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Issues in Neonatal Transport

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Responding to Traumatic Birth

Subgaleal Hemorrhage, Assessment, and Management During Transport

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ABSTRACT
Subgaleal hemorrhage is an uncommon but often fatal complication of a traumatic birth. Careful assessment and monitoring of the infant following birth are necessary to ensure prompt intervention, referral, and improved outcomes. Additional care, planning, and communication are especially important in the transport environment.
KEY WORDS: birth trauma, head trauma, neonatal transport, subgaleal hemorrhage

Subgaleal hemorrhage is a rare but potentially fatal complication of birth.[1-6] A subgaleal hemorrhage is an accumulation of blood in the loose connective tissue of the subgaleal space, which is located between of the galea aponeurotica and the periosteum.[1-3] Subgaleal hemorrhage most frequently occurs when forces, such as forceps and vacuum extraction, compress and then drag the head through the pelvic outlet.[1-6] It may present following a less traumatic delivery in infants with coagulation disorders. Early recognition and intervention and proper management reduce neonatal morbidity and mortality and lead to improved outcomes.[1-3]

Incidence of subgaleal hemorrhage is reported as approximately 1 in 2500 spontaneous vaginal deliveries,[2] without the use of vacuum or forceps, and a 10-fold increase is reported with the use of forceps or vacuum.[2] Vacuum use is reported in approximately 49% of all subgaleal hemorrhage.[2] Because of the strong correlation of subgaleal hemorrhage and vacuum-assisted delivery, the Food and Drug Administration issued an advisory warning regarding the use of vacuum-assisted devices, stating that serious and fatal complications have been reported with the use of these devices.[1,2]

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ANATOMY

The scalp is composed of 5 layers: skin (epidermis and dermis), subcutaneous tissue, galea aponeurotica, subgaleal space, and periosteum. The third layer of tissue is the galea aponeurotica; this layer is composed of dense fibrous tissue that covers the entire upper cranial vault. The subgaleal space (Figure 1) is located directly below the galea aponeurotica and extends throughout cranial vault from the occiput to both the frontal and temporal fascia.[1,2] Unlike other layers of the scalp, this is a space composed of loose, fibroareolar tissue that allows for movement of the upper layers of the scalp (all firmly bound together) over the periosteum (strongly adhered to the surface of the cranium). This subgaleal space also contains large, valveless emissary veins (Figure 2) that connect the dural sinuses inside the skull with the superficial veins of the scalp.[1,2]

PATHOPHYSIOLOGY

Subgaleal hemorrhage develops when blood accumulates in the subgaleal space of the scalp. Blood accumulates when shearing forces during birth cause the emissary veins to sever and rupture allowing blood to accumulate. The subgaleal space is not limited by sutures lines and has no anatomical boundaries, so the potential for blood accumulation in this space is massive. The space extends from the nape of the neck to

FIGURE 1.

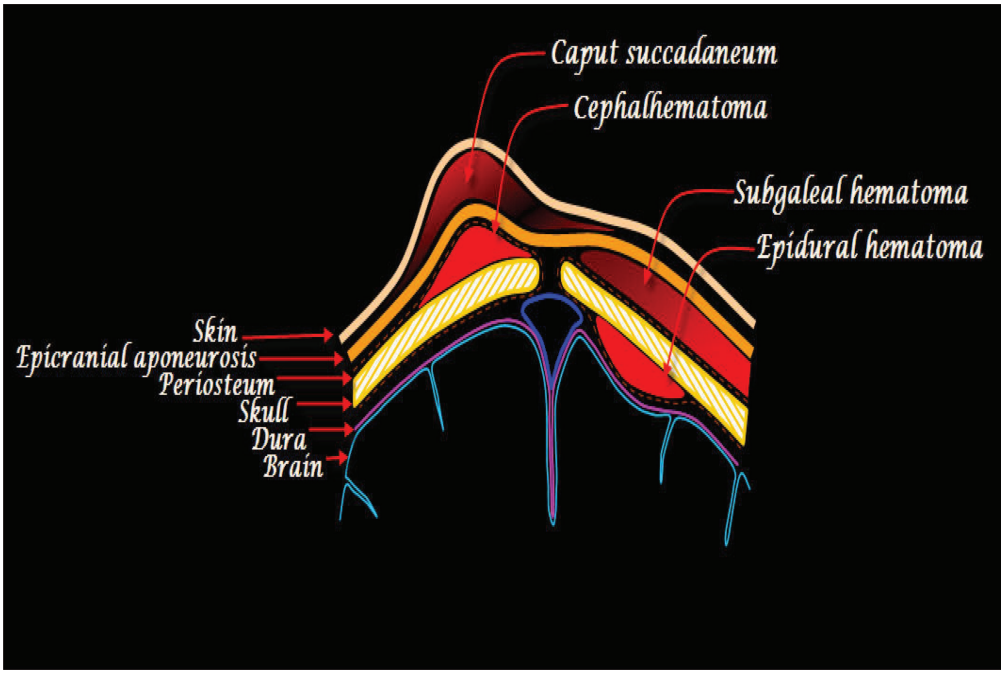

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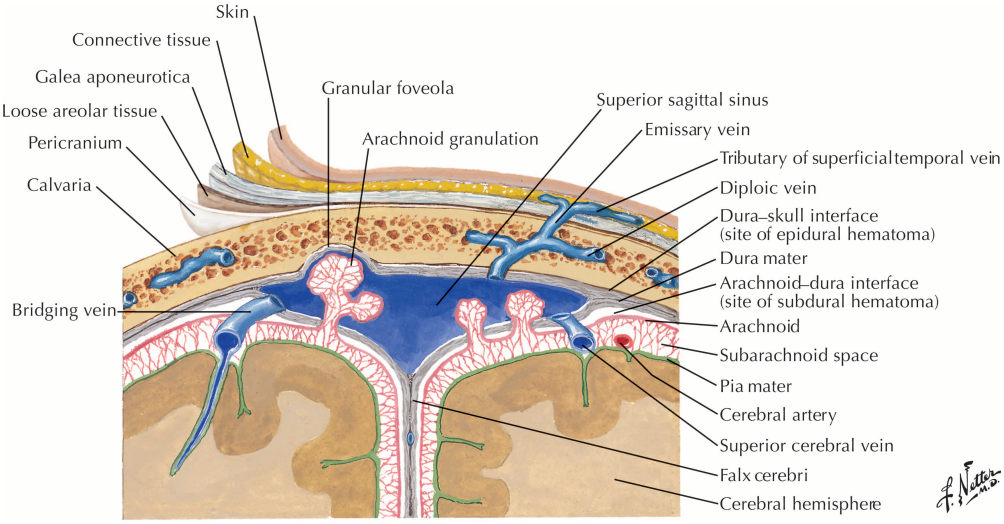
FIGURE 2.



Anatomy of the Scalp, Skull, and Meningeal and Cerebral Blood Vessels. Netter illustration used with permission of Elsevier, Inc. All rights reserved.

the orbits of the eyes and laterally to the temporal fascia above the ears.[1-3] It is estimated that the subgaleal space has the potential to accommodate up to 260 mL of blood.[1-3] The total blood volume of a term neonatal infant is approximately 80 mL/kg. Robinson and Rossiter[10] estimate that for every centimeter increase in head circumference above baseline approximately 40 mL of blood is lost in this space.

Coagulopathy is frequently reported in association with subgaleal hemorrhage.[2,3] Activation of hemostasis occurs when a vessel is ruptured or severed. In the event of a subgaleal hemorrhage there has been significant damage to the tissue in the subgaleal space; this tissue damage, along with vessel damage and bleeding, activates the coagulation cascade to help to stop the bleeding. When normal hemostasis cannot be maintained because of the extensive damage and injury, disseminated intravascular coagulation develops, often exacerbating the subgaleal hemorrhage.[1] Disseminated intravascular coagulation is a diffuse, systemic disorder and can cause bleeding and abnormal clotting in peripheral tissues, vessels, and internal organs.[1]

Assessment

All babies delivered after difficult extraction with either forceps or vacuum assistance should be carefully assessed and observed for signs of subgaleal hemorrhage.[1-4] It is recommended that all infants born with risk for subgaleal hemorrhage be monitored carefully for 48 hours.

The initial examination should include head circumference and presence of scalp swelling. A subgaleal hemorrhage is distinct from other extra cranial hemorrhages–caput succedaneum and cephalhematoma, in that it is a fluctuant mass that crosses suture lines, fontanels, or both.[1,2] The fluid frequently accumulates at the nape of the neck and behind the ears. The presenting signs of subgaleal hemorrhage are often those of shock, pallor, delayed capillary refill time, hypotension, hypotonia, and respiratory distress.[1,2] Vital signs should be carefully monitored for signs of shock, depending on the stage of shock heart rate may be elevated or decreased, blood pressure may initially be normal and then decrease rapidly.

While the initial injury occurs at delivery, the signs and extent of injury may present immediately or may be delayed, sometimes up to hours after birth.[1-6] The health care team should be aware that the initial assessment and laboratory work may essentially be normal.[1]

Management

In all cases in which subgaleal hemorrhage is suspected or confirmed, therapy should include replacing blood volume, treating for shock to maintain organ perfusion, managing coagulation disorders to assist in stopping bleeding and treating neurologic disturbances if present.[1]

Blood products including fresh frozen plasma (FFP) and packed red blood cells are used to initially replace volume and correct anemia from a falling hematocrit. The infant with signs of hypovolemic shock may also require inotropic support during volume replacement with blood products. Infants with disseminated intravascular coagulation will additionally require administration of platelets and clotting factors.

The recent literature reports case studies of off label use of recombinant factor VIIa (Food and Drug Administration approved for hemophilia A and B) to stop bleeding and decrease blood product administration.[7-9] It has most frequently been successful in cases of trauma, general and cardiac surgery, and obstetrics, and its use in pediatrics and infants has not been studied.[7] Both Hunseler et al[8] and Struass et al[9] provide recent case studies in its use in neonatal hemorrhage.

The care required for the critical infant with subgaleal hemorrhage is complex and challenging (Table 1). There are often concomitant diagnosis including seizures, anemia, hyperbilirubinemia, hypoxic ischemic encephalopathy, skull fracture, and subdural and parechymal bleeds, which must be managed as well. Care for these infants requires multiple resources including subspecialty consultation. The availability of the necessary resources for initial stabilization, management, and follow-up is most often found in a facility with a neonatal intensive care unit. Not all infants with subgaleal hemorrhage or suspected subgaleal hemorrhage are delivered in facilities with a NICU and therefore must be transported to higher level of care. Regardless of the place of birth, recognition and initiation of treatment of subgaleal hemorrhage is crucial by those caring for infants at risk.

Case Report

A male infant M.B. was delivered at 39 weeks, with a birth weight of 2924 g. Labor was spontaneous with

TABLE 1. Subgaleal Hemorrhage Cooling Therapy?

Frequently the initial presentation of an infant after a difficult delivery includes low Apgar scores, cord or initial blood gas with profound acidosis, and a pale infant with respiratory distress—these may be the result of a subgaleal hemorrhage and/or may be a result of birth asphyxia, which may qualify the infant for cooling therapy. Careful assessment and examination with consideration of disease process and best therapies must be considered. Initial stabilization and resuscitation must be established before cooling therapy is initiated.

variable decelerations. M.B. was delivered vaginally with vacuum assistance, time from initiation of vacuum until delivery was 21 minutes, and multiple "pop-offs" of the vacuum were noted. The Apgar score was 4 at 1 minute, 6 at 5 minutes, and 7 at 10 minutes. M.B. was noted to be pale after delivery, and positive pressure ventilation was given for approximately 4 minutes. On examination, bogginess of the scalp was noted in the delivery room. He was immediately taken to the nursery for further management. An umbilical artery catheter and an umbilical venous catheter were placed, and a complete blood cell count and differential and blood culture were obtained. A call was made at approximately 30 minutes of life for transport to a neonatal intensive care unit. The neonatal transport team delayed immediate departure to wait for FFP requested by the accepting physician in anticipation of treatment for the infant.

On initial examination by transport team, the infant was noted to be irritable with normal reflexes, a large fluctuant mass was noted over the right occipital area, infant was not in respiratory distress, infant was pale with decreased pulses, and head circumference was increased by 2 cm from recorded birth head circumference. Vital signs on arrival were recorded to be heart rate, 167 beats per minute; blood pressure, 51/30 mm Hg with a mean of 37; oxygen saturation in room air, 94%; and temperature, 36.5°C.

On arrival the transport team continued current therapies and additionally obtained the newborn genetic screen and started an FFP transfusion of 15 mL/kg and O negative packed red blood cells of 15 mL/kg. Calcium gluconate was also administered. Follow-up laboratory test findings included hematocrit, 35% arterial blood gas (ABG), pH 7.35, P_{O_2} 73, P_{CO_2} 33, bicarbonate 18, and base deficit −7. The infant received the remainder of available blood products; FFP 10 mL/kg and blood 5 mL/kg en route to the referral facility.

On admission to the NICU, the infant's hematocrit level was 36.4%. The infant's respiratory status remained stable. Coagulation studies were done and were significant for prothombin time: 12.2, partial thromboplastin time: 30.4, fibrinogen level: 214, with positive D-dimers. The infant received additional packed red blood cells and FFP during the hospital stay and was discharged home at approximately 1 week of age.

Several factors were critical in the outcome of this infant. Early identification by the delivery room team enabled the transport team to arrive quickly. Communication with the accepting physician enabled the transport team to utilize additional resources in order to provide FFP at the initiation of transport instead of waiting until the return to the NICU. Rapid intervention of administration of blood products prevented significant volume loss, maintained circulating volume, and prevented significant hypovolemic shock in this infant.

Implications for Transport

Transport is a dynamic environment. Many potentially adverse conditions are encountered in the transport environment. A critical care neonatal transport team is prepared to resuscitate and stabilize all infants, but there are often limitations in available resources. In the care of the infant with a subgaleal hemorrhage that requires blood product administration, frequent laboratory monitoring and detailed head assessment, there is not a blood bank on transport, laboratory results are limited, and space and care providers are limited. The team arranging and preparing for transport of these infants must carefully consider these limitations and evaluate additional available resources to successfully care for the infant during transport (Table 2). In the case presented earlier, the transport team was able to take FFP with them. Identifying the availability and accessibility of blood products is very critical. There are many community hospitals that have very limited blood and blood products available for infants. It is the early identification and intervention that leads to improved outcomes in these infants. The transport team must evaluate length of transport, condition of the infant, location of family, and access to resources to provide optimal care for these infants during transportation.

Family

Subgaleal hemorrhage is not a diagnosis that can be prepared for or anticipated before labor and delivery.

TABLE 2. Caring for the Infant With Subgaleal Hemorrhage

Assess and stabilize respiratory status
Assess head and skull for abrasion, ecchymosis, and swelling
Measure head circumference
Obtain laboratory studies: blood gas, type and cross, complete blood count, and coagulation studies
Establish intravenous access, umbilical lines when appropriate
Identify availability of blood products
Communicate status and plan of care with parents
Communicate status with transport team and/or referral facility/physician
Continue frequent assessment of vital signs, respiratory status, head examination, and laboratory studies including blood gases, hematocrit, ionized calcium, and pottassium.

Parents are most often anticipating the birth of a healthy new baby. It is important that a member of the health care team inform the parents of the risks and treatment of subgaleal hemorrhage and provide specific information regarding their new baby's condition. When transportation is necessary, methods of communication with the parents must be established to keep the parents updated.

Conclusion

Subgaleal hemorrhage is a potentially fatal complication of birth. Onset may be rapid or delayed. All infants with history of difficult delivery especially with vacuum or forceps assistance should be carefully monitored for signs and symptoms of subgaleal hemorrhage. Early identification, prompt communication, and planning can assist in improved outcomes especially when transport is required. The successful transport of an infant with subgaleal hemorrhage requires flawless participation of all members of the transport team.

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