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# Nutritional Rickets in Northern Iraqi Children – Response to Vitamin D

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## ABSTRACT

The biochemical bone profile (BBP) which include serum calcium, phosphorus, alkaline phosphatase (ALP) and albumin was studied on twenty seven rachitic children aged 6-60 months who attended the outpatient department in Al-Khansa maternity and children's Hospital in Mosul during the period from July 2000 to April 2001 and were followed up 6-8 weeks after treatment by oral massive single dose of vitamin D . The radiological and biochemical characteristics of cases ware ascertained before and after therapy .The biochemical changes ware analyzed by student (t) test.

There was a significant increase in the level of serum calcium($p<0.006$), phosphorus, and albumin ($P<0.0001$), with a significant decrease in the ALP activity after vitamin D therapy with no risk of hypercalcaemia ($P< 0.0001$).

In conclusion, ALP is the main test in the follow up of rachitic children ,also oral massive single dose of vitamin D is effective in reversal of BBP to normal levels with no risk of hypercalcaemia

Key words: Rickets, Calcium, Phosphorus, Albumin, Alkaline phosphatase, Biochemical Bone Profile, Vitamin D.

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## الكساح التغذوي لدى اطفال شمال العراق - الاستجابة للعلاج بفيتامين د

### الملخص

الواجهة الكيماوية الحيوية للعظام والمقصود بها فحوصات الكيمياء الحيوية المكونة من الكالسيوم و الفسفور اللاعضوي و فعالية إنزيم الفوسفاتيز القاعدي و الزلال (الألبومين ) تمت دراستها على سـبعة و عشرين طفلا مصابون بالكساح من عمر 6-60 شهرا و الذين كانوا يراجعون العيادة الخارجيـة فـي مستشفى الخنساء للولادة و الأطفال في الموصل و تمت متابعتهم مدة 6-8 أسابيع من العـلاج بجرعـة فموية واحدة من فيتامين د . أجريت لهم فحوصات الأشعة و الواجهة الكيماوية الحيوية قبل و بعد العلاج.

تمت دراسة مقارنة التغيرات الكيمياوية الحيوية بواسطة اختبار t و كانت هناك زيـادة معتـدة إحصائيا في مستوى الكالسيوم ( ب < 0.006 ) والفسفور و الألبومين (ب<0.0001) مع انخفاض معتد إحصائيا في فعالية إنزيم الفوسفاتيز القاعدي (ب<0.0001) في كافة الحالات بعد العلاج .لم تكن هنالك خطورة فرط الكالسيوم بعد العلاج بفيتامين د.

نستنتج من ذلك أن إنزيم الفوسفاتيز القاعدي هو الفحص الرئيسي الذي يمكن الاعتماد عليه في متابعة مرض الكساح و أن جرعة فموية كبيرة واحدة من فيتامين د فعالة في تغيير ايجابي في قياس الواجهة الكيميائية الحيوية و بانعدام خطورة فرط الكالسيوم.

## INTRODUCTION

In Iraq, rickets is a fairly common in spite of the abundant sunlight (Nagi, 1972). Its persistent in severe forms beyond infancy is present in the tropics (Al-Jarayyan *et al*., 2002). Sun exposure plays a major role in maintaining calcium homeostasis and bone metabolism in human (Maddison *et al*., 1999). Treatment of vitamin D deficiency rickets is by oral administration of a single dose of 600,000 I.U. of vitamin D or in divided dose over 24 hours, alternatively, those children may be treated with 5000-10,000 I.U. of vitamin D per day for six to eight weeks (Root and Harrison, 1976). This study looks for the biochemical changes before and after treatment and to find out the most useful biochemical test in the follow up of rachitic children after therapy.

## PATIENTS AND METHODS

Twenty seven cases of rickets aged from 6-60 months were seen in the Outpatient Department of Al-Khansa Maternity and Children's Hospital in Mosul from July 2000 to April 2001.

The diagnosis were confirmed radiologically by wrist x-ray. Biochemical bone profile (BBP) which includes serum calcium, inorganic phosphorus, alkaline phosphatase (ALP) and albumin were done. Any patient gave negative radiological signs, obvious infection or liver disease was excluded from this study, since infection and liver disease could influence the level of ALP. All children in the study were given a single oral massive dose of calciferol 15 mg (600,000 I.U). Mothers were educated to give diet rich in calcium to their rachitic children. The parents were instructed to bring their children after 6-8 weeks for follow up.

On follow up of these cases, x ray of the wrist was done to assess the response to treatment. A positive response was based on the reappearance of the provisional zone of calcification in the wrist. Blood sample was taken for laboratory analyses of BBP.

The mother was instructed to come back after another 6-8 weeks, given the same treatment to her child, if there was a negative response on the first follow up visit

Serum calcium was measured by O-cresophthalein complexone method (CPC) (Connerty and Briggs, 1966) and serum phosphorus by molybdate reaction (Taussky and Shorr, 1953). ALP activity was estimated according to method of Kind and King (Kind and King, 1954) and serum albumin by bromocresol green (BCG) (Silverman and Christenson, 1994). Unfortunately the kit for measurement 25-Hydroxy vitamin D was not available in Iraq.

Kits for the determination of calcium, phosphorus and ALP were obtained from bio Merieux (France), while albumin kit was obtained from Randox (U.K).Student t-test was used for statistical analysis of the results.

## RESULTS

Serum calcium, phosphorus and albumin were increased significantly ($p<0.0001$). At the same time ALP decreased significantly ($p<0.0001$) as shown in table (1).

Table 1: Effect of treatment on BBP (mean ± SD) in rachitic children.

| Parameters | Before Treatment | After Treatment | Reference interval | t-value | p |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | | | |
| **Calcium (mg/dl)** | 8.27 ± 0.57 | 8.33 ± 1.82 | 8.8-11 | 2.82 | 0.006 |
| **Phosphorus (mg/dl)** | 2.57 ± 0.38 | 3.26 ± 0.70 | Infants 4.8 older children 3.6-5.9 | 4.92 | 0.0001 |
| **ALP (Kind & KingU/dl)** | 30.89 ± 4.38 | 16.90 ± 2.28 | 10 - 25 | 6.32 | 0.0001 |
| **Albumin (g/dl)** | 3.40 ± 0.30 | 4.38 ± 0.29 | 3.5 - 5.0 | 4.01 | 0.0001 |

Figure (1) shows ALP activity in rachitic patients before and after treatment. It is apparent that ALP level in all studied rachitic children became less than 25 (Kind & King U/dl) after treatment except one child where ALP is 26 (Kind & King U/dl).

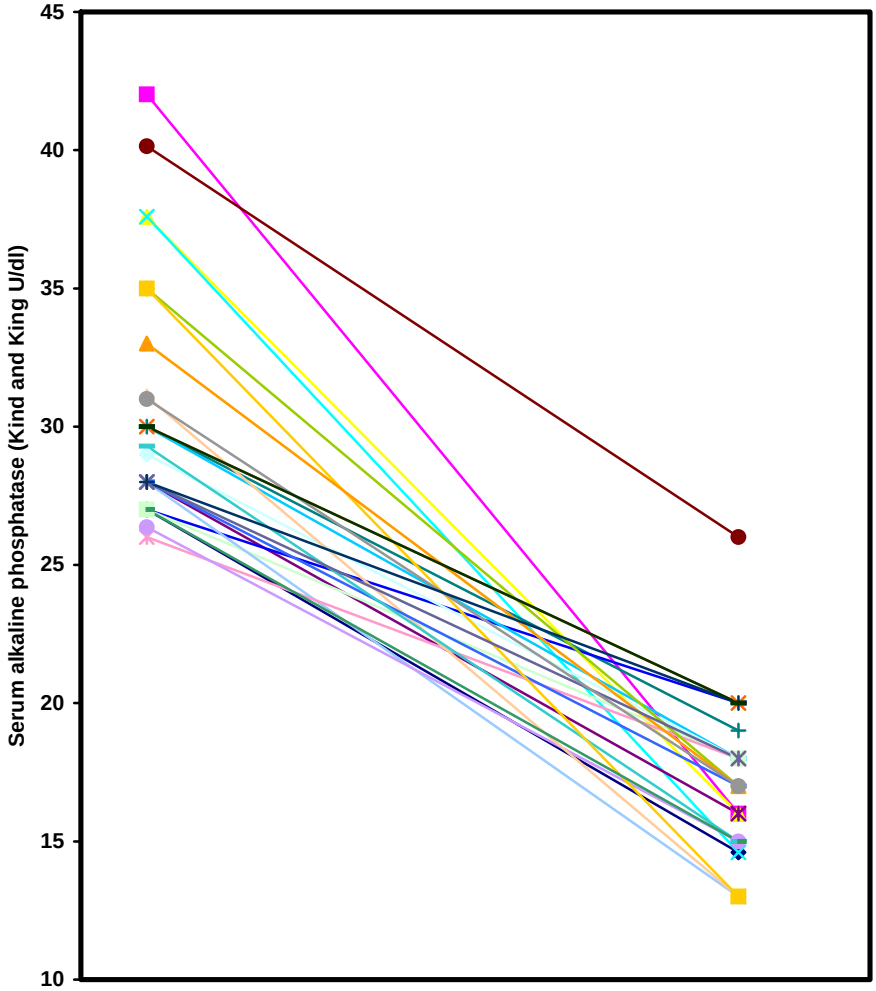


Fig. 1 **:**Serum alkaline phosphatase levels in rachitic patients before and after initiation of therapy.

## DISCUSSION

Following the administration of vitamin D, children with rickets showed improvement in all parameters. It has been reported that some workers had given also calcium during therapy (Khalifa *et al*., 1971), while others had given calcium, sodium salt and proteins and they considered that was necessary for subsequent growth (Laditan and Adeniyi, 1975). No calcium or sodium salts were given in this study but parents were informed about the value of dairy products, protein and sun exposure.

In the present study, serum calcium was increased after therapy in the studied rachitic children; however, calcium level was still within normal range. This is consistent with the findings of other investigators (Khalifa *et al*., 1971; Laditan and Adeniyi, 1975; Silverman and Christenson, 1994).

Hypercalcaemia was not found following large dose of vitamin D therapy. This is consistent with studies of other investigators (Khalifa *et al*., 1971; Laditan and Adeniyi, 1975; El-Hag and Karrar, 1995). The absence of hypercalcaemia might be explained on the basis that the studied patients were markedly depleted in vitamin D before the onset of therapy, so the therapeutic response, with complete healing was achieved with out hypercalcaemia in any child (Khalifa *et al*., 1971; Laditan and Adeniyi, 1975).

The serum inorganic phosphorus in the studied rachitic children was decreased which is characteristic of vitamin D deficiency rickets. It increased after therapy. This is consistent with the studies of other investigators (Khalifa *et al*., 1971; Laditan and Adeniyi, 1975; Silverman and Christenson, 1994; El-Hag and Karrar, 1995).

Alkaline phosphatase activity in the studied rachitic children was high. It decreased after treatment which means that ALP level returned to normal. This showed that it is the most sensitive criterion for healing (Smith and Maizel, 1932). Alkaline phosphatase returned to normal (below 25 Kind an King U/dl) 4-10 weeks after treatment (Doxiadis *et al*., 1976) which means complete healing (Root and Harrison, 1976) and that proper dose is reached (Lovinger, 1980) and effective treatment is given (Hutchison and Cockburn, 1989).

After therapy, ALP level in all the studied rachitic children was less than 25 Kind and King U/dl except in one child where (ALP was 26 Kind and King U/dl) this could be explained on the basis that proper dose was not reached and more vitamin D therapy is needed (Lovinger, 1980), unfortunately the child was not seen again. These results are compatible with findings of other investigators (Hojer and Gebre-Medin, 1975; Doxiadis *et al*., 1976; Raghuramulu and Reddy, 1980; Sabih, 1993; El-Hag and Karrar, 1995; Kreiter *et al*., 2000).

An elevated level of ALP was found to be a constant finding in vitamin D deficiency rickets and is the last parameter to return to normal after initiation of therapy and indicates definitive healing (David, 1992).

In this study, albumin in rachitic children was lower than normal range. The reduced albumin in rickets could be explained partly on a nutritional deficiency basis and also due to amino acid uria which is well known to occur in active rickets (Doxiadis *et al*., 1976). Furthermore, Albumin rose in rachitic children after treatment might be due to correction of malnutrition which means a good return to normal as albumin is used as nutritional parameter (Walter *et al*., 1997).

## CONCLUSION

An elevated ALP activity is a constant finding in vitamin D deficiency rickets and it is the most useful biochemical parameter with radiological examination in diagnosis and follow up of rickets.

Oral single massive dose of vitamin D is effective in reversal of serum calcium, phosphorus and ALP to normal and it is safe in treatment of vitamin D deficiency in rickets without risk of hypercalcaemia.

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