New Edition of NRP Released
Emphasis on use of blended oxygen and pulse oximetry

The American Heart Association and American Academy of Pediatrics have released the 6th edition of the *Textbook of Neonatal Resuscitation*, the new textbook for the Neonatal Resuscitation Program (NRP). The major changes with this edition include the use of pulse oximetry in the delivery room, delivery of blended oxygen, and changes in course administration.

**Pulse Oximetry in the Delivery Room** – $\text{SPO}_2$ monitoring has been added to the NRP flow diagram anytime a newborn requires positive-pressure ventilation or is perceived to have persistent cyanosis. The recommendation is to place an oximeter probe on the newborn’s right palm or wrist. The textbook emphasizes that cyanosis is normal in the first few minutes after birth, while the oxygen level is gradually increasing during normal transition. If oxygen levels are rising as expected, it may not be necessary to administer oxygen. See the box (right) for normal values at various points during the first 10 minutes after birth.

**Delivering Blended Oxygen** – The previous edition of NRP emphasized the benefits of blended oxygen to premature infants and recommended blenders in the delivery rooms of hospitals that routinely delivered premature infants. The new edition recommends this for **all facilities** that deliver babies. Administering oxygen at variable concentrations rather than administering pure (100%) oxygen gives the provider the ability to try to mimic the normal gradual rise in oxyhemoglobin (see box below). To achieve this, it is recommended to increase or decrease the concentration of the oxygen being administered based on the reading from the pulse oximeter. For most facilities, this means new equipment should be added to the delivery room: compressed air and an oxygen blender. There are a variety of models of

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**Targeted Pre-ductal $\text{SPO}_2$ After Birth**

<table>
<thead>
<tr>
<th>Time</th>
<th>$\text{SPO}_2$</th>
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</thead>
<tbody>
<tr>
<td>1 minute</td>
<td>60%-65%</td>
</tr>
<tr>
<td>2 minutes</td>
<td>65%-70%</td>
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<tr>
<td>3 minutes</td>
<td>70%-75%</td>
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<tr>
<td>4 minutes</td>
<td>75%-80%</td>
</tr>
<tr>
<td>5 minutes</td>
<td>80%-85%</td>
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<tr>
<td>10 minutes</td>
<td>85%-95%</td>
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*continued under “NRP” page 2*
Electronic Fetal Monitoring Strip Teaser

A 27 year-old G1, at 39 weeks and 0 days presented to triage at 0930 for complaint of low back pain. Her vital signs were normal and a vaginal exam revealed her cervix to be closed/thick/-2. Her pregnancy had been uncomplicated. An external fetal monitor was applied: FHR was 155 bpm with average to minimal variability, no accelerations or decelerations over the next hour; contractions were every 2-4 minutes, lasting 50-80 seconds, palpated by nurse as moderate to firm, resting tone not documented. The patient rated her pain as 2 out of 10. The patient was encouraged to increase oral fluids and walk in the hallways. After walking for 35 minutes she returned to her room and external monitors were reapplied. This is her tracing 1 hour later.

By 1300 the FHR was 140 bpm with minimal variability and intermittent late decelerations. The physician was notified of a "non-reactive FHR". At 1420 the physician arrived at the bedside to review the FHR strip below. An IV was started and the patient was sent to radiology for a biophysical profile (BPP).
The patient returned to triage at 1600; BPP results were 4 of 8, with 2 off for both fetal movement and fetal breathing. The patient was moved to a labor room, membranes ruptured to apply a fetal scalp electrode (FSE) and an internal uterine pressure catheter (IUPC). Oxytocin was started at 2 mu/min. She was dilated 2cm/thick/-2. She then rated her pain as 6 out of 10. This is her next tracing, about 3 minutes later:

Describe FHR and contractions for each tracing. What category are these tracings? What actions, if any, would you suggest?

COMMENTS: The first tracing demonstrates a Category II tracing with a normal baseline rate of 150 bpm, minimal variability, and without accelerations or decelerations. The fetal acid base status in indeterminate at this time and the situation requires thorough evaluation and clinical interventions appropriate to the circumstances. The toco monitor needs to be adjusted. Possible causes of prolonged minimal variability should be investigated. These may include fetal sleep, ingestion of any potential CNS depressants, medical complications that may decrease utero-placental perfusion. In light of a normal baseline, scalp stimulation or acoustic stimulation could be used to try to elicit an acceleration. Accelerations, whether spontaneous or induced, are predictive of adequate fetal oxygenation and a normal fetal acid-base status at that time.

In the second tracing the FHR baseline is 140 bpm, variability is absent, there are no accelerations, and late decelerations are present. Contractions are every 1½-2½ minutes lasting 50-80 seconds. Intensity and resting tone must be palpated. This is classified as a Category III tracing due to the absent variability and recurrent late decelerations. This tracing is indicative of a fetus whose acid base balance is abnormal. Although an IV was started, no other intrauterine resuscitation measures, such as lateral positioning, or administering oxygen to the mother were done. Lack of clear communication from the nurse at 1300 resulted in the physician delaying coming to the hospital to evaluate. The nurse did not clearly describe the 1300 tracing as a Category II with intermittent late decelerations and minimal variability. A Category III tracing requires prompt evaluation, intrauterine resuscitative measures, and prompt delivery if the situation is not resolved quickly.

In the third tracing the FHR baseline is now 130 bpm (originally 155), variability is absent, and subtle late decelerations are present. This is also a Category III tracing. Contractions are every 1-1½ minutes, lasting 50-80 seconds, intensity is 40-50 mmHg, and resting tone is 25-30 mmHg. Resting tone must be palpated to verify if the resting tone is truly elevated or if the IUPC needs to be recalibrated. The Category III tracing and the biophysical score of 4 out of 8 demonstrate this fetus is compromised. Oxytocin administration quickly results in tachysystole (greater than 5 contractions in a 10 minute period). Tachysystole and elevated resting tone can each reduce perfusion to the intervillous space decreasing oxygen availability to a fetus that is already in danger. The woman remains in a Semi-Fowlers position without supplemental oxygen, and an IV bolus is infusing. Twenty minutes later, at 1700, the oxytocin is discontinued and the patient is prepared for a Cesarean birth.

OUTCOME: The FHR was 100 bpm when in the operating suite. An emergent Cesarean section was performed under general anesthesia. The 3589 gram female infant was born at 1744 with apgars of 1, 3, and 6 at 1, 5, and 10 minutes respectively. Arterial cord gases demonstrated a mixed respiratory and metabolic acidosis with pH 6.9, PCO2 94 mmHg, PO2 12.6 mmHg, base deficit 18.4. The infant was transferred to NICU and was diagnosed with neonatal encephalopathy. A large placental abruption was discovered at delivery.
DISCUSSION: This tracing demonstrates a pattern subtly deteriorating over time. This patient's obstetrical and medical histories were uncomplicated. She presented with low back pain, and seemed unaware of the uterine contractions she was having that the nurse palpated as moderate to firm. The patient presented with no risk factors for abruption, mild back pain, and no vaginal bleeding, so an initial diagnosis of placental abruption was not be made. However, any tracing with minimal variability and no accelerations requires further investigation. Minimal variability for short periods of 20 to 30 minutes, followed by moderate variability, is probably due to fetal sleep cycles. However, prolonged minimal variability not attributed to maternal medication or substance use may be indicative of hypoxic stress and should be further assessed. Until fetal well-being can be established by moderate variability or FHR accelerations, the mother should remain on the monitor. While demonstrating an abnormal FHR the patient was taken off the monitor and sent to radiology for the next hour and a half before returning to her room. Under these circumstances of a Category III tracing and a compromised full term fetus the biophysical profile will not add significantly to the diagnosis and may delay necessary action.

With each successive tracing one can see the baseline slowly changes from 155 bpm to 140 bpm, then to 130 bpm, and finally 100 bpm in the OR. The variability declines from minimal to absent in the tracings depicted. There were no decelerations on admission, then intermittent late decelerations, then recurrent late decelerations. Regular palpation of contractions and uterine resting tone may help identify what is happening when viewed in conjunction with the abnormal FHR tracing. Contractions associated with abruption may present as firm contractions with poor relaxation and tachysystole, or contractions may be low intensity and high frequency. With continuing placental abruption, the woman will usually experience significant pain. Vaginal bleeding may or may not be present. There is nothing to be gained and much to be lost by administering oxytocin in these circumstances. The FHR has demonstrated an abnormal pattern for quite some time indicating loss of fetal oxygen reserves and abnormal acid base balance. Increasing uterine activity through use of oxytocin will only further decrease placental oxygen delivery to the fetus by decreasing blood flow through the endometrial arteries with each contraction. The amount of time from decision to proceed with a Cesarean delivery to birth of the infant was 44 minutes. Even though that is slightly longer than the recommended 30 minutes from decision to incision, the more vital concern in this case is the lack of reaction to an abnormal tracing at the time the woman presented to the labor unit. There were many opportunities for intervening for this patient. Perhaps with prompt recognition and intervention the clinical outcome may have been different.