Disorders of the Umbilical Cord

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Education Gap

Clinicians should understand the embryology of the umbilical cord to recognize the signs of congenital and acquired lesions of the umbilical cord to facilitate optimal diagnosis of associated conditions and provide anticipatory guidance regarding cord care.

Objectives After completing this article, readers should be able to:

1. Understand the embryology and pathophysiology of congenital disorders of the umbilical cord.
2. Characterize common lesions of the umbilical cord and review their presentation, investigations, and management.
3. Counsel parents on the normal course, appearance, and care of the umbilical cord, and provide anticipatory guidance on abnormal appearances of the umbilical cord and its discharge.

Abstract

The umbilical cord, a vital conduit between the placenta and the fetus, loses much of its significance after birth. However, newborns can often present with various abnormalities of the umbilicus, such as benign granulomas or more serious lesions due to persistent remnants, many of which can change the normal course of cord separation and may be associated with significant morbidities if left unrecognized and uncorrected. Although not uncommon, sanguineous drainage from the umbilical stump can be quite alarming to new parents. Parental counseling regarding normal umbilical cord changes, as well as abnormal findings, such as discharge and skin changes, are important for the recognition and timely treatment of potentially significant umbilical cord disorders.

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ABBREVIATIONS

MD	Meckel diverticulum
OMD	omphalomesenteric duct

EMBRYONIC DEVELOPMENT OF THE UMBILICAL CORD

Knowledge of umbilical embryology helps one understand how best to recognize and manage congenital disorders of the umbilical cord. At 3 weeks' gestation, the developing embryo is connected to the chorion by a connective stalk, which

contains the developing umbilical vessels and allantois. The primitive gut develops from the yolk sac and is connected, along with vitelline vessels, to the extracoelomic part via the vitelline duct (Fig 1). As the embryo grows, the amniotic cavity expands, drawing the connective stalk and vitelline duct together with proteoglycan-rich Wharton jelly to form the primitive umbilical cord (Fig 1). By the 9th week of gestation, the vitelline duct involutes, whereas the allantois obliterates by the 5th month into the urachus, a fibrous structure that connects the urinary bladder to the umbilicus, to leave behind the umbilical cord composed of 2 umbilical arteries and a single umbilical vein supported by Wharton jelly. (1)(2)(3) Failure of obliteration of allantois and/or the omphalomesenteric duct (OMD) or vessels either completely or partially can lead to congenital disorders of the umbilical cord. The umbilical cord lengthens throughout gestation, from a mean of 12.6 in (32 cm) at 20 weeks' gestation to a mean ± SD of 23.6 ± 4.7 in (60 ± 12 cm) at term, (4) with a mean ± SD circumference of 1.5 ± 0.3 in (3.76 ± 0.7 cm). (5)

After birth, the umbilical cord should be carefully examined for the presence of 3 vessels, vascular abnormalities (including varicosities), hemangioma, and evidence of cord rupture. The incidence of a 2-vessel cord with a single umbilical artery is 0.4% to 0.6% of live births. Although most infants with a single umbilical artery have no coexisting anomalies, approximately 20% to 30% may be associated with congenital abnormalities involving the central nervous, genitourinary, gastrointestinal, or cardiovascular systems. The incidence of renal anomalies associated with a single umbilical artery is 4% to 16%, most of which are minor anomalies and clinically insignificant. Current evidence does not support routine imaging for detecting anomalies in infants with a single umbilical artery; however, these infants should be carefully examined for dysmorphic features and associated anomalies. (6)(7)(8)

SEPARATION OF UMBILICAL CORD

The mechanism of cord separation is not fully understood. After the umbilical cord is cut and clamped, cord separation is thought to be initiated by thrombosis and contraction of the umbilical vessels. This is followed by granulocyte- and phagocyte-mediated necrosis, collagenous degeneration, and infarction of the cord tissue. (9)(10) The stump gradually shrivels, dries, and separates by the end of the first to second postnatal week (mean, 6–13 days). (11)(12)(13)(14) Age at which the cord separates may vary based on factors such as mode of delivery, gestational age, birthweight, and

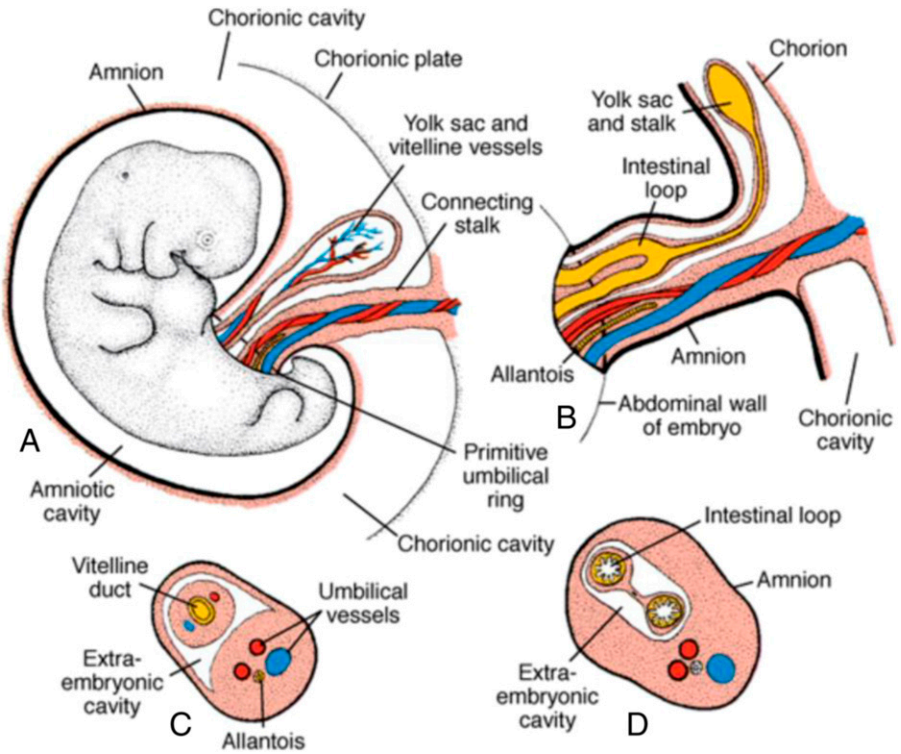

Figure 1. Primitive umbilical cord and contents. A. A 5-week embryo showing structures passing through the primitive umbilical ring. B. The primitive umbilical cord of a 10-week embryo. C. Transverse section through the structures at the level of the umbilical ring. D. Transverse section through the primitive umbilical cord showing intestinal loops protruding in the cord. (Reprinted with permission from Sadler TW. *Langman's Medical Embryology*. 13th ed. Philadelphia, PA: Wolters Kluwer Health; 2015.)

neonatal infections. (11)(12) The timing of umbilical cord separation is often a source of concern to parents. (9)

DELAYED SEPARATION OF UMBILICAL CORD

There is no standard definition of delayed cord separation, probably due to the variations seen in normal cord separation. Separation of the cord beyond 3 weeks of age is generally considered to be significantly delayed. (11)(12) Perinatal factors that are associated with delayed separation of the umbilical cord include prematurity, low birthweight, administration of topical antimicrobial agents, systemic antibiotics for neonatal infections, and delivery by cesarean route. (12)(13)(14) Topical antimicrobials and/or isopropyl alcohol are usually applied after delivery. Studies have shown longer time to separation of the cord with use of antiseptic topical agents such as chlorhexidine, 70% alcohol, and triple dye. (15)(16) In addition to the various umbilical cord care regimens, infections, immune disorders including leukocyte adhesion deficiency, and omphalomesenteric and urachal remnants can delay umbilical cord separation. (17) Although most infants with delayed cord separation do not have infections, (11)(12) infants with delayed cord separation and presentation of omphalitis or skin infections should be investigated for immunologic disorders, including leukocyte adhesion deficiency. (18) Lotus birth or nonseverance of cord is a practice where the umbilical cord is not cut after birth and is allowed to naturally separate, which often takes a few days. However, this practice may be associated with an increased risk of infection, and currently there is no evidence to support this practice. (19)

UMBILICAL GRANULOMA

After the separation of the cord, granulation tissue may persist at the base as a small mass. The tissue, usually light pink in color, is composed of fibroblasts and capillaries and is typically 1 to 10 mm in diameter. Persistent serous or serosanguinous drainage around the umbilicus may be suggestive of an umbilical granuloma. (2)(20)

Conventional treatment of umbilical granulomas includes cauterization with silver nitrate. Generally, only a few applications of silver nitrate are required for successful treatment. (2)(20)(21) Caution should be exercised in applying silver nitrate because of the risk of chemical burns or temporary discoloration of the surrounding skin. (22) Pedunculated umbilical granulomas that do not respond to chemical cauterization may be treated with ligature using absorbable sutures. (23) Persistence of a presumed umbilical granuloma or those that do not resolve with conventional measures may warrant further evaluation to rule out other pathologic abnormalities, including polyps, which require surgical exploration and excision. (2)(20)(21)

OMPHALITIS

Infection of the umbilicus and/or surrounding tissues is referred to as omphalitis. It is usually characterized by an unhealthy, discolored, and craggy-appearing umbilical stump; purulent drainage; periumbilical erythema; and induration. Infants may also have systemic signs of sepsis, including lethargy, irritability, poor feeding, and temperature instability. (24)(25)

The incidence of omphalitis is estimated to be approximately 1 in 1,000 infants in developed countries where aseptic delivery and hygienic dry cord care are practiced. However, the incidence may be as high as 8% in low-income communities or developing countries. (25) The risk factors associated with the development of omphalitis include prolonged rupture of membranes, maternal infection, nonsterile delivery practices, home delivery, and neonatal factors such as umbilical catheterization, low birthweight, improper cord care or cultural practices of cord care (such as application of cow dung, charcoal dust, or products such as cooking oil and baby powder to the cord stump, and lotus births), delayed cord separation, and immunologic conditions, namely, leukocyte adhesion deficiency. (24)(25)(26)(27)(28) *Staphylococcus aureus* is the most reported pathogen causing omphalitis, followed by gram-negative bacteria, including *Escherichia coli* and *Klebsiella*. Other bacteria that have been implicated are group A and B *Streptococcus*, and anaerobic bacteria such as *Clostridium*, *Bacteroides*, and polymicrobial infections account for a small proportion of omphalitis. (24)(25)(26)(29)

The clinical spectrum of omphalitis ranges from infection limited to the umbilical cord (funisitis presenting with malodorous discharge) and omphalitis with cellulitis of the periumbilical region to a more severe presentation with systemic signs of infection, and in the severest presentation as necrotizing fasciitis with dermal and myonecrosis. Overall mortality is reported to be 7% to 15%, but mortality may be as high as 60% in infants with necrotizing fasciitis. (30)(31) Necrotizing fasciitis starts initially as periumbilical cellulitis and rapidly spreads to the subcutaneous tissues, with the overlying skin appearing edematous with purplish-blue discoloration. Necrotizing fasciitis may also present with bullae, crepitus and peau d'orange appearance. (31)

Complications of omphalitis include umbilical venous phlebitis, portal vein thrombosis, intra-abdominal and retroperitoneal abscess, peritonitis, peritoneal adhesions, and bowel ischemia. (30) Management of omphalitis should

include umbilical stump and skin cultures, as well as a full sepsis evaluation, including lumbar puncture in infants with systemic signs. Parenteral broad-spectrum antibiotics such as a combination of clindamycin and cefotaxime or gentamicin should be initiated empirically, and the area of cellulitis marked and closely followed. The antibiotics are generally continued for 10 days, and a longer course may be required for severe infections. In communities with a high prevalence of methicillin-resistant *S aureus*, vancomycin should be used. Metronidazole or piperacillin/tazobactam should be considered to provide coverage against anaerobic bacteria if there is a concern of systemic infection or necrotizing fasciitis. (32) Necrotizing fasciitis should be recognized early and treated aggressively by debridement, broad-spectrum antibiotics, and supportive care. (21)

OMPHALOMESENTERIC (VITELLINE) REMNANT

Omphalomesenteric duct anomalies result from partial or complete failure of obliteration of the OMD that connects the yolk sac to the gut in the embryo. The exact etiology of incomplete obliteration remains unknown. Persistence of OMD occurs in 2% to 3% of children (33) and, depending on the degree and location of involution, has a variety of anatomical patterns that include vitelline cyst (patent central portion, Fig 2 A and D), umbilical sinus (patent at umbilical end, Fig 2B), umbilical polyp (mucosal remnant at umbilicus, Fig 2C), Meckel diverticulum (MD) (partially patent at intestinal end, Fig 2E), and completely patent duct (omphalomesenteric fistula, Fig 2F). Although OMD remnants are usually asymptomatic, 40% of these lesions may present with symptoms, including gastrointestinal bleeding, intestinal obstruction, and umbilical abnormalities, depending on the specific type of defect. (34) The simultaneous presence of more than 1 anomaly of OMD in the same patient has also been reported. (35)

Meckel diverticulum is the most common anomaly resulting from incomplete obliteration of the OMD. An estimated overall prevalence of MD in the general population is 0.6% to 4%. (36) The rule of 2s is a useful aid in MD's description because MD occurs in 2% of the population, appears within 2 feet of the ileocecal valve, is 2 in long, approximately 2% to 4% of patients develop complications over the course of their lives, and typically presents before age 2 years. (20) Two-thirds of patients with MD have 2 types

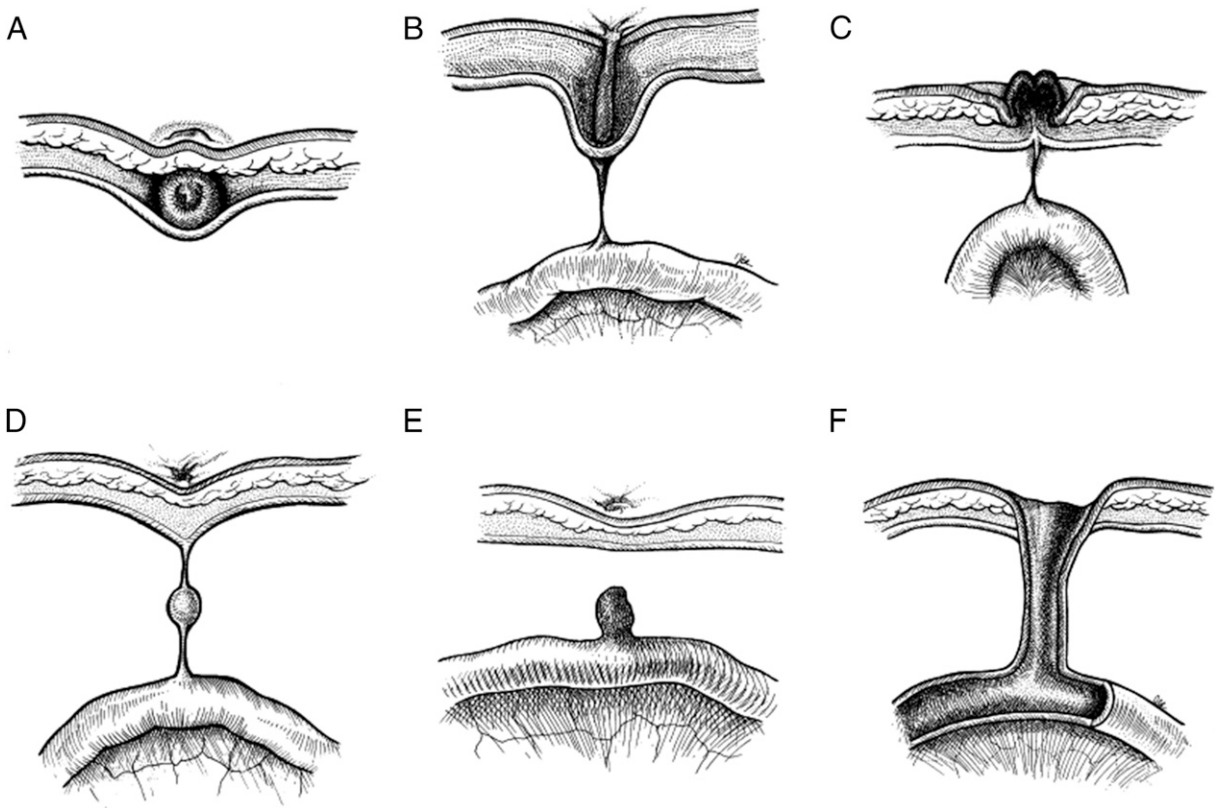

Figure 2. Omphalomesenteric duct remnants. A. An umbilical cyst containing intestinal tissue. B. Umbilical sinus with a band. C. Umbilical polyp covered with intestinal mucosa. D. Fibrous band containing a cyst. E. Meckel diverticulum. F. Patent omphalomesenteric duct. (Reprinted with permission from Ciley R. Disorders of the umbilicus. In: *Pediatric Surgery.* 7th ed. Philadelphia, PA: Elsevier; 2012:961–962.)

of heterotopic mucosa (gastric and pancreatic), although colonic heterotopic mucosa has also been reported. Most MD is asymptomatic. Clinical presentations include lower gastrointestinal bleeding due to ulceration of the heterotopic gastric mucosa and intestinal obstruction due to intussusception or volvulus. (2)(16) Technetium 99 scan, or Meckel scan, is the most commonly used modality for detecting heterotopic gastric mucosa associated with MD. Radiologists may use histamine-2 receptor blockers as an adjunct to Meckel scan to improve the diagnostic yield, especially in cases of profuse gastrointestinal bleeding, by enhancing visualization of the contrast. (20)(37) Additional diagnostic evaluations, such as ultrasonography, computed tomographic scan, upper gastrointestinal barium studies, or selective angiography, may be considered. However, some infants with negative imaging and a high degree of suspicion may require exploratory laparotomy. (20)(38)

Patent OMD (umbilical enteric fistula), a patent conduit connecting the umbilicus to the ileum, is one of the least common variants of OMD anomalies and usually presents with minimal but persistent discharge of intestinal contents or stool at the umbilicus (Fig 3). Diagnosis is usually made during infancy as feces or bilious drainage is noted at the umbilicus. (2)(20) Severe, erosive dermatitis may occur in the skin adjacent to the umbilicus due to the irritating effects of fecal drainage. Accidental intestinal perforation and pneumoperitoneum have been reported during umbilical vessel catheterization in the neonatal period. (39) The umbilical cord should be carefully examined at birth and during catheterization by health-care professionals performing these tasks to prevent such complications. The recommended technique for placement of umbilical catheters can be viewed from the referenced video. (40)

Umbilical cysts may present as a firm, erythematous, cystic swelling at the umbilicus but are typically asymptomatic. In some cases, they may present with bowel obstruction or infection. (2) An OMD sinus should be suspected when mucus discharge is noted in the presence of an umbilical polyp or granuloma. (2)(20) Patent OMD may be identified early in the neonatal period due to persistent feculent discharge. However, cysts and sinus tract may require additional evaluation, including ultrasonography and fistulography. Management involves surgical exploration to exclude associated OMD or urachal remnants and excision of the duct. (2)(20)(21)

UMBILICAL POLYP

An umbilical polyp is a remnant of OMD or urachal embryologic remnant (Fig 4). An umbilical polyp may coexist with OMD or urachal sinus, cyst, fistula, or a band and may be associated with urine or fecal discharge. (33)(38)

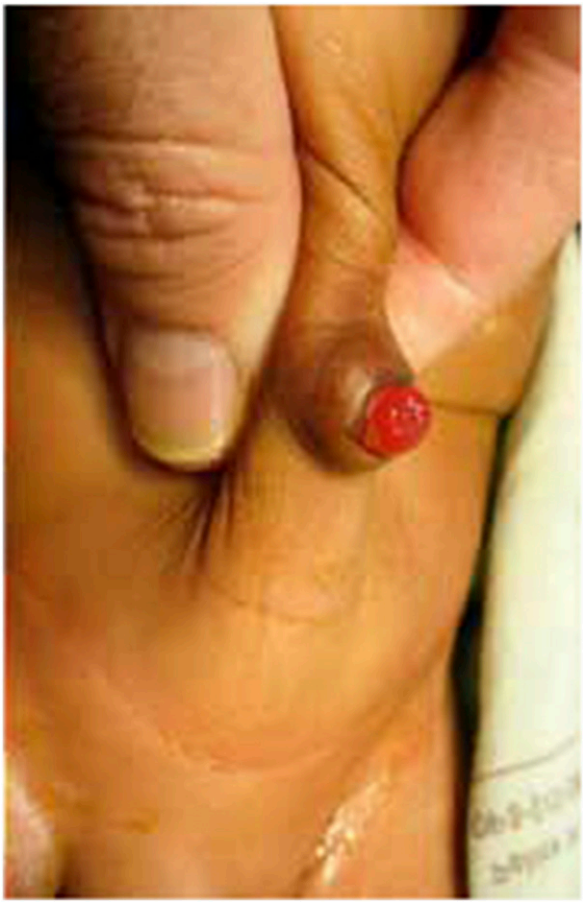

Figure 3. Patent omphalomesenteric duct. (Reprinted with permission from Rakotomalala JH, Poenaru D, Mayforth RD. Disorders of the umbilicus. In: *Paediatric Surgery: A Comprehensive Text for Africa.* Seattle, WA: Global HELP; 2010:353; www.global-help.org.)

Umbilical polyps present as a bright red, firm, painless mass with mucoid/bloody discharge. They may be mistaken clinically for umbilical granulomas or pyogenic granulomas, which may have a pink or velvety appearance. Unlike umbilical granulomas, umbilical polyps do not respond to chemical cauterization. Histopathologic evaluation is warranted if there is any doubt whether an umbilical mass in a neonate is a polyp or granuloma. If a polyp is diagnosed, further evaluation for associated embryologic anomalies (eg, MD) should be performed. Umbilical polyps are associated with an underlying OMD anomaly in 30% to 60% of patients. (20) In such conditions, ultrasonography or fistulography may be beneficial. Early diagnosis and treatment of an umbilical polyp may decrease the risk of associated complications.

URACHAL ANOMALIES

The urachus normally obliterates by 5 months of gestation to become the median umbilical ligament. Failure of urachal

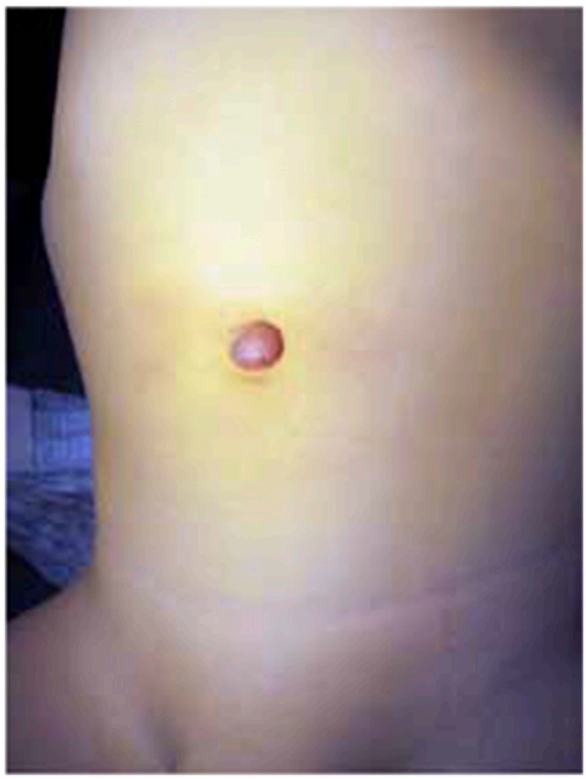

Figure 4. Umbilical polyp. (Reprinted with permission from Rakotomalala JH, Poenaru D, Mayforth RD. Disorders of the umbilicus. In: *Paediatric Surgery: A Comprehensive Text for Africa*. Seattle, WA: Global HELP; 2010:354; www.global-help.org.)

obliteration leads to urachal anomalies. Depending on the degree of involution, a variety of anatomical patterns may occur, including a complete patent urachus, partially patent urachus at the umbilical end (urachal sinus), patent central portion (urachal cyst), urachal remnant at bladder (bladder diverticulum), or mucosal remnant at the umbilicus (umbilical polyp). (2)(20)

The true incidence of urachal anomalies is not known, as most anomalies are reported as incidental findings in patients undergoing imaging for unrelated indications. A recent retrospective study estimated the prevalence of urachal anomalies to be approximately 1% in the general pediatric population, with ultrasonography being the most common imaging modality in diagnosing urachal anomalies. (41)(42) In those who present with symptoms, clear discharge from the umbilicus is the most common presentation, followed by a mass or cyst. Rare presentations include pain and retraction of the umbilicus during voiding. (2) A giant umbilical cord as an initial presentation of a patent urachus has been described. (43)(44) Urinary ascites due to spontaneous rupture or perforation of the urachus during umbilical catheterization has also been described, highlighting the importance of closely examining the umbilical cord before performing the procedure. (45) Simultaneous presence of stool and urine should increase suspicion for the presence of a patent OMD with a coexisting patent urachus.

Complications of urachal anomalies include infection calculus formation, urinary ascites, peritonitis, and an increased risk of malignancy such as adenocarcinoma of the bladder. (2)(20)(41)

Ultrasonography is the preferred modality of imaging for urachal anomalies and can help make the diagnosis in most patients. Magnetic resonance imaging or computed tomographic scan may be considered when ultrasonography is nondiagnostic. A sinogram with injection of radiocontrast material into the urachal opening may be used to identify the presence of a patent urachus or sinus tract. Renal ultrasonography and voiding cystourethrography should be considered to evaluate for associated renal and lower urinary tract obstructions such as a posterior urethral valve. (2)(20)(46)

An infected urachal cyst is initially treated with antibiotics, followed by complete excision. Surgical excision is recommended to prevent recurrent infections in cases of persistent symptoms. To prevent the development of urachal adenocarcinoma, complete surgical excision of the entire lesion, including the cuff of the bladder, has been the recommended treatment for a patent urachus. (2)(20) However, more recent literature has demonstrated a much higher incidence of asymptomatic anomalies and has questioned the benefit of surgery in asymptomatic children. Based on some research evidence as well as consensus, it is generally agreed that symptomatic urachal diverticula must be surgically treated, whereas asymptomatic and uncomplicated urachal diverticula require close monitoring. (41)

UMBILICAL HERNIA

During fetal life, a fascial opening with a fibrous ring in the abdominal wall functions as a channel that allows blood flow between the placenta and fetus. As the gestation progresses, the umbilical ring contracts and eventually closes after birth, with separation of the cord and fusion of the rectus abdominis muscle. Posteriorly, the umbilical opening is covered by Richet fascia and peritoneum. The umbilical ring is also reinforced superiorly by a round ligament and inferiorly by median and medial ligaments. Complete or partial failure of attachment by Richet fascia or the ligaments may weaken the umbilical ring and result in the development of an umbilical hernia. Umbilical hernias are protrusions of the peritoneum covered by skin and may contain peritoneal fluid, fat, intestine, or omentum. (2)(20)

A higher incidence of umbilical hernias is seen in African American infants and in infants with Beckwith-Wiedemann syndrome, trisomy 21, congenital hypothyroidism, and mucopolysaccharidoses. Umbilical hernias are much more common in preterm infants, with some studies reporting as many as three-fourths of infants with very low birthweight having umbilical hernias. (2)(16)(47)

Umbilical hernias can be easily diagnosed during the newborn abdominal examination, particularly during periods of crying when there is increased intra-abdominal pressure. Umbilical hernias are easily reduced, even if they are quite large, and the borders of the fascial defects can be palpated through the skin.

Most hernias close spontaneously during the first 3 years of life, and most will close by 6 years of age, although closure at up to 14 years of age has been reported in African American children. A factor that supports spontaneous closure is a smaller diameter size of the fascial defect rather than the size of the hernia. Most hernias with defects less than 1 cm close spontaneously, whereas hernias with defects larger than 1.5 cm are less likely to close spontaneously. (47)(48)(49)(50) Complications, including incarceration, strangulation, and rupture of umbilical hernias, may occur rarely.

Due to the high rate of spontaneous closure, conservative management with reassurance and observation are sufficient, and repair is deferred until age 5 years at most institutions. Early closure is indicated if the defect is larger than 1.5 cm; in children with large, proboscoid (trunk-like) hernias without any decrease in the size of the umbilical ring defect over time; or in the rare instance of complications associated with umbilical hernias. (2)(20)(21)

HERNIA OF THE UMBILICAL CORD

A small omphalocele may present as herniation of abdominal viscera through the umbilical ring at the base of the umbilical cord. (2) If missed, this condition can lead to intestinal damage by a low-placed umbilical cord clamp. Approximately 70% of infants with omphalocele have associated anomalies, including cardiac, genitourinary system, or spinal abnormalities. Thirty percent of affected infants have associated chromosomal abnormalities, with 10% of infants having Beckwith-Wiedemann syndrome. (51) Small omphaloceles require prompt surgical closure and evaluation for associated anomalies. (21)

BLEEDING FROM UMBILICAL CORD

Persistent and prolonged bleeding from the umbilical cord is abnormal and should raise suspicion of coagulation abnormalities such as factor II, factor X, and factor XIII deficiency. Factor XIII almost exclusively presents with umbilical cord bleeding in the neonatal period and may present along with intracranial hemorrhage. (52)(53)

CORD CARE

Colonization of the umbilical cord with pathogenic bacteria has been implicated in omphalitis, sepsis, and neonatal morbidity. The umbilical stump can provide an optimal media for growth of pathogens, and with direct communication with neonatal blood vessels, there is a high risk of invasive bacteremia. With practice of good hygiene and aseptic delivery, risk of colonization with pathogenic bacteria has been reduced considerably in high-resource countries. (25) In low-resource communities and in developing countries, use of antiseptic solutions such as chlorhexidine has been shown to reduce omphalitis/infection by half and neonatal mortality by 12%. However, the routine use of chlorhexidine in infants born in hospitals and birthing centers in resource-rich countries has not been shown to be beneficial. (54)

The World Health Organization and the American Academy of Pediatrics recommend dry cord care for infants born in hospitals in high-resource countries.(25)(55) "Dry cord care involves keeping the cord clean and dry by exposure to room air or with light clothing with no application of antiseptic or antimicrobial agents. Chlorhexidine may be considered for unplanned home births or low resource communities. Gentle washing with soap and sterile water has been recommended for a soiled umbilical cord." (25)

ACKNOWLEDGMENT

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Summary

- Based on strong research evidence as well as consensus, dry cord care should be considered for infants born in hospitals and birthing centers and after planned home births because use of antimicrobial agents does not provide additional benefits. Whereas in resource-limited communities and unplanned home births, prophylactic topical antimicrobial agents may be beneficial in reducing the risk of omphalitis. (25)(54)(55)

- Based on moderate research evidence as well as consensus, infants with suspected or confirmed umbilical polyps, omphalomesenteric ducts, and urachal remnants should be referred promptly to pediatric surgeons for surgical evaluation. (20)(21)
- Based on moderate evidence as well as consensus, an umbilical granuloma may be treated with topical silver nitrate. Surgical referral may be warranted for large pedunculated granulomas or for those who do not respond to topical treatment. (20)(21)
- Based on strong research evidence as well as consensus, and due to high risk of mortality and morbidity associated with omphalitis and its complications, omphalitis should be treated aggressively with parenteral antibiotics. (20)(21)(25)
- Parental education and anticipatory guidance to parents regarding cord care, the normal course of cord separation, abnormal discharge, and signs and symptoms of omphalitis may result in early recognition and prompt medical attention, which may help reduce morbidities. (25)

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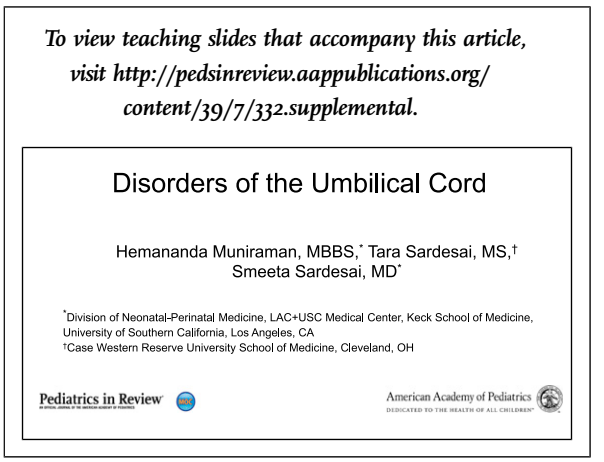

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1. When admitting a term newborn to the well-baby nursery, you notice that the baby has a 2-vessel cord with a single umbilical artery. You prepare to discuss the finding with the parents. Which best describes the most appropriate next step in the management of this patient?
    A. Abdominal ultrasonography.
    B. Full physical examination.
    C. Head ultrasonography.
    D. Reassurance.
    E. Renal ultrasonography.
2. A 1-month-old, well-appearing term baby boy is seen in the clinic for a health maintenance visit. During the physical examination, the parents point out that the umbilical cord has not yet separated. In obtaining further history, the physician confirms that they have not applied any topical agents to the cord since birth and have been practicing dry cord care. On physical examination, there is mild periumbilical erythema and purulent drainage. The remainder of the examination findings are normal. Investigations for which of the following disorders should be considered for this child?
    A. Collagen type IV disorders (COL4A).
    B. Factor XIII deficiency.
    C. Leukocyte adhesion deficiency.
    D. Omphalomesenteric duct anomalies.
    E. Umbilical hernia.
3. A 1-week-old newborn is brought to urgent care with a concern about drainage from the umbilicus. On further history, the parents report that they have been carefully applying baby oil to the cord stump daily. On physical examination, the baby has normal vital signs and is irritable. Purulent drainage is noted from the umbilical stump, and there is periumbilical skin erythema and tenderness. Which of the following is the most appropriate next step in the management of this baby?
    A. Skin surface culture, and starting oral antibiotics.
    B. Skin surface culture warm compresses, and application of topical antibiotics.
    C. Complete blood cell count; blood, urine, and cerebrospinal fluid cultures; and initiation of parenteral antibiotics.
    D. Marking of area of erythema with instructions to return in 3 to 5 days for follow-up.
    E. Chlorhexidine washes to the area, reassurance, and education regarding dry cord care.
4. A 6-month-old girl is brought to urgent care with lower gastrointestinal bleeding. She had been seen at the same office with the same problem a month earlier, at which time results of abdominal ultrasonography were negative. She is afebrile, with stable vital signs. On physical examination, she has no abdominal tenderness or distention, and no masses are palpated. The potential diagnosis of Meckel diverticulum is suspected. Which of the following approaches is most commonly used for detecting heterotopic gastric mucosa associated with Meckel diverticulum?
    A. Colonoscopy.
    B. Exploratory laparotomy.
    C. Magnetic resonance imaging.
    D. Technetium 99 scan.
    E. Ultrasonography-guided biopsy.

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5. You meet a first-time mother in the postpartum ward after an uncomplicated delivery of a term baby boy. His examination findings are normal. The mother asks you what she should do to take care of the umbilical stump after going home because relatives have advised various regimens to her. Which of the following is the recommended measure by the World Health Organization and the American Academy of Pediatrics for cord care for infants born in hospitals in high-resource countries?

   A. Application of baby powder to facilitate cord drying.
   B. Covering the cord with gauze to avoid infection.
   C. Daily application of topical antimicrobial agents.
   D. Gentle washing with soap and sterile water if the cord becomes soiled.
   E. Vigorous cleansing with 70% alcohol with each diaper change.