

ANALYSIS OF EARLY POST INTUBATION LESIONS IN LARYNX AFTER PROLONGED INTUBATION IN CHILDREN

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Summary

Introduction. Respiratory failure followed by endotracheal intubation can lead to severe post intubation laryngeal lesions in small group of patients. Complications are classified as acute (early) and chronic on a base the laryngoscopy findings.

Aim. To assess the statistical relationship between early post intubation complications and intubation duration, birth weight and gestational age.

Material and methods. The study included 65 children threatened in Pediatric Otolaryngology Department presented with early post intubation complication such as subglottic edema, subglottic ulceration, granulation and non-specific lesions. The study was based on the medical records taken during direct laryngoscopy procedure as well as on the demographic factors, such as birth weight and gestational age. Additional factor included into the study was duration of intubation.

Results. Most of the acute lesions of intubated larynx depend on trauma of mucous membrane. Dysfunction of mucosal blood supply during intubation leads to inflammation, edema, infection, ulceration, necrosis or destruction of laryngeal cartilages. Not only the local risk factors matter but also the demographic factors are important. Endoscopy of larynx makes it possible to determine the progression of lesions. Our study revealed, that early post intubation complications such as edema were more likely to affect children with advanced gestational age or higher birth weight. Moreover, the subglottic edema appeared in the group of children with considerably shorter intubation duration. However, the subglottic ulcerations in children are significantly correlated with lower birth weight.

Conclusion. early post intubation lesions, such as edema and subglottic ulcerations are clinically important. Early post intubation lesions strongly depend on the intubation duration, prematurity and low birth weight.

Key words: post intubation complication, subglottic ulceration, subglottic granulation, tracheostomy

INTRODUCTION

In children prolonged endotracheal intubation is commonly used in cases of respiratory failure and it had replaced tracheostomy procedure in this condition. Most of the paediatric patients have no complications related to intubation, but in about 1-2% of cases, a severe post intubation lesions in larynx may occur. Lesions in larynx induced by prolonged intubation are classified into two groups, in accordance with the direct laryngoscopy findings (1, 2). The first group includes acute lesions observed during intubation period or in early days after extubation. The second includes chronic lesions diagnosed a week or later after extubation. Early post intubation lesions include: edema, ulceration, granulation, non-specific lesions as well as direct injury related to intubation procedure.

MATERIAL AND METHODS

A study was performed on a group of 65 pediatric patients with tracheostomy carried out due to prolonged intubation. Based on medical records from endoscopy of larynx, an early post intubation lesions as edema, ulceration, granulation, non-specific lesions as well as

acute injuries related to intubation procedure were defined. Statistical relationship between early lesion occurrence and intubation duration, birth weight and gestational age was analyzed.

RESULTS

In a group of 65 patients following conditions were diagnosed: subglottic edema in 30 cases (46.15%), subglottic ulceration in 29 cases (44.62%), acute subglottic post intubation granulation in 5 cases (7.69%), early non-specific lesions in 3 cases (4.62%) and acute injuries related to intubation procedure in 3 cases (4.62%). Some of the patients were diagnosed with more than one post intubation lesion. In our study, only subglottic edema and subglottic ulceration have a statistical significance (tab. 1).

The mean duration of intubation in children with subglottic edema was of 42.3 days and it was significantly shorter than it was in other children with early post intubation lesions. The mean duration of intubation in other children was of 57.2 days (tab. 2).

The mean gestational age in children with subglottic edema was of 34.5 weeks. The mean gestational age in

Table 1. Relationship between subglottic edema and duration of intubation.

	N	Median	Mean	SD
No edema	35	59.0	57.2	31.9
Edema	30	35.5	42.3	25.0
In total	65	45.0	50.3	29.7

U Mann-Whitney test: $Z = 2.101$; $p = 0.0356$

Table 2. Relationship between subglottic edema and gestational age.

	N	Median	Mean	SD
No edema	35	32	31.4	5.5
Edema	30	36	34.5	3.7
In total	65	36	32.8	5.0

U Mann-Whitney test: $Z = -2.105$; $p = 0.0353$

other children with early post intubation lesions was of 31.4 weeks and it was significantly shorter than it was in children with subglottic edema.

The mean birth weight in children with subglottic edema was of 2310 g. The mean birth weight in other children was of 1797.9 g. It shows that the subglottic edema appeared mainly in children with higher birth weight (tab. 3).

The duration of intubation was estimated to be an important clinical part of the study. An assessment of relationship between ulceration occurrence and duration

Table 3. Relationship between subglottic edema and birth weight.

	N	Mean	SD
No edema	35	1797.9	1067.3
Edema	30	2310.0	898.4
In total	65	2034.2	1018.4

Student's t-distribution: $t = -2.073$; $df = 63$; $p = 0.0423$; F-test: $p = 0.3470$

Table 4. Relationship between subglottic ulceration and duration of intubation.

	N	Median	Mean	SD
No ulceration	36	35.5	41.2	26.4
Ulceration	29	60.0	61.7	30.0
In total	65	45.0	50.3	29.7

U Mann-Whitney test: $Z = -2.827$; $p = 0.0047$

of intubation was made and revealed that in a group of children with subglottic ulceration the mean duration of intubation was the longest (61.7 days). The difference is significant because in the group of children with other complications the mean duration of intubation was of 41.2 days. Subglottic ulceration is significantly correlated with longer duration of intubation (tab. 4).

The analysis of relationship between the gestational age and subglottic ulceration occurrence revealed that children of shorter gestational age more often had early complications such as subglottic ulcerations. The mean gestational age was calculated: for the group of subglottic ulceration was of 30.2 weeks and for the others was of 34.9 weeks. Subglottic ulceration was relevantly more often diagnosed in children of shorter gestational age (tab. 5).

The mean birth weight in children with subglottic ulceration was of 1538.5 g. The mean birth weight in other children was of 2433.6 g. There is a considerable difference in birth weight in both groups. In our study a subglottic ulceration is significantly correlated with a low birth weight (tab. 6).

The most frequent complications such as edema and ulceration was evaluated in terms of their mutual correlation. It was revealed that they weren't present in any of the cases at the same time. Both variables are mutually exclusive. If a patient has a subglottic edema he won't have a subglottic ulceration at the same time (tab. 7).

GRANULATION

Granulation can be an early post intubation complication. The group of children with granulation was analyzed. The statistical significance between granulation occurrence and birth weight was identified. Results

Table 5. relationship between subglottic ulceration and gestational age.

	N	Median	Mean	SD
No ulceration	36	37.0	34.9	3.5
Ulceration	29	29.0	30.2	5.3
In total	65	36.0	32.8	5.0

U Mann-Whitney test: $Z = 3.7099$; $p = 0.0002$

Table 6. Relationship between subglottic ulceration and birth weight.

	N	Median	Mean	SD
No ulceration	36	2695.0	2433.6	874.7
Ulceration	29	1130.0	1538.5	977.0
In total	65	2050.0	2034.2	1018.4

Student's t-distribution: $t = 3.8927$; $df = 63$; $p = 0.0002$; F-test $p = 0.5303$

Table 7. Relationship between both edema and subglottic ulceration.

	No ulceration	Ulceration	Number of children	%
No edema	6	29	35	53.85%
% kolumn	16.67%	100.00%		
% row	17.14%	82.86%		
Wanke	0.31	1.86		
Edema	30	0	30	46.15%
% kolumn	83.33%	0.00%		
% row	100.00%	0.00%		
Wanke	1.81	0.00		
Number of children	36	29	65	
%	55.38%	44.62%		100.00%

chi2 test = 44.881; df = 1; p = 0.0000

are presented in table 8. There was no significant correlation between granulation, duration of intubation and gestational age.

The mean birth weight was calculated for the group of children with laryngeal granulation as well as for the group with other early post intubation complications. In the group with laryngeal granulation the mean birth weight was of 3166 g (much higher than in the second group). The mean birth weight in the group with other complications was of 1939.9 g. It means that the laryngeal granulation was diagnosed more often in children with a high birth weight. In conclusion, the laryngeal granulation is statistically significant to occur in children with higher birth weight.

DISCUSSION

The nature of acute lesions of intubated larynx depend on the site and pressure applied on mucosa. Disturbance of mucosal blood supply in larynx during intubation can lead to mucosal irritation, inflammation, edema, infection, ulceration, necrosis or perichondrium and cartilage destruction in the next stage.

The severity of cartilage destruction varies among pediatric patients. Some of the children have small lesions, the others, though the intubation duration remains the

same, present severe destruction of larynx (3-5). Acute post intubation lesions include: early non-specific lesions, edema, granulation and ulceration (6, 7).

Early mucosal lesions has non-specific nature, such as hyperaemia and edema with surrounding inflammation. When endotracheal intubation continues, it may lead to formation of discolored, superficial ulcerations with granulation as a result of a healing process of irritated tissue.

Edema of the soft tissue with large mucosal inflammation can involve the vestibule of larynx, the vocal fold or subglottic area. Vocal fold edema can develop into a chronic condition with phonation disorder.

Subglottic edema develops commonly in early hours after extubation.

Granulation tissue appears where the endotracheal tube presses the mucosa, perichondrium and cartilage. Next, after 48 hours the granulation appears on vocal process, then continues towards frontal surface of intubation tube from both sides. The granulation overgrowths develop during chronic intubation. Sometimes, after extubation, the large flaps of overgrowth may cause severe airway obstruction that demand rapid re-intubation. The „mature” granulation can be unilateral or bilateral. The granulation mass proliferates in the posterior commissure of larynx and in the subglottic area. It can sometimes cicatrize which results in narrowing of the posterior commissure as well as subglottic area (1, 7).

Necrotic ulceration due to tissue pressure appears in the posterior part of larynx, medial part of arytenoid cartilage, in the cricoarytenoid joints and the anterior part of cricoid membrane. If an ulceration is superficial it heals with normal mucosa after extubation. A diffuse ulceration of perichondrium and cartilage causes narrowing cicatrix (8-10).

Table 8. Granulation and birth weight.

	N	Median	Mean	SD
No granulation	60	1945.0	1939.9	1001.9
Granulation	5	3150.0	3166.0	232.4
In total	65	2050.0	2034.2	1018.4

Student's t-distribution: t = -7.3888; df = 22.3; p = 0.0000; F-test p = 0.011

Anatomical anomalies, blind intubation, or stylet usage result in common injuries of larynx. Typical injuries include: mucosal trauma, bleeding, vocal cords hematoma, arytenoid cartilage dislocation, respiratory tract perforation with subsequent pneumothorax and tissue infection. Sometimes, during process of healing, an acute mucosal trauma evolves into cicatrix or isolated granuloma of untypical location. Very rarely acute barotrauma leads to ulceration in posterior subglottic part of cricoid cartilage. If a catheter causes an ulceration on the same level, a fistula appears in the upper part of esophagus.

Endoscopy performed during prolonged intubation helps to determine the progression of lesions (11, 12). Diffuse ulcerations on a large surface of posterior part of glottis or subglottis associated with erosion of perichondrium and inflammation of exposed cartilage can lead to severe and chronic destruction of the larynx with posterior part of glottis or subglottic narrowing. In that case, a tracheostomy procedure should be performed in children (13).

Our study revealed, that the early post intubation lesions development are influenced by the factors such as intubation duration, birth weight and gestational. Early post intubation complications such as edema were more likely to affect children with advanced gestational age or higher birth weight. The subglottic edema appeared in the group of children with considerably shorter intubation duration. This study makes an attempt to determine the correlation between two most frequent early post intubation complications such as edema and ulceration. Both variations are mutually exclusive with comparatively equal sample size.

The subglottic ulceration and edema was diagnosed in 29 and 30 patients, respectively. Edema is associated with intubation duration, gestational age and birth weight. The mean intubation duration in case of subglottic edema was of 42.3 days and was significantly shorter than in others. Subglottic edema appeared in children with significantly shorter intubation duration ($p = 0.0356$). The main gestational age in case of subglottic edema was of 34.5 weeks ($p = 0.0353$), while in other cases was of 32.4 weeks. The mean birth weight in case of subglottic edema was of 2310 g. It was higher than in other children which was of statistical significance ($p = 0.0423$). The edema affected children with longer gestational age as well as with higher birth weight. Subglottic ulceration is significantly associated with longer intubation duration. Our study confirmed considerably more frequent

subglottic ulceration in children with shorter gestational age ($p = 0.0002$). The mean gestational age in case of subglottic ulceration was of 30.2 weeks. It was revealed, that the subglottic ulcerations in children are significantly correlated with lower birth weight ($p = 0.0002$). Premature newborns with intrauterine hypotrophy predominated in that group.

The crucial part of this study is to determine the risk factors for post intubation complications. There is a high likelihood of make decision when it must be acknowledged that. The more one knows about likelihood of complications in similar cases, the more appropriate decision one makes of when to perform tracheostomy or other possible treatment.

CONCLUSIONS

Early post intubation lesions in larynx are clinically important, particularly edema and subglottic ulceration. Early post intubation lesions depend on the intubation duration. Higher risk of ulceration in larynx correlates with longer intubation duration. Prematurity and low birth weight promotes development of ulcerations. □

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