Injuries to the brachial plexus in neonates present a malpractice dilemma not only for physicians who provide obstetric care, but also for those who administer immediate postnatal treatment for newborns who have these injuries and comorbid medical conditions. Although trauma remains the probable etiology for many brachial plexus injuries, other, nontraumatic etiologies need to be considered. The authors review current medical and legal principles related to brachial plexus injuries—principles that are of concern to all practitioners who provide obstetric and newborn care. They also make a number of recommendations for practitioners to reduce the risk of malpractice lawsuits related to these injuries. Among these recommendations are increasing one’s awareness of nontraumatic origins; making sure that appropriate testing (eg, electromyography) is performed for infants whose conditions fail to improve within several months after birth; and taking a proactive role in discussing brachial plexus injuries with patients’ families.

The present article addresses several recent medical and legal issues of concern to practitioners involved in the care of neonates with brachial plexus injuries.

Classification of Brachial Plexus Lesions
Injuries to the peripheral nerves that make up the brachial plexus are classified according to the nerve roots involved.1 For example, Erb’s palsy involves injury to the fifth and sixth cervical roots at the point where they meet the plexus. This injury causes weakness of the proximal muscles of the upper extremity. Another example, Klumpke’s palsy, which rarely occurs in isolation, involves injury to the eighth cervical and first thoracic roots at the point where they meet the plexus. This injury causes weakness of the muscles of the hand. The most severe injuries to the brachial plexus involve multiple root levels, with resulting weakness of most of the upper extremity.

Prognosis and Recovery
Prognosis for neonates with brachial plexus injuries is generally associated with the severity of motor deficit. The less severe the motor dysfunction at presentation, the less likely there will be a sequela of permanent significant weakness.1,3 Infants with total plexus palsy often have residual permanent weakness.

Recovery from congenital brachial plexus injuries may continue for as long as 1 year after birth. However, infants who are less severely affected usually recover within a matter of days or weeks. In 1982, Rossi et al4 reported a case in which the patient’s recovery lasted until school age.

Therapeutic Options
Therapy for neonates with brachial plexus injuries typically focuses on appropriate splinting and careful, passive range-of-motion exercises to prevent contracture and diminish the need for future orthopedic interventions.3 For infants who fail to show meaningful improvement after 3 to 6 months, electromyography (EMG) may be performed to establish prognosis.5 However, there is conflicting evidence regarding the prognostic value of routine EMG for neonates with brachial plexus injuries.6,7

For infants with poor recovery during their first few months of life, especially if there is extensive weakness in their conditions, surgery may be a viable option. Although the type and success of various surgical interventions remains contro-
versal,\(^8\) some infants have demonstrated improvement in motor function after certain interventions.\(^3,6,9\) For example, one surgical option for infants more than 3 months old who do not appear to be recovering is reanastomosis (grafting) of the affected nerves to promote nerve regeneration.\(^6,9\) Other surgical options, if improvement in function is followed by a plateau, include nerve transfers and neurolysis (scar tissue removal).\(^6,9\) In older children, surgical options include joint capsule release, tendon transfer, and osteotomy to promote improved functional capacity.\(^6,9\) These types of surgical interventions are best managed by physicians who specialize in treating patients with brachial plexus injuries.

Preoperative magnetic resonance imaging can also be important in management of brachial plexus injuries. It is of particular value in assessing patients for such complications as pseudomeningocele, traumatic arachnoid cyst, and syrinx.\(^6\)

**Associated Conditions**

Physicians who care for newborns place themselves at high risk of malpractice lawsuits if they are unaware of the medical conditions that can be associated with brachial plexus injuries, including diaphragmatic paralysis (the most serious condition associated with brachial plexus injuries) and various traumatic lesions.

Although only a small percentage of brachial plexus injuries are associated with diaphragmatic paralysis, most cases of diaphragmatic paralysis have associated brachial plexus injuries.\(^1\) Mortality of neonates with diaphragmatic paralysis, resulting from respiratory compromise, is approximately 15% in infants with unilateral lesions of the brachial plexus, but mortality approaches 50% in infants with bilateral lesions.\(^1\)

When a brachial plexus injury is presumed to be traumatic, the infant needs to be assessed for various other traumatic lesions. Such lesions include cervical spine injury with or without subluxation, facial paralysis, slippage of the capital band, and the umbilical cord have been implicated as etiologic factors.\(^13\)

Electrophysiologic studies have demonstrated evidence of denervation (ie, nerve injury) within days after birth—notwithstanding the fact that it usually takes at least 10 to 14 days after injury for denervation to be detected with EMG.\(^12,13\) Thus, an EMG result that indicates denervation within the first several days of life suggests that an injury is likely to be prenatal in onset—though recent data collected from animal subjects have raised questions about the use of EMG to time the onset of brachial plexus injuries in infants.\(^7\) Other studies have noted that EMG changes consistent with denervation may be found in the normal infant and, therefore, cannot be relied upon to determine etiology unless the findings are present only in the affected extremity.\(^16\)

Nontraumatic, hereditary origins, though rare, should also be considered. An inherited autosomal-dominant brachial plexopathy (often referred to as hereditary neuralgic amyotrophy) has been identified.\(^18\) Although this disorder typically affects individuals in the second or third decade of life, it has been rarely reported in neonates.\(^18,19\) Both adult and infant patients may have mild dysmorphisms (eg, cleft palate, epicanthal folds, hypotelorism, short stature, syndactyly). The cranial nerves and the nerves of the lower extremities may also be affected. Episodes of weakness are recurring, and, during an episode, symptoms progress over a period of hours or days. Recovery usually occurs within 30 days, but some weakness and atrophy may persist.

A gene for hereditary neuralgic amyotrophy has been localized to chromosome 17q24-q25.\(^18\) The key to diagnosis is a family history that shows a similar clinical syndrome. There is a single report of a patient with an apparent bilateral brachial plexopathy associated with agenesis of the biceps brachial plexus injuries may be related to compression of the nerve.

The possibility that some injuries of the brachial plexus are caused by intrauterine malpositioning rather than traumatic delivery or compression has been proposed by some authors.\(^12,13\) This possibility is supported by the high percentage of abnormal presentations at birth (eg, breech, occiput posterior, occiput transverse) among neonates with brachial plexus injuries.\(^13,14\) The possibility is also supported by the occurrence of brachial plexus injuries in infants who were born prematurely or delivered by cesarean section—in cases in which there was no shoulder dystocia but the posterior arm was the affected extremity.\(^11,13,14\) One study\(^13\) described Erb’s palsy in several infants of normal weight who did not experience traumatic delivery. The presence of either abnormal dermatoglyphics, muscle atrophy, undersized extremities, or deformation of the ribs or neck are useful in indicating prenatal onset caused by intrauterine malpositioning.\(^16,17\) In addition, compression of the plexus against the walls of a malformed uterus or uterine fibroma, exostosis of the first rib, an amniotic band, and the umbilical cord have been implicated as etiologic factors.\(^13\)

The etiology of brachial plexus injuries is complex and subject to debate. The prevailing etiologic theory relates to stretching of the nerves in an infant who is large for gestational age and who has sustained a “difficult” vaginal delivery.

Many injuries to the brachial plexus in neonates are presumed to have a traumatic origin resulting from a difficult delivery. Signs and symptoms of such injuries include abnormal presentation, fetal depression, high incidences of macrosomia and shoulder dystocia, and prolonged or augmented labor.\(^11\) A connection between injuries and difficult deliveries is consistent with the presumed pathogenesis of some brachial plexus lesions, which involves stretching of the nerve roots from traction or, in more severe lesions, severing of the nerve sheath. Other
muscle. It is likely that other nontraumatic hereditary origins of brachial plexus injuries will be reported in newborns.

Malpractice Monetary Judgments
As would be expected, permanent weakness in a newborn can result in a high malpractice monetary judgment, especially when the weakness is severe. According to the Data Sharing Project, which is a database of medical malpractice claims started in 1985 by the Physician Insurers Association of America, nearly 60% of lawsuits related to brachial plexus injuries between January 1985 and December 2001 resulted in payouts of monetary damages. These payments had a median indemnity of $301,000 (nearly four times the median payout for all malpractice claims during this period) and a total payout of $54 million. The total monetary judgment for brachial plexus injuries was greater for physicians working in teaching hospitals than for those in nonteaching hospitals (teaching, $31 million; nonteaching, $22 million), as was the median payout (teaching, $403,000; nonteaching, $221,000).

The potential for monetary payout far in excess of the median is possible. In one case involving a child who had Erb’s palsy with severe residual weakness, the verdict for the plaintiff was more than $3 million: $20,000 was awarded for past pain and suffering, $2 million for future pain and suffering, and $1 million for loss of future earnings.

Recommendations
To avoid creating evidence that might be misconstrued in later malpractice actions, it has been recommended that physicians adopt policies limiting how much of an infant’s delivery can be videotaped by family members. For example, a delivery involving the use of forceps or vacuum extraction might be interpreted by a plaintiff’s attorneys as a “difficult” one that should have been handled via cesarean section. The risks of permitting videotaping of a birth must be weighed against the possibility of its use as adverse, legal evidence. In one case involving a child who had Erb’s palsy with severe residual weakness, the verdict for the plaintiff was more than $3 million: $20,000 was awarded for past pain and suffering, $2 million for future pain and suffering, and $1 million for loss of future earnings.

Practitioners caring for infants with brachial plexus injuries need to take a proactive approach in discussing this medical condition with the infants’ parents. Communication between caregivers and parents can be an effective risk-management tool in reducing malpractice lawsuits. Studies have demonstrated that parents who later sue for malpractice involving neonates often note a lack of communication between themselves and their child’s physician. In one study, 89 (70%) of 127 mothers who subsequently sued for their newborn’s perinatal injury complained that their caregivers did not adequately inform them about the potential for long-term neurodevelopment problems.

Relevant to this discussion is a recent report suggesting a less promising outcome for patients with brachial plexopathy than had been previously reported. Pondaag et al reported that an estimated 20% to 30% of infants with brachial plexus palsy may have residual neurologic deficits—percentages that are much higher than the previously estimated 10%. In light of this revelation, it is imperative for physicians who care for infants and children to recognize the causes, associated medical conditions, appropriate treatments, and prognoses of brachial plexus injuries.

Based on our review of the medical and legal principles related to brachial plexus injuries, we conclude with the following recommendations:

- Physicians who practice obstetrics should be aware of the limits of their malpractice coverage. There is potential for a high payout for brachial plexopathy, especially if the patient has severe residual weakness and if the legal case is heard in a geographic area where such payouts are common.
- Practitioners should not assume that brachial plexus injuries are necessarily the result of traumatic deliveries. Such injuries can also result from intrauterine malpositioning.
- When appropriate, rare etiologic origins—including those of a hereditary, nontraumatic nature—should be considered. Obtaining a patient’s family medical history is important in determining etiologic origins.
- Newborns with brachial plexus injuries need to be carefully assessed for comorbid conditions.
- To ascertain the degree and extent of injury and to evaluate other treatment options in infants who do not recover within several months, appropriate testing and consultation (eg, EMG, neurosurgery) must be considered.
- Communication between the physician and the patient’s family is crucial. Parents should be informed of the possibility of long-term sequelae related to brachial plexus injuries.

References