



Management trends of infantile hemangioma: A national perspective



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ABSTRACT

Introduction: The primary management of infantile hemangioma (IH) has changed since 2008, with the initiation of propranolol. The change that propranolol has affected on resource utilization is unknown.

Materials and methods: The Kids' Inpatient Database (KID) in 2003, 2006, 2009, and 2012 was queried for ICD-9 codes for IH in children under age three. The number of patients undergoing the following procedures of interest: tracheostomy, tracheoscopy and laryngoscopy with biopsy, and excision of skin lesion were evaluated. Data was analyzed for demographics and details on the admission. Trends were identified. Weighted statistical analyses were performed with SAS 9.4.

Results: The number of qualified admissions significantly increased over the years (9271 in 2003–12029 in 2012, OR 1.042 per year increase, $p < 0.001$). The mean age at admission ranged from 26 to 28 days but did not vary over time ($p = 0.54$). The percentage undergoing tracheostomy significantly decreased from 1.05% in 2003 to 0.27% in 2012 ($p = 0.0055$), and the percentage undergoing tracheoscopy and laryngoscopy with biopsy significantly decreased from 7.29% in 2003 to 4.20% in 2012 ($p = 0.011$) among those with IH of unspecified or other sites. The percentage undergoing skin lesion excision also significantly decreased from 1.87% in 2003 to 1.03% in 2012 ($p = 0.0038$) among those with IH of skin and subcutaneous tissue. These findings suggest a potential impact of propranolol. After adjusting for inflation, the total hospital charges increased from a mean of \$17,838 in 2003 to an adjusted mean of \$41,306 in 2012 ($p < 0.0001$).

Conclusions: Total admissions and hospital charges in children with IH has increased from 2003 to 2012. The percentage of patients undergoing tracheostomy, tracheoscopy and laryngoscopy with biopsy, and skin lesion excision significantly decreased in 2012 compared to 2003, suggesting a potential impact of propranolol. Further studies are needed to examine these changes more closely.

1. Introduction

Infantile hemangiomas (IHs) are common, benign vascular tumors. They are the most common tumors in infants and children and affect about 4% of children [1]. These neoplasms undergo a rapid proliferative stage followed by involution with the majority of hemangiomas resolving by age seven without treatment [2].

About 60% of IHs are located in the head and neck region with most being solitary cutaneous and/or subcutaneous neoplasms [1]. In addition to occurring in the skin and subcutaneous tissue, IHs can also occur in the airway, leading to airway obstruction. About 1–2% of patients with cutaneous IHs will also have a lesion in the subglottis [3]. Additionally, IH in the V3 distribution will have upper airway involvement in 29%, and in patients with PHACE syndrome – a subset of patient with IH accompanied by structural anomalies of the brain, cerebral vasculature, eyes, sternum, and/or aorta – 52% will have

upper or lower airway involvement [4–6].

The primary management of IH is observation if there is no functional or dramatic cosmetic deficit. If there is such a deficit, management options include surgical resection, pulsed dye laser, corticosteroids, and vincristine. Additionally, and most recently, in 2008, it was discovered that propranolol, a nonselective β -adrenergic blocker, can be used to reduce the growth of these neoplasms [7]. Since this time, the management of IH has largely shifted to off-label use of propranolol for primary treatment. This change in management has likely affected trends in practices and resource utilization, including the number of procedures performed on these children, number of hospital admissions, and total hospital charges.

2. Materials and methods

The Kids' Inpatient Database (KID) – a set of publically available

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pediatric healthcare databases – part of the Healthcare Utilization Project (HCUP), created by the Agency for Healthcare Research and Quality (AHRQ) through a Federal-State-Industry partnership – was reviewed [8]. This national database contains data on admissions for patients under the age of 21 years from more than 4100 hospitals across the United States every 3 years since 1997.

The KID database in the years 2003, 2006, 2009, and 2012 were queried for the following diagnoses: (1) hemangioma of skin and subcutaneous tissue (ICD-9 code 22801), (2) hemangioma of unspecified site (ICD-9 code 22800), and (3) hemangioma of other sites (ICD-9 code 22809) in children under the age of 3 years. These diagnoses had to be in the top 15 of a patient's list of diagnoses. IRB approval was not necessary, as the KID database is publically available.

The following variables were analyzed in these patients: demographic data, length of stay, procedures performed during admission, co-existing diagnoses, insurance information, and hospital type and location.

Weighted statistical analyses were performed with SAS 9.4. Analyses were performed after accounting for the discharge weights. Logistic regression analysis was used for number of qualified admissions. Linear regression analyses were used for age, length of stay, and the number of procedures with log transformed outcomes. The Rao-Scott chi-square test was used for categorical outcomes.

3. Results

3.1. Demographics, number of procedures, and risk stratification

The number of qualified admissions, age at admission, gender, and length of stay are shown in Table 1. The number of procedures per admission, and percentages of patients undergoing certain procedures of interest are described in Table 2. When comparing the percentage of patients with IH of unspecified or other sites undergoing airway procedures in 2003 versus 2012, the percentage undergoing tracheostomy significantly decreased from 1.05% in 2003 to 0.27% in 2012 ($p = 0.0055$), and the percentage undergoing tracheoscopy and laryngoscopy with biopsy significantly decreased from 7.29% in 2003 to 4.20% in 2012 ($p = 0.011$). In patients with hemangioma of skin and subcutaneous tissue, there was a significant change when comparing the percentage undergoing excision of skin lesion in 2003 to that in 2012 (1.87%–1.03%, $p = 0.0038$). The percentage of patients with Medicaid, Medicare, private insurance, and other types of insurance is depicted in Table 3. In all four years combined (2003, 2006, 2009, and 2012), patients with Medicare or Medicaid had a mean of 1.48 procedures compared to a mean of 1.51 procedures for those with private insurance ($p = 0.032$).

Table 1
Demographics and length of stay.

Year	2003	2006	2009	2012	p
Number of qualified admissions^a					
Unspecified or other sites ^b	9271	10,870	12,130	12,029	< 0.0001
Skin and subcutaneous tissue ^c	1989	2393	2649	2643	< 0.0001
	7283	8477	9481	9386	< 0.0001
Age (days)^d	26 ± 2.7	26 ± 2.7	28 ± 2.2	27 ± 2.5	0.54
Gender (% female)	60.1	59.7	59.8	60.7	0.68
Length of stay (days)^d					
Unspecified or other sites ^d	6.20 ± 0.25	6.37 ± 0.23	9.18 ± 0.32	11.66 ± 0.45	< 0.0001
Skin and subcutaneous tissue ^d	6.59 ± 0.44	6.79 ± 0.48	9.43 ± 0.53	9.96 ± 0.57	< 0.0001
	6.10 ± 0.26	6.25 ± 0.24	9.11 ± 0.36	12.15 ± 0.50	< 0.0001

^a Odds ratio (OR) = 1.042 per year increase.

^b Odds ratio (OR) = 1.044 per year increase.

^c Odds ratio (OR) = 1.041 per year increase.

^d Data presented are mean ± standard error of the mean.

3.2. Comorbid diagnoses

The percentage of patients with comorbid diagnoses of other anomalies of the larynx, trachea, and bronchus is depicted in Table 4. There was a significant increase in the percentage of patients with this diagnosis ($p < 0.001$).

3.3. Hospital characteristics

The percentage of admissions based on hospital type and location are shown in Table 5. There was no significant difference in the number of admissions by hospital region over the years. However, there was a significant increase in the number of admissions in urban teaching hospitals and a decrease in admissions in rural and urban non-teaching hospitals.

3.4. Total hospital charges

The total hospital charges increased from a mean of \$17,838 in 2003 to \$72,743 in 2012 ($p < 0.0001$) without accounting for 6.49% healthcare spending inflation annually (Fig. 1). Accounting for inflation, \$72,743 in 2012 dollar is equivalent to \$41,306 in 2003 dollar, which was also a statistically significant increase over years ($p < 0.0001$).

4. Discussion

From 2003 to 2012, the total number of qualified admissions significantly increased from 9271 to 12,029 with a 4.2% increase in the odds of having a qualified admission per year. Both the number of qualified admissions for patients with hemangioma of unspecified or other sites and the number of qualified admissions for those with hemangioma of skin and subcutaneous tissue increased significantly. There was no significant difference from 2003 to 2012 in the gender distribution or mean age at hospital admission. Mean length of stay almost doubled from 2003 to 2012. The use of propranolol may have resulted in an increase in admissions due to children being admitted for cardiovascular monitoring after treatment. Length of stay may be increased for a similar reason.

In patients with hemangioma of unspecified site or hemangioma of other sites, there was a significant decrease in the percentages undergoing tracheostomy and tracheoscopy and laryngoscopy with biopsy in 2012 compared to 2003. When comparing the change across the four time points from 2003 to 2012 (2003, 2006, 2009, and 2012), there was also a decrease which neared significance for both procedures. Although it is not known whether these children were treated with propranolol, given the paradigm shift in treatment in 2008, it can be

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