

ENDOSCOPIC AND ULTRASONOGRAPHIC EVALUATION OF EXTERNAL LARYNGEAL INJURIES IN CHILDREN

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Summary

Aim. The aim of the research is to evaluate the possibilities of diagnosing laryngeal injuries with the use of laryngoscopy and ultrasonographic examination.

Material and methods. There were diagnosed and treated 15 children aged 5-14 (6 girls and 9 boys) with external injuries of the larynx. In all cases laryngoscopy under general anesthesia and radiological examinations including ultrasound of the larynx, X-ray of the cervical spine and in selected cases CT of the chest and neck were performed.

Results. In the studied group of 15 children we observed: hit of neck into a blunt object in 10 children, strangulation with a rope or a scarf in 2 children, transport trauma in 2 children and kick in the neck in 1 child. In ultrasonographic examination the following disorders were revealed: unilateral paralysis of vocal folds (7 children), bilateral paralysis of vocal folds (1 child) and asymmetry of vocal fold movement (1 child). In laryngoscopy immobilization of one vocal fold in 7 children, adhesions in the area of the posterior commissure in 3 children and partial adhesion of vocal folds in one child were confirmed. Incorrect, asymmetrical unilateral adjustment of aryepiglottic folds was observed in ultrasound examination and laryngoscopy in 7 children.

Conclusions. Direct laryngoscopy is a standard in diagnostics of injuries of the larynx. Ultrasonography of the larynx is recommended in every case of laryngeal injury as an additional, non-invasive, complementary diagnostic examination. Ultrasonography in comparison with laryngoscopy under general anesthesia more precisely evaluates mobility of vocal folds and diagnoses fractures of cartilages without dislocation.

Key words: injury, larynx, laryngoscopy, ultrasound, children

INTRODUCTION

In children external injuries of the larynx can occur as an isolated and more frequent problem than in adults. Among the most frequent causes of injuries we can list: a hit in the arm, handle bar of a bike or scooter, on the edge of a table, bath or swimming pool, and strangulation with a rope. Seemingly these injuries appear to be insignificant in comparison to severe multiple organ traumas in car accidents; however, not always do the direct clinical symptoms correlate with the degree of respiratory tract failure. The symptoms of laryngeal injuries depend on the extent and severity of the trauma and always relate to impaired patency of the respiratory tract. This means that a patient with an injury of the larynx even with minimal symptoms is in a life-threatening condition. The symptoms can deteriorate during 24 hours. A direct hit in the area of the larynx can cause fracture with or without dislocation of laryngeal cartilages, subluxation in the cricoarytenoid joint, hematomas and edemas of the subglottic area, perforation of the respiratory tract, as well as damage of laryngeal nerves and mucosa of the larynx and trachea (8, 13, 15).

AIM

The aim of the study is to evaluate the possibilities of diagnosing laryngeal injuries with the use of laryngoscopy and ultrasonographic examination and also monitoring the progress of treatment with application of the above-mentioned methods.

MATERIAL AND METHODS

Between 2004 and 2010 there were diagnosed and treated 15 children aged 5-14 (6 girls and 9 boys) with external injuries of the larynx. In all cases laryngoscopy under general anesthesia and radiological examinations including ultrasound of the larynx, X-ray of the cervical spine and in selected cases CT of the chest and neck were performed. The clinical observations and control examinations were performed in a period from 6 to 24 months after injury.

RESULTS

- In the study group of 15 children we observed:
- hit of neck into a blunt object – 10 children
 - strangulation with a rope or scarf – 2 children

- transport trauma – 2 children
- kick in the neck – 1 child

Dyspnea, present in 10 cases, was a predominant symptom. Others included hoarseness in 7 cases, change in voice quality, even aphonia in 6 cases, pain while speaking and swallowing in 4 cases, cough and hemoptysis in 2 cases.

In ultrasonographic examination the following disorders were revealed: unilateral paralysis of vocal folds (7 children), bilateral paralysis of vocal folds (1 child) and asymmetry of vocal fold movement (1 child). In laryngoscopy immobilization of one vocal fold in 7 children, adhesions in the area of the posterior commissure in 3 children and partial adhesion of vocal folds in one child were confirmed. Incorrect, asymmetrical unilateral adjustment of aryepiglottic folds was observed in ultrasound examination and laryngoscopy in 7 children.

The thickness of vocal folds in ultrasound examination was observed in 6 children. Simultaneously in this group of children in laryngoscopy edema of vocal folds in 4 and hematoma of vocal folds in 2 children were observed. On the basis of ultrasonography, in 2 children fracture of cricoid cartilage without dislocation and hematoma in this area was observed. In laryngoscopy fracture without dislocation was not observed.

In radiological examination pneumomediastinum with traumatic rupture observed in laryngotracheoscopy of the trachea was found.

Subcutaneous emphysema, pneumothorax and cervical emphysema were diagnosed in radiological examination in 4 cases with different stages of severity of laryngeal injury.

All 15 children were hospitalized. Seven of them on the basis of clinical view and diagnostics were qualified as not serious trauma and were treated conservatively. In the group of 8 children with severe trauma, in 2 cases tracheotomy was performed, in 4 cases short-term intubation was performed, and in 2 cases intralaryngeal procedures were performed.

DISCUSSION

Injury of the larynx is a life-threatening condition because of impairment of patency of the respiratory tract or cardiogenic shock due to bradycardia, arrhythmia, blood pressure drop or cardiac arrest. It has close a connection with innervation of the larynx by the vagus nerve through the laryngeal nerves. The right vagus nerve supplies the sinus node, while the left vagus nerve supplies the vestibuloventricular node. That is why every patient with an injury of the larynx should stay under observation in hospital (1, 2, 4).

Traumas of the larynx constitute around 1% of all traumas of the human body. The type of treatment and possibilities of post-traumatic complications depend on the extent and location of laryngeal trauma (3, 9-11). The qualification with regard to localization of laryngeal trauma includes epiglottic, glottic and subglottic trauma.

In adults laryngeal traumas are due to traffic accidents, especially on motorbikes, in sportsmen, with

use of firearms and during hamgign attempts (3, 4). In children injuries of the larynx occur more rarely than in adults and can happen during games, playing sports (bike, scooter), or falling and hitting the edge of an object, and are more often unrecognized because laryngeal symptoms are not serious.

The size, anatomy and location of the larynx of a child differ compared to an adult. The exposure of the larynx to injury in children is greater than in adults. In children the larynx is situated higher, and the narrowest dimension (at the level of the cricoid cartilage) in children is situated at the level of C3, whereas in adults it is at the level of C7; this means that the larynx in children is protected by the mandible. Dimensions of the respiratory tract in children are definitely smaller, which is the reason for more frequent impairment of its patency in case of edema in this region. That is why even small injuries of the subglottic region can cause in children serious dyspnea. Functional disorders of the larynx are more frequent and less tolerated in children (4, 10, 12).

Greater flexibility and resilience of laryngeal cartilages in children results in fewer fractures of cartilages than in adults and usually without dislocation of fragments. In the studied group of 15 persons only in 2 cases was fracture of the thyroid cartilage without dislocation observed. On the other hand, flexibility and resilience of cartilages causes unfavorable conditions for protection of soft tissues in exposure to external trauma. Dislocation of the larynx as a result of falling, hitting or pressure of the anterior surface of the neck moves the larynx towards the stiff spine. Trauma can cause mechanical injury of vocal folds, laryngeal nerves, cricoarytenoid joints, arytenoid cartilages, cricoid cartilage, laryngeal ligaments and soft tissues, and rupture of mucosa (1, 5, 6, 13). In children trauma frequently leads to primary immobilization or paralysis of vocal folds, and also to secondary immobilization of vocal folds as a result of adhesions (8, 12, 14, 16). Ultrasound examination perfectly visualizes immobilization of vocal folds, but does not enable one to distinguish primary immobilization of vocal folds from immobilization caused by adhesion in the posterior commissure between vocal folds. In this situation the decisive examination is laryngoscopy with evaluation of mobility in cricoarytenoid joints.

Whereas fracture of laryngeal cartilages is properly visible in ultrasound examination, if there are no dislocations of cartilaginous fragments laryngoscopy can miss such injuries, especially with accompanying serious edemas of soft tissues. Ultrasound examination properly evaluates dislocation of arytenoid cartilages and in this case in 100% is consistent with laryngoscopy.

Ultrasonographic examination is non-invasive, does not require special preparation and is possible to perform regardless of the age of the child. Movements of vocal folds, arytenoid cartilages, thickness of vocal folds, fractures of thyroid cartilage and hematomas of this area can be observed clearly. In ultrasound examination the epiglottis is partially visible – only its apex. The subglottic area is filled with air; hence its evaluation

in ultrasound examination is limited, and only the anterior and lateral walls can be exposed (7).

Direct laryngoscopy is an invasive examination, requiring general anesthesia. In this examination the following structures can be properly evaluated: epiglottis, aryepiglottic folds, arytenoid cartilages, mobility in cricoarytenoid joints, vocal folds and subglottic region. The use of optics with different angles allows one to evaluate laryngeal ventricles and the region below the vocal folds. Diagnostic laryngoscopy can become therapeutic at the same time; one can remove adhesions, evacuate hematoma, and administer local steroids. Due to the intensity of anesthesia the evaluation of proper mobility of vocal folds can be problematic, it is also difficult to evaluate the fracture of thyroid cartilage without dislocation, especially with accompanying edema of mucosa of the larynx.

Both laryngoscopy and ultrasound examination are valuable in diagnostics of external injuries of the larynx and complement one another. The standard procedure in diagnostics of injuries of the larynx is laryngoscopy. On the basis of our own experience, we recommend also conducting ultrasound examination of the larynx. This examination is valuable and non-invasive, especially as mobility of the vocal folds is concerned.

CONCLUSIONS

1. Direct laryngoscopy is a standard in diagnostics of injuries of the larynx.
2. Ultrasonography of the larynx is recommended in every case of laryngeal injury as an additional non-invasive complementary diagnostic examination.
3. Ultrasonography in comparison with laryngoscopy under general anesthesia more precisely

evaluates mobility of vocal folds and diagnoses fractures of cartilages without dislocation.

4. Direct laryngoscopy precisely evaluates all areas of the larynx, and differentiates primary and secondary immobilization of vocal folds. □

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