

# Extensive Late-Onset Primary Subarachnoid Hemorrhage in a Preterm Infant

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**Primary subarachnoid hemorrhage is a rare event in the preterm infant and is most often diagnosed at the postmortem examination. An extremely preterm infant who developed septicemia from *Staphylococcus aureus* infection in the second postnatal week and presented with hypotension, metabolic acidosis, anemia, thrombocytopenia, and seizures is reported. Cranial ultrasound revealed a large extra-axial fluid collection involving the left parietal cortex that at postmortem examination was observed to be a large left-sided primary subarachnoid hemorrhage. The subarachnoid hemorrhage is most likely secondary to events associated with septic shock and probable disseminated vascular coagulopathy. © 1999 by Elsevier Science Inc. All rights reserved.**

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## Introduction

Germinal matrix/intraventricular hemorrhage is the most common form of bleeding in the very low-birth-weight infant, affecting 40-60% of those infants weighing less than 1,000 gm [1]. In contrast, severe or catastrophic primary subarachnoid hemorrhage (SAH) is rarely observed in this patient population. When it occurs, SAH is most often observed incidentally at postmortem examina-

tion [2]. In general, SAH is considered a "benign intracranial lesion" [3]; however, when extensive in nature, the risk of morbidity and mortality is markedly increased [4,5]. We describe a case of extensive SAH in an extremely preterm infant with sepsis to illustrate the salient clinical, radiologic, and pathologic features in this patient population.

## Case Report

The patient was a 646-gm, 25-week, appropriate for gestational age, female infant, the second of a twin gestation, born to a 21-year-old mother. The infant was delivered vaginally in the breech position. The Apgar scores were 3, 6, and 8 at 1, 5, and 10 minutes, respectively. The initial hospital course was complicated by hyaline membrane disease requiring surfactant therapy, patent ductus arteriosus that was treated with indomethacin, hyperglycemia, and hypernatremia. Cranial ultrasound scans at 3 and 7 days of age were normal. At 9 days of age, the infant became lethargic and hypotensive and developed necrotizing enterocolitis with pneumatosis, associated with a sudden fall in hematocrit from 35% to 19%. A hemogram revealed leukocytosis with a left shift and a platelet count of 33,000/mm<sup>3</sup>. A C-reactive protein measurement was not obtained. A septic evaluation, including a spinal tap, was performed. The cerebrospinal fluid revealed 79/mm<sup>3</sup> erythrocytes, with protein 105 mg/dL and glucose 171 mg/dL without evidence of meningitis. Antibiotics were initiated. On the following day, the infant exhibited generalized tonic-clonic seizures that were treated with phenobarbital. A third cranial ultrasound scan obtained at that time revealed a large extra-axial fluid collection in the left parieto-occipital region (Fig 1A). A second scan 24 hours later demonstrated a significant midline shift (Fig 1B). The infant remained hypotensive and acidotic despite aggressive medical treatment. Because of the unstable condition and grave prognosis, no surgical intervention was attempted, and the infant died at 11 days of age. The blood cultures were positive for methicillin-resistant *Staphylococcus aureus*. Cultures for herpes simplex and other viruses were negative.

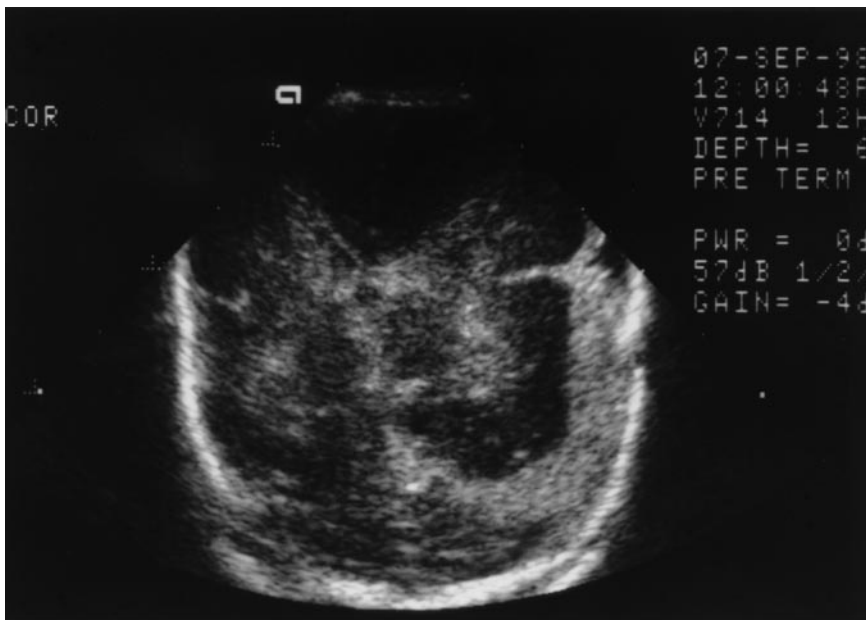
The postmortem examination revealed a large, organized hematoma confined to the subarachnoid space that compressed the left parietal lobe with a midline shift of the hemisphere (Fig 2). There was minimal evidence of acute neuronal necrosis within the cortex. A small hemorrhage was observed within the fourth ventricle. The cerebral vessels were congested, and no aneurysm was identified. System findings included evidence of necrotizing enterocolitis with terminal ileal perforation. There was multifocal hemorrhage into the acinar spaces of the lungs and hemorrhage at the corticomedullary junction within the kidneys.

## Discussion

SAH is a relatively common intracranial hemorrhage observed more often in term than in preterm infants [3]. Although most cases of SAH are asymptomatic, the diagnosis in term infants is usually based on symptoms

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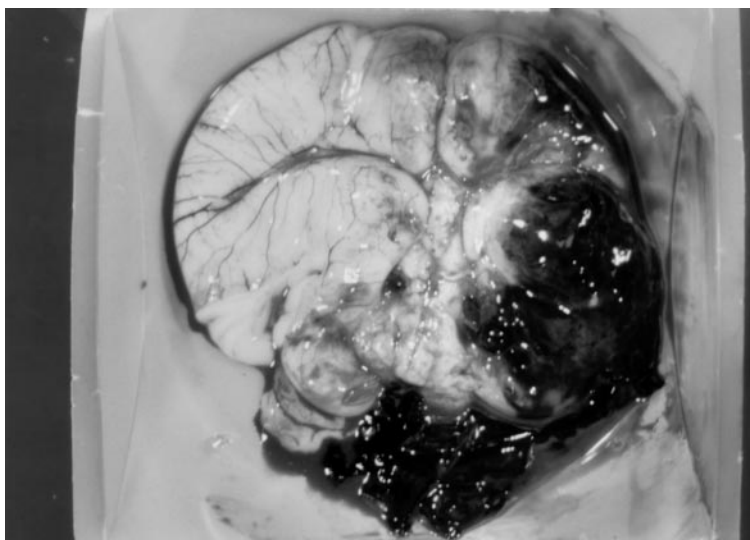
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Figure 1. (A) Cranial ultrasound scan obtained on day 9. Observe the increased echogenicity extending inferiorly from within the left sylvian fissure. (B) Coronal ultrasound scan obtained 24 hours later. Observe the larger appearing lesion with areas of hyperechogenicity interspersed with areas of hypoechogenicity. A midline shift is also present.

(e.g., seizure, apnea), abnormal neurologic signs (e.g., lethargy, tense anterior fontanel), or bloody cerebrospinal fluid without clearing during drainage [3,6]. The diagnosis is most frequently confirmed by cranial computed tomography. The etiology of SAH in term infants is presumed to be related to the processes of delivery in most cases. Less common causes include hemophilia [7], saccular aneurysm [8-11], mycotic aneurysm [12], and arteriovenous malformation [13]. In these circumstances, the subarachnoid blood usually extends from the primary site of bleeding (i.e., intraventricular, cerebellar, or subdural). In preterm infants, SAH is more difficult to diagnose clinically because the symptoms are often nonspecific or

related to other primary disease processes [3]. Most commonly, it is incidentally diagnosed at postmortem examination [2,3]. SAH in most cases involving the preterm infant is secondary to intraventricular hemorrhage, with extension of blood through the foraminae of Luschka and Magendie into the subarachnoid space [3]. Primary SAH is much less common. The distribution of small-to-moderate SAH is usually over the cerebral hemisphere or within the sylvian fissure [2]. When severe, SAH may present as a circumscribed blood coagulum or subarachnoid hematoma. In one large postmortem examination series the hematoma mostly involved the temporal lobe, with a left-sided predominance [2]. The pathogenesis

Figure 2. Brain specimen from the infant from the postmortem examination. Observe the large organized hematoma involving the left posterior parietal cortex. The hematoma was confined to the subarachnoid space.



of primary SAH remains unclear. Factors considered important include previous hypoxia, fragility of blood vessels within the subarachnoid space, and elevations in venous pressure [2].

The sonographic diagnosis of SAH is less well described than that of germinal matrix/intraventricular hemorrhage. SAH presents as an extra-axial fluid collection that is difficult to distinguish from that observed with a subdural hematoma. Computed tomography is often used to reveal the characteristic findings of sulci and fissures filled with blood [14]. In the present report the extra-axial fluid collection observed on the sonogram was initially interpreted as representing a large subdural hematoma. However, the location of blood within and extending beyond the sylvian fissure was more consistent with SAH, which was confirmed at postmortem examination. The late development of the unilateral subarachnoid hematoma in the absence of marked bleeding within the germinal matrix

or intraventricular system was unanticipated. Although the unilateral involvement was somewhat unusual, it is consistent with the previous postmortem examination findings of Larroche [2]. There are three previous case reports of similar late hemorrhage in preterm infants (Table 1). In two of the cases the blood was confined to the subdural space [15], and it was confined to the subarachnoid space in one infant [4]. All three infants were extremely premature (i.e., birth weight less than 1,000 gm) and had evidence of Gram-negative septicemia (i.e., *Escherichia coli* and *Klebsiella pneumoniae*). In the authors' patient, evidence of multiorgan hemorrhage at postmortem examination supports the role of sepsis and probable disseminated intravascular coagulopathy in the genesis of the SAH. Bleeding from bridging veins is a less likely possibility. Interestingly enough, *Staphylococcus aureus*, the organism identified in this case, has been previously associated with mycotic aneurysms [12,16]. However,

Table 1. Characteristics of subarachnoid and subdural hematomas in preterm infants

Reference	GA, BW	Primary Diagnosis	Postnatal Age (day)	Radiologic Findings	Postmortem Examination Findings
4	32 wk, 2,100 gm	Septicemia, <i>K. pneumoniae</i>	11	HUS (day 11): large extra-axial fluid collection over left temporal lobe, small GMH CT scan (day 11): large subarachnoid hematoma	—
15	33 wk, 935 gm	Septicemia, DIC, <i>E. coli</i>	6	HUS (day 6): large extra-axial fluid collection with midline shift CT scan (day 15): large SDH over left cerebral hemisphere, hydrocephalus	—
	27 wk, 795 gm	Septicemia, DIC, <i>K. pneumoniae</i>	8	HUS (day 8): large extra-axial fluid collection over right cerebral hemisphere CT scan (1 mo): resolving SDH, hydrocephalus, porencephalic cyst	Same

Abbreviations:

BW = Birth weight

CT = Computed tomography

DIC = Disseminated intravascular coagulopathy

*E.* = *Escherichia*

GA = Gestational age

GMH = Germinal matrix hemorrhage

HUS = Cranial ultrasound

*K.* = *Klebsiella*

SDH = Subdural hematoma

aneurysmal dilatation of any vessel was not identified at postmortem examination.

The authors described the unusual and late appearance of massive unilateral SAH in a preterm infant diagnosed by cranial ultrasound scan with postmortem examination correlation. The SAH in this patient was most likely secondary to events associated with septic shock and probable disseminated intravascular coagulopathy.

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