Cricopharyngeal Achalasia in Children: Surgical and Medical Treatment

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ABSTRACT: **Background:** Cricopharyngeal achalasia (CA) is a rare cause of dysphagia in children presenting with non-specific symptoms such as choking, food regurgitation, nasal reflux, coughing, recurrent pneumonia, cyanosis, and failure to thrive. It results from failure of relaxation of the upper esophageal sphincter (UES) and may appear either as an isolated lesion or in conjunction with other pathologies. Recognition and early diagnosis of this condition may minimize morbidity in children.

Objectives: To evaluate the clinical course of four children with cricopharyngeal achalasia presenting to our clinic.

Methods: We conducted a 5 year retrospective chart review in a tertiary referral center.

Results: Four children were diagnosed with primary cricopharyngeal achalasia between 2006 and 2010. Diagnosis was established by videofluoroscopy and all underwent uneventful cricopharyngeal myotomy. Three children recovered completely and one child showed partial improvement. For residual UES spasm in a partially improved patient, botulinum toxin was injected into the UES which led to further improvement. Dysphagia recurred in one child who was successfully treated with botulinum toxin injection.

Conclusions: Cricopharyngeal myotomy is a safe procedure in infants and young children. Botulinum toxin injection of the UES was found to be effective in refractory cases.

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KEY WORDS: cricopharyngeal achalasia (CA), cricopharyngeal myotomy, botulinum toxin, upper esophageal sphincter (UES), oropharyngeal dysphagia

The upper esophageal sphincter is a functional unit of high pressure zones comprising the inferior pharyngeal constrictor muscle, cricopharyngeal muscle, and the upper parts of the cervical esophagus. The primary muscular element that maintains the tonus of the UES is the cricopharyngeal muscle [1]. This muscle remains in tonus preventing the passing of air to the esophagus, and relaxes during swallowing to permit free passage. Failure of relaxation leads to oral and nasal regurgitation of food and tracheal aspirations.

Cricopharyngeal achalasia is a rare cause of dysphagia in children, resulting from failure of relaxation of the UES. Jackson in 1915 [2] was the first to describe this condition among adults, and Utian and Thomas in 1969 [3] described it in infants. Cricopharyngeal achalasia may develop between birth to 6 months of age [4-11]. However, diagnosis may be delayed due to non-specific symptoms including choking, food regurgitation, nasal reflux, coughing, recurrent pneumonia, cyanosis, and failure to thrive. Treatment includes cricopharyngeal myotomy, balloon dilatation or botulinum toxin injection to the UES. We present the clinical course of four children with cricopharyngeal achalasia, emphasizing the importance of early diagnosis and treatment in minimizing infant morbidity.

UES = upper esophageal sphincter

PATIENTS

PATIENT 1

A 4 month old infant presented with recurrent episodes of choking during feeding. He was born at full term by natural delivery after an uneventful pregnancy. He weighed 3030 g at birth and was breast-fed with very little weight gain. At 6 weeks of age he was hospitalized for bronchiolitis (negative for respiratory syncytial virus). Recurrent choking, aspirations during feeding and poor weight gain were noted with no significant improvement after the feeding formula was changed [12]. Neurologic, ophthalmologic and otolaryngologic examinations including laryngoscopy, esophagoscopy and magnetic resonance imaging of the brain and cervical spine were normal. Barium swallow showed significant aspiration of contrast material, and at age 10 weeks a gastrostomy was performed. On presentation to our clinic the infant weighed 3600 g. Videofluoroscopy revealed a cricopharyngeal bar, establishing the diagnosis of primary cricopharyngeal achalasia [Figure 1]. Cricopharyngeal myotomy was performed through the left lateral neck. The sternocleidomastoid muscle and the carotid sheath were retracted posteriorly and the larynx rotated contralaterally, exposing the

Figure 1. Videofluoroscopy of a patient with dysphagia. CP Bar = cricopharyngeal bar, BT = base of tongue, V = vallecula, PS = pyriform sinuses, E = cervical esophagus

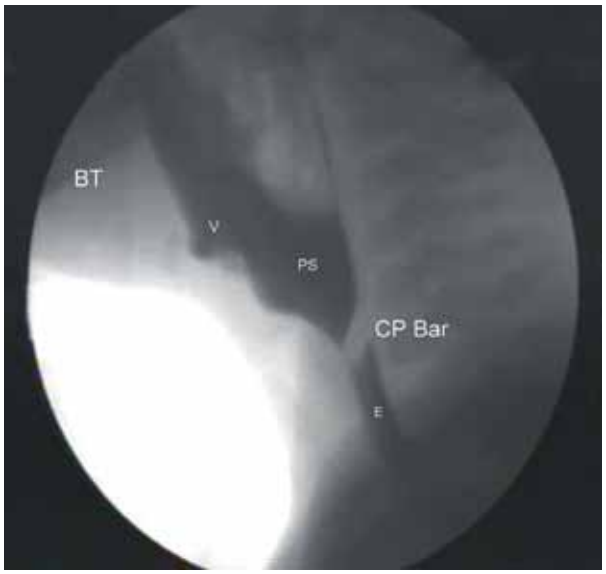


Figure 2. The arrow indicates the spastic upper esophageal sphincter. The arrowhead in **[A–C]** indicates enlarged pharynx. The arrowhead in **[D]** indicates aspiration

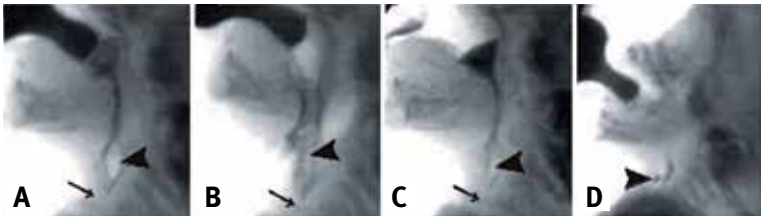
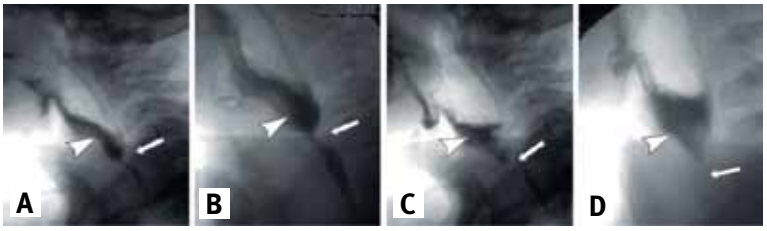


Figure 3. Selected sequences in a child with a cricopharyngeal achalasia. The arrowhead indicates the enlarged pharynx above the upper esophageal sphincter. The arrow in **[A–C]** indicates the cricopharyngeal bar, and in **[D]** the persistent spastic UES. The amount of bolus passage through the UES is gradually decreased from **[A]** to complete blockage in **[D]**



cricopharyngeal muscle. A Foley catheter, inserted into the upper esophagus, was inflated to facilitate better exposition of the muscle. The muscle was divided with cold steel dissection and sutured laterally on both sides.

Transient fever and leukocytosis (white blood cells 29,000/mm^3, neutrophils 42%) were noted on the first postoperative day. The physical examination, chest X-ray, urine and blood cultures were normal. Wide-spectrum intravenous antibiotics (piperacillin sodium 100 mg/kg, tazobactam sodium 12.5 mg/kg) were initiated. The child was discharged from hospital on the third postoperative day and began oral feeding 2 weeks later without difficulty and with good weight gain. The gastrostomy was removed one month after surgery.

At the age of 2 years and 8 months, following an upper respiratory infection, the child presented with gradual dysphagia to solids and liquids, to the extent that he was unable to swallow his own saliva. Videofluoroscopy revealed no propulsion of contrast material through the UES. The diagnosis of secondary cricopharyngeal achalasia was suggested. After balloon dilatation of the UES failed, botulinum toxin (Botox® 10 units divided between two sites) was injected into the UES under general anesthesia via rigid endoscopy. Two weeks later the child regained unlimited oral intake. One year follow-up was uneventful.

PATIENT 2

A 2 month old male infant, delivered at full term by natural delivery after an uncomplicated pregnancy, presented to our clinic with a history of progressive difficulty in breastfeeding since birth. His weight at birth was 3235 g. At 4 weeks of age he was unable to drink anything and weighed 3275 g. Videofluoroscopy revealed complete stoppage of contrast material at the level of the upper esophageal sphincter with aspiration of the contrast material to the trachea [Figure 2]. MRI of the head and neck was normal, as was an electroencephalogram. A nasogatric tube was inserted with satisfactory weight gain and development. At 3.5 months of age cricopharyngeal myotomy was performed. The infant started breastfeeding in the recovery room. Complete oral feeding with satisfactory weight gain was documented thereafter. The patient was followed uneventfully for 2 years.

PATIENT 3

A 4 year old boy with cerebral palsy presented to our clinic with a history of severe dysphagia, choking and aspiration on feeding and recurrent pneumonia since birth and was fed via a nasogastric tube. At age 1 year a gastrostomy was performed and at 18 months he underwent Nissen's fundoplication surgery.

Videofluoroscopy revealed UES spasm with nasal regurgitation and over-spillage of barium to the larynx. At presentation he was unable to swallow his own saliva and could not stay in a supine position. Cricopharyngeal myotomy resulted in improved swallowing, enabling him to drink liquids and to sleep in a supine position without aspirations. Dysphagia to semi-solid and solid foods was still present. Repeated videofluoroscopy demonstrated residual UES spasm [Figure 3]. Botulinum toxin was injected into the UES with further

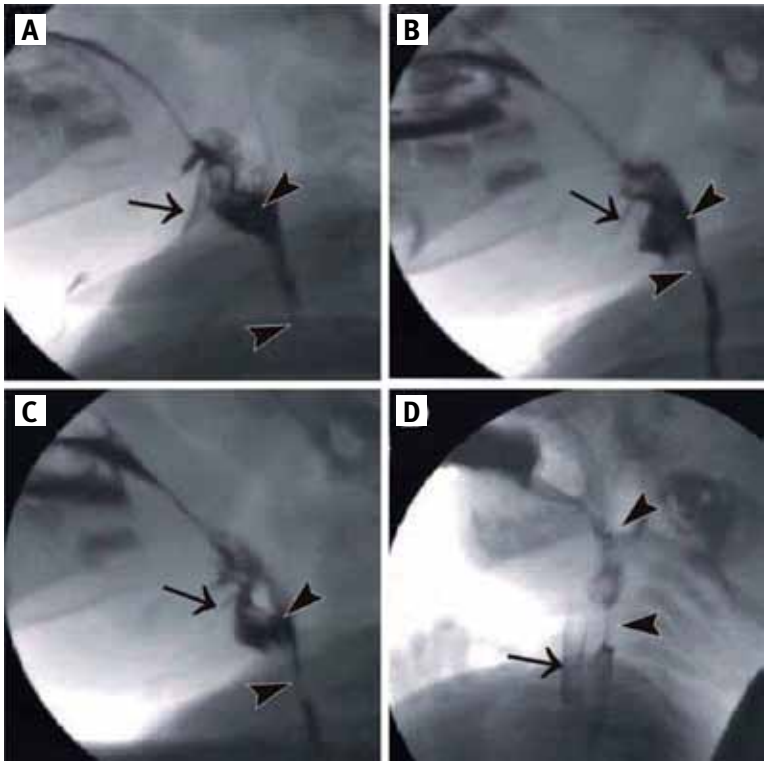
improvement. However, to date, difficulty swallowing and aspirations of saliva are still noted.

PATIENT 4

A 4 year old boy with CHARGE syndrome presented to our clinic with a history of dysphagia and recurrent aspirations. The child was able to manage liquids and semi-solids but had severe dysphagia to solids. At birth he had undergone surgical repair of type-D esophageal atresia with distal and proximal tracheoesophageal fistulae, through a right thoracotomy. Also, he had a permanent tracheostomy due to bilateral vocal cord palsy and tracheomalacia. His medical profile also included cardiac anomalies (a small patent ductus arteriosus and bicuspid aortic valve), genital abnormalities (hypogonadotropic hypogonadism), bilateral hearing loss and developmental autistic features. Videofluoroscopy demonstrated slow propagation of the solid bolus through the pharynx, inadequate opening of the UES, and gross aspiration of contrast material.

The child underwent cricopharyngeal myotomy uneventfully with immediate improvement of swallowing, enabling him to manage solid food. Repeated videofluoroscopy demonstrated improved swallowing with no aspirations. Two years of follow-up was uneventful.

Figure 4. Forced passage through a constricted upper esophageal sphincter. The arrow on the left indicates the laryngeal penetration and tracheal aspiration in **[D]**. The upper arrowhead indicates the enlarged hypopharynx. The lower arrowhead indicates the constricted UES



DISCUSSION

Cricopharyngeal achalasia is a rare disorder with non-specific symptoms of coughing, choking and aspirations that may delay its diagnosis. Possible associated anomalies, such as Arnold-Chiari malformation, meningomyelocele or cerebral palsy, mandate MRI evaluation of the brain and cervical spine. We were unable to address the cause of the recurrence of cricopharyngeal achalasia 2 years after successful surgery in one of our patients (patient 1).

Videofluoroscopy allows detailed analysis of oropharyngeal swallowing. Typical findings establish its diagnosis, such as stasis of contrast in a dilated pharynx with little passage to the esophagus, cricopharyngeal bar or shelf-like projection of the pharynx posteriorly at the level of the sixth vertebra, aspirations or nasal regurgitations of contrast material [Figure 4]. Manometric study is technically difficult to perform in infants because of the short distance between the pharynx and the UES, leading to the transducers slipping out during swallowing [5,11].

There is no consensus regarding the preferred treatment for cricopharyngeal achalasia in infancy. Balloon dilatation was proposed as an initial trial, especially in those with mild symptoms or associated abnormalities. Several dilatation attempts may be needed because of the high rate of recurrence; however, long-term success has been reported in a few cases [6,11,13]. Botulinum toxin injections have been shown to provide temporary relief but rarely constitute a permanent solution [14,15].

Some authors [6,14,15] suggest surgery for failures of non-surgical measures. The incidence of complications of cricopharyngeal myotomy is low [7,10,16]. This condition can be associated with a variety of complications including wound infection, hemorrhage, inadequate sectioning of UES, transient or permanent vocal cord paralysis, and esophageal perforation with mediastinitis or fistula formation. Nevertheless, reports of such complications are few and rarely severe [17]. In our modest experience however, except for transient fever all four procedures were uneventful.

Operative success may depend on associated esophageal abnormalities, i.e., gastro-esophageal reflux [10,16]. Although severe gastro-esophageal reflux was suggested to cause hyperactive UES, the data are conflicting [10]. At times, control of the lower esophageal sphincter should be achieved before cricopharyngeal myotomy [10].

In conclusion, cricopharyngeal myotomy was found to be safe in infants and young children and can be considered as a primary treatment of cricopharyngeal achalasia. Botulinum toxin can be used for failed or refractory cases.

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Capsule

Vector transmission regulates immune control of Plasmodium virulence

Defining mechanisms by which Plasmodium virulence is regulated is central to understanding the pathogenesis of human malaria. Serial blood passage of Plasmodium through rodents, primates or humans increases parasite virulence, suggesting that vector transmission regulates Plasmodium virulence within the mammalian host. In agreement, disease severity can be modified by vector transmission, which is assumed to 'reset' Plasmodium to its original character. However, direct evidence that vector transmission regulates Plasmodium virulence is lacking. Spence et al. used mosquito transmission of serially blood passaged (SBP) *Plasmodium chabaudi chabaudi* to interrogate regulation of parasite virulence. Analysis of SBP *P. c. chabaudi* before and after mosquito transmission demonstrated that vector transmission intrinsically modifies the asexual blood-stage parasite, which in turn modifies the elicited mammalian immune response, which in turn attenuates parasite growth and associated pathology. Attenuated parasite virulence associates with modified expression of the *pir* multi-gene family. Vector transmission of Plasmodium therefore regulates gene expression of probable variant antigens in the erythrocytic cycle, modifies the elicited mammalian immune response, and thus regulates parasite virulence. These results place the mosquito at the center of our efforts to dissect mechanisms of protective immunity to malaria for the development of an effective vaccine.

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Eitan Israeli

Capsule

Exosomes mediate the cell-to-cell transmission of IFNα-induced antiviral activity

The cell-to-cell transmission of viral resistance is a potential mechanism for amplifying the interferon-induced antiviral response. In this study, Li et al. report that interferon-α (IFNα) induced the transfer of resistance to hepatitis B virus (HBV) from non-permissive liver non-parenchymal cells (LNPCs) to permissive hepatocytes via exosomes. Exosomes from IFNα-treated LNPCs were rich in molecules with antiviral activity. Moreover, exosomes from LNPCs were internalized by hepatocytes, which mediated the intercellular transfer of antiviral molecules. Finally, the authors found that exosomes also contributed to the antiviral response of IFNα to mouse hepatitis virus A59 and adenovirus in mice. Thus, they propose an antiviral mechanism of IFNα activity that involves the induction and intercellular transfer of antiviral molecules via exosomes.

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