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Original Article

Fibreoptic Endoscopic Assessment of Post Intubation Laryngotracheal Injuries in Neonatal and Pediatrics Intensive Care Units. A Prospective-Cross Sectional Study

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Abstract

Background: Endotracheal intubation is an invasive procedure that is associated with many short and long term complications. Post intubation laryngeal injury is not uncommon, however, there is insufficient data regarding the frequency of post intubation laryngeal sequels in Egyptian children. Fiber optic endoscopy provide bedside inexpensive tool for early detection of post-intubation sequels.

Aim: To assess the different forms of laryngeal post intubation sequelae using fibro optic laryngoscope.

Subjects and methods: this cross sectional descriptive study included 30 infants and children who underwent endotracheal intubation for at least 24 hours regardless the indication of intubation. Post extubation fiber optic endoscopic examination was performed for all included children. Laryngeal complications were correlated to patient complaint, duration of intubation and number of attempts.

Results: Post intubation laryngeal complications were detected in 63.3% of included children. The commonest presenting symptoms were stridor (30%) followed by dysphagia (16.7%). The commonest abnormality detected by fiber optic endoscopy was subglottic stenosis (40%). A significant positive correlation was detected between the number of post intubation complication and the number of attempts for tube insertion. All asymptomatic infants and children did not show any laryngeal abnormalities.

Conclusions: Post-extubation laryngeal injuries are not uncommon, with the majority of patients having subglottic stenosis especially those who were intubated for longer duration. Hence, post-extubation fiberoptic laryngoscopy following extubation is recommended for neonates and infants for early diagnosis and interventions..

Key words: Endotracheal intubation; Fiber optic laryngoscope; larynx; subglottic stenosis

Introduction

Intubation is a common procedure in pediatrics that is required for variable neurological, respiratory and cardiac disorders either in emergency room, operations or those admitted to intensive care [1].

Intubation is an invasive procedure that is associated with numbers of short and long-term sequels that can adversely impair the quality of life of previously intubated children. Among these sequelae, laryngeal complications represent a major sequela [2]. .

Infancy is a vulnerable period due to the continuous process of growth and development so any laryngeal injury at this period can lead to long-term morbidity extend to adulthood life [3].

Post intubation sequela is not uncommon. Previous studies demonstrate a frequency rate of such complication ranged between 13% and 80%. However, there is insufficient data regarding the frequency of post intubation sequelae in Egyptian children [4].

Aim of the Work: The aim of the current study is to assess the different forms of laryngeal post intubation sequelae using fibro optic laryngoscope.

Methods

This cross sectional descriptive study included 30 post intubated subjects who underwent endotracheal intubation for at least 24 hours regardless the indication of intubation. Four of them were neonates (age below one month), 7 were infants aged from one month to one year and 19 of them were children aged more than one year. They were recruited from pediatric department, Al-Zahraa University hospital during the period from 2018-2019. Children with airway malformations were excluded from the study.

All included infants were subjected to detailed history with stress on the age, sex, indication of intubation, age at intubation, duration of intubation, frequency of intubations, post extubation period, type of endotracheal tube and symptoms suggestive laryngeal and/or

pharyngeal injury such as aphonia, dysphonia, strider, irritative cough and difficulty of feeding. Complete general and systematic examinations were done, as well as local assessment of oral cavity and pharyngeal mucosa was done.

Flexible fiberoptic laryngeal endoscopy (karl Storz, 3.4mm), Flexible fiberoptic laryngeal endoscopic examination was done to all included children at ENT department, audiovestibular and phoniatrics centre, Kobree El-Kobba military hospital. It is a bedside non-invasive examination that did not require any sedation or analgesia. Patient is sitting upright with head support. Laryngoscope is passing through the nose and advanced into the pharynx to visualize the base of tongue, hypo pharynx, larynx and check vocal cord movements.

Ethical considerations

This study was approved from The Ethics Committee of Faculty of Medicine, Al-Azhar University and written informed consents were obtained from the parents and they informed about the nature and steps of the study.

Statistical analysis

All data were gathered, tabulated and statistically analysed using SPSS soft wear program version 20. Numerical data was expressed as mean and standard deviation while non-numerical data was expressed as number and percentage. Comparison between groups was done using chi-square test. Person correlation analysis was done to determine the correlation between the studied variables.

Results

Among our studied subjects: 21 were males (70%) and 9 were females (30%) with mean age of 845.34 ± 621.59 days**.** Eleven were < 1 year of age (4 of them were neonates < 1 month old), while the remaining 19 were older than 1 year old. Twenty one were males (60%) and 9 were females (30%); their age ranged between 12 days – 6 years with mean age of 27.394 ± 20.854 months. Age at intubation ranged between 1 day and 5

years with a mean of 27.394 ± 20.854 months.

The duration of intubation ranged between 3-28 days with mean duration of 11.571 ± 8.549 days and the range numbers of intubation attempts 13.700 ± 8.343 times.

As regard the indication of intubation among the studied groups: Status epilepticus and apnea were the commonest cause of intubation (23.3%) followed by cyanosis (20%), low Glasgow coma scale (GCS) (16.7%), failed CPAP (13.3%) and lastly foreign body (FB) aspiration (3.3%).

As regard the presenting symptoms, most of the studied subjects have stridor (30%) followed by dysphagia (16.7%), irritative cough (13.3%), hoarseness of voice (10%) and lastly regurgitation (3.3%); while 26.7% were asymptomatic. As regard the laryngoscopic findings, the commonest abnormalities were subglottic stenosis (40%) (Figure 4).

Congenital laryngomalacia was discovered accidently in 10% of cases (Figures 5,6).

Among our studied subjects; all asymptomatic infants and children did not have any abnormalities by laryngoscope, while all children presented by hoarseness of voice, stridor and irritative cough have laryngeoscopic abnormalities as demonstrated in. No abnormalities were detected in 36.7% of the studied neonates and children. (Tables 1-3).

There was statistically significant positive correlation between the duration of intubation, reintubation attempts and the number of complicated cases as shown in (Table 4) and (Figures 2 and 3).

Discussion

The most common causes for intubation among our studied subjects were respiratory followed by neurological disorders. Apnea was the commonest cause in neonates and cyanosis was the commonest cause in infants. This age variation reflects that younger age is more liable for apnea due to immaturity of respiratory center while respiratory

failure is the main respiratory indication in older ones.

This is in accordance with Kojima et al. (2017) [5]. who found that respiratory causes were the commonest indications for intubation in children (45%) followed by neurological causes in 18%. Andrea et al. (2004) [6] reported that respiratory distress was the commonest cause of intubation (73.8%) in neonate and 57.8% in infants and children but neurological causes have been detected at lower percentage in neonate and children (3.2%).

The main duration of intubation in our studied population was 11.5 days. In a meta-analysis for the duration of intubation in PICU, Esteller-Moré et al. (2005) [7] found that the intubation periods ranged between 5.2 to 14.4 days. Brodsky et al. (2018) [8] reported that the main duration of intubation in children was 8.2 days. On the other hand Rivera and Tibballs (1992) [9] reported shorter duration of intubation of average 4 days. These contradictions reflect different causes of intubation and variability of ventilators techniques among different population.

The mean frequency of intubation attempts in our studded population was 13 times. Higher rate of intubation attempts was reported by Donnell et al. (2006) [10] with mean attempts of 60 times. The difference in attempts rate may be related to physician skills and training that is greatly variable among health care centers.

Post-intubation laryngeal complications were detected in 49,9% of included subjects using fiber optic laryngoscope. The most common findings are subglottic stenosis (40%) and Subglottic edema (3.3%) in children groups. Furthermore, the rate of post intubation complications was higher in those younger than 1 year old [8 out of 11 (72.7%)] in comparison to those older than 1 year old [11 out of 19 (57.8%)]. This finding reflects that the mucous larynx of younger infants is more fragile and more susceptible to injury during intubation.

The reported laryngoscopic findings were variable among previous studies; Schweiger et al. (2013) [11] reported that the incidence of subglottic stenosis was 11.38%, while Eliandra et al. (2016) [12] reported that the most common alternation was edema of supraglottic location (78%) followed by hyperemia (69%), laryngomalacia (22%), subglottic stenosis (9.6%) and vocal cord immobility (1.7%).

In the current study, children were included regardless the presence of obvious complains to avoid missing any asymptomatic laryngeal complications. Among our studied populations, those above than 1 year 26.3% were asymptomatic. This high rate of asymptomatic subjects in our study could be partially explained by the lack between extubation and clinical assessment as the post extubation period was 10.5±20 days. All of the included patients were assessed after hospital discharges so many transient immediate post extubation sequelae may be missed. Additionally, many of included patients had short duration of intubation that is insufficient to induce permanent sequels. Most of phonatory symptoms are limited and disappear within of 24 to 48 hours of extubation.

Among our studied population, no abnormalities were detected by fiber optic laryngoscopy in 36% of infants and 42.1% of children. This high rate of normal examination could be related to involvement of large number of asymptomatic post intubation patients (26.7%). Furthermore, examination was done after hospital discharge, so most of laryngeal edema and laceration was already healed that explain absence of such findings in our included populations. Several post-intubation laryngeal injuries heal spontaneously due to the great capacity of regeneration of the laryngeal epithelium. Additionally, many risk factors involved in the development of complications including hemodynamic instability, systemic infection, anemia, hypotension and

malnutrition. Such coexistent factors increase the liability of some children for laryngeal complications than others [13].

As regard the presenting symptoms, most of the studied infants and children were presented by stridor. In agreement with our findings, Schweiget et al. (2018) [14] demonstrated that stridor was the most common complaint of post extubation children 44.3%. On the other hand Brodsky et al. (2018) [8] reported that post extubation symptoms were hoarseness of voice (63%) followed by dysphagia (49%). This contradiction could be related to the difference in the cause and duration of intubation between different studies.

Among our studied populations, all asymptomatic infants and children had no abnormalities, while 86.3% of symptomatic children had abnormal findings upon laryngoscopic examination. These findings reflect the high degree of sensitivity of fiber optic laryngoscopic examination to detect post intubation laryngeal complication.

The current study revealed that the longer the duration of intubation was associated with higher rate for post intubation complications. This agrees with previous studies that concluded that the duration of intubation is among the risk factors for post intubation complications. The risk of complications increases with the longer duration of the intubation [15,16].

Patients who have severe systemic disease that require long duration of intubation are possibly more seriously ill and prone to complications. In addition, the longer intubation duration may increase the opportunity for equipment malfunction, iatrogenic injury, or self-extubation.

The present study demonstrated strong significant positive correlation between the number of post intubation complication and the number of attempts for tube insertion. This is in accordance with, Hypes et al. (2017) [17] who had reported that the post intubation complication of those intubated on the

first attempt was 19.8% while higher rate of complications 64.5% had reported in those who required more than one attempt. The higher the number of intubation trials expose patient to higher risk of injury to oro-laryngeal structures.

Traumatic injury to the airway during intubation can occur when intubation is performed by professionally inexperienced physicians due to less skilled and need for rapidity in the access of the airways, and the difficult exposition of glottis that need highly experienced well-trained physicians, in addition to the difficulty of rank of the endotracheal tube in the appropriated place. [15]

Among the studied infants and children 21 (67%) were male and 9 (33%) were females. The male sex predominance had related to the high incidence of RDS and asthma in males than females. Additionally males are more exposed to outdoor activities so more liable to allergens, infection and injuries than females that make them at greater risk for intensive care admission and intubation. Similar to our findings, Manica et al. (2017) [18] reported that intubation was more frequent in males 55.9% than females children 44.1%. On the other hand, Bharti et al. (2016) [19] showed similar incidence of intubation between males and females.

Limitations

The number of patients within the different diagnostic groups is not representative of the true incidence of some of these disorders.

Conclusions

Post-extubation laryngeal injuries are not uncommon with the majority of patients having subglottic stenosis especially those who were intubated for longer duration. Long intubation duration and associated comorbidities are critical factors deciding the severity of these lesions. Hence, post-extubation fiberoptic laryngoscopy following extubation is recommended for neonates and infants.

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Author's contributions

All authors contributed equally in this work and approved the manuscript for publication

Conflict of interest

The authors have no conflict of interests to declare.

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Table (1): Indications and clinical presentations according to the age groups

Item	<1 month (N=4)	1month – 1year (N=7)	>1year (N=19)	Chi square test	
	N , %	N , %	N , %	X^2	p-value
Indications of intubation					
Status epileptics	0 (0%)	2 (28.6%)	5 (26.3%)	1.419	0.491
Apnea	2 (50%)	1 (14.3%)	4 (21%)	1.965	0.374
Cyanosis	1 (25%)	4 (57.1%)	1 (5.3%)	8.677	0.013*
Failed CPAP	0 (0%)	0 (0%)	4 (21%)	2.672	0.262
FB aspiration	0 (0%)	0 (0%)	1 (5.3%)	0.598	0.741
GCS<7	1 (25%)	0 (0%)	4 (21%)	1.863	0.393
Clinical presentations					
Asymptomatic	2 (50%)	1 (14.3%)	5 (26.3%)	1.663	0.435
Regurgitation	1 (25%)	0 (0%)	0 (0%)	6.724	0.034*
Hoarsiness of voice	0 (0%)	1 (14.3%)	2 (10.5%)	0.593	0.743
Dysphagia	1 (25%)	1 (14.3%)	3 (15.8%)	0.239	0.887
Stridor	0 (0%)	2 (28.5%)	7 (36.8%)	2.145	0.342
Irritative cough	0 (0%)	2 (28.5%)	2 (10.5%)	2.151	0.341

*significant (p-value <0.05)

Table (2): Fiber optic laryngoscopic findings of the studied infants and children

Findings	Studied infants and children (N=30)	
	Number	%
Normal	11	36.7 %
Vocal cord nodule	1	3.3 %
Subglottic stenosis	12	40 %
Subglottic edema	1	3.3 %
Accumulation of saliva	1	3.3 %
Arytenoid dislocation	1	3.3 %
Severe degree Laryngomalacia	3	10 %

Table (3): The relation between clinical presentations and fiberoptic laryngoscopic findings

Finding Symptoms	Normal N=11	Vocal cord nodule N=1	laryngeomalcia N=3	Subglottic stenosis N=12	Subglottic edema N=1	Accumulation of saliva N=1	Arytenoid dislocation N=1
Asymptomatic	8 (72.7%)	-------	-------	----	-------	-------	-------
Regurgitation	-------	-------	--------	-------	-------	1 (100%)	------
Horsiness of voice	-------	------	1 (33.3 %)	1 (8.3%)	-------	-------	------
Dysphagia	3 (27.2%)	------	1 (33.3 %)	-------	------	--------	1 (100%)
Stridor	-------	------	1 (33.3 %)	9 (75%)	-------	------	-------
Irritative cough	-------	1 (100%)	-------	2 (16.7%)	1 (100%)	-------	-------

Table (4): Correlation between the duration of intubation, reintubation attempts and the number of complicated cases

Item	Number of complicated cases	
	r	P-value
Duration of intubation (days)	0.573	0.004*
Numbers of intubation attempts	0.394	0.0354*

*significant (p-value<0.05)

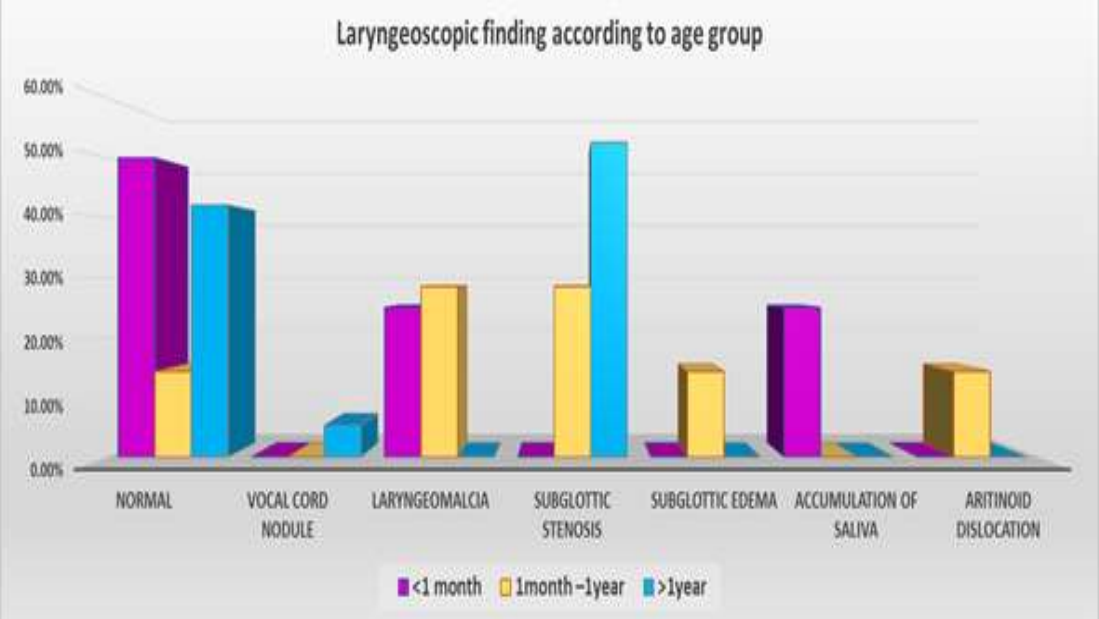

Figure (1): Fiber optic laryngoscopic findings according to the age group

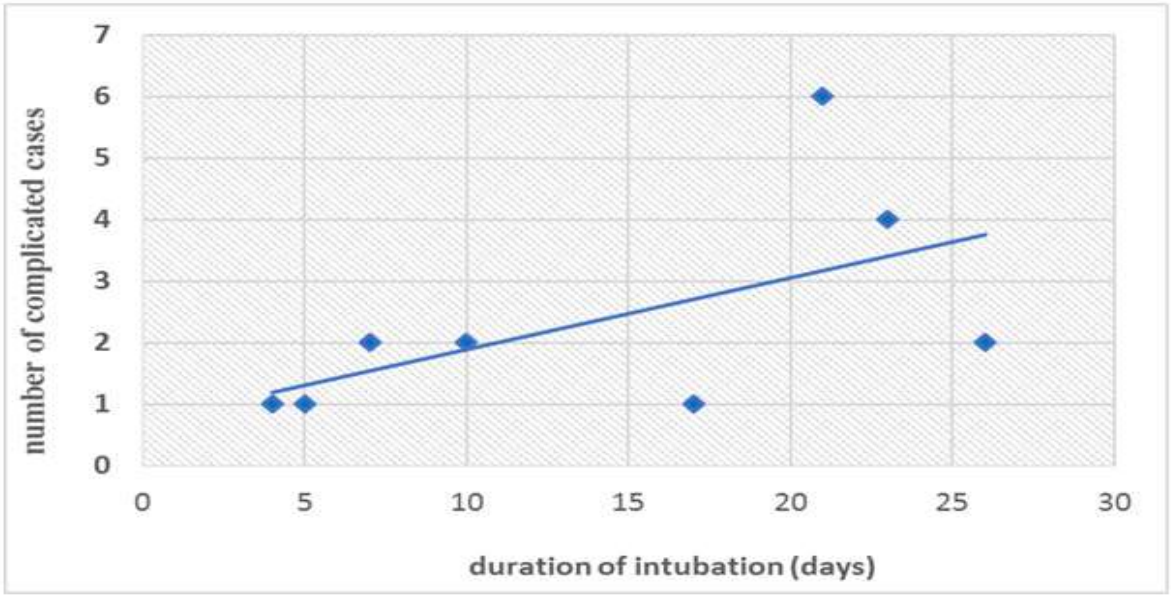

Figure (2): Correlation between the duration of intubation and the number of complicated cases.

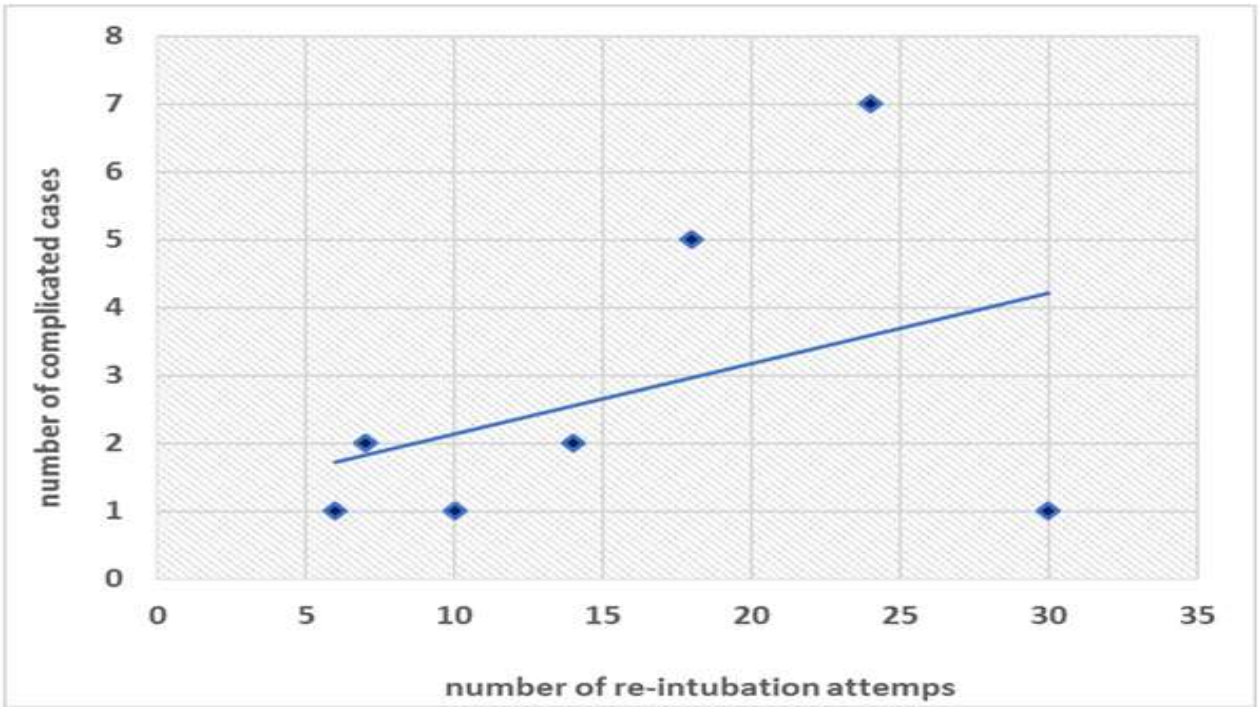

Figure (3): Correlation between the number of re-intubations and the number of complicated cases

Figure (4): Subglottic stenosis

Figure (5): Laryngomalacia

Figure (6): First degree laryngomalacia

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