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Original Article

Assessment of relation between otitis media and wheezy chest in pediatric

Pediatrics

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ABSTRACT

Background: In children, wheezing is a common symptom that needs medical consultations, emergency care services, and hospitalization. The middle ear may behave in a "similar manner to the lungs under allergic inflammatory insults" and that the middle ear may be included in the united airways.

Objective: To detect the association between the wheezy chest and the presence of otitis media (OM).

Methodology: This study included 100 children with a wheezy chest, 54 male and 46 females; all cases were subjected to entire history taking, clinical examination, complete blood count (CBC) and C- reactive protein (CRP) analysis, otoscopic examination, tympanometry, audiometry, additionally auditory brain stem response (ABR) in non-cooperative children.

Results: In the current study, 47 cases (47%) had bronchial asthma, and 53 cases (53%) had pneumonia. Among the studied cases, 43% had OM (61% suffering from bronchial asthma and 26.4% suffering from pneumonia). Among the 43 cases of OM, 39 cases (90.6%) were complicated by conductive hearing loss (CHL), while 4 cases (9.3%) were complicated by sensory neural hearing loss (SNHL). Anemia has a strong correlation with OM.

Conclusion: there is an association between wheezy chest, whether caused by bronchial asthma or pneumonia, and OM development.

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Keywords: Children, wheezy chest, otitis media, conductive hearing loss.

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INTRODUCTION

In children, wheezing is a common symptom that needs medical consultations, emergency care services, and hospitalization [1]. Childhood asthma is triggered and exacerbated by respiratory viral infections. The early childhood viral infections which infect the lower airways can be associated with chronic lower respiratory tract symptoms, including asthma [2]. Otitis media can be subdivided into acute otitis media (acute suppurative, non-suppurative, and recurrent acute otitis media) and chronic otitis media (chronic suppurative, non-suppurative with effusion, and non-suppurative without effusion) [3].

After viral upper respiratory tract infection, inflammation in the nose, nasopharynx, eustachian tubes, and middle ear mucosa leads to OM development. This inflammation leads to edema that obstructs the eustachian tube; this, in turn, causes a decrease in ventilation and a cascade of events that finally increased the middle ear's negative pressure and increased exudate from the inflamed mucosa. Inflamed mucosa organisms lead to suppuration in the middle ear [4]. The middle ear is ventilated 3 to 4 times/min. The affection of middle ear patency develops negative pressure that leads to accumulation of fluid which causes hearing loss. Eustachian tube dysfunction may be secondary to allergies, inflammation in the nasopharynx, or benign or malignant tumors [5].

Asthma patients have inflammation of the lower airway due to Th1 and Th2 immune responses. This inflammation may induce the inflammation of the mucosal orifice of the eustachian tube and impeding the ventilation of the middle ear [6]. Recurrent wheezing and airway secretions could physically obstruct the eustachian tube. This obstruction affects the mucociliary clearance and promotes the accumulation of infection and OM development [6]. This work aimed to find an association between a wheezy chest and the presence of OM.

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The study rationale: It is essential to do an audiological study (tympanogram and audiometry alternatively auditory brain stem response (ABR) in every child with wheezy chest to assess the presence of otitis media.

SUBJECTS AND METHODS

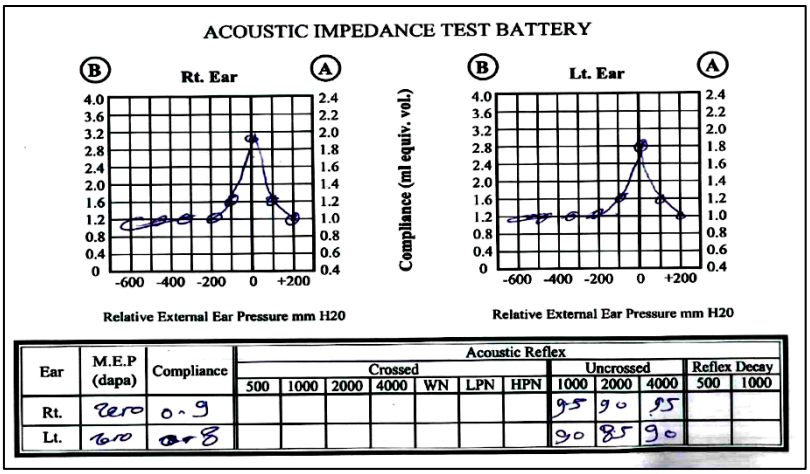
This observational, descriptive cross-sectional study was carried out on 100 children selected from the pediatric department in Al-Zahraa University Hospital, Cairo, Egypt, from November 2019 to May 2020. Their age ranges from two to ten years old. They were 54 male, 46 females. Chest auscultation was revealed that all selected children had expiratory rhonchi. Children-are known to have congenital hearing loss, congenital anomalies of the chest, or congenital anomalies of the ear. Also, we excluded children with a history of taking any ototoxic drugs.

All the studied cases were subjected to history taking, complete systemic examination, including the respiratory system. Investigations in CRP and complete blood count analysis by Sysmex Xp300, Egypt, and Chest X-ray-were done for all studied children. Audiological examination in the form of an otoscopic examination, tympanometry, audiometry was done for all children, while auditory brain stem response was made only for non-cooperative children (Eclipse Ep 25 intercostal machine, Denmark).

Bronchial asthma was diagnosed according to GINA (2020). Pneumonia was diagnosed based on clinical and radiological findings [7]. Suppurative otitis media (SOM) was diagnosed by the presence of congestion, hyperaemic, and bulging tympanic membrane by otoscope and tympanometry showing type B OM. Disturbed cone of light and retracted tympanic membrane (DCL and RTM) diagnosed by otoscope showing dull and retracted tympanic membrane and tympanometry showing type B OM. Anemia in our cases diagnosed based on hemoglobin level (Hb), hematocrit %(Hct%), and mean corpuscular volume (MCV) according to nelson guidelines [8]. The study was approved by the institutional review board of faculty of medicine for girls, Cairo, Al-Azhar University, Egypt, (IRP number was201911244). Informed written consent was taken from the parents of the studied children.

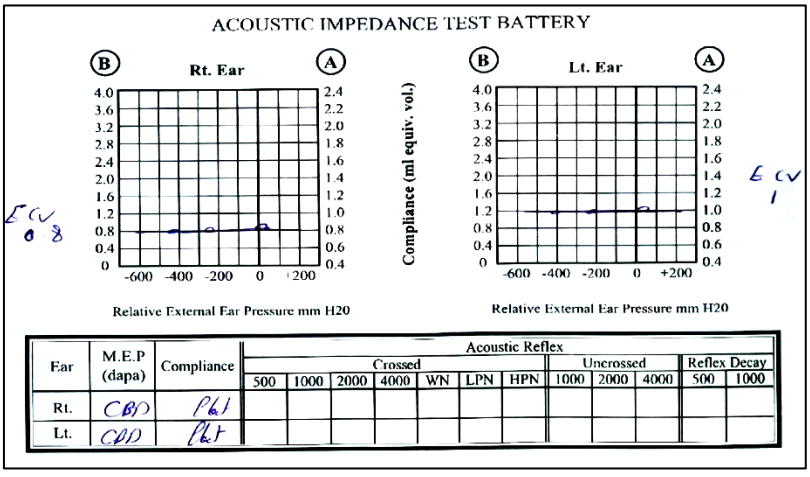
Statistical analysis Statistical analysis was performed using SPSS version 25. for Windows & MedCalc v. 20 The difference in the means of continuous variables was analyzed using the independent sample T. test. The quantitative variables were in the form of mean ± standard deviation (SD), minimum and maximum. Description of qualitative variables was in the form of numbers (n) and percent (%). Comparison between qualitative variables was carried out by Chi-squared test. The results were significant when p-value≤ 0.05 (CI 95%)

a)



Ear	M.E.P (dapa)	Compliance	Acoustic Reflex: Crossed 500	1000	2000	4000	WN	LPN	HPN	Uncrossed 1000	2000	4000	Reflex Decay 500	1000
Rt.	Zero	0.9								95	90	95		
Lt.	60	0.8								90	85	90		

b)



Ear	M.E.P (dapa)	Compliance	Acoustic Reflex: Crossed 500	1000	2000	4000	WN	LPN	HPN	Uncrossed 1000	2000	4000	Reflex Decay 500	1000
Rt.	CBD	Flat												
Lt.	CBD	Flat												

c)

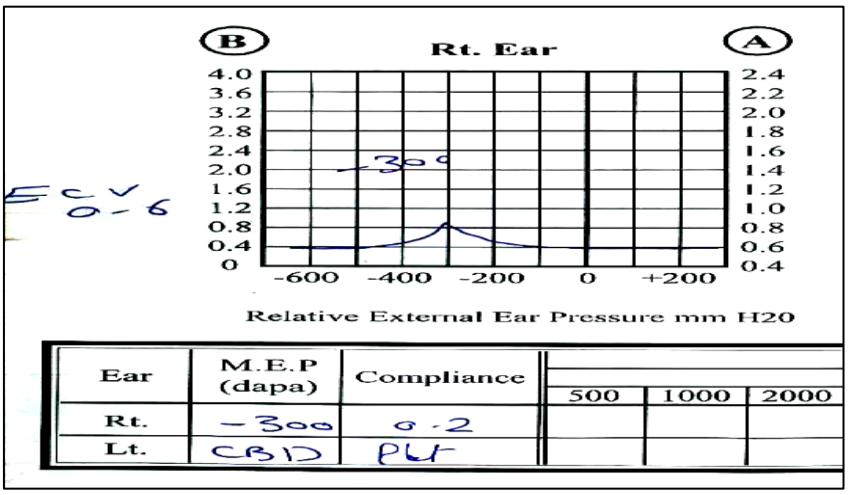
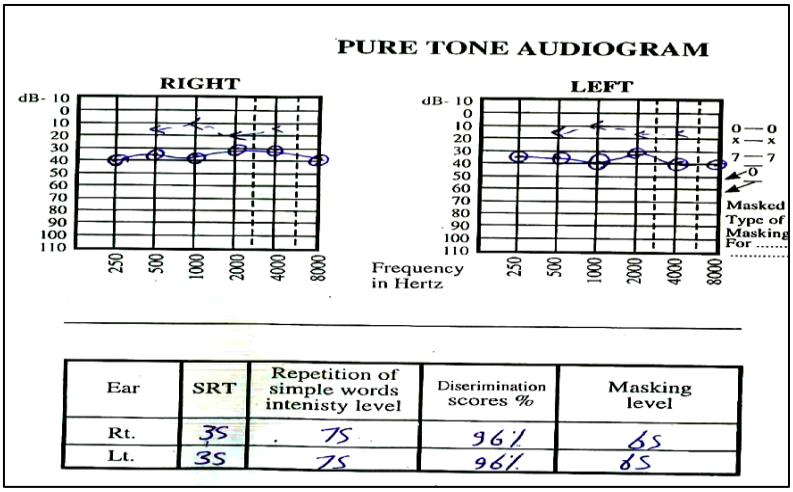
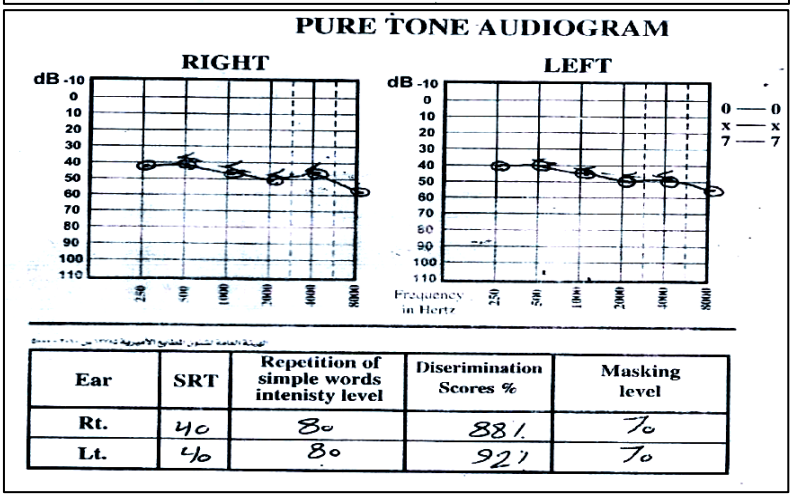


Figure (1): Tympanogram of one of our cases has bronchial asthma, a) showing bilateral type A tympanogram (standard), **b)** Tympanogram of one of our cases has pneumonia and leading bilateral type B tympanogram, **c)** Tympanogram of one of our cases has bronchial asthma and showing right ear type C tympanogram.

a)



b)



c)

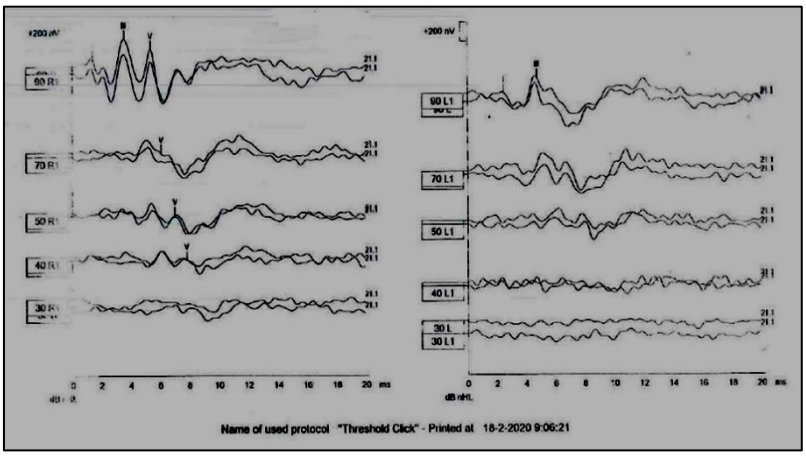


Figure (2): a) Audiometry of one of our cases has bronchial asthma. It shows a bilateral conductive hearing loss, **b)** Audiometry of one of our cases has bronchial asthma and shows a bilateral sensory neural hearing loss**, c)** ABR of one of our cases has pneumonia and showing Bilateral identified. Repeatable ABR waves (1&3&5), wave 5 traced down to 40 dbnhl in RT ear and down to 50 dbnhl in LT ear representing bilateral mild conductive hearing loss most probably due to conductive element (type B tympanogram).

RESULTS

Table (1): General characters of the studied cases

Sex	**n (%)**
Male	54 (54%)
Female	46 (46%)
Anthropometric data	**Mean ±SD (Range)**
Weight Z score	0.00 ± 1.00 (-1.5-3.1)
Height Z score	0.00 ± 1.00 (-2.1- 2.2)
BMI Z score	-0.00 ± 1.00 (-2.2- 2.9)
Vital signs	
Heart rate (Median, IQR)	120 (20.5)
Respiratory rate (Median, IQR)	29 (14.5)
Temperature (Mean ±SD (Range)	37.43 ± 0.67 (37-39)
Systolic blood pressure (Mean ±SD (Range)	102.99 ± 9.64 (85-120)
Diastolic blood pressure (Mean ±SD (Range)	65.94 ± 6.78 (50-80)
Laboratory results	**Mean ±SD (Range)**
WBCs (x109 cells/L)	11.63 ± 5.11 (3.90-25)
RBCs (x1012 cells/L)	4.24 ± 0.61 (3-5.40)
Hb (g/dl)	10.77 ± 1.05 (7.30-12.90)
Hct %	35.52±2.67 (30-40)
MCV (femtoliter)	75.88±2.67 (70-79)
Platelets (109/L)	389.6 ± 125.2 (159-665)
Eosinophil %	0.76 ± 0.68 (0.10-2)
CRP (mg/L)	22.12 ± 19.09 (6-96)
Otitis media	**n (%)**
Total	43 (100%)
With bronchial asthma	29 (67.5%)
With chest infection	14 (32.5%)

Table (1) demonstrates general characters of the studied cases. Table (2) revealed that 29 patients (61.7%) out of 47 patients with bronchial asthma had DCL and RTM, while 14 patients (26.4%) out of 53 patients with pneumonia had SOM. Table (3) revealed that 43 patients (43%) out of the total studied children were diagnosed as OM; they subclassified into 39 cases (90.6%) had conductive hearing loss (CHL), and 4 cases (9.3%) had sensory neural hearing loss (SNHL). Table (4) revealed that there was a significant increase of leucocytic count and CRP in cases with suppurative OM in comparison to cases with a disturbed cone of light (DCL) and retracted

tympanic membrane (RTM), with significantly low hemoglobin level in cases of OM as 95.3% of patient had OM had anemia. Table (5) revealed a statistically significantly higher incidence of OM in males (65.12 %) than females (34.88 %). Additionally, there was a statistically significant higher means of vital signs in SOM cases compared to cases with the (DCL and RTM). Table (6) revealed that only eosinophil % was significant in cases with a wheezy chest with otitis media compared to cases without OM.

Table (2): Distribution of otitis media cases in patients with either bronchial asthma or pneumonia

Studied groups. / Types of OM	Wheezy chest (n=100)	
	Bronchial asthma (n =47)	Pneumonia (n =53)
	n (%)	n (%)
DCL and RTM	29 (61.7%)	0 (0%)
SOM	0 (0%)	14 (26.4%)

DCL and RTM: disturbed cone of light and retracted tympanic membrane, SOM: suppurative otitis media.

Table (3): Otoscopic, tympanogram, audiometry, and auditory brain stem response findings in the studied cases

Otoscope findings	n (%)
Normal	57 (57)
DCL &RTM	29 (29)
SOM	14 (14)
Total	100 (100)
Tympanogram	
Type A (normal)	57 (57)
Type B	34 (34)
Type C	9 (9)
Total	100 (100)
Hearing loss	
Normal hearing	57 (57)
Conductive hearing loss (CHL)	39 (39)
Sensorineural hearing loss (SNHL)	4 (4)
Total	**100 (100)**

Table (4): Comparison of CBC, CRP and hemoglobin level according to otoscopic findings

Laboratory items	Otoscopy		p value
	DCL and RTM (n=29)	SOM (n=14)	
CBC & CRP	**Mean ± SD**	**Mean ± SD**	
WBCs (x10^9 cells/L)	9.45± 3.66	16.35± 5.54	0.001*
RBCs (x10^{12} cells/L)	4.37± 0.63	4.20± 0.64	0.421
Hb (g/dl)	11.07± 1.19	10.83± 0.93	0.137
Hct %	33.03±2.40	32.42±1.50	0.089
MCV (femtoliter)	73.72 ±2.28	72.35 ± 1.73	0.131
Platelets (10^9/L)	377.55± 124.33	402.85± 121.78	0.799
Eosinophil %	0.43± 0.60	0.22± 0.097	0.2031
CRP (mg/L) (median, IQR)	6 (6)	48 (24)	0.001*
Otitis media (n= 43)			
Anemia			
Positive [n (%)]	41 (95.3)	X^2= 11,4	0.001*
Negative [n (%)]	2 (4.7)		

*: p value < 0.05.

Table (5): Comparison of vital signs and gender according to otoscopic findings

Clinical data	Otoscopy		p value
	DCL and RTM	SOM	
Vital signs	**Mean ± SD**	**Mean ± SD**	
Heart rate (b/m)	111.10± 12.23	130.36 ± 12.79	0.001*
Respiratory rate (c/m)	25.10± 5.69	39.79± 10.10	0.005*
Temperature (℃)	37.17± 0.45	38.06± 0.75	0.001*
Systolic pressure (mmHg)	102.72± 4.73	107.50± 7.84	0.0169*
Diastolic pressure (mmHg)	64.29± 7.30	70.93± 6.61	0.0048*
Otitis media			
Sex	**n (%)**		
Male	28 (65.12)		0.0474*
Female	15 (34.88)		

*: p value < 0.05.

Table (6): Comparison of studied variables between wheezy chest cases with and without OM

Parameter	Wheezy chest		p value
	Without OM (n=57)	OM (n=43)	
Age and sex			
Age (Mean ±SD)	5.23 ±2.23	5.73±2.40	0.306
Sex n (%)			
Male	29 (50.9%%)	28 (65.12)	0.4767
Female	28 (49.1%)	15 (34.88)	0.4645
Anthropometric data (Mean ±SD)			
Weight Z score	-0.17±0.96	0.23±1.01	0.053
Height Z score	-0.18±0.96	0.20±1.01	0.074
BMI Z score	0.017±0.97	-0.02±1.05	0.844
Vital signs (Mean ±SD)			
Heart rate (b/m)	121.73± 15.64	118.65±15.37	0.352
Respiratory rate (c/m)	33.14± 17.60	30.76±10.63	0.474
Temperature (℃)	37.43± 0.66	37.46±0.70	0.825
Systolic blood pressure (mmHg)	102.53± 9.65	103.88±9.82	0.514
Diastolic blood pressure (mmHg)	65.84± 6.84	66.18±6.85	0.819
Laboratory results (Mean ±SD)			
WBCs ($x10^9$ cells/L)	11.76 ± 4.80	11.80±5.57	0.969
RBCs ($x10^{12}$ cells/L)	4.16± 0.61	4.38±0.60	0.091
Hb (g/dl)	10.65± 1.03	10.95±1.10	0.188
HCT %	34.09±1.73	33.44±2.25	0.093
MCV (femtoliter)	74.33±1.83	73.95±2.38	0.182
Platelets (10^9/L)	394.72± 131.57	378.06±112.43	0.533
Eosinophil %	0.55 ± 0.54	1.04±0.76	0.001*
CRP (mg/L) (median, IQR)	12 (18)	16 (22)	0.307
Anemia [n (%)]			
Yes	54 (94.7%)	41 (95.3%)	0.8926
No	3 (5.3%)	2 (4.7%)	0.8926
Causes			
Bronchial asthma	18 (31.6%)	29 (67.4%)	0.041*
Pneumonia	39 (68.4%)	14 (32.6%)	

*: p value < 0.05.

DISCUSSION

The eustachian tube connects the middle ear cavity with the nasopharynx, so the eustachian tube considers an extension of the upper respiratory tract. So, one airway is one disease because bronchial provocation in the lower airway affects allergic rhinitis in the upper airway, while nasal provocation affects asthma in the lower airway [9].

The middle ear response to allergic and inflammatory insults in a similar manner to the lungs [10]. Streptococcus pneumonia colonizes the nasopharynx, sense threatening changes in the nasopharynx resulting from viral infection by upregulating specific sets of genes involved in releasing biofilm, dissemination from the nasopharynx to other sites, become protected against the host immune system [11].

In the present study, among the studied cases, 43% have OM (67.4% suffering from bronchial asthma and 32.6% suffering from pneumonia) with significant difference between them. Much literature revealed that solid association was present between upper and lower respiratory tract infections. Also, there was a strong association present between bronchial asthma and OM. Wright et al. [12] and El-Sharnoby et al. [13] were found that there was increased expression of allergy-associated inflammatory cells (CD3) and cytokines on the middle ear mucosal specimens from atopic patients compared to control. So, there is a relationship between allergy and inflammation in the middle ear. Igde and Erkİlet [14] reported that the mucosa of the middle ear could respond to antigen in the same manner as does the lower respiratory tract mucosa because the mucosa and effusion from atopic patients with OM with effusion reveal cellular profiles and Th2 cytokine consistent with an allergic response, revealing the allergy role in otitis media with effusion. Shishegar and Ashraf [15] and Sharma et al. [16] reported that upper respiratory tract infections are among the most common causes of eustachian tube dysfunction and thus OM with effusion Hurst [17] Found that among (97%) patients with otitis media with effusion, (62%) had documentation of additional atopic signs (whatever skin atopy or bronchial asthma), and bronchial asthma was diagnosed in 22% of the studied cases. As explained by middle ear mucosa of atopic patients, all components respond to allergic stimulation as respiratory system as TH2, inflammatory response, IL-5, and specific IgE are present in most ear of the atopic patient. Chants et al. [18] also were found that increased the incidence of OM with effusion among atopic children up to five-fold than non-atopic ones. The increasing frequency of respiratory viral infection is explained, which is the primary trigger of acute asthma exacerbation. Interaction between viral infection and allergy increases the risk of middle ear effusion and immunological reaction unrelated to mechanical obstruction only. However, the middle ear is the target organ for allergic reactions, so the reaction to external stimuli affects the middle ear. Chonmaitree et al. [19] were found that respiratory viral and bacterial infections are considered a risk factor for developing acute otitis media.

The eustachian tube dysfunction in our cases may cause by proceeding upper respiratory tract infection, the inflammatory process in the nasopharynx, allergies (in asthmatic cases); all these processes can cause eustachian tube dysfunction. In the present study, among the cases who developed OM, (39) cases have conductive hearing loss (CHL), and four cases have (SNHL). Costa et al. [20] were revealed that hearing loss in OM is usually conductive, resulting from tympanic membrane rupture or changes in the ossicular chain due to erosion or fixation caused by the chronic inflammation, and they reported that the cause of sensorineural hearing loss in OM is due to the passage of toxins through the membrane of the round window causing permanent loss of hair cell. Costa acts on Six hundred and fifty patients of Chronic Otitis Media and determined bone-conduction thresholds of the affected and normal ear or frequencies 500, 1,000, 2,000, 3,000, and 4,000 Hz. Moreover, found a statistically significant difference between the average bone-conduction thresholds of ears with COM and their controls for all frequencies.

In the present study, leucocytic count and CRP show marked elevation in SOM cases than cases of DCL&RTM. Peltola et al. [21], Tejani et al. [22], and Nofal and Al Kwatly [23] found that elevated CRP level among children with suppurative otitis media than other with only having disturbed the cone of light and retracted the tympanic membrane. Also, Schwartz et al. [24] and Polachek et al. [25] revealed that leucocytic count elevated in acute otitis media.

Among our studied cases who develop otitis media, anemia is a constant risk factor for the development of OM, as 95.3% of them had anemia Wintergerst et al. [26] concluded that decreased neutrophil and macrophage function and decreased production of pro-inflammatory cytokines are more in anemic children than non-anemic one.

In our study, there is a statistically significant higher mean of vital signs in suppurative otitis media cases compared to typical cases and cases with DCL&RTM. In agreement with, Salah et al. [27] revealed that vital signs could be used to differentiate children with non-serious bacterial infections from those with serious bacterial infections.

In the present study, out of 43 cases who developed otitis media, (28) males were male compared to (15) females. Association of gender to OM was studied by Teele et al. [27], Pukander et al. [29], and Matsuoka [30], who explained this finding by the association of lower IgG2 among the male of their included cases rather than females. While our cases all are immune-competent, depends on history, clinical and laboratory findings.

There is an increase in eosinophil in OM patients in the present study compared to patients without OM. This agreement with Ohta et al. [31] reported that the number

of blood eosinophils and the level of IgE increase in otitis media.

This study has a limited number of patients, so studies with a larger sample size would confirm our finding regarding the association between the wheezy chest and otitis media.

CONCLUSION

In the present study there was an association between the wheezy chest caused by either (bronchial asthma and bronchopneumonia) and OM.

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Conflict of interest: authors declare any conflict of interest.

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الملخص العربي

تقييم العلاقة بين التهاب الأذن الوسطى وصرير الصدر عند الأطفال

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ملخص البحث

الخلفية: في الأطفال يعتبر صرير الصدر عرض مشهوره يحتاج الى استشارات طبيه وخدمات الرعاية في حالات الطوارئ، والاستشفاء. قد تتصرف الأذن الوسطى بطريقة مماثلة للرئتين عند التعرض للالتهابات التحسسية ولذلك فان الأذن الوسطى قد تكون متضمنة في الشعب الهوائية الموحدة

الهدف: الكشف عن الارتباط بين صرير الصدر ووجود التهاب الأذن الوسطى في الأطفال

الطرق: شملت هذه الدراسة 100 طفل يعانون من صرير الصدر، 54 ذكر 46 أنثى. خضعت جميع الحالات للأخذ الكامل للتاريخ المرضى، والفحص الإكلينيكي، وتحليل صوره دم كامله وبروتين سي المتفاعل والفحص التنظيري للأذن وقياس ضغط الطبلة، وقياس السمع، بالإضافة إلى استجابة جذع الدماغ السمعي في الأطفال غير المتعاونين

النتائج: في دراستنا، 47 حالة (47٪) مصابون بالربو القصبي، و53 حالة (53٪) مصابون بالالتهاب الرئوي. من بين الحالات التي تمت دراستها، 43 ٪ لديهم التهاب في الاذن الوسطى (61 ٪ يعانون من الربو القصبي و26.4 ٪ يعانون من الالتهاب الرئوي).

حالات التهاب الاذن الوسطى كانت 39 حالة (90.6٪) تعاني من من بين 43 حالة من

فقدان السمع التوصيلي، في حين أن 4 حالات (9.3٪) كانت تعاني من فقدان السمع العصبي الحسي. فقر الدم له علاقة قوية مع التهاب الاذن الوسطى

الأستنتاجات: هناك ارتباط بين صرير الصدر، مهما كان سببه الربو القصبي أو الالتهاب الرئوي، وحدوث التهاب الاذن الوسطى.

الكلمات المفتاحية: الأطفال، صرير الصدر، التهاب الأذن الوسطى، فقدان السمع التوصيلي.

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