

Effects of seasonality on blood ionized calcium in early neonatal periods

Zheng Ming-Ci, Zhou Lu Sheng, Zhang Guo Feng

Department of Pediatrics, Affiliated Hospital, Guilin Medical College, Guilin, 541001, China.

The levels of whole blood ionized calcium were observed in 200 healthy neonates in the first week of life in spring and in summer. Levels of blood ionized calcium were lower in neonates born in spring compared to those of neonates born in summer. The levels of blood ionized calcium in adults did not change in different seasons. This study suggested that seasonality had a significant effect on blood ionized calcium in early neonatal life.

Introduction

Ionized calcium is thought to be the biologically important fraction of calcium¹. With the introduction and development of commercially available instruments, measurements of ionized calcium have become feasible in clinical practice. Such capillary blood measurements in neonates², have become important for the assessment of neonatal calcium disturbances²⁻⁴. Recently, cross-sectional and longitudinal reference values have been proposed for ionized calcium in neonates^{5,6}. However the published reference values for ionized calcium are widely dissimilar among laboratories. Differences in analytical systems and sample materials may partly account for this⁷. Since significant changes of 25-hydroxyvitamin D₃ levels in humans occur in plasma with the seasons^{8,9}, we examined the hypothesis that seasonality may affect levels of blood ionized calcium in young neonates.

Materials and methods

Ninety neonates born in the spring, ie between March and April, and 110 neonates born in the summer, ie between August and September, were studied during the first week of life in the Chinese city of Guilin. The reference values of neonates are shown in Table 1. All neonates were healthy and were fed with human breast milk. The mean age of participating mothers was 26.7±4.3 years and the mothers had no previous history of bone disease, nor were they receiving vitamin D supplements.

Permission for this study was obtained from each

Table 1. Study neonates born in the spring and summer.

	Spring	Summer
Number of infants	90	110
Number of specimens	185	197
Birth weight (g)	3354±323	3438±412
Gestational period (week)	39.5±1.1	39.3±0.8

mother. The control group consisted of 30 healthy adult volunteers.

Analytical instrument

Ionized calcium concentrations and pH values in whole blood were measured with a 634 ionized calcium analyzer (Ciba Corning), which calculated ionized calcium at pH 7.4. Our intra-assay coefficient variation for ionized calcium was 2%.

Collection of blood

Capillary blood for measurement of ionized calcium was collected from the earlobe of adults and the lateral edge of the heels of neonates in the first 8 hours and again in 1-7 days of life in special heparinized capillary tubes (Corning). The venous blood of the umbilical cord was collected with syringes heparinized by calcium balanced heparin (Corning).

Statistical methods

The results were expressed as mean±SD. Statistical analysis was performed by Student's T-test using a Lotus-1,2,3 program on an EPSON computer.

Results

The values of blood ionized calcium of neonates born in the spring were lower than that of those born in the summer (Table 2). There were no differences in mean values for ionized calcium in healthy adults between the spring and the summer.

Discussion

Ionized calcium is the biologically important fraction of

Table 2. Comparison of blood ionized calcium in different seasons.

Age (days)	Cord blood		0		1		2		3	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Number	19	20	26	21	23	22	22	21	24	24
Mean±SD	1.31±0.11	1.34±0.06	1.12±0.10	1.19±0.09	1.05±0.06	1.11±0.11	1.02±0.07	1.13±0.11	1.02±0.08	1.18±0.11
P value	<i>t</i> =1.25, <i>P</i> >0.05		<i>t</i> =2.05, <i>P</i> <0.05		<i>t</i> =2.17, <i>P</i> <0.05		<i>t</i> =3.86, <i>P</i> <0.01		<i>t</i> =5.83, <i>P</i> <0.01	
Age (days)	4		5		6		7		Adults	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Number	21	23	17	24	17	19	16	23	18	20
Mean±SD	1.06±0.09	1.25±0.08	1.14±0.11	1.75±0.07	1.15±0.07	1.29±0.06	1.23±0.07	1.31±0.07	1.26±0.04	1.25±0.05
P value	<i>t</i> =7.27, <i>P</i> <0.01		<i>t</i> =4.09, <i>P</i> <0.01		<i>t</i> =6.49, <i>P</i> <0.01		<i>t</i> =3.32, <i>P</i> <0.01		<i>t</i> =0.67, <i>P</i> >0.05	

calcium and therefore should theoretically be clinically more relevant than total calcium. Some researchers have stated that neonatal hypocalcemia is best defined in terms of ionized calcium concentration. In the early neonatal periods, calcium metabolism is affected by several factors¹⁰⁻¹². With respect to the significant seasonal variation in serum 25-hydroxyvitamin D₃ in man, it is speculated that seasonality may affect ionized calcium levels in early stages of neonatal life. Our data showed that in the first week of life neonates born in the spring had lower blood ionized calcium levels compared to those of neonates born in the summer, demonstrating the seasonal effect on blood ionized calcium in neonates.

Our mean values for blood-ionized calcium in healthy adults were similar to those of previous reports⁷ and no difference was found between the spring and the summer. This suggested that season had no effect on blood ionized calcium level in adults. The reason for this may be attributable to the adequate storage of vitamin D and stable regulation system for blood-ionized calcium in healthy adults. In contrast to adults, in early neonatal life, the regulatory system for blood ionized calcium is not well established and calcium homeostasis is easily affected by the vitamin D status of mothers^{12,13}. Because the content of vitamin D in the ordinary diet is inadequate, the synthesis of vitamin D in the skin by ultraviolet rays in sunlight is important. Due to inadequate direct exposure to sunlight of pregnant women, neonates born in the spring may have less storage of vitamin D in their bodies¹⁴. As a result, the regulatory ability for ionized calcium and the absorption of calcium in intestine may be assumed to be deficient and cause the lower blood ionized calcium levels in these neonates.

Our present study suggests an effect of seasonality on the blood-ionized calcium in neonates during the first week of life. The discrepancies in different laboratories for ionized calcium may also be seasonal. It is necessary to consider seasonality when the normal reference values of blood-ionized calcium for neonates in early life are established.

Acknowledgements — This study was supported in part by grants from the Ministry of Education of China.

References

- Buckley BM and Russell LJ. The measurement of ionized calcium in blood plasma. *Ann Clin Biochem* 1988; 25:447-51.
- Wandrup J et al. The concentration of free calcium ions in capillary blood from neonates on a routine basis using the ICA 1. *Scand J Clin Lab Invest* 1984; 44:19-24.
- Nelson N et al. Neonatal reference values for ionized calcium phosphate and magnesium. *Scand J Clin Lab Invest* 1987; 47:111-7.
- Wandrup J et al. The concentration of free calcium ions and total calcium in pregnancies at term. *Scand J Clin Lab Invest* 1982; 42:273-7.
- Manzke H, Haas HJ, Engel E. Verlaufsuntersuchungen des Kalziumstoffwechsels bei Mutter und Kind warend der Perinatal-periods. *Med Welt* 1980; 31:241-7.
- Wandrup J et al. Age-related reference values for ionized calcium in the first week of life in premature and full-term neonates. *Scand J Clin Lab Invest* 1988; 48:255-60.
- Wandrup J. Critical analytical and clinical aspects of ionized calcium in neonates. *Clin Chem* 1989; 35:2027-33.
- Kobayachi T et al. Variation of 25-hydroxyvitamin D₃ and 25-hydroxyvitamin D₂ levels in human plasma obtained from 758 Japanese healthy subjects. *J Nutr Sci Vitaminal* 1983; 29:271-81.
- Savolainen K et al. A seasonal difference in serum 25-hydroxyvitamin D₃ in a Finnish population. *Med Biol* 1980; 58:49-52.
- Lewis P et al. Circulating levels of biologically active and immunoreactive intact parathyroid hormone in human newborns. *Pediatr Res* 1991; 29:201-7.
- Bonny L et al. Low serum calcium and high parathyroid hormone levels in neonates fed 'humanized' cow's milk-based formula. *AJDC* 1991; 145:941-5.
- Pitkin RM. Calcium metabolism in pregnancy and the perinatal period: A review. *Am J Obstet Gynecol* 1985; 151:99-109.
- Hoogenboezem T et al. Vitamin D metabolism in breast-fed infants and their mothers. *Pediatr Res* 1980; 25:623-8.
- Ron M et al. Transfer of 25-hydroxyvitamin D₃ and 1,25-dihydroxyvitamin D₃ across the perfused human placenta. *Am J Obstet Gynecol* 1984; 148:370-4.

Effects of seasonality on blood ionized calcium in early neonatal periods

Zheng Ming-Ci, Zhou Lu Sheng and Zhang Guo Feng.

Asia Pacific J Clin Nutr (1993) 2:125-127

季節對新生兒早期血液離子鈣的影響 摘要

作者在春、夏季觀察了200個健康新生兒頭一周的全血離子鈣含量。發現在春季出生的新生兒的全血離子鈣含量比夏季出生者低，成人全血離子鈣含量並無季節差異，該研究指出了季節對新生兒早期血液離子鈣有明顯的影響。

