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Risk of Middle Ear Complications in Intubated Patients on Mechanical Ventilation Versus Non Intubated

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الملخص:

مخاطر مضاعفات الأذن الوسطى للمرضى الذين تم وضعهم على أجهزة التنفس الصناعي مقارنة بغيرهم من الذين لم يتم وضعهم علي هذه الأجهزة .صُممت هذه الدراسة الاستباقية لتقييم مخاطر مضاعفات الأذن الوسطى في الأذنين بضغط الهواء الإيجابي ، والمرضى الذين يخضعون للتهوية الميكانيكية من خلال التنبيب الجوي الاصطناعي قد يتسبب في اختلال وظيفة الضغط الطبيعي لقناة اوستاكيوس (النفير) وتوازن ضغط الهواء. وجد أن المرضى الذين يخضعون لأجهزة التنفس الصناعي من خلال تنبيب الرغامى الاصطناعي قد يتسبب في اختلال وظيفة لقناة اوستاكيوس (النفير) الضغط الطبيعي وتوازن ضغط الهواء في الأذنين الوسطى الدراسة الاستباقية لنتائج عدد من المرض بتشخيصات مختلفة ، والذين تم إدخالهم لأكثر من عشرة أيام في وحدات العناية المركزة في مختلف مستشفيات مدينة بنغازي وعلى مدى ستة أشهر. تم استبعاد إصابة الرأس الدماغية وتمزق الغشاء الطبلي للأذنين في هذه الدراسة. كما تم استخدام منظار الأذن لفحص 120 مريضًا بواسطة أخصائي الأنف والأذن والحنجرة (تراوحت أعمارهم من 14 يومًا إلى 75 عامًا). وأجريت المقارنة بين مجموعتين من المرضى الذين خضعوا لتنبيب الرغامى (40 حالة) والذين بدون التنبيب الرغامى (80 حالة) من بين 40 مريضًا خضعوا للتنفس الصناعي وتنبيب الرغامى ، أصيب 37 مريضًا منهم بنسبة 92.5٪ بمضاعفات في الأذن الوسطى ، في حين أصيب تسعة (9) فقط من أصل 80 مريضًا بنسبة (11.3٪) بمضاعفات في الأذن الوسطى تشير هذه النتيجة إلى أنه يجب فحص جميع المرضى الذين يتم تنبيبهم (تنبيب الرغامي) والذين خضعوا للتنفس الصناعي ولمدة تزيد عن 10 أيام بشكل روتيني وإخضاعهم للفحص بواسطة جهاز متنقل موضعي لقياس ضغط الطبلة لتقييم وظيفة الأذن الوسطى المرضي قد يحتاجون إلى إدخال أنابيب تهوية فغر الطبلة (تنبيب طبلة الاذن) وذلك حفاظا علي سلامة الاذن الوسطي.

الكلمات المفتاحية:

اجهزة التنفس الصناعي، الاذن الوسطى، مضاعفات.

Abstract

Patients on mechanical ventilation through artificial airway intubation may compromise their normal eustachian tube function and equilibration of middle ear pressures. Aim of the study is to evaluate the risk of middle ear complications in the positive pressure air-filled middle ears. A prospective study of patients findings with a different diagnosis, who were admitted for more than ten days duration in Intensive Care Units (ICU) in different hospitals of Benghazi city over a period of six months . Head injury and tympanic membrane rupture were excluded in this study. The approach that had been used was otoscope examination of the ears of 120 ICU patients by an ENT specialist, Results: (the age ranged from 14 days to 75 years). The comparison between two groups of intubated (40 cases) and non-intubated (80 cases) patients was performed. Among 40 mechanically ventilated patients, 37 patients (92.5%) developed middle ear complications. Whereas only nine out of 80 patients in non intubated group(11.3%) were developed middle ear complications. These results suggest that all intubated patients on mechanical ventilation for more than ten days should be routinely examined, and subjected for portable tympanometry evaluation of the middle ear. They may need tympanostomy tubes insertion.

Keywords: Ventilation, Middle Ear, Complications.

1. INTRODUCTION

The Eustachian tube has three important functions with respect to the middle ear: ventilation (equalizing the pressure between the middle ear and ambient air), protection of the middle ear from ascending nasopharyngeal secretions, pressure variations and clearance of secretions towards the nasopharynx. The infant Eustachian tube is anatomically different from the adult tube, contributing to the increased incidence of otitis media in early childhood. In infants and young children, the Eustachian tube is short, lacks stiffness and is horizontally orientated [1]

Eustachian tube dysfunction and migration of pathogenic flora from the nasopharynx to the middle ear had a role in the pathology of middle ear pressure. Being confined to bed for a long time leads to gastroesophageal reflux and increases passage of probable microorganisms from the nasopharynx into the middle ear [2,3] Liquid and microorganisms accumulate in the nasopharynx, and they can cause the formation of potential infection extending from the Eustachian tube toward the middle ear [3,4] . Application of a nasogastric catheter added to the intubation tube prominently affect middle ear pressure as a factor causing edema. Additionally, the presence of a tube, mucosal irritation, local edema, and potential pathogen carriage

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can also contribute to the occurrence of otitis media due to the nasogastric catheter [2,5] .Infection is one of the most important parameters of mortality in intensive care patients [6]. Rhinosinusitis and otitis media are two major diseases of otorhinolaryngology, which can lead to sepsis, even a little, and which have high potential, especially for intracranial complications [7] . Although there are different opinions about the relationship between septal pathology and middle ear pressure as Duran et al [8]. found that middle ear pressure decreased at a rate of 30% in patients who underwent septoplasty for septum pathology. In addition, Van Cauwenberge et al.[9] concluded that patients with septal pathology had a higher rate of negative middle ear pressure compared to patients without septal pathology in the same way nasal intubation may affect middle ear pressure. Hyperbaric oxygenation therapy (HBO2) is proposed as a treatment for various diseases such as iatrogenic gas embolism (IGE), decompression sickness (DCS), carbon monoxide poisoning, necrotizing fasciitis or wound healing [10] . Middle ear barotrauma (MEB) is a known complication of HBO2 [11]. As ICU patients are sedated and ventilated, they are unable to perform a Valsalva maneuver to prevent MEB; they might be at higher risk of MEB. Middle ear barotrauma is one of the most common side effects of HBO2 [12] ; reported incidences to range from 8-68.7% and up to 91% in patients unable to auto-inflate their middle ear [13,14,15] . Other known risk factors for MEB include female sex, older age [16] , artificial airways intubation [17] , and history of Eustachian tube dysfunction [18] or the inability to auto-inflate the middle ear . The successful equalization of pressure by inflating the middle ear has been reported to be protective [13,14] , whereas the prophylactic use of nasal decongestants has not [19] .

The aim of this study is to identify patients of affected middle ear function who are on mechanical ventilation and provide treatment befor complications develops.

2. PATIENTS AND METHODS:

A prospective study of patients findings with a different diagnosis, who were admitted for more than ten days duration in Intensive Care Units (ICU) in hospitals of Benghazi city, after a verbal permission from their relatives. Head Injury and tympanic membrane rupture were excluded in this study. The approach used was otoscopy examination of 120 patients, including 80 (66.6%) non-intubated and 40 (33.3%) intubated patients. An ENT specialist did the ear examination. The age ranged from 14 days to 75 years. All intubated group of patients were mechanically ventilated, with an endotracheal tube or with a tracheostomy tube. In these patients who were admitted in Intensive Care Units (ICU).A pathogenesis duration of ten days was taken as the sufficient period of time to produce numbers of patients with middle ear complications.

RESULTS:

The comparison between intubated and non-intubated patients. The total intubated group were forty patients; three of them (7.5%) did not develop middle ear complications, while the other 37 patients (92.5%) developed the middle ear complications, and pathogeneses of Tympanic membrane like

1. A retracted tympanic membrane in 20 patients (50%). This finding effect was seen commonly in old age group (>60 years).
2. Hyperemia and bulged tympanic membrane in 14 patients (35%), which was seen more common in children.
3. Hyperemia and bulged tympanic membrane of 2 neonates (5%).
4. Rupture of the tympanic membrane after intubation and mechanical ventilation was seen only in one neonate (2.5%), no complications was noticed in the young age group, as seen on table (1) .

Table 1 Otoscope finding in intubated patients

No	Age	Finding	Number of cases(percentage)
1	>60 years	Tympaic membrane retraction (bilateral)	20 (50%)
2	18-60 years	No middle ear compications	3(7.5%)
3	1-<18 years	Hyperemia &bulging of tympanic membrane (bilateral)	14 (35%)
4	< 1year	Hyperemia &bulging of tympanic membrane (bilateral)	2 (5%)
5	<1 month (neoate)	Tympaic membrane rupture in one side	1 (2.5%)
Total			**40**

In non itubated group the percentage is different, no complications are noted in the age group range from 18 to 60 years as in table 2.

Table 2 otoscopic finding in non intubated patients

No	Age in years	finding	Number of cases(percentage)
1	>60	Retracted T.M	7 (8.75%)
2	18-60	No middle ear complications	71 (88.75%)
3	<18	Hyperemia &bulged T.M	2 (2.5%)
Total			**80**

3. DISCUSSION:

Lying position is an important factor disrupting the function of the Eustachian tube [6] . In patients hospitalized for more than 3 weeks, other muscular and neuromuscular disruptions, like compression necrosis related to gravity or impaired circulation associated with vascular stasis, might have increased the frequency of effusion [20] . Hsiung et al [21] reported that the frequency of middle ear pressure decreased from 46% low down to 22% in the patients for whom intubation was replaced by tracheotomy. Apart from mechanical factors influencing middle ear pressure, gas absorption, posture, and especially disruption of the microcirculation system of the middle ear can have a role in this result[22] . In the study conducted by Lin et al [20] ,after the 7th day, which was considered prolonged intubation, otitis media developed only in one patient. While in the patients intubated for 14 days and longer, otitis media occurred on the 10th day. There are some factors affecting the mechanism of Eustachian tube function. First, in intubated patients, mechanical ventilation (air flow dynamic change) increases the mucus viscosity by influencing mucociliary function and thus creates secretion accumulation or drainage impairment [2,4] Moreover, mechanical ventilation usually leads to moderate hypocapnia and inhibits spontaneous respiration. Unconcious patients on mechanical ventilation are prone to complications at air containing cavities like middle ear, lung alveoli and paranasal sinuses [22].The second cause is that the patient's loss of consciousness or intake of sedative drugs contributes to the nasopharyngeal tube dysfunction by influencing the neuromuscular system or disrupt swallowing function, which causes negative middle ear pressure and effusion [20] In this study, middle ear pressure changed in intubated patients, and otitis media or middle ear effusion developed in the presence of an additional factor. In non-intubated group of patients who were treated by masked O2 breathing, nine patients (11.3%) out of eighty developed a middle ear complications. 77.7% of patients with complications, developed retracted tympanic membrane, whereas 22.2% developed hyperemia and bulged tympanic membrane in non intubated group. It was noticed that extreme age group are susceptible to middle ear complications in both intubated and non-intubated group. Table 2. These groups were either elderly who had already physiological deafness (prysbecusis), or children who need hearing for language and intellectual function development. that is why identification and early treatment are extremely important in these two groups.

4. CONCLUSION:

The results of this study reveal a high incidence of middle ear complications in intubated patients with artificial airways on mechanical ventilation more than ten days. They should be routinely examined by an otoscope, and subjected to portable tympanometry evaluation as they may need tympanostomy tubes insertion.

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