Hoarseness in children

ABSTRACT

Hoarseness or dysphonia are terms used to describe a change in the quality of the voice. The voice quality can be raspy, breathy, strained, fatigued, rough, tremulous or weak. There may be a change in pitch, restriction of range, voice breaks, decreased projection, or abnormal resonance. It is important to remember that a voice disorder is not a disease in itself but rather a presentation of an underlying pathology.

Clinicians' knowledge of paediatric hoarseness is limited as it can be difficult to examine children using fibreoptic laryngoscopy and the child may not comprehend the need for detailed examination. However, paediatric flexible naso-laryngoscopy provides a dynamic view of the laryngeal anatomy and function. Recent advances in diagnostic equipment, pharmacology and therapeutics mean that this problem can be managed more successfully but it still remains a challenge. This article discusses the presentation, aetiology and management of hoarseness in children.

Hoarseness or dysphonia are terms used to describe a change in the quality of the voice. The voice quality can be raspy, breathy, strained, fatigued, rough, tremulous or weak. There may be a change in pitch, restriction of range, voice breaks, decreased projection or abnormal resonance. The prevalence of hoarseness in children ranges from 4–23% (Duff et al, 2004; Carding et al, 2006). Hoarseness in children is usually the result of benign lesions of the vocal folds (e.g. nodules, polyps, haemorrhage or haematoma). Causes may range from viral upper respiratory infection to vocal abuse and misuse and can be managed with education, watchful waiting, and voice therapy. It is important to remember that a voice disorder is not a disease in itself but rather a presentation of an underlying pathology.

Clinicians' knowledge of paediatric hoarseness has improved in recent times, but it can be difficult to examine children clinically using fibreoptic laryngoscopy. They may not understand the need for detailed examination. Children have shorter phonation times, shorter attention span, difficulty completing vocal tasks and a small larynx, all making visualization difficult. However, paediatric flexible naso-laryngoscopy provides a dynamic view of the laryngeal anatomy and function. Advances in diagnostic equipment, pharmacology and therapeutics mean that this problem can be managed more successfully but it still remains a challenge.

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Anatomy and function of the larynx

The larynx is a complex structure which has protective, respiratory, deglutition and vocalization functions. It has a cartilaginous skeleton, intrinsic and extrinsic muscles and a mucosal lining. The vocal fold or cords are mainly responsible for production of sound. Sound is produced by air flow from the lungs causing the vocal folds to vibrate producing sound waves. Various cartilages and muscles in the larynx maintain a specific position, shape and tension in the vocal folds altering the mechanics of the sound quality. Voice production can be thought of as having three components:

1. Generation of airflow (lungs)
2. Vocal cord vibration (vocal folds) which produces sound
3. Shaping of the sound to produce various resonances (oropharynx, nasopharynx, tongue, palate, cheeks and lips).

Changes to any structures from the lungs to the nasopharynx may result in dysphonia or hoarseness.

Some characteristics of the larynx of children differ from those in adults. These include:

- The larynx is situated higher in the neck, closer to the soft palate and other articulating structures, hence the vocal tract is shorter
- The cartilage and vocal folds change size and shape as the child matures. Anatomical changes in the layers of the vocal fold also affect the characteristics of the larynx
- The lack of the protective three-layered structure of the vocal ligament in immature vocal folds makes them prone to tissue reactions if there is heavy voice use.

History

A detailed history is important, including age of onset of hoarseness, its progression and its duration. Characteristics of cry can be important in small babies who have not yet vocalised. The quality of voice is important (breathy, alteration in pitch). Any associated symptoms like pain, difficulty swallowing and reflux are important. The prenatal history and maternal condylomata acuminata may be important as this may indicate a viral aetiology.

Prematurity requiring intubation for ventilator support may result in laryngeal injury (dislocated arytenoid or division of vocal fold) and scarring. The timing of the symptoms if seasonal or perennial may indicate allergic pathology. Any history of possible foreign body aspiration or concurrent illness details can be helpful to make a diagnosis. Any previous surgery for other congenital disorders, especially cardiac problems or tracheo-oesophageal fistula, may be important. Any concurrent illness or any medications can be an important contributing factor.

Before puberty, asking about a history of vocal abuse, i.e. excessive and inappropriate use of voice (shouting or screaming), particularly in young boys, can help determine the likelihood of vocal fold nodules. Growth of the vocal folds and laryngeal apparatus, change in habits, and change in the hormonal milieu that occur during puberty often contribute to changed voice quality.

Surgery can be considered for persistent lesions with noted anatomical alterations or if any clinical concerns arise in view of the detailed history and examinations.

The duration and progression of onset are important to make a diagnosis. Usually a duration of symptoms less than 2 weeks is considered acute in nature. A latency period of more than 3 weeks is considered chronic and may suggest a more serious aetiology. Chronic hoarseness can have a negative impact on children physically, emotionally and socially, especially when they are going through puberty, although hoarseness seems to affect children less than adults.

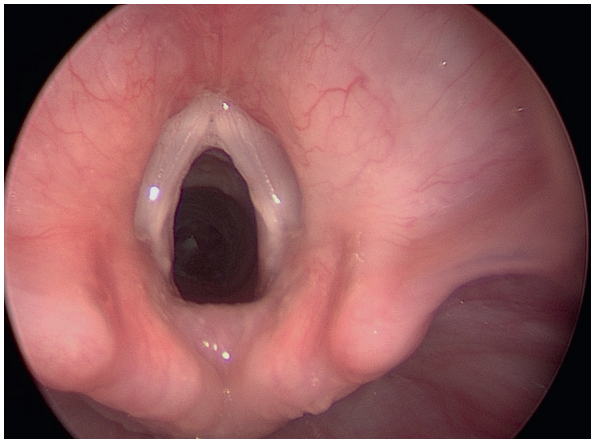
Assessing and analysing the patient's voice use pattern can be important. Associated symptoms such as pain, dysphagia, cough, shortness of breath or passive smoking can be important.

Assessment

Any abnormal syndromic or craniofacial feature may indicate possible structural causes for hoarseness. The oral cavity and oropharynx should also be inspected, particularly to evaluate the size and volume of the pharynx as well as the appearance and degree of movement of the entire palate. Tongue mobility should also be assessed.

Examination with visualization of the larynx (*Figure 1*) is fundamental to making a diagnosis. Microlaryngotracheobronchoscopy is the gold standard procedure for diagnosis, although this requires a general anaesthetic. Palpation of crico-arytenoid mobility to check for joint fixation and laryngeal cleft (*Figure 2*) is vital during microlaryngotracheobronchoscopy to make a correct diagnosis. Passive and active mobility of vocal cords will give more information about the possible cause of vocal cord pathology. In the outpatient department or ward a fibreoptic or indirect laryngoscopy is required for any child with voice change, although this may depend on the child's compliance and parental agreement. A flexible laryngoscopy (*Figure 3*) procedure in outpatients can provide dynamic assessment of the vocal cords and may also reduce the need to perform a laryngoscopy under anaesthesia. However, the two procedures are often complementary as awake assessment in children is difficult and view can be limited.

Figure 1. Normal supraglottic view.



Listen to the voice and document the voice quality. A weak voice is often the result of poor vocal fold movement or incomplete closure of the vocal folds during speech. Endoscopic examination can give some idea about the pathology but it does not give any information about its impact on the child's life. Zur et al (2007) discussed the importance of tools such as paediatric voice outcome survey, paediatric voice related quality of life questionnaires and paediatric voice handicap index – the latter consisting of 23 questions covering three domains: functional, physical and emotional. The use of a standardized tool, such as the Grade, Roughness, Breathiness, Asthenia, Strain scale (GRBAS), may be beneficial to measure perceptions of voice quality. GRBAS ranks each component of voice from 0 (normal) to 3 (severe). However, practical use of these tools among children is complicated because of difficulties performing the examination and because children may not clearly understand and comprehend these assessment scoring tools.

Aetiology

The aetiology of hoarseness is varied. Possible causes are outlined in *Table 1*.

Figure 2. Probe used to check mobility and laryngeal cleft.

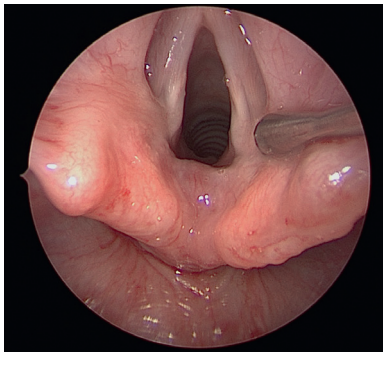


Figure 3. Flexible laryngoscopy showing interarytenoid congestion.

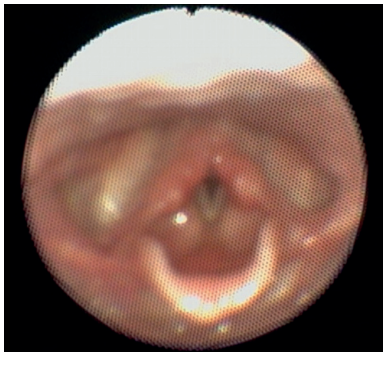


Table 1. Aetiology of hoarseness	
Infection	Laryngitis (supraglottitis), laryngotracheobronchitis (croup)
Inflammation	Vocal cord granuloma, gastro-oesophageal reflux disorder, corrosive ingestion
Traumatic	Birth trauma, road traffic accident
Iatrogenic	Chest or throat surgery, nasogastric tube placement
Congenital	Laryngomalacia, subglottic haemangioma, laryngeal cysts, webs or clefts, Arnold–Chiari malformation
Functional	Abnormal mechanics and structural problems of aerodigestive tract
Tumours	Malignancy: human papillomavirus-related

Common causes

Vocal cord nodules

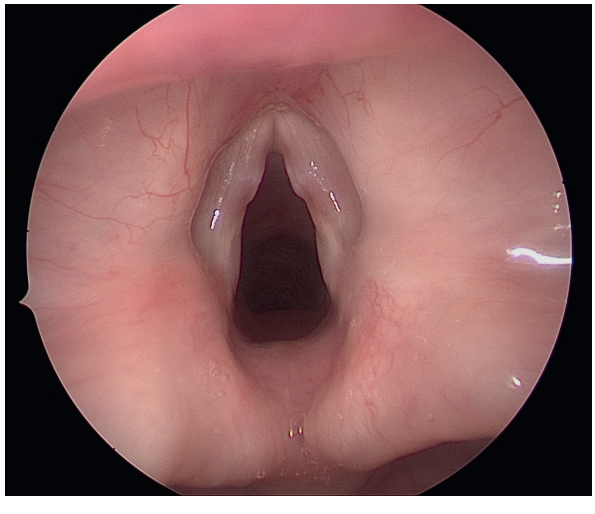
Vocal cord nodules are the most common cause of hoarseness in children as a result of vocal abuse. They form at the junction of the anterior third and posterior two thirds of the true vocal cord margin (*Figure 4*) usually as a result of phono-trauma as the point of contact is greatest here (Martins et al, 2013).

Recurrent respiratory papillomatosis

Recurrent respiratory papillomatosis is a disease of viral aetiology (*Figure 5*) caused by HPV type 6 and 11. It results in exophytic lesions, typically in the larynx, which may affect any portion of the respiratory tract with voice and breathing changes. The digestive tract is very rarely involved. Patients with HPV-11 tend to demonstrate more aggressive disease than those with HPV-6, with younger age of onset, more frequent recurrence, multiple surgical procedures and a higher rate of subglottic or bronchogenic spread.

However, an earlier age of onset is more important than HPV type for predicting aggressive disease. High risk subtypes HPV-16 and HPV-18 account for only 1% of cases and are often associated with malignant transformation.

Figure 4. Cord nodules.



Recurrent respiratory papillomatosis is the second most common cause of paediatric hoarseness. Although this is a benign condition it has extremely morbid potential as a result of airway involvement and the small risk of malignant transformation. A link to malfunction of the cell-mediated immune response has been demonstrated in patients with juvenile recurrent respiratory papillomatosis (Bonagura et al, 2010).

The mainstay of treatment is repeated surgical debridement to provide a safe airway and a good voice. Medical treatment with interferon or cidofovir is also an option, but neither is curative and both treatments have their own side effects and risks. The quadrivalent HPV vaccine may reduce the incidence of recurrent respiratory papillomatosis in future.

Laryngomalacia

Laryngomalacia is the commonest cause of stridor in children and may cause hoarseness in severe cases as a result of associated oedema (*Figure 6*). Its hallmark is inspiratory stridor. Initially it may get worse over the first few months but children usually get better by the age of 2 years. Most

Figure 5. Laryngeal papilloma.

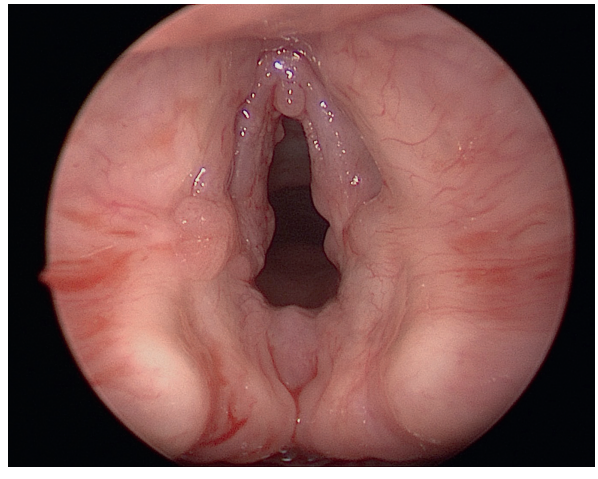


Figure 6. Laryngomalacia.

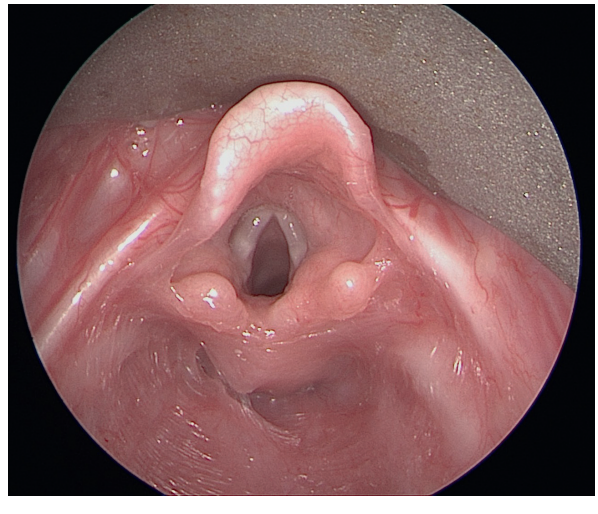


Figure 7. Vocal cord granuloma.

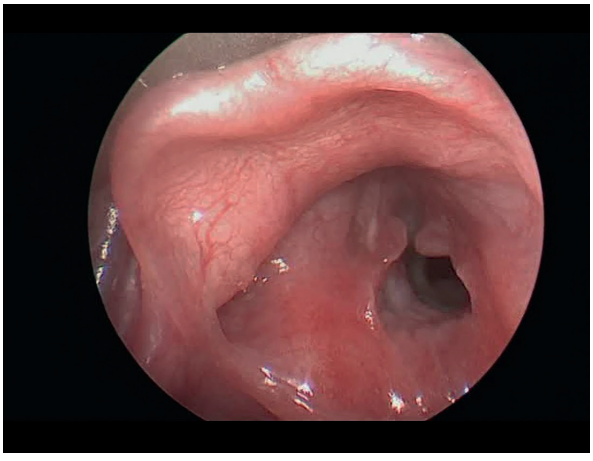


Figure 8. Intubation granuloma.

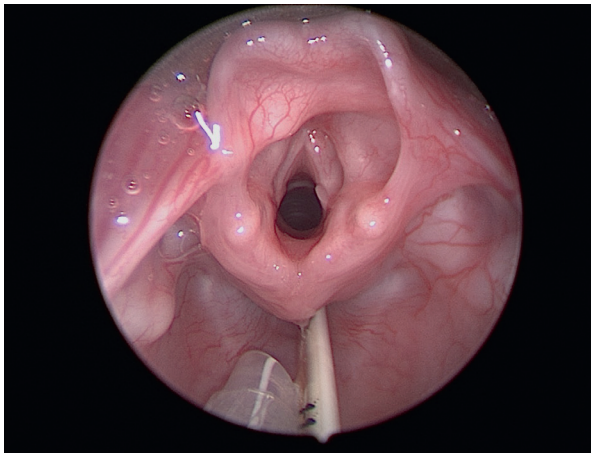


Figure 9. Laryngeal cord cyst.

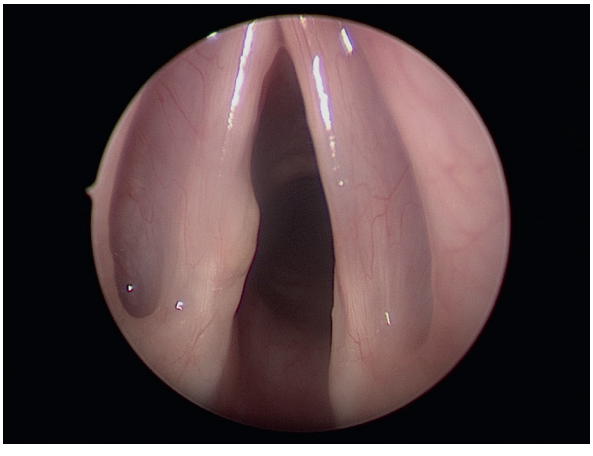
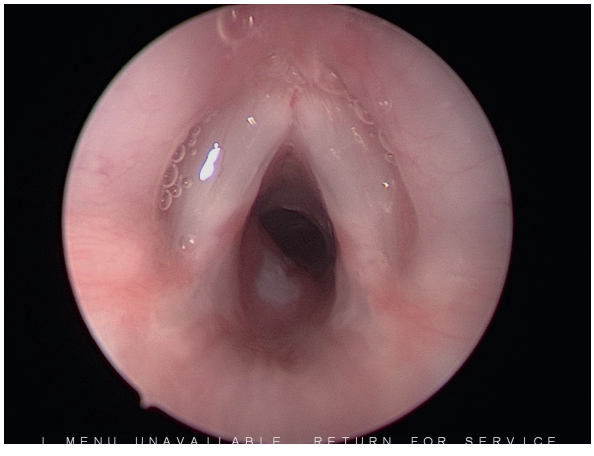


Figure 10. Subglottic haemangioma.



cases are self-limiting and need only reassurance. However, if associated feeding problems lead to failure to thrive, surgical intervention to relieve airway obstruction may be required.

Vocal cord granulomas

Vocal cord granulomas (*Figure 7*) are benign inflammatory lesions in the posterior glottis, associated with arytenoid cartilages. They can be iatrogenic as a result of prolonged intubation (*Figure 8*) or secondary to reflux. Treatment is similar to that for vocal cord nodules.

Subglottic cysts, webs and haemangiomas

Subglottic cysts or webs (*Figure 9*) and subglottic haemangioma (*Figure 10*) are lesions which may cause hoarseness as they may affect the vocal cord mucosal wave by mass effect. Cysts and small webs can be treated by excision, under the microscope with cold steel or lasers. Most complete webs and occasional haemangiomas may require conventional open surgical treatment via a longitudinal incision in the larynx – a laryngofissure. Some laryngeal webs may need laryngeal keels or reconstructions. Most haemangiomas are initially treated with medical propranolol after a definite diagnosis is made, so surgery for haemangiomas is relatively rare nowadays. These may present with altered cry and feeding problems. Around 50% of subglottic lesions will have cutaneous haemangioma and only 10% with cutaneous haemangioma have subglottic haemangioma.

Infections and inflammatory

Short-term vocal abuse and upper respiratory tract infections are the most common causes of acute laryngitis (*Figures 11–13*). They could be fungal or bacterial. Epiglottitis is caused by *Haemophilus influenzae* type B and may affect children aged 3–7 years. It is characterized by high fever, muffled voice, toxicity, stridor, dyspnoea and drooling. The child may be sitting with the neck extended in a tripod position. In recent years the incidence has reduced dramatically following the widespread use of the Hib vaccine. An oedematous swollen cherry red epiglottis visualized in a controlled environment with anaesthetic support for intubation is the hallmark of diagnosis and is now very rare. Chronic laryngitis may result with chronic voice abuse and smoking, reflux, allergies and use of inhaled corticosteroids.

Respiratory symptoms and the contribution of gastro-oesophageal reflux disorder to development of vocal cord nodules was discussed by de Lábio et al (2012) and Vaezi (2010). Voice therapy is an effective method of improving

Figure 11. Supraglottic oedema.

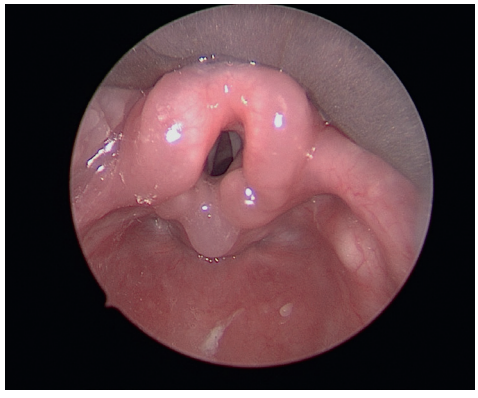


Figure 12. Supraglottic oedema.

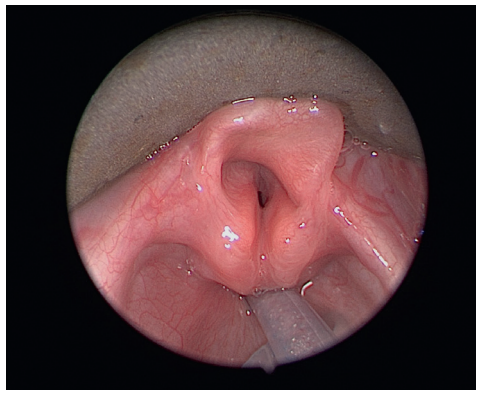
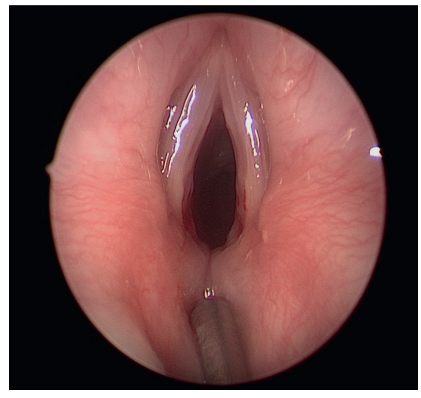


Figure 13. Laryngitis.



voice quality and vocal performance although this can be difficult in children. Micro laryngeal surgery for refractory cases where speech therapy fails may be an option but is best avoided.

Vocal cord paralysis

Vocal cord palsy is the second commonest cause of congenital stridor and may account for 10% of laryngeal anomalies in children (Holinger and Brown, 1997). Unilateral cord paralysis may present with stridor, an abnormal cry and risk of aspiration. In bilateral cord palsy, the patient's cry may be normal but stridor and increased work of breathing will be significant. As the newborn becomes more active, the respiratory signs become more obvious. A viral respiratory condition may trigger a decompensation.

Vocal fold mobility impairment

Abnormalities of vocal folds motion may result from both congenital and acquired causes with unilateral vocal fold mobility impairment occurring 4–5 times more frequently that bilateral. The most common causes are idiopathic, traumatic and neoplastic.

Other rare causes

Mitchell and Pereira (2009) discussed allergy causing post-nasal drip and resulting in hoarseness. This is typically seen in children over 4 years of age and allergy testing may be warranted.

Rare systemic causes can include hypothyroidism, acromegaly, rheumatoid arthritis, sarcoidosis or amyloidosis.

Genetic syndromes such as Williams's syndrome, DeLange syndrome or Farber disease may cause hoarseness. Certain degenerative neurological conditions manifest themselves early on as dysphonia in older children.

Use of antihistamines or inhaled steroids can cause hoarseness. Often advice about using spacers and rinsing the mouth and throat after using steroid inhalers helps to improve symptoms.

Identified risk factors

Carding et al (2006) proposed that having an older sibling, male gender, spending long days in large groups, and environmental factors such as high background noise in preschools or schools, are all factors which may predispose patients to voice abuse and ultimately development of vocal cord nodules.

Hirano et al (1983) showed that anatomical changes in the vocal folds are gradual and not developed until after puberty. Casper et al (2006) commented that the lack of the protective three-layered structure of the vocal ligament in immature vocal folds may make children more susceptible to tissue reactions as a result of heavy use.

Functional dysphonia is sometimes referred to as psychogenic or behavioural dysphonia. These patients present without any obvious organic lesions. In some patients this dysphonia manifests consciously or subconsciously for the purpose of secondary gain. Diagnosis can be challenging and is typically made after other common aetiologies are ruled out following detailed assessment.

Management

Hoarseness is characterized by altered vocal quality, pitch, loudness or vocal effort that impairs communication or reduces voice-related quality of life. The treatment will vary with the exact pathology and the diagnosis. Schwartz et al (2009) recommended the following initial management:

- No role for routinely prescribing antibiotics
- Voice therapy should be advised if voice is affecting the quality of life
- Education and counselling form an important method of control and prevent long-term problems.

Speech and language therapists are trained in behaviour modifications. They may also advise altering the method of speech production thereby minimizing any trauma to the vocal folds. Options depend upon identification and treatment of any underlying conditions, vocal hygiene, voice therapy and specifically treating the vocal cord lesions. Reiter et al (2015) and Block and Brodsky (2007) proposed a role for anti-reflux treatment. The best advice for treating laryngitis is adequate hydration and reducing voice abuse. If there are associated breathing problems then urgent assessment may be necessary. Some older children may smoke but not necessarily tell the clinician this so the need to advise about smoking cessation should be kept in mind while dealing with such cases.

Vocal hygiene

Some evidence suggests that vocal hygiene may be effective in the management of hoarseness. Chan (1994) proposed education in environmental changes, behaviour changes like avoiding repeated clearing of the throat, maintaining adequate hydration and reducing caffeine or tea intake, changing vocal habit, and rarely dietary changes.

Voice therapy

Voice therapy or training refers to non-surgical methods to improve or modify the voice quality. It helps to modify vocal behaviours to reduce laryngeal trauma. Its success depends upon active participation in therapy sessions, parent compliance, adherence to vocal hygiene and practicing the exercises.

Surgery

Surgical or other targeted interventions are indicated whenever conservative management is unsuccessful, if dysplasia or carcinoma is suspected or if some airway obstruction is anticipated. Surgery may have a role in management of the paralysed cord or in cases where the problem is causing obstructive symptoms.

Conclusions

The variable prevalence of voice disorders in children is multifactorial, including developmental, personal and environmental factors. In children the majority of vocal changes causing hoarseness are secondary to phonotrauma. The child's own perception of the problem is an important consideration to see if there is sufficient motivation for any intervention. The success of treatment will depend on the age of the child, motivational levels, cooperation and support of the family, and skill of the therapist. The aim of the intervention is to raise awareness of environmental factors that strain the voice and thus avoid them. It was believed that problems with the vocal cords will resolve with time; while this is sometimes the case, supported options like vocal therapy, vocal hygiene and modifying behaviours that cause trauma to cords are extremely helpful. Avoiding irritants (smoking and chemicals), maintaining good hydration, isolating medical conditions and treating them will all help. Maximal control of gastro-oesophageal reflux disorder can be helpful to avoid any further local trauma to the healing laryngeal structures. Voice assessment and management of hoarseness requires a multidisciplinary approach with specialist laryngologist, paediatric and speech and language therapist input. It should be noted that vocal improvement does not necessarily indicate that the underlying process has been resolved and therefore follow up and continued care are needed with behavioural modification change. Compliance with treatment regimens is a great factor in long-term success. Multidisciplinary voice clinics serve as a promising model for optimizing voice and vocal care in children. **BJHM**

KEY POINTS

- Paediatric hoarseness can be multifactorial and can be a presentation of an underlying pathology.
- Treatment requires a multidisciplinary approach with speech and language therapy and advice regarding lifestyle changes.
- Hallmark of the treatment is institution of voice therapy but compliance with various treatment regimens is an important factor in long-term management.
- Success of the treatment will depend on the age of the patient, motivation for improvement, cooperation and support of family, and skill of the therapist.

Conflict of interest: none.

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