OBSERVATION

Association of Solitary, Segmental Hemangiomas of the Skin With Visceral Hemangiomatosis

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Background: Multiple hemangiomas of the skin have traditionally been recognized as a clue to potential visceral hemangiomas. Recently, hemangiomas have been recognized to have subcategories, localized and segmental, which correlate with risk of complications. While less common, segmental hemangiomas of the skin have a higher risk of being life- or function-threatening and/or having associated structural anomalies such as those that occur in PHACE (posterior fossa brain malformations, hemangiomas, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities) syndrome (PHACES, if sternal clefting/supraumbilical raphe is included). However, the potential association of solitary, segmental hemangiomas of the skin with visceral hemangiomatosis has not been previously emphasized.

Observations: A total of 47 cases of segmental hemangiomas of the skin in association with visceral hemangiomatosis were found. The location of the cutaneous hemangiomas most commonly, but not exclusively, involved the face (37 cases [79%]). The most common site of internal organ involvement was the liver (20 cases [43%]), followed by the gastrointestinal tract (16 [34%]), brain (16 [34%]), mediastinum (9 [19%]), and lung (7 [15%]). The percentages of reported cases of hemangiomas of the pancreas, spleen, bones, or kidneys were 6% or less. Forty percent of patients met criteria for the diagnosis of PHACE(S) syndrome. In this subgroup, internal organ hemangiomas were most commonly found in the brain or mediastinum (18 cases [53%]). Overall, 12 patients (25%) died during infancy, most commonly because of gastrointestinal involvement or congestive heart failure secondary to liver involvement.

Conclusion: Segmental hemangiomas of the skin have an associated risk of visceral hemangiomatosis, with the potential of causing vital organ compromise.

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HEMANGIOMAS OF INFANCY (HOI) are the most common benign tumors of childhood. Unique in their behavior, HOI classically undergo an initial phase of proliferation, followed by slow involution and often complete regression. Demonstrating a striking predilection for the head and neck region, HOI occur in 2 morphologic forms. Most are localized, tumor-like lesions, with a relatively low risk of associated complications. Less commonly, HOI are of "segmental" morphology, which are generally larger, involving a region or territory of skin.[1] Many, but not all, segmental hemangiomas have a more plaquelike morphology. It is now recognized that segmental HOI have a higher risk of causing life- or function-threatening complications and of having associated structural anomalies. For example, PHACE (Online Mendelian Inheritance in Man [OMIM] 606519) is a neurocutaneous syndrome in which segmental hemangiomas, most commonly of the face, are associated with 1 or more of the following anomalies: posterior fossa brain malformations, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities (called PHACES if ventral developmental defects such as sternal clefting and/or supraumbilical raphe are included).[2]

In contrast, multifocal cutaneous hemangiomas (generally defined as 5 or more) have a "localized" type of morphology and a well-recognized potential for concomitant visceral hemangiomas. The term "disseminated neonatal hemangiomatosis" has been used to describe the uncommon presentation of several to hundreds of small, multifocal hemangiomas of the skin in association with extracutaneous hemangiomas, most commonly hepatic.[3] In this article, we report 4 cases and present data from 43 additional reports of segmental hemangiomas of the skin asso-

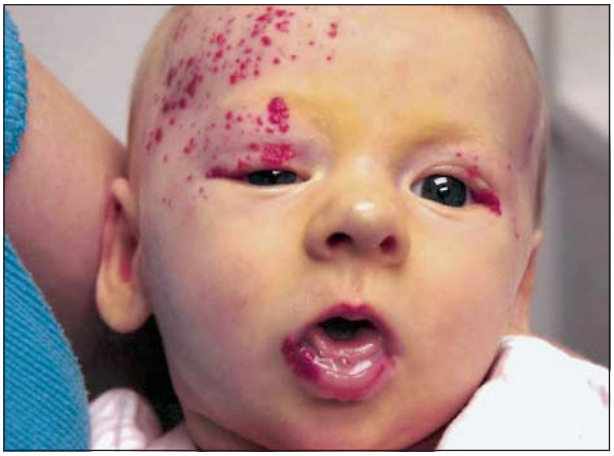

Figure 1. Multiple facial hemangiomas present in a segmental distribution in patient 1.

ciated with visceral hemangiomas, emphasizing the potential of extracutaneous hemangiomas in this setting.

METHODS

We retrospectively reviewed the records of 4 patients with both segmental cutaneous and visceral hemangiomas. In addition, a PubMed search using the key words *hemangiomatosis, large hemangioma,* and *hemangioma* AND *liver, hepatic, gastrointestinal, brain, cardiac, pancreas, spleen, thyroid, mediastinum, bone,* and *trachea* was performed, and each discovered case was then cross-referenced. Reports of ocular and/or airway hemangiomas, as well as cases of visceral involvement due to contiguous extension from the skin, were excluded. The 130 cases of PHACE(S) syndrome detailed by us in 2001, as well as 31 additional cases since reported, were also reviewed for the presence of internal organ involvement.

REPORT OF CASES

CASE 1

A 2-month-old white female infant presented to the pediatric dermatology service for multiple facial hemangiomas that had progressively developed over her first month of life. She was also known to have a large perimembranous ventricular septal defect, a small secundum atrial septal defect, and pulmonary stenosis, and thus met criteria for PHACE(S) syndrome. On examination, she had multiple erythematous papules in a bilateral, segmental distribution involving her temples, eyelids, and lower lip (**Figure 1**). No extrafacial cutaneous hemangiomas were present. Prednisolone treatment (2 mg/kg per day) was initiated because of right visual obstruction and she was immediately evaluated by an ophthalmologist. However, after 6 weeks, the treatment was rapidly tapered owing to poor weight gain and progressive cardiac compromise.

Brain magnetic resonance imaging (MRI) performed when she was 4 months old showed a large right orbital hemangioma, a hemangioma in the deep parotid space, and angiomatous thickening along the seventh and eighth cranial nerves and internal auditory canal. No structural malformations of the brain were present. Brain magnetic resonance angiography demonstrated anomalous cerebral vasculature with persistent fetal circulation and an essentially absent internal carotid artery on the right side; anomalous fenestration and duplication of the cavernous internal carotid artery on the left side; enlarged external carotid branches on the right side; and an enlarged right ophthalmic artery. Although many of her small cutaneous facial hemangiomas had resolved, the right periorbital lesion was continuing to enlarge. An intralesional steroid injection was performed and patching of the left eye was recommended.

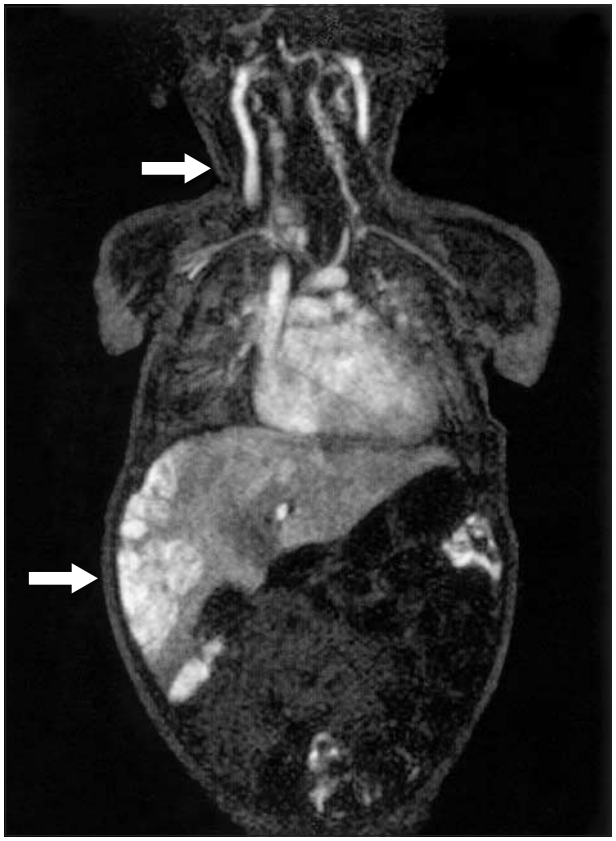

Figure 2. Magnetic resonance image revealing multiple hepatic and paratracheal hemangiomas (arrows) in patient 1.

At 5 months of age she was admitted to Texas Children's Hospital in Houston for progressive failure to thrive. Chest radiographs demonstrated cardiomegaly and increased pulmonary vascularity. Limited MRI of the chest and abdomen was performed to determine whether hemangiomas were present, which could have complicated an anticipated cardiovascular surgery. The image revealed multiple hepatic hemangiomas mainly involving the right lobe of the liver, with a small focus in the medial segment of the left lobe (**Figure 2**). There was arteriovenous shunting from the hepatic arterial to the portal venous systems. Abnormal soft tissue was also visualized from the superior mediastinum and lower neck to the thoracic inlet, which corresponded to paratracheal hemangioma although no airway compromise was evident.

Cardiac catheterization indicated that the intracardiac shunt was the most significant. Preoperative laboratory data, which included thyroid function tests, were

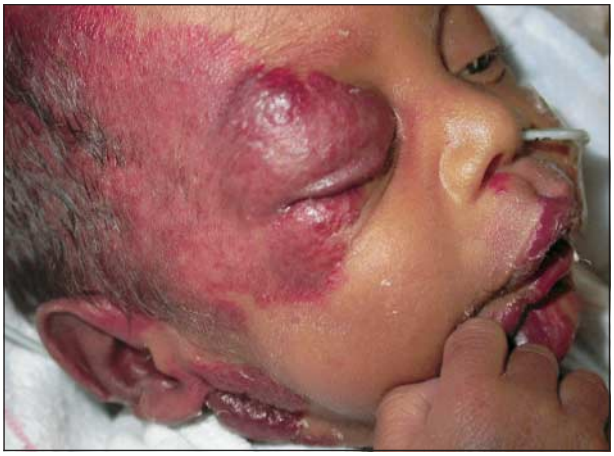

Figure 3. Right-sided, segmental hemangioma of the face and scalp in patient 2.

within normal limits except for a slightly elevated serum aspartate aminotransferase level. Cardiac repair included closure of the atrial and ventricular septal defects, right ventricular outflow tract resection, and patch augmentation of the main pulmonary artery. Five weeks postoperatively she had gained weight, and although persistent hepatomegaly and a diastolic inflow rumble were found on examination, furosemide could be discontinued. She has since undergone continuous monitoring by the cardiology, dermatology, hepatology, and neurology services. She has remained stable except for mild bilateral conductive hearing loss, for which she has been fitted with hearing aids. Both her cutaneous and visceral hemangiomas have undergone slow but steady involution.

CASE 2

A 2-month-old African American male infant born 13 weeks prematurely was transferred to Texas Children's Hospital for the evaluation of multiple medical problems. He was noted to have a right-sided segmental hemangioma of the face and scalp (**Figure 3**), ventricular septal defect, patent foramen ovale, right-sided aortic arch, and severe pulmonary stenosis, and thus met criteria for PHACE(S) syndrome. Further workup on admission included MRI of the chest and abdomen, which confirmed the known cardiac defects but revealed no visceral hemangiomas. Magnetic resonance angiography of the brain showed an aberrant course of the right internal carotid artery with persistent basilar anastomosis with the fetal carotid. An MRI of the brain did not reveal any structural abnormalities but showed a right cerebellopontine angle mass consistent with an intracranial hemangioma, which extended into the internal auditory canal (**Figure 4**).

A daily dose of 3 mg/kg of prednisolone was initiated because of right visual axis obstruction and the intracranial hemangioma. However, the patient's course was further complicated 2 weeks after admission by the development of a methicillin-resistant *Staphyloccus aureus* sepsis that required rapid tapering of the steroid treatment. His cutaneous hemangiomas are being monitored

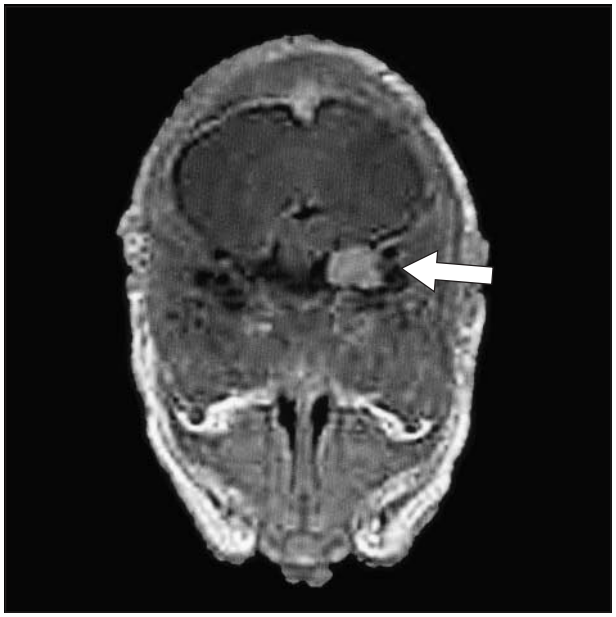

Figure 4. Magnetic resonance image revealing an intracranial hemangioma (arrow) in patient 2.

clinically and his intracranial hemangioma with serial imaging studies.

CASE 3

A white infant girl presented at 7 months of age with a segmental, right-sided hemangioma of the face, scalp, and neck. Mild gastrointestinal bleeding had occurred earlier in infancy, and MRI and endoscopy confirmed the presence of hemangiomas in the gastrointestinal tract. No intervention was required. A complete workup for PHACE(S) syndrome was negative.

CASE 4

A female infant presented at 4 months of age with a segmental hemangioma of the lumbosacral spine and gluteal cleft. During MRI studies evaluating for possible tethered spinal cord (which was not present), an asymptomatic hemangioma of the right lobe of the liver measuring 1.2 cm in diameter was noted.

ADDITIONAL REPORTS

Besides our 4 cases, we discovered 43 additional reports of segmental, cutaneous hemangiomas associated with internal organ involvement[1,4-24] (**Table 1**). Hemangiomas of the airway and eye were excluded. Most patients were female, and the segmental hemangioma was located on the face in most, and most commonly unilaterally. We found only 1 case with a hemangioma morphology similar to that described in case 1—specifically, with multiple small facial hemangiomas in a segmental distribution.[13]

Thirty (64%) of the total of 47 cases described only 1 extracutaneous site of visceral hemangioma; 11 patients (23%) had 2 and 6 patients (13%) had 3 or more sites involved. The liver was the most common extracu-

Table 1. Segmental Hemangiomas of the Skin and Visceral Hemangiomatosis: Summary of Findings in 47 Patients Without Associated PHACE(S) Syndrome*

Hemangioma Location	No. (%) of Cases
Skin	
Face	37 (79)
Unilateral	17 (36)
Left	7 (15)
Right	7 (15)
Ear	2 (4)
Unspecified	3 (6)
Face, scalp, and neck	11 (23)
Face, upper extremity, and/or trunk	3 (6)
Face and multifocal	1 (2)
Nonfacial	1 (2)
Neck, trunk, and arm	1 (2)
Trunk and arm	1 (2)
Trunk	1 (2)
Chest	1 (2)
Thigh	1 (2)
Buttock	1 (2)
Gluteal cleft	1 (2)
Occiput, cervical spine, and lumbar spine	1 (2)
Internal organ	
Liver	20 (43)
Within right lobe	1 (2)
Partial replacement of left lobe	1 (2)
Gastrointestinal tract	16 (34)
Small intestine	4 (5)
Rectum	2 (4)
Greater omentum	1 (2)
Brain	16 (34)
Leptomeninges	6 (13)
Cerebellar-pontine angle	6 (13)
Pituitary gland, stalk, and/or hypophysis	4 (5)
Cranial nerves	1 (2)
Ventral basis pontis	1 (2)
Frontal horns	1 (2)
Cavernous sinus	1 (2)
Middle fossa/suprasellar cistern	1 (2)
Uncohippocampal	1 (2)
Hypothalamus	1 (2)
Vermis	1 (2)
Cerebral cortex	1 (2)
Mediastinum	9 (19)
Retro-oropharyngeal	2 (4)
Paratracheal	1 (2)
Thymus	1 (2)
Heart/pericardium	1 (2)
Pyriform sinus	1 (2)
Thyroid	1 (2)
Lung	7 (15)
Left lobe/pleural cavity	1 (2)
Right upper lobe	1 (2)
Pancreas	3 (6)
Distal half	1 (2)
Head	1 (2)
Spleen	3 (6)
Bone	3 (6)
Lower thoracic spine	1 (2)
Kidney	1 (2)
Suprarenal gland	1 (2)
Segmental facial hemangioma and visceral hemangiomatosis	19 (40)

Abbreviations: PHACE, posterior fossa brain malformations, hemangiomas, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities; PHACE(S), if sternal clefting/supraumbilical raphe is included with PHACE.

*There were 37 female (79%) and 10 male (10%) patients.

taneous site, followed by the gastrointestinal tract, brain, mediastinum, and lung. Of the patients in whom laterality of both the visceral and cutaneous hemangiomas were noted, 7 had ipsilateral facial and intracranial hemangiomas[4,6,14,22]; only 1 was contralateral.[22] Two cases each of pulmonary[6,8] and liver hemangiomatosis[4,6] were also noted to be ipsilateral to their cutaneous hemangioma.

The 19 patients (40%) who met the criteria for PHACE(S) syndrome included a patient with a segmental hemangioma in addition to multifocal generalized lesions described by Geller et al[10] (**Table 2**). All patients with PHACE(S) had a segmental hemangioma located on the face except 1, who was described as having a deep segmental hemangioma of the left side of the chest.[17] Of these 19 patients, 8 patients (42%) were noted to have 1 extracutaneous PHACE(S) manifestation, 6 patients to have 2, 3 patients to have 3, and 2 patients to have 4. The most common PHACE(S) manifestations noted were structural anomalies of the brain, followed by cardiac anomalies and/or coarctation of the aorta, arterial anomalies, eye abnormalities, and ventral developmental defects. The most common sites for visceral hemangiomas among such patients were the brain and mediastinum. Nearly an equal number of patients with segmental hemangiomas of the face did not have PHACE(S) syndrome.

Twelve patients died in early infancy, and 4 of these deaths were the result of extensive gastrointestinal involvement. The first patient received supportive care alone and died of sepsis and massive cerebral edema[7]; the second had PHACE(S) syndrome and arterial anomalies that included aortic coarctation and died despite aortic and intestinal surgery[17]; the third died of massive gastrointestinal bleeding despite intravenous treatment with steroids and interferon[21]; and the fourth died of massive gastrointestinal bleeding and seizures.[15] Three of the 12 deaths were the result of congestive heart failure secondary to hepatic involvement despite treatment with corticosteroids in 1 patient[9] and embolization, liver irradiation, and corticosteroid treatment in the other 2.[9] Three deaths were the result of of multiorgan failure that included the liver, gastrointestinal tract, and brain. One patient died of congestive heart failure,[23] another from seizures, pneumonia, and sepsis,[6] and the third from pneumonitis and possibly congestive heart failure.[4] Of the 2 remaining deaths, one was the result of progressive neurologic decline during infancy and the other occurred in the patient described by Geller et al.[10] The latter patient had multifocal, generalized hemangiomas and a segmental cutaneous hemangioma of the face, PHACE(S) syndrome, and intracranial involvement. Death occurred on this patient's 26th day of life despite treatment with intravenous steroids. Although only intracranial hemangiomas were noted, multiorgan involvement was likely although an autopsy was denied.

COMMENT

Hemangioma involvement of the internal organs, generally associated with multiple cutaneous hemangiomas, is a known entity distinct from PHACE(S) syndrome. Some authors have used the term "hemangiomatosis" to describe the presence of multiple (>5)

small, generalized hemangiomas, and draw a distinction between "benign" and "disseminated" or "diffuse" hemangiomatosis on the basis of the extent of internal organ involvement and associated morbidity risk.[3,25-27] Others have proposed the designation "multiple hemangiomas with or without extracutaneous involvement" as a more appropriate description of the spectrum of possible manifestations.[28]

It has recently been recognized that "segmental" HOI have a markedly higher risk of being life- or function-threatening and/or having associated structural anomalies, that they generally require more intensive and prolonged therapy, and that they are associated with a poorer outcome.[1] Although segmental hemangiomas of the face overlying the mandibular skin and neck (in a so-called beard distribution) have a known risk of noncontiguous hemangiomas of the airway,[29] the potential association of a segmental hemangioma (in any location) with visceral hemangiomatosis has received much less attention.[9] Because HOI, especially those of segmental morphology, show an increased incidence among female infants and are most commonly located in the head and neck,[1,30] the female and facial predominance demonstrated in our series were expected findings. More important was the association of internal organ hemangiomas (with or without PHACE[S]) syndrome, with segmental HOI in cutaneous locations other than the face. This finding serves to further support the significance of lesion morphology as a risk factor for potential complications, even independent of hemangioma location. Interestingly, the cutaneous and extracutaneous hemangiomas were found to be ipsilateral in most reports in which laterality was noted.

Most our patients were found to have only 1 extracutaneous site of visceral involvement with hemangioma. However, this finding, in addition to the general association of segmental hemangiomas of the skin with internal organ hemangiomatosis, is likely underestimated since extensive imaging is not performed in otherwise asymptomatic patients. For example, in 2 of our patients, liver hemangiomas were only discovered upon routine imaging for another indication. Similarly, it is likely that cases of visceral hemangiomatosis in association with solitary cutaneous hemangiomas of localized morphology exist, although the extensive cross-referencing undertaken in our series revealed no such cases. In addition, there is always the possibility of diagnostic heterogeneity in any review of the literature, especially in relation to vascular lesions. The diagnosis of visceral hemangioma in our series was often based on characteristic imaging results and/or clinical course, without accompanying histopathologic studies or confirmatory immunostaining with glucose transporter protein 1. Thus, despite the presence of a cutaneous hemangioma, we cannot exclude the possibility that the visceral lesions in some of the cases included in our series represented vascular anomalies or other glucose transporter protein 1–negative vascular tumors.

The liver was the most common site of organ involvement with hemangioma in our series, followed by the gastrointestinal tract and the brain. These results are similar to those found in patients described under the syndrome of "multiple hemangiomas with extracutaneous involvement."[25] However, we discovered a higher-than-expected number of cases of hemangiomas of the mediastinum and brain. In fact, these were the most common sites of extracutaneous involvement among patients with PHACE(S) syndrome, a finding not appreciated in our previous review of the syndrome but recently noted in a report by Poetke et al.[23] However, patients with PHACE are more likely to undergo imaging of the head and neck to look for potential anomalies. Consistent with our previous review of PHACE(S) syndrome, most patients in the present series were noted to have only 1 extracutaneous manifestation of PHACE(S), which supports the concept of this syndrome as a spectrum of disease.[24]

Table 2. Segmental Hemangiomas of the Skin and Visceral Hemangiomatosis: Summary of Findings in 19 Patients With Confirmed PHACE(S) Syndrome*

Abnormality	No. (%) of Cases
Cutaneous segmental hemangioma	
Face	18 (95)
Chest	1 (5)
Structural brain malformation	11 (58)
Cardiac anomalies/coarctation of the aorta	10 (53)
Arterial anomalies	8 (42)
Eye anomalies	5 (26)
Ventral developmental defects	3 (16)
Visceral hemangiomas	
Brain	10 (53)
Mediastinum	9 (47)
Gastrointestinal tract	6 (32)
Liver	5 (26)
Lung	3 (16)
Pancreas	1 (5)
Bone	1 (5)

Abbreviations: PHACE, posterior fossa brain malformations, hemangiomas, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities; PHACE(S), if sternal clefting/supraumbilical raphe is included with PHACE.

*There were 19 cases of segmental facial hemangioma and visceral hemangiomatosis in patients without PHACE(S).

Approximately one fourth of the patients in our series died early in infancy, most commonly from complications related to gastrointestinal bleeding or hepatic involvement—known worrisome locations. Hepatic hemangiomas may manifest with coagulopathy, heart failure, and/or respiratory distress. Internal hemorrhage is also of significant concern with hemangiomas in hepatic or gastrointestinal locations. A recent review of hepatic hemangiomas reported mortality rates between 15% and 43%, depending on the mode of treatment.[31] In a recent review by Iyer et al,[32] one third of hepatic hemangiomas were associated with hemangiomas in other sites, and most patients became symptomatic shortly after birth. Therapeutic options for hepatic and gastrointestinal hemangiomas may include surgical resection, embolization, corticosteroids, and interferon alfa.[31]

The small number of deaths noted in our series did not allow for an analysis of mode of treatment. However, it should be noted that 3 of the 12 deaths occurred prior to 1990, a time when systemic therapies with agents such as interferon were not routinely used for life-threatening hemangiomas. However, even with the pres-

ent availability of such agents, alternatives are sometimes needed for life-threatening hepatic hemangiomas.

The potential presence of extracutaneous hemangiomatosis should be considered in patients with segmental hemangiomas, including those with PHACE(S) syndrome. Comprehensive full-body imaging of all patients with segmental hemangiomas is not recommended because of the expense involved and the need for general anesthesia when obtaining magnetic resonance studies in young infants. In addition, it should be noted that many extracutaneous hemangiomas will remain completely asymptomatic. Instead, evaluation should be tailored to other risk factors (depending on the anatomic location of the hemangioma) and other signs and symptoms that may be present.

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REFERENCES

1. Chiller KG, Pasaro D, Frieden IJ. Hemangiomas of infancy: clinical characteristics, morphologic subtypes, and their relationship to race, ethnicity, and sex. *Arch Dermatol.* 2002;138:1567-1576.
2. Frieden IJ, Reese V, Cohen D. PHACE syndrome: the association of posterior fossa brain malformations, hemangiomas, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities. *Arch Dermatol.* 1996;132:307-311.
3. Holden KR, Alexander F. Diffuse neonatal hemangiomatosis. *Pediatrics.* 1970; 46:411-421.
4. Cooper AG, Bolande RP. Multiple hemangiomas in an infant with cardiac hypertrophy: postmortem angiographic demonstration of arteriovenous fistulae. *Pediatrics.* 1965;35:27-35.
5. Sawaya R, McLaurin RL. Dandy-Walker syndrome: clinical analysis of 23 cases. *J Neurosurg.* 1981;55:89-98.
6. Billson VR, Gillam GL. An unusual case of Sturge-Weber syndrome. *Pathology.* 1984;16:462-465.
7. Hersh JH, Rutledge J, Harrod MJE, et al. Sternal malformation/vascular dysplasia association. *Am J Med Genet.* 1985;21:177-186.
8. Geggel RL, Fulton DR, Chernoff HL, Cleveland R, Hougen TJ. Cor triatriatum associated with partial anomalous pulmonary venous connection to the coronary sinus: echocardiographic and angiocardiographic features. *Pediatr Cardiol.* 1987; 8:279-283.
9. Enjolras O, Riche MC, Merland JJ, Escande JP. Management of alarming hemangiomas of infancy: a review of 25 cases. *Pediatrics.* 1990;85:491-498.
10. Geller JD, Topper SF, Hashimoto K. Diffuse neonatal hemangiomatosis: a new constellation of findings. *J Am Acad Dermatol.* 1991;24:816-818.
11. Pongprasit P. Corticosteroid treatment of extensive hemangiomas: analysis of 22 cases in children. *J Med Assoc Thai.* 1992;75:671-679.
12. Ezekowitz RAB, Mulliken JB, Folkman J. Interferon alfa-2a therapy for life-threatening hemangiomas of infancy. *N Engl J Med.* 1992;326:1456-1463.
13. Reese V, Frieden IJ, Paller AS, et al. The association of facial hemangiomas with Dandy-Walker and other posterior fossa malformations. *J Pediatr.* 1993;122: 379-384.
14. Bar-Sever Z, Horev G, Lubin E, et al. A rare coexistence of a multicentric hepatic hemangioendothelioma with a large brain hemangioma in a preterm infant. *Pediatr Radiol.* 1994;24:141-142.
15. Moran CA, Suster S. Mediastinal hemangiomas: a study of 18 cases with emphasis on the spectrum of morphologic features. *Hum Pathol.* 1995;26:416-421.
16. Samuel M, Spitz L. Infantile hepatic hemangioendothelioma: the role of surgery. *J Pediatr Surg.* 1995;30:1425-1429.
17. Pascual-Castroviejo I, Viano J, Moreno F, et al. Hemangiomas of the head, neck and chest with associated vascular brain anomalies: a complex neurocutaneous syndrome. *Am J Neuroradiol.* 1996;17:461-471.
18. Patel SD, Cohen BA, Kan JS. Extensive facial hemangioma associated with cardiac and abdominal anomalies. *J Am Acad Dermatol.* 1997;36:636-638.
19. Enjolras O, Gelbert F. Superficial hemangiomas: associations and management. *Pediatr Dermatol.* 1997;14:173-179.
20. Burrows PE, Robertson RL, Mulliken JB, et al. Cerebral vasculopathy and neurologic sequelae in infants with cervicofacial hemangioma: report of eight patients. *Radiology.* 1998;207:601-607.
21. Scafadi DE, McLeary MS, Young LW. Diffuse neonatal gastrointestinal hemangiomatosis: CT findings. *Pediatr Radiol.* 1998;28:512-514.
22. Tortori-Donati P, Fondelli MP, Rossi A, Bava GL. Intracranial contrast-enhancing masses in infants with capillary hemangioma of the head and neck: intracranial capillary hemangioma? *Neuroradiology.* 1999;41:369-375.
23. Poetke M, Froemmeld T, Berlien HP. PHACE syndrome: new views on diagnostic criteria. *Eur J Pediatr Surg.* 2002;12:366-374.
24. Metry DW, Dowd CF, Barkovich AJ, Frieden IJ. The many faces of PHACE syndrome. *J Pediatr.* 2001;139:117-123.
25. Golitz LE, Rudikoff J, O'Meara OP. Diffuse neonatal hemangiomatosis. *Pediatr Dermatol.* 1986;3:145-152.
26. Lopriore E, Markhorst DG. Diffuse neonatal hemangiomatosis: new views on diagnostic criteria and prognosis. *Acta Paediatr.* 1999;88:93-97.
27. Stern JK, Wolf JE, Jarrat M. Benign neonatal hemangiomatosis. *J Am Acad Dermatol.* 1981;4:442-445.
28. Bruckner AL, Frieden IJ. Hemangiomas of infancy. *J Am Acad Dermatol.* 2003; 48:477-493.
29. Orlow SJ, Isakoff MS, Blei F. Increased risk of symptomatic hemangiomas of the airway in association with cutaneous hemangiomas in a "beard" distribution. *J Pediatr.* 1997;131:643-646.
30. Finn MC, Glowacki J, Mulliken JB. Congenital vascular lesions: clinical application of a new classification. *J Pediatr Surg.* 1983;18:894-899.
31. Boon LM, Burrows PE, Paltiel HJ, et al. Hepatic vascular anomalies in infancy: a twenty-seven year experience. *J Pediatr.* 1996;129:346-354.
32. Iyer CP, Stanley P, Mahour GH. Hepatic hemangiomas in infants and children: a review of 30 cases. *Am Surg.* 1996;62:356-360.