FAT SOLUBLE VITAMINS
INTRODUCTION

• Definition

• Classification

• Need to know
NEED TO KNOW
OBJECTIVES

• Active compound
• Physiology
• Sources & Recommended Daily Allowance
• Deficiency state & Treatment
• Prevention
• Hypervitaminosis
VITAMIN A
VITAMIN A

• Derivatives of Retinoids
• Normal maintenance and function
  • Vision
  • Cellular Integrity
  • Immune Competence
  • Growth
• Sources
  • Animal
  • Plant – Red / Yellow – β carotene (Anti oxidant)
• Recommended Daily Allowance
  • Infant 300 – 400 µ gm
  • Child 400 – 600 µ gm
  • Adolescent 750 µ gm
VITAMIN A

• Deficiency state
  – Sub clinical
  – Eyes
  – Skin
  – Genito urinary System

• Factors aggravating Deficiency
  – Measles
  – Diarrhea
  – Worm infestation

PREVENTABLE CAUSE OF BLINDNESS
VITAMIN A DEFICIENCY – EYE CHANGES
**WHO CLASSIFICATION - VITAMIN A DEFICIENCY**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>X N</td>
<td>Night Blindness</td>
</tr>
<tr>
<td>XI A</td>
<td>Conjunctival Xerosis</td>
</tr>
<tr>
<td>XI B</td>
<td>Bitot’s Spots</td>
</tr>
<tr>
<td>X 2</td>
<td>Corneal Xerosis</td>
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<tr>
<td>X 3 A</td>
<td>Corneal Ulcer &lt; 1/3</td>
</tr>
<tr>
<td>X 3 B</td>
<td>Corneal Ulcer &gt; 1/3</td>
</tr>
<tr>
<td>X F</td>
<td>Fundal Changes</td>
</tr>
<tr>
<td>X S</td>
<td>Corneal Scarring</td>
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</table>

**PREVENTABLE CAUSE OF BLINDNESS**
VITAMIN A DEFICIENCY - TREATMENT

Treatment

• Specific
  – Vitamin A Supplements
  – Dose
    < 06 m  50000 IU
    06m – 01 yr. 100000 IU
    > 01 yr. 200000 IU

• Local
  – Eye Patch
  – Mydriatics
VITAMIN A DEFICIENCY - PREVENTION

• Breast Feeding

• Along with Measles vaccination

• Diet
HYPERVITAMINOSIS

A Real Incident in Assam

• On a single day, (11 November 2001), 3.2 million children - Part of the UNICEF’s vitamin A campaign.
• Same day, about 1,000 children fell ill - vomiting, nausea and headache.
• **15 deaths** were in the **1-3 year** age group.
• **Bulging of anterior fontanels** 16% of young children

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HYPERVITAMINOSIS
VITAMIN A TERATOGENICITY

- Teratogens
- Antenatal mothers
- Treatment for Acne Vulgaris
SUMMARY - VITAMIN A

• Common Deficiency state

• Mostly Sub clinical

• Severe deficiency leads to Blindness

• Easily treatable

• Easily preventable
VITAMIN D
INTRODUCTION

• Vitamin D - bone health and calcium homeostasis
• Now - potential role vitamin D plays in health and disease
• Vitamin D is not a true vitamin
• Recent data - deficiency is pandemic
• Even the healthy and the young are not spared
• High prevalence rates are reported in otherwise healthy infants, children and adolescents
• Also from diverse countries around the world including India
Two main forms

- Vitamin D2 (ergocalciferol), obtained from influence of ultraviolet B radiations (UVR) on plants and yeast
- Vitamin D3 (cholecalciferol), produced in skin by UVR (UV-B and not UV-A)
VIT D RECEPTORS (VDRS)

• VDRs in non-osseous tissues - heart, intestine, liver, kidney, lungs, brain, muscle, skin, pancreas and various immune cells.

• Suggest local autocrine and paracrine role for vitamin D in addition to it’s role as an endocrine hormone

• Nonskeletal autocrine effects - independent of regulation by serum calcium, phosphorus and PTH levels

• This observation gave birth to the concept of maintaining an adequate blood level of vitamin D for regulating it’s various non-osseous functions.
PARADOX OF HYPOVITAMINOSIS D

• Factors inspite of abundant sunshine (duration and timing of sun exposure)
• Amount of skin exposed, atmospheric pollution, skin pigmentation, sunscreen use, dietary and genetic factors
• UV-B, having shorter wavelength, tend to scatter earlier or later in the day and hence cutaneous vitamin D synthesis is maximum between 10 AM to 3 PM, the time when most of the children are either in school or indoors.
• Exposure of only face, hands and arms due to clothing versus whole body is associated with marked differences in vitamin D synthesis
• Cloud cover, increasing water vapour and industrial pollution
SOME FACTS

• Epidermal melanin (a natural sunscreen)
  – reduces the risk of skin cancer induced by UVR
  – reduces cutaneous vitamin D synthesis
• Asian Indian would require 3 times the sun exposure than light-skinned person to produce equivalent amount of vit D
• It is interesting to note that women of all population have lighter skin than men, presumably because of increased vitamin D needs during pregnancy and lactation
• Sunscreens block UV-B more than UV-A and sunscreens with SPF of 8 and 15 will decrease vitamin D synthetic capacity by 95% and 98%, respectively
VITAMIN D - SOURCES

• Vegetarian / Non Vegetarian
  (dietary source through fatty fishes, organ meat, egg yolk, cod liver oil and milk products does not contribute significantly as these are not consumed in sufficient quantities by children)

• Recommended Daily Allowance
  Infant  400 IU
  Children 1 – 6 yr.  600 IU
  Later  1000 IU
VITAMIN D DEFICIENCY

- Easily diagnosed in presence of clinical features of rickets.

- Rickets is an extreme form and represents the tip of iceberg.

- Improved understanding of the detrimental effects of insufficient vitamin D before the appearance of rickets led to a growing interest in these lesser degrees of vit D deficiency and diagnosing this prerachitic, subclinical vit D deficiency is important for nonskeletal health benefits.

- Serum 25 (OH) D level is the best available biomarker for the diagnosis of vit D def. It should be emphasized here that serum level of 1,25(OH)2D is not a good indicator of vit D def.
VITAMIN D STATUS IN RELATION TO 25(OH) LEVEL (ng/ml)

• Severe deficiency ≤ 5
• Deficiency ≤ 15
• Insufficiency 15-20
• Sufficiency 20-100
• Excess > 100
• Intoxication > 150

• Vitamin D is measured in various units; 400 IU equals 10 µg or 26 nmol.
VITAMIN D DEFICIENCY

Rickets / Osteomalacia

• Disease of Growing Bone

• Unusual < 03 months

• Common > 06 months upto 03 years

• Types
  Nutritional (Vit D, Ca, P)
  Non Nutritional (Liver, Renal disorders)

NO GROWTH - NO MANIFEST RICKETS
RICKETS – CLINICAL FEATURES

Head
Craniotabes
Wide Anterior Fontanelle
Frontal & Parietal Bossing
Caput Quadratum
RICKETS – CLINICAL FEATURES

Eyes - Lamellar cataract
Oral - Poor Enamel formation
Upper limbs – Wide wrists
Chest
   Rachitic Rosary
   Pectus Carinatum
   Harrison’s Sulcus
RICKETS – CLINICAL FEATURES

Abdomen – Pot belly
  Viceroptosis
Spine – Kyphosis / Scoliosis
Lower limbs
  Bow legs
  Double malleoli
Easy Fractures
Short Stature
Motor Developmental Delay
RICKETS – BIO CHEMICAL CHANGES

Vit D → ↓ Ca Absorption from gut → ↓ Sr Ca

Ca - N P - ↓ Ca From Bone
↑ Ca Excretion from Kidneys
↓ Reabsorption from kidneys

↓ Ca P → ↑ Osteoblastic Activity → ↑ ALP

↑ PTH
RICKETS- RADIOLOGICAL CHANGES

- Cupping
- Fraying
- Splaying
RICKETS- RADIOLOGICAL CHANGES
RICKETS- DIAGNOSIS

• Clinical

• Bio chemical

• Radiological
RICKETS- TREATMENT

- 6 Lac units of Vitamin D
- Calcium, Phosphorus supplements
- Repeat X Ray after 2 weeks
- White line visible
- If not, Repeat 6 Lac units
- If no response, resistant rickets
## TREATMENT OF PRE RACHITIC DEFICIENCY
(BASED ON SERUM 25(OH)D LEVELS)

<table>
<thead>
<tr>
<th>Serum 25(OH)D (ng/mL)</th>
<th>Low dose Vitamin D therapy (IU/day)</th>
<th>High dose Vitamin D therapy (IU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>8000</td>
<td>50,000/week × 4 w</td>
</tr>
<tr>
<td>3 m</td>
<td></td>
<td>50,000/fortnight × 8 w x</td>
</tr>
<tr>
<td>5 – 15</td>
<td>4000</td>
<td>50,000/fortnight × 3 m</td>
</tr>
<tr>
<td>16-30</td>
<td>2000</td>
<td>50,000/month × 3 m</td>
</tr>
</tbody>
</table>
RICKETS- PREVENTION

- Diet
- Supplements
- Exposure to sunlight
HYPERVITAMINOSIS

- Anorexia
- Hypotonia
- Irritability
- Failure to thrive
- Calciuria
- Metastatic calcification
SUMMARY - VITAMIN D

• Not only endocrine, but also auto & paracrine
• Deficiency is called Rickets
• Disease of growing bone
• Causes – Nutritional / Non Nutritional
• Diagnosed by clinical, Bio chemical and Radiological
• Treated by supplements
VITAMIN E
VITAMIN E

• Active compound-Tocopherol

• Anti oxidant / Anti neoplastic effect

• Increases HDL cholesterol

• Sources – Nuts / Poly unsaturated vegetable oils

• Recommended Daily Allowance
  Premature 15 - 20 IU / d
  Infants 3 mg of α Tocopherol
VITAMIN E

Deficiency
Mainly in Low Birth Babies
Anemia, Thrombocytopenia, Reticulocytosis
Decreases Retinopathy of Prematurity

Clinically: Loss of Deep Tendon Reflexes, Ataxia, Muscle weakness, Ptosis, Dysarthria

Prevention
VITAMIN K
VITAMIN K

• Synthesis of clotting factors II, VII, IX, XI

• Sources - Green Leafy vegetables

• Deficiency - Coagulopathy
  New Born – Hemorrhagic Disease of New born
  Early / Classic / Late

• Treatment – Vitamin K Supplements

• Prevention – Inj Vitamin K at Birth
SUMMARY

• Fat soluble vitamins are A, D, E & K
• Vitamin A deficiency - Blindness
• Vitamin D deficiency - Rickets
• Vitamin E deficiency - Anemia
• Vitamin K deficiency - Coagulopathy
• Sources – Cheap, Easily available
• Early detection, mortality and morbidity
THANK YOU