CASE REPORT

Maternal vitamin D deficiency: A Culprit for Hypocalcaemia Induced Myocardial Failure in a Four-Month Old Infant: A Case Report From Tikur Anbessa Specialized Hospital, Ethiopia

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OPEN ACCESS

Citation: Tamirat Moges, Tigist Heye, Yemisirach Shiferaw. Maternal vitamin D deficiency: A Culprit for Hypocalcaemia Induced Myocardial Failure in a Four-month old Infant: A Case Report From Tikur Anbessa Specialized Hospital, Ethiopia. J Health Sci 2017;27(3):299. doi: http://dx.doi.org/10.4314/ejhs.v27i3.12

Received: September 11, 2016
Accepted November 22, 2016
Published: May 1, 2017

Funding: Nil

Competing Interests: The authors declare that this manuscript was approved by all authors in its form and that no competing interest exists.

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ABSTRACT

BACKGROUND: ***A rare but reversible cause of dilated cardiomyopathy occurs in infants born to vitamin D deficient mothers due to hypocalcaemia.***

CASE REPORT: ***We report a case of dilated cardiomyopathy due to hypocalcaemia secondary to maternal vitamin D deficiency in an infant presented with seizure disorder and heart failure. This was a four-month old female infant with respiratory distress and acute heart failure. The cause of her cardiac failure was dilated cardiomyopathy. Concomitant community acquired pneumonia was diagnosed on chest X ray. Despite treatment, the infant's clinical condition worsened. The mother was found to be house-bound, dark skinned and veiled while going outside of home. Laboratory studies revealed hypomagnesaemia and hypocalcaemia. The vitamin D levels of both the infant and the mother were found to be low. The infant was treated for the deficiency state until her cardiac condition fully recovered.***

CONCLUSION: ***This case report demonstrated the direct relationship between maternal vitamin D deficiency and the infant's acute heart failure. It also highlighted the importance of vitamin D supplementation during pregnancy in order to prevent the cardiac complication of maternal vitamin D deficiency in the infants.***

KEYWORDS: ***Dilated cardiomyopathy, Hypocalcaemia, vitamin D, cardiac failure***

INTRODUCTION

Hypocalcaemia is a rare, yet reversible cause of dilated cardiomyopathy in infants born to vitamin D deficient mothers. Calcium is essential for the initiation of excitation-contraction coupling via influx through L-type calcium channels (1). Calcium determines contractibility by expediting the tension developed between actin and myosin filaments via the troponin-tropomyosin complex. Reduced level of calcium leads to diminished reaction in these energy generating chemicals leading to cardiac dysfunction.

Maternal vitamin D deficiency induced hypocalcaemia resulting in dilated cardiomyopathy has been reported in few occasions (2). We report a case of dilated cardiomyopathy due to hypocalcaemia secondary to maternal vitamin D deficiency in an infant, presented with seizure and cardiac failure.

Although acute heart failure in relation to severe rickets was reported previously from the same setting, isolated dilated cardiomyopathy in the absence of rickets in the setting of vitamin D deficiency was not reported from Ethiopia at least to our knowledge (3). In this case report, the clinical features and possible explanations of the presentations were discussed.

CASE REPORT

A four-month old female infant was referred to our emergency unit after a two weeks' history of cough, fever and fast breathing. After visiting different local health institutions, she was diagnosed to have community acquired pneumonia on the basis of chest X-ray findings. Alerted by detection of a murmur, the primary physician suspected heart disease and ordered transthoracic echocardiographic test which showed dilated cardiomyopathy. After initiation of medication for pneumonia and cardiac failure at a private hospital, the doctors referred the patient to our institution. On evaluation of the history at our emergency unit, the baby had history of interrupted feeding but not perspiration. She was vaccinated for age and was fed on exclusive breast-feeding. Even though her birth time coincided with beginning of the rainy season, the parents claimed that she was exposed to sunshine appropriately. She was born to a 28 year-old Para-II mother at term by caesarean section for breech presentation. The mother reported loss of her first-born baby at the age of three months due to pneumonia. The mother was a dark skinned lady who gave history of poor sun exposure in herself for about five years period as she was living in an apartment as a maid. She got veiled whenever she went out in a sunny day which she did rarely. On examination of the patient, we found that she had signs of respiratory distress despite normal auscultatory finding of the lung fields. The arterial pulses were weak but palpable in all pulse areas. The neck veins looked distended. Apical beat was felt at the 5th intercostal space lateral to the mid clavicular line. S1 and S2 were heard with no P2 accentuation. There was Grade III/VI pan systolic murmur best heard at the apex radiating to the left axilla. There was S3 gallop. The liver was palpated 5cm below the right costal margin with total vertical span of 7cm (enlarged for age). There was bilateral pedal edema.

Table 1 shows the summary of anthropometric measurements and vital signs. After cardiologic consultation, treatment was re-initiated for pneumonia and congestive heart failure at our emergency ward with furosemide 1mg/kg intravenous 12 hourly, Captopril orally 2mg every 12 hour, Digoxin 0.0625mg per os once daily, and Ceftriaxone 260mg intravenous every 12 hour. On the second day of her admission to the emergency ward, the infant developed episodes of convulsions characterized by tonic clonic jerking movement of the extremities associated with upward eye movement. Symptomatic seizure secondary to meningitis or electrolyte imbalance was considered. Blood sample was sent for analysis. While we were waiting for the lab results, antibiotic dose was made anti-meningeal. Subsequently, the infant went into repeated cardio-respiratory arrest. After cardio-respiratory resuscitation, the patient was transferred to pediatric ICU for mechanical ventilation. The result of laboratory investigation is in Table 2. Imaging modality was also determined and showed the following results. Chest X-ray showed gross cardiomegaly with right upper lobe opacity and increased pulmonary vascularity. The infant's wrist X-ray was reported as normal. Electrocardiography was reported as sinus rhythm, Rate=166 bpm, PR- interval= 60ms, QTc=465 ms and R/S progression less than 1. Table 3 shows the pre- and post-treatment transthoracic echocardiographic profiles of the patient.

Maternal serum vitamin D level was determined to be 10.4ng/mL (normal value 20-100ng/ml)(ICL). Having confirmed hypocalcaemia and hypomagnesaemia, we initiated treatment for the infant with 10%

DOI: http://dx.doi.org/10.4314/ejhs.v27i3.12

Calcium gluconate 7ml in 15ml D/W over 15 minutes every six hours; Magnesium sulphate 0.7ml in 70ml N/S over 30 minutes every 8 hours; and Vitamin D 600,000 IU IM stat dose.

Table 1: Anthropometry and vital sign profile at admission.

Anthropometry	Result	Normal range
Weight-	7 kg	(50th- 85th centile WHO growth curve),
Length-	59 cm	(b/n 3rdth-15th centile on WHO),
Head Circumference-	43 cm	(at 75th centile on CDC growth chart)
Respiratory rate-	54 breath/minute,	(30- 50 breath/minute)
Apical Heart Rate-	140 bpm	(80-160bpm)
Temperature (rectal)-	37.9oc ,	(36.6-38oC)
Blood pressure measurement ^	88/49 mmHg, (lying left arm arm)	(88 -101mmHg- systolic) (50-76mmHg- diastolic)

Table 2: Laboratory test profile

Lab test	Result	reference range $
WBC	7,820,cells/mcl	3.5-10.5cells/mcL
Hgb	10.2gm/dl,	12.0-15.5gm/dl
Hct	35.1%,	34.9%-44.5%
MCV	80fl,	75- 95fl
Platelet count	430,000/mcl.	150,000-450,000/mcL
Ionized calcium	2.28mg/l	4.5-5.6mg/dl
Magnesium	1.5mg/l	1.9-2.5mg/dl
Potassium	3.9mmol/l;	3.5-5.1mmol/l
Sodium	133mmol/l;	136-145mmol/l
Chloride	112mmol/l;	98-107mmol/l
Phosphorus	7.3mg/l.	4.0-7.0mg/l
BUN	15mg/l,	15-48mg/l
Creatinine	0.5mg/l	0.6-1.1mg/l.
SGPT	32U/L	<42u/L
SGOT	102U/L	<37u/L
ALK phosphatase	80u	Normal.
*-25hydroxyvitaminD	6.0ng/mL	30-40ng/mL
Serum Parathyroid level	91.8pg/ml	15-65pg/mL.

$-referrence rage for the lab,*- Chemiluminescent Micro particle Immunoassay (CMIA); International clinical laboratories(Medpharm holdings Africa Ltd company). 1,25(OH)2-vitamin D -1,25 dihydroxy vitamin D,MD-medical doctor , SGPT-serum gluthamic pyruvic transaminase, SGOT-Serum Gluthamic Oxaloacetic transaminase, ICU-Intensive care unit,IV-intravenous, S3- third heart sound,PO- per OS,Bpm-Beat per minute,PR-P-R interval, QTc- Corrected QT interval, R/S - The ratio of R wave to S wave, LV-Left ventricle, S1-First heart sound, S2-Second heart sound , P2-Pulmonary heart sound, IU - International unit,IM-intramuscular

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After 12 days of treatment, the serum electrolyte abnormalities were corrected to normal level. Subsequent echocardiographic examination before discharge revealed significant improvement from the left ventricular (LV) EF of 37% at admission to LV EF of 56% at discharge. She was discharged after three weeks of hospital stay to have subsequent cardiologic follow-up.

Follow-up echocardiographic evaluation showed LV ejection fraction of above 60%. Mitral regurgitation disappeared. There was no seizure or localized neurologic deficit observed at least in the first six months of follow-up. Written informed consent was obtained from the parents for publication of this case report. The Research and Promotion Committee (DRPC) of the Department of Pediatrics and Child Health was also notified about the plan to publish this case report.

Table 3: Pre- and Post treatment transthoracic echocardiographic profile.

Laboratory Profile	Pre treatmet result	Post treatment	Reference value €
Left ventricle Ejection fraction (LVEF)	37%	range* (55%-66%)	45%-90%
Left ventricle Fractionalshortening	17%	range (28-37%)	28%-41%
Left atrial diameter	33mm	10-12mm	12-15mm
Left ventricular end diastolic diameter (LVEDd)	34mm	range (26-32mm)	22-31mm
Doppler study	Severe MR	No MR	

*Result in "range" indicate that the patient had multiple examination results.

-we stated only cardiac chambers that were affected in the pathology.

€-These reference value is partly taken from Park Text book of Pediatric Cardiology for practitioner 4th ed.2006.and partly from R.vidhun Borm Bruckme'er Publishing, LLC. www.media4u.com.

DISCUSSION

Our patient presented with sign and symptoms of acute heart failure. We were led to suspect hypocalcaemia by the occurrence of seizure. The fact that she responded to the initiation of calcium and magnesium, treatment confirmed that dilated cardiomyopathy was secondary to hypocalcaemia. Few reports were available on hypocalcaemia-induced cardiomyopathy secondary to maternal vitamin D deficiency. From the available reports, it was observed that infantile hypocalcaemia migt have been related to maternal vitamin D deficiency (4). Vitamin D level of both the infant and the mother in our case was significantly low. The fact that the mother was house-bound, dark skinned and veiled outdoor showed her risk of vitamin D deficiency. It is recommended that pregnant mothers, particularly those who are dark skinned, veiled and those who do not get adequate dairy products in their diet should be given vitamin D suppl ementati on (5).

The mother in our case did not get vitamin D supplementation as the program is not available in Ethiopia. Our case was fed on exclusive breast feeding. It is also reported that exclusively breast-fed infants are at high risk of developing hypocalcaemia if the mothers are vitamin D deficient. The British Pediatric and Adolescent Bone Group recommended that exclusively breast-fed infants should receive Vitamin D supplements from soon after birth (6). The reported previous infant death in the same family was reportedly said to be due to pneumonia. Co-existence between cardiac failure and pneumonia was described by Sado indicating that excess pulmonary congestion in heart failure, acting as a nidus of infection leading to lower respiratory tract infection (7). The association between vitamin D deficiency and increased risk of lower respiratory tract

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infection has also been described in children (8). Many studies demonstrated a high prevalence of maternal vitamin D deficiency on rachitic children (9). Vitamin D deficiency induced dilated cardiomyopathy cases have also been reported commonly in association with rickets (2). Despite severe hypocalcaemia and severe Vitamin D deficiency, our patient did not manifest clinical features of rickets. The bone effect of severe hypocalcaemia secondary to Vitamin D deficiency in infants has been well studied (10). However, cardiac effect of such low level of calcium in neonates has been reported in few occasions. Soliman et al observed that younger infants below the age of six months have less clinical features of rickets compared to older children. They explains that these infants have less adaptability to Vitamin D deficiency as their Parathyroid hormone secretion in response to hypocalcaemia is low. They also have decreased skeletal response to Parathyroid hormone decreased bone mass (11). It has also been suggested that hypomagnesaemia can impair or induce resistance to parathyroid hormone secretion. In both of these situations, renal synthesis of 1,25(OH)2-vitamin D may be reduced. Magnesium deficiency induces skeletal resistance to the action of Parathyroid hormone (12). Thus, instead of finding florid rickets, one may get other forms of clinical manifestations like convulsions and/or dilated cardiomyopathy, for which our patient is the best example. She had a low level of serum magnesium which might have blunted the bone response to moderately increased Parathyroid hormone level. Lulseged from the same setting, two decades ago, reported cases of congestive heart failure in relation to rickets. However, it is not clear wether the congestive heart failure was due to cor-pulmonale or hypocalcaemia (3,13,14,15). A similar case report presented from the gulf region on a 35-day old infant who developed respiratory distress. The first impression made was sepsis. However, detection of cardiomegaly on Chest X-ray with clinical features of heart failure prompted echocardiographic examination which confirmed dilated cardiomyopathy. The diagnosis of hypocalcaemia and vitamin D deficiency was also confirmed later when these tests were made. Similarly, the mother was severely vitamin D deficient who was not supplemented during pregnancy. The hemodynamic derangement was completely corrected after the deficiency state is treated in a similar fashion like our patient (16).

This Case report highlighted the importance of vitamin D deficiency in the diagnosis of dilated cardiomyopathy. To that effect we can teach the public on the importance of sunshine exposure not only to prevent rickets but also to prevent heart disease. We need to screen infants with dilated cardiomyopathy for hypocalcaemia if they are born to mothers with risk factors for vitamin D deficiency. This is because vitamin D deficiency has become public health problem. Early clinical suspicion and screening of at-risk mothers should also be considered by every physician. There is urgent need for well-designed studies to determine the prevalence of vitamin D deficiency during pregnancy at least in mothers with risk factors.

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DOI: http://dx.doi.org/10.4314/ejhs.v27i3.12