Babies are delivered everyday—just not by EMS providers

EMS 512 was dispatched to a rural family home at 3 a.m. for “a woman in labor.” Stephen, an experienced EMT, looked at his partner, Julia, and said, “Come on, let’s go give her a ride, that’s all they ever need.” Fifteen minutes later the crew arrived on the scene of a well-kept farm home. They were directed to the living room where they found a 34-year-old female patient lying on a couch. She looked up at the two EMTs anxiously and stated, “We thought we could make it to the hospital when I started having contractions, but my water broke.” After determining her water broke 25 minutes ago, the patient continued, “My daughter was born 10 minutes after my water broke.”

The anxiety experienced by prehospital care providers when caring for a patient in active labor is not due solely to a lack of familiarity with assisting with childbirth but also to an awareness of the potential for fatal complications of labor. In 2011, as in previous years, the vast majority—98.7%—of all births in the United States were delivered in hospitals. The 1.3% delivered out-of-hospital in 2011 represented nearly 50,000 births. Of these, 66.2% (33,043) occurred in residences and 28.5% in freestanding birth centers. The number of births occurring at home was the highest since reporting began for this item in 1989. It’s more likely than ever that you may be called upon to assist in a childbirth at home.

As such, it is necessary for EMTs and paramedics to continually reorient themselves to the process of assisting in both normal childbirth and treating the various complications of labor they may encounter. The next two EMS World CE articles will address these topics. This month’s
Female Reproductive Anatomy

The female reproductive anatomy includes the ovaries, the uterus (fallopian) tubes, the vagina, and the placenta. The ovaries are oval, almond-shaped glands held in place in the pelvic cavity on either side of the uterus by the broad ligament and suspensory ligament. The ovaries are unique in that they are both a gonad, in which eggs (ovum) develop in a process called oogenesis, as well as an endocrine gland that produces the female reproductive hormones estrogen and progesterone. Beginning at puberty, oogenesis occurs on a monthly cycle at the end of which an egg is released from the ovary, a process termed ovulation.

The paired uterine tubes, also commonly called the fallopian tubes, are attached bilaterally to the uterus and open at the ovary. They have a funnel-like structure (termed the infundibulum) at the distal end (closest to the ovary) and finger-like projections (termed fimbriae) on the infundibulum) at the distal end (closest to the ovary). The fimbriae beat with a wave-like motion, creating a current in the intraperitoneal fluid. As such, the ovum released from the ovary is drawn into the uterine tube. Fertilization usually takes place during the passage of the ovum through the length of the uterine tube. It travels the length of the uterine tube—through the ampulla and isthmus—before entering the uterus through the uterine ostium.

The uterus is a hollow, muscular, pear-shaped organ located in the pelvic cavity, which provides both a protective environment for a developing fetus as well as the expulsive power necessary for childbirth. The uterus consists of two main regions—the superior body and the inferior cervix. Together, these two structures comprise the superior portion of the birth canal. The body of the uterus, forming the superior two-thirds of the organ, includes the superior most fundus and the inferior isthmus. The thick wall of the body of the uterus is made up of three layers—the outermost perimetrium, the middle myometrium and the innermost endometrium. The endometrium thickens each month during the menstrual cycle to provide a place for the egg to implant and develop if fertilized by a sperm. If fertilization does not occur in a given month, the endometrium will be sloughed off and excreted (menstruation). The myometrium becomes greatly distended during pregnancy as the fetus grows, and during childbirth it is the muscular layer that contracts to expel the fetus, and eventually the placenta, into the vagina. The isthmus of the uterus serves as the transition to the cervix, the inferior-most third of the uterus. The cervix projects a short amount into the vagina, and the cervical os serves as the passageway between the uterine cavity and the vagina. During childbirth, the cervical os dilates and thins in response to hormonal changes to allow for the passage of the fetus and placenta into the vagina.

The vagina extends from the uterus to the external genitalia and serves many purposes. It serves as a passageway through which menstrual fluid produced in the uterus is eliminated during menses, receives the penis and semen during intercourse, and forms the inferior portion of the birth canal through which the fetus passes during childbirth. The vagina is a muscular tube that is usually collapsed so that its anterior and posterior walls are in contact. The vagina is markedly distended during childbirth, especially in the anterior-posterior direction. Distention in the lateral direction is limited by the ischial spines of the pelvis and supportive ligaments. This anatomical narrowing of the vagina in the lateral direction is the reason why a fetus will rotate its shoulders into the anterior-posterior plane during delivery.

Anatomy and Physiology of Pregnancy

If a woman has had intercourse within 24 to 48 hours prior to ovulation, fertilization may occur. Fertilization commonly takes place in the distal third of the fallopian tube, and the developing blastocyst travels the length of the fallopian tube and into the uterus, implanting in the endometrium where it continues to develop. Toward the end of the third week a rudimentary placenta has developed. The placenta is known as the “organ of pregnancy” and serves as a connection between the mother and developing fetus, allowing for nutrient and oxygen uptake and waste elimination via the

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>PHYSIOLOGIC CHANGES</th>
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<tbody>
<tr>
<td>Cardiovascular</td>
<td>Increases in circulating blood volume, red blood cells, resting heart rate and cardiac output. Decreases in systemic vascular resistance and blood pressure.</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Decreases in intrathoracic volume and functional residual capacity of lungs. Increase in tidal volume.</td>
</tr>
<tr>
<td>Gynecologic</td>
<td>Increased size, weight and volume of uterus. Increased uterine blood flow. Formation of mucus plug. Increased size and tenderness of breasts.</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Increased nausea and vomiting. Decreased gastric emptying and gut motility.</td>
</tr>
<tr>
<td>Urinary</td>
<td>Increased renal blood flow, glomerular filtration rate and urine production.</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Increased metabolism. Increased metabolic demand for nutrients and oxygen.</td>
</tr>
</tbody>
</table>
mother’s blood supply. In addition, it is involved in the immunologic protection of the developing fetus as well as the production of hormones. A fully developed placenta is disc-shaped, about 15 to 20 cm in diameter and 3 cm thick at the center, and weighs on average 500 g. Placental growth occurs throughout pregnancy, though the development of the maternal blood supply to the placenta is complete by the end of the first trimester. The blood supply between the mother and placenta is rich, and trauma to the placenta can result in significant blood loss.

The placenta is connected to the fetus by the umbilical cord, which in a full-term neonate is about 50 cm long and 2 cm in diameter. It contains a single umbilical vein, which carries nutrient-rich and oxygenated blood from the placenta to the fetus, and two umbilical arteries that carry deoxygenated blood and waste from the fetus to the placenta.

A developing fetus resides in the amniotic sac, a thin and transparent pair of membranes. It is commonly referred to as the “bag of waters,” as it contains amniotic fluid. Amniotic fluid is comprised of water, electrolytes, proteins, lipids and carbohydrates, which all aid in the growth of the fetus. It also suspends the developing fetus in the uterus, allowing for easier fetal movement, and serves to act as a cushion to protect the developing fetus from trauma. The amount of amniotic fluid increases throughout pregnancy, reaching its greatest volume (about 800 mL) at about 34 weeks gestation, and it decreases during the last trimester, with approximately 600 mL of fluid remaining at full term (40 weeks gestation). The amniotic fluid is released during labor when the amniotic sac breaks. A pregnant woman may describe the situation by saying “my water has broken.” Both the amniotic sac and the placenta are expelled after a normal childbirth and together they are termed the afterbirth.

A cervical mucus plug forms in and seals the cervical os during pregnancy. It consists of cervical fluid that thickens during pregnancy, and acts as a protective barrier by preventing the passage of bacteria into the uterus. The cervix thins toward the end of pregnancy, causing the mucus plug to become bloody, and it eventually is discharged from the cervical os as the cervix begins to dilate. The plug discharges and can present intact as a sterile technique should be used whenever time and situation allow.”
lump or as vaginal discharge over several days.

The physiologic changes that occur during pregnancy are listed in Table 1.

## Stages of Labor

Stage 1 of labor (dilation stage) begins with the onset of true labor contractions and ends with a fully dilated and effaced cervix. Dilation is the result of the relaxing and stretching of the cervical os, resulting in its opening to a width of up to 10 cm. Effacement occurs as the cervix, usually elongated, thins out as it is dilated. The mucus plug is discharged during this stage.

Stage 2 (expulsion stage) of labor begins with the complete dilation and effacement of the cervix and ends with delivery of the fetus. An increased urge to push with each contraction accompanies this stage.

Stage 3 (placental stage) of labor begins immediately after the birth of the fetus and ends with the delivery of the placenta.

## Spontaneous Uncomplicated Delivery

While complete sterility is not necessary for a successful delivery, sterile technique should be used whenever time and situation permits. EMS providers directly involved with the delivery should wear a mask, eye protection, a gown, booties and gloves to protect themselves as well as the mother and neonate. The patient should have a sterile, or at least clean, drape placed under her buttocks, below the vagina, over the abdomen, and over her legs so that the immediate area around the vagina is exposed.

Regarding positioning of the mother, the common position in Western nations is the lithotomy position, usually achieved by placing the mother on an examination table, lying on her back with her buttocks and perineum near the edge of the table, and her feet elevated above the level of her pelvis, usually with the aid of stirrups. This position increases the diameter of the mother’s pelvic outlet, creating a larger space for the delivering fetus to move through and ease the delivery. Unfortunately, EMS providers do not commonly have stirrups available for use. As such, an alternative position is placing the patient on a stretcher or bed with her hips and knees partially flexed and the soles of her feet flat on the stretcher or bed. Attempt to place the patient’s buttocks at the edge of the bed or stretcher to allow room for the delivery. Ultimately, a good position is any position that both opens up the pelvis and provides both good physical access and visualization of the perineal region.

If time and resources allow, set up separate delivery and resuscitation areas in case the neonate requires resuscitation after delivery. The resuscitation area should be prepared by first identifying a clean, open surface to work on. A bulb suction or other device must be available, as well as oxygen and a bag-mask, should oxygen administration by blow-by or ventilation with room air be necessary. (Yes, room air! The 2010 American Heart Association Neonatal Resuscitation Guidelines recommend ventilating depressed neonates with room air, not supplemental oxygen.2) If an imminent delivery is obvious—and you and your partner do not have additional resources—and you elect to stay on scene to deliver the baby, consider calling for an additional crew to stand by should resuscitative efforts for the neonate or mother become necessary. In a worst-case scenario, you could be presented with both an unstable neonate as well as an unstable mother, both of whom require resuscitation and who would quickly overwhelm the capabilities of a two-person EMS crew.

Clinically, labor is said to have started when cervical dilation has occurred. This cannot be determined by EMS providers in the field, so you should be familiar with other clinical indicators that your patient has entered labor, including:

- Rupturing of amniotic sac and release of amniotic fluid (“My water broke”).
- Contractions of increasing frequency and duration.
- Feeling a need to defecate.
- Perineal bulging during contractions (crowning).

An imminent delivery should be anticipated when you note the perineum bulging during each contraction. This occurs prior to crowning, when the head is visible as it protrudes from the vagina. Should a patient describe any of the above-listed signs or symptoms you should perform an external exam of the vagina for perineal bulging or crowning, as it is time for a delivery should...
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those be present. If a patient’s water has broken, and/or they are describing contractions that are increasing in frequency and duration but no perineal bulging or crowning is present, then you may have time to consider a rapid transport to an emergency department or obstetrics facility for childbirth.

Delivery

The spontaneous delivery of the vertex-presenting (head first) infant is divided into three phases: delivery of the head, delivery of the shoulders, and delivery of the body and legs. After delivery, you will need to clamp and cut the umbilical cord and anticipate the delivery of the placenta.

DELIVERY OF THE HEAD

Crowning indicates that delivery is imminent, and every effort should be made to ensure a gentle, controlled delivery and avoid an explosive delivery of the head. This can be accomplished by placing the palm of your hand over the exposed occipital area of the neonate’s head and applying gentle pressure to control delivery. Support the head as the forehead, face, chin and neck are delivered. The head will typically present oriented in a face-down position. After the head has delivered, look at and palpate the neonate’s neck to determine if the umbilical cord has wrapped around the neck. If a nuchal cord exists, carefully loosen the coil of umbilical cord and pull it over the neonate’s head. If you are unable to loosen the cord, clamp and cut it immediately, though carefully, and continue to deliver the infant.

DELIVERY OF THE SHOULDERS

After the head has fully delivered the neonate will typically rotate into a transverse position as the thorax rotates in the anterior-posterior diameter of the pelvis, as described above. If the shoulders do not deliver on their own, you can assist by holding on to the sides of the neonate’s head and applying gentle downward traction to facilitate delivery of the anterior shoulder. After the anterior shoulder appears, apply gentle upward traction to facilitate the delivery of the posterior shoulder, after which the rest of the body should immediately deliver.

There is some debate over the practice of suctioning the neonate’s mouth and nose at some point after the head has been delivered to clear it of amniotic fluid. The American Heart Association (AHA), in its 2010 AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science, Part 15: Neonatal Resuscitation, points out that there is evidence that suggests that suctioning of the nasopharynx can result in bradycardia. In addition, suctioning of the trachea in infants receiving mechanical ventilation can be associated with a decrease in pulmonary compliance and reduction of cerebral blood flow when performed in the absence of any obvious need for suctioning. As such, the AHA recommends suctioning during childbirth, including suctioning with a bulb syringe, be performed only in neonates with obvious obstructions or who require mechanical ventilation with a bag-mask on room air.

“Presently, the AHA recommends only suctioning those neonates who are nonvigorous.”

These cautions even extend to neonates with meconium staining. Meconium staining occurs when a distressed fetus defecates into the amniotic sac, staining the amniotic fluid with meconium. Past recommendations encouraged the aggressive endotracheal suctioning of all neonates when meconium was present regardless of whether the neonate was depressed or vigorous. Studies have shown that this practice offers no benefit if the neonate is vigorous. A vigorous neonate is one who has good muscle tone, a strong respiratory effort and a heart rate greater than 100/min. Presently, the AHA recommends only suctioning those neonates who are nonvigorous.

DELIVERY OF THE BODY AND LEGS

If the delivery of the body does not immediately occur, you can further assist the delivery by providing moderate traction on the neonate while applying moderate...
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pressure on the uterine fundus. If you apply traction, always do so along the long axis of the neonate. Do not bend the neonate or apply the traction obliquely, as it could cause injury to the neck and brachial plexus. In addition, do not hook your fingers into the neonate’s armpits and pull traction, as that too can result in a brachial plexus injury.6

Control of the neonate must be maintained so that you do not inadvertently drop the newborn! The neonate will be covered in a combination of blood, amniotic fluid and vernix—a waxy substance that develops on the skin of the fetus while in the womb—rendering him or her very slippery.

CLAMPING THE UMBILICAL CORD

EMS providers have traditionally been taught to clamp and cut the umbilical cord immediately after childbirth. However, it has been shown that delayed clamping of the umbilical cord for at least two minutes after birth consistently improves short- and long-term hematologic and iron status of full-term infants.7 Ultimately you should follow your local protocol when determining when you should clamp and cut the umbilical cord. There is no consensus on exactly where on the umbilical cord the umbilical cord clamps should be placed. In the absence of a specific measurement provided in your local protocol, place two umbilical clamps 4 to 5 cm from the neonate’s abdomen and cut the cord with a sterile scalpel or scissors.6

At some point immediately after birth—which may be before, during or after the cutting of the umbilical cord—the neonate should be assessed for the need for resuscitation. Infants who do not require resuscitation can be identified by a rapid assessment that asks the following three questions3:

• Was the neonate a term gestation?
• Is the neonate crying or breathing?
• Does the neonate have good muscle tone?

If the answer to these three questions is “yes,” the neonate does not require resuscitation and can be dried off and
placed on the mother’s breast for warmth and covered with a blanket. An Apgar score (Table 2) should be calculated at one and five minutes.

**DEPLOYMENT OF THE PLACENTA**

Placental separation and delivery occurs after delivery of the neonate, usually within five to 10 minutes. Upon examination you may note that the uterus will continue to contract and will be firm to the touch. Delivery of the placenta is obvious by the sudden gush of blood as it separates from the abdominal wall, the lengthening of the umbilical cord protruding from the vagina, and the delivery of the placenta itself. If you suspect the placenta has separated from the uterine wall but has not delivered you can ask the mother to bear down. The increased intra-abdominal pressure produced may be sufficient to complete the expulsion of the placenta. Alternatively, you can hold the umbilical cord and keep it slightly taut to facilitate the delivery of a placenta that has separated from the uterine wall. The umbilical cord should never be pulled, nor should you ever provide traction on the cord as it may cause uterine inversion or tear the placenta away from the uterine wall and result in severe bleeding. The delivered placenta should be inspected to ensure it is entirely intact and it should be also delivered with the mother and neonate to the ED for evaluation.

**Table 2: Apgar Scoring for Newborns**

<table>
<thead>
<tr>
<th>SIGN</th>
<th>0 POINTS</th>
<th>1 POINT</th>
<th>2 POINTS</th>
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<tbody>
<tr>
<td>Activity (muscle tone)</td>
<td>absent</td>
<td>arms and legs flexed</td>
<td>active movement</td>
</tr>
<tr>
<td>Pulse</td>
<td>absent</td>
<td>&lt; 100/min</td>
<td>&gt; 100/min</td>
</tr>
<tr>
<td>Grimace (irritability)</td>
<td>no response</td>
<td>grimace</td>
<td>sneezing, coughing, pulling away</td>
</tr>
<tr>
<td>Appearance (skin color)</td>
<td>cyanotic, pale core and extremities</td>
<td>normal core, cyanotic or pale extremities</td>
<td>normal core and extremities</td>
</tr>
<tr>
<td>Respiration</td>
<td>absent</td>
<td>slow, irregular</td>
<td>good, crying</td>
</tr>
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</table>

After delivery, the primary means by which maternal uterine bleeding is controlled is by contraction of the myometrium. The uterus should be massaged to promote contractions and control hemorrhage. Specifically, you should massage the superior-most part of the uterus—the fundus—by pushing gently on the supra pubic abdominal wall of the mother. On average, the blood loss that occurs during a normal vaginal delivery is usually under 500 mL. This blood loss is made up for, in part, by the increased circulating blood volume that is normal during pregnancy. A fundal massage should not delay transport to the hospital, and can be performed while en route.

**REFERENCES**