Plasma 25-hydroxycholecalciferol before and after supplementation in paediatric oncology patients from Scotland: a time-series cross-sectional study

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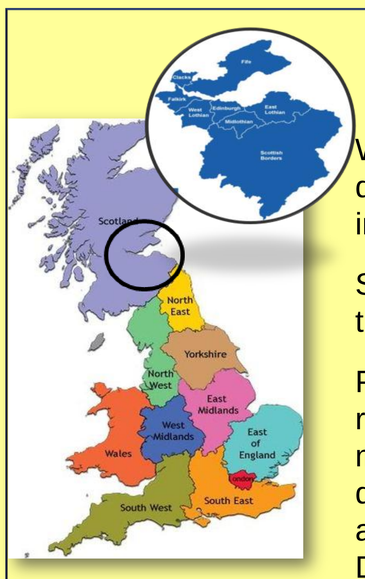
INTRODUCTION



Worldwide, 25-hydroxycholecalciferol [25(OH)D] deficiency and insufficiency ranges from 14-49% in healthy children and adolescents[1].

Symptomatic 25(OH)D deficiency is increasing in the Scottish paediatric population[2].

Paediatric oncology patients are at even higher risk of becoming deficient because they spend more time indoor, often have an inadequate dietary intake and increased 25(OH)D catabolism as a result of treatment induced side-effects[3]. Despite this, guidelines on supplementation remain inconsistent in this population.

Survivors of childhood cancer have an increased risk of developing the metabolic syndrome, cardiac complications and have a reduced peak bone mass due to related treatment side-effects, which might be exacerbated by vitamin D deficiency during and after the completion of therapy[3].

AIMS

- To assess the impact of micronutrient and macronutrient supplementation on plasma 25(OH)D in paediatric oncology patients from SE Scotland.
- To assess parathyroid hormone (PTH) levels before and after supplementation and whether this correlates with 25(OH)D in our paediatric oncology patient-cohort.

METHODS

A case-control time series cross-sectional study was performed.

We included patients aged <18 years, diagnosed and treated for cancer.

We excluded patients treated palliatively.

Childhood cancer was categorised into four groups: solid tumours, haematological malignancies, brain tumours and other associated-diagnoses.

Plasma 25(OH)D and PTH was measured in healthy children (controls) and paediatric oncology patients (cases).

Supplementation was prescribed to paediatric oncology patients according to Subjective Global Assessment by the multidisciplinary team and consisted of macronutrient (enteral, +/- parenteral nutrition) and micronutrient (vitamin D, multivitamins, +/-macronutrient).

Vitamin D obtained from both diet and macronutrient supplementation was documented.

25(OH)D deficiency was classified according to Endocrine Society Clinical Practice Guidelines 2011:

- Suboptimal (50-75nmol/L)
- Insufficient (25-50nmol/L)
- Deficient (<25nmol/L).

PTH range: 1.6-7.5pmol/L (Scottish Laboratory reference).

Plasma 25(OH)D was measured using the Automated Vitamin D Immunoassay in Glasgow Royal Infirmary Laboratory and the Great North Children's Hospital, Newcastle.

Descriptive statistics, Spearman's and Wilcoxon's test were performed.

RESULTS

35 healthy controls and 67 paediatric cancer patients were recruited.

Plasma 25(OH)D levels did not statistically differ between the 35 healthy-controls (median (IQR) 31 (15-56) nmol/L) and the 67 patients (median (IQR) 35 (20-58) nmol/L) at diagnosis. Characteristics of the controls and the cases did not differ.

Characteristics of the cases:

- Age: median (IQR) age: 7.8 (5.5-12.03) years
- Gender: 59% M and 41% F
- Ethnicity: non-white 2.5%, white 97.5%
- Diagnostic criteria: Solid tumours 46% (31); haematological malignancies 40% (27), brain and benign tumours 7.5% (5) and other associated diagnoses 6% (5)

40/67 patients had plasma 25(OH)D measured before and after supplementation

At diagnosis

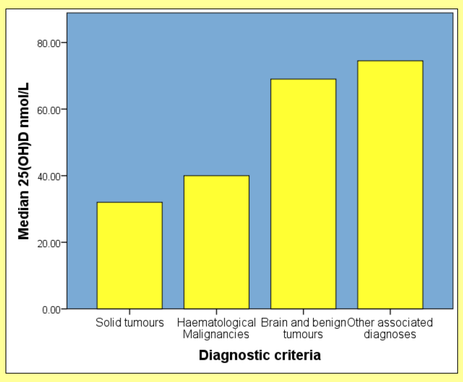


Figure 1. Plasma 25(OH)D levels of paediatric cancer patients at diagnosis express as median (nmol/L)

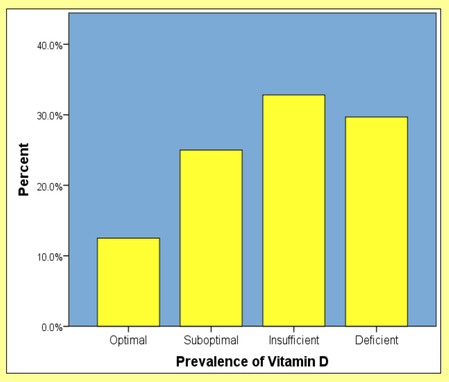


Figure 2. Overall prevalence of 25(OH)D levels in paediatric cancer patients at diagnosis (expressed as percentage)

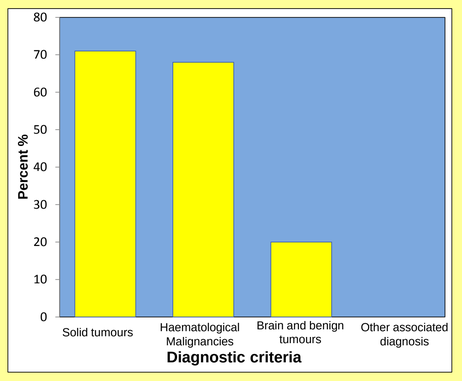


Figure 3. Prevalence of 25(OH)D deficiency and insufficiency in paediatric cancer patients (stratified by type of cancer) at diagnosis.

Plasma 25(OH)D before and after supplementation

Median (IQR) time between diagnosis and supplementation was 2.9 (0.9-6.3) months and between supplementation and the repeated 25(OH)D measurement 2.7 (1.6-6.7) months.

Baseline n=40
25(OH)D median (IQR) 35 (20-58) nmol/L
Suboptimal: 23%
Insufficient & Deficient: 62.5%
PTH median (IQR) 3.5 (2.3-5.0) pmol/L
Hypoparathyroidism: 12.5%
Hyperparathyroidism: 7.5%

Before macronutrient supplementation
(n=7;17.5%)
25(OH)D median (IQR)
77 (42-81) nmol/L
Suboptimal: 28%
Insufficient & Deficient: 14%
PTH median (IQR) 3.6 (1.45-5.75) pmol/L

Before micronutrient supplementation
(n=33; 82.5%)
25(OH) median (IQR) 26.5 (15-27) nmol/L
Suboptimal: 14%
Insufficient & Deficiency: 38%
PTH median (IQR) 3.3 (2.3-5.0) pmol/L
Hyperparathyroidism: 9% (3/33)
Hypoparathyroidism: 15% (5/33)

After macronutrient supplementation
(n=7;17.5%)
25(OH)D median (IQR) 54 (19-89) nmol/L (p>0.05)
Dietary vitamin D median (IQR) 8.55 (6.19-10.15) µg/day
43% of patients remained with suboptimal 25(OH)D
PTH median (IQR) 4.3 (1.45-5.75)

After micronutrient supplementation
(n=33; 82.5%)
25(OH)D median (IQR) 65.5 (44-87) nmol/L
sig ↑ p< 0.001; r=-0.7
20% remained with suboptimal 25(OH)D levels
PTH median (IQR) 3.0 (2.0-4.4)
9% remained with hypoparathyroidism

PTH and 25(OH)D correlated only in healthy controls, but no significant correlation was observed in paediatric cancer patients (figures 4,5,6).

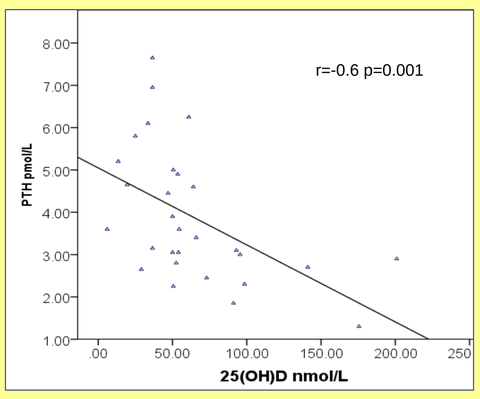


Figure 4. Correlation between 25(OH)D and PTH levels of healthy controls

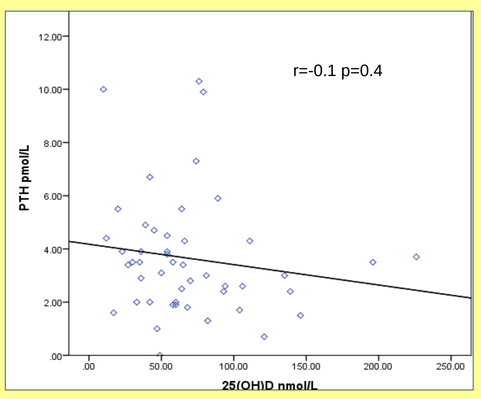


Figure 5. Correlation between 25(OH)D and PTH levels before supplementation

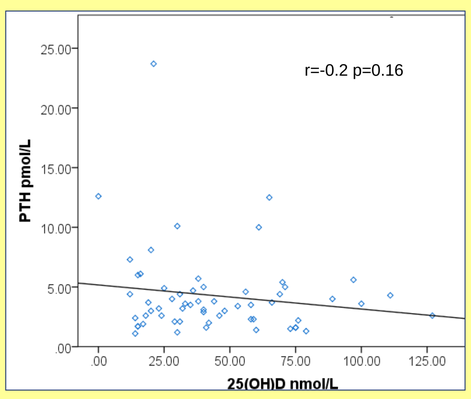


Figure 6. Correlation between 25(OH)D and PTH levels after supplementation.

Conclusion

- 25(OH)D deficiency was highly prevalent in paediatric cancer patients and in healthy controls from SE Scotland.
- Children diagnosed with solid tumours followed by haematological malignancies had the highest prevalence of vitamin D insufficiency and deficiency.
- PTH and 25(OH)D did not correlate at any stage measured, suggesting that there are other factors influencing both of these parameters.
- 25(OH)D levels improved only after micronutrient supplementation and deteriorated after macronutrient supplementation alone, suggesting that the latter form of supplementation does not meet the vitamin D needs of this population.
- To optimise the 25(OH)D status, regular monitoring alongside appropriate supplementation, which must be adapted to the specific needs of this population, should be incorporated into clinical practice.

Acknowledgements

We would like to thank the Fergus Maclay Leukaemia Trust, the Leukaemia Research Fund and Queen Margaret University for their generous grants. We would also like to thank to all the participants for their collaboration

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