# The Benefit of Brain MRI in the Evaluation of Pediatric Dysphagia

Terah Allis, MD[1,2]; , Ryan Romans, MD[2]; Deborah Goebel, MD[2]; Ryan Sewell, MD[1,2]; Heather Thomas, MD[1,2]
[1]University of Nebraska Medical Center, [2] Omaha Children's Hospital and Medical Center

## ABSTRACT

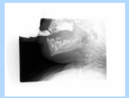
Title: The benefit of brain MRI in the evaluation of pediatric dysphagia

Objectives:
1. Determine rates of brain MRI abnormalities for dysphagia in a pediatric aerodigestive center.
2. Examine trends in swallowing improvement based on brain MRI pathology and syndromic status.
3. Recognize the incidence of Chiari malformations and the association with dysphagia.
4. Be able to counsel families regarding likelihood of swallowing improvement based on abnormal MRI.

Methods: IRB approved, retrospective review 222 pediatric medical records (2001-2010) enrolled in an aerodigestive clinic. Swallow studies & brain MRI reports were reviewed. Patients were subdivided into syndromic and nonsyndromic, n=62, 159. All patients with MRI for dysphagia were analyzed statistically for brain abnormalities, Chiari malformation, correlating with swallowing improvement and resolution.

Results: Of 222 children with dysphagia 45 had brain MRI for dysphagia. 14 had abnormalities. 11, 24%, were nonsyndromic with abnormal MRI. 2/11 were diagnosed with Chiari comprising 5% of MRIs performed for dysphagia in nonsyndromic children. 1 Chiari I patient did not undergo surgery and demonstrated improvement. No Chiari patients had resolution of dysphagia, yet 50% improved p=0.486. MRI did not correlate with symptom resolution. Nonsyndromic with abnormal MRI for dysphagia displayed 60% improvement vs. 56% with normal MRI improved, p=1.0. Resolution rates were similar for patients with abnormal MRI,18% resolution rate and 22% with normal MRI having resolution, p=1.0.

Conclusions: At our institution children with persistent dysphagia undergo brain MRI to exclude Chiari malformation. Two malformations were diagnosed (5%) supporting MRI in dysphagia evaluation in diagnosing Chiari. However, it does not support MRI utility in predicting resolution as there was no difference statistically between the brain MRI groups outcome.



**CONTACT**

UNMC & Omaha Children's Hospital
Dr. Ryan Sewell, Otolaryngology
Email: ryan.sewell@unmc.edu

Poster Design & Printing by Genigraphics® - 800.790.4001

## INTRODUCTION

Evaluation and management of the pediatric patient with dysphagia is complex. Many algorithms exist[1-3]; however, data to support these algorithms is limited. The utility of brain MRI in diagnosis of neurological explanation for dysphagia in the pediatric patient is unknown. A brain MRI with sedation involves risk to the patient and carries significant financial cost. The advantage to the patient includes the possibility of identifying an etiology for the dysphagia. Arnold Chiari malformations are one potentially reversible etiology of oropharyngeal dysphagia. In a specialized aerodigestive swallowing center a protocol for brain MRI would have substantial value. Current literature, however, does not define which patients would benefit from brain MRI. Our study aims to better delineate which patients would benefit and therefore undergo brain MRI for dysphagia.

Chiari malformations, type I (CMI), characterized by abnormal extension of the cerebellar tonsils below the foramen magnum (Figure 1.), and type II (CMII), in which the cerebellar vermis and caudal brainstem descend through the foramen magnum associated with myelomeningocele (Figure2.),[4] are potentially reversible causes of pediatric dysphagia particularly in children age less than 2.[5-6] While CMII are discovered commonly at birth due to myelomenigocele, CMI may remain undiscovered until adolescence or adulthood. CMI malformations may be more common in the population than previously reported. The natural history is not well defined and surgical management is not always indicated.[7] At our institution we utilize MRI to rule out this abnormality when the cause of dysphagia remains unknown. We hypothesized that MRI is beneficial to detect CMI in this population.

## METHODS AND MATERIALS

**Study Design:** IRB approved, retrospective review of 222 pediatric medical records (2001-2010) enrolled in an aerodigestive clinic, n=222. Swallow studies (speech pathology results, MBS, and esophagrams) and brain MRI reports were reviewed. Patients were subdivided into syndromic (known or suspected genetic abnormality or syndrome), n=62 and nonsyndromic (considered developmentally appropriate), n=159. All patients with MRI were investigated, n=141. Patients with an indication of dysphagia (feeding intolerance, aspiration, emesis, FTT, swallowing difficulty) were subdivided (n=45) and further analyzed statistically for: brain MRI abnormalities including chiari malformations (CMI and CMII) as well as other neurologic abnormalities (hydrocephalus, subdural hematomas, intracranial tumors/masses, periventricular leukomalacia, microcephaly). Swallowing improvement (aspiration to penetration) and resolution (no evidence of any penetration , aspiration, dysmotility) were analyzed. Patients with vocal cord dysfunction (VCD), tracheostomy and, gastrostomy button were noted.

Statistical analysis was performed with a PC SAS version 9.2 (significance < 0.05). Frequencies and percentages were presented for all binary variables. Chi-square or Fisher's Exact Test were used to test for an association between binary variables.

## RESULTS

Of the 222 pediatric patients presenting to our aerodigestive clinic with dysphagia, 45 had brain MRI for dysphagia. Age at brain MRI ranged from 1 day of life to 3090 days old (8.5 years) with an average age 3.5 years old. [28 children had vocal cord dysfunction, 66 had history or present tracheostomy]. A total of 14 children had abnormal brain MRIs (Figure 3., Chart 1.). 11 patients were nonsyndromic with abnormal MRI (11/45, 24.4%). Of the 11 patients who were nonsyndromic with abnormal MRIs two were diagnosed with CMI (2/11 or 18.1%) which comprised 5% of all MRIs performed for dysphagia in nonsyndromic children (Figure 4.). 7 out of the 9 patients with CMI or II had surgical management. One patient with CMI did not undergo surgical decompression and his swallow study demonstrated interval improvement with aspiration initially and only minimal penetration 11 months later. The second patient with CMI has yet to undergo surgical management. None of the children with CMI or II had resolution of dysphagia, yet, 50% improved with surgical management (p=1.0).

Of the 21 children who had vocal cord dysfunction (confirmed by endoscopy) who also had brain MRIs for any indication 12 had abnormal brain MRIs. Of these, 8 patients were nonsyndromic while the remaining 4 were syndromic.

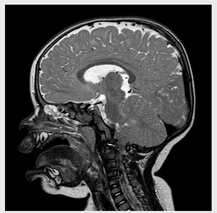


**Figure 1. 14 m old M nonsyndromic male with Chiari I found on MRI for dysphagia.**

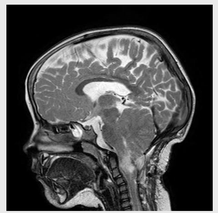


**Figure 2. 3 yr F with chiari II found at birth**

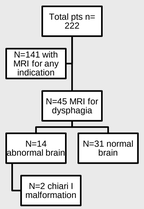



**Figure 3. Brain MRI without syndromic status**

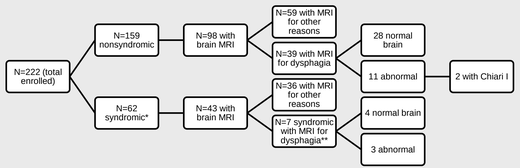



**Figure 4. Flowchart, MRI by syndromic status**

## RESULTS

Brain MRI did not appear to correlate with ultimate symptom resolution. Nonsyndromic patients with abnormal MRI for dysphagia demonstrated 60% improvement (6/10) while 56% with normal MRI reports improved (14/25), (p=1.0). Resolution rates were similar for patients with abnormal MRI showing an 18% resolution rate (2/11) and 22% of the patients with normal MRI having resolution (6/27) (p=1.0) (Chart 1.).

Overall swallow study improvement and dysphagia resolution, regardless of syndromic status demonstrated approximately 50% of children enrolled in our aerodigestive center improved and 30% of children had resolution.

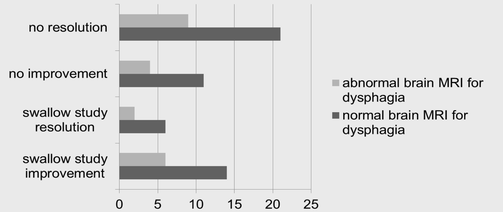



**Chart 1. Swallow study improvement and resolution based on brain MRI findings in nonsyndromic children**

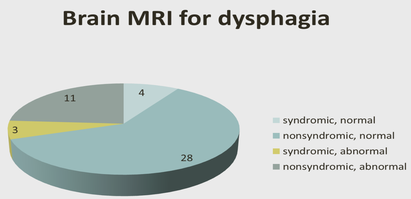



**Chart 1. Brain MRI results**

## DISCUSSION

Brain MRI is a recognized tool in the workup of persistent oropharyngeal dysphagia and developmental delay[1], however, to date no study has defined the role of MRI in this workup. We studied 45 children who had abnormal brain MRI analyzing syndromic status, swallow study improvement and resolution. By utilizing MRI two patients with CMI were diagnosed. Yet, 43 children underwent MRI for this finding and no correlation was made with abnormal MRI and swallow study improvement or symptom resolution (measured by swallow study without evidence of aspiration or penetration). We found that abnormal brain MRI does not in itself predict dysphagia outcomes. Other factors such as vocal cord dysfunction, sleep apnea, respiratory symptoms, specific neurological delay, or craniofacial abnormalities may better predict dysphagia resolution which future studies could address. Indeed pediatric dysphagia evaluation continues to be a challenging subject with ample possibility for study.

Limitations to this study include retrospective nature, subjective interval timing for swallow studies which may either over or underestimate time to symptom resolution, and small sample size.

## CONCLUSIONS

At our institution most children with persistent dysphagia undergo brain MRI to exclude CMs. Two children were found to have Chiari (5.0% of nonsyndromic abnormal brain MRIs) . Our study supports the use of MRI in the evaluation of dysphagia in diagnosing Chiari malformations. However, it does not support the benefit of MRI in predicting which patients will show resolution of their symptoms as there was no difference statistically between the abnormal and normal brain MRIs and dysphagia improvement and resolution.

## REFERENCES

1. Richer GT. Management of oropharyngeal dysphagia in the neurologically intact and developmentally normal child. Current Opinion in Otolaryngology & Head and Neck Surgery 2010, 18:000–000.
2. Sheikh S, Allen E, Shell R, et al. Chronic aspiration without gastroesophageal reflux as a cause of chronic respiratory symptoms in neurologically normal infants. Chest 2001; 120:1190–1195.
3. Arvedson Joan, Rogers Brian, Buck Germaine, Smart Paulette, Msall Michael Silent aspiration prominent in children with dysphagia International Journal of Pediatric Otorhinolaryngology, Volume 28, Issues 2-3, January 1994, 173-181.
4. Rosenbaum RB and DP Ciaverella. Bradley: Neurology in Clinical Practice, 5th Ed. Ch. 77 Disorders of bone, joints, ligaments, and meninges. 2150-2151.
5. Albert GW, Menezes AH, Hansen DR, et al. Chiari malformation Type I in children younger than age 6 years: presentation and surgical outcome. J Neurosurg Pediatr 2010; 5:554–561.
6. Greenlee JD, Donovan KA, Hasan DM, Menezes AH: Chiari I malformation in the very young child: the spectrum of presentations and experience in 31 children under age 6 years. Pediatrics 2002, 110:1212–1219.
7. Strahle J.Muraszko K, Kapurch J. et al. Natural history of Chiari malformation Type I following decision for conservative treatment. J. Neurosurg Pediatrics 2011, 8: 214-221.

*acknowledgement .UNMC statistician, Valerie Shostrom