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Neonatology. Introduction

Study guide

Edited by Doctor of Medicine, Professor V. E. Markevych
and Doctor of Medicine, Professor S. V. Popov

Recommended by the Academic Council of Sumy State University

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This study guide contains information about basic principles of care of newborn babies, transitory conditions and feeding of infants, main principles of neonatal resuscitation.

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INTRODUCTION TO THE NEONATOLOGY

Neonatology is a part of pediatrics which studies newborn infant, its physiology, and pathology; treatment, and prevention of its diseases, and disorders; peculiarities of nursing, and feeding.

The neonatal period is a highly vulnerable time for an infant, who is completing many of the physiologic adjustments required for extrauterine existence. The high neonatal morbidity and mortality rates attest to the fragility of life during this period, and of all deaths occurring in the 1st year, two thirds of which occur in the neonatal period.

Neonatology terms

Gestational age (or more correctly the menstrual age) is measured from the first day of the mother's last normal menstrual period. The average gestational age is 40 weeks (280 days). The majority of infants are born between 37 weeks (259 days) and 42 weeks (294 days) and are referring to as **term infants.**

Gestational age of the newborn infant can be estimated by noting various physical characteristics that normally appear at each stage of fetal development. Gestational age assessment of the newborn is facilitated by using a scoring system such as the one developed by Dubowitz and Dubowitz, or a modification of it by Ballard (see below).

Preterm infants are those born before 37 weeks while **post-term infants** are born on, or after 42 weeks. Infants born to the 38 week of pregnancy and after 42 weeks are determined as prematurely born and postmaturely accordingly.

Intrauterine periods of development:

1. Embrional development begins from the zygote formation, lasts till 8 weeks of gestation. In this period different organs and systems are formed. Risk factors: genetical, physical, chemical, alimentary, toxicosis, mother’s diseases.

2. Placental development begins in 8 weeks of gestation. It continuestill the end of pregnancy. It is

characterized by differentiations of fetal tissues and organs, enlargement of the fetus weight and length.

Neonatal period begins from the birth of the baby, extends until 28 days after the birth. Neonatal period divides on:

1. Early neonatal period – from the birth until 7 days after the birth.
2. Late neonatal period – from 7 days until 28 days after the birth.

Perinatal period begins from 28 weeks of gestation, extends until 7 days after delivery, and includes:
a) late antenatal period (from 28 weeks of gestation to 40 weeks of gestation);
b) intranatal period (from the first signs of the delivery until the baby is born);
c) early neonatal period (from the birth of the baby until 7 days after the birth).

Live birth – the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life such as heartbeat, umbilical cord pulsation, or definite movement of voluntary muscles, whether the umbilical cord has been cut or the placenta is attached. A live birth is not necessarily a viable birth (see early neonatal death).

An infant's **transition from intrauterine to extrauterine life** requires many biochemical and physiologic changes. It is no longer dependent on maternal circulation via the placenta, the newborn's respiratory system must function for exchange of oxygen and carbon dioxide. Newborn infants are also dependent on gastrointestinal tract function for absorbing food, renal function for excreting waste and maintaining chemical homeostasis, hepatic function for neutralizing and excreting toxic substances, and function of the

immunologic system for protecting against infection. The neonatal cardiovascular and endocrine systems also adapt for self-sufficient functioning. Many of a newborn infant's special problems are related to poor adaptation because of asphyxia, premature birth, life-threatening congenital anomalies, or the adverse effects of delivery.

Gestational Age

Gestational age and growth parameters help to identify the risk of neonatal pathology. Gestational age (menstrual age, postmenstrual age) is the time elapsed since the beginning of the woman's last menstrual period; it is usually counted in weeks. Because it is not based on the moment of fertilization, which is difficult to specify (except when in vitro fertilization is done), gestational age is not the actual age of the fetus. Gestational age is the primary determinant of organ maturity.

The best way to assess gestational age is antenatal ultrasonography and menstrual history. Clinicians also estimate gestational age during the newborn physical examination using the new Ballard score (Pic.1). The Ballard score is based on the neonate's physical and neuromuscular maturity and can be used up to 4 days after the birth (in practice, the Ballard score is usually used in the first 24 hours). The neuromuscular components are more consistent over time because the physical components mature quickly after the birth. However, the neuromuscular components can be affected by illness and drugs (e. g. Mg sulfate given during labor).

Table 1 – Assessment of gestational age – new Ballard score

Neuromuscular Maturity

Score	–1	0	1	2	3	4	5
Posture							
Square window (wrist)	 > 90°	 90°	 60°	 45°	 30°	 0°	
Arm recoil		 180°	 140–180°	 110–140°	 90–110°	 < 90°	
Popliteal angle	 180°	 160°	 140°	 120°	 100°	 90°	 < 90°
Scarf sign							
Heel to ear							

Physical Maturity

Skin	Sticky, friable, transparent	Gelatinous, red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash; few veins	Cracking, pale areas; rare veins	Parchment, deep cracking; no vessels	Leathery, cracked, wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel-toe 40–50 mm: –1 < 40 mm: –2	> 50 mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior 2/3	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	Stippled areola, 1–2 mm bud	Raised areola, 3–4 mm bud	Full areola, 5–10 mm bud	
Eye/Ear	Lids fused loosely: –1 tightly: –2	Lids open; pinna flat; stays folded	Slightly curved pinna; soft; slow recoil	Well curved pinna; soft but ready recoil	Formed and firm, instant recoil	Thick cartilage, ear stiff	
Genitals (male)	Scrotum flat, smooth	Scrotum empty, faint rugae	Testes in upper canal, rare rugae	Testes descending, few rugae	Testes down, good rugae	Testes pendulous, deep rugae	
Genitals (female)	Clitoris prominent, labia flat	Clitoris prominent, small labia minora	Clitoris prominent, enlarging minora	Majora and minora equally prominent	Majora large, minora small	Majora cover clitoris and minora	

Maturity Rating	
Score	Weeks
–10	20
–5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

Scores from neuromuscular and physical domains are added to obtained total score.

Based on gestational age, each neonate is classified as:

Premature: < 37 weeks of gestation;

Late preterm: 34 to < 37 weeks;

Early term: 37 0/7 weeks through 38 6/7 weeks;

Full term: 39 0/7 weeks through 40 6/7 weeks;

Late term: 41 0/7 weeks through 41 6/7 weeks;

Postterm: 42 0/7 weeks and beyond;
Postmature: > 42 weeks.

Post Conceptual Age (PCA):

PCA = weeks of age at birth + weeks of age since birth.
Example: 25 weeks at birth + 15 weeks since birth = 40 weeks PCA.

High-Risk Pregnancies

High-risk pregnancies are those that increase the likelihood of abortion, fetal death, premature delivery, intrauterine growth restriction, poor cardiopulmonary or metabolic transitioning at birth, fetal or neonatal disease, congenital malformations, mental retardation, or other handicaps. Some factors, such as ingestion of a teratogenic drug in the first trimester, are causally related to the risk; others, such as hydramnios, are the signs that alert a physician to determine the etiology and avoid the inherent risks associated with excessive amniotic fluid. Based on their history, 10–20 % of pregnant women can be identified as having high risk; nearly half of all perinatal mortality and morbidity is associated with these pregnancies. Although assessing antepartum risk is important in reducing perinatal mortality and morbidity, some women have high risk only during labor and delivery; therefore, careful monitoring is critical throughout the intrapartum course.

Identifying high-risk pregnancies is important not only because it is the first step toward prevention but also because therapeutic steps may often be taken to reduce the risks to the fetus or neonate if the physician knows of the potential for difficulty.

Factors Associated with High-Risk Pregnancy

Economic: poverty, unemployment, uninsured or underinsured health insurance, poor access to prenatal care.

Cultural-behavioral: low educational status, poor health care attitudes, no care or inadequate prenatal care, cigarettes, alcohol, illicit drug use, age less than 20 or over 35 years, short interpregnancy interval, lack of support group (husband, family, religion), stress (physical, psychological).

Biologic-genetic: previous low birthweight or preterm infant, low weight for height, poor weight gain during pregnancy, short stature, poor nutrition, inbreeding (autosomal recessive), intergenerational effects, low maternal birthweight, hereditary diseases (inborn error of metabolism).

Reproductive: previous cesarean section, previous infertility; conception of reproductive technology; prolonged gestation; prolonged labor; previous infant with cerebral palsy, mental retardation, birth trauma, congenital anomalies; abnormal lie (breech); multiple gestations; premature rupture of membranes; infections (systemic, amniotic, extra-amniotic, cervical); preeclampsia or eclampsia; uterine bleeding (abruptio placentae, placenta previa); parity (0 or more than 5); uterine or cervical anomalies; fetal disease; abnormal fetal growth; idiopathic premature labor; iatrogenic prematurity; high or low levels of maternal serum α-fetoprotein.

High-Risk Infant

Neonates at risk should be identified as early as possible to decrease neonatal morbidity and mortality. The term high-risk infant denotes an infant who should be under close observation by experienced physicians and nurses. Infants in the high-risk category are listed in Table 1. Approximately 9 % of all births require special or neonatal intensive care. Usually needed for only a few days, such observation may last from a few hours to several months. Some institutions find it advantageous to provide a special or transitional care nursery for high-risk infants, often within the

labor and delivery suite. This facility should be equipped and staffed similar to a neonatal intensive care area.

Examination of fresh placenta, cord, and membranes may help the physician to remain alert to newborn infants at high risk and may help to confirm diagnosis of a sick infant. Placental pallor, retroplacental hematoma, and tears in the velamentous cords or chorionic blood vessels supplying the succenturiate lobes may indicate fetal blood loss. Placental edema and secondary possible immunoglobulin G deficiency in newborns may be associated with fetofetal transfusion syndrome, hydrops fetalis, congenital nephrosis, or hepatic disease. Amnion nodosum (granules on the amnion) and oligohydramnios are associated with pulmonary hypoplasia and renal agenesis, whereas small whitish nodules on the cord suggest a candidal infection. Short cords and non-coiled cords occur with chromosome abnormalities and omphalocele. True umbilical cord knots are seen in approximately 1 % of births and are associated with a long cord, small fetal size, polyhydramnios, monoamniotic twinning, fetal demise, and low Apgar scores.

Chorioangiomas are associated with prematurity, abruptio, polyhydramnios, and intrauterine growth restriction (IUGR). Meconium staining suggests in utero stress and opacity of the fetal placental surface suggests infection. Single umbilical arteries are associated with an increased incidence of congenital renal abnormalities and syndromes.

Many infants who are born prematurely, are small for gestational age (SGA), have significant perinatal asphyxia, are breech, or are born with life-threatening congenital anomalies do not have previously identified risk factors. For any given duration of gestation, the lower the birthweight, the higher the neonatal mortality; for any given weight, the shorter the gestational duration, the higher the neonatal mortality. The highest risk of neonatal mortality occurs in infants who weigh < 1,000 g at birth and whose gestation was < 28 weeks. The lowest risk of neonatal mortality occurs in infants with a

birthweight of 3,000–4,000 g and a gestational age of 38–42 weeks. As birthweight increases from 500 to 3,000 g, a logarithmic decrease in neonatal mortality occurs; for every week of increase in gestational age from the 25th to the 37th week, the neonatal mortality rate decreases by approximately half. Nevertheless, approximately 40 % of all perinatal deaths occur after 37 week of gestation in infants weighing 2,500 g or more; many of these deaths take place in the period immediately before birth and are more readily preventable than those of smaller and more immature infants. Neonatal mortality rates rise sharply for infants weighing over 4,000 g at birth and for those whose gestational period is 42 weeks or longer. Because neonatal mortality largely depends on birth weight and gestational age.

Table 2 can be used to help identify quickly high-risk infants. This analysis is based on total live births and therefore describes the mortality risk only at birth. Because most neonatal mortalities occur within the first hours and days after birth, the outlook improves dramatically with increasing postnatal survival.

Table 2 – High-Risk Infants

Demog-raphic Social Factors	**Past Medical History**	**Previous Pregnancy**	**Present Pregnancy**	**Labor and Delivery**	**Neonate**
Maternal age < 16 or > 40 years; illicit drug, alcohol, cigarette use;	Genetic disorders; diabetes mellitus; hyperten-sion; asympto-matic bacteriuria;	Intraute-rine fetal demise; neonatal death; prematu-rity; intraute-rine growth restric-tion;	Vaginal bleeding (abruptio placentae, placenta previa); sexually transmitted infections	Premature labor (< 37 weeks); postdates (> 42 weeks); fetal distress; immature L/S ratio;	Birth-weight < 2, 500 or > 4,000g; birth before 37 or after 42 weeks of gestati-on;

Continuation of Table 2

poverty; emotional or physical stress	rheumatologic illness (SLE) long-term medication	congenital malformation; incompetent cervix; blood group sensitization; neonatal jaundice; neonatal thrombocytopenia; hydrops; inborn errors of metabolism	(colonization: herpes simplex, group B streptococcus), chlamydia, syphilis, hepatitis B, HIV; multiple gestation; preeclampsia; premature rupture of membranes; short interpregnancy time; poly/oligohydramnios; acute medical or surgical illness; inadequate prenatal care; familial or acquired hypercoagulable states; abnormal fetal ultrasonography; treatment of infertility	absent phosphatidylglycerol; breech presentation; meconium-stained fluid; nuchal cord; cesarean section; forceps delivery; Apgar score < 4 at 1 min	SGA, LGA growth status; tachypnea; cyanosis; congenital malformation; pallor; plethora; petechiae

L/S – lecithin/sphingomyelin ratio; LGA–large for gestational age; SGA–small for gestational age; SLE–systemic lupus erythematosus.

Transition to extrauterine physiology

The transition from life in utero to life outside the womb involves multiple changes in physiology and function.

To decrease neonatal morbidity and mortality, the practitioner must be able to identify rapidly infants whose transition from an intrauterine to extrauterine physiology is delayed. Neonatal transition requires spontaneous breathing and successful cardiopulmonary changes, as well as other changes to independent organ system functions. A thorough understanding of normal transitional physiology leads to a better understanding of the needs of the infant who is experiencing difficulties and thus should result in a more effective resuscitative effort.

Respiratory adaptation

After birth, the airways and the alveoli must be cleared of fetal lung fluid so that the lungs can operate as a functional respiratory unit providing adequate gas exchange. Pulmonary blood flow must increase, and spontaneous respirations must be established. In utero, most of the blood flow is shunted away from the lungs and directed to the placenta where fetoplacental gas exchange occurs.

Fetal pulmonary vascular resistance is high, and the fetal systemic vascular resistance is low. Within minutes of delivery, the newborn's pulmonary vascular resistance may decrease from 8- to 10-fold, causing a corresponding increase in neonatal pulmonary blood flow. At birth, the lungs must rapidly transit to become the site for gas exchange, or else cyanosis and hypoxia will rapidly develop.

Accordingly, an understanding of the structure and function of the fetal pulmonary vasculature and the subsequent transition to neonatal physiology is important for facilitating *the necessary adaptations during resuscitation. In utero, the lungs develop steadily from the beginning of pregnancy (see the table below). Knowledge of the stages of development

clarifies that neonates born before about 23–24 weeks of gestational age often lack sufficient lung development for survival because of the absence of a capillary network adjacent to the immature ventilatory units.

Table 3 – Embryologic stages of lung development

Stage	Gestational age	Structure development
Embryonic	5 weeks	Bronchi develop, and airway branching occurs; pulmonary veins return to left atrium
Pseudoglandular	5–17 weeks	Lungs take on glandular appearance, and there is continual branching of tracheal bronchial tree (ending at 18–19 weeks of gestation); blood vessels and lymphatics begin to form, and diaphragm develops
Canalicular	13–25 weeks	Rich vascular supply develops, and capillaries are brought closer to airways; primitive respiratory bronchioles begin to form
Terminal air sac	24–40 weeks	Alveoli appear and begin to increase in number, and blood-gas interface develops; type II alveolar cells appear between 20 and 25 weeks and start to produce surfactant between 24 and 25 weeks, though normal intra-airway concentrations are not reached until ~34 weeks
Postnatal	40 weeks	Thinning of alveolar sac linings and continued alveolar proliferation occur

Fetal pulmonary physiology

At term, the fetal lung is filled with approximately 20 mL of fluid. Fetal airways, alveoli, and terminal saccules are open and stable at normal fetal lung volumes, distended by lung fluid secreted by the pulmonary epithelium. This lung fluid maintains lung volume at about the functional residual capacity (FRC) and is a determinant of normal lung growth. A constant flow of this fluid is secreted into the alveolar spaces throughout development, which contributes to the fetal amniotic fluid.

Pulmonary and bronchial circulation also develops as the alveoli appear. Because of the compressive effect of the fetal lung fluid and the low alveolar partial pressure of oxygen (P_aO_2) in utero, the pulmonary capillary bed and pulmonary blood vessels remain constricted. High vascular resistance and low pulmonary blood flow occur.

The placenta provides the respiratory function for the fetus. The placental circulation has 2 major characteristics that enable the placenta to maintain adequate oxygenation of the fetus. First, the placenta has a multivillous circulation that provides the maximum surface area for the exchange of oxygen and carbon dioxide between the mother and fetus. Second, several factors result in the lowering of maternal pH and increasing of fetal pH, what results in increased transfer of oxygen from maternal to fetal hemoglobin or red blood cells (RBCs).

Maternal blood, carrying oxygen on adult hemoglobin, releases oxygen to the fetal circulation and accepts both carbon dioxide and various byproducts of metabolism from the fetal circulation. These transfers decrease maternal placental blood pH and shift the maternal oxygen-dissociation curve to the right, what results in lower affinity of the hemoglobin for oxygen and the release of additional oxygen to the fetal hemoglobin. The corresponding shift in the fetal oxygen-dissociation curve to the left allows the fetal hemoglobin to bind more oxygen.

Fetal “breathing” (i. e. chest wall and diaphragmatic movement) begins at approximately 11 weeks of gestation and increases in strength and frequency throughout gestation. Fetal breathing is controlled by chemoreceptors located in the aorta and at the bifurcation of the common carotid artery. These areas sense both pH and partial pressure of carbon dioxide (PCO_2).

A reflex response to altered pH and PCO_2 is present at approximately 18 weeks of gestation, however, the fetus is not able to regulate this response until approximately 24 weeks of gestation. Some studies have indicated that this response cannot be elicited in utero even when the pH and PCO_2 are altered, leading researchers to believe that the response is suppressed in utero and is not activated until birth.

Studies also suggest that the low P_aO_2 in utero may be the mechanism that inhibits continuous breathing, finding that when P_aO_2 is increased, continuous breathing is stimulated.

Neonatal pulmonary physiology

As noted (see above), the fetal airways and alveoli are filled with lung fluid that needs to be removed before respiration. Only a small portion of this fetal lung fluid is removed physically during delivery. During the thoracic compression, 25–33 % of the fluid (sometimes markedly less) may be squeezed from the oropharynx and upper airways. Thoracic recoil causes air to be passively drawninto the larger bronchioles. Effective transition requires any remaining liquid to be quickly absorbed to allow effective gas exchange.

The decrease of fluid in the lungs begins at labor. Studies using a fetal lamb model showed that the production of lung fluid decreases with the onset of labor. The subsequent reduction in lung fluid was associated with improved gas exchange and acid-base balance. Labor is also associated with increased catecholamine levels, which stimulate lymphatic drainage of the lung fluid.

In addition, with the onset of labor, the fetus produces adrenaline and the mother produces thyrotropin-releasing

hormone, which stimulates the pulmonary epithelial cells to begin reabsorption of fluid. These findings could account for the increased incidence of transient tachypnea of the newborn after birth by cesarean delivery without labor.

After birth, lung fluid is removed by several mechanisms, including evaporation, active ion transport, passive movement from Starling forces, and lymphatic drainage. Active sodium transport by energy-requiring sodium transporters, located at the basilar layer of the pulmonary epithelial cells, drives liquid from the lung lumen into the pulmonary interstitium, where it is absorbed by the pulmonary circulation and lymphatics.

Exposure to an air interface, along with high concentrations of glucocorticoids and cyclic nucleotides, reverses the direction of ion and water movement in the alveoli and leads to highly selective sodium channels. These changes shift the fetal lung epithelial cells from a pattern of chloride secretion to one of sodium reabsorption, which accelerates reabsorption of fetal lung fluid.

The first breath must overcome the viscosity of the lung fluid and the intra-alveolar surface tension. This first breath must also generate high transpulmonary pressure, which helps to drive the alveolar fluid across the alveolar epithelium. With subsequent lung aeration, the intraparenchymal structures stretch, and gases enter the alveoli, resulting in increased P_aO_2 and pH. The increased P_aO_2 and pH result in pulmonary vasodilation and constriction of the ductus arteriosus.

Lung expansion and aeration is also a stimulus for surfactant release, which results in the establishment of an air-fluid interface and the development of FRC. 80–90 % of FRC is established within the first hour of birth in term neonates with spontaneous respirations. Premature and critically ill infants with surfactant deficiency or dysfunction may have limited ability to clear lung fluid and establish FRC.

The pulmonary vasculature is stimulated to be dilated by chemical mediators, nitric oxide (NO), and prostaglandins.

NO is released when pulmonary blood flow and oxygenation increases. The formation of certain prostaglandins, such as prostacyclin, is induced by the presence of increased oxygen tension. Prostacyclin acts on the pulmonary vascular smooth muscle bed to induce pulmonary vasodilation. It has a short half-life in the bloodstream and therefore does not affect the systemic circulation.

Soon after birth, fetal respiratory activity must transit to normal spontaneous breathing. To overcome the viscosity of the lung fluid and the resistance generated by the fluid-filled lungs, the recoil and resistance of the chest wall, lungs, and airways, the infant must generate a negative pressure so that air could move from an area of higher pressure to one of lower pressure. There are 2 major physiologic responses that govern the initial lung inflation in the neonate.

The first response is the so-called rejection response, in which the neonate responds to positive-pressure lung inflation by generating a positive intraesophageal pressure to resist the inflation. That is, the infant actively resists attempts to inflate the lungs by performing an active exhalation. This response acts not only to reduce lung inflation but also may cause high transient inflation pressure.

The second response is Head's paradoxical reflex, in which the neonate responds to positive-pressure lung inflation with an inspiratory effort, which generates a negative intraesophageal pressure. This inspiratory effort and the resultant negative pressure produce a fall in inflation pressure but result in a transient increase in tidal volume.

Of course, the neonate may demonstrate no response to the inflation attempt and may not generate any change in intraesophageal pressure during positive-pressure inflation. In this case passive inflation results. These physiologic responses to positive-pressure inflation in the delivery room may cause large variability in tidal volume and intrapulmonary pressure, despite constant delivery of inflation pressure.

Stimuli for the first breath may be multifactorial. The environmental changes that occur with birth (e. g. tactile and thermal changes and increased noise and light) activate a number of sensory receptors that may help to initiate and to maintain breathing. Clamping the cord removes the low resistance placenta, causing increase in systemic vascular resistance and consequently causing increase in both systemic blood pressure and pulmonary blood flow.

Certain evidence also suggests that the increased arterial partial pressure of oxygen (P_aO_2) after the initial breath may be responsible for the development of continuous breathing via hormonal or chemical mediators that are still undefined.

When the newborn lungsare filled with air, the P_aO_2 should rise gradually. In term infants with a persistent hypoxia, the initial increase in ventilation occurs, followed by the decrease in ventilation. This effect is even more profound in premature infants whose central nervous system (CNS) is not so mature.

The carotid bodies and peripheral chemoreceptors located at the bifurcation of the common carotid artery are stimulated during hypoxia to increase minute ventilation. In asphyxiated infants who cannot increase minute ventilation (e. g. because of extreme prematurity or sedation), profound bradycardia may result.

The first breath

During vaginal delivery, intermittent compression of the thorax facilitates removal of lung fluid. Surfactant lining the alveoli enhances the aeration of gas-free lungs by reducing surface tension, thereby lowering the pressure required to open alveoli. Although spontaneously breathing infants do not need to generate an opening pressure to create airflow, the infants requiring positive pressure ventilation at birth require an opening pressure of 13–32 cm H_2O and are more likely to establish FRC if they generate a spontaneous, negative pressure

breath. Expiratory esophageal pressure associated with the first few spontaneous breaths in term newborns ranges from 45 to 90 cm H_2O. This high pressure, due to expiration through a partially closed glottis, may help in the establishment of FRC but would be difficult to mimic safely using artificial ventilation. There is accumulating evidence that the inspiratory phase of the first breath should be prolonged in order to establish FRC in infants who fail to establish spontaneous respirations.

The higher pressure needed to initiate respiration is required to overcome the opposing forces of surface tension (particularly in small airways) and the viscosity of liquid remaining in the airways, as well as to introduce about 50 mL/kg of air into the lungs, 20–30 mL/kg of which remains after the first breath to establish FRC. Air entry into the lungs displaces fluid, decreases hydrostatic pressure in the pulmonary vasculature, and increases pulmonary blood flow. This, in turn, increases the blood volume of the lung and the effective vascular surface area available for fluid uptake. The remaining fluid is removed via the pulmonary lymphatics, upper airway, mediastinum, and the pleural space. Fluid removal may be impaired after cesarean section or as a result of surfactant deficiency, endothelial cell damage, hypoalbuminemia, high pulmonary venous pressure, or neonatal sedation.

Initiation of the first breath occurs due to a decline in PaO_2 and pH and a rise in $PaCO_2$as a result of interruption of the placental circulation, a redistribution of cardiac output, a decrease in body temperature, and various tactile and sensory inputs. The relative contribution of these stimuli to the onset of respiration is uncertain.

Cardiovascular adaptation

Fetal circulation

To understand the cardiovascular changes that occur in the neonate at birth, one must have the knowledge about normal fetal circulation. The umbilical vein carries the oxygenated blood from the placenta to the fetus. Blood flow in this vein divides at the porta hepatis, with 50–60 % of the blood passing directly to the inferior vena cava (IVC) via the ductus venosus and the remainder passing into the portal circulation. This portal blood flow perfuses the liver and then passes into the IVC.

Flow studies have revealed that relatively little mixing of the blood from these 2 sites occurs in the IVC. The more highly oxygenated blood, which has bypassed the liver, streams into the IVC to pass preferentially through the patent foramen ovale into the left atrium. The desaturated blood returning from the liver and lower body streams into the IVC to the right atrium.

In the right atrium, the desaturated blood mixes with blood returning from the coronary sinus and superior vena cava (SVC) and flows into the right ventricle. The more highly oxygenated blood that crosses the foramen ovale, mixes with the small amount of pulmonary venous return and then crosses the mitral valve into the left ventricle. The output from the left ventricle passes into the ascending aorta to the heart, brain, head, and upper torso. The less saturated blood from the right ventricle passes into the pulmonary arteries.

Because the pulmonary vessels are constricted and highly resistant to flow, only about 12 % of this blood from the right ventricle enter the lungs; the remainder takes the path of least resistance through the patent ductus arteriosus into the descending aorta. Approximately one third of this blood is carried to the trunk, abdomen, and lower extremities, with the remainder entering the umbilical artery, where it is returned to the placenta for reoxygenation.

Neonatal circulation

The aeration of the lung results in increase in arterial oxygenation and pH with a resulting dilation of the pulmonary vessels. Decompression of the capillary lung bed further decreases the pulmonary vascular resistance. The corresponding decrease in right ventricular and pulmonary artery pressureis also observed. The decrease in pulmonary vascular resistance leads to the increase in blood flow to the lungs and in pulmonary venous return.

Clamping of the umbilical cord removes the low-resistance placental vascular circuit and thereby raises total systemic vascular resistance, with a resultant increase in the left ventricular and aortic pressure. The increased systemic vascular resistance combined with the decreased pulmonary vascular resistance reverses the shunt through the ductus arteriosus (from right-to-left shunting to left-to-right shunting) until the ductus closes completely.

All above-mentioned result in closure of the other fetal shunts. With the decrease in the right atrial pressure and the increase in the left atrial pressure, the 1-way “flap-valve” foramen ovale is pushed closed against the atrial septum. This functional closure at birth is followed by anatomic closure, which usually occurs at several months of age.

The ductus venosus closes because of the clamping of the umbilical cord, which terminates umbilical venous return. Functional mechanical closure of the ductus venosus is accomplished by the collapse of the thin-walled vessels. Anatomic closure subsequently occurs in approximately 1–2 weeks.

Permanent closure of the ductus venosus may be delayed in preterm infants or infants with persistent pulmonary hypertension. The constriction and closure of the ductus arteriosus is accomplished by contractile tissue within the walls of this blood vessel. The contraction of this tissue is dependent both on the increase in arterial oxygen related to the onset of

spontaneous respirations and on a fall in circulating prostaglandin E_2 (PGE_2).

Because the placenta is a major site of fetal PGE_2 production, removal of the placenta from the circulation causes circulating PGE_2 concentration to decrease markedly. Further reductions in PGE_2 concentration occur because of increased blood flow to the lungs (the site of PGE_2 metabolism). Functional closure of the ductus generally occurs within 72 hours of life, with anatomic closure by age 1–2 weeks.

In summary, functional postnatal circulation generally is established within 60 seconds, however, completion of the transformation can take up to 6 weeks.

Bilirubin metabolism

Aged or damaged fetal RBCs are removed from the circulation by reticuloendothelial cells, which convert heme to bilirubin (1 g of Hb yields 35 mg of bilirubin). This bilirubin is transported to the liver, where it is transferred into hepatocytes. Glucuronyl transferase then conjugates the bilirubin with uridine diphosphoglucuronic acid (UDPGA) to form bilirubin diglucuronide (conjugated bilirubin), which is secreted actively into the bile ducts. Bilirubin diglucuronide makes its way into meconium in the GI tract but cannot be eliminated from the body, because the fetus does not pass stool normally. The enzyme β-glucuronidase, present in the fetus' small-bowel luminal brush border, is released into the intestinal lumen, where it deconjugates bilirubin glucuronide; free (unconjugated) bilirubin is then reabsorbed from the intestinal tract and reenters the fetal circulation. Fetal bilirubin is cleared from the circulation by placental transfer into the mother's plasma following a concentration gradient. The maternal liver then conjugates and excretes the fetal bilirubin.

At birth, the placental connection is terminated, and although the neonatal liver continues to take up, conjugate, and excrete bilirubin into bile so it can be eliminated in the stool, neonates lack proper intestinal bacteria for oxidizing bilirubin

to urobilinogen in the gut; consequently, unaltered bilirubin remains in the stool, imparting a typical bright-yellow color. Additionally, the neonatal GI tract (like that of the fetus) contains β-glucuronidase, which deconjugates some of the bilirubin. Feedings invoke the gastrocolic reflex, and bilirubin is excreted in stool before most of it can be deconjugated and reabsorbed. However in many neonates, the unconjugated bilirubin is reabsorbed and returned to the circulation from the intestinal lumen (enterohepatic circulation of bilirubin), contributing to physiologic hyperbilirubinemia and jaundice.

Endocrine function

The fetus depends completely on the maternal supply of glucose via the placenta and does not contribute to glucose production. The fetus begins to build a hepatic glycogen supply early in gestation, accumulating most glycogen stores during the 2nd half of the 3rd trimester. The neonate's glucose supply terminates when the umbilical cord is cut; concurrently, levels of circulating epinephrine, norepinephrine, and glucagon surge, while insulin levels decline. These changes stimulate gluconeogenesis and mobilization of hepatic glycogen stores. In healthy, term neonates, glucose levels reach a nadir 30 to 90 min after birth, after which neonates are typically able to maintain normal glucose homeostasis. Infants at highest risk of neonatal hypoglycemia include those with reduced glycogen stores (small-for-gestational-age and premature infants), critically ill infants with increased glucose catabolism, and infants of diabetic mothers (secondary to temporary fetal hyperinsulinemia).

Hematopoietic function

In utero, RBC production is controlled exclusively by fetal erythropoietin produced in the liver; maternal erythropoietin does not cross the placenta. About 55 to 90 % of fetal RBCs contain fetal Hb, which has high O_2 affinity. As a result, a high O_2 concentration gradient is maintained across

the placenta, resulting in abundant O_2 transfer from the maternal to the fetal circulation. This increased O_2 affinity is less useful after birth, because fetal Hb gives up O_2 to tissues less readily, and it may be deleterious if severe pulmonary or cardiac disease with hypoxemia exists. The transition from fetal to adult Hb begins before birth; at delivery, the site of erythropoietin production changes from the liver to the more sensitive peritubular cells of the kidney by an unknown mechanism. The abrupt increase in PaO_2 from about 25 to 30 mm Hg in the fetus to 90 to 95 mm Hg in the neonate just after delivery causes serum erythropoietin to fall, and RBC production shuts down between birth and about 6 to 8 weeks, causing physiologic anemia and contributing to anemia of prematurity.

Immunologic function

At term, most immune mechanisms are not fully functional, especially at increasing prematurity. Thus, all neonates and young infants are immunodeficient relative to adults and are at increased risk of overwhelming infection. This risk is enhanced by prematurity, maternal illness, neonatal stress, and drugs (e.g. immunosuppressants, anticonvulsants). Neonates' decreased immune response may explain the absence of fever or localized clinical signs (e. g. meningism) with infection.

In the fetus, phagocytic cells, present at the yolk sac stage of development, are critical for the inflammatory response that fights bacterial and fungal infection. Granulocytes can be identified in 2 months of gestation and monocytes can be identified in 4 months of gestation. Their level of function increases with gestational age but is still low at term.

At birth, the ultrastructure of neutrophils is normal, but in most neonates, chemotaxis of neutrophils and monocytes is decreased because of an intrinsic abnormality of cellular

locomotion and adherence to surfaces. These functional deficits are more pronounced in premature infants.

By about the 14th week of gestation, the thymus is functioning, and hematopoietic stem cell–produced lymphocytes are accumulated in the thymus for development. Also by the 14th week, T cells are present in the fetal liver and spleen, indicating that mature T cells are established in the secondary peripheral lymphoid organs by this age. The thymus is most active during fetal development and in early postnatal life. It grows rapidly in utero and is readily noted on chest X-ray in a healthy neonate, reaching a peak size at age 10 year then involuting gradually over many years.

The number of T cells in the fetal circulation gradually increases during the 2nd trimester and reaches nearly normal levels by 30 to 32 weeks of gestation. At birth, neonates have a relative T lymphocytosis compared to adults. However, neonatal T cells do not function as effectively as adult T cells. For example, neonatal T cells may not respond adequately to antigens and may not produce cytokines.

B cells are present in fetal bone marrow, blood, liver, and spleen by the 12th week of gestation. Trace amounts of IgM and IgG can be detected by the 20th week and trace amounts of IgA can be detected by the 30th week; because the fetus is normally in an antigen-free environment, only small amounts of immunoglobulin (predominantly IgM) are produced in utero. Elevated levels of cord serum IgM indicate in utero antigen challenge, usually caused by congenital infection. Almost all IgG are acquired maternally from the placenta. After 22 weeks of gestation, placental transfer of IgG increases to reach maternal levels or greater at term. IgG levels at birth in premature infants are decreased relative to gestational age.

The passive transfer of maternal immunity from transplacental IgG and secretory IgA and antimicrobial factors in breast milk (e. g. IgG, secretory IgA, WBCs, complement proteins, lysozyme, lactoferrin) compensate for the neonate’s

immature immune system and confer immunity to many bacteria and viruses. Protective immune factors in breast milk coat the GI and upper respiratory tracts via mucosa-associated lymphoid tissue and decrease the likelihood of invasion of mucous membranes by respiratory and enteric pathogens.

Over time, passive immunity begins to wane, reaching a nadir when the infant is 3 to 6 month old. Premature infants, in particular, may become profoundly hypogammaglobulinemic during the first 6 months of life. By 1 year, the IgG level rises to about 60 % of average adult levels. IgA, IgM, IgD, and IgE, which do not cross the placenta and therefore are detectable only in trace amounts at birth, increase slowly during childhood. IgG, IgM, and IgA reach adult levels by about age 10 years.

Renal function

At birth, renal function is generally reduced, particularly in premature infants. GFR increases progressively during gestation, particularly during the 3rd trimester. GFR rapidly increases in the first months of life; however, GFR, urea clearance, and maximum tubular clearances do not reach adult levels until 1–2 years of age.

MEDICAL CARE FOR NEWBORNS IN PERINATAL CENTRE

NEWBORN PRIORITIES IN THE FIRST DAYS OF LIFE

1. Initiation and maintenance of respirations.
2. Establishment of extrauterine circulation.
3. Control of body temperature.
4. Adequate nourishment.
5. Waste elimination.
6. Prevention of infection.
7. Infant-parent.
8. Developmental care.

Immediate Care of the Newborn

I. Care of the newborn at the delivery room
(EXISTING PROTOCOL)

1. Establish and maintain respiration

Clearing the airway. Suctioning the mouth and pharynx is usually unnecessary if the infant cries well at birth and the first minute Apgar score is normal. Suctioning with a soft catheter and low negative pressure not exceeding 10 cm H_20 may be required to clear blood or excessive mucus in selected cases (e. g. after Caesarian section). Suctioning should be gentle and as brief as possible to avoid reflex apnea, bradycardia or damage to the mucous membranes.

Suctioning:

– turn head to one side;
– suction gently and quickly;
– suction the MOUTH first before the nose;
– test patency of the airway;
– proper position:

a. ensure an open airway;
b. do not hyperextend head;

– place neonate supine;
– head slightly extended.

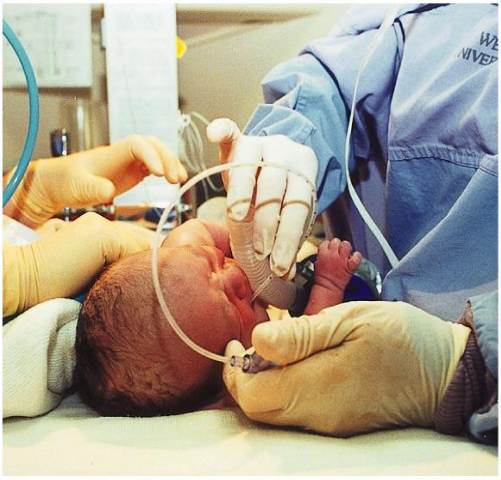

FIGURE 26-1 Suctioning a newborn with mechanical suction controlled by a finger valve. Suction is applied as the catheter is withdrawn. If the catheter is rotated as it is withdrawn, the risk of traumatizing membrane is reduced.

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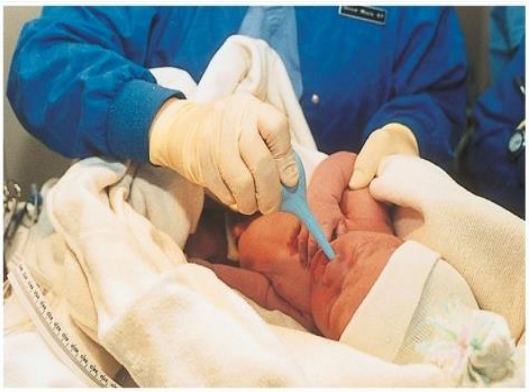


ALERT! Suction must be gentle and quick (5 to 10 seconds). Prolonged and deep suctioning of the nasopharynx during the first 5–10 minutes of life will stimulate the vagus nerve (located in the esophagus) and cause bradycardia.

1. Always humidify to prevent drying of mucosa.
2. Overdosage of 0_2 can lead to scarring of retina leading to blindness.

2. Establishment of extrauterine circulation

Circulation is initiated by lung expansion completed by cutting of cord › cord is clamped › placental gas exchange ceases › cause: increased $PaCO_2$ and decreased $Pa0_2$ and pH (transitory asphyxia) › stimulate: carotid and aortic chemoreceptors (send impulses to the respiratory center in the medulla) › stimulate respiration initiation.

CIRCULATION – several circulatory changes are necessary for successful changes from FETAL circulation to NEONATAL circulation.

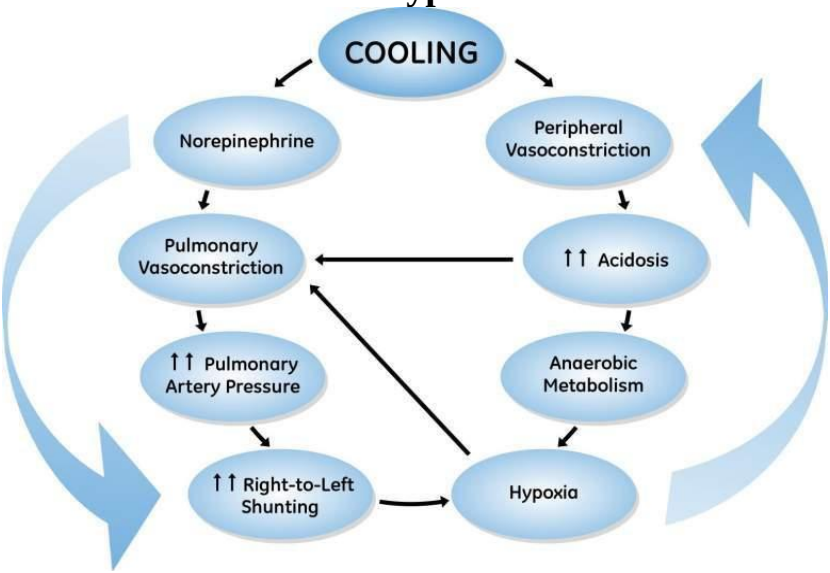
1. Pulmonary blood vessel – dilation, begins at first breath › results: lower pulmonary resistance; this allows the blood to circulate freely through the lungs to be oxygenated.
2. Ductus arteriosus – reversal blood flow › increased pressure in aorta and increase of O_2 in the blood › more blood flowing through the pulmonary arteries for oxygenation – complete closure within 24 hours; permanent – 3–4 weeks.
3. Foramen ovale – closes within minutes after birth because of the higher pressure in the left atrium (LA) than in the right atrium (RA) › increases blood flow in the lungs › decreases pressure in the RA › the return of blood from the lungs increases the pressure in the LA. Complete closure occurs approximately in 3 months. Failure to close becomes atrial septal defect (ASD).

3. Control of body temperature

Goal: to maintain not less than 36.5 ^{0}C (97.7 ^{0}F)

Newborn: prone to cold stress (hypothermia), not capable of shivering, born wet.

Effects of Hypothermia:



To Maintain Appropriate Body Temperature

1. Wrap the newborn immediately.
2. Wrap it warmly.
3. Put it under a droplight/radiant warmer.
4. Kangaroo care.

At birth, in the newborn must begin thermoregulation.

Heat production. The newborn produces heat. Thermogenesis – through general metabolism, muscular activity, nonshivering thermogenesis (unique to the newborn). Newborns rarely shiver as adults do to increase heat production. Shivering in newborns indicates that the metabolic rate has already doubled. Infant in a cool environment requires more heat. Metabolic rate increases producing more heat.

Newborn may cry and have muscular activity when it is cold, but there is no voluntary control of muscular activity. If the newborn's temperature is not adequately raised through increased metabolism, non shivering thermogenesis – the metabolism of brown fat begins.

Non shivering thermogenesis – the metabolism of brown fat. *Brown fat:*

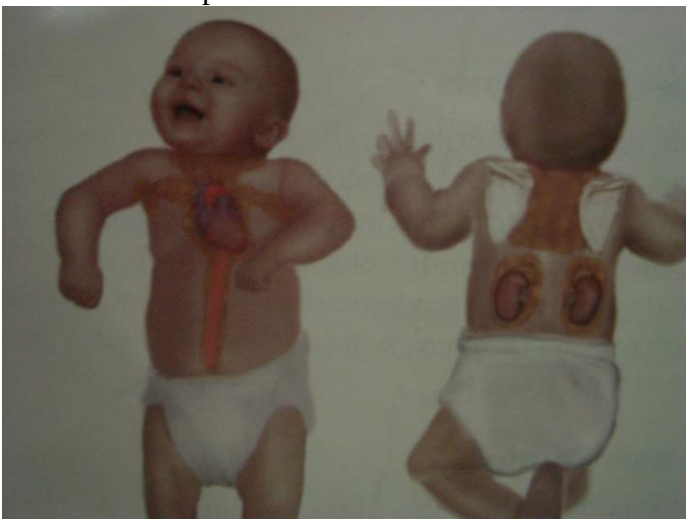
– special tissue/fat found only in newborns;

– appears at about 26–30 weeks AOG and increases until 2–5 weeks of age;

– highly vascularized giving it a brown color;

– oxidized to produce or conserve heat;

– located at the back of the neck, intrascapular region, thorax, around the kidneys and adrenals, in the axillae, around the heart and abdominal aorta and perineal area. If the brown fat has been once metabolized, the infant has no longer this method of heat production.



Heat loss. Newborn has thin skin with blood vessels close to the surface and little subcutaneous fat to prevent heat loss. Gold stress – excessive heat loss › increased metabolism › significant increase in need for oxygen › newborn may experience hypoxia. There may not be enough oxygen for the metabolic rate to increase, and the newborn will not be able to maintain body temperature.

Effects of cold stress (temperature < 36.5 ^{0}C)

1. Metabolic acidosis:

– increased BMR, anaerobic glycolysis;

– increased acid production, metabolic acidosis.

2. Hypoglycemia:

– increased energy requirement to produce heat;

– glucose necessary for increased metabolism becomes available when glycogen stores are converted to glucose;

– if the glycogen is depleted, hypoglycemia results.

Mechanisms of heat loss:

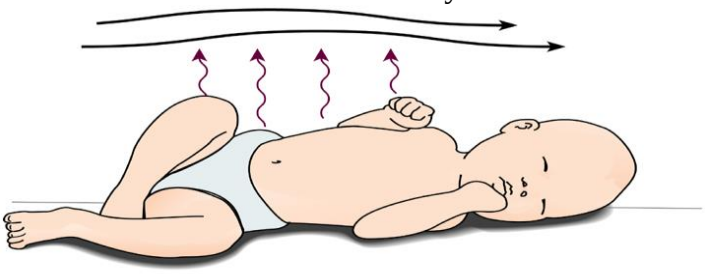
1. Convection – flow of heat from the newborn's body surface to cooler surrounding air.

2. Radiation – transfer of body heat to cooler solid object not in contact with the baby.

3. Conduction – transfer of body heat to cooler solid object in contact with the baby.

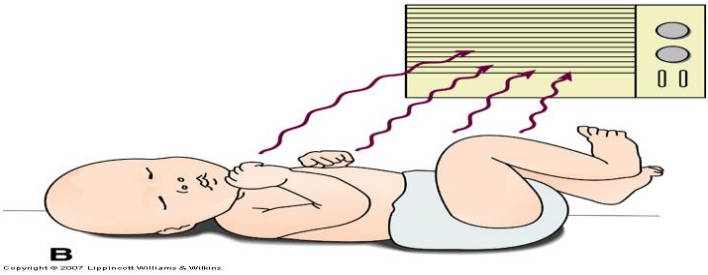
4. Evaporation – loss of heat through conversion of liquid to vapor.

Convection. Loss of heat by the movement of air



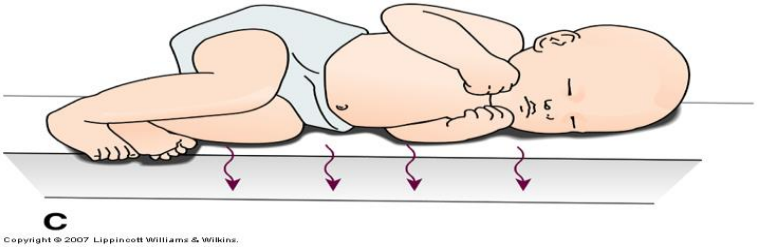
E. g. air current from the open door or windows, air conditioning or from people moving around increases heat loss.

Radiation. Loss of heat by transfer to cooler object nearby, but not through direct contact.



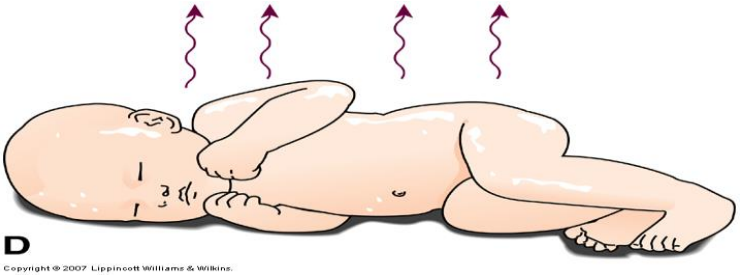
E. g. an infant placed near a cold window loses heat by radiation to the sides of the crib and the window.

Conduction. Loss of heat by direct contact with cooler object.



E. g. newborn touched by cold hands or cold stethoscope newborn placed on a cold surface such as Scale.

Evaporation. The body loses heat by evaporation of water.



E. g. When the wet body dries, heat is lost.

Other causes of heat loss – insulation in newborn is not effective (little subcutaneous fat), shivering is not present.

The Essential Newborn Care Protocol is a series of time bound, chronologically ordered, standard procedures that a baby receives at birth. This includes preventive measures which are needed to ensure the survival of the newborn.

Essential newborn care (ENC) is a set of preventive measures including hygienic cord care, thermal control (including drying and wrapping, skin-to-skin, and delayed bathing), and early and exclusive breastfeeding. These measures are needed to ensure the survival of all newborns and to assist babies to breathe when needed. Early recognition or detection of sick newborns is also a component of ENC.

Four Core Steps of Essential Newborn Care:

- immediate and thorough drying;
- early skin-to-skin contact;
- properly timed cord clamping;
- non-separation of the newborn and mother for early initiation of breastfeeding.

Rationale

Immediate drying prevents hypothermia, which is extremely important for survival.

Instead of immediately washing the newborn, the baby should be placed in skin-to-skin contact with the mother on the mother's chest or abdomen to provide warmth (prevents hypothermia), increase of the duration of breastfeeding, and allow the "good bacteria" from the mother's skin to colonize the newborn.

You must dry the baby immediately because hypothermia can lead to several risks. Delaying cord clamping from one to two minutes after birth (or waiting until the umbilical cord has stopped pulsing) has been shown to increase the baby's iron reserves. It also reduces the risk of iron-deficiency anemia in one out of three premature babies and one

out of seven term babies; improves blood circulation and prevents brain hemorrhage. Delaying the start of breastfeeding could make the newborn 2.6 times more prone to infection. Breastfeeding within the first hour of life prevents an estimated 19.1 % of all neonatal deaths. Washing should be delayed until after six hours after birth because this exposes a newborn to hypothermia and removes the vernix (skin covering) which is a natural protective barrier against bacteria. Washing also removes the baby's crawling reflex.

The ENC guidelines are classified into the time bound, non-time bound, and unnecessary procedures.

Time bound procedures:

– should be routinely performed first;

– refer to the four core steps of ENC which are: immediate drying; skin-to-skin contact followed by clamping the cord after 1–2 minutes; non-separation of the newborn from the mother; breastfeeding initiation.

Non-time bound or non-immediate interventions include:

– immunization, eye care, Vitamin K administration, weighing and washing.

Unnecessary procedures include:

– routine suctioning, routine separation of newborn for observation, application of alcohol, medicine and other substances on the cord stump and bandaging the cord stump or abdomen, and administration of prelacteals like glucose water or formula.

TIME-BOUND INTERVENTIONS

Immediate Newborn Care (The first 90 minutes)

TIME BAND: at perineal bulging, with presenting visible part (second stage of labor).

Prepare for the delivery:

- check temperature of the delivery room 25–28 ^{0}C;
- free of air drafts;
- notify appropriate staff;
- arrange needed supplies linearly;
- check resuscitation equipment;
- washing hands with clean water and soap;
- double glove just before delivery.

A. TIME BAND: within the first 30 seconds:

- call the time of birth.

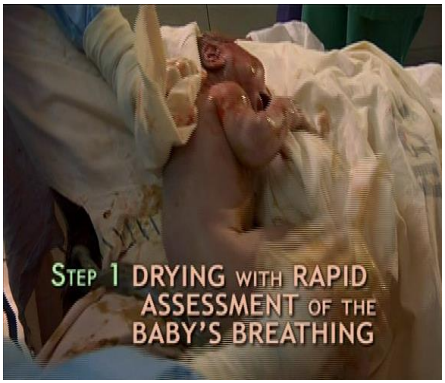
Dry and provide warmth:

- use a clean, dry cloth to dry thoroughly the baby by wiping the eyes, face, head, front and back, arms and legs;
- remove the wet cloth;
- check quickly newborn's breathing while drying.

During the first 30 seconds:

– do not ventilate unless the baby is floppy/limp and not breathing;

– do not allow suction unless the mouth/nose are blocked with secretions or other material.



B1. TIME BAND: if after 30 seconds of thorough drying, newborn is not breathing or is gasping:

- clamp and cut the cord immediately;
- call for help;
- transfer to a warm, firm surface;
- inform the mother that the newborn has difficulty breathing and that you will help the baby to breathe;
- start resuscitation protocol.

B2. TIME BAND: if after 30 seconds of thorough drying, newborn is breathing or crying:

- do skin-to-skin contact.

If a baby is crying and breathing normally, avoid any manipulation, such as routine suctioning, that may cause trauma or introduce infection. You should:

- place the newborn prone on the mother's abdomen or chest skin-to-skin;
- cover newborn's back with a blanket and head with a bonnet;
- place identification band on ***ankle (not wrist)***;
- skin-to-skin contact is doable even for cesarean section newborns.

Notes:

Do not separate the newborn from mother, as long as the newborn does not exhibit severe chest in-drawing, gasping or apnea and the mother does not need urgent medical stabilization e. g. emergent hysterectomy.

- *Do not put the newborn on a cold or wet surface.*
- *Do not wipe off vernix if present.*
- *Do not bathe the newborn earlier than 6 hours of life.*

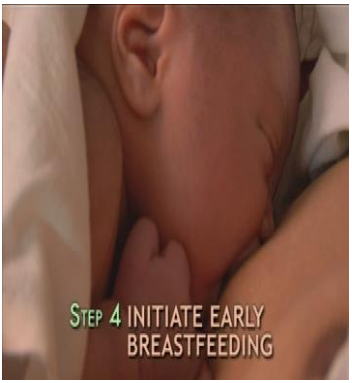
- *If the newborn must be separated from his/her mother, put him/her on a warm surface, in a safe place close to the mother.*

Note: *if there is a second baby, manage as multi-fetal pregnancy.*

C. TIME BAND: **1–3 minutes**

Do delayed or non-immediate cord clamping:

- remove the first set of gloves immediately prior to cord clamping;
- after the umbilical pulsations have stopped (typically in 1–3 minutes), clamp the cord using a sterile plastic clamp or tie at 2 cm from the newborn's umbilical base;
- clamp again at 5 cm from the base;
- cut the cord close to the plastic clamp with sterile instrument;
- observe for oozing blood.



Notes:
– Do not milk the cord towards the newborn.
– After the first clamp, you may "strip" the cord of blood before applying the second clamp.
– Cut the cord close to the plastic clamp so that there is no need for the second "trim."
– Do not apply any substance onto the cord.

Cord care

- Wash hands.
- Do not put anything on the stump.
- Fold diaper below the stump. Keep cord stump loosely covered with clean clothes.

- If stump is soiled, wash it with clean water and soap. Dry it thoroughly with clean cloth.
- Explain to the mother that she should seek care if the umbilicus is red or draining pus.
- Teach the mother to treat local umbilical infection three times a day.
- Wash hands with clean water and soap.
- Gently wash off pus and crusts with boiled and cooled water and soap.
- Dry the area with clean cloth.
- Paint with gentian violet.
- Wash hands.
- If pus or redness worsens or does not improve in 2 days, refer urgently.

Notes:

– Do not bandage the stump or abdomen.

– Do not apply any substances or medicine on the stump.

– Avoid touching the stump unnecessarily.

The cord will fall off after 7–10 days.

4. *TIME BAND*: within 90 minutes of age:

Provide support for initiation of breastfeeding.

Criteria for initiaing feeding:

1. No history of excessive oral secretion.
2. Non-distended, soft abdomen.
3. Clinically stable.
4. RR < 60.

Breastfeeding

The mother may breastfeed immediately after birth.

Ten Steps to Successful Breastfeeding

Every facility providing maternity services and care for newborn infants should accomplish the following:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.

2.Train all health care staff in the skills necessary to implement this policy.

3. Inform all pregnant women about the benefits and management of breastfeeding.

4. Help mothers to initiate breastfeeding within a half hour of birth.

5. Show mothers how to breastfeed and how to maintain lactation even if they should be separated from their infants.

6. Give newborn infants no food or drink other than breast milk unless medically indicated.

7. Practice rooming-in (allow mothers and infants to remain together) 24 hours a day.

8. Encourage breastfeeding on demand.

9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.

10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

Emphasize the importance of exclusive breastfeeding on demand for the first 6 months of life!

The advantages of breastfeeding for mother and child: bonding, uterine contraction, colostrum, contraceptive, inexpensive, right temperature, antibacterial (Lactoferrin, Lactobacillus, Bifidus, Lysozyme, Macrophage, T lymphocytes, Lactoperoxidase), breastfed baby has higher IQ, antibodies to E. coli, anti-staphylococcus factor, decreased incidence of dental caries.

Advantages of breastfeeding to the baby:

1. Contains secretory immunoglobulins A.
2. Contains lactoferrin (iron-binding chon in breast milk that interferes with growth of pathogenic bacteria.
3. Contains antibodies.
4. Reduces incidence of diarrhrea (presence of L. Bifidus interferes with colonization of pathogenic bacteria in the GIT).
5. Contains high amount of mineral and electrolytes.
6. Contains more linoleic acid (essential fatty acid for skin integrity and less Na, K, Ca and phosporous).

Advantages of breastfeeding to mother:

1. Serves as protective function in preventing breast cancer.
2. Release of oxytocin from the post. Pit. Gland aids in uterine involution.
3. Successful breastfeeding can have an empowering effect, skill only women can master.
4. Breastfeeding reduces the cost and preparation time.
5. Provides an excellent opportunity to enhance true symbolic bonding between mother and child.

Contraindications of breastfeeding: an infant with galactosemia (can't digest lactose in milk); herpes lesion on a mother's nipple; maternal diet is nutrient restricted, preventing quality milk production; maternal medication inappropriate for feeding; maternal exposure to radioactive compounds. You must:

- leave the newborn on mother's chest in skin-to-skin contact;
- observe the newborn. Only when the newborn shows feeding cues (e. g. opening of mouth, tonguing, licking, rooting), make verbal suggestions to the mother to encourage her newborn to move toward the breast.

Counsel on positioning and attachment. When the baby is ready, advise the mother to:

– make sure the newborn's neck is not flexed nor twisted;

– make sure the newborn is facing the breast, with the newborn's nose opposite her nipple and chin touching the breast;

– hold the newborn's body close to her body;

– support the newborn's whole body, not just the neck and shoulders;

– wait until the newborn's mouth is opened wide;

– move her newborn onto her breast, aiming the infant's lower lip to be well below the nipple;

Look for signs of good attachment and suckling:

– mouth wide open;

– lower lip turned outwards;

– baby's chin touching breast;

– suckling is slow, deep with some pauses.

If the attachment or suckling is not good, try again and reassess.

Notes:

– Health workers should not touch the newborn unless there is a medical indication.

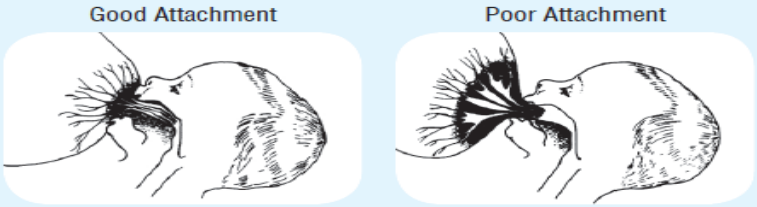
– Do not give sugar water, formula or other prelacteals.

– Do not give bottles or pacifiers.

– Do not throw away colostrum.

Diagrams of infants mouth showing good and poor attachment to the breast.

(Outside appearance)



Fr. WHO. Department of Child and Adolescent Health and Development. Relactation: A review of experience and recommendations for practice. Geneva, 1998

The capacity of the stomach in the newborn is an average of 30–35 ml; further it is increased to about 20–25 ml per month to 3 months reaching 100 ml, and to a year – 250 ml.

Waste elimination

There are 3 types of stools passed by newborn:

1. Meconium – greenish-blackish, viscous-amniotic fluid, intestinal secretions and cells shed from mucosa; take note of time when meconium first passed (normally: 24–36 hours). Failure to pass: Hirschsprung disease, imperforate anus, meconium ileus.

2. Transitional – passed from 3rd to 10th day.

3. Milk stool: a) breastfed infant stool – loose golden yellow in color with sweet odor, 2–3 times a day; b) bottle-fed infant stool – formed, pale yellow with a typical odor; usually passed 1–2 times a day.

Normal infant development depends partly on a series of affectionate responses exchanged between a mother and her newborn infant that binds them together psychologically and physiologically. This bonding is facilitated and reinforced by the emotional support of a loving family. The attachment

process may be important in enabling some mothers to provide loving care during the neonatal period and subsequently during childhood. It is initiated before birth with the planning and confirmation of the pregnancy and with the growing acceptance of the fetus as an individual. After delivery and during the ensuing weeks, sensory (visual, auditory, olfactory) and physical contact between the mother and baby triggers various mutually rewarding and pleasurable interactions such as the mother touching the infant's extremities and face with her fingertips and encompassing and gently massaging the infant's trunk with her hands. Touching an infant's cheek elicits responsive turning toward the mother's face or toward the breast with nuzzling and licking of the nipple, a powerful stimulus for prolactin secretion. An infant's initial quiet alert state provides the opportunity for eye-to-eye contact, which is particularly important in stimulating the loving and possessive feelings of many parents for their babies. An infant's crying elicits the maternal response of touching the infant and speaking in a soft, soothing, higher-toned voice. Initial contact between the mother and infant should take place in the delivery room, and opportunities for extended intimate contact should be provided within the first hours after birth. Delayed or abnormal maternal-infant bonding, as occurs because of prematurity, infant or maternal illness, birth defects, or family stress, may harm infant development and maternal caretaking ability. Hospital routines should be designed to encourage parent-infant contact.

Provide additional care for a small baby or twin

Kangaroo Mother Care

For a visibly small newborn or a newborn born > 1 month early:

– encourage the mother to keep the small newborn in skin-to-skin contact with her as much as possible;

– provide extra blankets to keep the baby warm;

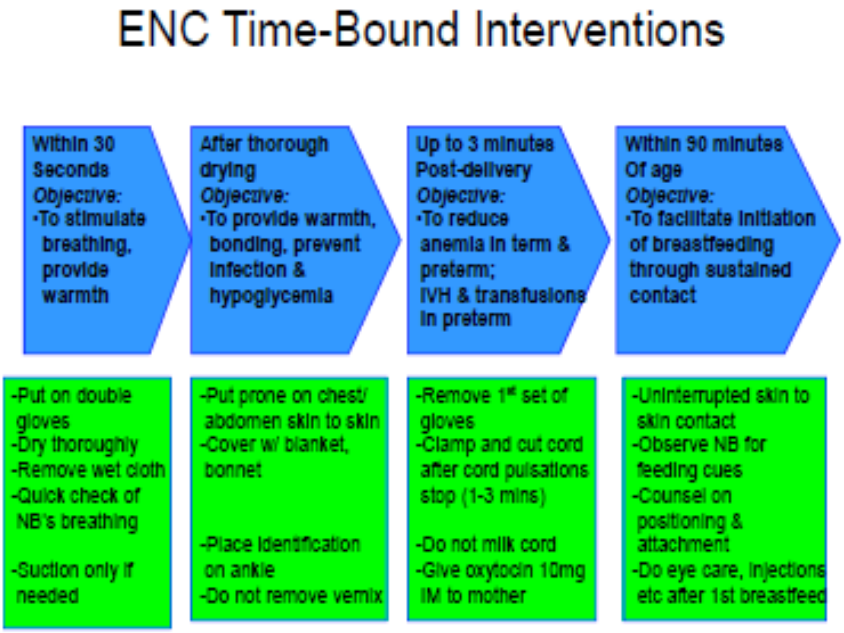
– if mother cannot keep the baby skin-to-skin because of complications, wrap the baby in a clean, dry, warm cloth and

place in a cot. Cover with a blanket. Use a radiant warmer if room is not warm or baby is small;

– do not bathe the small baby. Ensure hygiene by wiping with a damp cloth but only after 6 hours. Prepare a very small baby (< 1.5 kg) or a baby born > 2 months early for referral.

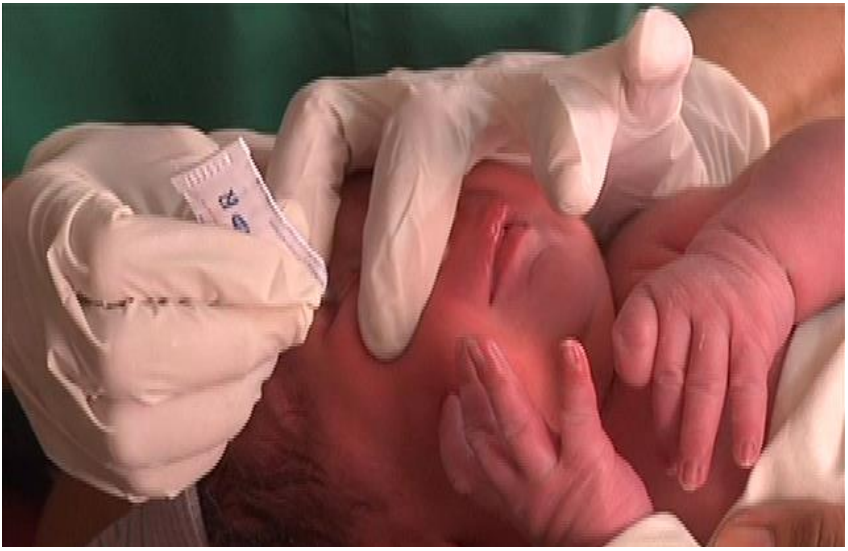
Notes:

- *avoid any manipulation, e. g. routine;*
- *suctioning that may cause trauma or infection;*
- *place identification band on ankle (not wrist);*
- *skin-to-skin contact is doable even for cesarean section newborns.*



Non-Immediate Interventions

To prevent ophthalmia neonatorum through proper eye care, you must: administer erythromycin or tetracycline ointment (tobramycin is used in Ukraine) to both eyes after newborn has located breast. Do not wash away the eye antimicrobial.



ASSESSMENT FOR WELL-BEING

Apgar score

Scoring system is designed by **Virginia Apgar** in 1953 for heart rate, respiratory effort, tone, reactivity, color. The **Apgar score** is used at birth to evaluate a newborn's condition and possible need for resuscitation; it was not initially intended to determine long-term neurologic prognosis. The Apgar score assigns 0 to 2 points for each of 5 measures of neonatal health (appearance, pulse, grimace, activity, respiration– see Table 4). Scores depend on physiologic maturity, maternal perinatal therapy, and fetal cardiorespiratory and neurologic conditions. A score of 7 to 10 at 5 minutesis considered normal, 4 to 6 – intermediate; and 0 to 3 – low. A low Apgar score is not by itself diagnostic of perinatal asphyxia but is associated with a risk of long-term neurologic dysfunction. A persistently low Apgar score (0 to 3 at 5 minutes) is associated with increased neonatal mortality.

Per parameter
*Lowest individual score is 0.
*Highest individual score is 2.

APGAR Scoring System– standard tool to evaluate the condition of the neonate.

Table 4 – Apgar score

		0	1	2
A	Appearance (body color)	pale or total blue	acrocyanosis	pink, ruddy
P	Pulse (apical), heart rate	absent	< 100	> 100
G	Grimace (reflex activity)	none	weak cry	good cry
A	Activity (muscle tone)	flaccid, limp	some flexion of extremities	well flexed, active motion
R	Respiration	absent	< 30, slow, irregular	> 60, good, crying

- appearance (color) – least important;
- pulse rate – most important;
- grimace (reflex activity), irritability;
- activity (muscle tone);
- respiration.

Sixty seconds after complete birth of the infant (disregarding the cord and placenta), the five objective signs above are evaluated, and each is given a score of 0,1, or 2. A total score of 10 indicates an infant in the best possible condition. An infant with a score of 0–3 requires immediate resuscitation.

Apgar Scoring System **–** standard tool to evaluate the condition of the neonate.

The **Apgar score** is a practical method of systematically assessing newborn infants immediately after birth to help to identify those, requiring resuscitation and to predict survival in the neonatal period. The 1-minute Apgar

score may signal the need for immediate resuscitation, and the 5-, 10-, 15-, and 20-minutes scores may indicate the probability of successfully resuscitating an infant. A low score may be due to a number of factors, including drugs given to the mother during labor and immaturity. The Apgar score was not designed to predict neurologic outcome. Indeed, the score is normal in most patients by whom cerebral palsy subsequently develops, and the incidence of cerebral palsy is low in infants with Apgar scores of 0–3 at 5 minutes (but higher than in infants with Apgar scores of 7–10). The Apgar score and umbilical artery blood pH both predict neonatal death. An Apgar score of 0–3 at 5 minutes is uncommon but is a better predictor of neonatal death (in both term and preterm infants) than an umbilical artery pH of 7.0 or less; the presence of both variables increases the relative risk of neonatal mortality in term and preterm infants. The earliest sign of asphyxia is cyanosis, followed by decreases in respiration, muscle tone, reflex response, and heart rate. Effective resuscitation leads initially to increased heart rate, followed by improved reflex response, color, respiration, and muscle tone. Evidence of intrapartum fetal distress, persistence of an Apgar score of 0 to 3 for > 5 minutes; an umbilical arterial blood pH < 7; and a sustained neonatal neurologic syndrome that includes hypotonia, coma, seizures, and evidence of multiorgan dysfunction are manifestations of hypoxic ischemic encephalopathy. The severity and prognosis of posthypoxic encephalopathy can be estimated with the Sarnat classification (see Table: Clinical Staging of Posthypoxic Encephalopathy) in conjunction with EEG, neuroradiologic imaging, and brain stem auditory and cortical evoked responses.

Assessment tool determines respiration of baby

Table 5 – Grading of Neonatal Respiratory Distress (Silverman Anderson)

Feature observed	0	1	2
1. Chest movement	synchronized	lag	seesaw
2. Intercostal retractions	none	just visible	marked
3. Xiphoid retraction	none	just visible	marked
4. Nares dilatation	none	minimal	marked
5. Expiratory grunt	none	audible by stetho-scope	audible

Assessment tool determines respiration of baby:
0 – no respiratory distress;
1–3 – slight distress;
4–6 – moderate distress;
7–10 – serious distress.

How will you know my age

if my mommy doesn't know her LMP?

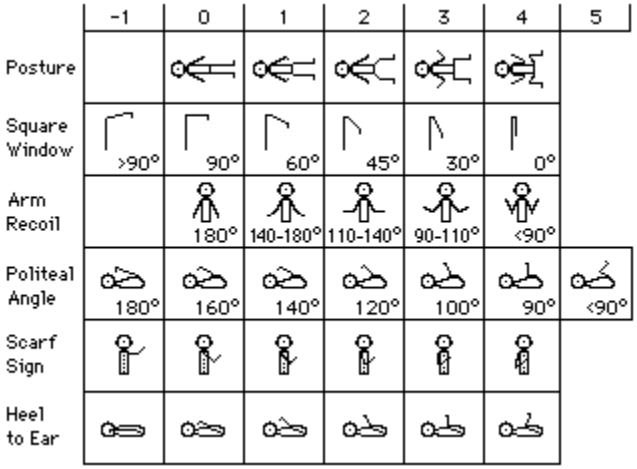
Assessment of gestational age

It is determined in the first 4 hours after birth so that age related problems can be identified, and appropriate care can be initiated. Second assessment is done within 24 hours.

Ballard Score is the most commonly used tool. It has 2 elements: external physical characteristics and neuromuscular maturity.

Dubowitz/Ballard Exam for Gestational Age

Table 6 – Neuromuscular Maturity



Posture: in the supine and quiet infant, scores are as follows:

- arms and legs extended = 0;
- slight or moderate flexion of hips and knees = 1;
- moderate to strong flexion of hips and knees = 2;
- legs flexed and abducted, arms slightly flexed = 3;
- full flexion of arms and legs = 4.

Square window: flex the hand at the wrist. Exert pressure sufficient to get as much flexion as possible. The angle between the hypothenar eminence and the anterior aspect of the forearm is measured and scored:

- > 90 degrees = –1;
- 90 degrees = 0;
- 60 degrees = 1;
- 45 degrees = 2;
- 30 degrees = 3;

- 0 degrees = 4.

Arm recoil: in the supine infant, fully flex the forearm for 5 seconds, then fully extend by pulling the hands and release. Score the reaction:

- remains extended 180 degrees, or random movements = = 0;
- minimal flexion, 140–180 degrees = 1;
- small amount of flexion, 110–140 degrees = 2;
- moderate flexion, 90–100 degrees = 3;
- brisk return to full flexion, < 90 degrees = 4.

Popliteal angle: in the supine infant the pelvis is flat on the examining surface, the leg is flexed on the thigh and the thigh fully flexed with the use of one hand. With the other hand the leg is then extended and the angled scored:

- 180 degrees = –1;
- 160 degrees = 0;
- 140 degrees = 1;
- 120 degrees = 2;
- 100 degrees = 3;
- 90 degrees = 4;
- < 90 degrees = 5.

Scarf sign: in the supine infant, take the infant's hand and draw it across the neck and across the opposite shoulder as far as possible. Assistance to the elbow is permissible by lifting it across the body. Score according to the location of the elbow:

- elbow reaches or nears level of opposite shoulder = –1;
- elbow crosses opposite anterior axillary line = 0;
- elbow reaches opposite anterior axillary line = 1;
- elbow at midline = 2;
- elbow does not reach midline = 3;

- elbow does not cross proximate axillary line = 4.

Heel to ear: in the supine infant, hold the infant's foot with one hand and move it to the head as near as possible without forcing it. Keep the pelvis flat on the examining surface. Score as shown in the diagram above.

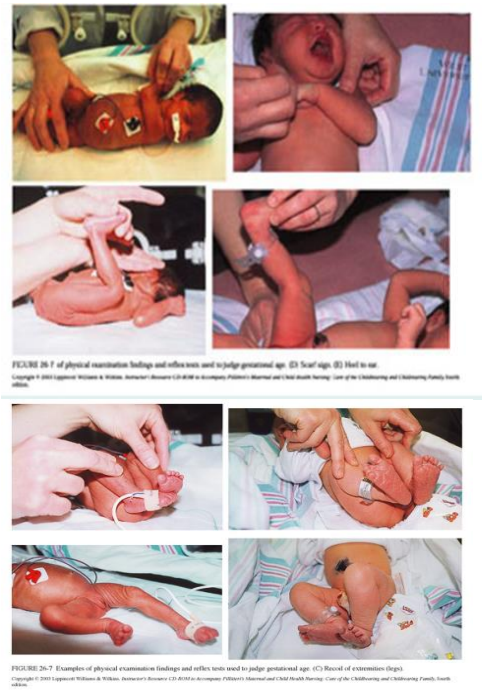
Table 7 – Physical Maturity

Sign	–1	0	1	2	3	4	5
Skin	Sticky, friable, transparent	Gelatinous-red, translucent	Smooth pink, visible veins	Superficial peeling and/or rash, few veins	Cracking, pale areas, rare veins	Parchment, deep cracking, no vessels	Leathery, cracked, wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar Creases	Heel-toe 40–50 mm = 1, < 40 mm = 2	Heel-toe > > 50 mm, no creases	Faint red marks	Anterior transverse crease only	Creases over anterior 2/3	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	1–2 bud	Raised areola, 3–4 mm bud	Full areola, 5–10 mm bud	
Eye and ear	Lids fused, loosely = 1, tightly = 2	Lids open, auricle – flat, stays folded	Slightly curved auricle, soft with slow recoil	Well-curved auricle, soft but ready recoil	Formed and firm, with instant recoil	Thick cartilage, ears tiff	
Genitals, male	Scrotum – flat, smooth	Scrotum-empty, faint rugae	Testes in upper canal, rare rugae	Testes descending, fewr ugae	Testes down, good rugae	Testes pendulous, deep rugae	
Genitals, female	Clitoris – prominent, flat labia	Prominent clitoris, small labia minora	Prominent clitoris, enlarging minora	Majora and minora – equally prominent	Majora – large, minora – small	Majora cover clitoris and minora	

Add up the individual neuromuscular and physical maturity scores for twelve categories, then obtain the estimated gestational age from the Table below.

Table 8 – Maturity Rating

Total Score	Gestational Age, weeks
– 10	20
– 5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44



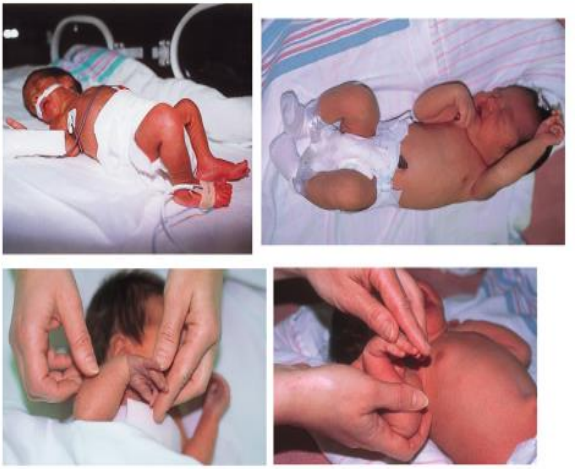
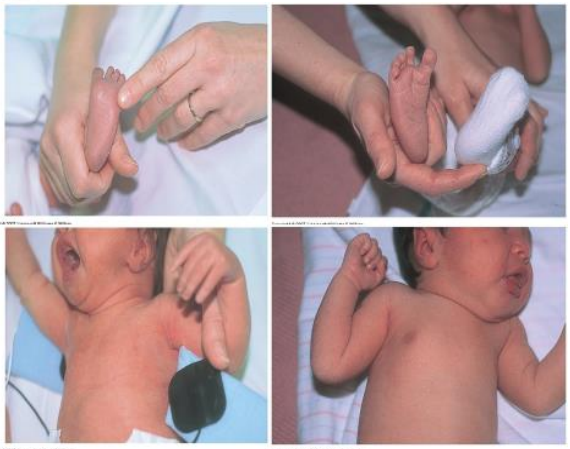


FIGURE 26-7 Examples of physical examination findings and reflex tests used to judge gestational age. (A) Resting posture. (B) Wrist flexion.

F

G



Neonatal resuscitation

Problems in the Neonate That May Require Resuscitation

Failure to breathe

Antepartum mechanism: diabetes, intrauterine growth restriction, maternal toxemia renovascular hypertension.

Recent intrapartum asphyxia: cord compression, cord prolapse, fetal exsanguination, maternal hypotension, placenta previa, placental abruption, uterine tetany.

Central nervous system (CNS) depression: congenital abnormalities of the brain stem, intracerebral hemorrhage, spinal cord injury.

Drugs: analgesics or hypnotics, anesthetics, Mg, opioids, maternal drug abuse.

Failure to expand the lungs

Airway obstruction: blood, meconium, mucus.

Prematurity (respiratory distress syndrome).

Malformations involving the respiratory tract: agenesis, diaphragmatic hernia, hypoplasia, stenosis or atresia.

Key messages

Effective ventilation is the key to successful resuscitation.

The need for neonatal resuscitation at birth cannot always be anticipated or predicted.

At every birth, no matter how "low" is the risk, suitable equipment and staff must be available and prepared to resuscitate the newborn infant.

Approximately 10 % of newborns delivered in hospital require resuscitation assistance to breathe at birth. Less than 1 % will require extensive resuscitation. The aim of neonatal resuscitation is to prevent neonatal death and adverse longterm neurodevelopmental sequelae associated with perinatal asphyxia.

Substantial physiologic changes occur in the transition from fetal to extrauterine life including:

– the role of placenta in gas exchange is taken over by the lungs;

– changes from fluid-filled to air filled lungs;

– dramatic increase in blood flow to the lungs with reversal, then closure of intra and extra cardiac shunts.

Failure or disruption of these changes may result in further difficulties with resuscitation in the newborn infant. For example, failure to increase alveolar oxygen and reduce pulmonary vascular resistance may lead to persistence of fetal circulation or persistent pulmonary hypertension (PPHN).

The need for resuscitation of the newborn infant at birth cannot always be anticipated or predicted. Therefore, at every birth, no matter how "low" is the risk, suitable equipment and staff must be available and prepared to resuscitate the newborn infant.

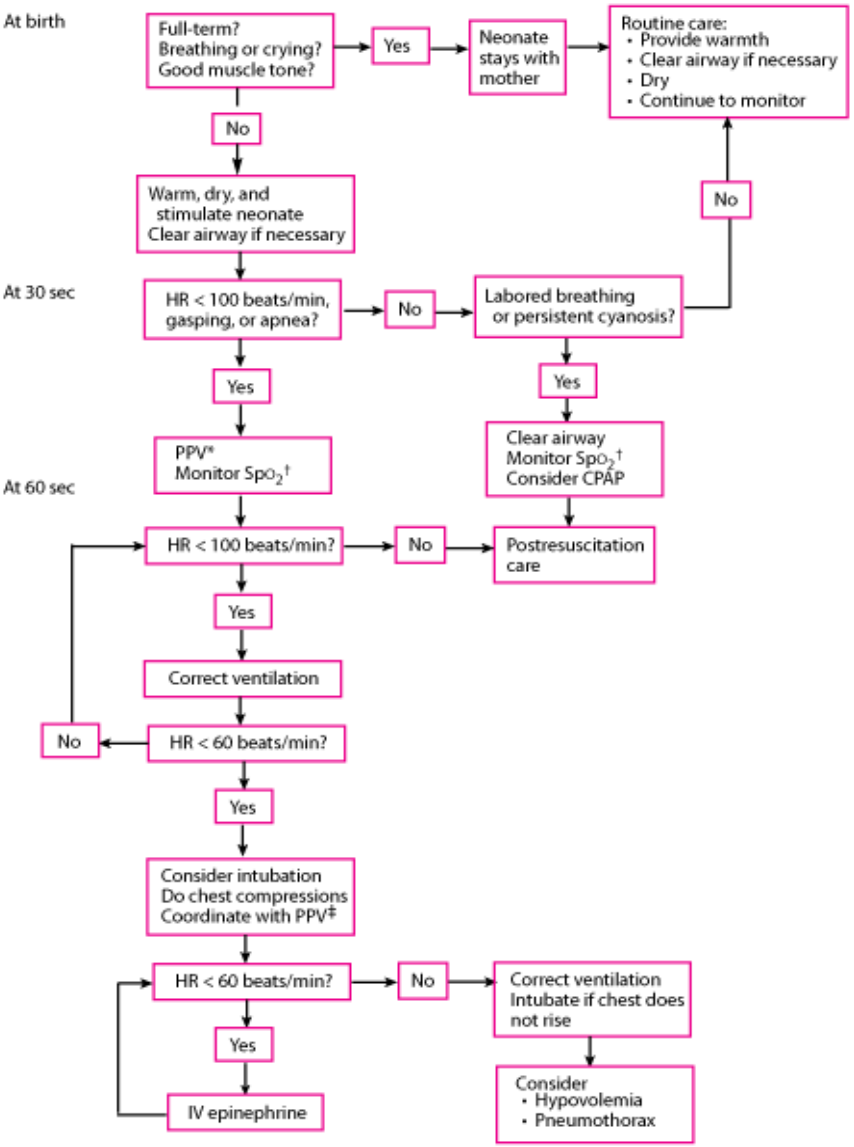
The steps in neonatal resuscitation are as follows:

a) anticipate and establish a patent airway by suctioning and, if necessary, performing endotracheal intubation;

b) initiate breathing by using tactile stimulation or positive-pressure ventilation with a bag and mask or through the endotracheal tube;

c) maintain the circulation with chest compression and medications, if needed. Steps to follow for immediate neonatal evaluation and resuscitation are outlined in the Figure below.

Figure – Algorithm for resuscitation of neonates



PPV: initiate resuscitation with room air. If SpO_2 targets are not achieved, titrate inhaled O_2 concentration upward. If HR is < 60 beats/min after 90 seconds of resuscitation with a lower O_2 concentration, increase O_2 concentration to 100 % until normal HR is recovered.

For SpO_2 monitoring targets.

3:1 compression: ventilation ratio with a total of 90 compressions and 30 breaths/min. Compressions and ventilations are delivered sequentially, not simultaneously. Thus, give 3 compressions at a rate of 120/min, followed by 1 ventilation over 1/2 seconds.

HR = heart rate; PPV = positive pressure ventilation; SpO_2= = O_2 saturation.

Preparation

Personnel

At least two trained people are required for adequate resuscitation involving positive pressure ventilation and chest compressions. Therefore, always call for help.

Issues to note:

– the most senior person needs to coordinate resuscitation;

– each person must have a dedicated job, for example with three people, one should be solely responsible for airway, one solely responsible for chest compressions and the last one person should coordinate the resuscitation and administer medication as necessary;

–if possible it is better to have another person who will record events including time of administration of drugs, and the infant's response to interventions.

Check equipment

Checking equipment is essential. Issues to note:

–resuscitation equipment should be checked at least daily and after each usage;

–when the use is anticipated at a birth recheck equipment including medical air and oxygen supply, suction, positive pressure devices, resuscitation equipment, largyngoscope, and endotracheal tubes;

– if an infant is expected to be in a poor condition you must have medication readily available (e. g. O negative red blood cells and 0.9 % normal saline in the presence of massive antepartum haemorrhage).

Communication

Communication is vital to smooth resuscitation. Ensure clear communication with:

– anaesthetic and obstetric staff regarding maternal condition, fetal condition, maternal therapies;

– the family meet with them before the birth if there is time.

Environment

Pay careful attention to the environment including:

– prevention of heat loss. Where possible deliver an infant into a warm draft free environment;

– the ambient temperature of the room should be at least 26 ºC for very preterm infants.

Assessment

The steps of evaluation and intervention during neonatal resuscitation are often simultaneous processes.

Evaluation begins immediately after birth with assessment of tone, breathing, and heart rate and continues throughout the resuscitation process until vital signs have normalised.

Key features in ongoing evaluation are as follows:

– the newly born breathing infant should establish regular respirations in order to maintain HR > 100 bpm;

– heart rate is determined from auscultation over the apex with a stethoscope or direct palpation of cord or with stethoscope. Peripheral pulses are often difficult to feel. If no pulsation is felt on palpation of the cord do not assume that there is no heartbeat but auscultate the chest. The HR should be > 100 bpm in a well newly born infant;

– color during labor in the uncompromised infant has oxygen saturations of about 60 % which after birth usually take 5–10 minutes to reach 90 %. The well newborn infant should

then be able to maintain a central pink color in the room air. Assessment of color is a poor proxy for oxygenation. Assessment of oxygenation can be aided by the use of a pulse oximeter with neonatal probe attached to the infant's right hand.

Management

Temperature control

A warm draft free environment should be available. Drying the infant with prewarmed towels will help minimise heat loss in addition to use of a radiant warmer.

Infants less than 28 weeks of gestation should be placed immediately after birth in a polyethylene bag or wrap (appropriate size, food grade, heat resistant) with their head out and the body completely covered.

Drying the infant's body prior to covering is not recommended. Seek after normothermia (36.5–37.5 ^{o}C) in all newborn infants and avoid iatrogenic hyperthermia.

Stimulation

Drying with a soft towel will stimulate most newborns to breathe.

If meconium is present in a non-vigorous infant, immediate suction below the vocal cords under direct vision may be appropriate. Delay tactile stimulation to avoid gasping in the infant with an oropharynx full of particulate meconium. Repeated suctioning of the trachea is not recommended and may unnecessarily delay commencement of active resuscitation.

Airway

The head should be in a neutral or slightly extended “sniffing” position.

Suction is rarely required and should not exceed –100 mm Hg. It should be limited in depth to 5 cm below the lips.

Breathing

Guidelines for breathing include:

– attend to adequate inflation and ventilation before oxygenation;

– the rate for assisted ventilation is 60 inflations per minute;

– positive pressure ventilation should be commenced in air (21 % oxygen) initially;

– supplemental oxygen administration should be guided by pulse oximetry;

– hyperoxia should be avoided as even brief exposure to excessive oxygenation can be harmful to the newborn during and after resuscitation;

– regardless of gestation, aim for oxygen saturations of 91–95 %;

–wean supplemental oxygen once the saturations reach 90 %.

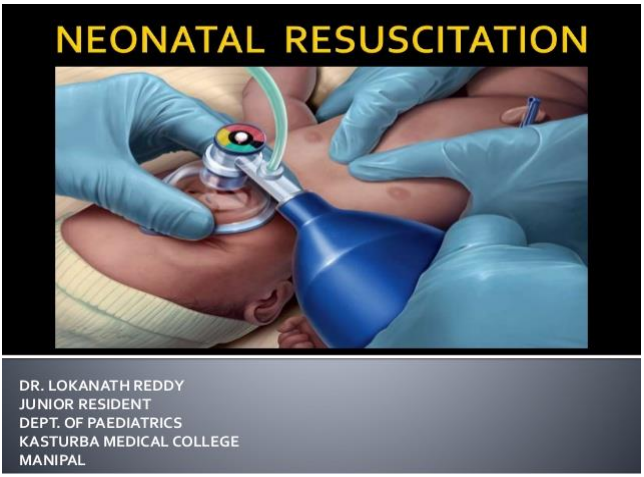
Table 9 - Target saturations

Time from birth	**Target saturations during resuscitation**
2 minutes	65 – 85 %
3 minutes	70 – 90 %
4 minutes	75 – 90 %
5 minutes	80 – 90 %
10 minutes	85 – 90 %

Effective ventilation is confirmed by observing these three signs:

- *increase in the heart rate to about 100/min;*
- *a slight rise in the chest and upper abdomen with each positive pressure inflation;*
- *oxygenation improves.*

Few infants require immediate intubation. The majority of infants can be managed with positive pressure ventilation via a face mask.



With improvement in the infant's condition, the inflation pressures and breath rate can be progressively reduced.

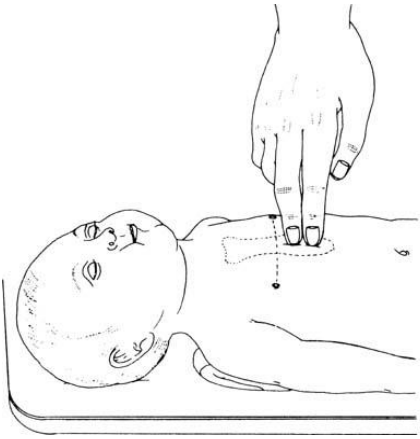
See intubation for technical details.

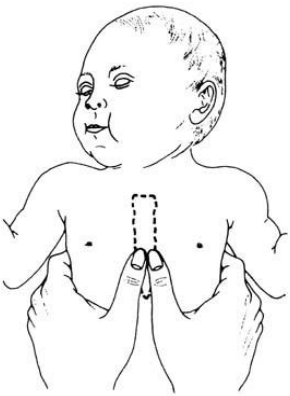
Circulation

In the majority of infants establishment of adequate ventilation will restore circulation.

Begin chest compressions for HR < 60 despite effective positive pressure ventilation for at least 30 seconds.

Aim for approximately ratio of 90 chest compressions to 30 breaths per minute (3:1). 120 events per minute one should count one-and-two-and-three-and-breath etc.





Supplemental oxygen should be increased to 100 % when compressions are commenced and titrated with guidance of pulse oximetry.

The “two thumb” technique is preferred. Both thumbs meet over the sternum with fingers around the chest wall. The sternum should be compressed to one third of the anterior-posterior chest dimension.

Medications

Route of delivery

Routes of delivery for medications include:

- umbilical venous catheter preferred route;
- ET for adrenaline only;
- peripheral intravenous line difficult to cannulate in the collapsed infant;
- intraosseous needle for failed or unsuccessful umbilical venous catheterization;
- umbilical arterial catheter should not be used for drug administration during resuscitation.

Adrenaline

For HR < 60 for > 30 seconds despite compressions and positive pressure ventilation.

Dosage:

0.3 ml/kg of 1:10,000 as a quick push IV repeated at 3–5 minute intervals. It should be followed by a small saline flush.

0.5–1.0 ml/kg of 1:10,000 ET (if no IV access).

Volume (preload)

10–15 ml/kg normal saline repeated 2 or 3 times.

This may need to be followed with O negative red blood cells in the setting of massive blood loss, especially in babies who are not responding to resuscitation interventions.

Naloxone

Naloxone does not form part of the initial resuscitation of newborns with respiratory depression in the delivery room.

Dosage – 0.1 mg/kg of 0.4 mg/ml solution

Contraindication. Naloxone may result in rapid withdrawal with seizures if given to infants of narcotic dependent women.

Bicarbonate

Bicarbonate is not indicated for routine use:

Argument for correction of acidosis includes theoretical concerns about hypoxia and elevated pulmonary vascular bed pressure and poor cardiac contractility with acidosis.

Argument against correction includes concerns regarding hyperosmolarity and CO_2 generation with intracellular acidosis from alkali infusion.

Ongoing care

Infants require careful observation and management in a special or intensive care nursery following active resuscitation. Attention to management of temperature, cardio-respiratory status (oxygenation, heart rate, respiratory pattern, blood gas analysis), blood glucose sugars and infection risk are required.

Term infants at risk of hypoxic ischemic encephalopathy should be considered for therapeutic hypothermia therapy (“cooling”).

Prompt discussion with PIPER is recommended as cooling must be initiated within 6 hours of birth.

Stopping resuscitation

Issues to note about stopping resuscitation:

It is difficult to accurately define a time beyond which active support worsens brain injury.

It is reasonable to consider stopping treatment if the infant has not responded with a spontaneous circulation by 10 minutes of age.

It is helpful to be able to review events during resuscitation and this is made easier when events are recorded during resuscitation.

Areas of uncertainty in clinical practice

Areas of uncertainty include:

Resuscitation for term infants should be commenced using medical air.

Many preterm infants less than 32 weeks of gestation will not achieve target saturations in air. Resuscitation should be commenced in 30 % oxygen in these babies and should be guided by pulse oximetry.

Hyperoxia and hypoxia should be avoided.

If a blend of medical air and oxygen is not available, resuscitation should be initiated with air (using a self-inflating bag and room air).

In all cases, the priority is to ensure adequate inflation of the lungs, followed by increasing the oxygen concentration.

PEEP

Positive end-expiratory pressure issues to note:

PEEP has been shown to be very effective for establishing and maintaining lung volume and improving oxygenation, especially in preterm babies.

If suitable equipment is available, PEEP of at least 5 cm H2O should be used during resuscitation.

It is possible to provide PEEP either by use of:

A T-piece device (e. g. Neopuff or similar). This technique can be easily applied but the device requires a flow of gas to operate.

An anaesthetic bag and mask. Considerable practice is required to develop competence with this technique.

Neonatal Resuscitation: specific treatment recommendations The International Liaison Committee on Resuscitation (ILCOR) in October 2015

• These guidelines are intended to be adapted by ILCOR member organisations.

• Subtle differences in treatment recommendations exist between member organisations.

• The European Resuscitation Council and the American Heart Association have published their guidelines.

• The Australian and New Zealand Resuscitation Council guidelines may differ in some recommendations.

1. Assessment of heart rate: ECG or oximetry or auscultation?

ILCOR suggest that ECG can be used to provide a rapid, accurate estimation of heart rate in newborns requiring resuscitation.

2. Cord clamping

ILCOR suggest delaying cord clamping for at least 1 minute after birth in uncompromised term and preterm infants. As yet, there is insufficient evidence to recommend timing of cord clamping in compromised newborns who require resuscitation.

3. Cord milking

ILCOR suggest against cord milking in infants born at 28 weeks of gestation or less because there is insufficient human evidence of benefit.

4. Temperature control

ILCOR recommend the temperature of non-asphyxiated newborn infant should be maintained between 36.5–37.5 ^{0}C after birth and during stabilisation. ILCOR suggest using a combination of interventions to reduce hypothermia in preterm infants < 32 weeks of gestation:

Environmental temperature 23 ^{0}C–25 ^{0}C

Plastic wrapping without drying

Hat and use of a thermal mattress

ILCOR suggest iatrogenic hyperthermia (> 38 ^{0}C) should be avoided.

5. Management of meconium

ILCOR found insufficient published human evidence to suggest routine tracheal intubation of non-vigorous infants born through meconium stained amniotic fluid as opposed to no tracheal intubation for suctioning.Initiating ventilation within the first 60 seconds after birth in the non-breathing, or ineffectively breathing newborn with poor muscle tone should take priority over tracheal intubation.

6. CPAP and IPPV

ILCOR suggest initial use of continuous positive airway pressure (CPAP) rather than intubation and intermittent positive pressure ventilation (IPPV) for spontaneously breathing preterm infants with respiratory distress.

7. PEEP versus no PEEP

ILCOR suggest using PEEP ventilation for preterm infants during delivery room resuscitation. Due to insufficient evidence, ILCOR were unable to make a recommendation for term infants.

8. Sustained inflation

ILCOR suggest against the routine use of sustained inflation (> 5 seconds duration) for preterm infants who are not breathing spontaneously immediately after birth.

A sustained inflation may be considered in individual clinical circumstances or research settings.

9. T-piece resuscitator versus self-inflating bag

Due to insufficient evidence, ILCOR were unable to make a recommendation of using one device over another.

10. Oxygen concentration for preterm infants

ILCOR recommend against initiating resuscitation of preterm newborns < 35 weeks of gestation with high concentrations of oxygen (65–100 %).

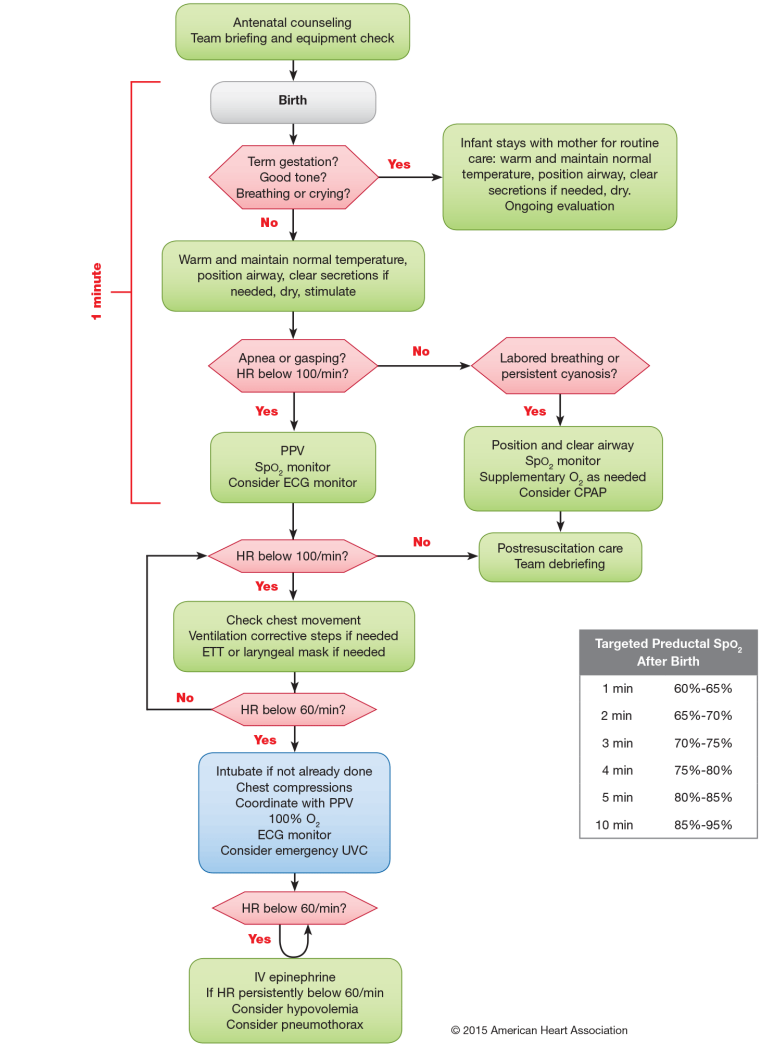
11. Oxygen concentration during CPR (cardiac compressions)

ILCOR found insufficient human evidence to inform practice. If used, supplementary oxygen should be weaned as soon as the heart rate has recovered.

12. Compression to ventilation ratio during neonatal CPR

ILCOR suggest continued use of the 3:1 compression to ventilation ratio for neonatal CPR.

Neonatal Resuscitation Algorithm—2015 Update



Newborn care from 90 minutes to 6 hours after birth

TIME BAND: from 90 minutes – 6 hours

Give Vitamin K prophylaxis:

Inject a single dose of Vitamin K 1 mg IM. To prevent bleeding because of decreased Vit K synthesis due to sterile GIT facilitates production of clotting factor.

Medications:

Phytonadione – Aquamephyton;

Phytomenadione – Konakion.

DOSE: Fullterm: 1 mg = 0.1 ml;

Preterm: 0.5 mg = 0.05 ml.

ROUTE: IM lateral anterior thigh (vastus lateralis)

Injection hepatitis B at birth

Inject hepatitis B vaccine intramuscularly.

PHYSICAL CHARACTERISTICS OF THE NEWBORN

Vital Signs. Anthropometric measurement. General Appearance

The newborn infant should undergo a complete physical examination within 24 hours of birth. It is easier to listen to the heart and lungs first when the infant is quiet. Warm the stethoscope before using to decrease the like hood of making the infant cry.

Initial Physical Examination:

General Guidelines: keep the newborn warm during the examination. Begin with general observations and then perform assessment that are least disturbing to the newborn first. Document all abnormal findings.

1. Vital Signs

A. Using apical **pulse** = PMI: point of maximum impulse (located at MCL 4th–5th ICS or below the left nipple line) 1 full minute. This is done using a stethoscope. Radial pulse is normally not prominent. If it is, it may be a sign of congenital heart anomaly (i. e., PDA). Femoral or brachial pulses – if absent, indicates, coarctation of the aorta and hip dislocation.

Pulse is irregular, rapid > 160–180 beats/min at birth; **120–140 (normal).** Pulse: heart rate in utero – 120–160 bpm after 1 hour newborn settles, heart rate stabilizes to an average of 120–140 bpm. Pulse:

– remains irregular because of immaturity of cardiac regulatory center in the medulla;

– when crying, rate might increase to 180 bpm;

– may decrease to 90–110 bpm during sleep;

– femoral pulses are more appreciated than radial and temporal pulses;

–always palpate for the femoral pulses; their absence suggests coarctation of aorta.

Respiration.1 full minute – irregular, shallow, rapid w/brief apneic spells < 15 seconds 60–80 breaths/min at birth.

NORMAL: 30–60/minute. Respiratory rate, rhythm, depth are likely to be irregular and short periods of apnea

(periodic respiration) are normal; coughing and sneezing are present at birth to clear the airway; newborns are obligate nose-breathers.

Blood Pressure – not usually measured, not routinely cobtained except for suspicion of coarctation of the aorta.

NORMAL: 80–60/45–40 mm Hg at birth; 100/50 mm Hg on the 10^{th} day.

Temperature. Normal range: 36.5–37.5 ^{0}C (axilla), skin: 36.0–36.5 ^{0}C, rectal: 36.6–37.2 ^{0}C. Temperature 37.2 ^{0}C at birth, crying increases body temperature slightly; radiant warmer falsely increases axillary temperature.

The initial assessment of the newborn. Immediately after birth the baby is briefly examined to exclude: birth trauma e. g. facial palsy, fractures, congenital deformities e. g. meningomyelocoele, club foot, exomphalos, anal atresia, genital anomalies, etc.; respiratory distress, severe anaemia.

2. Anthropometric measurement.

The baby should be weighed and the head circumference measured. Length usually is not recorded as it is difficult to measure accurately. If there is any doubt about the well-being of the baby, observe the newborn infant for a few hours in a nursery before it goes to the mother (the healthy infant delivered by Caesarian section is usually observed for a few hours only). This period provides an ideal opportunity to look out for hypothermia, respiratory distress, abnormal neurological features such as jitteriness, convulsions, excessive lethargy, etc. Normal term infants delivered vaginally should remain with their mothers.

Vital Statistics: **BW** (body weight): **2.5–4.0 kg; BL** (body length): **47.5–53.75 cm; HC** (head circumference): **33–35 cm; ChC** (chest circumference): **32–34 cm; Ac** (abdominal circumference): **32–34 cm.**

FIGURE 23-20 Weighing a newborn. Notice the protective hand held over the infant.

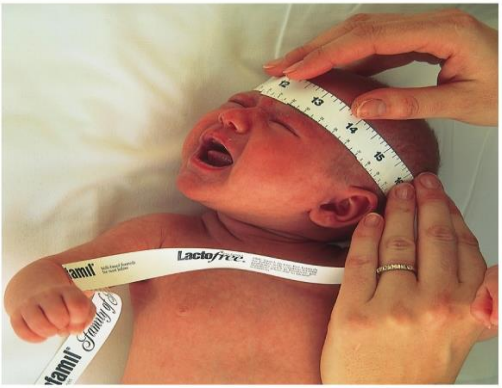
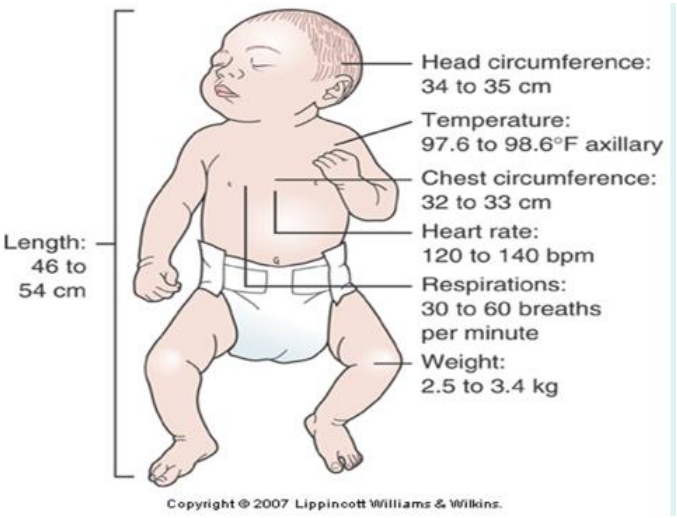


FIGURE 33-5 Measuring head circumference. The measuring tape passes just above the eyebrows and around the prominent posterior aspect of the head.

ChC term newborn – 1–2 cm less HC, measured at the level of the nipples. BL: mature female neonate – 53 cm (±2.5), mature male – 54 cm (±2.9). HC: mature newborn – 34–35 cm (±1.4); measure with the tape measure drawn across the center of the forehead and around the most prominent portion of the posterior head.



3. General appearance

General Measure and record height, weight, and head circumference. If the infant appears premature or is unusually large or small, perform a Dubowitz/Ballard exam to assess gestational age (see Dubowitz/Ballard score). The exam is divided into two parts: an external characteristics score, which is best done at birth, and a neuromuscular score, which should be done within 24 hours after birth.

Delivery Room Examination. The purpose of the delivery room history and examination is to identify major congenital malformations or other risk factors that would

mandate transfer to the Neonatal Intensive Care Unit rather than the Newborn Nursery.

History: inquire about high risk factors which may be assoclated with respiratory depression, such as: antepartum fetal bradycardia or tachycardia, meconium-stained amniotic fluid, maternal fever, placental abnormalities, premature or prolonged rupture of membranes (PROM), administration of narcotics, preeclampsia or eclampsia, diabetes, multiparity, use of recreational drugs, abnormal presentation of the fetus.

Immediate Assessment of the Newborn: skin, head, eyes, ears, neck, chest, abdomen, genitalia, back, extremities.

General. Are there petechiae, rash, evidence of birth trauma, lacerations, jaundice? Is the weight < 1800 gm?

Is the fontanelle bulging, depressed? Is the anterior fontanelle abnormally large (> 2x2 cm)? Is the posterior fontanelle open?

Is there caput succadaneum? (Soft, ill defined in outline, represents edema of the scalp e. g. often seen after suction extraction). Does it have **cephalhematoma?** (Does it cross suture lines, which usually appear on 2nd day of life). What about eyes? Are ears normally positioned? Are nares patent? Does it have cleft lip or palate? Neck masses? Does nasogastric tube pass normal?

Chest. Are breath sounds equal? Is there good air entry? Do you observe presence of stridor, wheezing, flaring, retracting, grunting, cyanosis in room air?

CVS. Is the rate > 120 and regular? Do you hear murmurs? Is PMI normal? Are femoral pulses easily palpated?

Abdomen. Are there masses? Which is the size of liver and spleen below mid-costal margin? Do you observe distension? Is it scaphoid? Is there 3-vessel cord?

GU. If male, are testes descended bilaterally? Are there inguinal masses? Is hypospadias observed? If female, is bulging hymen (imperforate) observed?

Back. Are there midline defects? Is anus patent?

Neuro. Is alertness observed? Tone? Are the movements symmetric? (Erbs Palsy: lack of movement in one arm). Is facial palsy observed? Do you observe Moro reflex, grasp, suck, cry, Babinski reflex? Is the evidence of neural tube abnormalities present?

Full term newborns have a flexed posture. The head is flexed. Arms are flexed on the chest. Legs are flexed on the abdomen.

DETAILED NEWBORN EXAMINATION

Skin colour.

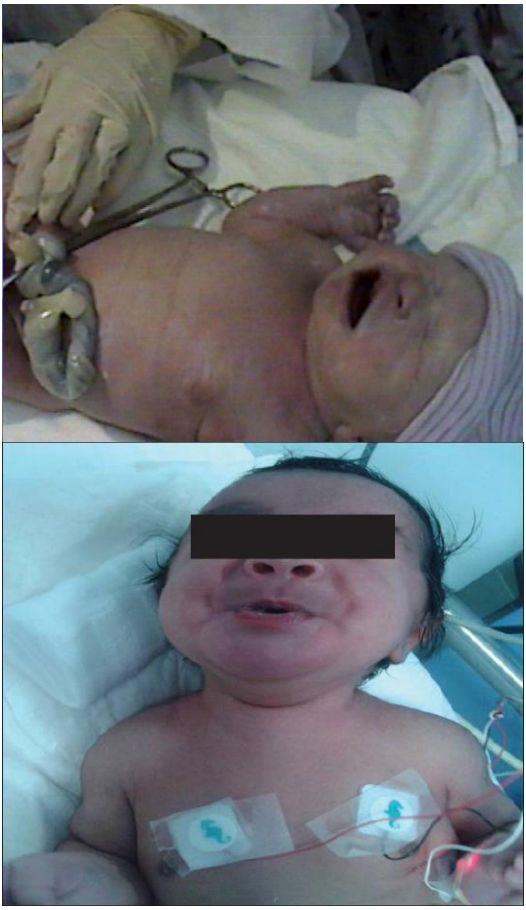
Plethora (deep, rosy red color) more common in infants with polycythemia vera but can be seen in an overoxygenated or overheated infant. Dark red skin – sign of prematurity.

Jaundice – elevated bilirubin.

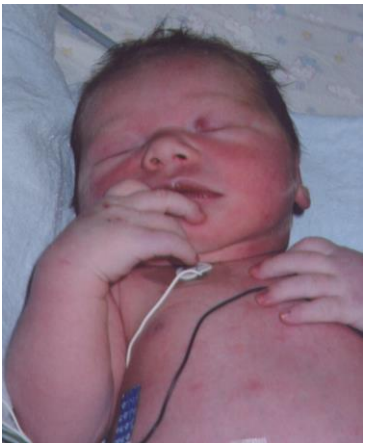
Gray colour skin – sign of infection. Slate grey colour is associated with methe-moglobinemia.

Pale color – anemia. Pallor anemia: excessive blood loss when cord is cut, untimely cutting of the cord, inadequate iron stores because of poor maternal nutrition, blood incompatibility.

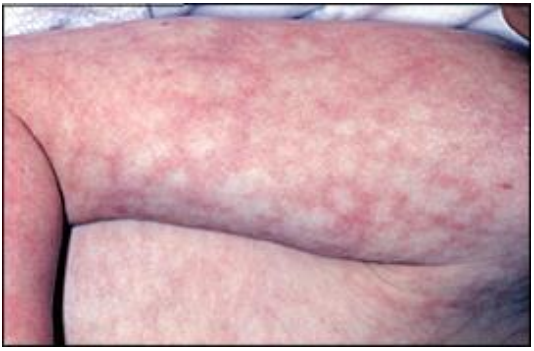
Cyanosis – etiological causes; hypothermia, hypoglycemia, infection, cardiac, respiratory, neurological abnormalities. *Central cyanosis* (bluish skin, including the tongue and lips) associated with low oxygen saturation in the blood, indicates decreased O_2, and it may be associated with congenital Heart disease (CHD). *Peripheral cyanosis* – bluish skin with pink lips and tongue. *Acrocyanosis* – bluish hands and feet only – may be normal for an infant who has just been born; acrocyanosis – up to 48 hours.



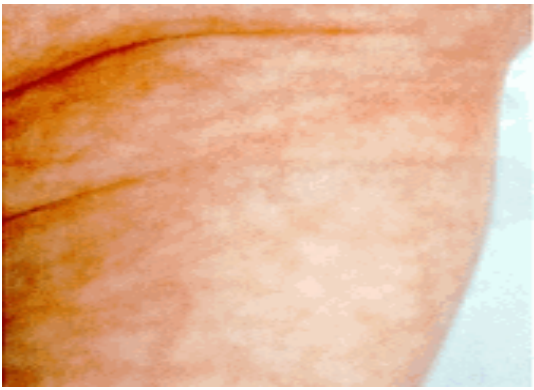
Central cyanosis.
Peripheral cyanosis



Acrocyanosis

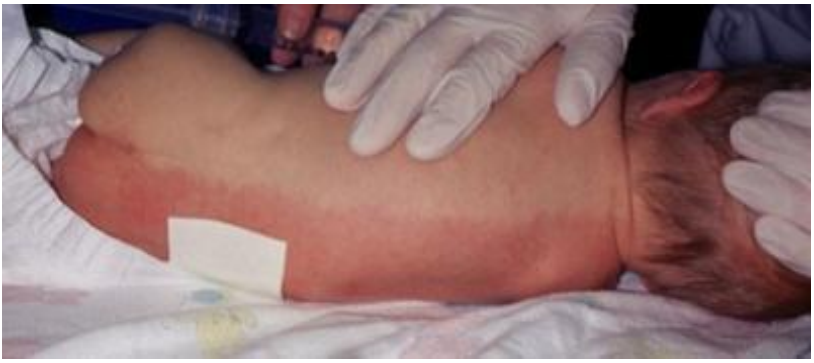


Generalized mottling – mottling lacy pattern may be seen in the healthy infant or infant with cold stress, hypo-volemia, sepsis. Persistent mottling referred to as cutis marmorata.



Cutis marmorata

Harlequin sign – pale and pink. Harlequin color change occurs when the newborn lies on his or her side. It consists of erythema of the dependent side of the body with simultaneous blanching of the contralateral side. The color change develops suddenly and persists for 30 seconds to 20 minutes. It resolves with increased muscle activity or crying. This phenomenon affects up to 10 % of full-term infants, but it often goes unnoticed because the infant is bundled. It occurs most commonly during the second to fifth day of life and may continue for up to three weeks. Harlequin color change is thought to be caused by immaturity of the hypothalamic center that controls the dilation of peripheral blood vessels.



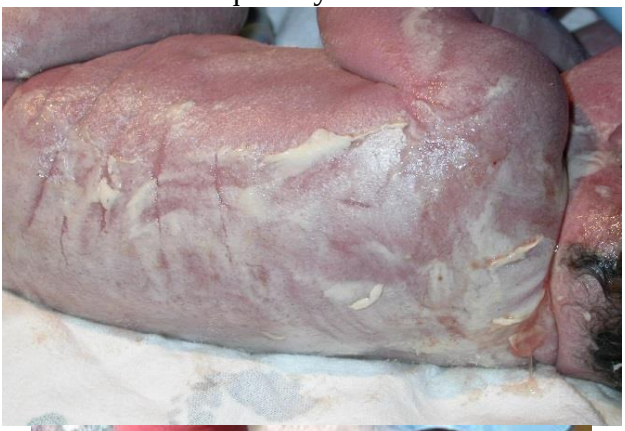
Harlequin sign

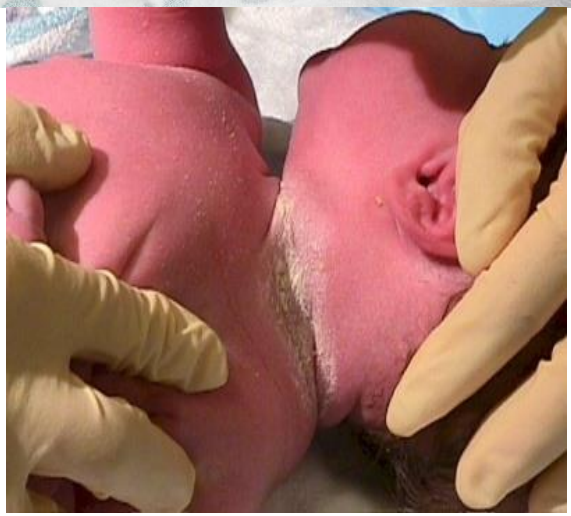
Fat necrosis. Localized areas of induration on back, thighs, or face (after forceps delivery). It has a dark red appearance and may fluctuate. It resolves spontaneously but needs to be differentiated from skin abscesses.

Sclerema. Very firm rubbery feel to the skin. Associated with severe infection, hypothermia or severe asphyxia.

Wasting Dry. Loose skin hangs in folds due to loss of muscle and subcutaneous fat resulting from recent intrauterine starvation.

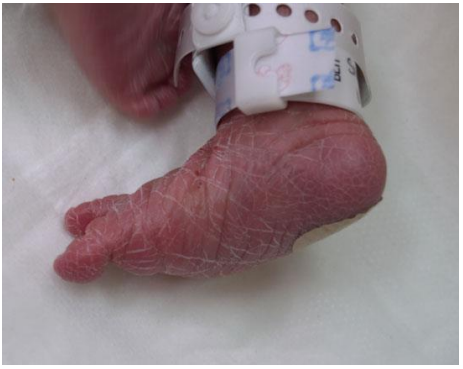
Vernix caseosa. Protective greasy white substance secreted by fetal sebaceous glands. Not present in preterm infants, and decreases in quantity after term.



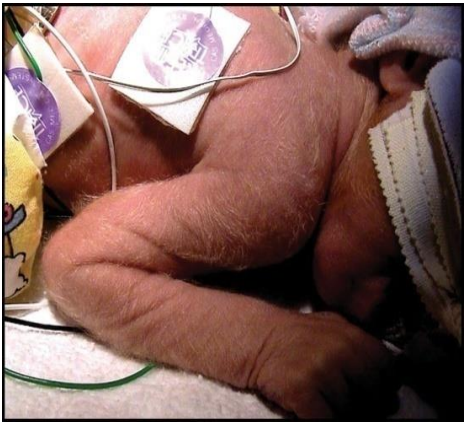


Vernix caseosa – a white creamy substance may thinly cover the skin.

Traumatic cyanosis of the face. Due to many small petechial haemorrhages in the skin after congestion of the head with the cord around the neck.



Superficial skin peeling. It is Common during the first week and especially marked in post-term or wasted babies. Dry peeling skin.



Hair Color at birth is a poor mark of future shade. Lanugo is fine facial and body hair which is a feature of preterm babies.

Lanugo – fine downy hair, may still be seen on the forehead and shoulders or it may all disappear.

Neuromuscular

State of alertness – persistent lethargy or irritability.

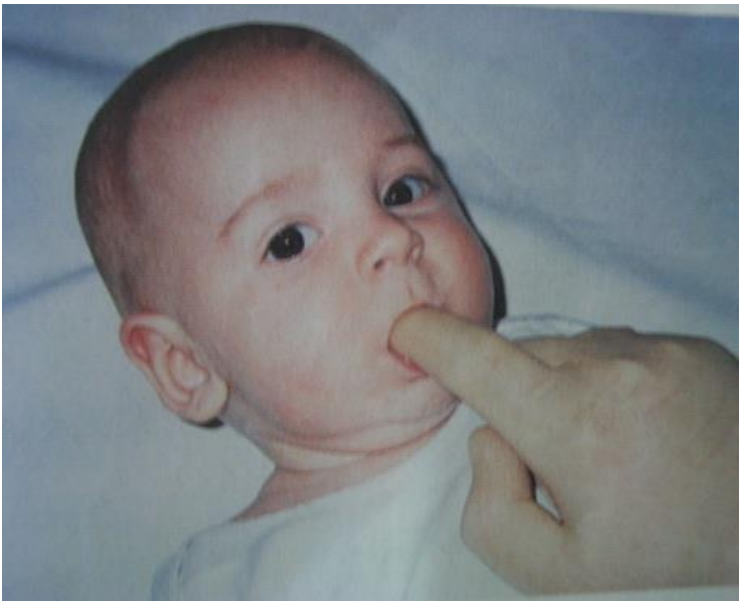
Posture.In term infant, normal position is one with hips abducted and partially flexed and with knees flexed. Arms are adducted and flexed at the elbow. The fists are often clenched, with fingers covering the thumb.

Tone. Support the infant with one hand under his chest. The neck extensors should be able to hold the head in line for 3 seconds. Should not have more than 10 % head lag when moving from supine to sitting position.

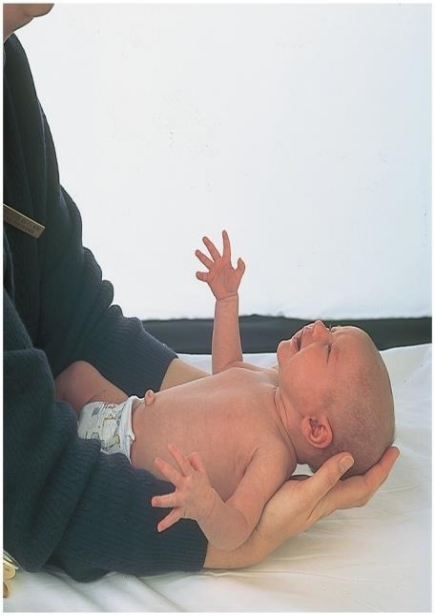
Full term newborns have a flexed posture. The head is flexed. There are arms are flexed on the chest, legs – on the abdomen.

Reflexes. Reflexes must be symmetrical. Biceps jerk test C5 and C6, knee jerk tests L2 – L4, ankle jerk tests S1, S2. Truncal incurvation reflex tests T2 through S1. Anal wink test S4, S5. Other primitive reflexes include the Moro reflex, palmer and planter grasps, sucking and rooting reflexes, and the asymmetric tonic neck reflex (ATNR). Asymmetric tonic neck reflex (seen in ventral suspension with arms rigidly extended and fists clenched) is abnormal. Blink Reflex – to protect the eye from any object coming near it by rapid eyelid closure. Babinski sign – stroking the sole of the foot from heel upward like an inverter “J” across ball of foot

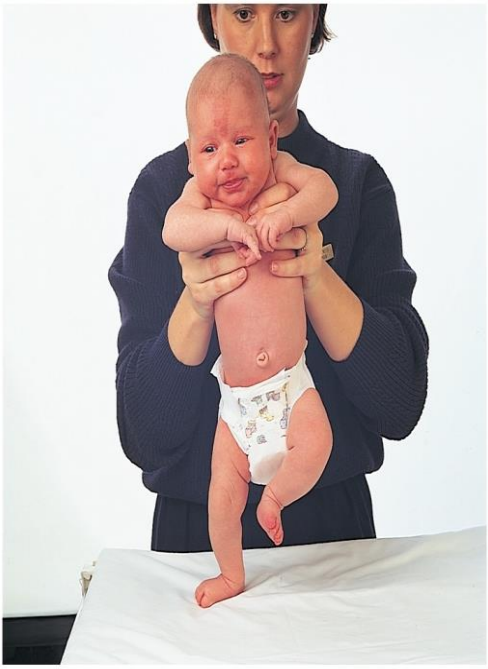
will cause all toes to fan (reverts to usual adult response by 12 months). Sucking reflex – when newborn's lips are touched, the baby makes a sucking motion. It diminishes at about 6 months of age. If it disappears immediately/if never stimulated – tracheoesophageal fistula. Swallowing reflex – food that reaches the posterior portion of the tongue is automatically swallowed.



Moro or startle reflex – elicited by sudden disturbance in the infant's immediate environment, body will stiffen, arms in tense extension followed by embrace gesture with thumb and index fingers "c" formation (disappears by 6 months); can be stimulated by startling the newborn with loud noise or by jarring the bassinet, fades on 4th or 5th month of life startle reflex.



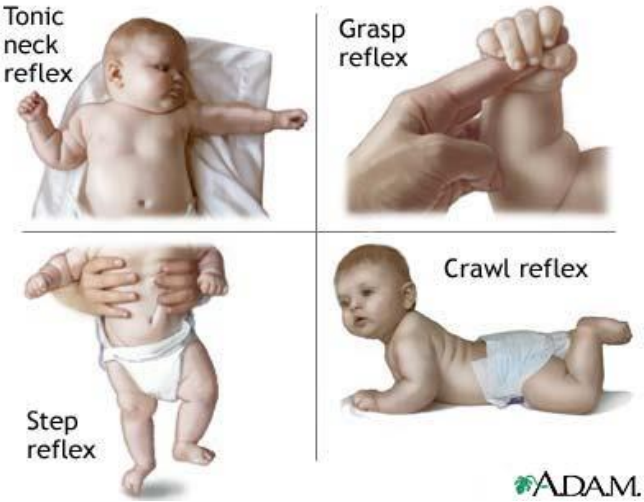
If the reflex persists, it is a sign of brain damage, neurological impairment, or motor reflex difficulties.



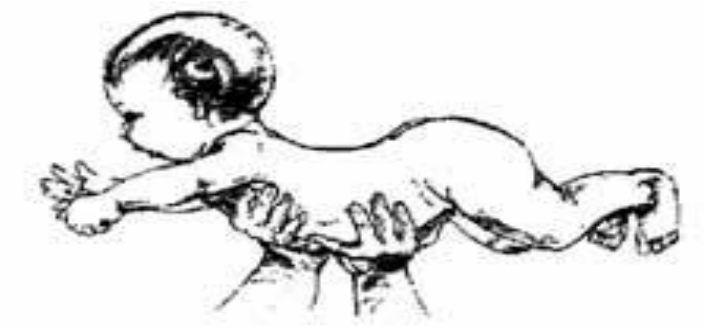
The walking or stepping reflex – newborn who is held in a vertical position with its feet touching a hard surface will take few alternating steps, disappears by 3–4 months of age.

Tonic neck (fencing) reflex – if the babies' head is rotated to the left, the left arm (face side) stretches into extension, the right arm flexes up above head. Opposite reaction if head is rotated rightward.

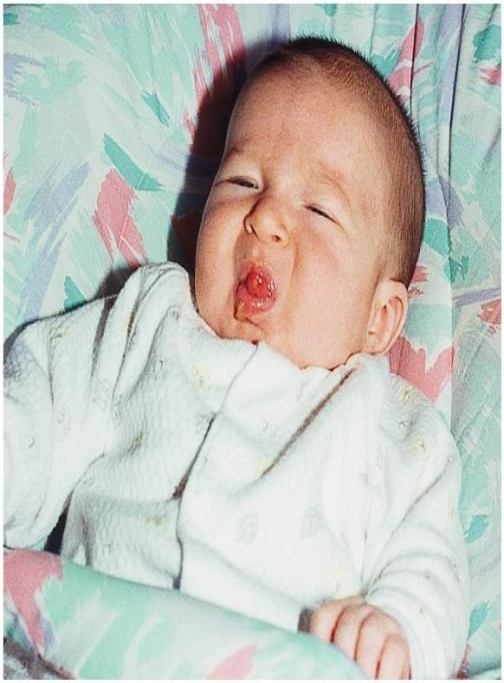
FIGURE 23-6 Tonic neck reflex.



Landau reflex – displayed at about three months of age. When a newbornis placed on its stomach faced down, newborn will raise her head and arch its back. This reflex will persist until 1 year old. Absence of this reflex suggests problems in motor development.

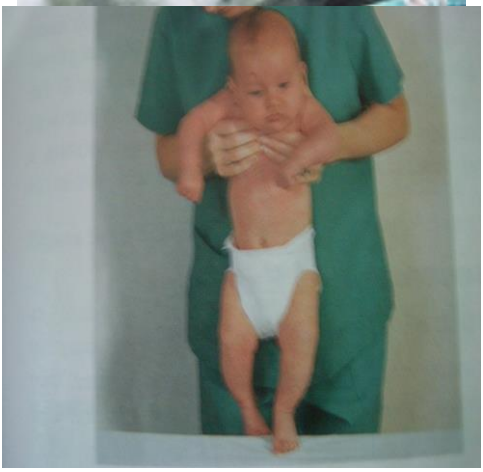


Extrusion reflex – a newborn will extrude any substance that is placed in the anterior portion of the tongue. Protective reflex prevents the swallowing of inedible substance, disappears for 6 weeks to 3 months.



Palmar grasp – pressure on palm elicits grasp (fades by 3–4 months).

Placing reflex – similar to stepping reflex, besides, it is elicited by touching the anterior surface of a newborns leg against the edge of a bassinet or table. A newborn will make a few quick lifting motions as if to step onto the table, it is obtainable in the normal infant up to the age of six weeks.



Parachute reflex – occurs in the slightly older infant, and is elicited by holding the child upright then rotating the body quickly face forward (as if falling). The arms are reflexively extend as if to break a fall.

Rooting reflex – turns toward any object touching/stroking cheek/mouth, opens mouth, and sucks rhythmically when finger/nipple is inserted into mouth (usually disappears by 6 weeks).

Trunk incurvation reflex (Gallant reflex) – a newborn lies on prone position and is touched along the paravertebral area by probing finger, newborn flexes its trunk and swings pelvis toward the touch.

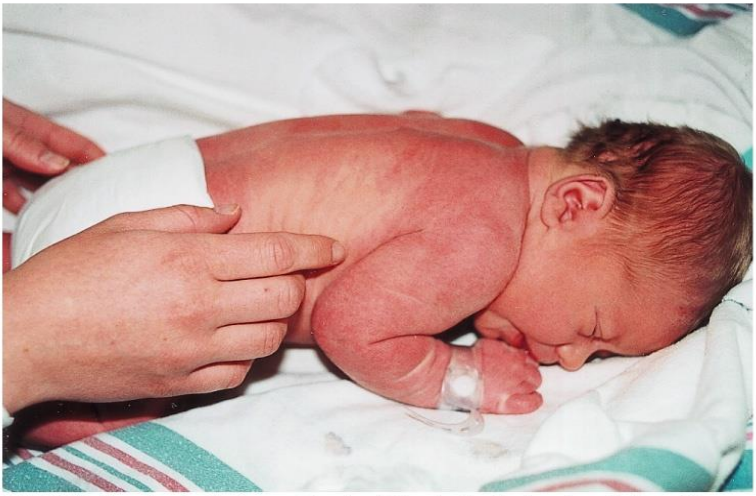


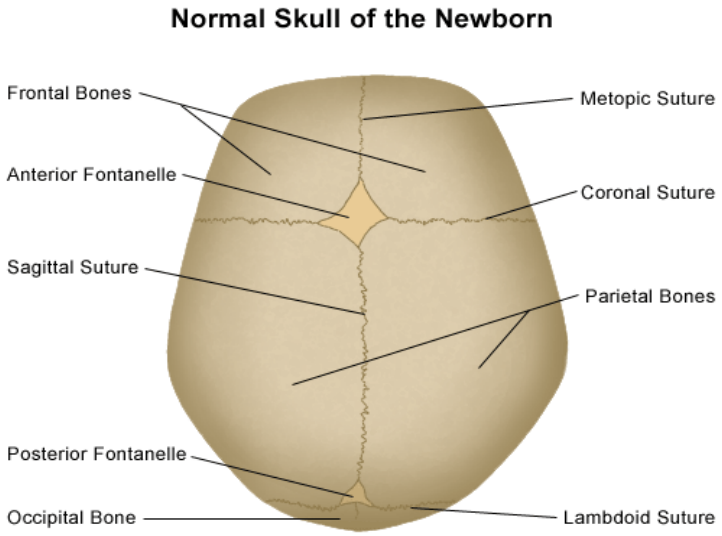
FIGURE 23-9 Trunk incurvation reflex. When the paravertebral area is stroked, the newborn flexes his or her trunk toward the direction of the stimulation.

Head

Head check for overriding sutures, the number of fontanelles and their size. Check for abnormal shape of head. Check for encephaloceles. Measure the head circumference.

Head is the largest part of the newborn body – 1/4 of his total body length – 25 % of the body length (cephalocaudal development), forehead is large and prominent, chin is receding when startled or crying. Larger part sutures are palpable: lambdoid –2, coronal – 2, frontal – 1, sagittal – 1.

Fontanels are unossified membranous tissue at the junction of the sutures. Molding is asymmetry of the head resulting from the pressure in the birth canal, overlapping of sagittal and coronal suture line. Anterior fontanel – diamond shape, closes at 12–18 months, 3–4 cm long/2–3 cm wide, junction of 2 parietal bones and 2 fused frontal bones, not indented/not depressed, suture lines – never appear widely separated. Posterior fontanel – triangular in shape, – junction of the parietal bones and the occipital bones, 1 cm wide, closes by 2–3 months of age.



Molding – overlapping of sagittal and coronal suture lines.

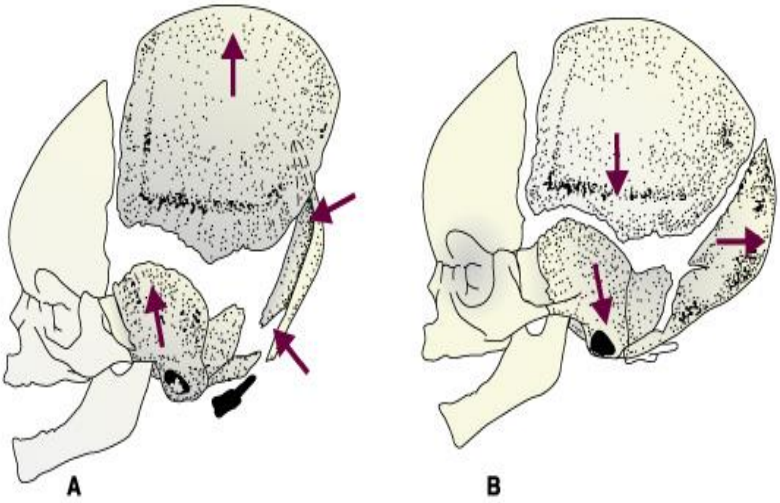
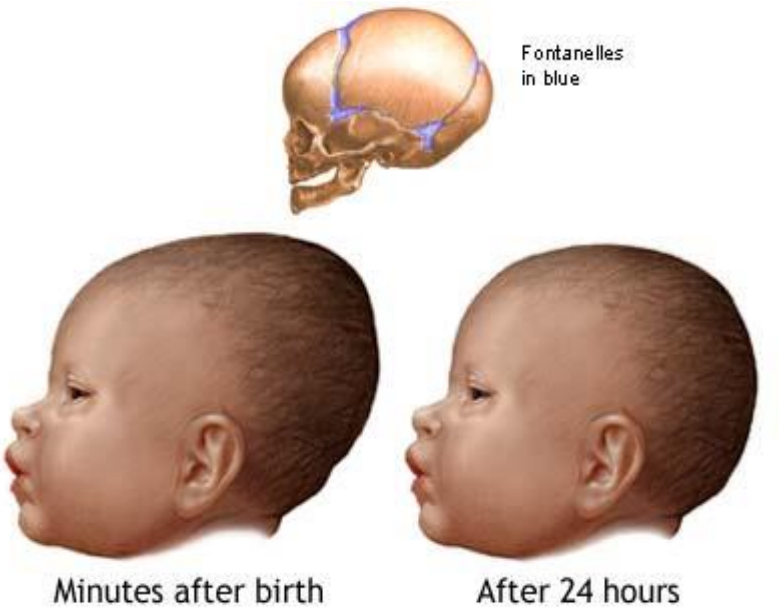
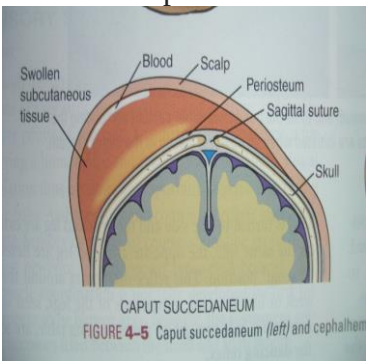
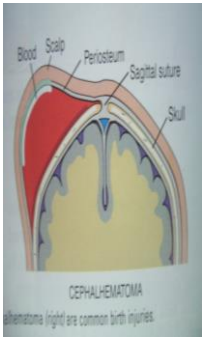


FIGURE 23.14 Molding. (A) The infant head molds to fit the birth canal more easily. On palpation, the skull sutures will be felt to be overriding. (C) The head shape returns to normal within 1 week.



Masses from birth trauma: *caput succedaneum* – edema of the soft tissue over bone (crosses over suture line), no treatment; subsides in few days; *cephalhematoma* – swelling caused by bleeding into an area between the bone and its periosteum (does not cross over suture line), absorbed within 10–14 days or neurosurgical treatment (suction) if there was no natural resorption of.

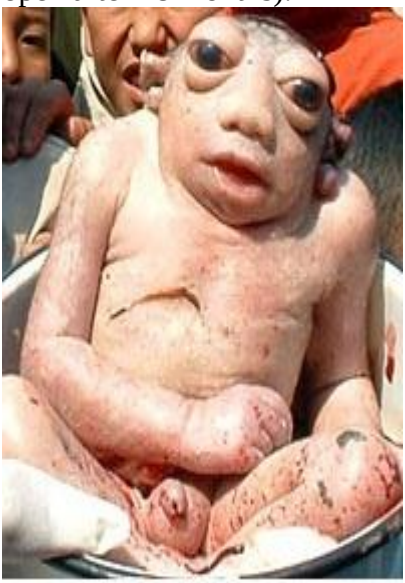




Craniosynostosis – suture lines separated or fontanels prematurely closed; leads to mental retardation.

Craniotabes – localized softening of cranial bones, indented by pressure of a finger. Corrects w/o treatment in weeks or months. Common to firstborn because of early lightening.

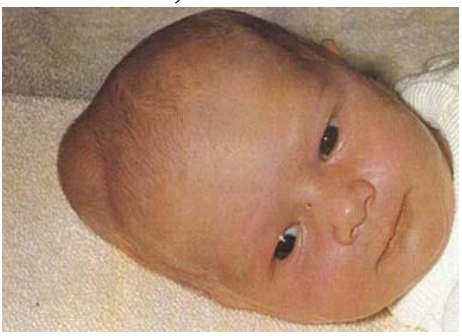
Hydrocephalus – (without treatment anterior fontanel open after 18 months).



Microcephaly – small growing brain.

Anencephaly – absence of cerebral hemisphere.

Signs of alarm: fused sutures, bulging or depressed fontanels when quiet, widened sutures and fontanels, craniotabes.



Widened sutures and fontanels

Eyes

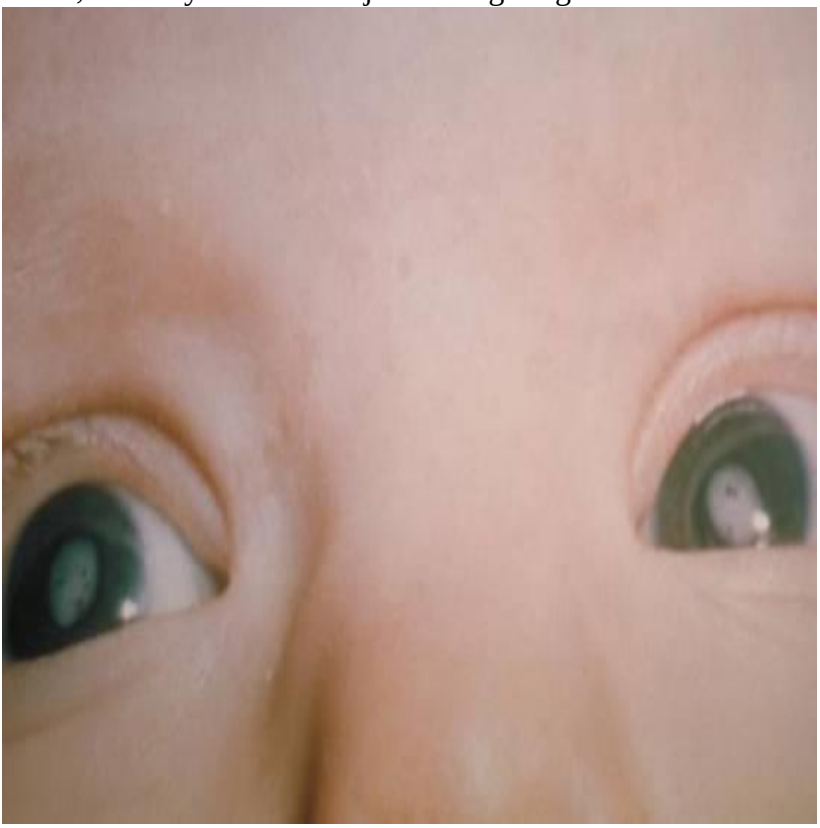
Eyes (the norm for a newborn): symmetrical and clear; pupil equal, round, react to light by accommodation; blink reflex present; strabismus common – weak EOM; ability to track and fixate momentarily; red reflex present; eyelid often edematous; absence of tears; corneal reflex (+); visual acuity = 20/200; 20/800.

Eyes check for colobomas, heterochromia.

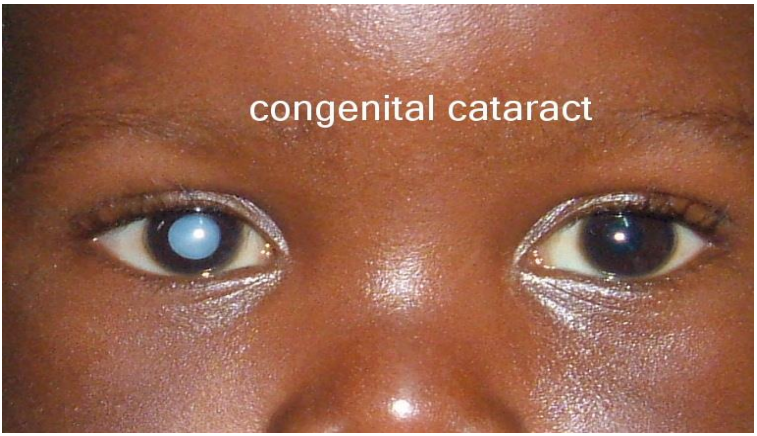
Cornea – check for cloudiness.

Conjunctiva – inspect for erythema, exudate, edema, jaundice and hemorrhage. Silver nitrate prophylaxis can cause a chemical conjunctivitis. Check for pupillary size and reactivity to light. **Red reflex –** hold the ophthalmoscope 6–8" from the eye. Use the + 10 diopter lens. The normal newborn transmits a clear red color back to the observer. Black dots may represent cataracts. A whitish color may be suggestive of retinoblastoma.

Signs of alarm: congenital cataract, constricted or dilated pupil, yellow sclera; absence of red reflex, corneal reflex; inability to follow object or bright light to midline.



Congenital cataract



Ears

Ears (the norm for a newborn): symmetrical, firm cartilage with recoil; top of pinna/ear should align with inner and outer canthus of the eye; sense of hearing – highly developed in a newborn.

Ears check for asymmetry, irregular shapes. Look for auricular or pre-auricular pits, fleshy appendages, lipomas, or skin tags.

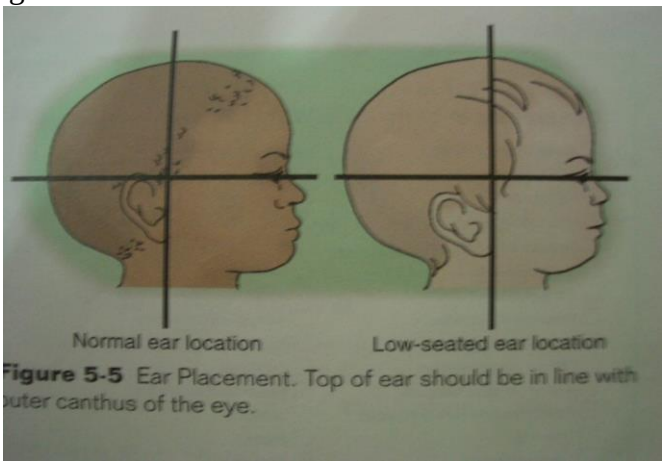


Figure 5-5 Ear Placement. Top of ear should be in line with outer canthus of the eye.

Signs of alarm: low set ears and minor abnormalities (chromosomal defect and kidney anomalies); absence of startle reflex in response to loud noise.

Nose

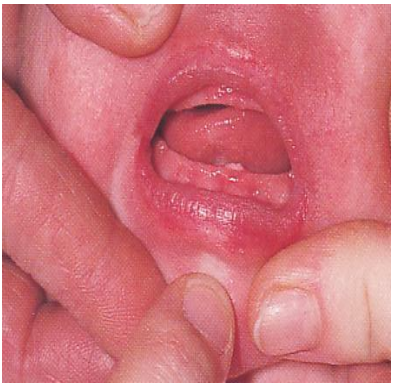
Nose (the norm for a newborn): nasal obligates, sense of smell – least developed. Note for marked flaring of alae nasi – indicative of airway obstruction; causes of obstruction: secretions, septal deviation. Check for choanal atresia (CA) as manifested by respiratory distress (neonates are obligate nose breathers). A soft NG tube should be passed through each nostril to confirm patency if choanal atresia is suspected.

Mouth

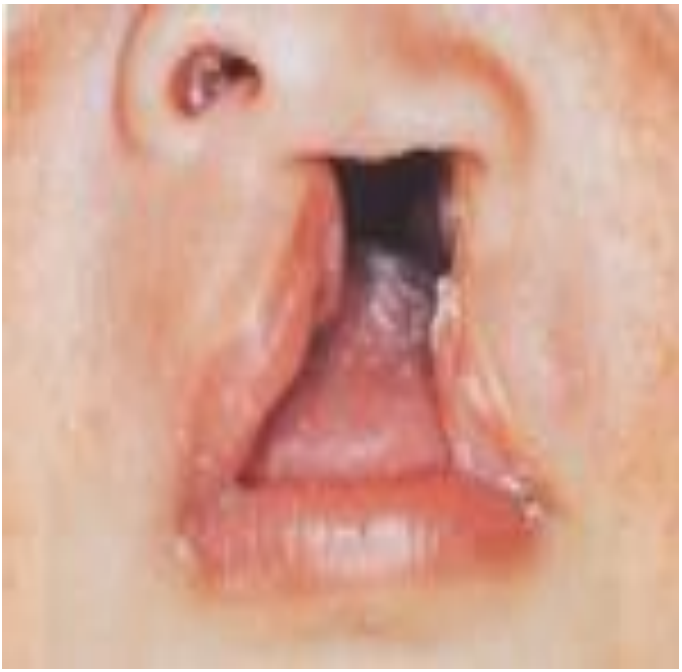
Mouth (the norm for a newborn): pink, moist gum; soft and hard palates intact; Epstein pearl (small, white cyst which contain keratin) that may be present on hard palate; ranulas – small bluish white swellings of variable size on the floor of the mouth representing benign mucous gland retention cysts; uvula midline; symmetrical and free moving tongue; sucking and crying movement symmetrical; able to swallow; gag reflex presents.

Observe the size and shape of the mouth: microstomia – observed when trisomy 18 and 21; macrostomia – when mucopolysaccharidoses; fish mouth – observed when fetal alcohol syndrome; macroglossia – hypothyroidism, mucopoly-saccharidoses. Natal teeth – occur in 1/2,000 births.

Mostly lower incisors. Risk of aspiration if loosely attached.



Chin micrognathia – occurs with Pierre Robin syndrome, Treacher Collins syndrome, Hallerman-Streiff syndrome. Check the palate for cleft lip and palate.



Natal teeth. Cleft lip, cleft palate.

Potential danger: cleft lip, cleft palate, large protruding tongue, profuse salivation or drooling, candidiasis (thrush).

Tongue – macroglossia. Candidiasis

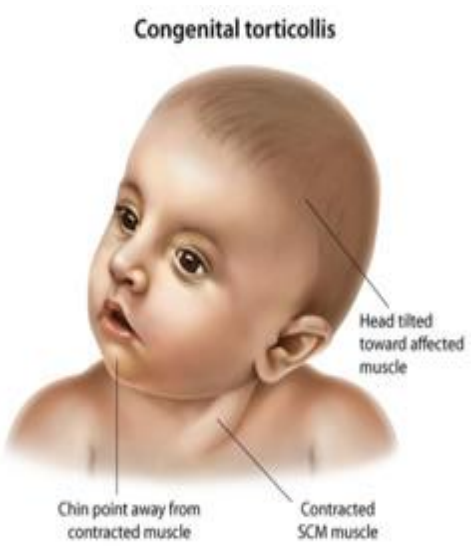
Neck

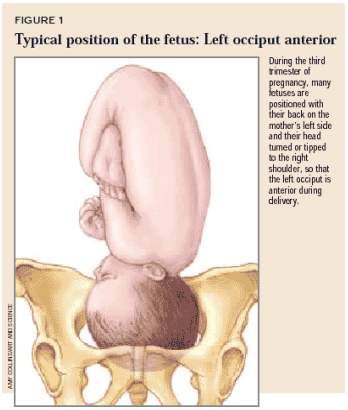
Neck (the norm for a newborn): thyroid gland is not palpable; soft, palpable and creased with skin folds; head – rotates freely on the neck and flexes forward and back.

Palpate the neck over all muscles, palpate clavicles for possible fractures. Webbed neck is found when Turner and Noonan syndromes. Torticollis is usually secondary to sternocleidomastoid hematoma.

Blokage of lymphatic system – cystic hygromas most common neck mass. Lymph nodes are unusual at birth and their presence usually indicates congenital infection. Note: suspect tracheo-esophageal fistula (TEF) if polyhydramnios is present.

Potential danger: (+) rigidity of the neck – congenital torticollis (injury to sternocleidomastoid); a newborn whose membranes ruptured 24 hours before birth > nuchal rigidity > meningitis.





Cystic hygroma

Chest and Lungs

Observe respiratory rate, respiratory pattern (periodic breathing, periods of true apnea). Observe chest movements for symmetry and for retractions. Listen for stridor, grunting. Note that there may be some enlargement of the breasts secondary to maternal hormones.

Chest (the norm for a newborn): circular appearance – AP and lateral diameter are about equal; diaphragmatic respiration; bronchial sounds heard on auscultation; nipples prominent and edematous; milky secretion common (witch's

milk); breast tissue present; clavicles need to be palpated to assess for fracture; symmetrically expands (retraction indicates respiratory distress). Breasts may be engorged (due to maternal hormones); there could be passage of thin, transparent watery fluid known as witch's milk.

Commonly seen: pectus excavatum (funnel shaped); pectus carinatum (pigeon chest); supernumerary nipples.

Signs of Potential Danger:depressed sternum, marked retraction of chest and ICS (during respiration), redness and firmness around nipple, wide spaced nipples.

Lungs (the norm for a newborn):abdominal respiration; cough reflex is absent at birth, (+) by 1–2 days; bilateral equal bronchial breath sound; respiration is irregular rate and depth; (+) crackles – after birth.

Potential Danger: inspiratory stridor, expiratory grunt and retraction, persistent irregular breathing, periodic breathing with repeated apneic spells, see-saw respiration (paradoxical), unequal and diminished breath sound, persistent fine crackles, peristaltic bowel sounds on one side with diminished breath sounds on the same side.

Cardiovascular System

Measure heart rate, blood pressure in upper and lower extremities, respiratory rate.

Inspection check baby's color for pallor, cyanosis, plethora. Palpation check capillary refill. Check pulses; note any decrease in femoral pulses or radio-femoral delay as a sign of possible coarctation of the aorta, note character of pulses (bounding or thready). Locate PMI with single finger on chest; abnormal location of PMI can be clue to pneumothorax, diaphragmatic hernia, situs inversus, or other thoracic problem. Auscultation note rhythm and presence of murmurs, which may be pathologic.

Heart (the norm for a newborn): located – apex 4th–5th ICS, lateral to left sternal border; heart rate increases with inspiration and decreases with expiration; transient cyanosis when crying or straining.

Potential danger: dextracardia – heart at right side, cardiomegaly, displacement of apex, muffled, (+) murmur or thrills, persistent cyanosis, hyperactive precordium.

Abdomen

Note shape of abdomen. Flat abdomens signify decreased tone, abdominal contents in chest, or abnormalities in abdominal musculature. Note abdominal distension. Examine umbilical cord and count the vessels. Note color of cord. Palpate liver and spleen. If the spleen is felting, be alert for congenital infection or extramedullary hematopoeisis. After locating these organs (checking for situs inversus), palpate for any abnormal masses. Auscultate for bowel sounds. Examine for hernias – umbilical or inguinal. Observe for diastasis recti. Observe for any obvious malformations e. g. omphalocoele. An omphalocoele has a membrane covering (unless it has been rupturing during the delivery) whereas a gastroschisis does not. Inspect anal area for patency and/or presence of fistulas.

Abdomen (the norm for a newborn): bowel sounds – audible 1–2 hours after birth; liver palpable 2–3 cm below right costal margin; the spleen is not usually palpable, spleen tip palpable at the end of first week of age; kidney palpable 1–2 cm above umbilicus.

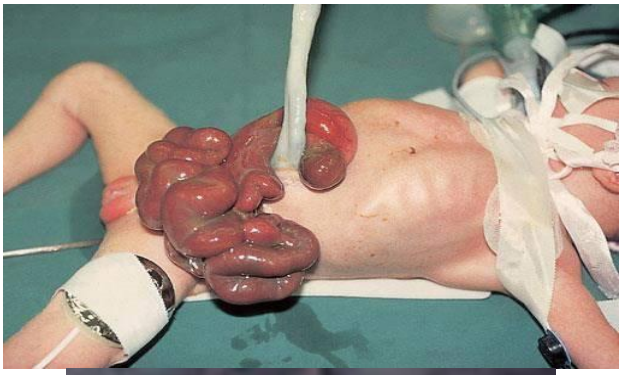
The umbilical cord contains the two umbilical arteries, the vein, the rudimentary allantois, the remnant of the omphalomesenteric duct, and a gelatinous substance called Wharton's jelly. The sheath of the umbilical cord is derived from the amnion. The muscular umbilical arteries contract readily, but the vein does not. The vein retains a fairly large lumen after birth. The normal cord at term is 55 cm long. Abnormally short cords are associated with antepartum abnormalities including fetal hypotonia, oligohydramnios, uterine constraint, and with increased risk for complications of labor and delivery for both motherand infant. Long cords (> 70 cm) increase risk for true knots, wrapping around fetal parts (neck, arm) or prolapse, and straight untwisted cords are

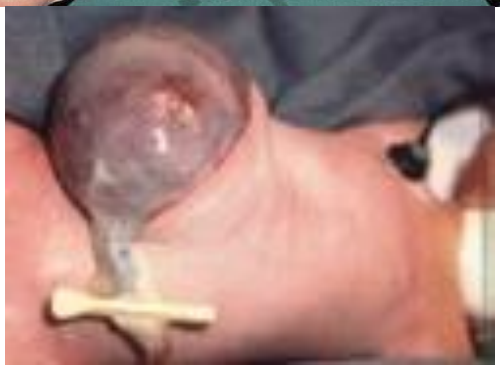
associated with fetal distress, anomalies, and intrauterine fetal demise.

When the cord sloughs after birth, portions of these structures remain in the base. The blood vessels are functionally closed, but anatomically patent for 10–20 days. The arteries become the lateral umbilical ligaments; the vein, the ligamentum teres; and the ductus venosus, the ligamentum venosum.

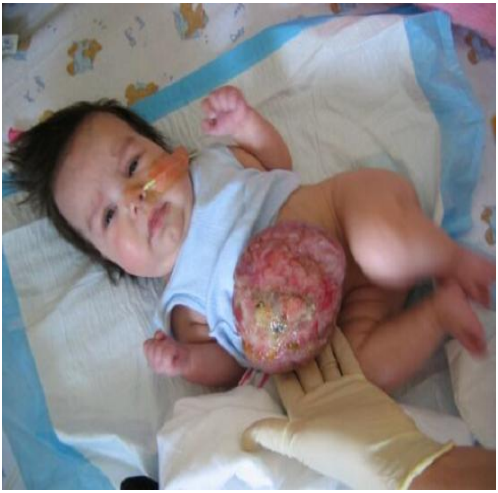
Potential Danger: during this interval, the umbilical vessels are potential portals of entry for infection. The umbilical cord usually sloughs within 2 weeks. Delayed separation of the cord, after more than 1 mo, has been associated with neutrophil chemotactic defects and overwhelming bacterial infection.

A single umbilical artery is present in about 5–10/1,000 births; the frequency is about 35–70/1,000 in twin births. Approximately 30 % of infants with a single umbilical artery have congenital abnormalities, usually more than one; many such infants are stillborn or die shortly after birth. Trisomy 18 is one of the more frequent abnormalities. Because abnormalities may not be apparent on physical examination, it is important that at every delivery the cut cord and the maternal and fetal surfaces of the placenta be inspected. The number of arteries present should be recorded as an aid to the early suspicion and identification of abnormalities in such infants. For infants with a single umbilical artery, many recommend renal ultrasonography.





Gastroschisis. Omphalocoele



Potential danger: abdominal distention, distended veins, absent bowel sound, enlarged spleen and liver, ascites,visible peri-staltic waves, scaphoid or concave abdomen, green umbilical cord, presence of only 1 artery in cord.

Omphalocoele

Gastrointestinal system

Features of the gastrointestinal tract:

- newborn's stomach holds about 60–90 ml;
- has limited ability to digest fat and starch because the pancreatic enzymes, lipase and amylase, are deficient for the first few months of life;
- because milk, the infant's main diet for the first year is low in vitamin K, intestinal synthesis is necessary for blood coagulation.

Anus: ensure anal opening is patent; some passage of first stool meconium usually occurs within the first 12 hours after birth; 99 % of term infants and 95 % of premature infants pass meconium within 48 hours of birth. Imperforate anus is not always visible and may require evidence obtained by gentle insertion of the little finger or a rectal tube. Roentgenographic study is required. Passage of meconium does not rule out an imperforate anus if a rectal-vaginal fistula is present. The dimple or irregularity in skinfold often normally present in the sacrococcygeal midline may be mistaken for an actual or potential neurocutaneous sinus.

Vomiting. Babies normally swallow a variable quantity of air when feeding and commonly bring up a small amount of milk when winded. Occasional large vomits without cause may occur. Persistent vomiting should be assessed carefully and investigated especially if bile is present, however.

Serious causes: alimentary tract obstruction due to atresia, meconium ileus, volvulus, strangulated hernia, inspissated milk, Hirschsprung's disease and necrotising enterocolitis; marked gastrooesophageal reflux; infection (including urinary tract); cerebral pathology (including intracranial bleed or meningitis); metabolic disorders.

Faces

More than 90 % of full-term newborn infants pass meconium within the first 24 hours. The possibility of intestinal obstruction should be considered in any infant who does not pass meconium by 24–36 hours. Intestinal atresia, stricture, or stenosis; Hirschsprung disease; milk bolus

obstruction; meconium ileus; or meconium plugs may manifest as constipation or, more often, obstipation. About 20 % of very low birthweight (VLBW) infants do not pass meconium within the first 24 hours. Constipation not present from birth but appearing during the first month of life may be a sign of short-segment congenital aganglionic megacolon, hypothyroidism, strictures after necrotizing enterocolitis (NEC), or anal stenosis. It must be kept in mind that infrequent bowel movements do not necessarily mean constipation. A breast-fed infant usually has frequent bowel movements, whereas a formula-fed infant may have 1–2 movements a day or every other day. Stools replace meconium on 3rd or 4th day.

Breast milk stools are usually bright yellow (vary from orange to green), may vary from watery to pasty, and may contain mucus or milk curds. Two to five stools are usually passed each day, but the variation ranges from one stool a week to 12 a day.

Cow's milk (formula) stools are pale yellow, firmer and less frequent (up to 5 a day).

“Starvation stools” which occur in under-fed infants are characteristically small and dark green.

Blood in stools is commonly due to swallowed maternal blood (distinguished from fetal blood by Apt test).

Urinary system

Kidneys are examined by palpation. The kidneys should be about 4.5–5 cm vertical length in the full term newborn. The technique for palpation is either:

a) one hand with four fingers under the baby's back, palpation by rolling the thumb over the kidneys;

b) palpate the left kidney by placing the right hand under the left lumbar region and palpating the abdomen with the left hand (do the reverse for the right kidney).

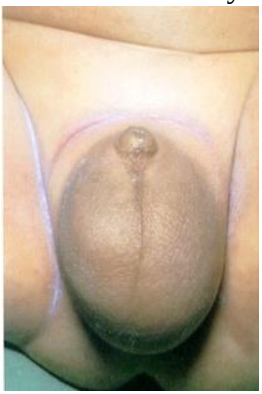
The norm for a newborn: the average newborn voids within 24 hours after birth; a single voiding in a newborn is only about 15 ml; the daily urinary output for the first 1–2 days is about 30–60 ml total; in the first few weeks the infant

empties his bladder up to 20 times a day. Boys should pass urine with a good stream (dribbling suggests posterior urethral valves); the 1st voiding may be pink or dusky because of uric acid crystals that were formed in the bladder in utero. Urates may colour the urine heavily leaving a brick-red stain on the nappy (sometimes mistaken for blood); the newborn kidney is less able to excrete a solute load and has a reduced concentrating capacity in comparison with the older child. Urine collection: most easily done using a collecting bag, but contamination is a risk. Uncontaminated urine may be obtained by suprapubic bladder puncture.

Potential danger: newborns who do not void within this time should be examined for the possibility of ureteral stenosis or absent kidneys or ureter.

Genitals

Male genitalia. Termnormal penis is 3.6±0.7 cm stretched length. Inspect glans, urethral opening, prepuce and shaft. Normally difficult to completely retract foreskin. Observe for hypospadias, epispadias. Inspect circumcised penis for edema, incision, bleeding. Full term infant should have brownish pigmentation and fully rugated scrotum. Palpate the testes. Scrotum may be edematous due to maternal hormones.

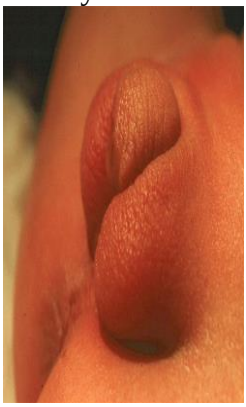


Testes should be present;term male infants usually have testes in the scrotum at birth. The majority of incompletely descended testes come down within the first month; if undescended – cryptorchidism. Preterm babies tend to have incompletely descended testes and a less well-developed scrotum.

Fluid hernia (soft swelling of scrotum which transilluminates easily) is common. Most

disappear spontaneously within the first year. Foreskin is normally adherent to the glans penis and cannot be pulled back without trauma: 90 % become fully retractable by the age of 3 years. Pulling back the foreskin in infancy is therefore not advisable and routine circumcision is medically unnecessary.

Hydrocele



Ambiguous Genitalia

Female genitalia. Inspect the labia, clitoris, urethral opening and external vaginal vault. Often a *whitish mucoid vaginal discharge is present*, in nearly all mature female

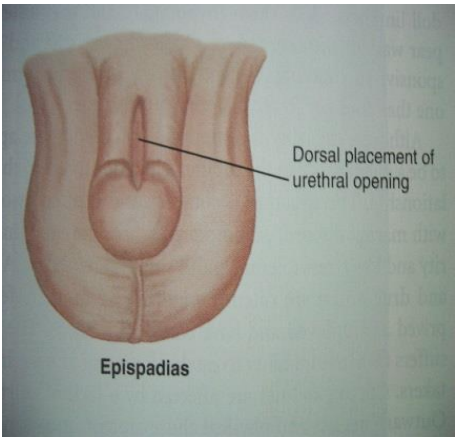
infants at birth; this is normal, *as is a small amount of bleeding*, which usually occurs a few days after birth and is secondary to maternal hormone withdrawal. Hymeneal tags may be present normally.

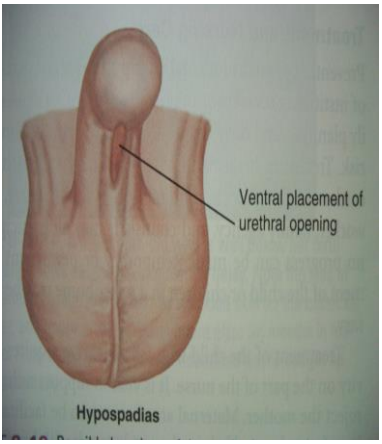
The genitals and mammary glands normally respond to *transplacentally acquired maternal hormones to produce enlargement and secretion of the breasts in both sexes* and prominence of the female genitals, often with considerable nonpurulent discharge. *These transitory manifestations* require observation but no intervention.

An imperforate hymen may result in **hydrometrocolpos** and a lower abdominal mass. A normal scrotum at term is relatively large; its size may be increased by the trauma of breech delivery or by a transitory hydrocele, which is distinguished from a hernia by palpation and transillumination. The testes should be in the scrotum or palpable in the canals in term infants. Black male infants usually have dark pigmentation of the scrotum before the rest of the skin assumes its permanent color.

The prepuce of a newborn infant is normally tight and adherent. Severe hypospadias or epispadias should always lead one to suspect either that abnormal sex chromosomes are present or that the infant is actually a masculinized female with an enlarged clitoris because this finding may be the 1st evidence of adrenogenital syndrome. Erection of the penis is common and has no significance. Urine is usually passed during or immediately after birth; a period without voiding may normally follow. Most void by 12 hours, and about 95 % of preterm and term infants void within 24 hours.

Congenital malformations of the urinary tract





Epispadias – urethral opening on the dorsal surface of the penis, surgical correction. **Hypospadias –** male urethral opening on the ventral surface of penis, or female urethral opening in vagina, surgical reconstruction.

Spine

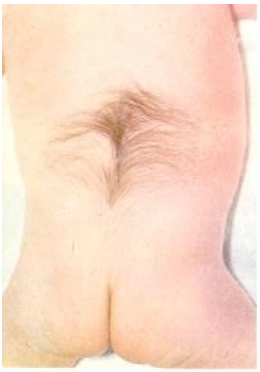
The norm for a newborn: straight, posture flexed, supportive of head momentarily when prone, arms and legs flexed; chin flexed on upper chest; well-coordinated, sporadic movement.

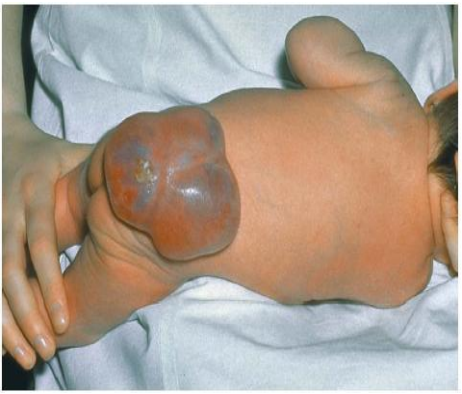
Hypotonic or hypertonic indicates CNS damage.

Back

The norm for a newborn: on prone appears flat, (curves start to form when child learns to sit or stand).

Note: for mass, hairy nodule and a dimple along axis. This may be indicative of spina bifida.





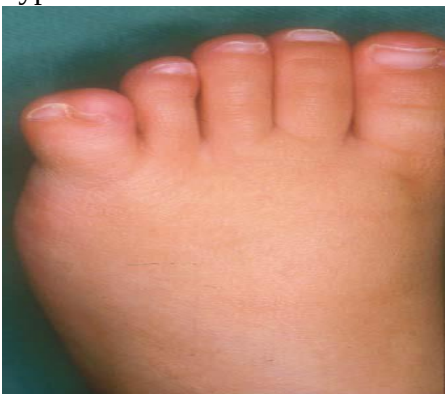
Spina bifida

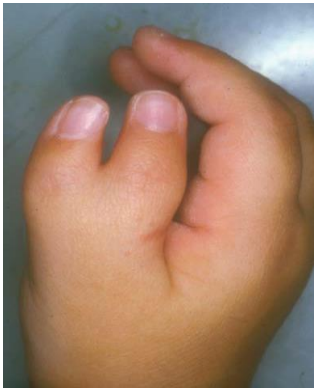
Extremities

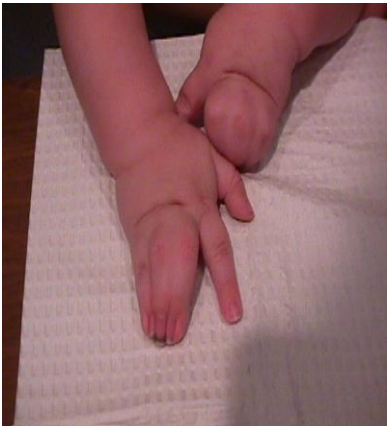
The norm for a newborn: flexed, symmetrical movement, fists clenched, ten finger, 10 toes (supernumerary = = polydactyly, fused or webbed = syndactyly), Simian line; legs – bowed; creases on soles of feet, pulses palpable; **slight tremor** common but could be **sign of hypoglycemia.**

Danger: upper extremity look forclavicular fracture, absence of radius or ulna;assess for hip dysplasia – no click should be heard; asymmetrical movement of upper and lower extremities – Erb-Duchenne paralysis; observe for clubfoot deformities. Also higher in infants born in the breech position and infants with certain other congenital abnormalities,

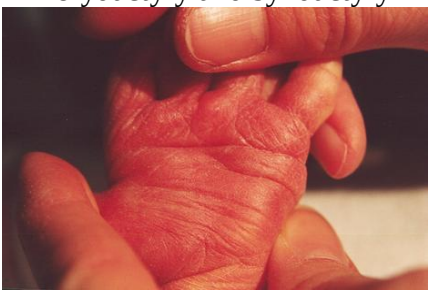
including torticollis, clubfoot, metatarsus adductus, and hyperextension of the knee.





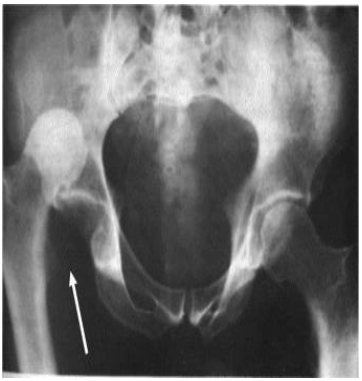


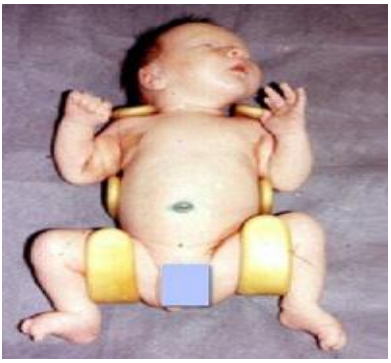
Polydactyly and syndactyly



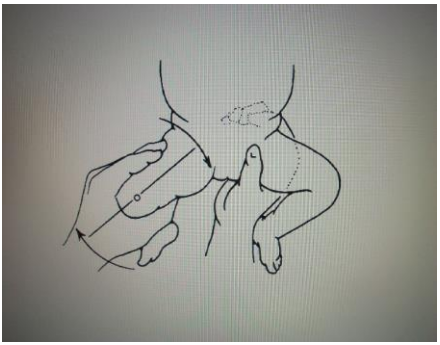
Simian line

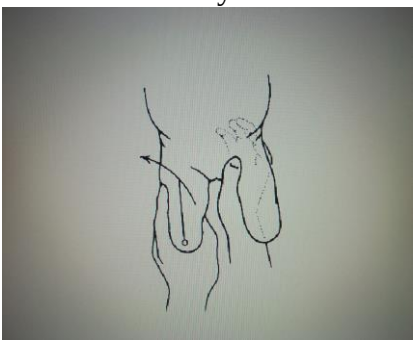
Congenital hip dysplasia/dislocation: 0.1% of infants with a predilection for females to males of 5:1; infants with a family history (first-degree relative affected) of CHD, the incidence is 10 times higher.





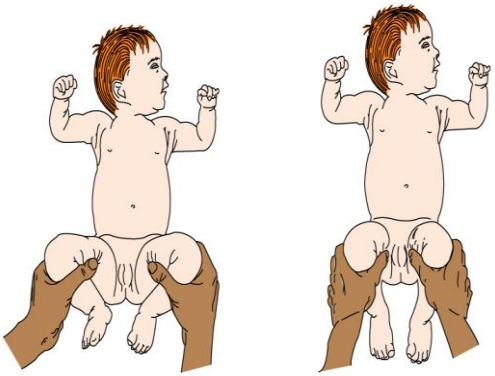
A. Ortolani's test. In this maneuver, the infant is examined in the supine position. Place the infant in frog-leg position. Abduct the hip by using the middle finger to apply gentle inward and upward pressure over the greater trochanter. In the infant with an unstable hip, the examiner will feel a sudden shifting sensation and may hear or feel a "click" simultaneously as the hip reduces anteriorly.





Ortolani's test

Barlow's test



Nursing Procedure 39.1: Assessing Ortolani's and Barlow's Signs

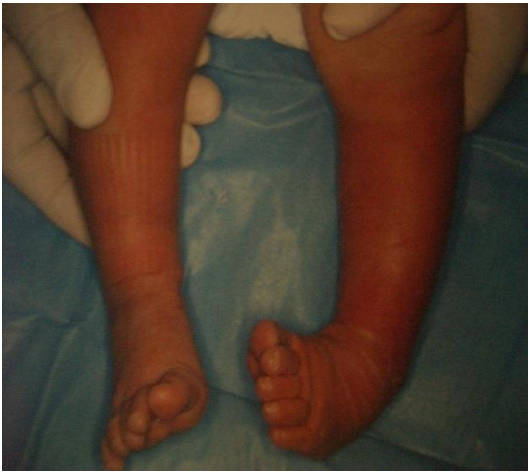
B. Barlow's test. In this maneuver, the infant is examined in the supine position. The examiner holds the infant's pelvis with one hand to stabilize it during manipu-lation. Adduct the hip by using the thumb to apply outward and backward pressure over the inner thigh. In the infant with an unstable hip, a similar "click"may be felt as the hip subluxes posteriorly.

A. Ortolani's test

B. Barlow's test

Assessment on the R and L hips may be done simultaneously.

Clubfoot



A birth defect in which the front portion of the foot is deformed and turned inward. It can be benefited greatly by surgery.

Immune system

- a newborn receives passive immunity via placenta (IgG);
- a newborn receives passive immunity from colostrum (IgA);
- infection – IgM;
- use aseptic technique when handling a newborn;
- observe standard precaution when handling a newborn;
- handwashing;
- infection-free staff cares for a newborn;
- monitor a newborn's temperature.

Metabolic system/GI system:

- a newborn can digest simple CHO, unable to digest fat because of lack of lipase;
- CHON broken down only partially;
- a newborn small stomach capacity (60–90 ml);
- rapid intestinal emptying time 2–3 hours;
- observe feeding reflexes;
- observe for normal stool;
- perform NB screening test.

Blood Values

80 (mature) –110 (preterm) ml/kg of body weight or about 300 ml.

High WBC at birth about 15,000 to 30,000 cells/mm3

Increased WBC count should not be taken as evidence of infection.

Hb of newborns – 170 – 220 g/l.

Blood Coagulation

Most newborns are born with a prolonged coagulation or prothrombin time, because their blood levels of Vitamin K are lower than normal. It takes 24 hours for flora to accumulate and vitamin K to be synthesized.

CARE PRIOR TO DISCHARGE

Support unrestricted, per demand breastfeeding, day and night

Keep the newborn in the room with mother, in her bed or within easy reach. Do not separate them (rooming-in).

Support exclusive breastfeeding on demand day and night.

Assess breastfeeding in every baby before planning for discharge. Ask the mother to alert you if with difficulty breastfeeding.

Praise any mother who is breastfeeding and encourage her to continue exclusively breastfeeding.

Explain that exclusive breastfeeding is the only feeding that protects her baby against serious illness. Define that exclusive breastfeeding means no other food or water except for breast milk.

Notes:

– Do not discharge if baby is not feeding well.

– Do not give sugar water, formula or other prelacteals.

– Do not give bottles or pacifiers.

Ensure warmth of the baby

Ensure the room is warm (> 25 ^{0}C and draft-free).

Explain to the mother that keeping baby warm is important for the baby to remain healthy.

Keep the baby in skin-to-skin contact with the mother as much as possible.

Dress the baby or wrap in soft dry clean cloth. Cover the head with a cap for the first few days, especially if baby is small.

Washing and bathing (Hygiene)

- Wash your hands.
- Wipe the face, neck and underarms with a damp cloth daily.
- Wash the buttocks when soiled, dry thoroughly.

Bathe when necessary, ensuring that the room is warm and draft-free, using warm water for bathing and thoroughly drying the baby, then dressing and covering after the bath.

If the baby is small, ensure that the room is warmer when changing, wiping or bathing.

Sleeping

Let the baby sleep on its back or side. It is essential to discuss sleep position, since prone sleeping is a known risk factor for sudden infant death syndrome. Parents should be instructed to put their infant to sleep in a supine position. Pillows, blankets and thick comforters may pose a suffocation risk and should not be present in a crib or bassinet.

Keep the baby away from smoke or from smoking people.

Ensure mother and baby are sleeping under impregnated bed net if there is malaria in the area. General safety issues should also be addressed. The law requires rear facing car seats for infants less than 1 year of age and less than 20 pounds. Parents should be warned to never leave an infant unattended on a raised surface, in a bathtub or near water (beach, pool, bucket, etc.). Parents should also be instructed about thermal regulation. Because infants lose much of their heat from their heads, caps should be used in the hospital and in cold environments. Otherwise, newborns should be dressed as is appropriate for their immediate environment.

Arents should anticipate that their baby may lose up to 10 % of their birth weight within the first 3 to 5 days of life. The baby should regain or exceed their birth weight by 2 weeks of age.

Physiologic jaundice is common in the first few days of life. Risk factors for pathologic jaundice include O+ maternal blood type, bruising/cephalohematoma, prematurity, infants of diabetic mothers, polycythemia, and ethnic groups (males) at risk for G6PD deficiency.

A baby's first follow up appointment may be scheduled 2 weeks after discharge for infants who remain in the hospital for more than 48 hours after delivery. However, many physicians choose to see the baby 1 to 2 days after discharge. This is especially the case for infants discharged from the

hospital at less than 48 hours of age. Hepatitis B immunization is offered to all infants prior to discharge. If a mother is hepatitis B surface antigen (HBsAg) positive, the immunization should be administered along with hepatitis B immune globulin.

Look for danger signs

Look for signs of serious illness:

– fast breathing (> 60 breaths per min);
– slow breathing (< 30 breaths per min);
– severe chest in-drawing;
– grunting;
– convulsions;
– floppy or stiff;
– fever (temperature > 38 ^{0}C);
– temperature < 35 ^{0}C or not rising after rewarming;
– umbilicus draining pus;
– more than 10 skin pustules or bullae, or swelling, or redness, or hardness of skin (sclerema);
– bleeding from stump or cut;
– pallor.

If any of the above is present, consider possible serious illness.

Managing Newborn Problems

– start resuscitation, if necessary;
– rewarm and keep warm during referral for additional care;
– give first dose of two IM antibiotics;
– stop bleeding;
– give oxygen, if available.

Look for signs of jaundice and local infection.

Look at the skin. Is it yellow? Refer urgently, if jaundice presents:

– on the face of < 24 hour old newborn;
– on the palms and soles of ≥ 24 hour old infant.

Encourage breastfeeding. If feeding is difficult, give expressed breast milk by cup.

Look at the skin, especially around the neck, armpits, inguinal area.

Are there pustules? If there are less than 10 pustules, consider local skin, infection. Teach mother to treat skin infection. Follow up in 2 days. If pustules worsen or do not improve in 2 days or more, refer urgently. If there are more than 10 pustules, refer for evaluation.

Look at the eyes.

Are they swollen and draining pus? If the pus is present, consider gonococcal eye infection. Give single dose of appropriate antibiotic for eye infection. Teach mother to treat eyes. Follow up in two days. If pus or swelling worsens or does not improve refer urgently. Assess and treat mother and her partner for possible gonorrhea.

Look at the umbilicus.

What has been applied to the umbilicus? Advise mother proper cord care. If there is redness that extends to the skin, consider local umbilical infection. Teach mother to treat umbilical infection. If there will be no improvement in 2 days, or if it becomes worse, refer urgently. If the umbilicus is draining pus then consider possible serious illness. Give first dose of two IM antibiotics. Refer baby urgently.

Nursery Care

Non-high-risk healthy infants may be taken to the "regular" newborn nursery or be placed in the mother's room if the hospital has rooming-in.

The bassinet, preferably of clear plastic to allow for easy visibility and care, should be cleaned frequently. All professional care should be given in the bassinet, including the physical examination, clothing changes, temperature taking, skin cleansing, and other procedures that if performed elsewhere, would establish a common contact point and possibly provide a channel for cross infection. The clothing and bedding should be minimal, only that needed for an infant's comfort; the nursery temperature should be kept at

approximately 24 °C (75 °F). The infant's temperature should be taken by axillary measurement. Although the interval between temperature taking depends on many circumstances, it need not be shorter than 4 hours during the first 2–3 days and 8 hours thereafter. Axillary temperatures of 36.4–37.0 °C (97.0–98.5 °F) are within normal limits. Weighing at birth and daily thereafter is sufficient. Healthy infants should be placed supine to reduce the risk of sudden infant death syndrome.

Vernix is spontaneously shed within 2–3 days, much of it adhering to the clothing, which should be completely changed daily. The diaper should be checked before and after feeding and when the baby cries; it should be changed when wet or soiled. Meconium or feces should be cleansed from the buttocks with sterile cotton moistened with sterile water. The foreskin of a male infant should not be retracted. Circumcision is an elective procedure.

Early discharge(< 48 hours) or very early discharge (< 24 hours) may increase the risk of rehospitalization for hyperbilirubinemia, sepsis, failure to thrive, dehydration, and missed congenital anomalies. Early discharge requires careful ambulatory follow-up at home (visiting nurse) or in the office within 48 hours.

Additional criteria for the early discharge of term neonates.

Table 10 – Recommendations for early discharge from the normal newborn nursery

Uncomplicated antepartum, intrapartum, postpartum courses

Vaginal delivery
Singleton at 38th–42nd weeks: appropriate for gestational age
Normal vital signs including respiratory rate < 60 breaths/min; axillary temperature 36.1–37 °C (97.0–98.6 °F) in open crib
Physical examination reveals no abnormalities requiring immediate attention
Urination; stool × 1
At least two uneventful, successful feedings
No excessive bleeding after (2 hours) circumcision
No jaundice within 24 hours of birth
Evidence of parental knowledge, ability, and confidence to care for the baby at home
Feeding
Cord, skin, genital care
Recognition of illness (jaundice, poor feeding, lethargy, fever, etc.)
Infant safety (car seat, supine sleep position, etc.)
Availability of family and physician support (physician follow-up)
Laboratory evaluation
Venereal Disease Research Laboratories (VDRL)
Hepatitis B surface antigen and vaccination or appointment for vaccination
State screening (e. g., phenylketonuria, thyroid, galactosemia, sickle cell)
Coombs' test
No social risks

Continuation of Table 10

Substance abuse
History of child abuse

Domestic violence
Mental illness
Teen mother
Homeless

Discharge instructions

1. Advise the mother to return or go to the hospital immediately if:

- jaundice of the soles;
- difficulty of feeding;
- convulsions;
- movement only when stimulated;
- fast or slow or difficult breathing (e. g. severe chest in-drawing);
- temperature > 37.5 ^{0}C or < 35.5 ^{0}C

2. Advise the mother to bring her newborn to the health facility for routine check-up at the following prescribed schedule:

- postnatal visit 1: at 48–72 hours of life;
- postnatal visit 2: at 7 days of life;
- immunization visit 1: at 6 weeks of life.

3. Advise additional follow-up visits appropriate to problems in the following cases:

Two days – if there is difficulty with breastfeeding, low birth weight in the first week of life, red umbilicus, skin infection, eye infection, thrush or other problems.

Seven days – if there is low birth weight discharged more than a week of age and not gaining weight adequately.

4. Advise for newborn screening

Screening for hearing, metabolic, endocrine, and hematologic disease should also be done prior to discharge. The USA has recently expanded the newborn screening program to test for over 30 disorders. The previous newborn screen tested for 7 disorders: hypothyroidism, phenylketonuria (PKU), congenital adrenal hyperplasia (CAH), galactosemia,

sickle cell anemia, biotinidase deficiency, and maple syrup urine disease (MSUD).

Newborn Screening Test

1. Congenital Hypothyroidism (CH).
2. Congenital Adrenal Hyperplasia (CAH).
3. Phenylketonuria (PKU).
4. G6PD-deficiency.
5. Galactosemia.

Newborn screen:

• should be done after 24–48 hours of life;
• after the infant is fed;
• done through extraction of blood in the heel of the foot.

Table 11

Disorder Screened	Effect of disorder	Benefit if screened and treated
CH Congenital	Severe mental	Normal

Hypothyroidism	retardation	
CAH Congenital adrenal hyperplasia	Death	Alive and normal
GAL Galactosemia	Death, cataract	Alive and normal
PKU Phenylketonuria	Severe mental retardation	Normal
G6P deficiency	Severe anemia, kernicterus	Normal

1. Congenital hypothyroidism:

• thyroid hypofunction or enzyme defect;
• reduced T3, T4;
• s/sx: excessive sleeping, enlarged tongue, noisy respiration, poor suck, cold extremities, slow pulse and respiratory rate, lethargy and fatigue, short and thick neck, dull expression, open mouthed, slow DTR, obesity, brittle hair, delayed dentition, dry, scaly skin;
• dx: low T3 T4, inc TSH;
• mx: synthetic thyroid hormone;
• care: assist parents administer drugs.

2. Congenital adrenal hyperplasia:

• inability to synthesize cortisol >>> inc ACTH >>> stimulate adrenal glands to enlarge >>> inc androgen;
• s/sx: masculinization, sexual precocity;
• mx: steroids to decrease stimulation of ACTH.

3. G6PD deficiency (Glucose 6 phospate dehydrogenase deficiency):

• reduction in the levels of the enzyme G6PD in RBC leads to hemolysis of the cell upon exposure to oxidative stress;
• dx: blood smear – heinz bodies rapid enzyme screening test, electrophoresis;
• mx: avoid drugs ie ASA, sulfonamides, antimalarials, fava beans.

3. Galactosemia:

• (-) enzyme that converts galactose to glucose Galactose 1 phosphate uridyltransefrase;
• s/sx: weight loss, vomiting, hepatosplenomegaly, jaundice and cataract;
• dx: Beutler test;
• tx: decrease lactose – soy based formula regulate diet.

4. Phenylketonuria (pku):

• deficient or absent phenylalanine hydroxylase w/c converts phenylalanine to tyrosine;
• s/sx: mental retardation, musty odor of urine, blond hair, blue eyes;
• dx: Guthrie blood test;
• tx: decrease phenylalanine (Lofenalac) regulate diet.

CARE AFTER DISCHARGE TO 7 DAYS

TIME BAND: from discharge to 7 days.

Support unrestricted, per demand exclusive breastfeeding, day and night. Ensure warmth for the baby. Look for danger signs.

Kangaroo Mother Care (KMC)

Start kangaroo mother care when:

– the baby is able to breathe on its own (no apneic episodes);

– the baby is free of life-threatening disease or malformations.

Notes:

– the ability to coordinate sucking and swallowing is not a pre-requisite to KMC. Other methods of feeding can be used until the baby can breastfeed;

– KMC can begin after birth, after initial assessment and basic resuscitation, provided the baby and mother is stable. If kangaroo mother care is not doable, wrap the baby in a clean, dry, warm cloth and place in a crib. Cover with a blanket. Use a radiant warmer if room is not warm or baby is small.

Explain KMC to the mother:
– continuous skin-to-skin contact;
– positioning her baby;
– attaching her baby for breastfeeding;
– expressing her milk;
– caring for her baby;
– continuing her daily activities;
– preparing a “support binder”;
Position the baby for KMC:
– place the baby in upright position between the mother’s breasts, chest to chest;
– position the baby’s hips in a “frog-leg” position with the arms also flexed;
– secure the baby in this position with the support binder;
– turn the baby’s head to one side, slightly extended;

– tie the cloth firmly.

Notes:

KMC should last for as long as possible each day. If the mother needs to interrupt KMC for a short period, the father, a relative or friend should take over.

The maturity of the newborn is determined by amorphological and functional indicators in relation to its gestational age. Morphological maturity is determined by a complex series of attributes: the ability to maintain a constant body temperature, presence of sucking and swallowing reflexes, normal muscle tone sufficient motor activity, emotional reactions, well-pronounced physiological reflexes, lack of regurgitation, cyanosis, apnea.

TRANSIENT CONDITIONS OF NEWBORNS

After the birth of the child takes place in the body physiology restructuring of all major organs and systems.The reactions that show the process of adaptation to the new conditions of life, called the transition (boundary, transient). They are called transitional not only because they occur after the transition from fetal to adult life, but also under certain conditions, especially if violation of the care of a child can easily move in pathological conditions.

Table 12 – Transitory conditions of newborns

System	***Physiological changes in childbirth and early neonatal period***	***Transition states***	***Signs***
External respiration	Activation of the respiratory center The filling of the lungs with air and creation of functional residual capacity Removal of fetal lungfluid (30 ml/kg).	**Transient hyperventilation**	The minute pulmonary ventilation for 2–3 days in 1.5–2 times higher than that of older children. The first breathing motion is carried out according to the Gaspe with a deep inhalation, and difficulty exhalation. For the purpose of delay the air in the lungs and distention of the alveoli

Continuation of Table 12

The blood circulation	Ejection red blood cells from depot in response to hypoxia during labor Termination of placental circulation Increasing the of blood circulation in the small circle Closing of fetal shunts (ductus arteriosus, patent foramen ovale between the atria, the ductus venosus)	**Transient polycythemia (erythrocytosis), and hypervolemia** **Transient circulation of the blood (left-right shunt)**	Normal hematocrit value in the first days of life 0.55–0.65, hemoglobin of 200–220 g/l. The mean value the circulating blood volume in the early neonatal period – 85–90 ml/kg Cyanosis of the lower extremities in the first hours of life
Digestive system	Microbial colonization by the normal microflora by mother occurs in 3 phases: 1ph (10–20 hours) – aseptic Phase 2 (3–5 day) – increasing infection 3 phase – transformation when bifidoflora becomes the basis of the	**Transient intestines catarrh**	Primary stool (meconium) – dense, viscous mass of dark green color Transitional feces – non-homogeneous in consistency and color, is determining by microscopy mucus, leuco-cytes to 30 in the field, fatty acids After 2–4 days

Continuation of Table 12

	microbial		stool becomes

	landscape		homogeneous, yellow, WBC count decreases
Skin	Dilation of the skin capillaries as a response to stimulation of receptors	**Simple erythema. Physiological peeling** **Toxic erythema**	Hyperemia of the skin appears in the first hours of life, and is retaining for several days and then can be defurfuration often on the abdomen and chest Small dense whitish papules surrounded by red corolla
Metabolism	The dominance of catabolic metabolism for the first 3 days of life – when the energy value sucked milk does not cover the needs of even the basic metabolism The weight loss associated with the discharge of meconium, urina-tion, loss of water through the skin and at breath, the drying up of the umbilical residue Heightened heat emission in the	**Activation of glycolysis, glycogenosis, lipolysis; gluconeogenesis** **Transient hypoglycemia** **Transient acidosis** **Transient weight loss**	Lowering glucose level during the first hours of life (minimum – 2.8 mmol/l). Acidosis immediately after birth and the first day of life. Transient weight loss starts with 2 days of life, reaching a maximum at 3–4 days, 3–10 % of initial body weight. Loss of more than 10% of initial

	newborn conditioned by triple large specific values of body surface for 1 kg of body weight, as well as twice as large values of minute volume of breath for 1 kg of body weight	**Transient violation of thermal balance (hypothermia, hyperthermia)**	body weight considered as pathological. Recovery of body weight normally occurs 6–10 days of life **Hypothermia** occurs in the first day of life. **Hyperthermia** can occurs in 3–5 days of life, the child becomes restless, and thereis dryness of mucous membranes
Hemato-poiesis	The transition from the synthesis of fetal hemoglobin (HbF) to the adult type (HbA) Decreasing of synthesis of erythropoietin	**Transient hyperbilirubine-mia (physiological jaundice of newborns)**	Yellow coloring of the skin, sclera and/or mucous membranes appears due to an increase bilirubin level in the blood of the newborn. Jaundice appears after 36 hours of life, the bilirubin level does not exceed 205 mmol/l. Jaundice appears at 2–3 days of life, it accrues up to 4–5 days, and it disappears 10–14 days before

Continuation of Table 12

	Activation of		

	lymphocytopoiesis in connection with the activation of the immune system		
Hemostasis	Low protein synthetic function of the liver. Deficiency of vitamin K	Heightened vessel wall permeability Insufficiency of vitamin K-dependent coagulation factors (2–4 day of life)	The tendency to hemorrhagic manifestations Hemorrhagic disease of the newborn
Urination organs	Loss of fluid (loss of water through the skin and at breath) The disintegration of white blood cells. From the nucleic acids of leukocytes from the decay of nuclei is produced many purine and pyrimidine compounds. The final stage of their metabolism is uric acid	**Transient oliguria** **Proteinuria** **Uric acid infarct is**	Transient oliguria is observing within 3 days of life “Infarct” urine is observed in the first week of life in 50 % of newborns. Urine yellow-brick color, muddy, it leaves spots on a diaper is the same color

Continuation of Table 12

Endocrine system	The stress response to delivery, both	**Transient activation sympathoadrenal**	The sexual kriz starts on 3–4 days of life; reaches a

	mother and the fetus. Cooling of the baby during birth. Increasing the concentration of estrogens in the body of the newborn due to transfer from the mother through the placenta and milk	**system, pituitary, adrenal gland, thyroid gland** **The sexual kriz: swollen mammary glands in both girls and boys;** **desquamate vulvovaginitis** **bleeding from the vagina** **Mila**	maximum at 7–8 days. Swelling of the mammary glands is gradually reducing until the end of the neonatal period. It is due to the effect of estrogen and progesterone. No treatment is necessary. Handling must be avoided as this may cause true mastitis Desquamate vulvovaginitis is characterized by considerable mucous discharge from the genital slit gray-white color. It appears in 60–70 % of girls in the first 3 days of life Vaginal bleeding usually appear 5–8 days of lifein 5–10 % of girls. Bleeding lasts 1 day, sometimes 2–3 days; blood volume is 0.5–1 ml

Continuation of Table 11

			Rash whitish nodules as caused by accumulation

			of secretions in the ducts of the sebaceous glands, most often on the wings of the nose and chin

Transient and boundary condition of the skin in newborns

Erythema toxicum neonatorum

Erythema toxicum neonatorum is the most common pustular eruption in newborns. Estimates of incidence vary between 40 and 70 %. It is most common in infants born at term and weighing more than 2,500 g. Erythema toxicum neonatorum may be present at birth but more often appears during the second or third day of life. Typical lesions consist of erythematous, 2- to 3-mm macules and papules that evolve into pustules. Each pustule is surrounded by a blotchy area of erythema, leading to what is classically described as a “flea-bitten” appearance. Lesions usually occur on the face, trunk, and proximal extremities. Palms and soles are not involved.

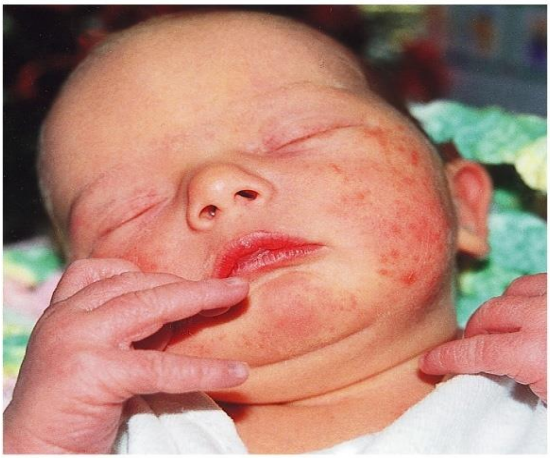
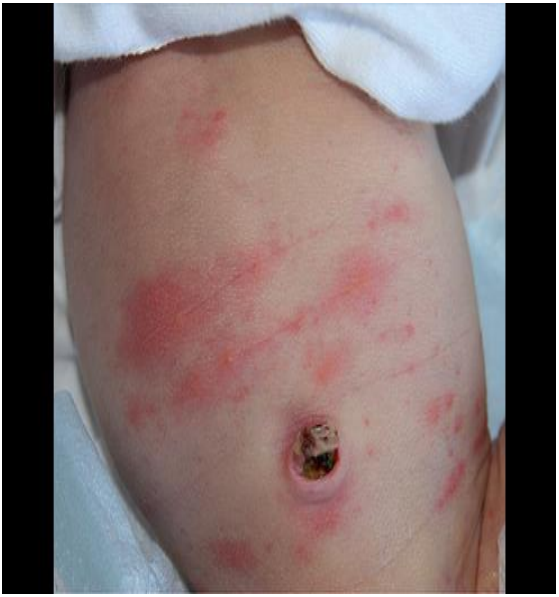
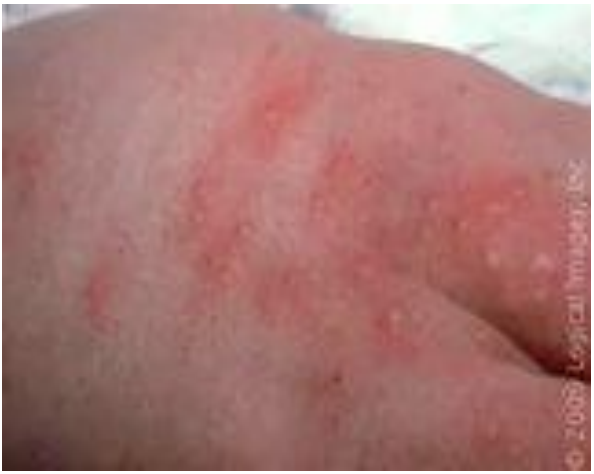


FIGURE 23-12 Erythema toxicum is found on almost all newborns. The reddish rash consists of sporadic pinpoint papules on an erythematous base. It fades spontaneously in a few days.





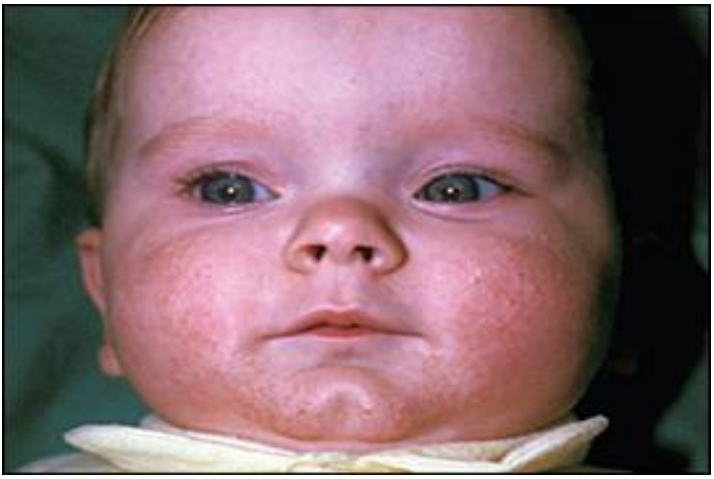
Erythema toxic

Erythema toxicum neonatorum can result in a “flea-bitten” appearance.

Several infections (e. g., herpes simplex, *Candida*, and *Staphylococcus* infections) also may present with vesicopustular rashes in the neonatal period; infants who appear sick or who have an atypical rash should be tested for these infections. In healthy infants, the diagnosis of erythema toxicum neonatorum is made clinically and can be confirmed by cytologic examination of a pustular smear, which will show eosinophilia with Gram, Wright, or Giemsa staining. Peripheral eosinophilia may also be present. The etiology of erythema toxicum neonatorum is not known. Lesions generally fade over five to seven days, but they may recur for several weeks. No treatment is needed, and the condition is not associated with any systemic abnormality.

Acne neonatorum.

Acne neonatorum occurs in up to 20 % of newborns. It typically consists of closed comedones on the forehead, nose, and cheeks, although other locations are possible. Open comedones, inflammatory papules, and pustules can also develop.



Acne Neonatorum

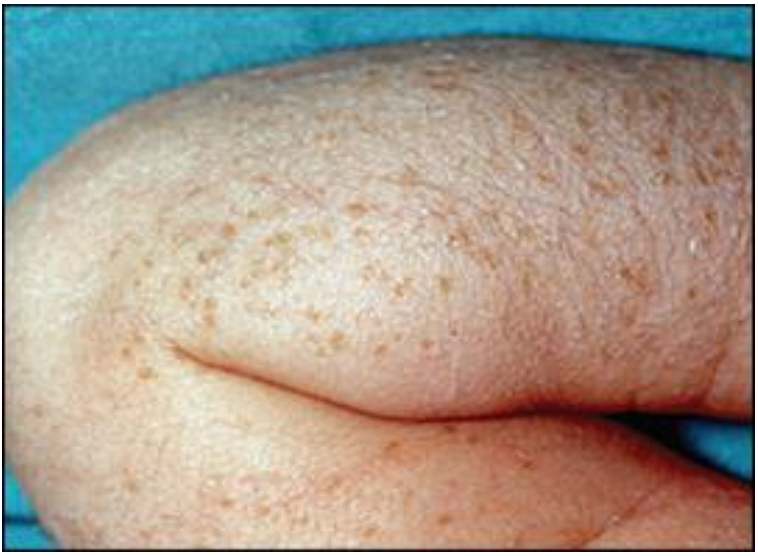
Neonatal acne is thought to result from stimulation of sebaceous glands by maternal or infant androgens. Parents should be counseled that lesions usually resolve spontaneously within four months without scarring. Treatment generally is not indicated, but infants can be treated with a 2.5 % benzoyl peroxide lotion if lesions are extensive and persist for several months. Parents should apply a small amount of benzoyl peroxide to the antecubital fossa to test for local reaction before widespread or facial application. Severe, unrelenting neonatal acne accompanied by other signs of hyperan-drogenism should prompt an investigation for adrenal cortical hyperplasia, virilizing tumors, or underlying endocrinopathies.

Transient Neonatal Pustular Melanosis

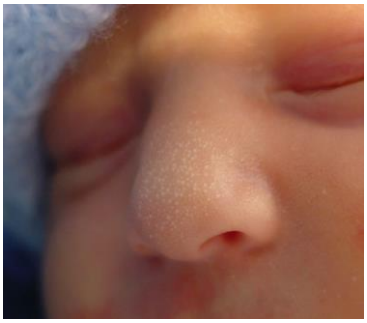
Transient Neonatal Pustular Melanosis is a vesiculopustular rash that occurs in 5 % of black newborns, but in less than 1 % of white newborns. In contrast with erythema toxicum neonatorum, the lesions of transient neonatal pustular melanosis lack surrounding erythema. In addition, these lesions rupture easily, leaving a collarette of scale and a pigmented macule that fades over three to four weeks. All areas of the body may be affected, including palms and soles. Clinical recognition of transient neonatal pustular melanosis can help physicians avoid unnecessary diagnostic testing and treatment

for infectious etiologies. The pigmented macules within the vesicopustules are unique to this condition; these macules do not occur in any of the infectious rashes. Gram, Wright, or Giemsa staining of the pustular contents will show polymorphic neutrophils and, occasionally, eosinophils.

Milia



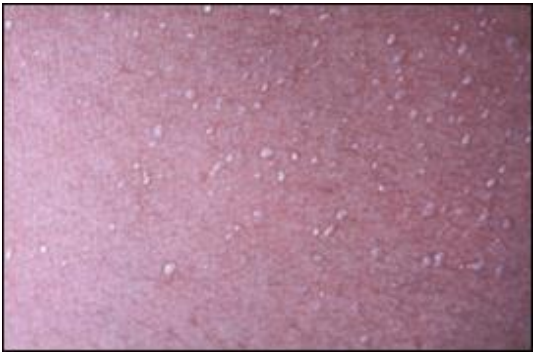
Transient neonatal pustular melanosis results in pigmented macules that gradually fade over several weeks. *Milia* are 1- to 2-mm pearly white or yellow papules caused by retention of keratin within the dermis. They occur in up to 50 % of newborns. Milia occur most often on the forehead, cheeks, nose, and chin, but they may also occur on the upper trunk, limbs, penis, or mucous membranes. Milia disappear spontaneously, usually within the first month of life, although they may persist into the second or third month. Milia are a common source of



parental concern, and simple reassurance about their benign, self-limited course is appropriate.

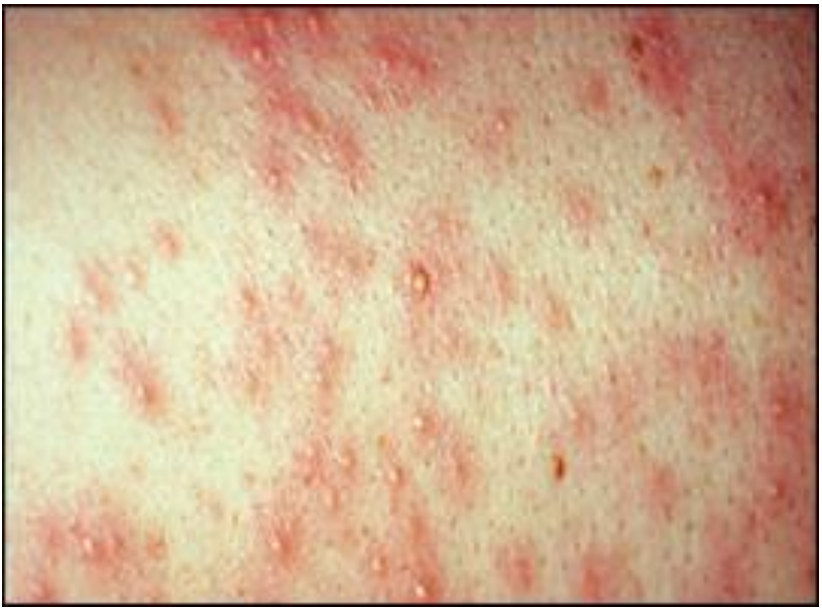
Milia

Miliaria results from sweat retention caused by partial closure of eccrine structures. Both milia and miliaria result from immaturity of skin structures, but they are clinically distinct entities. Miliaria affects up to 40 % of infants and usually appears during the first month of life. Several clinically distinguishable subtypes exist; miliaria crystallina and miliaria rubra are the most common.


Miliaria

Miliaria crystallina is caused by superficial eccrine duct closure. It consists of 1- to 2-mm vesicles without surrounding erythema, most commonly on the head, neck, and trunk. Each vesicle evolves, with rupture followed by desquamation, and may persist for hours to days.

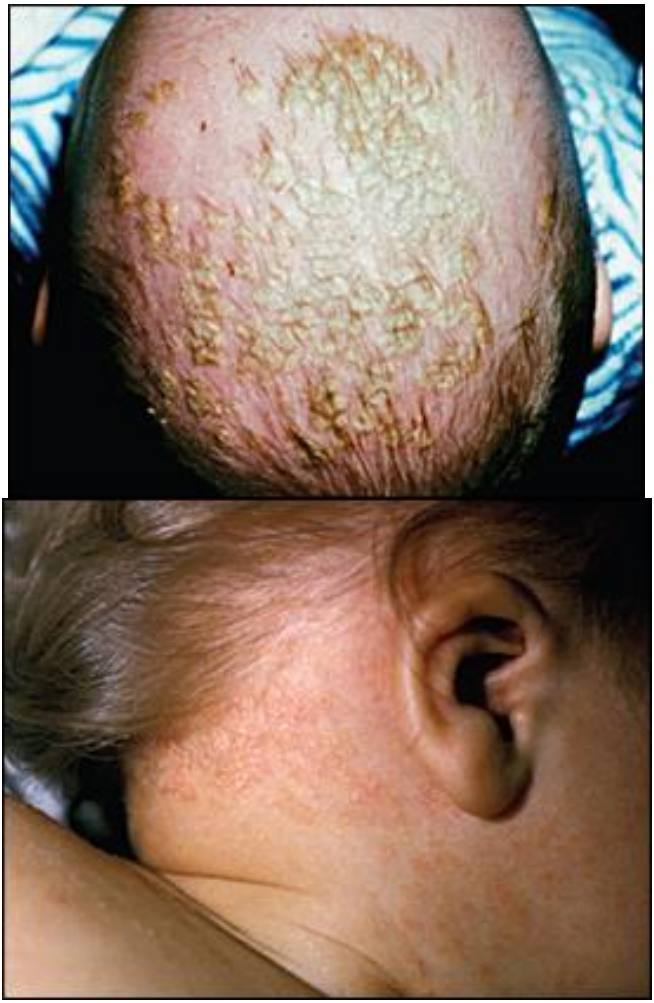
Miliaria rubra, also known as heat rash, is caused by a deeper level of sweat gland obstruction. Its lesions are small erythematous papules and vesicles, usually occurring on covered portions of the skin. Miliaria crystallina and miliaria rubra are benign. Avoidance of overheating, removal of excess clothing, cooling baths, and air conditioning are recommended for management and prevention of these disorders.



Miliaria rubra, also known as heat rash, consists of small erythematous papules and vesicles on covered portions of the skin.

Seborrheic Dermatitis

Seborrheic dermatitis is an extremely common rash characterized by erythema and greasy scales. Many parents know this rash as “cradle cap” because it occurs most commonly on the scalp. Other affected areas may include the face, ears, and neck. Erythema tends to predominate in the flexural folds and intertriginous areas, whereas scaling predominates on the scalp. Because seborrheic dermatitis often spreads to the diaper area, it is important to consider in the evaluation of diaper dermatitis.



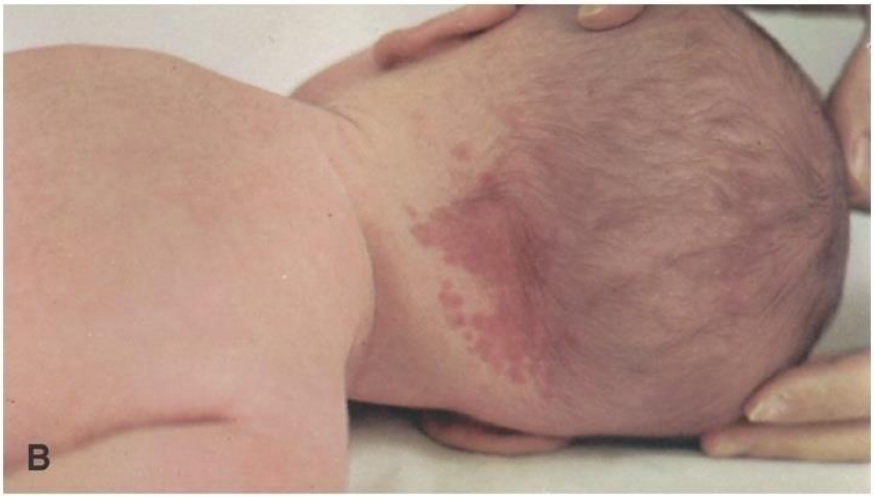
Seborrheic dermatitis can affect the scalp, face, ears, neck, and diaper area. Infantile seborrheic dermatitis is commonly called “cradle cap” when it occurs on the scalp.

Seborrheic dermatitis can be difficult to clinically distinguish from atopic dermatitis, but age at onset and the presence or absence of pruritus can be helpful. Psoriasis also has a clinical appearance similar to that of seborrheic dermatitis, but it is less common.

Vascular Birthmarks

Nevi – stork bites or Telangiectasia Nevi

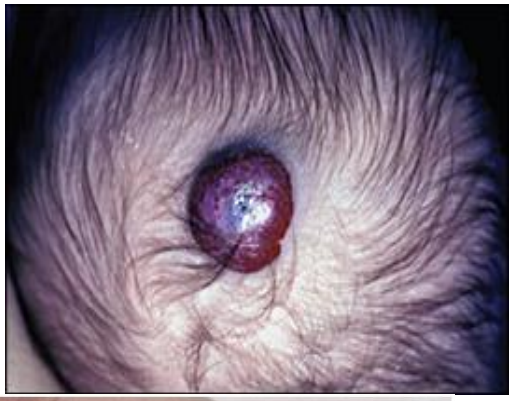
It is pink or red flat areas of capillary dilatation at upper eyelids, nose, upper lip, lower occiput bone, nape and neck. It can be blanched by the pressure of the finger; usually fade during infancy – 1st and 2nd year.

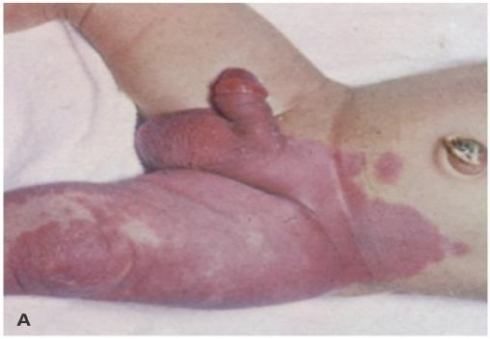


Telangiectasia nevi

Hemangiomas

Hemangiomas of infancy are often referred to as strawberry hemangiomas. They occur in 1.1 to 2.6 % of newborns. At birth, these lesions may be clinically unapparent or marked by only a pale patch of skin. Infants can develop hemangiomas anytime in the first few months of life; they are present in 10 % of infants at one year of age. Hemangiomas of infancy tend to involute and disappear after infancy; 50 % of hemangiomas resolve by five years of age, 70 % by seven years of age, and 90 % by 10 years of age.

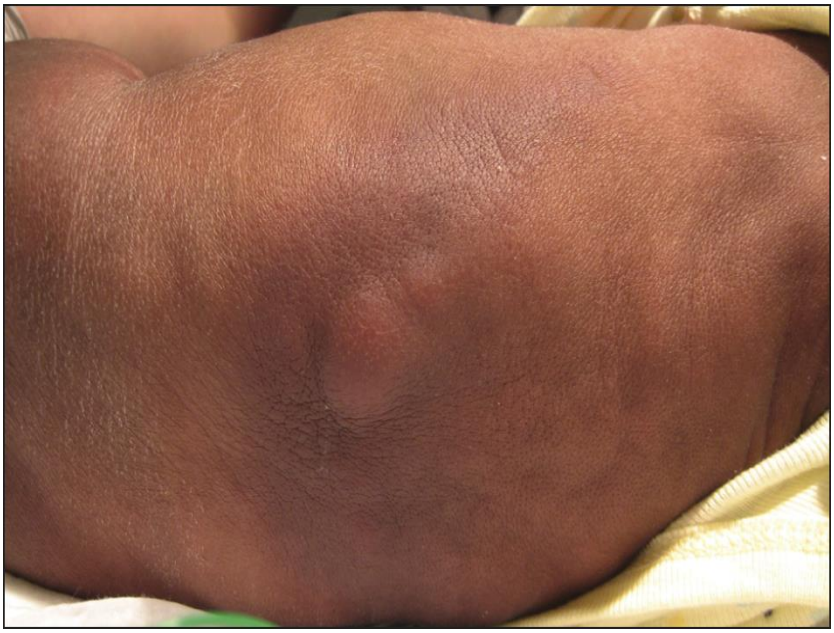




Capillary hemangiomas can develop in the first year of life

Subcutaneous fat necrosis

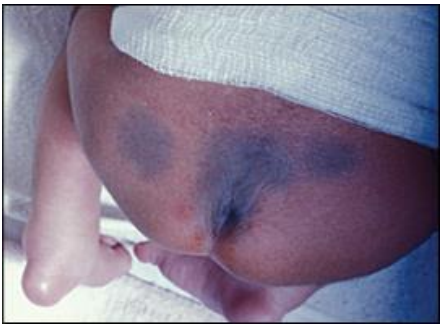
Subcutaneous fatnecrosis of the newborn (SFNN) is an uncommondisordercharacterizedbyfirm, erythematousnodules and plaquesover the trunk, arms, buttocks, thighs, and cheeks or face (afterforceps delivery) of full-term newborns. Ithas a darkredappearance and mayfluctuate. The nodules and plaquesappearin the first several weeks of life. Subcutaneous fatnecrosis of the newborn usually runs a self-limitedcourse, butitmaybe complicated by hypercalcemia and other metabolic abnormalities. It needs tobe differentiated from skin abscesses.

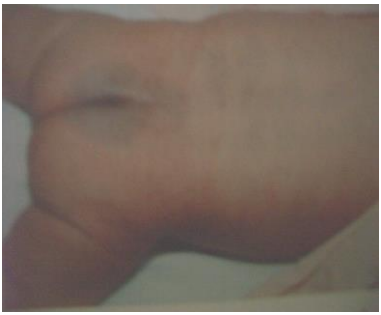


Subcutaneous fat necrosis

Dermal melanosis

*Dermal melanosis*is type of pigmented birthmark. Commonly known as “mongolian spots” these flat bluish-gray or brown lesions arise when melanocytes are trapped deep in the skin. These lesions most often occur on the back or buttocks and may easily be mistaken for bruises. The incidence of dermal melanosis varies widely among racial and ethnic groups; they are more common in black, Native American, Asian, and Hispanic populations. Because the “bruise” appearance may raise suspicion for child abuse in some settings, dermal melanosis should be documented in the medical record. Most lesions fade by two years of age and do not require treatment.





Mongolian spots. Dermal melanosis is a flat, bluish-gray or brown lesion, most commonly located on the back or buttocks.

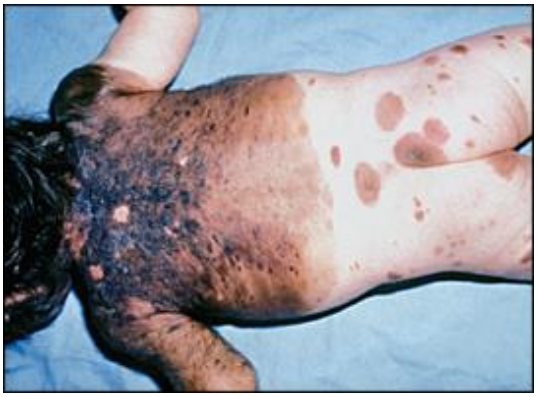
Congenital melanocytic nevi

Congenital melanocytic nevi occur in 0.2 to 2.1 % of infants at birth. They are thought to arise from disrupted migration of melanocyte precursors in the neural crest. Colors range from brown to black. Most of these lesions are flat, but raised nevi may also occur. Congenital melanocytic nevi present difficult management decisions for parents and physicians because of their potential for malignancy. A systematic review of studies of patients with mostly large lesions showed that melanoma developed in 0.5 to 0.7 % of patients. The mean age at diagnosis of melanoma was 15.5 years (median, seven years; range, birth to 57 years).

The predicted size of lesions in adulthood is the most useful prognosticfactor. Giant congenital melanocytic nevi (i. e., “garment nevi”) are larger than 40 cm in adulthood and carry the highest risk of malignancy. Large lesions(20 to 40 cm in adulthood) occur in 0.025 % of newborns and carry 4–6 % lifetime risk of malignancy. Greater numbers of satellite nevi near a large lesion also increase risk. Smaller nevi are not well studied, but lesions that are projected to grow to less than 1.5 cm in adulthood rarely progress to melanoma.

Nevi invariably change as a child grows, making evaluation challenging. Nevertheless, any nevus that changes

in color, shape, or thickness warrants further evaluation to rule out melanoma. Prophylactic removal of high-risk lesions does not guarantee protection from melanoma. Recurrence at the original site is possible. In addition, one third of melanomas arise in different sites from the original nevus. Thus, patients must be followed regularly, even after the congenital melanocytic nevus is removed. Giant congenital melanocytic nevi carry an increased risk of malignancy.



Physiologic jaundice (icterus neonatorum)

Under normal circumstances, the level of indirect-reacting bilirubin in umbilical cord serum is 17.1–51.3mmol/l and rises at a rate of < 85.5 mmol/l/24 hours; thus, jaundice becomes visible on the 2nd–3rd day. Usually peaking between the 2nd and the 4th days at 85.5 – 102/6 mmol/l and decreasing to below 34.2 mmol/l between the 5th and 7th days of life. Jaundice – associated with these changes is designated ***physiologic*** and is believed to be the result of increased bilirubin production from the breakdown of fetal red blood cells combined with transient limitation in the conjugation of bilirubin by the immature neonatal liver.

Overall, 6–7 % of full-term infants have indirect bilirubin levels > 220.59 mmol/l and less than 3 % have levels > 256.5 mmol/l. Risk factors for elevated indirect hyperbilirubinemia include: maternal age, race (Chinese,

Japanese, Korean, and Native American), maternal diabetes, prematurity, drugs (novobiocin), altitude, polycythemia, male sex, trisomy 21, cutaneous bruising, blood extravasation (cephalohematoma), oxytocin induction, breast-feeding, weight loss (dehydration or caloric deprivation), delayed bowel movement, and a family history/sibling who had physiologic jaundice (see Table 12). In infants without these variables, indirect bilirubin levels rarely rise above 205.2 mmol/l, whereas infants with several risk factors are more likely to have higher bilirubin levels. A combination of breast-feeding, variant UDP-glucuronosyl transferase activity (1A1) and alterations of the organic anion transporter 2 gene increases the risk in Asian children. Prediction of which neonates are at risk for exaggerated physiologic jaundice can be based on hour-specific bilirubin levels in the first 24–72 hours of life. Indirect bilirubin levelsin full-term infants decline to adult levels (17.1 mmol/l) by 10–14 days of life. Persistent indirect hyperbilirubinemia beyond 2 weeks suggests hemolysis, hereditary glucuronyl transferase deficiency, breast-milk jaundice, hypothyroidism, or intestinal obstruction. Jaundice associated with pyloric stenosis may be due to caloric deprivation, deficiency of hepatic UDP-glucuronyl transferase, or an increase in the enterohepatic circulation of bilirubin from an ileus. In premature infants, the rise in serum bilirubin tends to be the same or somewhat slower but of longer duration than in term infants. Peak levels of 136.8–205.2 mmol/l are not usually reached until the 4th–7th day, and jaundice is infrequently observed after the 10th day, corresponding to the maturation of mechanisms for bilirubin metabolism and excretion.

The diagnosis of physiologic jaundice in term or preterm infants can be established only by precluding known causes of jaundice on the basis of the history, clinical findings, and laboratory data (see the Table). In general, a search to determine the cause of jaundice should be made if:

1) it appears in the first 24–36 hours of life;

2) serum bilirubin is rising at a rate faster than 85.5 mmol/l /24 hours;

3) serum bilirubin is > 205.2 mmol/l in full-term infants (especially in the absence of risk factors)or 171.1–239.4mmol/l in preterm infants;

4) jaundice persists after 10–14 days of life;

5) direct-reacting bilirubin is > 34.2 mmol/l at any time.

Other factors suggesting a nonphysiologic cause of jaundice are family history of hemolytic disease, pallor, hepatomegaly, splenomegaly, failure of phototherapy to lower bilirubin, vomiting, lethargy, poor feeding, excessive weight loss, apnea, bradycardia, abnormal vital signs (including hypothermia), light-colored stools, dark urine positive for bilirubin, and signs of kernicterus.

Jaundice may be present at birth or may appear at any time during the neonatal period, depending on etiology. Jaundice usually becomes apparent in a cephalocaudal progression starting on the face and progressing to the abdomen and then feet, as serum levels increase. Dermal pressure may reveal the anatomic progression of jaundice (face, = 85.5 mmol/l; mid-abdomen, = 256,5 mmol/l; soles, = = 342 mmo/l), but clinical examination cannot be depended on to estimate serum levels. Jaundice to the mid-abdomen, signs or symptoms, high-risk factors that suggest nonphysiologic jaundice, or hemolysis must be evaluated further (see tables).

Noninvasive techniques for transcutaneous measurement of bilirubin (TcB) that correlate with serum levels may be used to screen infants, but determination of serum bilirubin level is indicated in patients with elevated age-specific transcutaneous measurement, progressing jaundice, or risk for either hemolysis or sepsis. Whereas jaundice from deposition of indirect bilirubin in the skin tends to appear bright yellow or orange, jaundice of the obstructive type (direct bilirubin) has a greenish or muddy yellow cast. Although signs of kernicterus rarely appear on the first day, affected infants

may present with lethargy and poor feeding and, without treatment, can progress to acute bilirubin encephalopathy

Table 13 – Risk factors for development of severe hyperbilirubinemia in infants of 35 or more weeks of gestation (in approximate order of importance)

Major risk factors
Predischarge TSB or TcB level in the high-risk zone
Jaundice observed in the first 24 hours
Blood group incompatibility with positive direct antiglobulin test, other known hemolytic disease (G6PD deficiency), elevated $ETCO_c$
Gestational age 35–36 weeks
Previous sibling received phototherapy
Cephalohematoma or significant bruising
Exclusive breastfeeding, particularly if nursing is not going well and weight loss is excessive
East Asian race
Minor risk factors
Predischarge TSB or TcB level in the high intermediate-risk zone
Gestational age 37–38 weeks
Jaundice observed beforedischarge
Previous sibling with jaundice
Macrosomic infant of a diabetic mother
Maternal age ≥ 25 years
Malegender
Decreased risk (these factors are associated with decreased risk of significant jaundice, listed in order of decreasing importance)
TSB or TcB level in the low-risk zone
Gestational age ≥ 41 weeks
Exclusive bottle feeding
Black race
Discharge from hospital after 72 hours

Pathologic hyperbilirubinemia

Jaundice and its underlying hyperbilirubinemia are considered pathologic if the time of appearance, duration, or pattern varies significantly from that of physiologic jaundice or if the course is compatible with physiologic jaundice but other reasons exist to suspect that the infant is at special risk for neurotoxicity. It may not be possible to determine the precise cause of an abnormal elevation of unconjugated bilirubin, but many of these infants have associated risk factors such as Asian race, prematurity, breast-feeding, or weight loss. Frequently, the terms *exaggerated physiologic jaundice* and *hyperbilirubinemia of the newborn* are used for infants whose primary problem is probably a deficiency or inactivity of bilirubin glucuronyl transferase (Gilbert syndrome) rather than an excessive load of bilirubin for excretion (see the table). The combination of glucose-6-phosphate dehydrogenase (G6PD) deficiency and a mutation of the promoter region of UDP-glucuronyl transferase-1 produces indirect hyperbilirubinemia in the absence of signs of hemolysis. Nonphysiologic hyperbilirubinemia may also be caused by mutations in the gene for bilirubin UDP-glucuronyl transferase.

The greatest risk associated with indirect hyperbilirubinemia is the development of bilirubin-induced neurologic dysfunction, which typically occurs with high indirect bilirubin levels. The development of kernicterus (bilirubin encephalopathy) is dependent on the level of indirect bilirubin, duration of exposure to elevated levels, the cause of jaundice, and the infant's well-being. Neurologic injury including kernicterus occurs at lower bilirubin levels in preterm infants and in the presence of asphyxia, intraventricular hemorrhage, hemolysis, or drugs that displace bilirubin from albumin. The exact serum indirect bilirubin level that is harmful for VLBW infants is unclear.

Table 14 – Diagnostic features of the various types of neonatal jaundice

DIAGNOSIS	NATURE OF VANDEN BERGH REAC-TION	JAUNDICE		CONCENTRA-TION		BILIRUBIN RATE OF ACCUMULA-TION (mg/dL/day)	REMARKS
		Appears	Disappears	mg/dL	Age in days		
"Physiologicjaundice":							Usually relates to degree of maturity
Full-term	Indirect	2–3 days	4–5 days	10–12	2–3	< 5	
Premature	Indirect	3–4 days	7–9 days	15	6–8	< 5	
Hyperbilirubinemia due to metabolic factors							Metabolic factors: hypoxia, respiratory distress, lack of carbohydrate
Full-term	Indirect	2–3 days	Variable	> 12	First week	< 5	Hormonal influences: cretinism, hormones, Gilbert syndrome

Continuation of Table 14

Premature	Indirect	3–4 days	Variable	> 15	First week	< 5	Genetic factors: Crigler-Najjar syndrome, Gilbert syndrome Drugs: vitamin K, novobiocin
Hemolyticstates and hematoma	Indirect	May appear in first 24 hours	Variable	Unlimited	Variable	Usually > 5	Erythroblastosis: Rh, ABO, Kell Congenital hemolytic states: spherocytic, nonspherocytic Infanti-lepyknocytosis Drugs: vitamin K Enclosedhemorrhage-hematoma

Continuation of Table 14

Mixed hemolytic and hepatotoxic factors	Indirect and direct	May appear in first 24 hours	Variable	Unlimited	Variable	Usually > 5	Infection:bacterial sepsis, pyelonephritis, hepatitis, toxoplasmosis, cytomegalic inclusion disease, rubella, syphilis Drugs: vitamin K
Hepatocellulardamage	Indirect and direct	Usually 2–3 days, may appear by second week	Variable	Unlimited	Variable	Variable, can be > 5	Biliary atresia; paucity of bile ducts, familial cholestasis, galactosemia; hepatitis and infection

Conjugated Hyperbilirubinemia

This condition results from the failure of clearance from the body of the bilirubin, which has been already combined with glucuronic acid to form the soluble glucuronide. This generally implies an obstruction of large or small branches of the biliary tree. The problem is not so much the conjugated bilirubin, which is non-toxic, but the pathological underlying cause. It is not necessary to treat the jaundice as the conjugated form is not toxic, but also because phototherapy given to such babies causes the "bronze baby" syndrome.

Treatment should be focused on the underlying condition, once it is identified.

Breastfeeding jaundice

Breastfeeding jaundice develops in one sixth of breastfed infants during the first week of life. Breastfeeding increases enterohepatic circulation of bilirubin in some infants who have decreased milk intake and who also have dehydration or low caloric intake. The increased enterohepatic circulation also may result from reduced intestinal bacteria that convert bilirubin to nonresorbed metabolites.

Breast milk jaundice

Breast milk jaundiceis different from breastfeeding jaundice. It develops after the first 5 to 7 days of life and peaks at about 2 weeks. It is thought to be caused by an increased concentration of β-glucuronidase in breast milk, causing an increase in the deconjugation and reabsorption of bilirubin.

Pathologic hyperbilirubinemia

Pathologic hyperbilirubinemiain term infants is diagnosed if jaundice appears in the first 24 hours, after the first week of life, or lasts > 2 weeks. Total serum bilirubin (TSB) rises by > 85.5 mmol/L/day. TSB is > 308 mmol/L Infant shows symptoms or signs of a serious illness.

Key Points

Neonatal jaundice is caused by increased bilirubin production, decreased bilirubin clearance, or increased enterohepatic circulation.

Some jaundice is normal in neonates.

Risk varies with postnatal age, TSB value, prematurity, and health of the neonate.

Transient Tachypnea of the Newborn

(Neonatal Wet Lung Syndrome)

Transient tachypnea of the newborn is transient respiratory distress caused by delayed resorption of fetal lung fluid.

Transient tachypnea of the newborn affects premature infants, term infants delivered by elective cesarean delivery without labor, and infants born with respiratory depression, all of whom have delayed clearance of fetal lung fluid. Part of the cause is immaturity of the Na channels in lung epithelial cells; these channels are responsible for absorbing Na (and thus water) from the alveoli. (Mechanisms for normal resorption of fetal lung fluid are pulmonary function). Other risk factors include macrosomia, maternal diabetes and/or asthma, lower gestational age, and male sex.

Transient tachypnea of the newborn is suspected when the infant develops respiratory distress shortly after birth. Symptoms include tachypnea, intracostal and subcostal retractions, grunting, nasal flaring, and possible cyanosis.

Pneumonia, respiratory distress syndrome, and sepsis may have similar manifestations, so chest X-ray, CBC, and blood cultures usually are done. Chest X-ray shows hyperinflated lungs with streaky perihilar markings, giving the appearance of a shaggy heart border while the periphery of the lungs is clear. Fluid is often seen in the lung fissures. If initial findings are indeterminate orsuggest infection, antibiotics (e. g., ampicillin, gentamycin) are given while awaiting culture results.

Recovery usually occurs within 2 to 3 days. Treatment is supportive and involves giving O_2 by hood and monitoring ABGs or pulse oximetry. Rarely, extremely premature infants, those with neurologic depression at birth, or both require continuous positive airway pressure and occasionally even mechanical ventilation.

NUTRITION IN INFANTS

If the delivery was uncomplicated and the neonate is alert and healthy, the neonate can be brought to the mother for feeding immediately. Successful breastfeeding is enhanced by putting the neonate to the breast as soon as possible after delivery. Spitting mucus after feeding is common (because gastroesophageal smooth muscle is lax) but should subside within 48 hours. If spitting mucus or emesis persists past 48 hours or if vomit is bilious, complete evaluation of the upper GI and respiratory tracts is needed to detect congenital GI anomalies.

Daily fluid and calorie requirements vary with age and are proportionately greater in neonates and infants than in older children and adults (Calorie Requirements at Different Ages). Relative requirements for protein and energy (g or kcal/kg body weight) decline progressively from the end of infancy through adolescence, but absolute requirements increase. For example, protein requirements decrease from 1.2 g/kg/day at 1 year to 0.9 g/kg/day at 18 years, and mean relative energy requirements decrease from 100 kcal/kg at 1 year to 40 kcal/kg in late adolescence. Nutritional recommendations are generally not evidence-based. Requirements for vitamins depend on the source of nutrition (e. g., breast milk vs standard infant formula), maternal dietary factors, and daily intake.

Calorie requirements at different ages*

Age	kcal/kg/day

< 6 months	**110–120**
< 1 years	**95–100**
15 years	**44**

***When protein and calories are provided by breast milk that is completely digested and absorbed, the requirements between 3 months and 9 months of age may be lower**

Feeding problems

Minor variations in day-to-day food intake are common and, although often of concern to parents, usually require only reassurance and guidance unless there are signs of disease or changes in growth parameters, particularly weight (changes in the child's percentile rank on standard growth curves are more significant than absolute changes).

Loss of > 5 to 7 % of birth weight in the first week indicates undernutrition. Birth weight should be regained by 2 weeks, and a subsequent gain of about 20 to 30 g/day (1 oz/day) is expected for the first few months. Infants should double their birth weight by about 6 months.

Breastfeeding

Breast milk is the nutrition of choice. The American Academy of Pediatrics (AAP) recommends exclusive breastfeeding for a minimum of 6 months and introduction of appropriate solid food from 6 months to 1 year. Beyond 1 year, breastfeeding continues for as long as both infant and mother desire, although after 1 year breastfeeding should complement a full diet of solid foods and fluids. To encourage breastfeeding, practitioners should begin discussions prenatally, mentioning the multiple advantages:

– **for the child**: nutritional and cognitive advantages and protection against infection, allergies, obesity, Crohn disease, and diabetes;

– **for the mother**: reduced fertility during lactation, more rapid return to normal prepartum condition (eg, uterine involution, weight loss), and protection against osteoporosis, obesity, and ovarian and premenopausal breast cancers.

Milk production is fully established in primiparas by 72 to 96 hours and in less time in multiparas. The first milk produced is colostrum, a high-calorie, high-protein, thin yellow fluid that is immunoprotective because it is rich in antibodies, lymphocytes, and macrophages; colostrum also stimulates passage of meconium. Subsequent **breast milk** has the following **characteristics**:

- has a high lactose content, providing a readily available energy source compatible with neonatal enzymes;
- contains large amounts of vitamin E, an important antioxidant that may help prevent anemia by increasing erythrocyte life span;
- has a Ca:P ratio of 2:1, which prevents Ca-deficiency tetany;
- favorably changes the pH of stools and the intestinal flora, thus protecting against bacterial diarrhea;
- transfers protective antibodies from mother to infant;
- contains cholesterol and taurine, which are important to brain growth, regardless of the mother's diet;
- is a natural source of ω-3 and ω-6 fatty acids.

These fatty acids and their very long-chain polyunsaturated derivatives (LC-PUFAS), arachidonic acid (ARA) and docosahexaenoic acid (DHA), are believed to contribute to the enhanced visual and cognitive outcomes of breastfed compared with formula-fed infants. Most commercial formulas are now supplemented with ARA and DHA to more closely resemble breast milk and to reduce these potential developmental differences.

If the mother's diet is sufficiently diverse, no dietary or vitamin supplementation is needed for the mother or her term breastfed infant. However, to prevent vitamin D deficiency rickets, vitamin D 200 units once/day beginning in the first 2

months is given to all infants who are exclusively breastfed. Premature and dark-skinned infants and infants with limited sunlight exposure (residence in northern climates) are especially at risk of vitamin D deficiency. After 6 months, breastfed infants in homes where the water does not have adequate fluoride (supplemental or natural) should be given fluoride drops. Clinicians can obtain information about fluoride content from a local dentist or health department.

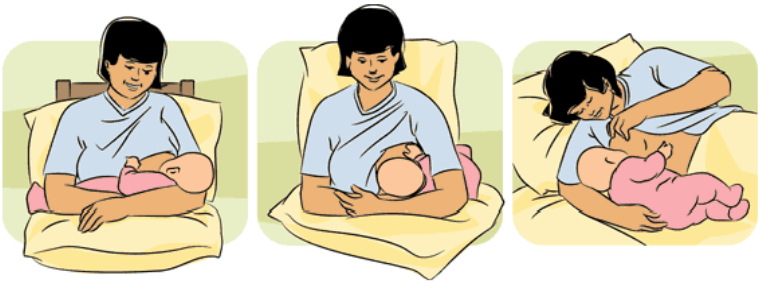
Infants < 6 monthsshould not be given additional water because hyponatremia is a risk.

Breastfeeding Technique

The mother should use whatever comfortable, relaxed position works best and should support her breast with her hand to ensure that it is centered in the infant's mouth, minimizing any soreness. The center of the infant's lower lip should be stimulated with the nipple so that rooting occurs and the mouth opens wide. The infant should be encouraged to take in as much of the breast and areola as possible, placing the lips 2.5 to 4 cm from the base of the nipple. The infant's tongue then compresses the nipple against the hard palate. Initially, it takes at least 2 min for the let-down reflex to occur. Volume of milk increases as the infant grows and stimulation from suckling increases. Feeding duration is usually determined by the infant. Some mothers require a breast pump to increase or maintain milk production; in most mothers, a total of 90 min/day of breast pumping divided into 6 to 8 sessions produces enough milk for an infant who is not directly breastfed.

The infant should nurse on one breast until the breast softens and suckling slows or stops. The mother can then break suction with a finger before removing the infant from one breast and offering the infant the second. In the first days after birth, infants may nurse on only one side; then the mother should alternate sides with each feeding. If the infant tends to fall asleep before adequately nursing, the mother can remove the infant when suckling slows, burp the infant, and move the

infant to the other side. This switch keeps the infant awake for feedings and stimulates milk production in both breasts.



Mothers should be encouraged to feed on demand or about every 1½ to 3 hours – "free- breastfeeding newborn on demand" (8 to 12 feedings/day), a frequency that gradually decreases over time; some neonates < 2500 g may need to feed even more frequently to prevent hypoglycemia. In the first few days, neonates may need to be wakened and stimulated; small infants and late preterm infants should not be allowed to sleep long periods at night. Large full-term infants who are feeding well (as evidenced by stooling pattern) can sleep longer. Eventually, a schedule that allows infants to sleep as long as possible at night is usually best for the infant and family.

Mothers who work outside the home can pump breast milk to maintain milk production while they are separated from their infants. Frequency varies but should approximate the infant's feeding schedule. Pumped breast milk should be immediately refrigerated if it is to be used within 48 hours and immediately frozen if it is to be used after 48 hours. Refrigerated milk that is not used within 96 hours should be discarded because risk of bacterial contamination is high. Frozen milk should be thawed by placing it in warm water; microwaving is not recommended.

Infant Complications

The primary complication is underfeeding, which may lead to dehydration and hyperbilirubinemia (see Neonatal Hyperbilirubinemia). Risk factors for underfeeding include small or premature infants and mothers who are primiparous, who become ill, or who have had difficult or operative

deliveries. A rough assessment of feeding adequacy can be made by daily diaper counts. By age 5 days, a normal neonate wets at least 6 diapers/day and soils at least 4 diapers/day; lower numbers suggest underhydration and undernutrition. Also, stools should have changed from dark meconium at birth to light brown and then yellow. Weight is also a reasonable parameter to follow (see Care of Newborns and Infants: Feeding Problems); not attaining growth landmarks suggests undernutrition. Constant fussiness before age 6 weeks (when colic may develop unrelated to hunger or thirst) may also indicate underfeeding. Dehydration should be suspected if vigor of the infant's cry decreases or skin becomes turgid; lethargy and sleepiness are extreme signs of dehydration and should prompt testing for hypernatremia.

Maternal Complications

Common maternal complications include breast engorgement, sore nipples, plugged ducts, mastitis, and anxiety.

Breast engorgement, which occurs during early lactation and may last 24 to 48 hours, may be minimized by early frequent feeding. A comfortable nursing brassiere worn 24 h/day can help, as can applying cool compresses after breastfeeding and taking a mild analgesic (e. g., ibuprofen). Just before breastfeeding, mothers may have to use massage and warm compresses and express breast milk manually to allow infants to get the swollen areola into their mouth. Excessive expression of milk between feedings facilitates engorgement, so expression should be done only enough to relieve discomfort.

For sore nipples, the infant's position should be checked; sometimes the infant draws in a lip and sucks it, which irritates the nipple. The mother can ease the lip out with her thumb. After feedings, she can express a little milk, letting the milk dry on the nipples. After breastfeeding, cool compresses reduce engorgement and provide further relief.

Plugged ducts manifest as mildly tender lumps in the breasts of lactating women who have no other systemic signs of illness. Continued breastfeeding ensures adequate emptying of the breast. Warm compresses and massage of the affected area before breastfeeding may further aid emptying. Women may also alternate positions because different areas of the breast empty better depending on the infant's position at the breast. A good nursing brassiere is helpful because regular brassieres with wire stays or constricting straps may contribute to milk stasis in a compressed area.

Mastitis is common and manifests as a tender, warm, swollen, wedge-shaped area of breast. It is caused by engorgement, blocking, or plugging of an area of the breast; infection may occur secondarily, most often with penicillin-resistant *Staphylococcus aureus* and less commonly with *Streptococcus*sp or *Escherichia coli*. With infection, fever ≥ 38.5 °C, chills, and flu-like aching may develop. Diagnosis is by history and examination. Cell counts (WBCs > 10^6/mL) and cultures of breast milk (bacteria >10^3/mL) may distinguish infectious from noninfectious mastitis. If symptoms are mild and present < 24 hours, conservative management (milk removal via breastfeeding or pumping, compresses, analgesics, a supportive brassiere, and stress reduction) may be sufficient. If symptoms do not lessen in 12 to 24 hours or if the woman is acutely ill, antibiotics that are safe for breastfeeding infants and effective against *S. aureus* (e. g., dicloxacillin, cloxacillin, or cephalexin 500 mg poqid) should be started; duration of treatment is 10 to 14 days. Community-acquired methicillin-resistant *S. aureus* should be considered if cases do not respond promptly to these measures or if an abscess is present. Complications of delayed treatment are recurrence and abscess formation. Breastfeeding may continue during treatment.

Maternal anxiety, frustration, and feelings of inadequacy may result from lack of experience with breastfeeding, mechanical difficulties holding the infant and getting the infant to latch on and suck, fatigue, difficulty

assessing whether nourishment is adequate, and postpartum physiologic changes. These factors and emotions are the most common reasons mothers stop breastfeeding. Early follow-up with a pediatrician or consultation with a lactation specialist is helpful and effective for preventing early breastfeeding termination.

Drugs

Breastfeeding mothers should avoid taking drugs if possible. When drug therapy is necessary, the mother should avoid contraindicated drugs and drugs that suppress lactation (e. g, bromocriptine, levodopa, trazodone). The US National Library of Medicine maintains an extensive database regarding drugs and breastfeeding at the Drugs and Lactation Database, which should be consulted regarding use of or exposure to specific drugs or classes of drugs. For some common drugs contraindicated for breastfeeding mothers, Some Drugs Contraindicated for Breastfeeding Mothers.

When drug treatment is necessary, the safest known alternative should be used; when possible, most drugs should be taken immediately after breastfeeding or before the infant's longest sleep period, although this strategy is less helpful with neonates who nurse frequently and exclusively. Knowledge of the adverse effects of most drugs comes from case reports and small studies. Safety of some drugs (e. g., acetaminophen, ibuprofen, cephalosporins, insulin) has been determined by extensive research, but others are considered safe only because there are no case reports of adverse effects. Drugs with a long history of use are generally safer than newer drugs for which few data exist.

Table 15 – Some Drugs Contraindicated for Breastfeeding Mothers

DrugClass	Example	General Concerns and Specific Effects in Infants
Anticoagulants	Dicumarol Warfarin	May be given cautiously but, in very large doses, may cause hemorrhage (heparin is not excreted in milk)
Cytotoxicdrugs	Cyclophosphamide Cyclosporine Doxorubicin Methotrexate	May interfere with cellular metabolism of a breastfeeding infant, causing possible immunosuppression and neutropenia Unknown effect on growth and unknown association with carcinogenesis
Psychoactivedrugs	Anxiolytics, includingbenzodiazepines (alprazolam, diazepam, lorazepam, midazolam, prazepam, quazepam, temazepam) andperphenazine Antidepressants (tricyclics, SSRIs,	For most psychoactive drugs, unknown effect on infants, but because drugs and metabolites appear in breast milk and in infant plasma and tissues, possible alteration of short-term and long-term CNS function

Continuation of Table 15

	bupropion) Antipsychotics (chlorpromazine, chlorprothixene, clozapine, haloperidol, mesoridazine, trifluoperazine)	Fluoxetine: Linked to colic, irritability, feeding and sleep disorders, and slow weight gain Chlorpromazine: Possible drowsiness, lethargy, decline in developmental scores Haloperidol: Decline in developmental scores
Individual drugs that are detectable in breast milk and pose theoretical risk	Amiodarone	Possiblehypothyroidism
	Chloramphenicol	Possible idiosyncratic bone marrow suppression
	Clofazimine	Potential for transfer of high percentage of maternal dose Possible increase in skin pigmentation
	Corticosteroids	With large maternal doses given for weeks or months, can produce high concentrations in milk and may suppress growth and interfere with endogenous corticosteroid production in the infant

Continuation of Table 15

	Lamotrigine	Potential for therapeutic serum concentrations in the infant
	Metoclopramide	None described
	Metronidazole Tinidazole	In vitro mutagens May stop breastfeeding for 12–24 hours to allow excretion of dose when a mother is given a single dose of 2 g Safe after the infant is 6 mo
	Sulfapyridine Sulfisoxazole	Caution required if infants have jaundice or G6PD deficiency or are ill, stressed, or premature
Individual drugs that are detectable in breast milk and have documented risk	Acebutolol	Hypotension, bradycardia, tachypnea
	Aminosalicylic acid	Diarrhea
	Atenolol	Cyanosis, bradycardia
	Bromocriptine	Suppresses lactation May be hazardous to the mother

Continuation of Table 15

	Aspirin (salicylates)	Metabolic acidosis With large maternal doses and sustained use, may produce plasma concentrations that increase risk of hyperbilirubinemia (salicylates compete for albumin-binding sites) and hemolysis only in G6PD-deficient infants that are < 1 month
	Clemastine	Drowsiness, irritability, refusal to feed, high-pitched cry, neck stiffness
	Ergotamine	Vomiting, diarrhea, seizures (with doses used in migraine drugs)
	Estradiol	Withdrawal vaginal bleeding
	Iodides Iodine	Goiter
	Lithium	$^1/_3$ to $^1/_2$ therapeutic blood concentration in infants
	Phenobarbital	Sedation, infantile spasms after weaning, methemoglobinemia

Continuation of Table 15

	Phenytoin	Methemoglobinemia
	Primidone	Sedation, feedingproblems
	Sulfasalazine (salicylazosulfapyridine)	Bloody diarrhea
	Nitrofurantoin, sulfapyridine, sulfisoxazole	Hemolysis in infants with G6PD deficiency; safe in others
Drugs of abuse*	Amphetamine	Irritability, poorsleepingpattern
	Alcohol	With < 1 g/kg daily, decreased milk ejection reflex With large amounts, drowsiness, diaphoresis, deep sleep, weakness, decrease in linear growth, abnormal weight gain in the infant
	Cocaine	Cocaine intoxication: Irritability, vomiting, diarrhea, tremulousness, seizures
	Heroin	Tremors, restlessness, vomiting, poor feeding
	Marijuana	Components detectable in breast milk but effects uncertain
	Phencyclidine	Hallucinogen
*Effects of smoking are unclear; nicotine is detectable in breast milk, and smoking decreases breast milk production and infant weight gain but may decrease incidence of respiratory illness.		

Weaning

Weaning can occur whenever the mother and infant mutually desire, although preferably not until the infant is at least 12 month old. Gradual weaning over weeks or months during the time solid food is introduced is most common; some mothers and infants stop abruptly without problems, but others continue breastfeeding 1 or 2 times/day for 18 to 24 months or longer. There is no correct schedule.

Formula Feeding

The only acceptable alternative to breastfeeding during the first year is formula; water can cause hyponatremia, and whole cow's milk is not nutritionally complete. Advantages of formula feeding include the ability to quantify the amount of nourishment and the ability of family members to participate in feedings. But all other factors being equal,these advantages are outweighed by the undisputed health benefits of breastfeeding.

Commercial infant formulas are available as powders, concentrated liquids, and prediluted (ready-to-feed) liquids; each contains vitamins, and most are supplemented with iron. Formula should be prepared with fluoridated water; fluoride drops (0.25 mg/day po) should be given after age 6 mo in areas where fluoridated water is unavailable and when using prediluted liquid formula, which is prepared with nonfluoridated water.

Choice of formula is based on infant need. Cow's milk–based formula is the standard choice unless spitting up, diarrhea (with or without blood), rash (hives), or poor weight gain suggests sensitivity to cow's milk protein or lactose intolerance (extremely rare in neonates); then, a change in formula may be recommended. All soy formulas in the US are lactose free, but some infants allergic to cow's milk protein may also be allergic to soy protein; then, a hydrolyzed formula is indicated. Hydrolyzed formulas are derived from cow's milk, but the proteins are broken down into smaller chains, making them less allergenic. True elemental formulas made from free

amino acids are available for the few infants who have allergic reactions to hydrolyzed formula.

Bottle-fed infants are fed on demand, but because formula is digested more slowly than breast milk, they typically can go longer between feedings, initially every 3 to 4 hours. Initial volumes of 15 to 60 ml can be increased gradually during the first week of life up to 90 ml about 6 times/day, which supplies about 120 kcal/kg at 1 week for a 3-kg infant.

Solid Foods

The WHO recommends exclusive breastfeeding for about 6 mo, with introduction of solid foods thereafter. Other organizations suggest introducing solid food between age 4 mo and 6 mo while continuing breastfeeding or bottle-feeding. Before 4 mo, solid food is not needed nutritionally, and the extrusion reflex, in which the tongue pushes out anything placed in the mouth, makes feeding of solids difficult.

Initially, solid foods should be introduced after breastfeeding or bottle-feeding to ensure adequate nourishment. Iron-fortified rice cereal is traditionally the first food introduced because it is nonallergenic, easily digested, and a needed source of iron. It is generally recommended that only one new, single-ingredient food be introduced per week so that food allergies can be identified. Foods need not be introduced in any specific order, although in general they can gradually be introduced by increasingly coarser textures (e. g., from rice cereal to soft table food to chopped table food). Meat, pureed to prevent aspiration, is a good source of iron and zinc (both of which can be limited in the diet of an exclusively breastfed infant) and is therefore a good early complementary food. Vegetarian infants can get adequate iron from iron-fortified cereals and grains, green leafy vegetables, and dried beans and adequate zinc from yeast-fermented whole-grain breads and fortified infant cereals.

Home preparations are equivalent to commercial foods, but commercial preparations of carrots, beets, turnips, collard greens, and spinach are preferable before 1 year if available because they are screened for nitrates. High nitrate levels, which can induce methemoglobinemia in young children, are present when vegetables are grown using water supplies contaminated by fertilizer.

Foods to avoid include eggs and peanuts until children age 1 year to prevent food sensitivities. Honey until 1 year because infant botulism is a risk. Foods that, if aspirated, could obstruct the child's airway (e. g., nuts, round candies, popcorn, hot dogs, meat unless it is pureed, grapes unless they are cut into small pieces). Nuts should be avoided until age of 2 or 3 years because they do not fully dissolve with mastication and small pieces can be aspirated whether bronchial obstruction is present or not, causing pneumonia and other complications.

At or after 1 year, children can begin drinking whole cow's milk; reduced-fat milk is avoided until 2 years, when their diet essentially resembles that of the rest of the family. Parents should be advised to limit milk intake to 16 to 24 oz/day in young children; higher intake can reduce intake of other important sources of nutrition and contribute to iron deficiency.

Juice is a poor source of nutrition, contributes to dental caries, and should be limited to 4 to 6 oz/day or avoided altogether.

By about 1 year, growth rate usually slows. Children require less food and may refuse it at some meals. Parents should be reassured and advised to assess a child's intake over a week rather than at a single meal or during a day. Underfeeding of solid food is only a concern when children do not achieve expected weights at an appropriate rate.

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