

Serum Retinol Level and its Clinical Correlation in Children

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Abstract- Background : Vitamin A is an essential nutrient required for various important body function. Deficiency would affect any and every system including vision. Serum vitamin A level is low in children with protein energy malnutrition.

Objective : to know the serum retinol in different presentation of vitamin A deficiency.

Study design : cross sectional study.

Setting : pediatric clinic at a tertiary centre.

Methodology : 50 cases and 50 controls were chosen. A detailed history, examination and serum retinol level was estimated by modified Carr – price reaction of all the children. The serum retinol level was graded according to WHO classification and was correlated with the manifestations.

Results : of the 50 cases Bitot spots are associated with reduced serum retinol level, while xerophthalmia, night blindness and phrynoderma are usually present when serum retinol level is too low (deficient state i.e. <9µg/dl).

Index Terms- serum vitamin A; malnutrition; xerophthalmia, night blindness, Bitot spots

I. INTRODUCTION

Vitamin A deficiency is a major public health problem among the preschool children, mostly from the world health organisation (WHO) regions of Africa and South East Asia. It is estimated that world – wide 2.8 million children have vitamin A deficiency and another 250 million children have low serum retinol concentration¹, thus are potentially at risk to develop vitamin A deficiency. Infants and young children have increased vitamin A requirements to support growth and to help combat infections. Generally infants are born with low vitamin A stores and are dependent on external sources, most importantly breast milk, for optimization of their vitamin A levels and body stores². Vitamin A deficiency increases the risk of morbidity and mortality in young children and supplementation has been shown to reduce mortality in children by as much as 23%³. Recent evidence showed that subclinical vitamin A deficiency is associated with an increased risk of severe illness and even death, from such common childhood infections as diarrhoea and respiratory infections⁴.

II. METHODOLOGY

Among the children attending to the pediatric OPD 50 children between the age 1 -10yrs were selected who were

malnourished with or without the vitamin A deficiency manifestation in the study group and 50 children of age and sex matched with normal nourishment were taken into the control group. Children who received vitamin A supplementation in past 6 months were not included in the study.

A detailed history, dietic history, socio –economic status was taken as per the preformed questionnaire. The nutritional status was assessed according to the IAP classification for less than 5yrs and according to WHO classification for children between 6 -10yrs. Child was examined for signs of vitamin A deficiency and was noted.

Blood samples of all the children were collected for estimation of vitamin A levels.

Procedure for taking blood sample for estimation of serum vitamin A : After the admission 5 ml of fasting blood drawn in to a plain test tube (sample free from haemolysis and protected from light) and immediately submitted to the laboratory once the serum is separated, samples were processed by modified Carr – price reaction.

Principle of by modified Carr – price reaction : Vitamin A reacts with antimony trifluoroacetic acid to form a blue colored complex, having absorption maxima at 620nm. The intensity of blue color is found to be proportional to vitamin A content of the solution. The resulted serum retinol level was graded according to report of WHO (2011) serum retinol level in excess of 20µg/dl are normal state, values between 10 - 19µg/dl indicates low stores and values less than 10µg/dl of serum retinol as deficient state.⁵

III. STATISTICAL ANALYSIS

Data were expressed in mean ± SD and percentage. Comparison between control and study group was done using student's t-test and relation of serum retinol with parameters was done by using chi-square test. A p-value less than 0.05 were considered as significant. Data analysis were done by software SPSS v16.0

IV. RESULTS

Among the 50 children in both group 25 were girls and 25 were boys. All the children in the study group were malnourished and in control group all children were normally nourished. Among the study group (malnourished children) 31 cases had serum retinol level <10µg/dl indicating deficiency and 19 cases had serum retinol level 10-19µg/dl indicating low stores. While

no case had serum retinol level $>20\mu\text{g}/\text{dl}$, indicating normal levels of serum retinol. (Table 1), and only 4 among the control group (normally nourished) had low stores and none had deficient state.

The mean serum retinol level among the study group was found to be $9.87 \pm 3.9 \mu\text{g}/\text{dl}$ and in control group it was $23.47 \pm 2.54 \mu\text{g}/\text{dl}$. The serum retinol level in the study group was significantly low when compared to children in the control group And was statistically very significant. (Table 2) (fig 1)

Among the 50 cases in study group 26 had conjunctival xerosis, 19 had bitot spots, 2 had night blindness, 12 had phrynoderma and 4 had generalized hyperpigmentation. And among the control 3 children had bitot spots. (Table 3)

Relation with eye manifestation.

In the present study 26 out of 50 cases had xerophthalmia out of which 18 cases had serum retinol level of $<10\mu\text{g}/\text{dl}$ and remaining 8 cases had deficient state i.e. $10-19\mu\text{g}/\text{dl}$ of serum

retinol. 19 out of 50 cases had bitot spots, out of which 10 cases had serum retinol level of $<10\mu\text{g}/\text{dl}$ and remaining 9 cases had deficient state i.e. $10-19\mu\text{g}/\text{dl}$ of serum retinol. 3 out of the 50 control children had bitot spots, the serum retinol level of all the 3 were in the range of deficiency state.

We had two cases of night blindness and both had severe deficient state that is $3.03\mu\text{g}/\text{dl}$ and $2.65\mu\text{g}/\text{dl}$.

Relation with skin manifestation

Among the skin manifestations 12 cases had phrynoderma among which 8 cases had serum retinol level of $<10\mu\text{g}/\text{dl}$ and remaining 4 cases had deficient state i.e. $10-19\mu\text{g}/\text{dl}$ of serum retinol. 4 cases had generalised hyper pigmentation and among which 3 cases had serum retinol level of $<10\mu\text{g}/\text{dl}$ and remaining 1 case had deficient state i.e. $10-19\mu\text{g}/\text{dl}$ of serum retinol

Children with more than 1 manifestation had serum retinol level of less than $10\mu\text{g}/\text{dl}$.

Table 1: Serum retinol status in study group and control group with WHO standard

Group	Serum retinol levels			Total
	$<10\mu\text{g}/\text{dl}$	$10-19\mu\text{g}/\text{dl}$	$>20\mu\text{g}/\text{dl}$	
Study group (n=50)	31	19	-	50
Control group (n=50)	-	4	46	50

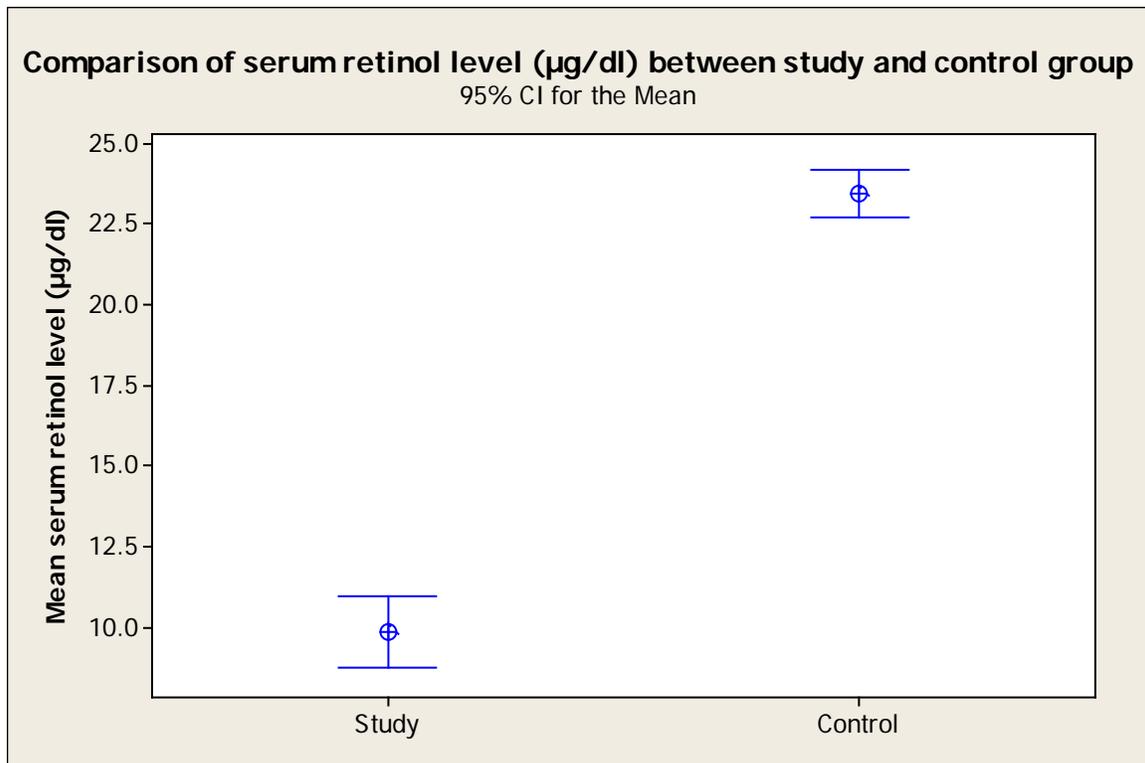
Table 2: Mean Serum retinol levels in the study group and control group

	Study (n=50)	Control (n=50)	Mean difference	p-value
Mean serum retinol level ($\mu\text{g}/\text{dl}$)	9.87 ± 3.9	23.47 ± 2.54	13.59	$P < 0.001$

Table 3 : Relation between serum retinol level and clinical manifestation in the case group

Clinical manifestation	Serum retinol levels		
	$\geq 20\mu\text{g}/\text{dl}$	$10-19.99 \mu\text{g}/\text{dl}$	$\leq 9.99 \mu\text{g}/\text{dl}$
Conjunctiva Xerosis (X1A)	0	8	18
Bitot spots (X1B)	0	9	10
Corneal Xerosis(X2)	0	0	0
Corneal ulceration / Keratomalacia $< 1/3$ rd corneal surface (X3A)	0	0	0
Corneal ulceration / Keratomalacia $> 1/3$ rd corneal surface (X3B)	0	0	0
Night blindness (XN)	0	0	2
Corneal Scar (XS)	0	0	0
Xerophthalmia fundus(XF)	0	0	0
Phrynoderma		4	8
Generalized hyper pigmentation		1	3

Figure 1 :



V. DISCUSSION

In the present study all the malnourished children had serum retinol level $<20 \mu\text{g/dl}$. According to report of WHO (2011) serum retinol level in excess of $20 \mu\text{g/dl}$ are not associated with deficiency state, but the values between $10 - 19 \mu\text{g/dl}$ indicates low stores and values less than $10 \mu\text{g/dl}$ of serum retinol are associated with severe deficiency.⁵ According to Interdepartmental Committee on Nutrition for National Development (ICNND) manual of nutritional survey published in the year 1963, serum retinol has been suggested as per $\mu\text{g/dl}$, normal $>20 \mu\text{g/dl}$, low $10 - 19 \mu\text{g/dl}$ and deficient $<10 \mu\text{g/dl}$. Similarly McLaren in the year 1991 reported that the serum retinol levels falls below normal limits ($20 - 50 \mu\text{g/dl}$) before functional or structural changes occur. Values below $<10 \mu\text{g/dl}$ are strongly suggestive of deficiency, but values between $10 - 20 \mu\text{g/dl}$ are difficult to interpret.⁷

This reduced serum retinol levels is probably due to reduced intake. Infections which causes reduced intake and defective absorption of vitamin A as well as increased renal loss as suggested by Semba R D⁸. Protein energy malnutrition- (Kwashiorkor) Deficiency of proteins leads to impaired synthesis of RBP. This indicates that vitamin A deficiency in serum is due to decrease in RBP and plasma prealbumin. Guillermo Arrova, Dorothy W, Jose M, Moises B and Nevin S S, under the study title 'serum and liver vitamin A and lipids in children with severe protein malnutrition'⁹, studied serum levels of total lipids, phospholipids, cholesterol vitamin A and carotene in children with kwashiorkor on admission to the hospital and at regular intervals during the recovery, their data indicated that total lipids

and vitamin A decrease in liver tissue simultaneously with an increase in the serum components suggesting that an initial impairment in lipid and vitamin A blood transport is possibly associated with decrease in plasma protein fraction to which the lipid compounds are normally bound. In the year 2012, Gopalan C, Venkatachalan, P S Bhavani, in their study 'studies of vitamin A deficiency in children'¹⁰ found that there was a lack of association between the incidence of night blindness and ocular signs of vitamin A deficiency. They also found that by supplementing high protein diet without vitamin A supplementation brought about a significant increase in the levels of vitamin A in the serum of the children with kwashiorkor while not seen who had only vitamin A supplementation. In the study titled 'impaired intestinal localization of mesenteric lymphoblasts associated with vitamin A deficiency and protein calorie malnutrition'¹¹ M R McDermott, D A Mark, A. D. Befus, B.S. Baliga, R M Suskind and J Bienenstock in the year 1981 suggested that the early stages of protein calorie malnutrition or protein calorie malnutrition with vitamin A deficiency interferes with the traffic of immunocompetant lymphocytes between the various anatomical sites included in the common mucosal immunological system.

In a study titled "Vitamin A deficiency and the prevalence of xerophthalmia in southern Rwanda" by Selim Rashed, Henk Renkema, Jose d'Astous, Katherine Gray-Donald, and Jean Lambert found that the serum retinol level was significantly lower than children without bitot spots.

This study was taken up to study the relation of serum retinol level and vitamin A manifestation. As majority of the studies have found out the various vitamin A deficiency manifestation, few extensive studies have been able to find the

serum retinol level and have graded as normal (20µg/ dl, low stores (10 - 19µg/dl) and deficient state (less than 10µg/dl).

In our study we found 69% of children with xerophthalmia had deficiency state. 53% of the children with bitot spots had low stores of retinol level and the remaining 47 % of the children had other manifestations along with bitot spots . 3 out of the 50 control children had bitot spots , and all the 3 children had low stores of retinol with normal nourishment.

We had two cases of night blindness and both had severe deficient state that is 3.03µg/dl and 2.65µg/dl.

Among the skin manifestations 67% of children with phrynoderma had low serum retinol level indicating deficiency state.75% of the children with generalised hyper pigmentation had deficiency state i.e. 10 -19µg/dl of serum retinol.

Children with more than 1 manifestation had serum retinol level of less than 10µg/dl.

VI. CONCLUSION

The serum retinol level is lower than normal level in malnourished state. In our study children with normal serum retinol level had no manifestation, children with low stores presented mainly with bitot spots, xerophthalmia, phrynoderma in the order. All other manifestation were seen when the serum retinol level is in the deficiency state. more than one manifestation is an indication of very low serum retinol level (deficiency state).

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