Metabolic Bone Disease of Prematurity

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Metabolic Bone Disease of Prematurity

- Aetiology
- Fractures
- Assessment
- Prevention
Aetiology of Metabolic Bone Disease of Prematurity
Aetiology of Metabolic Bone Disease of Prematurity

- **Preterm birth** - bulk of the mineral transfer from mother to baby occurs in last third of pregnancy

- **Inadequate supply of minerals** in diet after birth

- **Increased loss of minerals from infant’s bones** after birth:
  - Stoppage of movements
  - Loss of oestrogen
Aetiology of Metabolic Bone Disease of Prematurity

Increased risk of MBP

- ≤1000 gm birth weight (ELBW)
- Prolonged TPN (>2 weeks)
- Medications
  - Corticosteroids
  - Frusemide
- Inadequate bone-nutrient intake
- Increased urinary Phosphate wastage
Metabolic Bone Disease of Prematurity

- Humerus of 26 week gestation, preterm infant at birth (A) and 6 weeks later (B)
- Marked thinning of the cortex
- Osteopaenia

Poznanski et al. Radiology 1980
Post-natal Changes in Bone Mineralisation

Greer FR J Peds 1988
Aetiology of Metabolic Bone Disease of Prematurity

- Longitudinal study in 85 preterm infants < 1.5 kg
- Measured Speed of Sound (SOS m/s)
- Tibial length (measured by knemometry)
A longitudinal study of tibial speed of sound and lower limb length in preterm infants

Knee heel length (mm) over time

Postnatal age (weeks)

Knee heel length (mm)

120 110 100 90 80 70 60 50

0 2 4 6 8 10 12 14 16

Postnatal age (weeks)

Tibial SOS (m/s)

r = 0.96; p < 0.001

r = -0.28; p < 0.033
A longitudinal study of tibial speed of sound and lower limb length in preterm infants

Tibial SOS (m/s) over time

Postnatal age (weeks)

16 14 12 10 8 6 4 2 0

Tibial SOS (m/s)

3200 3000 2800 2600 2400 2200

Individual tibial SOS (m/s) over time

Postnatal age (weeks)

0 2 4 6 8 10 12 14 16

Tibial SOS (m/s)

3200 3100 3000 2900 2800 2700 2600 2500 2400 2300 2200

Postnatal age (weeks)
Post-natal Immobilisation

Hormones (e.g. oestrogen)
Cytokines
Calcium
Vitamins
Growth factors etc

Fractures
Fracture Incidence in Low Birth Weight Infants

- 78 VLBW infants; 23 to 36 week gestation
- Human milk or formula fed
- 69% had evidence of fracture
- Most common sites:
  - Ribs
  - Radius ulna
  - Femur

How common are rib fractures in extremely low birth weight preterm infants?

D Smurthwaite,¹ N B Wright,² S Russell,³ A J Emmerson,⁴ M Z Mughal¹

ABSTRACT

Background: This study was prompted by incidental finding of healing rib fractures on chest radiographs of ex-preterm born infants, who were admitted to hospital with acute respiratory illnesses within a few weeks of discharge from the neonatal intensive care unit (NICU). Rib fractures in infants, particularly those situated posteriorly, are considered to be specific for non-accidental injury (NAI).

Methods: Retrospective examination of radiographs of extremely low birth weight (ELBW) infants (<1000 g) with a gestation range of 22 of 33 weeks, cared for at a tertiary NICU, between 1998 and 2002, and who had survived ≥4 weeks.

Results: Five out of 72 (7%) infants studied had radiologically apparent rib fractures. None involved posterior rib shafts. All infants with rib fractures died on the NICU.

Conclusions: The possibility of NAI should be considered in ex-ELBW infants found to have rib fractures.

What is already known on this topic

1. Fractures of ribs can occur in very low birth weight infants with metabolic bone disease of prematurity.
2. In young infants, posterior rib fractures are considered to be specific of non-accidental injury.

What this study adds

1. Radiologically apparent rib fractures were present in 7% of extremely low birth weight preterm infants who had survived ≥4 weeks.
2. No infant had posterior rib fractures and all infants with rib fractures died on the neonatal intensive care unit.
Subjects

- 106 infants identified
- 72 included in the study
- Birth weight range 450 - 990g
- Gestation range 22 - 33 weeks
- All radiographs reviewed by Dr Neville Wright (n=1762)
- 20% radiographs reviewed by Dr Sarah Russell (n=558)

Results 1

*Number and Sites of rib fractures*

- 5 infants (7%) had Rib #s
- NONE had posterior shaft #s
- All infants with rib #s died
- 3 infants had non Rib #s

Mann Whitney U Test: *Infants with Rib #s* vs *those with No #s*

- Highest Alkaline Phosphatase (ALP) \( p = 0.08 \)
- Birth weight \( p = 0.52 \)
- Gestation \( p = 0.22 \)
- Corticosteroids \( p = 0.07 \)
- Frusemide \( p = 0.03 \) *
- Chronic Lung Disease \( p = 0.36 \)
- Chest Drains \( p = 0.57 \)
- Total Parenteral Nutrition (TPN) \( p = 0.08 \)

Summary

- Only 7% of ELBW infants had radiologically apparent Rib #s
- All infants with Rib #s died
- None had posterior Rib #
- No temporal relationship between CPR & Rib #s
- Infants with Rib #s more likely to be treated with Frusemide.

Assessment & Prevention
Assessment of MBDP

- **Clinical:**
  - Serum Calcium and Phosphate concentrations
  - Serum Alkaline Phosphatase activity
  - Serum PTH
  - Radiographs – when necessary

- **Research:**
  - Biochemical markers of bone turnover
  - Bone densitometry
  - Quantitative ultrasound
Recommended Intake for Premature Infants (per Kg/day)

- **Energy**: 110 - 130 Kcal
- **Calcium**: 140 - 180 mg
- **Phosphorus**: 80 - 90 mg
- **Vitamin D**: 400 IU

*Needs met by fortification of mother’s milk or premature infant formula*
Severe Secondary Hyperparathyroidism
Could a program of daily physical activity with adequate dietary intake improve bone mineralisation in premature infants?
Distal 1/3 Radius Bone Mineral Change by pDXA

Moyer-Mileur et al, J Peds 1995
Thank You