattern and the uterine contraction pattern (Fox & Druzin, 1983). This strip provides the information necessary to comment upon the type of fetal heart rate pattern present (Gross et al., 1979).

### Fetal Heart Rate Patterns

The fetal heart rate has been classified into various types of patterns depending upon the recorded tracing of the fetal heart rate on the fetal monitor strip. The tracing of the fetal heart rate is visually inspected and then classified according to its characteristics. The various types of fetal heart rate patterns are described below.

Baseline fetal heart rate is the number of beats per minute that is maintained over a 10-minute period and is the rate during intervals in between contractions or other significant events (Krebs, Petres, Dunn, Jordaan & Segreti, 1979a,b; Miller & West, 1986). Normocardia baseline is defined as 120 - 160 beats per minute, tachycardia is defined as 160 - 180 beats per minute, and bradycardia is defined as below 100 beats per minute (Fox
Fetal heart rate variability consists of the irregular oscillations or fluctuations in the recorded heart rate that are secondary to the constantly changing fetal heart rate (Krebs & Petres, 1978; Krebs et al., 1979a,b). The resting heart rate of a healthy fetus, newborn, or adult will show a considerable moment-to-moment variability around the average baseline rate when recorded by instantaneous monitoring (Martin, 1978).

Fetal heart rate variability has two components, long-term and short-term variability. Short-term or beat-to-beat variability describes the changes in the interval between two successive fetal electrocardiograph complexes. It is a product of the interaction between the sympathetic and parasympathetic components of the autonomic nervous system (Fox & Druzin, 1983; Gross et al., 1979). Short-term variability is defined as being either absent or present. Present short-term variability is the normal finding for a healthy fetus and reflects fetal well-being (Franz, 1983; Sampson, Mudaliar & Lele, 1980). Long-term variability is defined as the oscillations of the fetal heart rate that are described in terms of frequency of cycles per minute and of amplitude in beats per minute (Gross et al., 1979). Normal frequency for long-term variability is two to six cycles per minute. Normal
amplitude is 10 to 15 beats per minute (Gross et al., 1979; Quirk & Miller, 1986).

Fetal heart rate variability is a very important characteristic of the fetal heart rate pattern. Variability contains information about fetal well-being (Young, Weinstein, Hochberg & George, 1978). It represents normal neurologic modulation and cardiac responsiveness, and is a measure of fetal reserve (Miller & West, 1986).

Periodic changes in the fetal heart rate are defined as changes that are below or above the established baseline rate. These changes are classified as accelerations and decelerations.

Accelerations of the fetal heart rate are defined as a rise of the fetal heart rate above the established baseline. Accelerations that indicate fetal well-being are defined as rising to a peak of at least 15 beats per minute and the entire acceleration being maintained for at least 15 seconds (Barrada et al., 1979; Bracero et al., 1986; Clark & Paul, 1985; Gagnon, Campbell, Hunse & Patrick, 1987; Harvey, 1987; Krebs et. al., 1979a,b). Lee and associates (1975, 1976) found that accelerations were the most noted fetal heart rate change throughout labor. Their studies are the most notable and quoted concerning accelerations.

It is the consensus of the reviewed investigators that the observation and proper evaluation of fetal heart
rate accelerations will give a reflection of fetal well-being (Fox & Druzin, 1983; Freeman, 1987; Freeman, Anderson & Dorchester, 1982; Gross et al., 1979; Krebs et al., 1982; Lee & Drukker, 1979; Lee et al., 1976; Martin, 1978; Miller & West, 1986).

Fetal heart rate decelerations are changes in the rate below the established baseline. Decelerations are divided into different types and will only be described here briefly as reported by many of the reviewed resources (Franz, 1983; Gross et al., 1979; Low et al., 1981; Martin, 1978; Miller & Paul, 1978; Miller & West, 1986). Early decelerations are uniform in shape, begin early in the uterine contraction, and return to baseline with the end of the contraction. The fetal heart rate rarely falls more than 20 to 30 beats below baseline. Authorities agree that early decelerations are caused by compression upon the fetal head. Early decelerations are not associated with fetal compromise. Variable decelerations are variable in duration, intensity, and relationship to the uterine contraction. These decelerations are caused by compression of the umbilical cord. The amount of fetal compromise will vary directly with the duration, frequency, and degree of cord compression and with the amount of fetal reserve. Late decelerations are described as having an onset 20 to 30 seconds after the onset of the uterine contraction and not returning to baseline until
after the contraction is over. Late decelerations are often subtle. The fetal heart rate may not fall any more than 10 to 30 beats below the baseline. Late decelerations are caused by uteroplacental insufficiency, and, if repetitive, can be associated with either acute or chronic fetal distress.

Assessments of Fetal Well-Being

Antepartum. Antepartum fetal assessments allow the health care provider to continually ascertain fetal well-being to ensure timely delivery of a healthy infant (Franz, 1983). Antepartum fetal assessments began in 1966 when Hammacher introduced the oxytocin challenge test (OCT) (Duhring, 1979). This test evaluated the fetal heart rate for reassuring patterns while uterine contractions were elicited. Reassuring patterns include good variability and accelerations with no serious variable decelerations or repetitive late decelerations. The OCT procedure includes administration of pitocin to induce the needed uterine contractions (Duhring, 1979). Currently, nipple stimulation can usually replace the need for pitocin in inducing contractions. After completion of the test, the health care provider will evaluate the monitor strip and make an assessment of the state of fetal well-being.

A simpler and less time-consuming test for antepartum fetal well-being has been in use since 1975. It is called
the nonstress test (NST) (Barrada et al., 1979; Duhring, 1979). NST theory is based on the belief that a fetus with good reserve will accelerate its heart rate in response to the stimulation of fetal movement (Krebs et al., 1979a,b; Lee et al., 1975). The NST correlates fetal movement with associated fetal heart rate accelerations in the assessment of fetal well-being (Evertson, Gauthier, Shifrin & Paul, 1979; Lee et al., 1976). If fetal heart rate accelerations are present, then the NST is said to be reactive and is an indicator of antepartum fetal well-being (Evertson et al., 1979; Gandhi & Gugliucci, 1982; Read & Miller, 1977). Many studies have shown that the reactive NST is a reliable indicator of antepartum fetal well-being (Serafini et al., 1984). The benefits of the NST are that it is noninvasive, convenient, and yields accurate, reliable, and immediately available results (Brar, Platt & Devore, 1987; Nochimson, Turbeville, Terry, Petrie & Lundy, 1978; Read & Miller, 1977). Currently, health care providers will assess antepartum fetal well-being by performing an NST, and only if the NST is not reactive will the health care provider perform a contraction stress test.

Studies have demonstrated that the autonomic control of the fetal heart rate in a healthy fetus is not mature until 30 weeks gestation, so it is recommended that NSTs should not be initiated until after this point in the
Recently, the NST has been augmented by fetal acoustic stimulation testing. It has been found that by stimulating the healthy fetus with sound, fetal heart rate accelerations can be elicited, thus giving the results of a reactive NST (Smith, Phelan, Platt, Broussard & Paul, 1986; Trudinger & Boylan, 1980).

**Intrapartum.** Labor represents a physiological stress to the fetus. Uterine contractions are a repetitive stress because of the transient reduction in placental blood flow and oxygenation (Gaziano & Freeman, 1979). Assessment of the fetal heart rate and the uterine contraction pattern from the monitor strip will provide the data necessary to ascertain fetal status during labor (Bracero et al., 1986; Pillay et al., 1979). The presence of fetal heart rate variability and accelerations demonstrate an intact fetal neurocardic system and a fetus with sufficient reserve in terms of levels of oxygenation and placental reserve to tolerate the stress of labor well (Powell, Melville & MacKenna, 1979). When fetal heart rate patterns are normal, it is the reflection of a state of fetal well-being and can be correlated with good fetal outcome (Bracero et al., 1986; Gaziano & Freeman, 1979).

Unimpeded umbilical blood flow is of prime importance for fetal well-being (Marx, Patel, Berman, Farmakides &
Schulman, 1986). During late pregnancy when a woman lies supine, the enlarged uterus compresses both the inferior vena cava and the abdominal aorta (Marx et al., 1986). This compression results in reduction of uterine arterial blood flow and maternal hypotension (Abitbol, Monheit, Poje & Baker, 1986). Abitbol (1985) reported abnormal fetal heart rate patterns resulting from reduced uterine blood flow as a consequence of aortic compression. In 1988, Calvin, Jones, Knieriem, and Weinstein reported the beneficial hemodynamic effects of the pregnant woman lying in the lateral position. They concluded that in order to maintain the best possible uterine blood flow, thus providing the fetus with optimal blood flow, the maternal position should be lateral. Researchers agree that women in the last part of pregnancy should avoid the supine position and choose the lateral position for labor.

In 1961, Saling introduced fetal scalp blood pH sampling as an assessment of fetal status during labor (Goodlin, 1979). The procedure, described by Wood in 1978 and Duhring in 1979, is accomplished by placing the patient in a supine position and placing an amnioscope vaginally. The fetal scalp is exposed using a fiberoptic light. The scalp is rubbed vigorously to cause hyperemia. Two or three stab incisions are made close together in the scalp. The blood sample is collected in a heparinized
tube and taken immediately to the lab for pH analysis. Pressure against the fetal scalp after sampling is necessary to stop bleeding. Normal fetal pH values are between 7.25 and 7.35, values between 7.25 and 7.20 are considered preacidotic, and those below 7.20 are considered acidotic (Bracero et al., 1986 Seeds, 1978).

There are many problems associated with fetal scalp sampling. Technically, the pressure on the amnioscope cannot be too strong or the scalp circulation will be obliterated, thus causing acidosis in the area to be sampled. Also, inaccurate collection of blood in the tube can lead to the presence of air bubbles in the blood (Wood, 1978). Other difficulties described by Clark and Paul (1985) include unavailability of trained personnel, questionable pH analysis results, time delay in obtaining the pH results, misinterpretation of the pH results, the need for repetitive sampling, and the potential hazard of introducing infection. Fetal blood sampling is intermittent, a time consuming procedure, and requires laboratory support around the clock (Miller & Paul, 1978).

According to Clark and Paul (1985), properly interpreted fetal heart rate assessments are equal to, and in some cases superior to, fetal scalp sampling in prediction of fetal well-being. In recent years, there has been a shift away from fetal scalp sampling toward a better understanding of the fetal mechanisms that underlie
the production of fetal heart rate patterns (Clark & Paul, 1985).

The aforementioned problems with fetal scalp sampling and the need for a fetal assessment tool that is easy and less invasive have brought attention to fetal scalp stimulation as a method of assessing fetal well-being during labor. In 1980, Sampson and associates suggested that fetal central nervous system reactivity could be checked by assessment of the fetal heart rate pattern in correlation with stimulation, either external or vaginal.

In recent years, a few studies have been conducted evaluating fetal heart rate response to scalp stimulation. In 1984, Clark and associates stated that scalp stimulation was anticipated to be a noninvasive procedure that would reduce the need for fetal scalp sampling and provide necessary information about the state of fetal well-being. The study included manual fetal scalp stimulation, followed by transvaginal application of an Allis clamp to the fetal scalp, and concluded with scalp blood sampling. The fetal heart rate patterns were studied during all stimulations. Clark et al. concluded that a normal fetal heart rate tracing with good variability and accelerations was an excellent indicator of fetal well-being. Their study demonstrated that if the fetal heart rate accelerates in response to tactile stimulation, it appears to be an indicator of good fetal acid-base balance. Clark
et al. also stated that the scalp stimulation test might be superior to the scalp sampling pH measurement because it is a direct assessment of the fetal physiological status, rather than a biochemical estimation of fetal status. Clark and associates concluded by stating that if an acceleration was elicited by scalp stimulation, the clinician could be reassured that the scalp blood pH was greater than 7.20.

In 1987, Arulkumarran, Ingemarsson, and Ratnam reported their study of scalp stimulation. The study consisted of fetal scalp stimulation with an Allis clamp, followed by fetal scalp blood sampling. They concluded that if a fetal heart rate acceleration was elicited by a painful stimulation, the risk of fetal acidosis was small. It was also concluded that a positive test (i.e., presence of accelerations) indicated an uncompromised fetal state. Arulkumarran and associates stated that if scalp stimulation was used to evaluate fetal well-being, the necessity for fetal scalp sampling could decrease by 50%. The investigators concluded that further research was necessary to evaluate the scalp stimulation test as a measure of fetal well-being.

The third study of fetal scalp stimulation was reported by Harvey in 1987. During active labor, Harvey used brisk digital scalp stimulation to elicit a fetal heart rate acceleration. If digital stimulation did not
cause an acceleration, Harvey then stimulated the scalp with an Allis clamp. Harvey found that in the majority of cases, digital stimulation was sufficient to elicit an acceleration. The fetal response to stimulation was compared to the Apgar score and the umbilical cord pH. Harvey stated that scalp stimulation provides objective data concerning the fetal acid-base balance and the state of fetal well-being. Harvey concluded that scalp stimulation is relatively low risk, is easy to perform, and provides immediate information.

Immediately after delivery. The Apgar score, pioneered by Apgar, is the initial assessment of the newborn's adaptation to extrauterine life (Gabbe, Niebyl & Simpson, 1986). It is performed at 1 minute and again at 5 minutes after delivery. Five areas of newborn responsiveness and condition are assessed. A maximum of 2 points per area are given. A perfect score equals 10. The areas assessed are the newborn's respiratory rate and effort, heart rate, muscle tone, reflex response, and skin color. The 1-minute Apgar score is an indicator of how the newborn tolerated the stress of labor, and the 5-minute score is a predictor of how the newborn will tolerate the immediate neonatal period.

Since the Apgar score is an indicator of the newborn's condition, it is frequently correlated with other indicators of fetal and neonatal well-being. A
normal reassuring fetal heart rate pattern during labor accurately predicts that 99% of the infants will have a 5-minute Apgar score of at least 7 (Bracero et al., 1986; Quirk & Miller, 1986). In 1986, Page et al. suggested that the combination of proper fetal heart rate assessment, cord blood pH, and Apgar score is a better evaluation of fetal status than just one parameter.

Umbilical cord blood pH analysis immediately after delivery is another way of assessing fetal well-being just prior to delivery and of anticipating well-being during the immediate neonatal period. In 1986, Page and associates reported that umbilical cord blood gas values are easier to obtain than scalp samples and are more timely than later neonatal evaluation measures.

Summary

Fetal scalp stimulation has been studied as a favorable test of fetal well-being because of its ease, convenience, and ability to provide immediate results with the least amount of patient inconvenience. Recent studies were reviewed and found to indicate the need for further research concerning fetal scalp stimulation as an indicator of fetal well-being during labor.

Hypothesis

The hypothesis formulated for this investigation was:

Manual fetal scalp stimulation of a low-risk fetus
during labor will produce an acceleration of the fetal heart rate.

Assumption
In this investigation, it was assumed that fetal heart rate accelerations noted after manual fetal scalp stimulation would be a result of the stimulation.

Operational Definitions

Low Risk Mother and Fetus
A low-risk mother and fetus, as described by Hobel (1973), will receive no more than 9 points on the prenatal/intrapartum high-risk screening tool.

Baseline Fetal Heart Rate
Normal baseline fetal heart rate is defined as 120 to 160 beats per minute (Miller & West, 1986; Quirk & Miller, 1986). For a specific fetus, the baseline is the rate that is maintained over a period of 10 minutes (Miller & West, 1986).

Long-Term Variability
Long-term variability is defined as the oscillations of the fetal heart rate. The oscillations are described in terms of frequency in cycles per minute and of amplitude in beats per minute (Gross et al., 1979). Normal long-term variability is two to six cycles per minute and the normal change in amplitude is 10 to 15
beats per minute (Gross et al., 1979; Quirk & Miller, 1986).

**Short-Term Variability**

Short-term variability, or beat-to-beat variability, is defined as the changes in the interval between two successive fetal electrocardiogram complexes (Gross et al., 1979). It is the instantaneous change in the fetal heart rate. Short-term variability is defined as being either absent or present (Franz, 1983; Sampson et al., 1980). The presence of short-term variability is normal.

**Fetal Heart Rate Accelerations**

Accelerations of the fetal heart rate are defined as the rise of the fetal heart rate above established baseline. Accelerations that indicate fetal well-being are defined as rising at least 15 beats above baseline and being maintained for at least 15 seconds (Gagnon et al., 1987; Krebs et al., 1979a,b).

**Fetal Heart Rate Decelerations**

Decelerations of the fetal heart rate are defined as a change in the rate below the established baseline (Miller & Paul, 1978; Miller & West, 1986).

**Window of Fetal Surveillance**

The window of fetal surveillance is defined as the 2-minute period of time when the fetal heart rate is
observed, measured, and evaluated. This time period will occur immediately after fetal scalp stimulation and at the specific, dictated time for fetal heart rate observation without fetal scalp stimulation.
CHAPTER II

METHODOLOGY

Design

A quasiexperimental design called the equivalent time samples design was selected for this study. This design is a form of the Latin square, crossover, or split-plot design (Campbell & Stanley, 1963). It is a form of one-group experimentation that employs two equivalent samples of occasions. In one occasion, the experimental variable is present and in the other occasion, the experimental variable is not present. This design involves the repeated introduction of the experimental variable to the same group according to specified time frames and includes observed intervals in which the variable is absent.

The subjects for this study design were not randomized into experimental groups, but were randomized to a specific series of treatment conditions using a table of random numbers. Each subject's treatment condition consisted of a series of observations, some observations with the experimental treatment present, and some with the treatment absent (Table 1).

This study design does control for all threats to
Table 1
Equivalent Time Samples Design
Treatment Conditions

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<tr>
<td></td>
<td>Stimulated</td>
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</tr>
<tr>
<td>#4</td>
<td>Without</td>
<td>With</td>
<td>With</td>
<td>Without</td>
<td>Without</td>
</tr>
<tr>
<td></td>
<td>Fetal</td>
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<td>Fetal</td>
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<tr>
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<tr>
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</tbody>
</table>
internal validity. However, it does not control for threats to external validity. In order to help control for external validity in this study, the observations of fetal heart rate were based upon the clock. The introduction of the experimental variable, fetal scalp stimulation, was controlled by specific timing.

For this study, the subjects were low-risk fetuses who met the sample specifications. The experimental treatment was digital fetal scalp stimulation.

Sample

Subjects were 28 low-risk fetuses of laboring women. These women were in the first stage of labor, with cervical dilation of 3 to 7 cm. All women had ruptured amniotic membranes and had fetal scalp electrodes in place on the presenting fetal vertex. Hobel's (1973) prenatal/intrapartum high-risk screening tool was used to determine the low-risk subjects for this study. In order to qualify as low risk, the mother and fetus could not score more than 9 points on the Hobel scale.

This study excluded all maternal/fetal dyads that scored more than 9 on the Hobel screening tool. High-risk maternal or fetal factors could compromise the ability of the fetus to respond appropriately to scalp stimulation. This researcher evaluated only how a low-risk fetus responds to scalp stimulation.
Instrumentation

Intervention

Digital fetal scalp stimulation, the experimental treatment, was performed solely by the researcher. With a gloved hand, the researcher performed a vaginal exam and located the fetal head through the dilated cervix. Scalp stimulation was then accomplished by stroking the fetal head five times with either the tip or the knuckle of the examining finger.

Measurement of Outcome

Fetal response to digital scalp stimulation was measured by evaluation of the fetal heart rate patterns seen in the tracing on the monitor strip. The fetal heart rate patterns were ascertained by using a fetal scalp electrode applied to the presenting fetal vertex. The fetal heart rate patterns were identified and measured according to baseline, variability, and accelerations or decelerations present during the specified windows of fetal surveillance.

By using a fetal scalp electrode, the fetal electrocardiogram was obtained and recorded on the monitor strip. This direct method of monitoring the fetal heart rate involves placing the stainless steel spiral electrode on the fetal head. The second pole of this bipolar electrode is in contact with the mother through the vaginal secretions. These two leads are then connected to
a grounding plate, which is placed on the maternal abdomen or thigh. The peak of the fetal R wave is used to trigger the cardiotachometer, thus allowing for the precise measurement of the fetal heart rate (Miller & West, 1986).

The cardiotachometer within the fetal monitor system counts the fetal heart rate signals. These signals may vary greatly in intensity and since the cardiotachometer counts best with uniform signals, an automatic gain control amplifier is used (Klapholz, 1978). The signals detected from the fetal scalp lead are filtered to remove electrical noise and the maternal heart signals.

The fetal heart rate tracing is generated by the fetal scalp electrode sending the R wave signals through the grounding plate to the bedside monitoring unit. Within the unit, the signals are filtered, amplified, and then counted by the cardiotachometer (Miller & Paul, 1978). The rate is calculated and printed onto the moving timed monitor strip.

**Procedure**

An appropriate fetal/maternal dyad was selected by reviewing the prenatal record and laboring woman's chart and establishing their low-risk status as described in Hobel's screening tool. The study was explained to the mother and she was asked for her participation. The mother was asked to sign the consent form (Appendix).
The fetal/maternal dyad was then randomly assigned to a treatment condition by using a table of random numbers.

The researcher explained to each mother the importance of proper positioning throughout the treatment conditions. The mother was assisted to assume positions of comfort that did not predispose to maternal hypotension.

The timing of the assigned treatment condition was specifically dictated by the clock. Directly after the patient signed the consent form, the researcher noted the time and began the procedure. The windows of fetal surveillance were exactly 15 minutes apart and lasted for exactly 2 minutes.

If the assigned treatment condition included no fetal scalp stimulation prior to observation, the researcher marked the fetal monitor strip and observed the fetal heart rate patterns for 2 minutes. This comprised the window of fetal surveillance. The researcher measured the fetal heart rate patterns observed during the window of fetal surveillance by identifying and documenting the baseline, variability, accelerations, and/or decelerations.

If the assigned treatment condition included fetal scalp stimulation prior to observation, the researcher marked the fetal monitor strip and immediately performed fetal scalp stimulation. With a gloved hand, the
researcher performed a vaginal examination and located the fetal head through the dilated cervix. Stimulation was accomplished by stroking the fetal head five times with either the tip or the knuckle of the examining finger. Immediately after the stimulation, the researcher observed the fetal heart rate patterns for 2 minutes. This was the window of fetal surveillance. The researcher measured the fetal heart rate patterns that occurred during the window of fetal surveillance by identifying and documenting the baseline, variability, and accelerations and/or decelerations.

Each subject's fetal heart rate patterns were observed four times (two observations with and two observations without fetal scalp stimulation). The order of the observations was dictated by the assigned treatment condition. Each observation consisted of a 2-minute window of fetal surveillance. The observations were 15 minutes apart to allow for independence of each separate observation.

To ensure that the results of this study provided information about low-risk fetuses, the umbilical cord, blood pH and pCO2 values, and the Apgar score were documented for each newborn infant. If these data were not within the accepted normal limits for any individual newborn in the study, then the fetal scalp observation data that accompanied that infant were discarded from the
results. Normal umbilical cord blood values for pH are 7.34 +/- 0.15, for pCO2 are 35 +/- 8 (Gabbe et al., 1986). The low-risk fetus is expected to have a 1-minute Apgar score of at least 7 (Gabbe et al., 1986).

Limitations

The following limitations are noted:

1. This investigator did not propose to identify the reasons why a fetus may not respond to fetal scalp stimulation with a heart rate acceleration.

2. This investigator did not propose to state how a high-risk or compromised fetus may respond to fetal scalp stimulation.
CHAPTER III

RESULTS AND DISCUSSION

The data were analyzed to identify the effect of fetal scalp stimulation on fetal heart rate. Statistical results were computed using a Hewlett-Packard 15C scientific programmable calculator. Descriptive statistics were generated to define characteristics of the sample. T-test analyses for two related samples were performed to identify differences between fetal heart rate with and without fetal scalp stimulation. The statistical level of confidence was set at 0.05.

Descriptive Data

The study was conducted at a community hospital located in a metropolitan area August through December, 1988. Subjects included 28 low-risk fetuses. The maternal patients were healthy women in the first stage of labor with cervical dilation ranging from 3 to 7 centimeters. Each patient had ruptured amniotic membranes, and each had a fetal scalp electrode placed on the fetal vertex in order to maintain a continuous tracing of the fetal heart rate. During the study, all patients were assisted to the lateral position in order to assure
optimal placental blood flow (Table 2).

The gestational ages of the fetuses ranged from 36 to 42 weeks. All fetal/maternal dyads qualified as low risk as determined by using Hobel's (1973) prenatal/intrapartum high-risk screening tool. In order to qualify, each couple needed to score 9 or less on the tool. The Hobel scores for the dyads ranged from 0 to 6.

The parity of the mothers was identified and compared. The number of term pregnancies ranged from 0 to 6. The number of preterm deliveries ranged from 0 to 1. The number of past abortions ranged from 0 to 4. The number of living children that these mothers had ranged from 0 to 6.

After birth, the Apgar scores and umbilical cord blood pH and pCO2 values for each neonate were recorded in order to assure that the study would provide information for the low-risk fetus. The 1-minute Apgar scores ranged from 7 to 8 and the 5-minute scores ranged from 7 to 9. The umbilical cord blood pH and pCO2 values were determined immediately after delivery. The pH values ranged from 7.30 to 7.46 and the pCO2 values ranged from 29 to 49. These values substantiated that the study was conducted using only low-risk fetuses.

Fetal heart rate patterns were observed and evaluated against criteria for normal fetal heart rate patterns. All fetal heart rate tracings showed a normal baseline
### Table 2

Descriptive Data

(N = 28)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min.</th>
<th>Max.</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational Age (wks)</td>
<td>36</td>
<td>42</td>
<td>6</td>
<td>39.32</td>
<td>1.31</td>
</tr>
<tr>
<td>Hobel Score</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>3.12</td>
<td>2.15</td>
</tr>
<tr>
<td># Term Pregnancies</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>1.34</td>
<td>1.40</td>
</tr>
<tr>
<td># Preterm Pregnancies</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0.04</td>
<td>0.19</td>
</tr>
<tr>
<td># Abortions</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0.29</td>
<td>0.81</td>
</tr>
<tr>
<td># Living Children</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>1.46</td>
<td>1.45</td>
</tr>
<tr>
<td>Apgar Score 1 minute</td>
<td>7</td>
<td>8</td>
<td>1</td>
<td>7.89</td>
<td>0.32</td>
</tr>
<tr>
<td>Apgar Score 5 minutes</td>
<td>7</td>
<td>9</td>
<td>2</td>
<td>8.96</td>
<td>0.19</td>
</tr>
<tr>
<td>Cord pH</td>
<td>7.30</td>
<td>7.46</td>
<td>0.16</td>
<td>7.37</td>
<td>0.04</td>
</tr>
<tr>
<td>Cord pCO2</td>
<td>29</td>
<td>49</td>
<td>20</td>
<td>39.64</td>
<td>4.56</td>
</tr>
</tbody>
</table>
ranging from 120 to 160 beats per minute. Long-term variability for all subjects was normal, ranging from 10 to 15 beats per minute and 2 to 6 cycles per minute. Short-term variability was present in all fetal heart rate tracings.

**Hypothesis**

The hypothesis for this investigation stated:

Manual fetal scalp stimulation of a low-risk fetus during labor will produce an acceleration of the fetal heart rate.

Each subject's fetal heart rate tracing was observed and measured during four separate windows of fetal surveillance. Each window was 2 minutes long and occurred 15 minutes apart. For each subject, two observations followed fetal scalp stimulation and two occurred without fetal scalp stimulation. During each observation window, the presence or absence of a heart rate acceleration was recorded. If an acceleration was present, it was measured in terms of the greatest number of beats it rose above baseline and the number of seconds the entire acceleration was maintained. In order to meet the established criteria for an acceleration indicative of fetal well-being, the acceleration must rise at least 15 beats above the baseline and be maintained for at least 15 seconds.

There were a total of 112 windows of fetal surveillance. These windows were divided into two related sample groups. One group consisted of the 56 windows of fetal
surveillance that were not preceded by fetal scalp stimulation (Table 3). During these times, the fetal heart rate acceleration above baseline ranged from 0 to 40 beats per minute with a mean of 5.86. The number of seconds the accelerations was maintained ranged from 0 to 175, with a mean of 12.80 seconds. These mean values of accelerations without scalp stimulation were below the established criteria for an acceleration to be indicative of fetal well-being. Of these 56 observations, 39 showed no acceleration, 10 presented an acceleration that did not meet the established criteria, and only 7 demonstrated accelerations that met the established criteria to be indicative of fetal well-being.

The second related sample group of 56 windows of fetal surveillance was preceded by fetal scalp stimulation. During these windows, the fetal heart rate acceleration above baseline ranged from 0 to 40 beats per minute with a mean of 18.48. The number of seconds the accelerations were maintained ranged from 0 to 160 with a mean of 36.59 seconds. The mean values of this group's accelerations exceeded the established criteria for an acceleration to be indicative of fetal well-being. Of these 56 observations, 50 demonstrated accelerations that met the established criteria, 4 presented accelerations that did not meet the criteria, and only 2 showed no acceleration.
Table 3
Descriptive Data for Accelerations
(N = 56)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min.</th>
<th>Max.</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beats/min. Acceleration</td>
<td>0</td>
<td>40</td>
<td>40</td>
<td>18.48</td>
<td>6.53</td>
</tr>
<tr>
<td>with stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beats/min. Acceleration</td>
<td>0</td>
<td>40</td>
<td>40</td>
<td>5.86</td>
<td>9.93</td>
</tr>
<tr>
<td>without stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seconds Acceleration maintained</td>
<td>0</td>
<td>160</td>
<td>160</td>
<td>36.59</td>
<td>34.35</td>
</tr>
<tr>
<td>with stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seconds Acceleration maintained</td>
<td>0</td>
<td>175</td>
<td>175</td>
<td>12.80</td>
<td>30.64</td>
</tr>
<tr>
<td>without stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1 shows the mean values of the two sample groups of fetal heart rate accelerations plotted in beats per minute by seconds maintained. The bold lines at 15 beats per minute and 15 seconds show the established criteria for an acceleration to be indicative of fetal well-being. This demonstrates that the mean values for both groups exceeded the established criteria. Figure 2 shows accelerations with stimulation compared to accelerations without stimulation. The shaded areas indicate the percentage of accelerations meeting criteria. Figure 3 summarizes the total 112 observed accelerations.

Differences between the two related sample groups, accelerations following scalp stimulation, and accelerations without stimulation, were analyzed using the t-test for two related samples. The results of the first t-test showed a significant difference in beats per minute of the accelerations after fetal scalp stimulation in contrast to the accelerations without fetal scalp stimulation (Table 4). Fetal scalp stimulation appeared to produce a significant increase in beats per minute of subsequent fetal heart rate accelerations (t = 9.83, df = 55, p < .001).

Differences between experimental and control treatment conditions were also identified with regard to seconds that the accelerations were maintained. The results of a second t-test showed a significant difference
Figure 1. Acceleration graph.
Figure 2. Fifty-six accelerations with and without stimulation.
Figure 3. Summary of 112 accelerations.
Table 4

T-Test for Two Related Samples' Fetal Heart Rate Accelerations in Beats per Minute

(N = 56)

<table>
<thead>
<tr>
<th></th>
<th>$\bar{D}$</th>
<th>S.E.M.</th>
<th>df</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beats/minute with stimulation</td>
<td>12.63</td>
<td>9.61</td>
<td>55</td>
<td>9.83</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Beats/minute without stimulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
in the number of seconds the acceleration was maintained following fetal scalp stimulation, in contrast to acceleration length in the absence of fetal scalp stimulation (Table 5). Following fetal scalp stimulation, the number of seconds the accelerations were maintained was significantly greater than the number of seconds the accelerations were maintained without fetal scalp stimulation ($t = 3.66$, $df = 55$, $p < .001$).

The descriptive data and the $t$-test results show that there was a significant difference in the occurrence and quality of fetal heart rate accelerations depending upon the absence or presence of fetal scalp stimulation. These findings support the studies by Clark et al. (1984), Arulkumarran et al. (1987), and Harvey (1987), who also found fetal scalp stimulation to be significant in producing fetal heart rate accelerations.

**Additional Findings**

After reviewing the fetal monitor strip tracings, the investigator discovered mild variable decelerations of the fetal heart rate following the acceleration associated with fetal scalp stimulation in 16 of the 56 stimulations. Several investigators have also noted the occurrence of mild variable decelerations following accelerations (Freeman, 1987; Gross et al., 1979; Lee et al., 1975; Timor-Tritsch et al., 1979). Variable decelerations are due to a reflex parasympathetic stimulation by the
Table 5
T-Test for Two Related Samples' Fetal Heart Rate Accelerations in Seconds Maintained
(N = 56)

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>S.E.M.</th>
<th>df</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seconds Maintained with Stimulation</td>
<td>23.79</td>
<td>48.59</td>
<td>55</td>
<td>3.66</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Seconds Maintained without Stimulation</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
vagus nerves (Low et al., 1981; Martin, 1978). Umbilical cord compression is thought to be the causative agent of variable decelerations (Freeman, 1987; Krebs et al., 1982; Lee et al., 1975; Low et al., 1981; Martin, 1978; Miller & Paul, 1978; Miller & West, 1986; Timor-Tritsch et al., 1979). A possible conclusion from this association of accelerations and decelerations is that the fetus that responds to fetal scalp stimulation with an acceleration followed by a variable deceleration may also be responding to cord compression.

During this study, the investigator made several additional observations. The investigator initiated the vaginal examination that accompanies fetal scalp stimulation between the uterine contractions. It was frequently observed that during the examination and fetal scalp stimulation, a uterine contraction occurred. Noted also were occasional prolonged fetal heart rate accelerations following fetal scalp stimulation. Many of these accelerations were also associated with fetal movement.

Occasionally, the fetal heart signal from the fetal scalp electrode was interrupted for 10 to 15 seconds during fetal scalp stimulation. This raises the possibility that the fetal scalp stimulation interfered with the functioning of the fetal scalp electrode for unexplained reasons. In order to overcome this interruption, the investigator connected the ultrasound transducer to
the woman's abdomen and left the fetal scalp electrode in place. The fetal monitor then gave a double tracing of the fetal heart rate. With this double monitoring technique, there was no further interruption of the fetal heart rate tracing on the monitor strip.

The women who took part in the study reacted very positively to the experience. The investigator explained the study completely to each participant before she signed the consent form. Many women asked questions about fetal heart rate monitoring and expressed interest in finding out more about their babies. In addition, many women took an active part in the study by watching the fetal monitor strip and asking to be shown the acceleration. They appeared excited when their babies responded appropriately to stimulation, understanding that an acceleration is an indication of fetal well-being. Following the study, as their labors progressed, many women continued to watch the monitor strip and enjoyed seeing spontaneous accelerations.

The investigator explained to each participant that it was not expected that each fetus would always respond to fetal scalp stimulation with an acceleration. The investigator reassured the occasional subject whose fetus did not respond with an acceleration. These subjects were shown other parts of the fetal monitor strip that did show fetal heart rate accelerations, thus indicating fetal
well-being. Patient education is an integral part of nursing. Information gained from this study reinforces the importance of informing the patient and allowing her to feel that she is taking an active part in her care.
CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to identify the effects of manual fetal scalp stimulation on fetal heart rate during labor. A review of the current literature confirmed that the presence of fetal heart rate accelerations is indicative of fetal well-being. The literature review also revealed the need to increase established methods of ascertaining fetal well-being during labor. Manual fetal scalp stimulation was proposed as an easy, relatively noninvasive method that provides immediate results and can be repeated as often as necessary. Thus, the hypothesis of this study was that manual fetal scalp stimulation of a low-risk fetus during labor would produce an acceleration of the fetal heart rate.

The sample of the study was comprised of 28 low-risk fetuses. Each subject's fetal heart rate tracing was observed, evaluated, and measured four separate times. These times were defined as windows of fetal surveillance. Each window was 2 minutes long and occurred precisely 15 minutes apart. For each subject, two windows included
fetal scalp stimulation and two windows did not include fetal scalp stimulation. The investigator measured the fetal heart rate tracing according to established criteria for normal fetal heart rates. The investigator was observing specifically for fetal heart rate accelerations occurring within the windows of fetal surveillance.

Analysis of the data was accomplished using a t-test for two related samples (one sample being the observed fetal heart rate windows without fetal scalp stimulation and the second sample being the observed fetal heart rate windows associated with fetal scalp stimulation). From the t-test analysis, it was determined that for this sample, there was a significant difference in the occurrence and quality of fetal heart rate accelerations that was dependent upon fetal scalp stimulation. These findings support the hypothesis that fetal scalp stimulation does produce fetal heart rate accelerations.

Conclusions

One conclusion derived from analysis of this study is that, for the sample defined, fetal scalp stimulation does produce fetal heart rate accelerations in a majority of subjects. Since it was established and supported through the literature review that fetal heart rate accelerations are indicative of fetal well-being, it can also be concluded that fetal scalp stimulation is a useful tool for the assessment of fetal well-being. Fetal scalp
stimulation is easily performed, gives immediate results, can be easily repeated, and is less invasive than other methods of establishing fetal status. Fetal scalp stimulation is an easy procedure for medical and nursing personnel to learn, and it requires no specialized technology or laboratory backup.

In order to establish and maintain an assessment of fetal status during labor, it is important to learn as much as possible from the fetal heart rate monitor tracing. The evaluation of fetal status is more accurate if consideration is given to multiple parameters of fetal well-being. Multifactorial analysis of the fetal heart rate tracing during labor is extremely useful. It is the conclusion of this investigator that fetal scalp stimulation, added to the already existing parameters of fetal well-being, will improve fetal assessment and improve overall patient care for the laboring mother and fetus.

Patient education is extremely important in all aspects of patient care. This investigator concludes that it was very positive for the laboring woman to be able to see a visual demonstration of fetal well-being as evidenced by an acceleration of the fetal heart rate. The laboring woman was comforted by the reassuring heart rate patterns and stated that it helped her cope with the uncertainties of labor.
Recommendations

Fetal scalp stimulation should be added to the already existing tools available to assess fetal status during labor. Presently, when vaginal examinations are performed, medical and nursing personnel comment upon the status of the cervix, but say little regarding fetal status. It is recommended that, when possible, fetal scalp stimulation be performed during vaginal examinations. Immediately after fetal scalp stimulation, there should be an evaluation and measurement of the fetal heart rate response to the stimulation. This added information about fetal status and fetal well-being will improve the quality of fetal assessments.

It is recommended that this study be replicated to further add to information regarding how low-risk fetuses respond to fetal scalp stimulation. This study could be repeated using a larger sample size and also using subjects from a variety of institutions.

It is also recommended that this study could be repeated with various high-risk maternal/fetal dyads as subjects. This proposed study would add information regarding the response of the high-risk fetus to fetal scalp stimulation and could lead to increased quality of care for the high-risk patient.

Another recommended area of research would be related to the fetuses who do not respond to fetal scalp stimul-
tion with an acceleration. There is a potential diagnostic value of the nonresponse pattern that some fetuses may provide.

The investigator recommends that medical and nursing personnel encourage patient education as it relates to the laboring woman. Encouraging maternal involvement by educating pregnant women about fetal heart monitoring and fetal well-being is very beneficial to patient care and patient satisfaction. The laboring woman enjoys seeing fetal heart rate accelerations when she understands that they indicate fetal well-being. Fetal scalp stimulation can be a useful patient education tool to reassure the laboring mother about fetal well-being.
APPENDIX

PATIENT CONSENT FORM
Fetal scalp stimulation is a common clinical procedure, but its effects are not well-documented in the research literature. This research study is designed to evaluate your baby's heart rate response to scalp stimulation. Scalp stimulation is performed by doing a vaginal examination and rubbing the baby's head with a finger. The baby's heart rate is then evaluated to see if the scalp stimulation caused an acceleration of the heart rate.

If you agree to participate, your baby's heart rate will be evaluated four times. Two of these four times, scalp stimulation will also be performed. The entire procedure takes about 45 minutes. You may experience some anxiety during this procedure. Also, you may experience comfort in knowing that your baby is responding to stimulation. There are no additional costs involved. Your participation is voluntary, you may change your mind and decline further participation at any time. Participation is confidential and only the investigator will have access to this information.

** * * * *

I understand that participation in this study is voluntary and that refusal to participate will not cause any penalty and will not affect the quality of my health care in any way. I understand that data and results obtained from this study may be used for medical and scientific purposes, including publication, but that my identity will not be revealed unless I give my expressed consent.

I have received a copy of this consent form. If I have any further questions I can call Leigh Pugh, R.N. at 272-9050 or Dr. Carol Kirgis at 581-8274. I can also call the Institutional Review Board office at 581-3655 if I cannot discuss a problem with the investigators.

Signature ________________________________

Date _______________________________
REFERENCES


Obstetrics and Gynecology, 139, 299-305.


