Annotated Outline

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Topic: Strontium Overload and Toxicity

Outline

A. Introduction

1. Strontium basic physical and biochemical properties {Schrooten, 1998 #1;Cabrera, 1999 #9}
    - Strontium exhibits a number of physiochemical similarities to calcium {Dahl, 2001 #49}
    - Distribution throughout the body {Cabrera, 1999 #9;Schrooten, 1999 #43}
2. Source of exposure: environmental
    - Strontium is a natural constituent of food (highest concentrations appear in cereals, grains, and seafood) {Schrooten, 1999 #43;Cabrera, 1999 #9}
    - Strontium is the most abundant trace element in ocean water {Cabrera, 1999 #9}
3. Source of exposure: industrial {Cabrera, 1999 #9}
    - Research on toxicity has focused on strontium-90, a constituent of nuclear fallout
4. Source of exposure: medical {Cabrera, 1999 #9}
    - Limited number of radioactive isotopes used for treating bone pain, and used for marker of calcium metabolism
    - Dietary supplementation to inhibit intestinal absorption of strontium-90 ingestion
5. Route of exposure {Cabrera, 1999 #9}
    - Gastrointestinal tract represents the main route of entry

- Strontium is also absorbed by the lung and skin

B. Renal Osteodystrophy {Monier-Faugere, 1996 #47;Couttenye, 1999 #2}

1. Hyperparathyroidism
2. Adynamic Bone Disease
3. Osteomalacia
    - Rare prevalence in developed countries since decrease in aluminum intoxication {Hercz, 1987 #55;Sherrard, 1993 #46}
    - Bone biopsies {Malluche, 1999 #56}
    - Several causes: acidosis, uremic toxin, vitamin D deficiency {Kraut, 1995 #57}
    - Metal causes: aluminum, iron, copper, cadmium, tin, fluoride, and strontium {Schrooten, 1998 #1;Smythe, 1982 #22;D'Haese, 1999 #4}

C. Fluoride and bone

1. Retention of fluoride in patients with chronic renal failure {Spencer, 1980 #50}
2. In rats with CRF, fluoride induced osteomalacia at high doses {Turner, 1996 #48}
3. In patients treated for osteoporosis, osteomalacia is observed with decreased renal function
4. Serum fluoride levels increased with renal failure {al-Wakeel, 1997 #51}
5. Bone fluoride levels are increased in dialyzed patients, but no histological fluorosis (Erben, 1987)

D. Strontium overload and bone diseases {D'Haese, 2000 #5}

1. Strontium is incorporated and retained in newly formed bone according to cumulative exposure and doses {Dahl, 2001 #49}
2. In normal rats: mineralization defects at high doses {Marie, 1993 #58;Grynpas, 1996 #19}
3. In renal insufficient rats: high doses induces osteomalacia {Morohashi, 1994 #17;Schrooten, 1998 #1}
4. High strontium content in osteomalacic patients dialyzed mainly in underdeveloped countries {Schrooten, 1999 #43;D'Haese, 2000 #5}

5. Strontium source in dialysis {Schrooten, 1999 #43}

E. Prevalence of dialysis osteomalacia and other renal bone diseases in bone biopsies: strontium and fluoride content (reference?)

1. Methods
2. Prevalence of osteomalacia, adynamic bone disease, and hyperparathyroidism
3. Strontium content
4. Fluorosis
    - Periosteocytic mottled osteoid
    - Intra-trabecular mineralization defects
    - Mottled bone
    - Low bone turnover
    - Increased osteoid thickness
    - Maintained cellular activity

F. Other Metals

1. Lanthanum