

Clinical Spectrum and Risk of PHACE Syndrome in Cutaneous and Airway Hemangiomas

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Objective: To describe the clinical presentation and risk of PHACE syndrome in infants with large facial hemangiomas and concomitant airway hemangiomas.

Design: The study involved a case series of infants with cutaneous hemangiomas and airway hemangiomas extracted from a prospective multicenter cohort study. Data regarding clinical features, diagnosis, treatment, and clinical course were obtained from medical charts and physician intake forms. All patients were evaluated for PHACE syndrome using a standardized protocol.

Setting: Six academic pediatric dermatology clinics.

Patients: The study included 17 patients younger than 1 year who were diagnosed as having large ($>22 \text{ cm}^2$) facial hemangiomas and airway hemangiomas.

Results: Thirteen patients (76%) had hemangiomas in the bilateral mandibular distribution. Other observed fa-

cial patterns included limited involvement of the lip and chin, unilateral reticular frontotemporal and preauricular hemangiomas, and large unilateral hemifacial hemangiomas. Fourteen patients (82%) had symptomatic airway involvement. All symptomatic patients had subglottic airway hemangiomas. The airway hemangioma was circumferential in 10 patients (58%) and more focal in distribution in 7 patients (42%). All patients were treated with oral prednisolone. Eleven patients required additional multimodal therapy. Eight patients (47%) met the criteria for PHACE syndrome.

Conclusions: Airway hemangiomas represent a potentially fatal complication of infantile hemangiomas. Our data highlight cutaneous presentations in patients with subglottic hemangiomas and large ($>22 \text{ cm}^2$) cutaneous hemangiomas. PHACE syndrome was detected in 8 such patients (47%) in our series.

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AIRWAY HEMANGIOMAS, while not common, represent one of the few life-threatening complications of infantile hemangiomas. Airway lesions typically present with the rapid onset of "noisy breathing," hoarse cry, stridor, or respiratory compromise.^{1,2} Recognizing cutaneous lesions that are at high risk for associated airway disease may facilitate early detection and prevent many of the complications of occult airway disease. Previous reports have recognized that hemangiomas in the mandibular region may indicate a risk of up to 40% for airway hemangioma³; this series supports that relationship.

Large facial hemangiomas, including those in the mandibular or "beard distribution," may also be associated with a neurocutaneous disorder termed *PHACE syndrome* (OMIM 606519). PHACE syndrome is defined as involving a facial hemangioma and 1 or more of the following ab-

normalities: structural brain anomalies, most characteristically of the posterior fossa; arterial cerebrovascular anomalies; coarctation of the aorta or cardiac anomalies; ocular anomalies; and/or ventral developmental defects.⁴ The incidence of PHACE syndrome in cases with airway hemangiomas is unknown. The incidence of PHACE syndrome in patients with large ($>5 \text{ cm}$) facial cutaneous hemangiomas was recently estimated to be 31%.⁵

We describe the clinical presentation of 17 patients with large facial hemangiomas and coexisting airway hemangiomas who were fully evaluated for PHACE syndrome and discuss their specific manifestations of PHACE syndrome.

METHODS

We conducted a cross-sectional analysis of a subset of children with airway hemangiomas who were part of a large multicenter prospec-

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tive cohort study of children with large facial hemangiomas.⁵ A total of 108 children with large facial hemangiomas were recruited from 2005 to 2008 by investigators at 8 academic clinical centers. Two additional patients refused enrollment. The original cohort of patients was enrolled consecutively, with enrollment offered to all patients who presented to the participating pediatric dermatology clinic with facial hemangiomas larger than 22 cm². For this study, those with known airway hemangiomas (17 of 108) were included.

All participating sites obtained approval from their institutional review boards. Parents or legal guardians were interviewed to complete standardized questionnaire forms. Data collection forms regarding clinical presentation (including the size, location, distribution, and morphological features of the hemangiomas), complications, and treatment at follow-up visits were filled out by the investigators at 6 of the 8 sites involved in the original cohort study (2 sites did not have any cases of airway hemangioma).

Hemangiomas were measured with a soft, flexible measuring tape. Clinical photographs were used to compare the distribution of the hemangiomas with previously described facial segments.⁶ Segment 1, the frontotemporal segment, includes the lateral aspect of the forehead, the lateral frontal scalp area, and the anterior temporal portion of the scalp. Segment 2, the maxillary segment, includes the upper part of the cheek and the upper lip. Segment 3, the mandibular segment, includes the preauricular region, mandible, chin, and lower lip. Segment 4, the frontonasal segment, includes the medial frontal scalp area, nasal bridge, nasal tip, ala, and philtrum.⁶

Each patient was investigated for PHACE syndrome with a complete physical examination, echocardiography, magnetic resonance imaging, magnetic resonance angiography, and ophthalmologic examination. The workup for PHACE syndrome was based on recommendations from a 2005 multidisciplinary National Institutes of Health workshop.⁷ Children with PHACE syndrome were identified using the diagnostic criteria established by a multidisciplinary expert panel⁴ (**Table 1**).

Clinical symptoms or the presence of a bilateral mandibular hemangioma prompted investigators to screen for airway hemangiomas. No standardized protocol for airway investigation was used. Detailed clinical and follow-up information regarding the airway hemangiomas was obtained by chart review.

RESULTS

Seventeen 17 cases of airway hemangioma in addition to large facial cutaneous hemangiomas were identified (**Table 2**). Sixteen of the patients (94%) were female, and 1 (6%) was male. Thirteen patients (76%) were white; 2 (12%) were Hispanic; 1 (6%) was African American; and 1 (6%) was of unknown ethnicity. The average age of gestation was 39 weeks, with a range of 37 to 40 weeks.

AIRWAY HEMANGIOMAS

Airway hemangiomas were confirmed in all 17 cases by direct visualization with a rigid bronchoscope or a flexible endoscope. Fourteen patients (82%) had symptomatic airway hemangiomas. The mean age at the onset of airway symptoms was 1.7 months (range of age at onset, 2 weeks to 5 months). Symptoms included noisy breathing, difficulty breathing, and stridor. Stridor was noted in 11 patients (65%). Six patients (35%) required a tracheostomy. No patients had a history of feeding dif-

Table 1. Diagnostic Criteria for PHACE Syndrome^a

Organ System	Major Criteria	Minor Criteria
Cerebrovascular	Anomaly of major cerebral arteries ^b	Persistent embryonic arteries (other than trigeminal artery) Intracranial hemangioma
Structural brain	Posterior fossa anomalies	Midline anomalies Neuronal migration disorder
Cardiovascular	Aortic arch anomalies Anomalous origin of subclavian artery with or without a vascular ring	Ventricular septal defect Right aortic arch (double aortic arch)
Ocular	Posterior segment anomalies	Anterior segment anomalies
Ventral or midline	Sternal defect	Hypopituitarism Ectopic thyroid

^a“Definite” PHACE syndrome involves a facial hemangioma larger than 5 cm plus 1 major criterion or 2 minor criteria. “Possible” PHACE syndrome involves a facial hemangioma larger than 5 cm and 1 minor criterion, an upper torso or neck region hemangioma plus 1 major criterion or 2 minor criteria, or 2 major criteria in the absence of a hemangioma.

^bMajor cerebral arteries include the internal carotid artery, middle cerebral artery, anterior cerebral artery, posterior cerebral artery, or verteobasilar system (adapted from Metry et al⁴).

iculties. Of the 14 symptomatic patients, 9 initially presented with airway symptoms before their initial visit with the pediatric dermatologist; 3 of the 9 patients initially went to the emergency department; and 1 patient presented to a primary care physician and was subsequently urgently hospitalized. Two patients were initially asymptomatic when seen by the pediatric dermatologist for evaluation of large cutaneous hemangiomas; the mandibular distribution of their hemangiomas prompted referral for direct visualization (bronchoscopy or laryngoscopy), by which airway lesions were noted. Two patients were treated with systemic steroids for their cutaneous hemangioma but developed airway symptoms only after systemic steroid treatment was tapered several months later. One of these patients presented with recurrent “croup” at 3 months of age so was not diagnosed as having an airway hemangioma until 7 months of age. The other infant with late-onset symptoms did not receive a diagnosis in the pediatric dermatology clinic but presented to another institution with respiratory systems after completing systemic therapy. No data detailing presentation of airway symptoms were available in the 1 case in which the pediatric dermatologist was seen for a consultative visit after the diagnosis of airway hemangioma had been established.

Of the 14 patients who were symptomatic, all had subglottic airway hemangiomas. The hemangiomas extended into the supraglottic region in 2 of these patients and into the supraglottic region as well as the oral cavity in 1. One patient had a sublingual hemangioma in addition to subglottic hemangioma. The extent of the airway hemangioma was reported in 12 cases: 7 (58%) had circumferential subglottic hemangiomas, and 5 (42%) had focal lesions. The percentage of airway obstruction was quantified in 10 patients: 9 had 50% or greater obstruction, and 4 had 80% or greater obstruction.

Table 2. Summary of Clinical Presentation and Treatment

Patient No.	Pattern of Facial Hemangioma	Size of Facial Hemangioma, cm ²	Type of Airway Hemangioma	Age at Onset of Airway Symptoms, mo	Tracheostomy	Systemic Steroids	Propranolol	Interferon	Vincristine	Laser Ablation	Pulsed-Dye Laser	Excisional Surgery	Wound Care	Intra-lesional Steroid, Facial	Intra-lesional Steroid, Airway
Symptomatic Patients															
1	S1 left S3 left (unilateral) S4	224	Focal subglottic	1	Yes	Yes	No	No	No	Yes	No	No	No	No	No
2	S3	360	Circumferential subglottic and sublingual	Unknown	Yes	Yes	No	No	No	No	No	No	No	No	No
4	S3	187	Circumferential supraglottic and subglottic	0.5	Yes	Yes	No	No	No	No	No	No	No	No	No
6	S1 left S2 left S3	50	Focal subglottic	1.5	No	Yes	No	No	No	No	Yes	Yes	No	No	No
7	S3	36	Focal subglottic	0.5	No	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes
8	S3	60.5	Circumferential subglottic and supraglottic	1.75	Yes	Yes	No	No	No	No	No	No	No	No	No
9	S1 right S3	252	Subglottic	4	No	Yes	Yes	No	No	No	No	No	No	No	No
10	S3	95	Circumferential subglottic	1	Yes	Yes	No	Yes	No	Yes	No	No	No	Yes	No
11	S3	78	Circumferential subglottic	5	No	Yes	No	No	No	Yes	No	No	No	No	Yes
13	S3	23	Focal subglottic	2	No	Yes	No	No	No	No	No	Yes	No	No	No
14	S1 left S2 left S3 left (unilateral) S4	200	Focal subglottic	1.25	No	Yes	Yes	Yes	No	Yes	No	No	No	No	No
15	S1 right S3 right (unilateral) Reticular	64	Circumferential subglottic	1	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No
16	S1 right S3 S4	100	Supraglottic and subglottic	Unknown	No	Yes	No	No	No	No	No	No	No	No	No
17	S1 right S3 right (unilateral) Reticular	64	Circumferential subglottic	3	No	Yes	No	No	No	No	No	No	Yes	No	No
Asymptomatic Patients															
3	S3	84.5	Subglottic	NA	No	Yes	No	No	No	No	No	No	No	No	No
5	S3	46.2	Focal supraglottic	NA	No	Yes	No	No	No	No	Yes	No	Yes	No	No
12	S1 left S3	100	Soft palate and supraglottic	NA	No	Yes	No	No	No	No	No	No	No	No	No

Abbreviations: NA, not applicable; S, segment.

Three infants had asymptomatic airway hemangiomas, which were diagnosed by direct visualization: 2 had a supraglottic hemangioma (1 of whom was noted to have a focal supraglottic hemangioma), and 1 had a subglottic hemangioma. These patients were all treated with systemic steroids for cutaneous hemangioma.

CUTANEOUS HEMANGIOMAS

Our series of 17 patients were extracted from a larger cohort of 108 patients with facial hemangiomas; 64 of the

108 patients had some involvement of the mandibular region of the face (segment 3), which includes the mandible, preauricular skin, chin, lower lip, and parotid gland. Seventeen of 64 patients (27%) had airway hemangiomas. In the original 108-patient cohort of infants with large facial hemangiomas, standardized screening for airway hemangiomas was not performed; therefore, 17 may be an underestimate if some patients had subclinical airway involvement.⁵

The mean size of the visible cutaneous hemangiomas was 128.1 cm² (range, 23.0-360.0 cm²) among the symp-



Figure 1. A patient with bilateral mandibular (segment 3) distribution of a facial hemangioma and a symptomatic subglottic hemangioma occluding 80% of the airway.



Figure 2. A patient with a bilateral facial hemangioma involving only the lip and chin (segment 3) and a symptomatic subglottic hemangioma occluding 80% of the airway.

omatic infants compared with 57.7 cm² (range, 46.2-100.0 cm²) among the asymptomatic infants. Bilateral segment 3 involvement was present in 13 of the 17 patients (76%) (**Figure 1**); however, 2 patients had hemangiomas limited to the lower lip and chin (**Figure 2**), and 4 had unilateral hemangiomas (**Figure 3**). Two of the 4 patients had strikingly similar lesions of flat telangiectatic patches involving the unilateral frontotemporal segment (segment 1), with a small component of mandibular (segment 3) involvement, and a deeper soft-tissue hemangioma involving the parotid gland or orbit (**Figure 4**). Further details of these 2 cases are reported elsewhere.⁸ The other 2 patients with unilateral distribution had large hemangiomas (>200 cm²), 1 of which was located in the left frontotemporal, left mandibular, and frontonasal regions and 1 in the left frontotemporal, left maxillary, left mandibular, and frontonasal regions. Three patients had hepatic hemangiomas, and 1 had a lumbosacral hemangioma.

MANAGEMENT

All 17 cases were initially treated with oral prednisolone for the threat of airway compromise or symptomatic airway disease. The mean duration of the sys-



Figure 3. A patient with unilateral distribution of a facial hemangioma involving the left frontotemporal (segment 1), left mandibular (segment 3), and frontonasal (segment 4) segments. This patient had a symptomatic subglottic hemangioma with 50% airway obstruction. The patient, at 21 months of age, still had a tracheostomy in place at the last follow-up visit. The patient also met the criteria for "definite" PHACE syndrome with anomalies in the cerebrovasculature, cerebral structure, cardiovascular, and sternum.



Figure 4. A unilateral reticular facial hemangioma involving the right frontotemporal segment (segment 1) and a minimal portion of the right mandibular segment (segment 3) associated with a symptomatic subglottic airway hemangioma.

temic steroid treatment was 8 months (range, 2-16 months). The mean age at the initiation of systemic steroid treatment was 1.5 months. Eleven patients re-

Table 3. Clinical Manifestation of PHACE Syndrome

Patient No.	Facial Hemangioma Location	Airway Symptom	PHACE Anomalies	Central Nervous System Anomaly (Cerebral Structure and Cerebrovasculature)	Cardiovascular Anomaly	Ventral Development Defects
1	Left S1 Left S3 (unilateral) S4	Yes	Cerebral structure Cerebrovasculature Cardiovasculature Sternal defect	Persistent trigeminal artery agenesis/ hypoplasia and anomalous course of major cerebral arteries Arachnoid cyst Hypoplasia of cerebellum Vermian hypoplasia	Aortic aneurysm	Sternal defect
3	S3	No	Cerebrovasculature	Agenesis/hypoplasia and dysplasia of major cerebral arteries	None	None
6	Left S1 Left S2 S3	Yes	Cerebrovasculature Cardiovasculature (minor criteria)	Persistent trigeminal artery	Ventricular septal defect	None
9	Right S1 S3	Yes	Cerebral structure Cerebrovasculature	Agenesis/hypoplasia of a major cerebral artery Hypoplasia/atrophy of cerebellum	None	None
12	Left S1 S3	No	Cardiovasculature Sternal defect	None	Aortic coarctation	Sternal defects
13	S3	Yes	Sternal defect	None	None	Sternal defect and midline abdominal raphe
15	Right S1 Right S3 (unilateral) Reticular pattern	Yes	Cerebrovasculature	Hypoplasia of a major cerebral artery	None	None
16	Right S1 S3 S4	Yes	Cerebrovasculature	Dysplasia and anomalous course of major cerebral arteries	None	None
10 ("Possible" PHACE syndrome)	S3	Yes	Cardiovasculature (minor criteria)	None	Ventricular septal defect	None

Abbreviation: S, segment.

quired additional therapy, and 5 required additional systemic treatment: 3 received propranolol, 2 received interferon, and 1 received vincristine. Two required multimodal systemic therapy with steroids, propranolol, and either interferon or vincristine. Interferon and vincristine were used only in refractory cases in which other systemic therapies had failed. Three patients received wound care for ulceration, with 1 patient receiving additional treatment, including pulsed-dye laser treatment, and 1 patient receiving pulsed-dye laser treatment and an intralesional steroid. One patient received only pulsed-dye laser treatment for ulceration. Additional targeted treatments for the 17 cases of airway hemangioma included laser (5 patients [29%]), intralesional steroid therapy (2 patients [12%]), excisional surgery (2 patients [12%]), and tracheostomy (6 patients [35%]). The mean percentage of airway obstruction was 66% (50%-95%) in those requiring a tracheostomy. Indications for cutaneous hemangioma treatment included disfigurement, rapid cutaneous growth, ulceration, bleeding, and visual compromise.

PHACE SYNDROME

All patients were uniformly screened for PHACE syndrome as described in the "Methods" section, and 8 of

17 patients (47%) met the criteria for "definite" PHACE syndrome, and 1 patient had "possible" PHACE syndrome.⁴ Six of those with definite PHACE syndrome and 1 with possible PHACE syndrome had airway symptoms. Two patients had 1 "major" cardiovascular anomaly: one with an aortic aneurysm and the other with aortic coarctation. Six of the patients with definite PHACE syndrome had central nervous system anomalies. All 6 had cerebrovascular anomalies, which included findings such as persistent trigeminal arteries and hypoplasia and dysplasia of the major cerebral arteries. Two patients had structural brain anomalies, including an arachnoid cyst, hypoplasia of the cerebellum, and hypoplasia of the vermis. Three patients had sternal defects. The 1 patient with possible PHACE syndrome had a ventricular septal defect, which is classified as a "minor" cardiovascular anomaly. None had ocular defects (**Table 3**).

OUTCOMES

The mean age at follow-up was 17 months, with ages ranging from 6 to 41 months among the 15 patients for whom data were available. All patients were asymptomatic at their last follow-up visit. Three patients (18%) still had tracheostomies in place at the conclusion of the study, with ages of 13, 24, and 30 months at the last visit.

To our knowledge, this is the first prospective study of infants with large facial hemangiomas in which airway hemangiomas, their characteristics, and the risk for PHACE syndrome have been ascertained. Our findings support the assertion that patients with mandibular hemangioma are at significant risk for airway hemangioma (27%), with the vast majority of these patients having symptomatic disease (82%). Although a limitation of our study was that screening for airway disease was not universally done in all cases, the mean age at follow-up was 17 months, thereby reducing the probability of missing clinically significant disease. The incidence of airway hemangioma in patients with large facial hemangiomas in general cannot be determined by this study because standardized screening was not performed.

CUTANEOUS HEMANGIOMA AS A CLINICAL CLUE FOR AIRWAY INVOLVEMENT

The association of airway hemangiomas and cutaneous hemangiomas is well established. More than 50% of infants with airway hemangiomas also have cutaneous hemangiomas.^{9,10} Patients with hemangiomas in the mandibular or beard distribution are known to be at especially high risk. Orlow et al³ described 16 patients who had cutaneous lesions in a beard distribution. Of these, 10 had symptomatic airway involvement, and 4 of the 10 required a tracheostomy. Our series supports this distribution as a risk factor for airway hemangiomas, with 13 (76%) of those with airway hemangiomas having bilateral mandibular involvement, and 27% of those with bilateral or unilateral mandibular involvement having an airway hemangioma. Our series also describes 2 additional patterns of facial hemangioma associated with airway hemangioma: the reticular or telangiectatic hemangioma in a frontotemporal/mandibular distribution and the presence of unilateral multisegment, large facial hemangiomas. Both of the patients with these facial hemangioma patterns were symptomatic, and the presence of symptoms prompted direct laryngoscopy and bronchoscopy. Only 2 of the 17 patients in this series had airway lesions detected by screening direct laryngoscopy and bronchoscopy. Both of these asymptomatic patients had hemangiomas in the beard distribution, which prompted the screening evaluation. It appears at this time that direct laryngoscopy and bronchoscopy to detect subglottic hemangiomas is indicated in patients with clinical airway symptoms or in asymptomatic patients with beard hemangiomas.

Reticular or telangiectatic hemangiomas are infantile hemangiomas that are macular and have a telangiectatic appearance.¹¹ Two of our patients had reticular hemangiomas of the right frontotemporal segment, with only a small extension into the ipsilateral mandibular segment (preauricular region) and coexisting subglottic hemangiomas that occluded 70% to 90% of the airway (Figure 4). One of these 2 patients also had PHACE syndrome with cerebrovascular anomalies. Unilateral hemangiomas are

much less commonly associated with airway hemangiomas than bilateral mandibular hemangiomas. The 2 patients in our series with unilateral hemangiomas had very large lesions (>200 cm²) spanning multiple segments (Figure 3). Both patients presented with stridor relatively early, at 4 to 5 weeks of age. One patient also met the criteria for PHACE syndrome and was found to have hepatic hemangiomatosis.

Hemangiomas of even relatively small size in the mandibular distribution may be associated with significant airway hemangiomas. Two of our patients had small hemangiomas on the lip and chin but had significant airway compromise, and 1 patient had a sternal defect and midline abdominal raphe, fitting the criteria for PHACE syndrome (Figure 2). Of note, many hemangiomas have a relatively small superficial component but are associated with a more subtle and extensive subcutaneous component that may be difficult to appreciate clinically early in life. The deeper component may become visible only in the second or third month of life.¹² Close clinical observation of relatively innocuous-appearing hemangiomas in the mandibular, lip, and chin area may increase the sensitivity for recognizing segmental hemangiomas that could potentially be associated with airway disease or with PHACE syndrome.

RISK OF PHACE SYNDROME

The cutaneous counterparts of airway hemangiomas are most often segmental, a subtype of hemangioma that is associated with PHACE syndrome in one-third of cases.⁵ In this study, 8 of 17 patients (47%) were diagnosed as having PHACE syndrome, highlighting the need for adequately screening patients with both cutaneous hemangiomas and airway hemangiomas for central nervous system, cardiac, and ocular anomalies. The incidence of PHACE syndrome in our series may not accurately represent the incidence in patients who have airway hemangiomas without cutaneous hemangiomas, as our patient population was confined to those who had coexisting cutaneous hemangiomas. Although the long-term clinical implications of specific cerebrovascular anomalies are uncertain, there are reports of children with PHACE syndrome who have experienced ischemic stroke, seizures, chronic headaches, and developmental delays. Further studies are needed to better correlate central nervous system anomalies with the risk for neurologic sequelae so that better management guidelines can be developed. The knowledge of cardiac and central nervous system arterial anomalies is important to therapeutic decision making, because these anomalies may increase the risk of adverse events in patients who are receiving both steroids (which can induce hypertension) and propranolol (which can induce hypotension).

In a cohort of infants with large facial hemangiomas recruited by the Hemangioma Investigator Group,⁵ 33 of 108 patients (31%) met the criteria for definite PHACE syndrome. Twenty-two of the 33 infants had hemangioma in the segment 3 distribution. Eight (24%) had airway hemangiomas. Two of the 8 infants (25%) with airway hemangiomas required a tracheostomy. Rudnick et al¹³ described 246 infants with facial segmental hemangiomas and

identified 5 with PHACE syndrome through a retrospective chart review. All 5 infants had segmental mandibular facial hemangiomas and 3 of the 5 had airway hemangiomas. One patient required a tracheostomy. Because no standardized protocol was used for screening and evaluating patients with PHACE syndrome, Rudnick and colleagues likely underestimated the incidence of PHACE syndrome in their population. However, it is striking that airway hemangiomas were common in the infants who were reported as having the syndrome.

PATHOGENESIS

The pathogenesis of cutaneous hemangiomas and airway hemangiomas is unknown. The association of cutaneous segmental hemangiomas and subglottic hemangiomas implies that the error in development is temporally related early in gestation. The development of the hemangioma precursor or "microenvironment" for subsequent hemangioma development may be traced back to the time of airway development. Subglottic hemangiomas and cutaneous infantile hemangiomas have identical histopathologic and immunophenotypic characteristics, which implies that their pathogenesis may be similar.⁸ GLUT-1, an erythrocyte-type glucose transporter expressed in infantile hemangiomas,¹⁴ has also been shown to be expressed in most subglottic hemangiomas.

TREATMENT

Treatment options vary, and there are no specific protocols for the treatment of subglottic hemangiomas.^{15,16} For small, asymptomatic airway hemangiomas, conservative therapy with close monitoring may be appropriate because airway hemangiomas will eventually involute similar to their cutaneous counterparts. Systemic steroid therapy, as is illustrated in our cases, is a common treatment for airway-endangering lesions. However, recently some authors have advocated using propranolol as a first-line agent.¹⁷ To our knowledge, no randomized controlled trials have compared the more novel use of propranolol with systemic steroids. Recalcitrant airway hemangiomas may also be treated with vincristine or interferon. Adjunctive treatment with ablative carbon dioxide laser therapy or surgical excision may be required in some cases. Laser ablation is helpful for bulky lesions, but its utility is limited by the high risk of stenosis when patients require multiple procedures. Even surgical excision may be complicated by subsequent stenosis.¹⁸ Tracheostomies have a high complication and morbidity rate and are reserved for cases with large or multiple hemangiomas that are resistant to other therapies.¹⁶ Multimodal, multidisciplinary approaches integrating medical and surgical therapies are ideal to minimize the need for tracheostomy and to improve patient outcomes.

In conclusion, providing accurate diagnosis and early treatment of an airway hemangioma can prevent serious airway compromise. The possibility of an airway hemangioma in patients who present with respiratory distress and concomitant facial infantile hemangiomas, especially large lesions in the mandibular region, should be

recognized by physicians who are treating infants. This report highlights other presentations of cutaneous hemangiomas that may be associated with airway hemangiomas, including unilateral large, multisegment facial hemangiomas, small lower lip and chin hemangiomas, and segmental reticular hemangiomas of the frontotemporal and preauricular regions. Almost half of our patients also had PHACE syndrome. Whether the incidence of PHACE syndrome is increased in patients with airway hemangiomas is uncertain, but the relatively high incidence of extracutaneous anomalies in this series suggests that these patients should be screened for underlying PHACE syndrome.

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