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STUDY OF DILATED CARDIOMYOPATHY AMONG PNEUMONIA IN INFANTS NOT RESPONDING TO STANDARD TREATMENT

By

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ABSTRACT

Background: Childhood pneumonia is an important cause of morbidity in the developed world, and morbidity and mortality in the developing world.

Objective: To clarify the correlation of dilated cardiomyopathy (DCM) in infancy and pneumonia.

Patients and Methods: Cross sectional observational study of 200 patients with pneumonia who were admitted to Al-Azhar University Hospitals were subjected to echocardiogram assessment within 24 hours after admission, chest X-Ray, CBC and CRP, creatinine, and for those whom diagnosed with dilated cardiomyopathy troponin I assessment within 24 hours. The study included 200 patients in the age of 1 month to 2 years during the period from August 2019 to June 2021.

Results: DCM was associated with significant change regarding to respiratory rate, O2 saturation, platelet count, serum creatinine, grunting, retraction, sex of patients, and troponin I.

Conclusion: DCM was found in 5% of the infants with pneumonia. So, in infants with pneumonia we recommend ECHO especially if associated with significant change regarding to respiratory rate, O2 saturation, platelet count, serum creatinine, grunting, retraction, sex of patients, and troponin I.

Keywords: Dilated Cardiomyopathy, Pneumonia, Troponin I, Echo.

INTRODUCTION

Globally, pneumonia is a leading cause of morbidity and mortality in children younger than the age of 5 years *(Gupta et al., 2012)*. Patients with pneumonia are at substantial risk for a concurrent acute cardiac event, such as serious arrhythmia, cardiomyopathy or new or worsening CHF. This concurrence significantly increases mortality due to pneumonia *(Daniel et al., 2017)*. Dilated cardiomyopathy is characterized by abnormal enlargement of the left and/or right ventricle because of a weakening of the heart's pumping action, causing a limited ability to circulate blood to the lungs and the rest of the body which may result in fluid buildup in the lungs and various body tissues. In some individuals, all four chambers of the heart may be affected. Symptoms of congestive heart

failure may depend upon an affected child's age and other factors. In young children, heart failure may be manifest as fatigue and shortness of breath. Additional symptoms may include swelling of the legs and feet and, in some people, chest pain. Initial symptoms of dilated cardiomyopathy in infants and children may include irritability, a persistent cough, shortness of breath, and poor feeding resulting in the failure to gain weight at the expected rate. More serious complications may include fainting episodes, abdominal pain, irregular heartbeats, and fluid accumulation within the lungs resulting in a persistent cough *(Joseph et al., 2010)*.

The present work aimed to clarify the correlation of DCM in infancy and pneumonia.

PATIENTS AND METHODS

This was a cross sectional observational study of 200 patients with pneumonia who were admitted to Al-Azhar University Hospitals.

Inclusion criteria: Infants with pneumonia at the age of one month up to 24 months old of both genders. Based on either, temperature 38.5 or more, tachypnea according to age, retraction, oxygen saturation 95 % or less, and grunting or not.

All patients with DCM based on left ventricular end diastolic dimension (LVEDd) > + 2SD, and fractional shortening (FS) < 25 %.

Exclusion criteria: Infants less than 1 month and more than 24 months, and those with congenital heart diseases, asthmatic infants, infants with immune deficiency, metabolic DCM, well-known DCM, acute and chronic kidney injury and sepsis.

During the period from August 2019 to June 2021, any infants admitted to Al-Azhar University Hospitals and diagnosed as pneumonic patient and fulfilled the above-mentioned criteria were subjected to be managed as soon as possible according to local guidelines through history taking and complete physical examination.

All infants diagnosed with pneumonia were subjected to the following investigations during time of hospitalization: ECHO assessment within 24 hours after admission, chest X-Ray, CBC and CRP (To differentiate between bacterial and viral pneumonia), and creatinine (To exclude high troponin level due to renal diseases). For those whom diagnosed with Dilated Cardiomyopathy troponin I assessed. An informed consent was taken from parents before study.

We have developed a new scoring system predicting DCM in patients with pneumonia. For every patient scores were calculated **(Table 1)**.

Table (1): A new scoring system predicting DCM in patients with pneumonia

Variables	Category	Score
Gender	Male	1
	Female	2
Respiratory rate	< 51	0
	51-60	1
	> 60	2
Retraction	Absent	0
	Present	1
O_2 saturation	>90	0
	≤90	1
Grunting	Absent	0
	Present	1
Platelets	>450	1
	≤450	0
Troponin I	Negative	0
	Positive	1

Cut-off point was score above 14 with sensitivity of 80% and specificity of 98.9%. Area under the Curve was 0.865, confidence interval 0.676-1, p-value < 0.001. on scores above 14 we have calculated Positive Predictive Value=80% and Negative Predictive Value=98.9%. This means that among those who had a positive new score >14, the probability of DCM was 80%. Also, among those who had a negative new score ≤14, the probability of being non-DCM was 98.9% **(Figure 1)**.

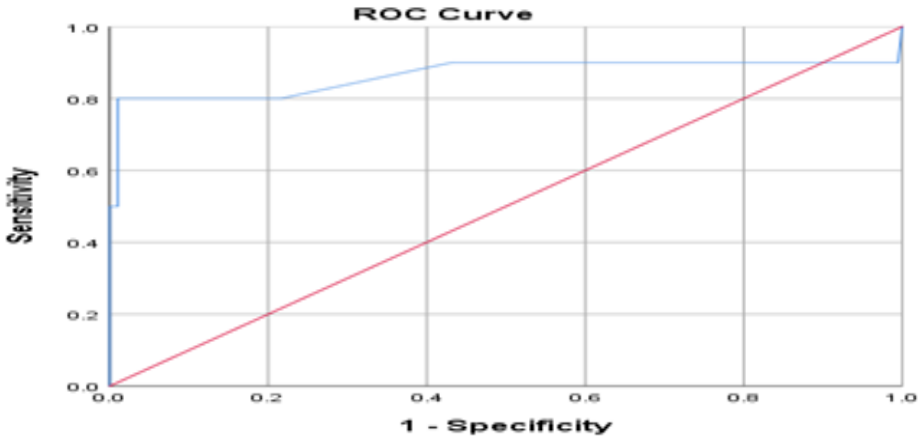

Figure (1): The probability of being DCM or non-DCM according to the new scoring system

Statistical Analysis:

The collected data were revised, coded, tabulated and introduced to a PC using statistical package for Social Science (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp). Description of quantitative variables were mean, SD and range. Descriptions of qualitative variables were number and percentage. Chi-square test was used to compare qualitative variables. Two samples t-test was used to compare quantitative variables between independent groups in parametric data, and Mann Whitney U in cases of two independent groups with non-parametric data. $P < 0.05$ was considered significant.

RESULTS

DCM was found in 10 (5%) of the included patients. No significant association was found between DCM in type of pneumonia **(Table 2)**.

Table (2): Prevalence of DCM among pneumonia patients and association between DCM and pneumonia

Groups / Parameters	Normal		DCM		P
	190.00	95.00%	10.00	5.00%	
Atypical pneumonia	1	0.5%	0	0.0%	0.125
Broncho-pneumonia	133	70.0%	4	40.0%	
Lobar Pneumonia	56	29.5%	6	60.0%	

By running Mann-Whitney U-test and t-test for equality of means between normal cases and DCM cases, respiratory rate, O2 saturation, neutrophils%, lymphocytes%, platelets, PH, HCO3, creatinine (mg/dl), LVIDD(cm), LVIDS(cm), FS% and EF% some variables showed difference in means between DCM and normal patients $p<0.05$ **(Table 3)**.

Table (3): Association between DCM and other continuous variables

Groups / Parameters	Normal(N=190)		DCM(N=10)		P
	Mean	**SD**	**Mean**	**SD**	
Age(monthes)#	8.71	7.51	5.80	7.66	0.058
Weight(kg)#	7.16	3.38	5.40	3.50	**0.031**
BSA(m2)#	0.36	0.11	0.30	0.12	**0.033**
Temperature©*	38.64	0.48	38.80	0.42	>0.05
Respiratory rate*	50.87	8.05	59.30	6.68	**0.002**
O_2 Saturation*	92.46	1.81	90.00	3.06	**<0.001**
White blood cells#	11.22	5.38	14.10	5.99	0.081
Neutrophils%#	50.94	22.11	33.68	17.10	**0.016**
Lymphocytes%#	38.87	21.60	60.15	21.21	**0.005**
HB*	10.82	1.61	11.20	2.04	>0.05
Platelets#	336.75	97.87	426.70	181.02	**0.043**
PH*	6.90	0.61	7.50	0.53	**0.003**
HCO3#	20.15	3.72	26.10	8.14	**0.005**
PCO2#	41.02	7.90	38.80	16.01	0.073
Creatinine(mg/dl)#	0.23	0.06	0.29	0.09	**0.039**
LVIDd(cm)#	2.40	0.69	2.85	0.67	**0.016**
LVIDs(cm)#	1.44	0.48	2.30	0.55	**<0.001**
FS%*	39.24	7.21	19.00	4.26	**<0.001**
EF%*	71.31	9.06	45.79	9.63	**<0.001**

Using: # Mann-Whitney U-test; * Independent Sample t-test

DCM was more prevalent in females (90%). It was also associated with increased rate of grunting (P<0.001) and retractions (P<0.003). Regarding troponin I, 50% of patients with DCM was positive for troponin I P<0.001 **(Table 4)**.

Table (4): Association between DCM and other categorical variables

Parameters \ DCM		DCM				P
		Normal		DCM		
CRP	**Positive**	55	28.9%	3	30.0%	0.943
	Negative	135	71.1%	7	70.0%	
CX-R	**Atypical pneumonia**	1	0.5%	0	0.0%	0.125
	Broncho-pneumonia	133	70.0%	4	40.0%	
	Lobar Pneumonia	56	29.5%	6	60.0%	
GRUNTING	**Positive**	60	31.6%	9	90.0%	**<0.001**
	Negative	130	68.4%	1	10.0%	
RETRACTION	**No**	69	36.3%	2	20.0%	**0.003**
	Mild	98	51.6%	3	30.0%	
	Moderate	23	12.1%	5	50.0%	
SEX	**Male**	97	51.1%	1	10.0%	**0.011**
	Female	93	48.9%	9	90.0%	
TROPONINE I	**Negative**	190	100.0%	5	50.0%	**<0.001**
	Positive	0	0.0%	5	50.0%	

DISCUSSION

Pneumonia is a major concern for under-5 mortality and morbidity especially in developing countries *(Chisti et al., 2015)*. To our knowledge, the incidence of DCM in infants suffering from pneumonia was not reported in previously published literature. In our study, we have studied this association. Patients showed that 51% were females and the mean age was 8.56±7.53 months. The mean weight was 7.07±3.39, and the mean body surface area reached 0.36±0.11.In previous studies, it was found that younger children (age of ≤ 12 months) were double the likelihood of developing pneumonia when compared to older age group *(Fonseca Lima et al., 2016*; *Abuka et al., 2017* and *Fadl et al., 2020)*.

Rambaud-Althaus et al. (2015) by meta-analysis showed that features with the highest pooled positive likelihood ratios to identify radiological pneumonia in children younger than 5 years were respiratory rate higher than 50 breaths per minute and grunting. Body temperature and respiratory rate could be used to monitor the clinical course of non-severe pneumonia. *Ahmad Al Najjar et al. (2013)* recorded fever in 87.4% of cases of pneumonia. *Yaguo-Ide and Nte (2011)* reported fever in 70.7%.

Neuman et al. (2011) reported that hypoxia (oxygen saturation ≤92%) was the strongest predictor of pneumonia. Oxygen saturation was the best clinical predictor for pediatric pneumonia; in *Modi et al. (2013)* study, only oxygen saturation had a statistically significant area under the ROC curve (AUC) of 0.675 (95% confidence interval. An increase in body temperature results in an increased oxygen consumption in brain tissue, and

aggravating cerebral hypoxia *(Li et al., 2016)*.

Results of the present study recorded mild retraction in 50% of the cases and moderate retraction in 14%. Grunting was positive in 34.5% of the studied cases.

Ahmad Al Najjar et al. (2013) reported retraction in 80% cases of pneumonia.

Champatiray et al. (2017) reported chest retractions in 100% of children aged two -months to five-years.

Leukocytosis was recorded in *Nimdet and Techakehakij (2020)* study included children aged 2–59 months admitted with diagnoses of pneumonia. The mean white blood cell counts were 15516.56 ± 6649.06 cells/ mm3.

Hesham and Heba (2012) evaluated platelet count in hospitalized patients with the community-acquired pneumonia and found that platelet count may be more informative to predict poor outcome than abnormal leukocyte count.

Anemic children were found to be 4.6 times more susceptible to acute lower respiratory tract infections by *Hussain et al. (2014)*. Anemia was a risk factor for childhood pneumonia in Egyptian children *(Rashad et al., 2015)*. Like severe community-acquired pneumonia, ICU-acquired pneumonia may present marked immunological changes, with lymphocytopenia being one of the most frequently observed *(Hotchkiss et al., 2013* and *Bermejo-Martin et al., 2017)*.

Arterial blood gases (ABG) components were determined in the current study and results showed that, the mean pH was 6.93±0.62, the mean HCO3 was 20.44±4.23, and the mean PCO2 was 40.91±8.44. According to *Laserna et al. (2012)*, 41% had normal PaCO2 (35-45 mm Hg), 42% of patients had aPaCO2, 35 mm Hg, and 15% had a PaCO2 45 mm Hg. PaCO2 should be considered as an important variable in severity stratification of community acquired pneumonia patients.

Results of the current study showed that the mean creatinine was normal in the study cases. Childhood pneumonia often causes elevation of serum creatinine owing to bacteremia or sepsis *(Shahrin et al., 2016)*. *Peng et al (2012)* showed that, patients with bacterial pneumonia had higher creatinine values, compared to the nonbacterial group.

Troponin levels may be used as a tool of risk stratification for patients hospitalized with pneumonia *(Efros et al., 2020)*. *Lee et al (2015)* stated that 58% of patients with severe pneumonia had detectable cardiac troponin levels. Troponin determination had been shown to be useful for short and long-term mortality prediction in septic and community-acquired pneumonia patients *(Lee et al., 2015)*. Troponin I was positive in 2.5% of the study cases and the mean value was 0.75±3.71.

Echocardiogram findings of the study cases showed that the mean LVIDd was 2.43±.70, the mean LVIDs was 1.49±.52, the mean FS was 38.23±8.35 %, and the mean EF was 70.04±10.65%.

Nimdet and Techakehakij (2020) showed that the mean LVDD was 24.97 ± 4.17 and LVEF % was 70.99 ± 9.56.

Some previous studies agreed with our results. The majority of young children with female dominance were affected by

idiopathic dilated cardiomyopathy, and 50% of presentations were before 14 months of age *(Azhar, 2013)*. Results of the present study revealed significant association between DCM and respiratory rate (P=0.003), O2 saturation, neutrophils %, lymphocytes %, platelets, pH, HCO3, creatinine, LVEDD, LVEDS, FS% (P and EF%.

Tekin et al. (2012) showed that the mean platelet volume was significantly greater in patients with DCM than in control patients.

Arterial blood gas analysis in a 2 month-old girl with dilated cardiomyopathy was pH 6.988, pO2 325.9 mmHg, pCO2 31.0 mmHg, and HC O3 7.3 mmol/L under 40% O2 mask *(Kim et al., 2010)*. Our findings revealed the prevalence of DCM in females 90%. The association between DCM with increased rate of grunting and retractions. Regarding troponin I, 50% of patients with DCM was positive for troponin I.

CONCLUSION

DCM was found in 5% of the infants with pneumonia. So, in infants with pneumonia we recommend ECHO especially if associated with significant change regarding to respiratory rate, O2 saturation, platelet count, serum creatinine, grunting, retraction, sex of patients, and troponin I.

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دراسة إعتلال عضلة القلب التوسعي في حالات الإلتهاب الرئوي الغير مستجيب للعلاج

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خلفية البحث: المرضى الذين يعانون من الإلتهاب الرئوي معرضون لخطر كبير لحدث قلبي حاد متزامن، مثل عدم إنتظام ضربات القلب الخطير أو إعتلال عضلة القلب أو فشل القلب الإحتقاني الجديد أو التدهور. هذا التوافق يزيد بشكل كبير من الوفيات بسبب الإلتهاب الرئوي.

الهدف من البحث: دراسة العلاقة بين الإلتهاب الرئوي و إعتلال عضلة القلب في الأطفال.

المرضى وطرق البحث: تم إجراء الدراسة على ٢٠٠ من مرضى الإلتهاب الرئوي. في مستشفيات جامعة الأزهر.

نتائج البحث: وجد إعتلال القلب التوسعي في 5٪ من المرضى المشمولين ولم يتم العثور على إرتباط كبير بين إعتلال القلب التوسعي ونوع الإلتهاب الرئوي، وكان إعتلال القلب التوسعي أكثر إنتشارًا بين الإناث (90٪)، كما ارتبط بزيادة معدل الشخير الزفيري وإنقباض القفص الصدري. وكان 50 ٪ من المرضى الذين يعانون من إعتلال القلب التوسعي إيجابيًا للتروبونين، كما إرتبط إعتلال القلب التوسعي بتغيير كبير فيما يتعلق بمعدل التنفس، وتشبع الأكسجين، وعدد الصفائح الدموية، ومستوى الكرياتينين، ومعدل الشخير الزفيري، ومعدل إنقباض القفص الصدري، وجنس المرضى، وإيجابية التروبونين.

الإستنتاج: تم العثور على إعتلال القلب التوسعي في 5٪ من الرضع المصابين بالتهاب رئوي. لذلك، نوصي بإجراء موجات صوتية على القلب خاصةً إذا كان مرتبطًا بتغيير كبير فيما يتعلق بمعدل التنفس، وتشبع الأكسجين، وعدد الصفائح

الدمويـــة، وكريـــاتينين، والشـــخير الزفيـــري، وانقبـــاض القفـــص الصـــدري، وجـــنس المرضى، وإيجابية التروبونين.

الكلمـــات الدالـــة: إعـــتلال عضـــلة القلـــب التوســـعى، الإلتهـــاب الرئـــوي، التروبـــونين، الموجات الصوتية على القلب.