



Acute Otitis Media-Associated Diarrhea in Children Less than 2 Years Old

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Abstract

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BACKGROUND: The reported incidence of diarrhea in non-enteric infections can be questioned because many cases of diarrhea are adverse events associated with antibiotics. Although it is well known that one of the non-enteric infections that have diarrhea as one of its manifestations is acute otitis media, it's sometimes missed as a possible cause.

AIM: The objectives of the study were to estimate the prevalence of acute otitis media (AOM) in children presented with diarrhea and to describe the characteristics of AOM-associated diarrhea (AOMD) after exclusion of antibiotics use among children <2 years old.

METHODS: Sixty patients (age < 2 years) complaining from diarrhea as their chief complaint were included in this cross-sectional study. Their ears had been examined using pneumatic otoscopy, looking for evidence of AOM. Mother-directed specific questions related to the characters of diarrhea, constitutional symptoms, and associated symptoms had been used, in addition to laboratory stool examination.

RESULTS: Patients involved in this study were 60, from them, 22 were female (36.7%). Their ages range from 1 to 19 months (8.31 ± 4.30). AOM was present in 27 cases (45%). There was a significant association between AOMD and age under 1 year ($p = 0.017$), underweight ($p = 0.012$), and ear pain ($p < 0.001$).

CONCLUSION: The prevalence of AOM in diarrheal cases is 45%, making it a very possible diagnosis for any young baby presented with diarrhea, especially in underweight infant with ear pain, so pneumatic otoscopic ear examination is recommended to be a routine for them.

Introduction

Diarrhea is a very common problem, especially in infants and young children. It is classified according to the underlying cause into non-infectious diarrhea (gastrointestinal and systemic diseases) and infectious one (gastrointestinal infection and systemic infection) [1], [2]. In one report, of 594 adult patients diagnosed with gastroenteritis, 21% had non-infectious diseases, 71% had gastrointestinal infections, 8% had systemic infections, including urinary tract infections (UTIs) (19 patients), respiratory tract infections (eight patients), septicemia (six patients), pelvic inflammatory disease (five patients), malaria (two patients), and others [2]. The pathogenesis of diarrhea in systemic infection might include cytokine action, intestinal inflammation, sequestration of red blood cells, apoptosis and increased permeability of endothelial cells in the gut microvasculature, and direct invasion of gut epithelial cells by various infectious agents [1]. One of the systemic infections that have diarrhea as one of its manifestations is acute otitis media (AOM) [3].

Children younger than 2 years are physiologically predisposed to AOM because their Eustachian tubes are shorter, of smaller caliber, and more horizontal compared with those of adults [4]. As the symptoms of AOM (irritability, a change in sleeping or eating habits, fever, otalgia, otorrhea, headache, vomiting, and diarrhea) are not sensitive nor specific [3], [5], and as without proper treatment, it has serious complications (mastoiditis, labyrinthitis, petrositis, meningitis, brain abscess, hearing loss, lateral and cavernous sinus thrombosis, facial nerve palsy, and others) [5], high suspicion of index should be present and otoscopic ear examination is required. The pneumatic otoscope is the ideal tool [6], [7], as pneumatic methods evaluate tympanic membrane immobility, a reliable sign of middle ear effusion [8], [9], [10]. The reported incidence of diarrhea in non-enteric infections can be questioned, because many cases of diarrhea are adverse events associated with antibiotics [1], so, the present study was undertaken to estimate the prevalence of AOM in children presented with diarrhea and to describe the characteristics of AOM-associated diarrhea (AOMD) after exclusion of antibiotics as its possible cause.

Methods

During a period of 17 months (December 2016–May 2018), a non-randomized convenience sample of 60 patients who visited one of the private pediatrics clinic in Hilla/Iraq complaining from diarrhea was included in this cross-sectional descriptive study. Inclusion criteria were age <2 years with diarrhea as a chief complaint. Any patient with documented antibiotic use recently before the onset of diarrhea and those who already had diagnosed chronic disease that may cause diarrhea (as celiac disease, cystic fibrosis, pancreatic insufficiency, etc...) had been excluded. The questionnaire that had been used in this study was specially designed by its authors. It contains sociodemographic characteristics, in addition to mother-directed specific questions related to the characters of diarrhea, and constitutional and associated symptoms. Weighing of patients was by the same scale and plotted on CDC chart. They considered underweight, normal, or overweight when their weight <5th, 5–95th, and >95th centile, respectively. Assessment of dehydration is according to the World Health Organization (WHO) [11]. Diarrhea was considered as chronic if its duration is more than 14 days, and according to the frequency of bowl motion per 24 h, diarrhea was classified as mild (<6), moderate (6–9), and sever (>9). Stool samples were sent to the same lab for microscopic stool examination and stool pH, and it was considered invasive diarrhea when stool puss cell or red blood cell is more than 10/HPF and acidic stool when stool pH is less than 5.5 [12]. Ears were examined by the same expert otolaryngologist using pneumatic otoscopy, and AOM was diagnosed depending on the following criteria [5]:

1. Acute purulent otorrhea not due to otitis externa, or
2. Middle ear effusion with at least one of the followings:
 - Substantial ear pain, including unaccustomed tugging or rubbing of the ear.
 - Marked redness of tympanic membrane.
 - Distinct fullness or bulging of tympanic membrane.

According to otoscopic examination, patients were divided into two groups; those with AOM and those without, and the study variables were compared between them. Statistical analysis was carried out using SPSS version 21. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as mean \pm SD. Pearson's Chi-square (χ^2) and Fisher's exact tests were used to find the association between categorical variables. $p \leq 0.05$ was considered as statistically significant.

This study was approved by the local ethical committee and the scientific committee of Pediatrics Department/College of Medicine/Babylon University. All participants provided informed written consent.

Table 1: Association between AOMD and risk factors among the study patients

Study variables	AOM		Total	p-value
	Present	Absent		
Age				
1–12 months	26 (96.3)	24 (72.7)	50 (83.3)	0.017
More than 1 year	1 (3.7)	9 (27.3)	10 (16.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Gender				0.306
Female	8 (29.6)	14 (42.4)	22 (36.7)	
Male	19 (70.4)	19 (57.6)	38 (63.3)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Type of feeding*				0.422
Breast	3 (11.1)	6 (18.2)	9 (15.0)	
Bottle	16 (59.3)	22 (66.7)	38 (63.3)	
Mixed	8 (29.6)	5 (15.2)	13 (21.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Season				0.235
Winter	4 (14.8)	11 (33.3)	15 (25.0)	
Spring	15 (55.6)	18 (54.5)	33 (55.0)	
Summer	4 (14.8)	2 (6.1)	6 (10.0)	
Autumn	4 (14.8)	2 (6.1)	6 (10.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Weight				0.012
Normal	20 (74.1)	30 (90.9)	50 (83.4)	
Underweight	7 (25.9)	1 (3.0)	8 (13.3)	
Overweight	0 (0.0)	2 (6.1)	2 (3.3)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	

*In the first 6 months of life, P-value ≤ 0.05

Results

Patients involved in this study were 60, from them, 22 were female (36.7%). Their ages ranged from 1 to 19 months with a mean 8.31 ± 4.30 months. AOM was present in 27 cases, making its prevalence among diarrheal case as 45%. AOMD was significantly more common in those below 1 year age and in underweight child, $p = 0.017$ and 0.012 , respectively (Table 1), and it had no special characters, as shown in Tables 2 and 3. Ear pain is the only symptom that is significantly more in AOMD in comparison with diarrhea without AOM, $p < 0.001$ (Table 4). Of total patients, 93.3% had

Table 2: Association between AOMD and characteristics of diarrhea as described by the mothers

Study variables	AOM		Total	p-value
	Present	Absent		
Duration of diarrhea				0.649
≤ 14 days	24 (88.9)	31 (93.9)	55 (91.7)	
> 14 days	3 (11.1)	2 (6.1)	5 (8.3)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Type of diarrhea				0.681
Watery	25 (92.6)	29 (87.9)	54 (90.0)	
Bloody	2 (7.4)	4 (12.1)	6 (10.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Mucus in stool				0.795
Present	13 (48.1)	17 (51.5)	30 (50.0)	
Absent	14 (51.9)	16 (48.5)	30 (50.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Oily stool				0.127
Present	5 (18.5)	12 (36.4)	17 (28.3)	
Absent	22 (81.5)	21 (63.6)	43 (71.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Undigested food in stool				0.09
Present	2 (7.4)	9 (27.3)	11 (18.3)	
Absent	25 (92.6)	24 (72.7)	49 (81.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Offensive odor stool				0.065
Present	20 (74.1)	31 (93.9)	51 (85.0)	
Absent	7 (25.9)	2 (6.1)	9 (15.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Amount of stool				0.729
Large	11 (40.7)	12 (36.4)	23 (38.3)	
Small	16 (59.3)	21 (63.6)	37 (61.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Number of bowl motion per 24 h				0.078
Less than 6	13 (48.1)	10 (31.3)	23 (39.0)	
6–9	14 (51.9)	17 (53.1)	31 (52.5)	
More than 9	0 (0.0)	5 (15.6)	5 (8.5)	
Total	27 (100.0)	32 (100.0)	59 (100.0)	

Table 3: Association between AOMD and stool examination among the study patients

Study variables	AOM		Total	p-value
	Present	Absent		
Stool pus cell and/or RBC				
Present	5 (18.5)	6 (18.2)	11 (18.3)	1
Absent	22 (81.5)	27 (81.8)	49 (81.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Stool pH				
Acidic	7 (25.9)	9 (27.3)	16 (26.7)	0.907
Normal	20 (74.1)	24 (72.7)	44 (73.3)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	

no dehydration at presentation, with no significant difference between those with and without AOM, $p = 1$ (Table 5).

Table 4: Association of AOMD with associated and constitutional symptoms

Study variables	AOM		Total	p-value
	Present	Absent		
Vomiting				
Present	16 (59.3)	17 (51.5)	33 (55.0)	0.549
Absent	11 (40.7)	16 (48.5)	27 (45.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Fever				
High	10 (37.0)	9 (27.3)	19 (31.7)	0.45
Low	8 (29.6)	15 (45.5)	23 (38.3)	
No fever	9 (33.4)	9 (27.2)	18 (30.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Respiratory symptoms				
Present	18 (66.7)	20 (60.6)	38 (63.3)	0.628
Absent	9 (33.3)	13 (39.4)	22 (36.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Ear pain				
Present	23 (85.2)	7 (21.9)	30 (50.8)	<0.001
Absent	4 (14.8)	25 (78.1)	29 (49.2)	
Total	27 (100.0)	32 (100.0)	59 (100.0)	
Sleep disturbance				
Present	18 (66.7)	18 (54.5)	36 (60.0)	0.34
Absent	9 (33.3)	15 (45.5)	24 (40.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Decreased feeding				
Present	12 (44.4)	19 (57.6)	31 (51.7)	0.311
Absent	15 (55.6)	14 (42.4)	29 (48.3)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	
Decreased activity				
Present	11 (40.7)	13 (39.4)	24 (40.0)	0.916
Absent	16 (59.3)	20 (60.6)	36 (60.0)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	

Discussion

AOM is a common disease, especially in those below 2 years of age, and according to this study, it is a common cause for diarrhea in this age group as 45% of patients complaining from diarrhea had AOM. According to our best knowledge, there was no similar study to compare our result to it, but in comparison to UTI in children with diarrhea, AOM is more common than UTI, as the prevalence of UTI in children with diarrhea in two previous studies, those below 2 years [13], and below 5 years [14], was 8% and 27%, respectively. This high

Table 5: Association between AOMD and degree of dehydration among the study patients

Study variables	AOM		Total	p-value
	Present	Absent		
Degree of dehydration				
No dehydration	25 (92.6)	31 (93.9)	56 (93.3)	1
Some dehydration	2 (7.4)	2 (6.1)	4 (6.7)	
Total	27 (100.0)	33 (100.0)	60 (100.0)	

prevalence (45%) is explained by the fact that AOM is originally highly prevalent (80%) in those below 2 years' age [15], while the prevalence of UTI is 7.8% [16].

The present study showed that in general, most diarrheal cases (83.3%) occurred in the 1st year of life (Table 1). Two different studies showed that in comparison to the 2nd year of life, diarrhea is more common in the 1st year, especially 6–11 months, and they attributed these results to the combined effect of lowering maternal antibody levels, the infant's lack of active immunity, the introduction of food that may be contaminated with fecal bacteria and direct contact with human or animal feces when the infant begins to crawl [17], [18]. In addition to being diarrhea more common in the 1st year of life, AOMD is significantly more common at this age (Table 1).

Breast milk effect on prevention of diarrhea and otitis media is well known [19]. In this study, about 63% of total patient was feeding formula alone in the first 6 months of life and only 15% was exclusively breast fed, with no significant difference between those with and without AOM (Table 1). This finding (only 15% was exclusively breast fed) is so far away from the recommendations of the WHO and the medical communities in the United States and in Europe that based on mounting evidence of breastfeeding health benefits to the child [20], [21], [22], [23], and it represents a problem that needs a more serious practical efforts.

While there are controversial epidemiological data regarding gender variation in the occurrence of AOM [5], no significant gender variation in AOMD demonstrated in this study, in spite of being male more affected, and the same for seasonality ($p = 0.3$ and 0.235 , respectively) (Table 1).

As obesity [24], [25], [26], malnutrition represents a risk factor for AOM [27], [28], [29]. It has been inferred that obesity might contribute to the development of OM through multiple mechanisms such as changes in cytokines levels in host immunity, gastroesophageal reflux, and alteration in function and structure of Eustachian tube through adipocytes accumulation [30], while malnutrition makes a person more susceptible to infection by lowering immunity [31]. In this study, it was found that AOMD is significantly more common in underweight patients (Table 1).

The mechanism of diarrhea in systemic infection had been described for some of them [1], while it is not available for others as AOM. Accordingly, the characteristics of this diarrhea (AOMD) are not established. This study revealed that it mostly has the following features: Acute, mild to moderate, small amount, watery, offensive odor, not oily, not contain undigested food, not invasive, and with normal stool PH, but these features are not considered characteristic for AOMD as $p > 0.05$ (Table 2 and 3). Further studies are required to illustrate the underlying mechanism of AOMD.

Regarding associated and constitutional symptoms, only ear pain was significantly more in AOMD in comparison with diarrhea without AOM (Table 4). In children younger than 2 years, it can be manifested as unaccustomed tugging or rubbing of the ear [5], and according to this study, its presence in patient with diarrhea is a strong evidence that he has AOMD.

There was no significant difference between those with and without AOM regarding the degree of dehydration, and fortunately, about 93% of total patients had no dehydration at presentation (Table 5). The absence of dehydration in almost all patients (93.3%) in this study may reflect a good fluid management at home or an early medical consultation. Whatever of them, it indicates a good health awareness of patients' mothers or caregivers. Furthermore, it may be related to the nature of diarrhea itself, as it is mild to moderate in 91.5% of patients (Table 2).

Small sample size is the main limitation for this descriptive study that dealt with a very common pediatric problem (diarrhea) in a relatively good period of time (17 months). Wide use of antibiotics excluded large number of diarrheal cases presented during this period from this study. Other limitation is that we cannot decide that whether the finding of AOM in patients presented with diarrhea represents a causal relationship or just an association.

Conclusion

The prevalence of AOM in diarrheal cases is 45%, making it a very possible diagnosis for any young baby presented with diarrhea, especially in underweight infant with ear pain, so pneumatic otoscopic ear examination is recommended to be a routine for them.

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