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Calcitonin
calcium
low birth weight infants
magnesium
parathyroid hormone
phosphorus

Prevention of Early Neonatal Hypocalcemia in Low Birth Weight Infants with Continuous Calcium Infusion: Effect on Serum Calcium, Phosphorus, Magnesium, and Circulating Immunoreactive Parathyroid Hormone and Calcitonin

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Summary

This study was conducted in 41 premature infants during the first 48 hr of life to investigate the effect of a constant calcium infusion on serum calcium, phosphorus, magnesium, immunoreactive parathyroid hormone (iPTH), and immunoreactive calcitonin (iCT) in low birth weight infants (LBW). The infants were divided into two comparable groups. A control group (*group I*) included 16 infants who received a 10% glucose solution; a calcium group (*group II*) included 25 infants who received a 10% glucose solution with calcium gluconate, the amount of mineral calcium perfused being 35 mg/kg/day or 1.7 mEq/kg/day. No overall adverse effects were observed in the infants receiving the Ca infusion.

In the first group, mean serum Ca level decreased rapidly during the first 24 hr of life from 8.9 ± 0.7 mg/100 ml to 6.79 ± 1.07 mg/100 ml at 22–26 hr ($P < 0.001$) without any further significant change. In the second group, the mean serum Ca level remained stable from 1–3 hr (8.51 ± 0.61 mg/100 ml) to 44–48 hr (8.33 ± 0.94 mg/100 ml). The mean Ca levels were significantly higher in *group II* at 10–14 hr and 22–26 hr ($P < 0.001$). There was no significant change in mean serum P levels in both groups. The mean serum Mg levels were significantly higher in *group II* from 22–48 hr. Mean serum iPTH levels increased in both groups from 1–3 hr to 44–48 hr ($P < 0.001$) without significant difference at any time between the two groups. The mean serum iCT level showed a marked increase from 1–3 hr to 10–14 hr or 22–26 hr in both groups ($P < 0.001$) without significant difference between the two groups. In both groups of infants a negative correlation was observed between serum iCT and serum Ca levels at 22–26 hr. In *group I*, mean serum iCT levels decreased during the second day of life, whereas in *group II* there was no further significant change in mean serum iCT.

These data suggest that the administration of a continuous intravenous perfusion of calcium can prevent early neonatal hypocalcemia in low birth weight infants without depressing the parathyroid activity in the majority of the infants. They also indicate that the hypercalcitoninemia which is observed during the neonatal period is not closely dependent upon the serum Ca level; however, the finding of negative correlations between serum Ca and serum iCT levels suggests that the elevated serum iCT levels have a depressive effect upon serum Ca in low birth weight infants.

Speculation

The use of a prophylactic continuous calcium infusion has been advocated to prevent early neonatal hypocalcemia of low birth weight infants. In the normal adult calcium infusion is known to depress the parathyroid function and may stimulate the secretion of calcitonin. We wished to determine the effects of early continuous calcium infusion on serum parathyroid hormone and calcitonin levels in low birth weight infants.

Hypocalcemia occurs frequently in LBW infants during the first 48–72 hr of life (22, 30–32). For that reason some authors advocate a prophylactic continuous calcium infusion by peripheral vein in all LBW infants after birth (1, 20, 23, 27, 29). However, this proposal raises several important questions that have to be answered before it can be fully accepted. (*1*) What amount of calcium has to be given in order to be effective in preventing early neonatal hypocalcemia without risk of hypercalcemia? (*2*) Are there local or general complications to fear? (*3*) Calcium infusion depresses the parathyroid function and may stimulate the secretion of calcitonin in normal adults. Do such hormonal changes occur in the LBW infants under prolonged intravenous calcium infusion? If so, is late neonatal hypocalcemia to be expected once the calcium infusion is stopped? The aim of the present study was to answer these questions. Furthermore, we have examined the possible physiologic effect of a calcium infusion on serum magnesium, phosphorus, parathyroid hormone, and calcitonin levels in LBW infants.

MATERIALS AND METHODS

The study involved 41 premature and/or small for gestational age neonates, transferred during the first hours of life to the newborn intensive care unit of Edouard Herriot Hospital (Lyon) from March 1975 to September 1975. The gestational age was assessed by the Dubowitz score (11) (Table 1). According to Lubchencho's growth chart (19), 21 infants were small for gestational age. All but one infant had a birth weight below 2500 g. One infant with a gestational age of 37 weeks had a birth weight of 2700 g.

The clinical characteristics of the infants studied are presented in Table 1. The infants were divided into two groups: a control group, *group I*, included 16 infants who received a 10% glucose

Table 1. *Clinical characteristics*[1]

	LBW infants with Ca infusion, 35 mg/kg/day	LBW infants without Ca infusion	Student *t* test
No. of infants	25	16	
Prematures (GA below 37 weeks)	17	11	
SGA infants	11	8	
Weight (g), mean ± SD	2008 ± 392	2013 ± 351	NS
Range	1300–2700	1140–2500	
GA (weeks), mean ± SD	36.3 ± 3.34	36.2 ± 2.7	NS
Range	32–41	28–40	
Respiratory disorders	8	5	NS
pH at birth (mean ± SD)	7.32 ± 0.05	7.29 ± 0.07	NS

[1] LBW: low birth weight; GA: gestational age; SGA: small for gestational age; NS: not significant. Note that, in each group, three infants were SGA.

solution by a peripheral vein. 11 of the 16 infants were prematures; a "calcium group," *group II*, included 25 infants who received a 10% glucose solution with calcium gluconate added to the infusion; the amount of mineral calcium perfused was 35 mg/kg/day or 1.7 mEq/kg/day. Seventeen of the 25 infants of *group II* were prematures. The volumes (80 ml/kg) infused by a continuous calcium infusion (Braun pump, Perfusor IV, Melsungen, Germany) and the rate of infusion were similar in both groups of infants. Infusions were started immediately after the first blood sampling between 1 and 3 hr of age.

Thirteen of the 41 infants presented pathologic conditions including respiratory distress syndrome or mild transient tachypnea. There was no history of maternal diabetes. For each infant blood pH was determined just after birth, and was later checked regularly; corrections were made when necessary using appropriate intravenous bicarbonate infusions. No vitamin D supplement was given during the study. In all infants human milk was commenced at 12 hr of age.

DESIGN OF STUDY

One to 2-ml blood samples were drawn from the umbilical arterial catheter, or by peripheral venous puncture using a scalp vein needle at five given periods of time after birth; 1–3 hr; 10–14 hr; 22–26 hr; 34–38 hr; 44–48 hr. Forty infants had their sampling at time 1–3 hr; all infants had sequential blood sampling (two to five samples) and a total of 103 blood samples were submitted to laboratory analysis.

LABORATORY METHODS

The blood samples were centrifuged immediately after collection and the serum was stored at −28° until assay. Serum calcium, inorganic phosphorus, magnesium, and total protein were determined by an automatic Technicon SMA 12/60 analyzer, modified for microvolume serum analysis (400 μl). Serum Ca was determined by the method of Gindler (18), serum P by the method of Fiske and SubbaRow (14), and serum Mg by the method of Gindler (17). These methods allowed the determination of serum Ca and Mg on very small amounts of serum; we have previously observed that they are accurate and reproducible and that they give a very good correlation with the atomic absorption method ($r = 0.986$). Serum total protein was determined by the method of Weichselbaum (34); blood pH by the method of Astrup (25).

Serum immunoreactive parathyroid hormone (iPTH) levels were measured by a radioimmunoassay technique as described by Arnaud *et al.* (2). The guinea pig antiserum (GP6) and the purified bovine PTH used for ^{125}I labeling were a gift of Dr. Constantine S. Anast from the University of Missouri-Columbia, Department of Pediatrics. In gel filtration studies of serum from patients with primary and secondary hyperparthyroidism performed by C. S. Anast in his laboratory, GP6 antiserum detected a peak of immunoreactivity that corresponded to the ^{125}I bovine PTH marker (mol wt 9600) and a larger peak that eluted later than the marker. Further immunologic analysis of GP6 antiserum showed that the 1–34 synthetic bovine PTH fragment did not inhibit the interaction of GP6 with ^{125}I bovine PTH to a significant extent. This indicates that GP6 is a carboxyterminal type of antiserum which recognizes the 84 amino acid native hormones and the carboxyterminal circulating immunoreactive species (4, 13). A human hyperparathyroid serum was used as a standard reference and the concentration of iPTH in unknown serum samples was expressed in microliter equivalents of standard hyperparathyroid serum per ml (μl Eq/ml). The lower limit of sensitivity of the assay was 25 μl Eq/ml. Approximately 95% of normal children and adults have detectable values of serum iPTH with an upper limit of 100 μl Eq/ml. Mean ± SD serum iPTH from 37 normal children, aged 7 months to 16 years, was 63 ± 18 μl Eq/ml.

Serum immunoreactive calcitonin levels were determined by the radioimmunoassay technique of Tashjian and Voelkel (28). Synthetic human CT used for standards and as tracer antigen after ^{125}I iodination was kindly provided by Drs. Rittel and Maier from Ciba, Basel, Switzerland. Goat antiserum directed against human CT has been obtained from Drs. Dietrich and Fisher (Ciba, Basel, and Department of Orthopedic Surgery and Medicine, University of Zurich, Switzerland); a detailed description of this antiserum was published previously (9). Studies of the immunologic specificity of this antiserum performed in our laboratory indicated that large supraphysiologic concentrations of insulin, glucagon, growth hormone, gastrin, ACTH, or purified bovine PTH did not modify its interaction with ^{125}I labeled human CT. The antiserum was used at final dilution of 1/40,000. The lower limit of sensitivity of the assay was 150 pg/ml. In this system values of serum iCT were undetectable in normal children and adults. All samples were analyzed under identical conditions. In order to eliminate the effect of interassay and intraassay variations, samples from the same infant were grouped together in the same assay.

CALCULATION AND STATISTICAL ANALYSIS

For each period of time, results were expressed as mean ± SD. Paired tests, Student tests, and regression analysis were performed. All calculations were made by submitting the data to an Iris 60 computer (Département d'Informatique, Hospices Civils de Lyon).

RESULTS

GROUP I: INFANTS NOT RECEIVING CALCIUM INFUSION (PAIRED TEST ANALYSIS) (35)

Mean serum Ca level decreased rapidly during the first 24 hr of life from 8.99 ± 0.79 mg/100 ml at 1–3 hr to 7.07 ± 0.51 mg/100 ml at 10–14 hr ($P < 0.001$) and 6.79 ± 1.07 mg/100 ml at 22–26 hr ($P < 0.001$). There was no further significant change, mean serum Ca level at 44–48 hr was 7.42 ± 1.03 mg/100 ml (Fig. 1). There was no significant changes in mean serum P level from 1–3 hr (5 ± 0.74 mg/100 ml) to 22–26 hr (5.05 ± 1.17 mg/100 ml). However, at 44–48 hr a significant increase was observed with a mean serum *P* value of 5.92 ± 0.64 mg/100 ml ($P < 0.001$). Mean serum Mg level showed a small but not significant decrease during the first 24 hr of life from 1.6 ± 0.12 mg/100 ml at 1–3 hr to 1.45 ± 0.13 mg/100 ml at 22–26 hr; no significant change in mean serum Mg level was observed between 22–26 hr and 44–48 hr (1.54 ± 0.13 mg/100 ml) (Fig. 1). Serum protein levels did not show any significant change at any period of time (Table 2).

All infants studied at 1–3 hr had detectable levels of serum iPTH ranging from 25–240 μl Eq/ml with a mean of 77.2 ±

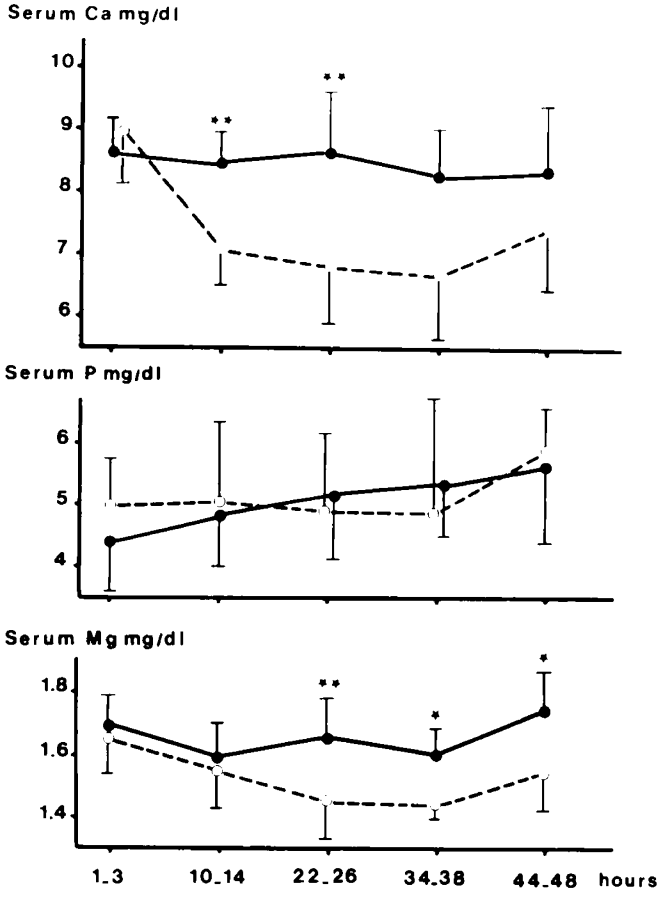

Fig. 1. Serum calcium, magnesium, and phosphorus during the first 48 hr of life in both groups. - - -: *group I* (without calcium infusion); ——: *group II* (with continuous calcium infusion); ★: significant difference ($P < 0.01$); ★★: significant difference ($P < 0.001$).

Table 2. *Total serum protein (grams per 100 ml) in both groups during the first 48 hr of life (mean ± SD)*[1]

Time	LBW with calcium infusion, 35 mg/kg/day	LBW without calcium infusion	Student *t* test
1-3 hr	4.80 ± 0.76	4.98 ± 0.67	NS
10-14 hr	4.27 ± 0.41	4.0 ± 0.52	NS
22-26 hr	4.26 ± 0.79	4.51 ± 0.65	NS
34-38 hr	4.22 ± 0.34	3.85 ± 0.34	NS
44-48 hr	4.55 ± 0.75	4.02 ± 0.7	NS

[1] LBW: low birth weight; NS: not significant.

45.9 μl Eq/ml (Fig. 2) (Table 3). There was a sustained increase in serum iPTH levels from 1-3 hr to 44-48 hr, reaching a mean serum iPTH value of 143.6 ± 47.9 μl Eq/ml ($P < 0.001$). All except 1 of the 16 infants showed an increase in serum iPTH levels above the 1-3 hr or 10-14 hr basal values.

Ten of the 14 infants studied at 1-3 hr had nondetectable serum iCT levels (<150 pg/ml); 4 infants had detectable levels of serum iCT ranging from 950-3000 pg/ml. In all 14 infants there was a marked increase in serum iCT levels from 1-3 hr to 10-14 hr and 22-26 hr, with a peak mean serum iCT value of 1850 ± 872 pg/ml at 10-14 hr (Fig. 3; Table 3). Serum iCT levels decreased during the second day of life. One of the eight infants studied at 44-48 hr had nondetectable serum iCT levels whereas five had detectable levels ranging from 700 to 2250 pg/ml. All nine infants studied serially at 10-14 hr and/or 22-26 hr on the one hand, and at 44-48 hr on the other hand, showed a decrease of serum iCT levels ($P < 0.001$).

GROUP II: INFANTS RECEIVING A CONTINUOUS CALCIUM INFUSION (PAIRED TEST ANALYSIS)

No remarkable local or general complications were observed during and after the infusion. Only one of the 25 infants demonstrated a serum Ca level above 10 mg/100 ml. This particular infant was a small for gestational age term neonate (gestational age: 39 weeks; birth weight: 1860 g); his serum Ca levels were 11.2 mg/100 ml at 22-26 hr and 9.6 mg/100 ml at 44-48 hr. In all but two infants the serum Ca level remained above 7 mg/100 ml.

The mean serum Ca level remained constant from 1-3 hr (8.51 ± 0.61 mg/100 ml) to 44-48 hr (8.33 ± 0.94 mg/100 ml) (Fig. 1). There was a significant increase in mean serum *P* levels from 4.39 ± 0.78 mg/100 ml at 1-3 hr to 5.69 ± 1.43 mg/100 ml at 44-48 hr. There was no significant change in mean serum Mg levels (Fig. 1). Serum total protein levels did not show any significant change at any period of time (Table 2).

All 13 infants studied at 1-3 hr presented detectable levels of serum iPTH (mean ± SD: 75.2 ± 45.9 μl Eq/ml). As in *group I*, there was a steady increase in mean serum iPTH from 1-3 hr to 44-48 hr (Fig. 2); this increase was already significant at 10-14 hr with a mean value of 116.2 ± 56.3 μl Eq/ml ($P < 0.05$). A mean value of 132 ± 56.2 μl Eq/ml ($P < 0.01$) was reached at 44-48 hr. All except 6 of the 25 infants showed an increase in serum iPTH levels above the 1-3 hr or 10-14 hr basal value (Fig. 2) (Table 3). Only 4 of the 14 infants studied at 1-3 hr had detectable levels of serum iCT ranging from 230-2400 pg/ml. A marked increase in serum iCT level was observed at 10-14 hr, reaching a mean value of 1686 ± 1327 pg/ml ($P < 0.01$). There was no further significant change in serum iCT (Fig. 3) (Table 3).

CORRELATION ANALYSIS

GROUP I: LBW INFANTS NOT RECEIVING CALCIUM INFUSION (35)

A negative correlation was found between serum Ca and serum P levels at 22-26 hr ($r = -0.51$; $P < 0.02$) and 34-38 hr ($r = -0.96$; $P < 0.01$). There was no correlation between serum Ca and serum Mg levels at any period of time. A negative correlation was found between serum Ca and serum iCT levels at 10-14 hr ($r = -0.72$; $P < 0.05$), 22-26 hr ($r = -0.62$; $P < 0.01$) (Fig. 4), and 44-48 hr ($r = -0.86$; $P < 0.01$). There was a negative correlation between serum Ca and serum iPTH levels at 10-14 hr ($r = -0.76$; $P < 0.05$). There

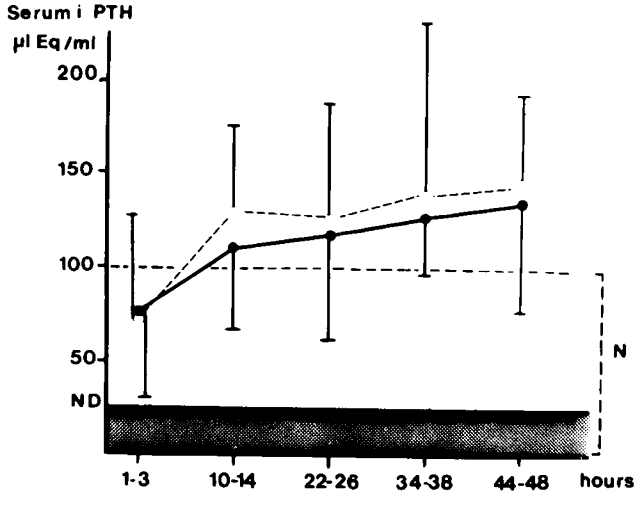

Fig. 2. Serum immunoreactive parathyroid hormone (*iPTH*) levels in both groups during the first 48 hr of life. - - -: *group I* (without calcium infusion); ——: *group II* (with continuous calcium infusion). Shadowed area indicates the nondetectable range of assay below 25 μl iCT (≤150 pg/ml)

Table 3. *Serum immunoreactive parathyroid hormone (iPTH) and immunoreactive calcitonin (iCT) in both groups in first 48 hr of life*[1]

	1-3 hr		10-14 hr		22-26 hr		34-38 hr		44-48 hr	
	Group I	*Group II*	*Group I*	*Group II*	*Group I*	*Group II*	*Group I*	*Group II*	*Group I*	*Group II*
No. of patients	14	13	6	11	13	19	4	7	8	7
iPTH (≤100 μl Eq/ml)										
Mean	77.2	75.2	128.8	110.9	125.6	116.2	137.5	126.7	143.6	132.2
	±	±	±	±	±	±	±	±	±	±
SD	45.9	58.6	71.8	43.6	60.8	56.3	90.8	29.7	47.9	56.2
iCT (≤150 pg/ml)										
Mean	567[1, 2]	343[1, 2]	1850	1686	1462	1272	1178[1, 3]	1818	535[1, 3]	1590
	±	±	±	±	±	±	±	±	±	±
SD	1000	708	872	1327	806	1000	988	860	378	1127

[1] For practical reasons, nondetectable values were given a value of zero in calculation of the means. Details for individual values are given in the text (see *Results*).

[2] Ten values at nondetectable level.

[3] One value at nondetectable level.

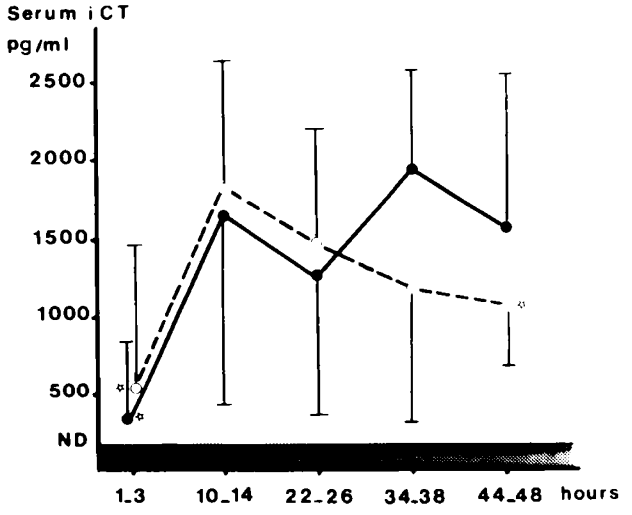

Fig. 3. Serum immunoreactive calcitonin (*iCT*) levels in both groups during the first 48 hr of life. - - -: *group I* (without calcium infusion); ——: *group II* (with continuous calcium infusion). Shadowed area indicates the nondetectable range of assay below 150 pg/ml. For practical reasons, nondetectable values (☆) were given a value of zero in the calculation of the means. Details for individual values are given in the text (see *Results*).

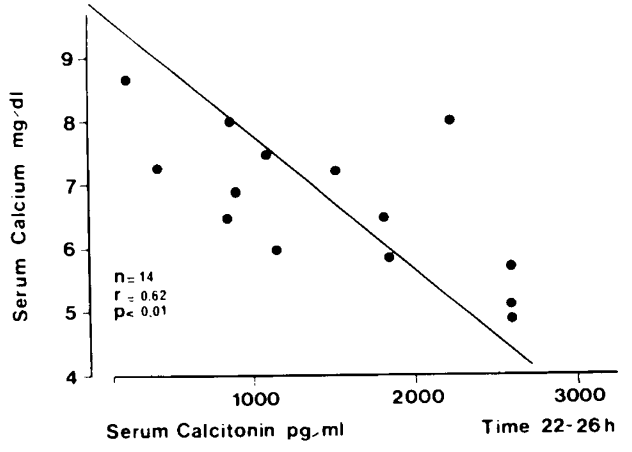

Fig. 4. Relationship between serum calcium and calcitonin at 22-26 hr in *group I*.

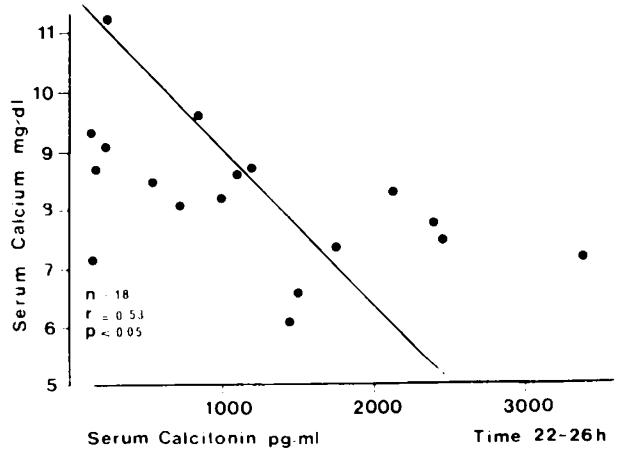

Fig. 5. Relationship between serum calcium and immunoreactive calcitonin at 22-26 hr in *group II*.

was also a positive correlation between gestational age and serum Ca at 22-26 hr ($r = 0.87$; $P < 0.01$).

GROUP II: LBW INFANTS RECEIVING CONTINUOUS Ca INFUSION

No correlation was observed between serum Ca and serum P levels at any period of time. A positive correlation was found between serum Ca and serum Mg levels at 10-14 hr ($r = 0.53$; $P < 0.05$) and 22-26 hr ($r = 0.36$; $P < 0.05$). There was a negative correlation between serum Ca and serum iCT levels at time 22-26 hr ($r = -0.57$; $P < 0.02$) (Fig. 5). No correlation was found between serum Ca levels and serum iPTH and gestational age at any period of time.

COMPARISON OF *GROUPS I* AND *II*

As indicated in Table 1, the two groups were comparable with regard to gestational age, birth weight, distribution of premature and small for gestational age infants, and incidence of respiratory disorders. There were no significant differences in mean blood pH at birth. The mean serum Ca levels were significantly higher in *group II* at 10-14 hr and 22-26 hr ($P < 0.01$) (Fig. 1). There were no significant differences in mean serum P levels at any period of time. By contrast, mean serum Mg levels were significantly higher in *group II* at 22-26 hr ($P < 0.01$), 34-38 hr ($P < 0.01$), and 44-48 hr ($P < 0.01$) (Fig. 1). There was no significant difference in mean serum iPTH and serum iCT levels at any period of time (Figs. 2 and 3).

DISCUSSION

It is well established that a relative hypercalcemia is present at birth in the newborn infant; plasma Ca levels in cord blood range from approximately 10–11.5 mg/100 ml, exceeding plasma Ca levels in maternal blood (7). In most normal full term neonates there is a progressive decline in plasma Ca levels toward the lower range of values (8.5–10 mg/100 ml (5)) during the first 48–72 hr of life. The decrease is more pronounced in LBW infants. In a recent survey, Rossli and Fanconi (22) observed that 53% of 174 LBW infants reached serum Ca levels below 7 mg/100 ml during the 3 first days of life; this is in agreement with our present findings in the control group of LBW infants not receiving calcium infusion. Another interesting aspect of the postnatal changes in serum Ca in LBW infants is the fall occurring during the very early hours of life; in our control group of infants the mean ± SD serum Ca values were, respectively, 7.0 ± 0.51 mg/100 ml at 10–14 hr and 6.57 ± 1.07 mg/100 ml at 22–26 hr. Assuming that in most of these infants serum Ca in cord blood was above 10 mg/100 ml, it is clear that the decrease in serum Ca takes place essentially during the first 10–26 hr of life.

Because we found in preliminary attempts that calcium infusion with 10 or 25 mg/kg/day calcium as calcium gluconate was insufficient to prevent this early fall in serum Ca in LBW infants, for the present study we used a continuous infusion of 35 mg/kg/day calcium. None of the 25 LBW infants infused with this amount of calcium demonstrated any local or general complications. In the great majority of the infants receiving calcium infusion the serum Ca levels remained above 7 mg/100 ml (23/25), indicating that continuous infusion with 35 mg/kg/day calcium gluconate is efficient in preventing the early decrease in serum Ca of LBW infants. It may be of significance that the only infant who demonstrated an increase of serum Ca above 10 mg/100 ml was a small for gestational age term infant. As indicated by the finding of a positive correlation between serum Ca levels and gestational age in the control group, LBW term infants tend to present a smaller postnatal decrease in serum Ca than LBW premature infants; therefore, the term infants may be more sensitive to Ca infusion than the prematures. This suggests that a Ca amount smaller than 35 mg/kg/day should be used in the small for gestational age term infants.

Serum magnesium was significantly higher in the group of LBW infants receiving calcium infusion than in the control group; furthermore, positive correlations between serum Ca and serum Mg levels were found in the former group and not in the latter. The significance of these findings is not clear. A positive relationship between serum Ca and serum Mg levels has been observed previously during the neonatal period (26); this relationship seems to indicate that extracellular Mg is subjected to the same physiologic and pathologic inferences as Ca (7, 26). In our study there were no remarkable differences in serum iPTH and serum iCT between the calcium group and the control group, suggesting that neither PTH nor CT was responsible for the changes in serum Mg. A mechanism of either competitive inhibition or simple interdependence between magnesium and calcium is known to exist at the renal tubular level (33); the increase in extracellular Mg induced by calcium infusion suggests that such a mechanism may be active more generally at the cellular level in the low birth weight infants.

By contrast, it is of interest that LBW infants with Ca infusion showed no difference in serum P levels as compared with control LBW infants. This suggests that calcium deposition as phosphate salts in bones was not increased by the Ca supplementation. This is a rather unexpected finding if we consider that during the last months of gestation the fetus retains a large amount of calcium in the range of 100–150 mg/kg/day (21) which mostly contributes to the skeletal mineralization. Thus our findings indicate that some limitation of the bone mineralization takes place during the early hours of life in LBW infants. This may result from a reduced synthesis of the organic matrix of bone because of the limited amount of protein available. On the other hand, it is possible that some hormonal factors intervene directly to inhibit the mineralization process.

Detectable levels of serum iPTH were present in all infants in both groups at 1–3 hr of age with mean values slightly higher than in normal control adults or children. Furthermore, serum iPTH levels increased steadily in most infants from 1–3 hr to 44–48 hr. These data confirm our previous findings in a group of 55 LBW infants (8), and are in agreement with the results obtained by Fleischman and coworkers (15) in preterm rhesus monkeys. Thus in most LBW infants, unlike normal full term infants (7), there is good evidence that parathyroid glands are active immediately after birth. It is of interest that no significant differences in mean serum iPTH levels were observed between the two groups of infants, although they demonstrated a marked difference in mean serum Ca levels. This indicates that continuous infusion with 35 mg/kg/day calcium has no suppressive effect on the parathyroid function in the majority of the LBW infants; the explanation may be that despite the Ca infusion, serum Ca levels remained below the normal range in the majority of the infants.

However, it may be of significance that 6 of 25 of the LBW infants with calcium infusion as compared with 1 of 16 infants of the control group did not show an increase in serum iPTH levels over the 1–3 hr or 10–14 hr basal values; this may indicate that in some infants the parathyroid function was depressed by the calcium infusion. On the other hand, the fact that mean serum iPTH levels were not increased in the control group as compared with the calcium group, in spite of much lower serum Ca levels, suggests that there exists some limitation of the parathyroid activity in the LBW infants during the first 48 hr of life. This is consistent with the observations of David and Anast (7) which show that there was no increase or a limitated increase in circulating iPTH during the acute hypocalcemia induced by exchange transfusion in infants younger than 48 hr.

Elevated levels of plasma iCT have been described during the neonatal period (3, 6, 10, 24). Bergman *et al.* (3) observed an increase in plasma iCT during the first day of life in nine newborns of diabetic mothers and five control full term infants; Samaan *et al.* (24) reported high levels plasma iCT in young newborn infants; Garel (16) found an increase in serum iCT levels between 14 and 24 hr of life in the lamb. Both groups of our LBW infants showed a marked increase in serum iCT between 1–3 hr and 10–14 hr of life. The significance of this increase is unclear but it may contribute to the early hypocalcemia of the LBW infants as suggested by the negative correlation observed between serum Ca and serum iCT levels. We did not find any significant differences in mean serum iCT levels between the infants receiving calcium infusion and the control infants, which suggests that continuous infusion with 35 mg/kg/day calcium does not result in an increased secretion of calcitonin. However, the tendency toward higher serum iCT level at 44–48 hr of age in the infants receiving calcium as compared with the control infants may indicate that in some infants the calcitonin secretion was sustained by the calcium infusion.

CONCLUSION

The prophylactic administration of continuous intravenous calcium gluconate on the basis of 35 mg/kg/24 hr Ca limits the postnatal depression of serum Ca in LBW infants during the first 48 hr of life. It has no overall adverse effect. It does not appear to depress the parathyroid activity in the majority of the infants. It has no significant influence on the postnatal calcitonin secretion.

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