Middle Ear Effusion in Intensive Care Unit Patients at Al-Sadder Teaching Hospital in Al-Najaf City-Iraq (A Prospective Randomized Comparative Clinical Study)

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ABSTRACT

Background: Middle ear effusion (MEE) is one of the commonest chronic otological conditions in childhood but has a lower incidence in normal adult. By definition it is an accumulation of non-purulent fluid in the middle ear. It is an inflammatory effusion behind an intact tympanic membrane that is not associated with acute otological symptoms or systemic signs.

Aim: To explore factors related to the occurrence of MEE in the intensive care unit (ICU) patients with prolonged oral endotracheal intubation in Al-Najaf city/Iraq.

Methods: Forty patients (80 ears) with a prolonged endotracheal intubation (> 5 days) in the ICU were studied. Information of the age, gender, level of consciousness, duration of endotracheal intubation and placement of nasogastric tube were retrospectively collected from history and patient`s data. All patients were subjected to otoscopic examination, tympanometry studies and acoustic reflectometry for evidences of MEE. Results: Out of the 80 ears examined, 46 ears had MEE (57.5%), 22 ears were normal (27.5%), and 12 ears (15%) had negative pressure in the middle ear by tympanometry. Patients who were intubated for more than 11 days and those with conscious disturbance had a significantly high incidence of MEE. No episodes of acute otitis media or systemic infection were encountered.

Conclusion: Prolonged endotracheal intubation (more than 11 days), age advancing and conscious disturbance contribute significantly to the occurrence of MEE in adult ICU patients.

Recommendation: Middle ear pathology like MEE in the ICU patients with prolonged intubation should not be underestimated.

Introduction

Middle ear effusion (MEE) is one of the commonest chronic otological conditions in childhood but has a lower incidence in normal adult. It is considered distinct from acute otitis media (AOM) [1,2]. By definition it is an accumulation of non-purulent fluid in the middle ear [3]. An inflammatory effusion behind an intact tympanic membrane that is not associated with acute otological symptoms or systemic signs [1]. The main symptom of middle ear effusion is deafness, which is clearly detectable by the patient, the condition is missed when the level of consciousness is disturbed.

The incidence and prevalence of otitis media with effusion leading to chronic otitis media are well documented in the pediatric population. When middle ear fluid is found in adult patients, however, it must be treated with suspicion, especially when unilateral in nature [3] Up to 70-80% of children eventually have at least 1 episode of otitis media before school age [4,5].

MEE result from alteration of the mucociliary system within the middle ear cleft where serous or mucoid fluid accumulates in association with negative pressure. Middle ear pressure is influenced by tubal function, the elasticity of the tympanic membrane, the middle ear volume and the gas exchange in the middle ear. Disturbances of these factors may lead to middle ear atelectasis. In clinical routine, these factors are difficult to assess [6].

The probability of MEE to occurre in adult is low, the possible reasons in adult are allergic rhinitis, sinusitis, nasopharyngeal carcinoma (NPC), and persistent otitis media since childhood, cigarette smoking, barotraumas and poor mastoid pneumatization. The distribution of the causes of MEE was: upper respiratory tract infection (URTI) (22%), chronic sinusitis (14%), allergic rhinitis (14%), nasopharyngeal carcinoma (6%) and other aetiologies (14%) [7]. Patients hospitalized in the ICU are also at high risk to develop MEE, especially those of nasal intubation (80%) [8].

The effusion is produced by middle ear mucosa in response to a variety of bacteria and possible other agents. Hypertrophy of middle ear mucosa and increase in the number of goblet cells are consistent findings. It usually results in moderate conductive hearing loss with air conduction threshold (20-30 dB) [9-11]. When the diagnosis is uncertain, tympanometry or acoustic reflectometry should be considered as an adjunct to pneumatic otoscopy [12].

Methods

Forty patients with prolonged oral endotracheal intubation (>5 days) in the ICU at Al-Sadder Teaching Hospital in Al-Najaf City / Iraq were reviewed during the period from May 2013 to september 2014. For patients to be included in the study, they had to be older than 16 years and should not have had a history of chronic otitis media, underlying skull base tumor (nasopharyngeal carcinoma) or craniofacial abnormalities. The admission history of patients was retrospectively collected, and each patient received a thorough otolaryngological examination. Information of the age, gender, duration of endotracheal intubation, level of consciousness and side of nasogastric tube (NG) placement were collected from medical charts and patient's database. The regular follow-up examination were done for the all patients from day zero to day 5 after intubation in the ICU. Using zero angled, 4mm rigid Hopkins rod nasoendoscopy after intubation, were carried out to exclude any pathology in the nose or nasopharynx. Ear examination was performed by a conventional handheld (Walch Allyn) otoscope. Pneumatic otoscopy were done with Peter's (Siegle's) pneumatic speculum, to evaluate the retraction and mobility of the tympanic membrane.

Impedance audiometry was carried out using a portable tympanometry and spectral gradient acoustic reflectometry. The resultant tympanograms were classified into 3 basic types (A, B, and C). Spectral gradient acoustic reflectometry was performed after otoscopic examination and tympanometry. A handheld instrument is placed in the external auditory canal to provide an 80 dB sound source that varies from 500 to 4000 Hz in a 100-millisecond period.

Middle ear effusion was diagnosed when accumulated fluid detected in the middle ear by otoscopic examination and when tympanometry studies showed type B. Patients were classified as normal when otoscopic examination results were normal and when tympanometry studies exhibited type A. All other patients were classified as having negative pressure in the middle ear (type C). Data were subjected to statistical analysis by using Pearson Chi-Square test.

Results

Forty adult patients (80 ears) were evaluated, 23 men (57.5%) and 17 women (42.5%), male to female ratio was 1.3:1. The mean age was 51.5 y (17-86 y).The duration of oral endotracheal intubation ranged from 6 to 17 days (mean: 11.5 days).Twenty three

patients had a NG tube after intubation, 10 in the left nostril and 13 in the right nostril.

Out of the total number of patients studied, 25 had MEE, 21 in both ears and 4 in one ear. Among the 80 ears, 46 ears had MEE (57.5%), 22 ears were normal (27.5%) and 12 ears had negative pressure in the middle ear (15%). Among the 15 patients without MEE, 6 had negative pressure in the middle ear (40%) and the other 9 patients were normal (60%). Out of the 8 patients aged less than 50 years, 3 had MEE (37.5%), 22 of the remained 32 patients older than 50 years were found to have MEE (68.75%). Among 25 patients who developed MEE, three patients aged less than 50 years found to have MEE (12%) and 22 patients aged more than 50 years developed MEE (88%). The incidence of MEE in the group of patients older than 50 y was found to be statistically significant (P = 0.001) with respect to those of less than 50 y.

Among the seven conscious clear patients, 1 had MEE (14.2%). Twenty four of the 33 patients with consciousness disturbance had MEE (72.7%). Patients with disturbed consciousness had a significantly (P= 0.007) higher rate of MEE than the conscious clear patients. Out of the 5 patients who received anesthetic agents, 4 had MEE (80%). There is no significant statistical difference in the incidence of MEE between disturbed consciousness patients and those who received anesthetic agents.

Eighteen patients were intubated for less than 11 days, 4 of them had MEE (22.2%). Twenty two patients were intubated for more than 11 days, 21 of them had MEE (95.4%) (Table 2). Patients who were intubated for more than 11 days had significantly (P= 0.01) higher rate of MEE than others who were intubated for less than 11 days (Table 1).

Among the forty patients, 23 with and 17 patients without NG tube. Out of the 23 patients with NG tube, 19 developed MEE (82.6%) and 4 patients did not do so (17.4%). Among the 17 patients without NG tube, 6 patients developed MEE (35.2%) and 11 were of no MEE (64.8%). The incidence of MEE in the group of patients with NG tube was evident to be significantly (P=0.03) higher than that of those without NG tube.

Nine out of the 13 patients who had NG tube in the right nostril, MEE is found in the same side (69.2%) and 2 in the opposite side (15.3%). Out of the 10 patients who had NG tube in the left nostril, 7 of them had MEE in the same side (70 %) and 1 in the opposite side (10%) (Table 2).

Table 1

Factors related to the occurrence of MEE in patients with prolonged oral endotracheal intubation

Variable studied	Outcome				Total Number
	MEE		No MEE		
Age	Number	Percentage	Number	Percentage	
< 50 Year	3	37.5%	5	62.5%	8
> 50 Year	22	68.75%	10	31.25%	32
Total number	25		15		40
Consciousness					
Clear	1	14.2%	6	85.8%	7
Unclear	24	72.7%	9	27.3%	33
Total Number	25		15		40
Days of Intubation					
11 or Less	4	22.2%	14	77.8%	18
12 or more	21	95.4%	1	4.6%	22
Total Number	25		15		40

Table 2

The incidence of MEE in relevance to NG insertion

Side of NG tube	Number	MEE				
		On the side of NG		On the opposite side		Number
		Number	Percentage	Number	percentage	
Right	13	9	69.2%	2	15.3%	11
Left	10	7	70%	1	10%	8
Total number	23	16	69.5%%	3	13%	19

Transnasal endoscopical findings of the pharyngeal orifice of the Eustachian tube in this study were described in table 3.

Table 3

Transnasal endoscopical findings of the pharyngeal orifice of the eustachian tube

Findings	Total No.	Percentage	Right	Percentage	Left	Percentage	Both sides	%
Oedema	13	32.5%	2	15.3%	1	7.69%	10	76.9
Blockage	7	17.5%	6	85.71%	-	-	1	14.29
Atrophy	4	10%	3	75%	1	25%	-	-
Normal	16	40%	-	-	-	-	-	-

Table 4

The mobility of tympanic membrane tested by pneumatic otoscopy

Mobility of TM	Total No.	Percentage	Right	Percentage	Left	Percentage	Both sides	%
Abnormal	58	72.5%	15	26.86%	5	8.62%	38	65.52
Normal	22	27.5%	-	-	-	-	-	-

1-Oedema of the orifice in 13 patients (32.5%), 10 of them had the oedema on both sides (76.9%). Out of the ten patients, eight had NG tube while the other 2 had not. The remainder patients had the oedema on the NG side (23.1%).

2-Blockage of the orifice by mucopurulent discharge in 7 patients, all of them with NG tube (17.5%). Six patients had the blockage in one side (the side of the NG tube) (85.7%). While the remainder had the blockage in both sides (14.3%).

3-Atrophy in 4 patients (10%). All of them in the sides of the NG tube (100%).

4-Normal appearance in 16 patients (40%).

Abnormal pneumatic speculum notes were seen in 58 ears (72.5%), 38 of them on both sides (Table 4). Tympanometric study showed 46 (57.5%) as type B, 12 (15%) type C and 22 (27.5 %) type A. Twenty-four (52.18%) patients with type B curve were bilateral (Table 5). Otoscopy findings consisted of 50 (62.5%) ears with retracted tympanic membranes, 5 (6.25%) cases of bulging membrane while 25 (31.25%) were normal (Table 6).

Discussion

Otitis media in general is not uncommon in otology practice in adults. The MEE prevalence rate has been reported to be 0.6% in a population aged 15 years or over [8]; however, we found that the incidence of MEE in adult ICU patients with prolonged endotracheal intubation was as high as 57.5%. This goes with Chia Lin et al. who found that prolonged endotracheal intubation (<7 days) in adult ICU patients contributes to the high incidence of MEE (50%) [13]. Chung et al. at the time of the tracheostomy studied, twenty-seven ICU patients who had undergone prolonged intubation (more than 14 days), 52% of these patients were classified as cases of MEE [14]. Cavaliere et al. performed bilateral impedance audiometries in 35 intubated ICU patients, tympanometry showed the presence of middle-ear effusion in 43.3% of the examinations [9].

There are several predisposing factors that may have contributed to MEE in prolonged endotracheal intubation patients, Eustachian tube dysfunction, sinonasal diseases and pathogens. In this study, several risk factors were found to correlate with MEE in patients with prolonged endotracheal intubation.

1- Advancing in age, we found a higher incidence of MEE in the group of patients Older than 50 years (68.75%), this goes with Chia Lin who found a similar findings in patients older than 60 years (64%) [13].

Table 5

Tympanometric findings

Tympanometry curve	Total No.	Percentage	Right	Percentage	Left	Percentage	Both sides	%
Flat B	46	57.5%	13	28.26%	9	19.56%	24	52.18
C	12	15%	2	16.66%	1	8.34%	9	75
A	22	27.5%	-	-	-	-	-	-

Table 6

The otoscopical findings of tympanic membrane position

Position	Total N0.	Percentage	Right	Percentage	Left	Percentage	Both sides	%
Retracted	50	62.5%	12	24%	8	16%	30	60
Bulging	5	6.25%	2	40%	1	20%	2	40
Normal	25	31.25%	-	-	-	-	-	-

2- Increase days of intubation, subjects who were intubated for more than 11 days had significantly higher rate of MEE (95.4%). Chung et al reported an increase in the incidence of MEE in patients intubated for more than 7 days (57%) [14].

3- The level of consciousness, in our study patients with conscious disturbance had an increase in the incidence of MEE (72.7%), this goes with Cavaliere who found 80% of unconscious patients in the ICU with MEE 9. Prolonged intubation (>11 days) and conscious disturbance were both associated with an increased frequency of MEE in this study. The occurrence of MEE was higher in the group older than 50 years and the result was statistically significant. This finding can be explained as all these conditions often characterized the seriously ill patients, nevertheless some of them are likely directed to affect the Eustachian tube function and incidence of effusion. During the prolonged bed rest in a supine position, gastro-oesophageal reflux can cause bacterial pathogens to migrate from the nasopharyngeal tube to the middle ear [9, 15].

4- The presence of NG tube, among 23 patients with NG tube, 19 of them developed MEE (82.6%), 16 on the same side (69.5%) and 3 on the opposite side (13%). The

presence of NG tube may have contributed to Eustachian tube dysfunction, oedema of the orifice on the side of NG (23.1%), blockage by mucopurulent discharge in (100%) and atrophy of the orifice also (100%). Eustachian tube dysfunction causes negative pressure in the middle ear, which may result in aspiration of nasopharyngeal matter and influx of bacteria and viruses from the nasopharynx when the Eustachian tube opens [16].

Several factors may be involved in the pathogenesis of Eustachian tube dysfunction. Mechanical ventilation of the intubated patients. Airflow dynamics change have decreased mucocillary function and increased viscosity of mucus. Moreover, mechanical ventilation is usually regulated to achieve moderate hypocapnia to suppress spontaneous breathing. Hypocapnia however, can cause negative pressure in the middle ear [17]. Patients having conscious disturbance or taking sedatives can develop neuromuscular system disorders or swallowing dysfunction, which can contribute to dysfunction of nasopharyngeal tube [9]. We found a high incidence of MEE in the unclear consciousness patients (72.7%) and in those who received anaesthetic agents (80%). There is no significant statistical difference in the incidence of MEE between disturbed consciousness patients and those who received anaesthetic agents. Anaesthesia and loss of consciousness result in reduced tone in the pharyngeal dilators and posterior displacement of the tongue. Like most anaesthetic agents, propofol "which is mainly used in prolonged intubated patients in this hospital" appears to consistently result in a faster time to extubation in patients receiving either short-term or long-term sedation. It is not clear, however, that this shorter time to extubation actually leads to a decrease in total time of ventilation or a shorter ICU stay. In addition, it is associated with a fall in blood pressure mediated by a number of mechanisms, including reduction in central sympathetic vasomotor tone and reduction in cardiac contractility [18].

The incidence of MEE in the presence of the NG tube was found to be statistically higher on the side of the NG tube (69.5%) in comparison to the opposite side (13%) (P=0.01). Wake et al. found that the use of post-operative nasogastric tubes is associated with reduced peak middle ear pressure (mmH2O) and reduced peak compliance volumes (ml) as assessed by tympanometry. In addition changes in the appearance of the tympanic membrane may occur with the protracted use of these tubes [19]. In the current study, 16 patients developed MEE in the same side of the NG tube and 3 patients in

the opposite side. That means the NG tube may act as a foreign body and obstruct the nasopharyngeal tube orifice or as a source of infection that may contribute to MEE .It has been obtained that one patient developed acute otitis media but none of the patients developed systemic infection. This may be attributed to the fact that patients were subjected to prolonged administration of wide-spectrum antibiotics as a routine policy in the ICU patients in our hospital.

Conclusion

Prolonged oral endotracheal intubation (>5 days) and advanced age contributed to the occurrence of MEE in adult ICU patients. Moreover, conscious disturbance with prolonged endotracheal intubation for (>11days) were also significant contributing factors of MEE, therefore, routine examination in prolonged endotracheal intubation patients by otoscopy should be done in ICU to improve the quality of intensive care. Nasogastric intubation is to be regarded as an additional risk for Eustachean tube dysfunction.

Recommendation

Middle ear pathology like MEE in the intubated patient in the ICU for long duration should not be underestimated. Further studies are needed to explore factors related to the occurrence of middle ear with effusion (MEE) in intensive care unit (ICU) patients with prolonged oral endotracheal intubation, to evaluate the preventive measures and to improve management. Nasogastric intubation is an additional risk factor, therefore the type of the tube, its management and the root of feeding may need to be reassessed.

References

1. Richard M. Rosenfeld, Larry Calpepper, Karen J. Doyle. Otitis Media With Effusion, AAFP; 2004 (14) :1947-1952.

2. A. Richard Maw, Otitis Media with Effusion (glue ear) in Alan G. Kerr. Scott-Brown’s Otolaryngology, Head &Neck Surgery. Volume 6, 5th edition/ London. Butterworth international companies; 1987/ page: 159- 176.

3. K. J. LEE. Infections of the Ear in: Marsha S. Loeb. Essential otolaryngology, Head & Neck Surgery. 9th edition/ New York. Mc Graw-Hill Companies.2008 Page: 310-320.

4. Teele DW, Klein JO, Rosner B, Epidemiology of otitis media during the first seven years of life in children in greater Boston, a prospective cohort

study: Journal of Infectious diseases, Volume 160, issue(1);1989/page : 83-94.

5. C. A. East, Hearing Loss-General Introduction and Childhood Aetiology in: R. S. Dhillon. EAR, Nose and Throat and Head & Neck Surgery.2th edition/ London. Harcourt Publishers Limited.2000/ Page: 6-7.

6. Henning Hildamm , Atelectatic Ear in: Maion Philipp. Middle Ear Surgery. 1st /New York. Springer- Verlag Berlin Heidelberg; 2006/ page: 99-100.

7. George Browning, Otitis media with effusion in: Michael Gleeson. Scott-Brown's otolaryngology, Head & Neck Surgery. Volume 1, 7th edition/ London. Hodder Arnold;2008/ Page: 878- 903.

8. Michael Chi Fai Tong And C Andrew Van Hasselt ,Otitis media with effusion in adult in: Michael Gleeson. Scott-Brown's otolaryngology, Head & Neck Surgery. Volume 3, 7th edition/ London. Hodder Arnold; 2008/ Page : 3388- 3393.

9. F, Masieri S, Proietti R, Magalini SI, Tympanometry for middle ear effusion in unconscious ICU patients. 1992; 9 (1);: 71-75.

10. G. G. Browning, Pathology of inflammatory conditions of the external and middle ear in: Scott-Brown's otolaryngology, Head & Neck Surgery. Volume 3, 5th edition/ London. Butterworth International Companies; 1987/page: 53-84.

11. Michael J. Belmont, Watchful. Waiting For Otitis Media With Effusion in: Guneyt M. Alper. Advanced Therapy of Otitis Media. 1st edition/ London. BC Decker Inc.2004/ page: 171-173.

12. Michael J. Rutter & Robin T. Cotton, Otitis Media, to treat or not to treat in: Esther Gumpert. Controversies in otolaryngology. 7th edition/ New York. Thieme Medical Publishers; 2006/ page : 402-403.

13. Ching-Chia Lin, Chia-Der Lin, Yuan-Kai Cheng, Ming-Hsui Tsai, Chia- Cheng Chang, Middle Ear Effusion in Intensive Care Unit Patients with prolonged endotracheal intubation: American Journal of Otolaryngology- Head & Neck Medicine & Surgery; 2006 (27) : 109-111

14. Chung H K, Lin C C, Wang C Y, Lin C D, Tsia M H, Chung C S, Improvement in Otitis Media with Effusion in Patients

undergoing tracheostomy after prolonged endotracheal intubation. 38; 2009 (5): 532-536.

15. Schwartz R, Rodriguez WJ, Mann R, et al, The nasopharyngeal culture in acute otitis media. A reappraisal of its usefulness: JAMA 241;1979(20): 2170-2173.

16. Margaret A. Tenna & Adriane DeWitt Latz, Otitis Media with Effusion in: Byron J. Bailey, Head & Neck Surgery-Otolaryngology. 4th edition / New York. Lippincott William & Wilkins; 2006/ Page : 1260-1271.

17. Derky CS, Bluestone CD, Thompson AE, Otitis media in the pediatric intensive care unit, a prospective study: Official Journal of American Academy of Otolaryngology- Head & Neck Surgery 100; 1989 (4) : 292-299.

18. Gavin G Lavery ,Adult Critical Care in : Michael Gleeson. Scott- Brown's Otolaryngology, Head & Neck Surgery. Volume 1, 7th edition/ London;2008/ Page : 527-528.

19. Wake M, Mc Cullough DE, Binnington JD, Effect of nasogastric tubes on Eustachian tube function: 104; 1990 (1): 17-19.