Heterotopic Neuroglial Tissue Causing Airway Obstruction in the Newborn

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Background: Heterotopic neuroglial (brain) tissue is a rare cause of airway obstruction in newborns. Fewer than 30 cases have been reported in the English literature. Brain heterotopias can mimic more common congenital anomalies of the head and neck.

Objective: To review our experience in the diagnosis and treatment of children with heterotopic pharyngeal neuroglial tissue.

Design: Case series.


Patients: Four newborns with airway obstruction caused by heterotopic neuroglial tissue.

Results: All patients were infants (3 full-term girls and a 32 weeks' gestation boy) who had airway obstruction in the newborn period. All patients underwent preoperative computed tomography and magnetic resonance imaging, which revealed a heterogeneous mass involving the pharynx, neck, and parapharyngeal space. Bony deformities of the skull base and mandible were present in all patients, although intracranial connection was absent. Multiple surgical procedures were performed in all 4 patients. Tracheotomy was performed in 2 patients, gastrostomy tube placement was required in 3, and a nasopharyngeal tube was used in 1. Combined cervicofacial and transoral approaches were used for resection, preserving vital structures. Histopathologic evaluation revealed mature glial tissue and choroid plexus–like structures.

Conclusions: Heterotopic neuroglial tissue must be considered in the differential diagnosis of airway obstruction in the newborn. Management is surgical resection, with attention to vital structures and function—analogous to surgery for lymphangioma. Multiple surgical procedures might be necessary in the treatment of these patients.


HETEROTOPIC pharyngeal neuroglial tissue was first described by Reid in 1852.1 Fewer than 30 cases have been reported in the English literature. Composed of differentiated neuroectodermal tissue, these lesions represent developmental heterotopias of neuroglial tissue rather than true neoplasms.2,3 Unlike meningoencephaloceles, brain heterotopias lack connection with the subarachnoid space.4,5 Patients usually are initially seen in the newborn period with airway obstruction, feeding difficulty, and a neck mass.6 The most common location for heterotopic neuroglial tissue is the nasal cavity, where it is traditionally, but erroneously, termed “nasal glioma.”7 Less commonly, brain heterotopias have been reported in the scalp, tongue, pharynx, palate, orbit, middle ear, and neck.8,9

The majority of patients with heterotopic neuroglial tissue had uncomplicated pregnancies.2 There seems to be a female predominance.2,4 No syndromic predisposition or known etiologic factor has been identified. Patients might have other craniofacial anomalies, including cleft palate, micrognathia, and choanal atresia.4

Computed tomography (CT) and magnetic resonance imaging (MRI) are complementary studies that are necessary in preoperative planning to determine the extent and location of the mass and to exclude intracranial connection. Mandibular deformity and skull base erosion, without intracranial connection, are common features. Surgical excision is the treatment of choice, although the timing of surgical excision is debatable. Resection should be as complete as possible, sparing vital neurovascular structures, analogous to treatment for lymphangioma.

We reviewed our 14-year experience and describe 4 additional patients with para-
pharyngeal heterotopic neuroglial tissue and provide recommendations for diagnosis and treatment of these patients. Patient 3 was previously reported to have a meningoencephalocele, however, on review of clinical, radiographic, and histopathologic features, the tumor is best classified as heterotopic pharyngeal brain tissue.

REPORT OF CASES

CASE 1

A full-term white girl developed respiratory distress and feeding difficulties 48 hours after birth. Prenatal history was unremarkable. The child experienced snorting, nasal flaring, and the inability to feed on initial evaluation. Physical examination revealed no gross craniofacial abnormalities. Flexible fiberoptic nasopharyngoscopy revealed no obvious mass lesion and patent bilateral posterior choanae. Worsening respiratory distress prompted endotracheal intubation. During the next several days an expanding neck mass appeared in the right submandibular space.

A CT scan of the neck revealed a heterogeneous mass in the right parapharyngeal space extending from the skull base to the right submandibular region. A cystic component was noted. Magnetic resonance imaging did not reveal an intracranial connection (Figure 1). Findings from CT of the brain were normal.

Intraoperative examination of the patient at 8 days of life revealed a submucosal mass in the nasopharynx that caused distortion of the soft palate. Subtotal transoral resection of the nasopharyngeal component was performed. Biopsy findings were consistent with neuroglial tissue. One week later, transcervical resection of the mass and placement of nasopharyngeal stents were performed. Residual tumor was left at the skull base. The patient did well at home for 3 months, tolerating oral feedings.

At 3½ months of age, she again experienced airway distress and a recurrent neck mass. A transcervical lateral pharyngotomy and primary closure were performed. Neurovascular structures were preserved. Histopathologic findings were consistent with heterotopic neuroglial tissue. Rigorous postoperative care initially included nasogastric feeding. Speech pathology and nutrition services were consulted for oropharyngeal rehabilitation. The patient was discharged from the hospital 1 month later tolerating oral feedings without aspiration. She is now 22 months old and is developing normally.

CASE 2

A full-term white girl (uncomplicated pregnancy) presented at birth with respiratory distress that prompted endotracheal intubation. The mandible was distorted by a large cervical mass, which also affected the hard and soft palates (Figure 2). Other anomalies were multiple

Figure 1. Patient 1. Coronal magnetic resonance image (T2 weighted) demonstrating skull base extension of the mass (arrow) without intracranial connection.

Figure 2. Patient 2. Preoperative photograph.
cardiac ventriculoseptal defects, patent ductus arteriosus, partial anomalous pulmonary venous return, and lop-ear.

A CT scan of the brain and neck showed a large heterogeneous mass extending from the skull base to the submandibular region (Figure 3). An MRI and a cisternogram did not reveal an intracranial connection.

Findings from laryngoscopy (Figure 4) and transoral biopsy of the extracranial portion of the mass at 1 week of age were consistent with heterotopic neuroglial tissue. Because of the patient's fragile cardiac status, resection was delayed, tracheotomy was performed, and a gastrostomy tube was placed at 1 month of age.

The patient underwent resection at 8 months of age. A transcervical approach with superficial parotidectomy and lateral pharyngotomy and closure of the cleft palate were performed. The patient was discharged from the hospital 1 month after resection and received speech and swallowing therapy and gastrostomy tube feedings. Tracheotomy decannulation was attempted but failed at 1 year of age. The patient is currently 22 months old and has recently been decannulated and is developmentally delayed. She is able to take some foods orally, but most of her caloric intake is via gastrostomy tube.

CASE 3

A black girl was born after an uncomplicated term pregnancy. She developed respiratory distress and nasal flaring shortly after birth. An 8-cm, soft, submandibular neck mass was visible. She was intubated on day 1 of life. The remainder of the physical examination was unremarkable.

A CT scan (Figure 5) and MRI were performed in preparation for surgical resection. Mandibular displacement by a large parapharyngeal and cervical mass was noted. Magnetic resonance imaging did not show an intracranial connection.

The working diagnosis was cystic hygroma. Transcervical excision of the mass was performed at 1 week of age. Tumor was residual at the skull base. Pathologic evaluation revealed heterotopic neuroglial tissue. The initial diagnosis was meningoencephalocele. After surgery, the patient was successfully extubated; however, she had difficulty with oral feeding. She was evaluated by the otolaryngology service and noted to have right vocal cord paresis and tongue deviation ipsilateral to the tumor. She required gastrostomy tube placement and fundoplication because of gastroesophageal reflux and aspiration.

Subsequent evaluation by the otolaryngology service at 3 months of age revealed an adequate airway and good function of both vocal cords, and the patient resumed bottle feeding. She was lost to follow-up at 4 months of age.

CASE 4

A white boy was born at 32 weeks' gestation by cesarean section after ultrasound diagnosis of a cervical mass and
preterm labor. Immediate endotracheal intubation was required. A 10-cm cervical mass extending into the pharynx was noted. Computed tomography revealed a parapharyngeal space mass that extended from the skull base to the clavicles.

He underwent transcervical resection of the mass and tracheotomy at a different facility at age 5 weeks. The initial diagnosis was teratoma. After surgery, the patient had difficulties with aspiration and required gastrostomy tube placement and fundoplication. In addition, he had long-term difficulties with bronchopulmonary dysplasia that required prolonged mechanical ventilation. Cranial nerves 7 and 9 ipsilateral to the tumor did not function well after resection.

He presented to our institution at 13 months of age for airway evaluation. A CT scan and MRI (Figure 6) of the neck revealed residual tumor in the nasopharynx and parapharyngeal space. Endoscopic airway evaluation revealed a submucosal, nonobstructing fullness in the lateral wall of the nasopharynx and tracheobronchomalacia. Biopsy of the mass revealed heterotopic neuroglial tissue. The patient was followed up with serial endoscopy and MRI, and no significant increase in tumor growth was noted during 2-year follow-up. He was decannulated at age 4½ years. He is currently 9 years old and attends school. He continues to require supplemental gastrostomy feedings but is able to tolerate some foods by mouth.

**COMMENT**

**EMBRYOLOGY AND PATHOGENESIS**

The pathogenesis of heterotopic neuroglial tissue is unclear. Several mechanisms have been proposed:

1. Brain tissue that protrudes through the early skull base (chondrocranium) at 12 weeks' gestation might result in a frontal encephalocele. An encephalocele that loses its intracranial connection might result in heterotopic neuroglial tissue.10-12
2. A change in the timing of the fusion of the chondrocranium might result in the separation of a segment of primitive neural tissue from the main portion of the developing brain.12
3. During early embryogenesis, displacement of totipotent neuroectodermal cells occurs and subsequently develops into mature neural tissue.1,11
4. There might be entrapment or abnormal migration of glial cells from the olfactory bulbs.10

**PATHOLOGY**

Brain heterotopias are composed of nests of neural tissue, without mitoses, embedded within varying amounts of fibrovascular stroma.10 Neurons can be present in up to 10% of cases. Focal calcifications might be present. Reactive changes, a paucity of neurons, and focal calcifications are changes usually observed in poorly perfused neural tissue.10 Unlike nasal glioma, heterotopic pharyngeal neuroglial tissue might contain neurons and astrocytes as well as more complex central nervous system elements such as ependymal-lined structures, a functioning choroid plexus, and pigmented cells of retinal differentiation (Figure 7).1,10 The absence of these more complex structures from nasal glioma might indicate that they are indeed separate entities.1 Heterotopic neuroglial tissue is composed solely of ectodermal elements,3 which distinguishes it from teratoma, which is composed of all 3 germ layers.

Grossly, heterotopic neuroglial tissue is solid, firm, and dark brown or red. It might have cystic components containing cerebrospinal fluid–like clear fluid. The tissue is relatively avascular and poorly encapsulated and adherent to surrounding soft tissues.

**RADIOLOGY**

Radiographic assessment of parapharyngeal heterotopic neuroglial tissue is best performed using CT complemented by MRI. Axial and coronal CT images of the head, neck, and brain delineate the location of the tumor and its relationship to the skull base. Displacement and distortion of the mandible and pterygoid plates at birth is commonly noted and seems to be a differentiating feature of these tumors.3 In addition, erosion of the floor of the middle cranial fossa is characteristically associated with brain heterotopias in the parapharyngeal space. These CT attributes might help differentiate brain heterotopias from more common congenital lesions such as cystic hygroma.13

If skull base erosion is present, MRI will be helpful in discerning an intracranial connection. Magnetic resonance characteristics of heterotopic neuroglial tissue resemble normal brain tissue in all pulse sequences.3 Cystic elements might be present and represent cerebrospinal fluid–like fluid-filled spaces. A CT cisternogram might give additional information regarding connection with the subarachnoid space.
TREATMENT

Surgical intervention is necessary in patients with heterotopic parapharyngeal neuroglial tissue that causes airway distress, dysphagia, or failure to thrive. Tumor resection in the newborn period might allow early oral feeding and avoidance of tracheotomy. The surgical approach should be analogous to that of cystic hygroma. Resection should be as complete as possible without sacrificing vital structures or compromising function. Multiple surgical resections might be necessary to accomplish this task.

The timing of the surgery is controversial. Early surgical intervention in the newborn period seems to be beneficial for 2 reasons. First, further growth of neuroglial heterotopias might cause distortion and erosion of bone and result in facial deformity requiring future correction. Second, delay in resection might preclude normal development of swallow function and pharyngeal coordination. Proponents of delayed resection believe that resection might be safer in the older child, in whom vital neurovascular structures are more easily salvageable and blood volume is greater. However, delayed resection of parapharyngeal heterotopic neuroglial tissue frequently requires airway control and alternate routes for feeding. The increased morbidity and mortality rates associated with tracheotomy and gastrostomy feeding might be considered. In addition, further distortion of surrounding soft tissue and bone of the facial skeleton might ensue.

Surgical excision can be performed through a transcervical, lateral pharyngotomy approach with primary closure of the pharynx. This allows early identification and preservation of vital neurovascular structures. Preservation of pharyngeal mucosa with meticulous dissection of the submucosal portion of the mass might improve functional outcome. A transoral and/or transpalatal approach can be combined with the external approach. Rigorous postoperative care includes attention to nutritional status and speech and swallowing therapy.

Tracheotomy and gastrostomy might be necessary in patients with comorbidities precluding early surgical extirpation (eg, complex congenital heart disease). A nasopharyngeal airway might be an alternative to tracheotomy in select newborns with a prominent nasopharyngeal component and minimal involvement of the oropharynx and hypopharynx.

MANAGEMENT APPROACH

The differential diagnosis of masses in the nose and pharynx causing airway obstruction in the newborn includes adenoid hyperplasia, glioma, teratoma, dermoid, cystic hygroma, hemangioma, neurofibroma, ectopic thyroid, branchial anomaly, heterotopic brain, and sarcoma. If a mass is identified in the vicinity of the skull base, CT (with and without cisternography) and MRI can be used to exclude an intracranial connection. Next, an incisional biopsy and airway endoscopy should be performed. If the biopsy specimen contains mature neural tissue, the differential diagnosis is limited to 3 entities: teratoma, encephalocele, and heterotopic neuroglial tissue. Differentiation of these tumors can be made by clinicopathologic and radiographic correlations (Table). Surgical resection can proceed if the general health of the child permits. A nasopharyngeal tube might be useful for airway management in some patients to avoid tracheostomy. Patients with airway compromise, failure to thrive, and other significant comorbidities might require delayed surgical resection, tracheostomy, or gastrostomy tube insertion.

| Comparison of Congenital Nasal and Pharyngeal Masses* |
|-----------------------------|-----------------|-----------------|------------------------|
| Skull Base Deformity at Birth | Intracranial Connection | Neurons | Specialized CNS Structures |
| Glioma | Uncommon | ~25% | No | No | No |
| Heterotopic brain | Frequent | No | Yes | No | Yes |
| Teratoma | Yes | Yes | Yes | Yes | Yes |
| Encephalocele | Uncommon | Yes | Yes | Yes | Yes |
| Vasoformative mass | Uncommon | No | No | No | No |

*CNS indicates central nervous system.
REFERENCES