Introduction

Vitamin D has become a hot topic in the world of nutrition because of the emerging science which suggests that vitamin D has pleiotropic effects in a variety of extraskeletal tissues that are important in health and prevention of disease. Vitamin D is actually a prohormone and the physiologic function of vitamin D has expanded beyond the mineralization of bone to include modulation of the immune system and suppression of malignant cells. Research has shown an association between vitamin D deficiency and an increased risk of colorectal cancer, breast cancer and autoimmune diseases.

Recent Institute of Medicine findings support a role for vitamin D and calcium in bone health, but as yet, have not confirmed use of these nutrients in other health conditions. Increases in vitamin D requirements were recommended as noted in the table below.

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#### Challenges in IV Therapy

Multivitamin preparations for individuals who receive home parenteral nutrition (HPN) contain 200 IU per day. Currently, there is not an available Injectable form of vitamin D for supplementation which necessitates the use of an alternate source such as an oral supplement.

#### Methods

Twelve patient cases were reviewed to determine the serum levels of vitamin D as well as the levels of vitamin D supplementation in 12 patients receiving HPN. All HPN patient cases came from one home infusion provider. All patients were managed by a home nutrition support team maintaining electrolytes (including Ca and Phos) within normal limits.

Data collected included: serum vitamin D levels, amount of vitamin D supplementation (outside of the HPN), HPN infusion schedule, diagnosis, gender and age. Most patients (9) were receiving the 50,000 IU vitamin D supplement in the form of D2.

#### Results

These patients resided in Oregon, Minnesota, New Jersey and Pennsylvania with one each residing in Texas and Washington.

- **Age of the patients ranged from 17 to 88**
  - Average BMI – 21.9 (males: 22.8; females: 21)
  - Vitamin D levels did not correlate with geographical distribution
  - Six males (average age 53.4 years) and six females (average age 58.5 years)
  - Diagnosis:
    - 7 – Short bowel syndrome, malabsorption, malnutrition
    - 2 – Malabsorption due to complications of bypass surgery
    - 1 – Small bowel obstruction
    - 1 – Enterocutaneous fistula
    - 1 – Pseudo-obstruction
  - Infusion schedule:
    - 9 – Received HPN daily
    - 1 – Received HPN five days per week
    - 1 – Received HPN four days per week
    - 1 – Received HPN three days per week

#### Case Examples

**Case Example 1**

17-year-old male with very poor oral intake due to Lyme disease with chronic inflammation receiving home PN. Initial vitamin D level was 19 ng/ml. After three months of oral supplementation with 50,000 IU of vitamin D weekly, the vitamin D level increased to 36 ng/ml indicating normal absorption. However, the patient was still unable to consume enough orally to meet nutritional needs.

**Case Example 2**

45-year-old female who had complication of a gastric bypass and had been receiving home PN since May 2008. Initial vitamin D level was of 14.8 ng/ml (July 2008). Oral calcium providing 1,200 mg with 1,200 IU vitamin D3 daily was started. Vitamin D level in October 2009 was 7.5 ng/dl. Oral supplementation with 50,000 IU of vitamin D weekly was initiated. Vitamin D status was rechecked every three to six months with the supplementation dose titrated up based on vitamin D level. The vitamin D level was 21.4 ng/dl in December 2009 with a dose of 50,000 IU of vitamin D four times per week. The dose was increased to five times a week at that time, and as of July 2010, vitamin D level rose to 33.2 ng/dl.

**Case Example 3**

52-year-old male requiring HPN due to a complication of gastric bypass surgery receiving 350,000 IU per week of supplemental vitamin D. Prior to HPN start, his initial vitamin D level was 9.7 ng/ml. After two months on HPN and supplemental oral vitamin D (50,000 IU daily), the vitamin D level increased to 20 ng/ml.

**Case Example 4**

29-year-old female with 20+ year history of chronic pseudo-obstruction who is currently receiving HPN four days/week in addition to oral diet. Despite receiving 50,000 units of D3 three times weekly, plus ADEKs multivitamin (400 IU D3) one tablet daily averaging 21,823 IU of oral vitamin D daily for 15 months, her vitamin D level remained low (6.2 ng/ml). Patient is on a regular diet and prefers high fat foods when selecting meals. Patient still has significant problems with inflammation receiving home PN. Initial vitamin D level was 19 ng/ml. After three months of oral supplementation with 50,000 IU of vitamin D weekly, the vitamin D level increased to 36 ng/ml indicating normal absorption. However, the patient was still unable to consume enough orally to meet nutritional needs.

**Summary Table (11 of 12 patients)**

<table>
<thead>
<tr>
<th>Life Stage Group</th>
<th>Estimated Average Requirement (mg/day)</th>
<th>Recommended Dietary Allowance (mg/day)</th>
<th>Upper Level (mg/day)</th>
<th>Estimated Average Requirement (IU/day)</th>
<th>Dietary Recommended Allowance (IU/day)</th>
<th>Upper Level (IU/day)</th>
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</thead>
<tbody>
<tr>
<td>Infants 0 to 6 months</td>
<td>400</td>
<td>600</td>
<td>1,000</td>
<td>200</td>
<td>300</td>
<td>400</td>
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<tr>
<td>Infants 6 to 12 months</td>
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<td>750</td>
<td>1,500</td>
<td>200</td>
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<td>400</td>
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<td>5,000</td>
</tr>
</tbody>
</table>

**Note:**

- For infants, Adequate Intake is 200 mg/day for 0 to 6 months of age and 200 mg/day for 6 to 12 months of age.
- For infants, Adequate Intake is 400 mg/day for 0 to 6 months of age and 400 mg/day for 6 to 12 months of age.

This data, while limited, indicate that vitamin D levels in this group of HPN patients were below the lowest level of normal. In addition, there was a wide range of oral vitamin D supplementation provided. Further research is warranted to determine if oral vitamin D supplementation is feasible to reach normal serum levels in HPN patients in lieu of an available IV form.

**Conclusion**

Vitamin D Status in Patients Receiving Home Parenteral Nutrition