Comparison of Vision Restoration Time With Vitamin A Levels in Pregnant Nigerian Women

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Abstract

Background: Vitamin A deficiency, subclinical or otherwise is associated with adverse maternal fetal and neonatal outcome, ditto excess vitamin A. The challenge in pregnancy is to detect subclinical vitamin A deficiency in patients for whom supplements or dietary manipulation will be of benefit.

Objective: To compare the usefulness of the vision restoration time with biochemical methods in the determination of vitamin A status in pregnancy.

Study Design And Setting: A cross sectional case controlled study in a University teaching hospital.

Methods: Data was collected from Antenatal patients (142). Using serum Biochemistry three categories of patients were recognised. Patients with normal vitamin A levels (N = 100 with blood vitamin A within two standard deviation of the mean) Twenty four patient (24) had low vitamin A levels (blood vitamin A level at less than 2 standard deviation below the mean). Eighteen patients (18) had high vitamin A levels (blood vitamin A levels at greater than two standard deviation above the mean).

Outcome Measures: The vision restoration time was compared for all three groups of patients.

Results: The vision restoration time (VRT) was found to have a high degree of sensitivity (80%) and a high specificity (83%) in detection of patients with vitamin A deficiency. The positive predictive value was 90% with a negative predictive value of 83%. The VRT was unable however to differentiate patients with normal and high vitamin A.

Conclusion: The vision Restoration time is a cheap effective method to detect subclinical vitamin A deficiency in pregnancy. It is an easy cost effective screening tool to select patients for whom dietary manipulation and or vitamin A supplementation will be beneficial.

Keywords: Vitamin A, Nutrition, Supplementation Pregnancy, Vision.

Introduction

Vitamin A is a general term, which covers all compounds with the biological activity of retinol. These include dehydroretinol (vitamin A_2) retinal and , carotene. Vitamin A occurs as retinal or retinal esters in animal food and as provitamin, A carotenoid primarily in plant food. It cannot be synthesised within the body. The bioavailability is more in foods of animal origin. The vitamin A status in pregnancy is influenced by age, parity and diet [1,2,3,4,5,6,8,9,10]. Socio-economic circumstance is particularly important because of the availability and cost of vitamin A rich foods [1,2,11,12]. The vitamin A status is also influenced by increased demands of pregnancy and lactation to cater for the need of the fetus. Other factors include malnutrition, measles and respiratory infection [1,13,14] food taboos and food preparation methods such as prolonged frying at high heat is likely to decrease the amount of vitamin A contained in these foods.

Vitamin A is required for growth and development. Maternal retinol level parallels fetal and consequently childhood vitamin A status. Both excess of vitamin A and vitamin A deficiency are associated with adverse fetal and neo-natal outcomes[15,16] vitamin A is also required for the maintenance of the immune status (both innate and acquired immunity). It is also essential for epithelial defences [17,18,19,20,21].Vitamin A deficiency is associated with adverse fetal and maternal outcome while hypervitaminosis A affects mainly the fetus and the neonate. Deficiency occurs, in the setting of malnutrition, poverty and adverse socio-economic and cultural practices common in the third world countries [24]. It is also associated with micronutrient deficiency, anaemia and consequent adverse pregnancy outcome [17,26,27].

Different qualitative and quantitative approaches are used to assess vitamin A status. These include conjuctival impression cytology [1,28] liver biopsy, xeropthalmia prevalence, physical signs, biochemical survey and the vision restoration time. Biochemical method is the only direct of all these methods. It uses a cut-off point of 0.7-1.5umol/litre as normal levels for serum vitamin [2,30,22,31,32,33]. The main drawback is the fact that it is invasive and it is not cost-effective, especially for community screening [5,22]. The conjuctival impression cytology assesses epithelial cells of tear film in order to evaluate clinical impression of vitamin A deficiency. It is also invasive. It is therefore not ideal as a screening tool as it is lacking in sensitivity and specificity. Liver biopsy assesses vitamin storage in the liver. It is also invasive and it is not for community screening. Xeropthalmia prevalence assesses disease progression rather than screening for vitamin A deficiency, ditto night blindness. The importance of vitamin A in maternal health and consequently child health makes estimation of it in pregnancy of vital importance.

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The vision restoration time is a relatively new test. In studies where it has been used it has been found to have a high degree of sensitivity and specificity [15,25,28,29]. It is a simple cost effective means of screening for vitamin A deficiency in the population. An abnormal vision restoration time merits further investigation with fundoscopy and biochemical means. This is because an abnormal V.R.T. is also seen in retinitis pigmentosa.
The basis of the test is this: The retina contains 2 photosensitive pigment rhodopsin in the rod cells and iodopsin in the cone cells. They are formed by binding of vitamin A aldhelyde pro-retinal to the protein opsin. Rhodopsin and to a lesser extent iodopsin is primarily responsible for ability to see in dim illumination. Exposure to light causes cleavage of the photopigments into opsin and retinal (bleaching).

.In the dark adapted eye rhodopsin is resynthesised. The vision restoration time is the earliest test of vitamin A deficiency. The vision restoration time is the time taken for the subject to identify letters illuminated by a fixed dim light. The rate of rhodopsin and **iodopsin** regeneration is dependent on vitamin A store in the retina. In the presence of replete stores and in hypervitaminosis, the vision restoration time is normal while it is abnormal in deficiency state.
The purpose of this study is to compare the vision restoration time (V.R.T) with Biochemical method in evaluation of vitamin A levels. A finding of a significant correlation would indicate that determination of the vision restoration time (a simple non-invasive easily performed evaluation) may be useful as a screening test for the determination of vitamin A status in pregnancy. The challenge in pregnancy is to maintain an optimal vitamin A millieu.

Materials and Methods

This was a cross sectional case controlled study conducted in the department of obstetrics and Gynaecology of the University of Benin Teaching Hospital between November 1999 July 2000. The department has 42 gynaecological and 84 obstetrical beds and undertakes about 2000 deliveries annually. A total of 142 consecutive patients attending the Antenatal Clinic were recruited. They were fairly well spread across all the three trimesters of pregnancy. All patients had.

A. Venepuncture for biochemical analysis
B. A dark adaptation test (vision restoration time)

The sample size required was calculated using Epi-info (stat calc). The sample size using 95% confidence level with an expected frequency of 10% yielded a sample size of 132.

A Blood Biochemistry

Determination of vitamin A in serum was done using the modified Bessey, Lowry, Brock and Lopez method of 1946.

B Vision Restoration Time (Dark Adaptation Testing)

The test was done in a dark room containing a table and two chairs.

The patient was made to sit at a distance of 3 metres from the chart (The log man chart was used because it contains letters of uniform characters and the letters used were 10 non-serif letters). The light source i.e. the dark adaptometer was placed 50cm from the subject. The intensity of light was about 100-10,000cd/m^2. The candelae (cd) is a measure of the luminous intensity of light. The light flashed from a distance of 50cm. The test was done binocularly and this was done for 2 minutes, for the first 2 minutes the photoreceptors of the eyes were expected to have been bleached. The bright light was then replaced by dim light with a reduced illumination and immediately, after the patient was asked to read the first line of the logman chart. The time interval between turning on the dim light and the verbal identification of the letter was recorded as the dark adapted time or vision restoration time. A vision restoration time (VRT) of less than or equal to 150 seconds is regarded as normal. A VRT of greater than 150 seconds is regarded as abnormal. The test was completed in 4-10 minutes.

Statistical Analysis

Statistical analysis was done using epi-info 2002 Revision 1. The chi-square test was used with a P value of < 0.05 being regarded as statistically significant.

Table 1 Clinical summary of age, parity and social class.

Clinical/Social variables	Group I n = 100	Group II n = 24	Group II n = 18	P value
Mean Age	30+ 4.36	31 + 4.31	32 +4.87	P > 0.05
Mean parity	3 + 1.85	1 + 0 .685	2 + 1.035	N/S
Social class				
I	25(25%)	4(16.7%)	2(11%)	N/S
II	21(21%)	2(8.3%)	8(44.4%)	
III	23 (23%)	4(16.7%)	2(11%)	
IV	16 (16%)	6(25%)	4(22.2%)	
V	15 (15%))	8(33.3%)	3(16.7)	

Results

A total of one hundred and forty two patients were recruited. They were categorized into three groups based on the result of serum vitamin A levels. The mean level of serum vitamin A in the 142 patients recruited was 1.54umol/litre with a standard deviation of 1.25 i.e. (1.54 ± 1.25umol/L). Patients with blood vitamin A levels within 2 standard deviation of the mean were grouped as having Average vitamin A levels (Group I). Patients with blood vitamin A at less than 2 standard deviation below the mean were assessed as having low vitamin A (Group II) while patients with blood vitamin A at two standard deviation above the mean were classified as having high vitamin A (Group III). One hundred patients (100) were in-group 1, 24 patients in group II while 18 patients were in group III.
The clinical and social [34] characteristics of the 142 patients were as shown in Table I. There was no statistically Significant differences between the three with regard to age, parity, and social class. The average age for the three groups was 30 and the mean parity was 2.

Eighty nine of the 142 patient (62.6%) assessed had a vision restoration time of less than or equal to 150 seconds. Fifty three patients (37.3%) had a vision restoration time of greater than 150 seconds. Only one patient volunteered a history of night blindness. All patients had normal fundoscopy. A vision restoration time of less or equal to 150 seconds was present in 69% of patients in group I ,20% of patients in group II and 83% of patients in group III. Patients in group II (low vitamin A) had a a statistically significant proportion of patients with an abnormal vision restoration time (VRT > 150 seconds). The vision restoration time (VRT) had a sensitivity of 80% and a specificity of 83% in patients with low vitamin A, with a positive predictive value of 90% and a negative predictive value of 83%.

Discussion

Vitamin A is a fat soluble vitamin derived from both plant and animal sources. It plays a very important role in human reproduction. Vitamin A status of pregnancy is influenced by age, parity and diet [1,2,3,4,5,6,7,23,24].
The methods of assessment of vitamin A status in this study was by xeropthalmia prevalence (night blindness), the vision restoration time and biochemical means. Other ways to asses vitamin A level which were not utilized here include conjunctiva impression cytology and liver biopsy [2,11,22,35].
The study confirms the high degree of sensitivity of the vision restoration time in patients with subclinical vitamin A deficiency. However unlike biochemical analysis it was unable to differentiate between patients with normal and high vitamin A levels (Table 1). The sensitivity was 80% while the specificity was 83%. This is similar to similar observation by other authors [2,11,22,28,29,35]. The positive predictive value was similarly high at 90% while the negative predictive value was 83% with a false negative rate of 20% and a false positive rate of 17%. This result indicates that V.R.T. is one of the earliest test of vitamin A deficiency [2,22,24,28,29,35]. The vitamin A storage in the rods and the cones is an indication of vitamin A stores in the body. An abnormal V.R.T. may is some cases pre-date low blood levels of vitamin [24,27,28,29].

Detection of vitamin A deficiency is probably of more importance in a socially and economically deprived third world environment like Nigeria. Diet rich in vitamin A are either not accessible or not affordable to a large segment of the Nigerian populace. On the other hand, hypervitaminosis A is a condition prevalent in Western industrialised countries. In these countries habitual vitamin A intakes exceed at least three times the RDA (about 30000 i.u or 2,400ug RE). The advantage of the vision restoration from this study is immediately obivous it is indicative of vitamin A deficiency. Again it is safe, cheap and acceptable. It is easily learnt and can be taught to community health workers and can be quite useful as a screening tool for vitamin A deficiency in pregnancy. It only requires a room, a logman chart and a dark adaptometer. (in the rural setting a torch light can suffice). These characteristics are unlike other tools of detection of vitamin A status which are expensive, invansive and require specialist knowledge and skill to analyse and interprete. Findings are similar to the observations of various other authors [22,23,24,28,29].

In conclusion although the series is small and follow up interval brief. Vitamin A deficiency as detected by vision restoration appears to be a useful tool of detection of Vitamin A deficiency. It is suggested that advantage be taken of its usefulness in screening for vitamin A deficiency in pregnancy. This will enhance good antenatal management. Intervention programmes by dietary manipulation and or direct supplementation can be designed based on results of the V.R.T. This is especially important considering the known adverse maternal and neonatal effects of vitamin A deficiency.

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