Chapter 45. Postnatal Care and Observation

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General Considerations

As the number of high-risk and preterm births increases, delivery centers are challenged to provide a consistently high standard of care for an increasingly heterogeneous population of infants. Thus, every nursery should regularly convene a multidisciplinary team to develop policies and procedures that best suit the local population of newborn infants. Routine care in any nursery should be considered only one part of a complex system focused on safe transitions from the hospital environs to the home.

The first step is to promote a healthy transition from intrauterine to extrauterine life. Routines vary from one nursery to another in details, but all should follow the principles given in Guidelines for Perinatal Care and may be further adapted on the basis of clinical guidelines from the American Academy of Pediatrics, the Centers for Disease Control and Prevention, or other expert panels. Every nursery should have written criteria for routine admission to well-baby nursery and for admission to high-observation, special or intermediate care, and intensive care nurseries.

Communication and transfer of information are critical to providing care for newborn infants. In a very short time period, the pregnant mother is processed through a minimum of 3 different care settings: the outpatient clinic, the delivery room, and the postpartum ward. Documentation from each setting provides essential information for risk assessment for each infant.

Infant Identification and Security

Human error and human behavior continue to be the root causes of infant switching and infant abduction. Movement of patients from one care area to the next and discharge from the hospital are critical times of increased risk. All mothers and newborn infants should be assigned matching identification bands in the delivery room. At minimum, the bands should include an identification number, the mother’s medical record number, the birth date and time, and the infant’s gender. The bands should be fastened securely on both mother and infant. Extremely premature infants should have their bands taped to the Isolette or warming bed and attached to the infant as soon as possible. Any time an infant is moved from or returned to the mother (eg, blood sampling, procedure, rest in the nursery, or discharged home), the identification bands should be verified for accuracy, and the care provider accepting or transferring the infant should document both the verification and the infant’s new location.

All hospitals should develop a security system that best suits their physical plant. Particular attention should be paid to emergency exits, hallways, and stairwells, and partnership with local law enforcement agencies is essential. The use of electronic card readers can limit access to patient care areas such as intensive care units, and infants may be equipped with sensors to track their location. Although technology can improve infant security, more can be achieved through hospital staff and parent education. In addition to equipment failure and limitation of the physical environment, inadequate patient education, insufficient staff training, delayed or improper communication, and organizational culture have all been cited as root causes of infant abduction.

Notification and Risk Assessment
The infant risk factors and clinical status should be assessed by hospital staff within the first 2 hours of life. The hospital should notify the newborn’s pediatrician or other health care provider, and the infant should be examined by the primary provider within the first 24 hours. Nursery policies should specify risk factors that require earlier notification or action by the nursing staff or physician. Several maternal conditions may prompt nurses to initiate screening protocols (diabetes, group B streptococcus status, fever), while others may prompt immediate notification of the responsible physician (chorioamnionitis, substance abuse).

Similarly, the type of delivery, complications of delivery, and the infant’s condition at the time of delivery influence the actions taken by nursing staff or physician. Duration of labor, rupture of membranes, presence of meconium, instrumentation at delivery, and need for resuscitation are key factors for assigning risk to the infant. Although a low Apgar score at 5 minutes is associated with increased risk, infants who are clinically stable following delivery should remain with their mothers in recovery or on the postpartum unit. Infants who required intervention in the delivery room and those with residual respiratory symptoms should be evaluated frequently in an observation or transition area. Hospitals should develop criteria for transferring infants who require continued monitoring and ongoing care. The review of available documentation coupled with the initial newborn assessment allows coordinated development of an appropriate care plan for each infant. Routine care usually begins with an initial assessment of the infant in the newborn nursery.

**Physical Assessment**

Generally, healthy infants will remain with their mothers for a period of recovery, skin-to-skin contact, breast-feeding, and bonding. This time together helps maintain the infant’s body temperature and facilitates successful breast-feeding. Guidelines suggest that the newborn’s condition should be evaluated every 30 minutes until it has been stable for 2 hours. Thereafter, observations can be less frequent if the infant appears well. Nursing staff in the postpartum area should perform a full assessment of the infant to identify potential problems.

**Body Temperature**

In the first few hours after birth, the infant's body temperature should be measured and recorded on a regular basis. Skin temperature is usually lower than central body or core temperature, particularly in a hypothermic infant in whom skin blood flow is reduced. Rectal temperature is a good indicator of core temperature, but a firm temperature probe left in the rectum without constant attention can perforate the large bowel. Measurement of axillary temperature is generally a suitable and safe alternative; however, any abnormal temperatures should be confirmed rectally. The range of normal axillary temperature is 36.5 °C to 37.4 °C.

The newborn is likely to lose much body heat after birth. At delivery, the skin is covered with amniotic fluid; the infant is usually exposed to low ambient temperature in the delivery room and frequently is kept unclothed to allow adequate initial observation. Therefore, heat is lost by evaporation, radiation, and convection. The infant responds to this cooling by sympathetic stimulation of metabolism, which increases heat production. Heat is also conserved by decreasing skin blood flow. The metabolic demands of these responses may double the infant’s oxygen consumption, but hypoxic infants are unable to respond with an increase in heat production. Thermogenesis also can be blocked by warming the skin, even though the central body temperature remains subnormal. If measures are not taken to prevent heat loss in the newborn, body temperature can fall precipitously. Drying the infant immediately after birth, wrapping the infant in a warm, dry towel, and placing a knit cap on the head all help to reduce heat loss. It is important to record occipital-frontal head circumference and document examination of the head before it is covered. Delivery room assessments and resuscitation should be performed under a radiant warmer. Care must be taken to avoid overheating and burns from radiant warmers. This is best achieved with a servocontrolled feedback device that attaches to the infant’s skin. Radiant warmers increase evaporative water loss and may cause hyperthermia, which increases metabolic demands and oxygen consumption. Infants may also be placed in an Isolette for observation in a thermoneutral thermal environment of 31 °C to 34 °C at 50% humidity. In
this range of ambient temperature and humidity, heat loss, metabolic demands, and oxygen consumption are lowest.\textsuperscript{5}

An infant who is hypothermic soon after birth should be warmed in an incubator or beneath a radiant warmer at a moderate rate to avoid the adverse consequences of cold stress and of excessive application of external heat. When an infant is in an incubator, both the infant’s temperature and the ambient temperature inside the incubator should be monitored and recorded. When an infant achieves a stable normal temperature, care can be provided in an open crib with adequate clothing and a blanket to prevent cooling. The nursery should be free of drafts at a temperature of 24 °C to 26 °C to assure a proper thermal environment for the healthy term infant. Temperature instability may be an important indicator of illness and, in particular, of infection.

**Cardiopulmonary Function**

The majority of life-threatening cardiopulmonary conditions appear during the first 6 hours after birth. The newborn’s heart rate, blood pressure, respiratory rate, quality of respirations, and color of skin and mucous membranes should be monitored and recorded frequently during this time.

In the first 10 minutes after birth, the average heart rate is 160 beats per minute (bpm) but may vary from 120 to 180 bpm. Thereafter, the average is 120 to 130 bpm (range 90–175 bpm). Consistently low or high heart rates suggest a pathologic condition. Tachycardia may be a sign of low intravascular volume, cardiovascular or respiratory disease, drug withdrawal, pain, or hyperthyroidism. Rates greater than 200 bpm should prompt consideration of tachydysrhythmias such as supraventricular tachycardia. Bradycardia is often seen after perinatal asphyxia and also may be an ominous sign in association with apnea, airway obstruction, or infection. An irregular rhythm is occasionally encountered during auscultations, most frequently due to premature atrial contractions. These are typically benign and resolve within 48 hours. More than 6 ectopic beats per minute should be evaluated with a 12-lead electrocardiogram and referral to a cardiologist if a conductive defect is suspected.

Normal newborns breathe approximately 40 times per minute. This rate is variable, and normal periodic breathing may even include brief pauses. These are usually 5 seconds or less in duration but occasionally last as long as 10 to 15 seconds. Prolonged apnea or apnea with associated bradycardia is abnormal and requires investigation. It is a nonspecific sign; it may be caused by such diverse conditions as sepsis, cardiac disease, hypoglycemia, polycythemia, and intracranial hemorrhage.

Tachypnea (respiratory rate > 60 breaths/min) in the newborn is also a nonspecific sign. Tachypnea is very common during the first few hours of normal transition, and in the first 24 hours, tachypnea is most often due to retained fetal lung fluid (transient tachypnea of the newborn). In addition to the causes noted above for apnea, tachypnea may also be caused by respiratory distress syndrome, meconium aspiration, pneumonia, and pneumothorax.

The normal range of blood pressure measured with a properly fitting limb cuff is 65 to 95 mm Hg systolic and 30 to 60 mm Hg diastolic in term infants. Arterial blood pressure varies directly with birth weight, gestational age, and age in hours. In the first 12 hours after birth, mean blood pressure averages 50 to 55 mm Hg in infants over 3 kg and 40 to 45 mm Hg in infants weighing between 2 and 3 kg.\textsuperscript{6} An abnormal gradient of upper extremity to lower extremity blood pressures and absent or weak femoral pulses may be signs of coarctation of the aorta.

**Gastrointestinal Function**

Feeding can be initiated once the infant has been assessed and is stable. If the mother has chosen to breast-feed, this should occur in the first hour after delivery. Careful observation during the first 1 or 2 feedings may yield valuable information regarding coordination of suck and swallow, possible presence of gastrointestinal obstruction, and the potential for aspiration of gastric contents.

Choanal and esophageal atresia should be excluded if the infant experiences difficulty breathing during feeding or if the infant regurgitates after each feeding. A soft catheter can be passed orally into the stomach, and nasal
airstreams can be assessed with a strip of cotton. Passing a catheter nasally is also safe but may cause swelling and further block narrowed choanae.

Newborns commonly regurgitate a few milliliters of milk with each feeding, especially when they burp. Recurrent vomiting or larger amounts or bile-stained emesis may reflect intestinal obstruction that requires immediate diagnostic evaluation. During the first day, infants who have large amounts of mucus or swallowed blood in the stomach may repeatedly regurgitate small amounts of material or have difficulty in feeding. Orogastric lavage with saline is sometimes used to remove this material and may improve feeding. If vomiting persists, further assessment, including abdominal radiographs, should be pursued.

In infants who are breast-fed, feeding behavior, frequency of feeding, stool characteristics, and initiation of maternal milk production should be noted and recorded. To determine nutritional intake, the change in weight before and after feeding can be measured. However, it is not necessary or appropriate to weigh a healthy term newborn with each breast-feeding. In babies who are fed milk formula, nutritional intake can be judged by the volume of formula taken. A family history of food allergy, asthma, or atopy should be considered prior to choosing the appropriate formula for feeding or supplementation (hydrolyzed, partially hydrolyzed, or cow milk formula). Exclusive breast-feeding for 3 to 6 months may help prevent these conditions from occurring in infancy and early childhood.

Approximately 70% of normal newborn infants excrete meconium during the first 12 hours, and 95% of infants pass at least 1 stool within 24 hours. An infant who does not pass meconium in the first 24 hours should be evaluated with an abdominal examination and a rectal examination. Passage of meconium may be delayed in infants with distal intestinal obstruction, as in meconium plug syndrome, or in infants with aganglionic colon (Hirschsprung disease). Other causes of abnormal gastrointestinal motility and delayed stool excretion are premature birth, sepsis, hypothyroidism, and various drugs, including narcotics.

Infants with high gastrointestinal obstruction usually present with vomiting but may not have abdominal distension or abnormal stool frequency during the first 24 hours after birth. Infants with lower intestinal obstruction are less likely to exhibit vomiting early but often exhibit abdominal distension and absent stools. Plain films of the abdomen are simple and effective in the initial evaluation of abdominal distention (see Chapter 389).

The color and consistency of stools change from green-black and very viscous on the first day to green-yellow and pastelike by the third or fourth postnatal day. Normal stools are not watery, but those of breast-fed infants are often softer and less formed than are the stools of formula-fed infants. During the first week, the normal frequency of stool output varies from 1 to 10 per day, usually averaging 3 to 5 stools daily. Delayed or infrequent stooling or persistently dark stools also increase the risk of hyperbilirubinemia during the first week. Rectal stimulation and glycerin suppositories can be used safely to encourage stooling in the first several days of life.

Stools that are dark red and tarlike in consistency are indicative of old blood, usually maternal in origin, which was swallowed at the time of delivery. This can be distinguished from the infant’s blood by a test that differentiates between adult and fetal hemoglobin (Apt test for alkali resistance of fetal hemoglobin). Small streaks of bright red blood in the stools often reflect the presence of a rectal fissure. If no fissure is found, or if there are large quantities of blood in the stools, further evaluation is indicated. Diarrhea is a common sign of systemic or gastrointestinal infection, feeding intolerance, or drug withdrawal.

**Urinary Function**

Approximately two thirds of newborn infants urinate within 12 hours of birth, and virtually all normal infants have voided at least once within 24 hours. Although the kidneys are relatively dehydrated at birth, an absence of urine output may be of prerenal origin (severe hypovolemia and hypotension, myocardial failure, dehydration); or it may reflect renal anomalies, such as absent kidneys, acute tubular necrosis from ischemia, or renal vein thrombosis; or it may signal obstruction to urinary outflow, possibly from posterior urethral valves or from a blocked urethra.

An infant who does not pass urine in the first 24 hours should be examined and have a Credé maneuver performed
over the bladder. The prenatal records should be reviewed for the presence or absence of oligohydramnios. The delivery summary should be reviewed for documentation of possible void at the time of delivery. The infant may also be challenged with a supplemental feeding. If no urine is excreted, a straight catheter may be passed to detect presence of urine in the bladder. If the bladder remains dry, initial work up would include blood urea nitrogen, creatinine, and renal and bladder ultrasound.

Neonatal urine is normally yellow or light brown. Urate crystals, which vary from brick red to tan in color, are a common source of diaper stain in the newborn period and are often misinterpreted as blood by new parents. Hematuria is pathologic and requires urgent evaluation. During the first week of life, female infants may experience estrogen withdrawal and have the equivalent of a small menstrual period, which may complicate the clinical picture. Such bleeding should be brief (1 day) and occur in tiny amounts.

**Size and Weight**

The newborn infant should be weighed daily in the hospital and at postnatal follow-up examinations. Hospital staff should refer to the mother’s menstrual history or ultrasound to assess gestational age, and then determine whether the infant is small, appropriate, or large for gestational age. A maturational assessment such as the Ballard score may be used to determine gestational age and is particularly useful for preterm infants. Infants who are small or large for gestational age may be at risk for postnatal complications, such as hypoglycemia or polycythemia.

The normal newborn loses approximately 5% to 10% of its birth weight during the first few days after birth and usually begins to regain weight by the second half of the first week. Weight loss beyond 7% should prompt an evaluation of feeding effectiveness. Weight loss of more than 10% in a term infant is considered abnormal.

Infant length is best measured with the infant supine, positioned with the head against the warming bed or crib. The infant’s knees should be held together and pressed gently to straighten the legs. A tape measure is then used to calculate the distance from the edge of the warming bed or crib down to the infant’s heels. Body length does not change measurably during this newborn period.

Occipital-frontal head circumference should be taken by placing a measuring tape above the eyebrows and the ears and wrapping it around the largest part of the occiput. The circumference may decrease by up to 1 cm as tissue edema abates during the week after birth. In some infants, head circumference may increase by up to 1 cm as the cranial molding that occurred during labor resolves. Rapid expansion of the head size in the first week may be a sign of ventricular enlargement and merits evaluation by cranial imaging studies. Infants who were delivered with instrumentation (vacuum or forceps) may be at increased risk for cephalohematoma, subgaleal hemorrhage, and intracranial hemorrhage and should have serial examinations and serial measurement of occipital-frontal head circumference.

**Prophylaxis**

**Eye Ointment**

Neisseria gonorrhoeae can penetrate the intact corneal epithelium and cause microbial keratitis, ulceration, and perforation. To prevent gonococcal ophthalmia, all newborn infants should have two drops of a solution of 1% silver nitrate or a 1- to 2-cm ribbon of ophthalmic ointment, containing either 1% tetracycline or 0.5% erythromycin, placed in each eye within 1 hour after birth. The solution or ointment should reach all parts of the conjunctival sac and should be dispensed from a single-use container. The eyes should not be rinsed after treatment because doing so decreases effectiveness.10

It is important to note that cases of penicillinase-producing gonococcus have been reported after application of silver nitrate. It is also important to note that neither silver nitrate nor erythromycin ointment is effective treatment for an already established case of gonococcal ophthalmia.11 Typical side effects of eye prophylaxis include chemical
conjunctivitis and blockage of the lacrimal duct.

**Vitamin K**

Hemorrhagic disease of the newborn has become a rare entity because of vitamin K prophylaxis. Vitamin K is necessary for synthesis of factors II (prothrombin), VII, IX, and X, and yet vitamin K is undetectable in cord blood. Lactobacillus, the primary gut flora in breast-fed babies, does not synthesize vitamin K, and breast milk contains only small amounts of vitamin K (1–9 mcg/L versus formula, 53–66 mcg/L).

All newborns should receive a single dose of vitamin K$_1$ (1 mg, intramuscularly) during the first few hours after birth to prevent the development of hemorrhagic disease of the newborn. Classically, this condition can cause gastrointestinal, intracranial, or generalized bleeding between 2 and 7 days after birth. However, the early form of the disease may present in the first 24 hours, and the late form may present anywhere between 2 weeks and 6 months of age. The late form of hemorrhagic disease occurs mainly in babies who are exclusively breast-fed but may also be associated with cystic fibrosis, celiac disease, chronic diarrhea, α$_1$-antitrypsin deficiency, or hepatitis.

For infants of parents who refuse the intramuscular injection, a 2-mg oral dose of vitamin K maintains normal coagulation status in the first few days, but the effect may be transient and the dose should be repeated. The recommended timing of additional dosing varies. Some recommend an additional dose of 2 mg at 6 to 8 weeks of age, while others recommend weekly dosing while breast-feeding. The intramuscular form of vitamin K can be given safely orally. Failures have been reported with oral dosing, and noncompliance with additional dosing has been noted as a major factor.  

**Hepatitis B Vaccine**

Because of the high likelihood of chronic infection with the hepatitis B virus and chronic liver disease that occurs when children under 5 years of age become infected, it is now public policy in the United States to immunize all infants against hepatitis B. In infants born to mothers who are negative for hepatitis B surface antigen, the first dose of recombinant vaccine should be administered before 2 months of age. Infants who receive the first dose in the delivery hospital are more likely to complete the 3-dose series. Delivery hospital protocols that encourage vaccination in the first 12 hours of life also protect the infant against maternal hepatitis B surface antigen conversion that may have occurred during the pregnancy. If the vaccine is given prior to discharge from the nursery, an immunization record should be filled out and given to the parents.

Infants born to mothers who are positive for hepatitis B surface antigen or to mothers of unknown hepatitis status need special management. Proper prophylaxis can prevent transmission in approximately 95% of exposed newborns that complete the 3-dose vaccine series. If the mother is positive for hepatitis B surface antigen, the infant should be bathed soon after birth to remove infectious bloody material, and the skin should be swabbed with disinfectant before any drug injection or blood drawing. In addition, the infant should receive hepatitis B immune globulin (0.5 mL) intramuscularly at one site and recombinant hepatitis vaccine concurrently in another site within the first 12 hours after birth.

Infants whose mothers are positive for hepatitis B surface antigen should be immunized on an accelerated schedule, with the second dose at 1 month and the third at 6 months after birth. For preterm infants less than 2000 g born to hepatitis B surface antigen–positive mothers, the initial vaccine dose at birth is not counted in the 3-dose series, which would begin at 2 months of age. The manufacturer’s guidelines should be checked for appropriate vaccine dose.

If the mother is of unknown hepatitis B status at the time of delivery, her blood should be sent for immediate testing, and the infant should receive the vaccine within 12 hours as described above for the infant whose mother is positive for hepatitis B surface antigen. If the mother is proven to be positive for hepatitis B surface antigen, the infant should then receive hepatitis B immune globulin as soon as possible and no later than 7 days postnatally. If the mother is...
hepatitis B surface antigen negative, the regular schedule of immunizations should be followed.

**Umbilical Cord Care**

Umbilical cords tend to dry quickly, naturally, and without any additional care. This simple observation has called into question the various methods of care previously thought necessary to prevent infection. Cord care is best accomplished by leaving the umbilicus exposed to air and/or by swabbing it daily with alcohol. Topical application of antiseptic agents such as triple dye or chlorhexidine to the cord may reduce colonization, but unless there is an increase in staphylococcal infection in the nursery, antiseptics usually are not necessary. Regardless, parental education regarding the signs and symptoms of omphalitis is imperative.

**Screening**

**Hypoglycemia**

Routine monitoring of blood glucose concentration is only recommended for symptomatic infants and infants at risk for hypoglycemia. Glucose concentration should be measured with a rapid bedside screening method as soon as possible, within 2 to 3 hours of life, before breast-feeding, and whenever clinical signs of hypoglycemia are noted. Hospital protocols specifying serial glucose measurements, early feedings, and transfer criteria should be developed for infants at risk for hypoglycemia.

Risk factors for hypoglycemia include diabetic mother, intrauterine growth restriction, small or large size for gestation, intrapartum asphyxia, prematurity or postmaturity, polycythemia, hypothermia, and stress from clinical conditions such as infection. Clinical signs of hypoglycemia include changes in level of consciousness, apnea or cyanosis, poor feeding, hypothermia, hypotonia, tremor, and seizures. Blood glucose measurement of below 40 mg/dL by the screening technique should be evaluated using a specific assay for serum or plasma glucose, and treatment for hypoglycemia should be initiated while the result is pending. The clinical signs of hypoglycemia may also occur with a variety of neonatal conditions (see Chapter 51).

Multiple definitions exist for hypoglycemia. Most healthy term infants have a serum or plasma glucose concentration higher than 40 mg/dL on the first day of life and over 45 to 50 mg/dL thereafter. However, there is believed to be a normal physiologic dip in blood glucose concentrations during the first 2 hours of life, and at this time, blood glucose levels as low as 25 mg/dL may be tolerated in an otherwise healthy, term infant who is able to feed appropriately. A steady state rate of glucose production has been measured in normal infants by 3 to 4 hours of life. It is important to note that individual infants exposed to high glucose levels in utero may become symptomatic at "normal" glucose concentrations above 40 mg/dL.

Hospital nurseries should define operational thresholds, or levels at which nurses and physicians should consider intervention. Protocols for treatment of hypoglycemia vary, but most agree that blood glucose concentration less than 20 to 25 mg/dL, persistent levels below 36 mg/dL after feeding, or persistent symptoms after feeding warrant intravenous infusion of dextrose and transfer to a higher level of care.

**Polycythemia and Anemia**

Hematocrit can be measured to exclude possible anemia or polycythemia at the same time that the blood glucose concentration is measured. Infants at risk should also have hematocrit measured. Anemia may result from hemolysis or blood loss, and special conditions such as suspected subgaleal hemorrhage may require measurement of serial hematocrits. Suspected fetomaternal hemorrhage can be detected by performing a Betke-Kleihauer acid elution test on maternal blood. Polycythemia is more common than anemia and is often associated with delayed cord clamping at birth (placental-to-infant transfusion), postmaturity, severe intrauterine growth restriction, large size for gestational age, monozygotic twins, or infants born to diabetic or hypertensive mothers. (See Chapter 53 for further information...
on anemia and polycythemia.)

Isoimmunization and Hyperbilirubinemia

It is the standard of care to obtain a mother’s blood type and Rh during pregnancy in order to avoid Rh sensitization and isoimmune hemolytic disease. Some centers have begun obtaining mother’s blood type and Rh upon admission to labor and delivery in order to avoid transcription errors of prenatal laboratory results. If a mother’s Rh status is negative, her infant’s blood type and Rh should be determined and a direct Coombs test should be performed. Blood type and direct Coombs test also should be performed if the mother has a positive antibody titer.

Many hospitals obtain blood type and direct Coombs tests on all infants born to type O mothers in order to detect ABO incompatibility, which is a major risk factor for hyperbilirubinemia. Other risk factors include prematurity, large size for gestational age, East Asian race, polycythemia, cephalohematoma or bruising, exclusive breast-feeding, delayed stooling, and sibling-required phototherapy. Jaundice within the first 24 hours or an elevated bilirubin prior to discharge also place an infant at higher risk. While each hospital should have a bilirubin or jaundice screening policy in place, approaches vary.

The most recent guideline from the American Academy of Pediatrics recommends that clinicians perform a systematic assessment of the risk of severe hyperbilirubinemia prior to hospital discharge. Some hospitals have implemented the guideline by obtaining a predischarge total serum or transcutaneous bilirubin and determining risk based on an hour-specific nomogram. However, it is important to note that bilirubin screening is only one piece of a systematic approach required for successful prevention of hyperbilirubinemia. Other components include serial examinations, documentation of progression of jaundice, and postdischarge follow-up care. The American Academy of Pediatrics and the Centers for Disease Control and Prevention have developed toolkits to assist birthing centers in following the guidelines for management of hyperbilirubinemia. (See Chapter 53 for further information.)

Metabolic Diseases and Hemoglobinopathies

Before hospital discharge, all newborns should be screened for at least primary hypothyroidism, galactosemia, phenylketonuria, and sickle cell disease (along with the other hemoglobinopathies that are detected with sickle cell testing). In the United States, screening tests are usually performed under the auspices of a mandated statewide program. Additional tests may be included depending on their availability in the region. In some states, neonatal screening tests for cystic fibrosis, congenital adrenal hyperplasia, maple syrup urine disease, additional hemoglobinopathies, and other infectious and metabolic diseases are routinely performed.

Newborn nurseries should have protocols in place to ensure that initial testing is performed on all infants at the proper time, that conditions affecting results are noted (eg, blood transfusion), that results are followed up in a timely manner, and that infants with positive results are referred for diagnostic testing and treatment. For the normal healthy infant, the optimal time for specimen collection is 3 to 5 days of life. However, at least 24 hours after delivery is considered acceptable in order to obtain the specimen prior to discharge. A specimen taken prior to 24 hours of life can adequately screen for galactosemia, biotinidase deficiency, medium-chain acyl-CoA dehydrogenase deficiency, cystic fibrosis, and sickle hemoglobin, but it cannot reliably detect the other disorders. The blood is usually obtained by heel stick and collected onto filter paper. Because of the flow of blood necessary for newborn screening, other laboratories tests, such as sepsis screening or total bilirubin, can be ordered and collected at the same time to minimize the number of blood draws. Some states require that hospitals implement programs to ensure follow-up of screening tests for metabolic diseases and hemoglobinopathies. Hospitals should perform regular audits of live births as well as outborn transfers, certify that each infant was tested or retested at the appropriate time, review all abnormal test results, and document referral for appropriate evaluation and treatment.

Hearing Loss

Screening newborn infants for deafness and auditory abnormalities is recommended by the American Academy of
Pediatrics so that infants with sensorineural or conductive hearing loss can be diagnosed by 3 months of age and early intervention initiated by 6 months of age. Hearing screening should be completed prior to discharge from the hospital, and hospital programs must ensure that tracking, follow-up, identification, intervention, and evaluation can be carried out when necessary.

Currently, there are 2 methods of automated testing: the auditory brainstem response and the otoacoustic emissions test. Both of these tests can be performed by nursery personnel trained in their use. Infants who fail these screening tests in one or both ears should be referred for formal diagnostic studies at an audiology center that is capable of testing young infants. The prevalence of newborn hearing loss is 1 to 2 per 1000 live births, and the incidence in normal newborns is 1 per 1000. The referral rate for diagnostic testing after failed hearing screening should be less than 4%. Hospitals that cannot implement universal screening may use a risk-based approach. However, such an approach may identify only 50% of all newborns with hearing loss.

**Exposure to Toxic Substances**

Infants who have been exposed in utero to drugs of abuse should be identified in the neonatal period so that they can be monitored carefully for signs of neonatal abstinence syndrome. Every nursery should have a protocol that defines specific criteria based on maternal risk factors and on infant symptoms to determine those patients for whom a urine or meconium sample should be sent for detection of illicit drugs. Common maternal risk factors include history of drug use; limited prenatal care; history of hepatitis B, HIV, syphilis, gonorrhea, or prostitution; and unexplained placental abruption. Clinical suspicion is increased when these risk factors are accompanied by preterm labor.

Infant risk factors include unexplained neurologic complications, unexplained intrauterine growth retardation, and evidence of drug withdrawal. The signs and symptoms of neonatal abstinence syndrome include neuroexcitability or central nervous system dysfunction; metabolic, vasomotor, and respiratory disturbances; and gastrointestinal dysfunction. The onset of symptoms depends on the drug, the time and extent of the last exposure, as well as the metabolism and excretion of the drug and its metabolites. Abstinence scores should be obtained regularly in exposed infants and may be used to guide therapy, which typically includes morphine, methadone, or tincture of opium. Abstinence scores may also be elevated in infants who have been exposed to stimulants, as these infants may have higher levels of excitability and may appear to be irritable or hungry. This usually represents drug effect rather than withdrawal.

Toxicology testing may be performed on the infant’s urine or meconium. Urine testing is the most readily available, although collection with a urine bag can be frustrating. The first void contains the highest concentration of drug or metabolites, but generally detects drug use in only the prior 72 hours. As such, negative urine toxicology results are common even with known drug use. Chronic use of certain drugs (marijuana, barbiturates, or phencyclidine) may allow detection up to 30 days after last use. Meconium screening may allow detection of drugs used a month or more before birth when collected in the first 2 days of life. Meconium is easier to collect than urine, but delayed passage of stool will also delay drug detection. Regardless of method used, positive results should ideally be confirmed by a second test.

A physician or other allied health professional should order the screening, document the indication, and inform the infant’s mother. Mothers with a history of drug use should also receive a social services evaluation, the focus of which should be the health and well-being of the mother, infant, and family. Such infants are not candidates for early discharge, and arrangements should be made for appropriate care and follow-up evaluation. Issues for long-term follow-up include increased risk of sudden infant death syndrome, difficult social situations, and abnormal cognitive and behavioral development.

**Renal Pelviectasis and Hydronephrosis**

Approximately 1% of infants will have urinary dilatation detected in utero by ultrasound. Most children with this
diagnosis will have a benign course, but some will suffer renal deterioration due to infection or obstruction. Of all cases with dilatation, the order of significant uropathy is approximately 20% (or 0.2% of all children). For this reason, nurseries must ensure that results from prenatal ultrasounds are communicated with the infant’s pediatrician or other care provider.

Currently, there is no consensus regarding subsequent evaluation once mild antenatal renal pelviectasis is noted. Most agree that a newborn infant with mild unilateral pelviectasis or hydronephrosis (< 7 mm of dilatation) does not require further evaluation. Those with greater than 7 mm of dilatation should have a renal ultrasound no earlier than 72 hours after delivery. This delay compensates for the physiologically dehydrated state of the kidney in the first 24 to 48 hours of life and helps to avoid false-negative results. The use of prophylactic antibiotics during this period is controversial but still widely practiced. Infants with a positive ultrasound should be placed on prophylactic antibiotics and a repeat renal ultrasound obtained at 1 month of age. A negative study at this time would warrant no further workup, while persistent findings should trigger referral to a specialist. For a more detailed discussion see Chapter 476.

Whether or not to perform a voiding cystourethrogram if the first renal ultrasound is negative is also controversial. Approximately 25% of infants with vesicoureteral reflux on complete evaluation (ultrasound plus voiding cystourethrogram) have a negative ultrasound. Grades 1, 2, and 3 vesicoureteral reflux also often have normal ultrasounds, as the findings of hydronephrosis with vesicoureteral reflux are often transient. Thus, care providers are encouraged to individualize care based not only on evidence but also on the family’s wishes.

More serious findings on fetal ultrasound require immediate action. These conditions include severe bilateral hydronephrosis, bilateral hydroureteronephrosis, multicystic dysplastic kidney, or male fetal hydronephrosis with prenatal history of oligohydramnios. Newborns with these conditions should be evaluated with a consult from a pediatric urologist, a same-day renal/bladder ultrasound, a chemistry panel at 12 hours of life, and a voiding cystourethrogram based on the recommendations of the consulting specialist. These infants should also be started on antibiotic prophylaxis.

**Developmental Hip Dysplasia**

Hip instability occurs in approximately 1% of newborns, while the incidence of dislocation is only 1 to 1.5 per 1000. The incidence of developmental hip dysplasia is higher in girls and with breech presentation. Overall, the left hip is involved 3 times more often than the right hip. The risk is also increased with a positive family history (6% risk with healthy parents and 1 affected child, 12% risk with an affected parent, and 36% risk with an affected parent and 1 affected child). A review of risk factors (family history, female gender, and breech position) for hip dysplasia and properly performed Ortolani and Barlow maneuvers are essential components of routine newborn care. After 8 to 12 weeks, the maneuvers are likely to be negative, regardless of the status of the femoral head. Infants with a positive Ortolani or Barlow sign at the time of newborn examination should receive a consultation by a pediatric orthopedist. Radiologic study is not recommended, and the use of triple diapers is not recommended because it delays appropriate treatment with a Pavlik harness. Infants who have “equivocally” positive examinations at birth should have a follow-up hip examination at 2 weeks of age, followed by a referral to a pediatric orthopedist if the examination remains positive.

Routine radiologic screening is not recommended for newborn infants with negative examinations. However, infants with one risk factor present should be reexamined at 2 weeks of age and then according to the periodicity schedule. Radiologic screening (ultrasound at 6 weeks or plain radiographs at 4 months) is recommended for female infants who were carried in the breech position, as these represent the 2 greatest risk factors for developmental hip dysplasia. 22

**Infection**

Acute infections acquired during the perinatal period are common. Progression is often rapid and potentially lethal if
detection and treatment are delayed. Sepsis and pneumonia commonly coexist, and spread of the infection to the central nervous system can lead to long-term disability or death. Individual risk factors increase the odds of sepsis in the newborn infant, and the presence of several risk factors increases the likelihood of sepsis. Prolonged rupture of membranes (>18 hours), fetal tachycardia, maternal fever, premature delivery, maternal chorioamnionitis, and birth depression are major risk factors in the perinatal period.

Signs and symptoms of neonatal sepsis include abnormal body temperature, poor feeding, abdominal distension, lethargy, hypoglycemia or glucose intolerance, hypotension, cyanosis, respiratory distress, petechiae, apnea, and irritability or seizures. Sepsis is often associated with poor peripheral perfusion, pallor or cyanosis, and mottled skin. Umbilical erythema, sometimes accompanied by a generalized rash, is indicative of serious infection and merits prompt evaluation and treatment with antibiotics. Jaundice in the first 24 hours after birth also may indicate the presence of infection.

Serious neonatal infections may present with either very low or very high white blood cell counts (<5000/mm^3 or >30,000/mm^3 of blood) with a high percentage of immature cells (bands, myelocytes, metamyelocytes). However, healthy newborns often have high white blood cell and absolute band counts because of the demargination that occurs during the stress of delivery. C-reactive protein may also be useful in the sepsis evaluation. C-reactive protein has good negative predictive value for sepsis when at least 2 values are obtained 24 hours apart and are both negative (<1 mg/dL). Conversely, C-reactive protein has positive predictive value for sepsis only when elevated above 6 mg/dL.23

The subtleties of presentation and potential gravity of neonatal sepsis are cause for a high index of suspicion and low threshold for conducting a careful diagnostic evaluation. The presence of multiple risk factors should prompt diagnostic tests for infection and immediate antibiotic treatment.24 Conditions associated with a modest risk of sepsis (eg, prolonged rupture of membranes) may warrant screening laboratory studies, including a white blood cell count and C-reactive protein, and careful clinical observation. Blood culture should also be considered during this period of observation.

Any infant with signs or symptoms of sepsis, regardless of laboratory values, should undergo a complete sepsis evaluation, including white blood cell count, blood culture, and cerebrospinal fluid culture, and should be started on empiric antibiotics immediately. For further discussion of the management of neonatal infections, see Chapter 230.

Group B Streptococcal Infection

Intrapartum antibiotic prophylaxis is recommended for group B streptococcus–positive mothers in order to minimize the risk of infection to the newborn.25 One dose of antibiotics (penicillin, ampicillin, or cefazolin) received 4 hours prior to delivery is considered adequate to achieve effective antibacterial levels in the fetus and amniotic fluid. Maternal group B streptococcus status, intrapartum antibiotic status, and other risk factors for neonatal sepsis (prematurity, intrapartum fever, or prolonged rupture of membranes) determine the approach to the newborn infant.

Infants of group B streptococcus–positive mothers who have received adequate intrapartum antibiotic prophylaxis can simply be observed for 24 hours. Infants of group B streptococcus–positive mothers who did not receive adequate intrapartum antibiotic prophylaxis may be observed for 48 hours, may receive supplemental antibiotic prophylaxis (intramuscularly) without diagnostic evaluation, or may be screened for sepsis. Infants born to mothers whose group B streptococcal status is unknown should be observed and evaluated for sepsis according to the general principles discussed here. The Centers for Disease Control and Prevention recommends that infants born to mothers with chorioamnionitis, infants with premature prolonged rupture of membranes, and infants with a sibling who had group B streptococcal sepsis should receive a full diagnostic evaluation and empiric antibiotic therapy. Above all, clinical signs and symptoms of systemic illness warrant prompt evaluation and treatment. For further discussion of group B streptococcal infection see Chapter 286.
Procedures

Circumcision

Circumcision, or removal of the penile foreskin to near the coronal sulcus, is frequently performed to prevent late inflammatory diseases of the penis (eg, balanoposthitis) and stenotic or constrictual foreskin problems (phimosis and paraphimosis). Many families also choose circumcision for personal, religious, or cultural reasons. Circumcision incidence in the United States varies geographically, with the highest incidence in the North Central census region and the lowest in the Western region (80% and 32% respectively). Circumcision is associated with decreased risk of penile cancer, urinary tract infection, and sexually transmitted diseases, including human papillomavirus, syphilis, gonorrhea, and HIV. The complication rate of circumcision is less than 1%, typically bleeding and infection at the surgical site. A recent policy statement of the American Academy of Pediatrics states that the potential medical benefits of circumcision are not sufficient to warrant its recommendation as a routine procedure. Written consent should always be obtained from a parent or guardian after discussing the potential risks and benefits of the procedure.

Circumcision is contraindicated in infants with a family history of bleeding disorder (hemophilia) and infants with structural abnormalities of the penis, including hypospadias, epispadias, chordee, or ambiguous genitalia. Other relative contraindications include prematurity, small or concealed penis, curvature or penile torsion, large hydroceles, and clinical instability or illness.

Circumcision is performed by either a surgical clamp technique (eg, Gomco or Mogen) or use of a plastic bell. With the former, diaper adhesion to the surgical site is prevented postoperatively by petrolatum gauze dressing or petrolatum applied to the diaper or penis. With the plastic bell technique, the underlying tissue is normally healed by the time the bell falls off. Circumcision should be performed using local anesthesia, most commonly with local dorsal penile nerve block or penile ring block (lidocaine). Use of topical anesthetic cream (mixture of lidocaine and prilocaine) is recommended if local injection of anesthetic is not available.

Parents of infants who remain uncircumcised should receive instruction soon after delivery and at subsequent physician office visits regarding proper hygiene. Parents should be discouraged from forcibly retracting the foreskin of the uncircumcised penis, until such time as the foreskin becomes naturally softened and detached from adhesions. Parents from cultures that routinely circumcise males between ages 7 and 12 years may be encouraged to circumcise their sons as newborns.

Sublingual Frenotomy

Ankyloglossia, or tongue-tie, is a condition in which the sublingual frenum extends out toward the tip of the tongue. Ankyloglossia occurs in up to 5% of newborns and when present, has been reported to cause difficulties with breast-feeding in approximately 25% of cases. Potential problems include poor and/or painful latch, decreased milk supply, poor infant weight gain, and decreased duration of breast-feeding. Although there are no reliable criteria for “clinically significant” ankyloglossia or to predict which infants will benefit from sublingual frenotomy, experience in multiple settings suggests that the procedure may improve latch and decrease mother’s nipple and breast pain associated with breast-feeding. There is no evidence for the benefit of early or prophylactic frenotomy during the first few days of life.

Complications of frenotomy are rare but include bleeding, infection, and salivary gland injury. Once the infant is immobilized, the sublingual frenum can be isolated manually or with the use of a tongue elevator. The white membrane can then be cut with sterile scissors at a line parallel with and fairly close to the tongue. Generally, the cut will be less than 5 mm in length. Mild compression with a gauze sponge can be used to slow any bleeding, and the infant can feed immediately at the breast.
Breast-Feeding and Lactation Support

The numerous benefits of breast-feeding and management approaches to encourage and facilitate breast-feeding are discussed in Chapter 24.

Successful breast-feeding depends on early initiation and support. Newborn infants should breast-feed within the first hour of life unless medically contraindicated.

Hospital staff should be trained to recognize breast-feeding difficulties and to help mothers achieve proper position and latch. Regular nursing assessments should include documentation of breast-feeding efficacy using a lactation scoring system. Mothers identified with greater needs should be referred for additional consultation with a lactation specialist.

Hospitals should also consider developing preventive management guidelines for infants at risk for feeding difficulties, which may exacerbate weight loss and hyperbilirubinemia. Mothers of premature infants and multiples often require additional lactation consultation, care planning, along with close, frequent follow-up. Although use of formula and pacifiers may negatively affect breast-feeding duration, early supplementation (with pumped milk or formula) may be appropriate for certain at-risk groups. Alternative feeding methods, including cup feeding or finger feeding, may be appropriate.

Breast-feeding should be encouraged except in those few circumstances where the risks to the infant outweigh the benefits. Breast-feeding is contraindicated in maternal conditions that may result in transmission of infection to the infant, such as active pulmonary tuberculosis (until treatment is started and the mother is considered to be noncontagious), herpetic breast lesions, or infection with HIV. Possible effects on the infant of maternal medications and chemical exposures also should be considered, as many drugs and other chemicals can pass from mother to infant in breast milk.30

Birth Plans and Refusal of Routine Care

Birth plans are becoming increasingly popular and play an important role in the relationships parents have with their newborn children and with their care providers. While a birth plan may cover many topics, its main goal is to convey parent preferences for the hospital stay. Preferences regarding childbirth should be discussed prenatally with the obstetrician or midwife, and ideally, preferences regarding routine newborn care also should be discussed at a prenatal visit with the pediatrician. Parents may request delayed administration or withholding medications or vaccines (erythromycin eye ointment, vitamin K, hepatitis B vaccine), exclusive breast-feeding without use of pacifiers or bottles, delayed or no separation from the infant, and delayed or no circumcision.

In most cases, there are safe, viable alternatives to accommodate parents and to allow the best hospital experience possible. Care providers should make every effort to discuss the birth plan and to address contingency plans in case of emergency (neonatal resuscitation, transfers to higher level of care, transports). Some components of routine care, such as eye prophylaxis, are mandatory in some states. Hospitals should ensure that policies are in place to obtain waivers of liability from parents when required by state law.

Preparation for Discharge

The time that a newborn infant spends in the hospital nursery provides an important opportunity for maternal education as well as for critical infant evaluation. Although legislation has guaranteed a 48-hour stay for vaginal deliveries and a 72-hour stay for cesarean sections, the needs of each mother-infant dyad dictate the amount of preparation deemed to be sufficient. Before the infant is discharged from the hospital, the mother should receive sufficient practical instruction to ensure appropriate home management of feeding, bathing, and general care of the infant, including recognition of well-being and illness.
The adequacy of the home situation should be evaluated, as well as the presence of particular stresses, such as domestic violence, isolation, depression, and homelessness. Social services and public health nurse referrals may be very helpful in ensuring a safe and nurturing environment for the baby after discharge. Additional anticipatory counseling should be done to promote infant safety and to prevent exposure to potential infections and toxins.

The discharge examination of the infant should be done, if possible, in the mother’s presence to allow her ample opportunity to express her concerns and ask questions about the findings she may think are abnormal. Plans for subsequent well-baby care of the infant should be established and instructions given for communicating concerns to the appropriate medical provider. The mother also should be advised that if her infant becomes sick in the neonatal period and receives treatment elsewhere, the relevant information should be transmitted to the nursery that provided early postnatal care.

Infants who are discharged within 48 hours after birth should be seen again in 2 to 3 days. Infants with risk factors such as prematurity, weight loss, poor feeding, or early jaundice may require earlier and more frequent follow-up visits. The hospital staff should document the location and date of the infant’s anticipated follow-up, ensure parental understanding of the time interval and any significant clinical conditions, and facilitate the transfer of information to the provider who will assume care of the infant.

**Car Seat Selection and Testing**

Every hospital should have policies to ensure that each newborn is transported home properly restrained in a car safety seat. The American Academy of Pediatrics recommends that such policies be developed with the help of an expert who has completed the course offered by the National Highway Traffic Safety Administration. The policies should ensure that parents are informed about the importance and proper use of car seats, that hospital staff are trained to assess infant car seat needs, that all infants less than 37 weeks’ gestation have a period of observation in a car seat, that all printed materials are reviewed periodically for accuracy, and that provisions are made for parents to obtain free or low-cost seats when needed.

**References**


