


# Clinical and Prognostic Value of Calcium and Phosphorus Levels as Possible Markers of Endothelial Dysfunction in Preterm Infants

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## Abstract

The system maintaining a sufficient level of calcium and phosphorus is formed only by the end of the first month of life, and in preterm infants even later. These elements play a crucial role in many physiological processes. They also affect vascular function, endothelium, and endothelial nitric oxide (NO) synthase. Therefore, the aim of our study was to analyze the relationship of serum phosphorus and calcium levels with markers of endothelial dysfunction and features of the early neonatal period. The study included 37 preterm infants that received standard clinical, laboratory, and instrumental examination. As markers of endothelial dysfunction, the 4a/4b polymorphism of the eNOS gene was investigated and quantitative measurement of NO metabolites in urine was performed. Phosphorus and calcium levels in 37 preterm infants on the first day were  $4.06 \pm 1.88$  mg/dL and  $1.89 \pm 2.08$  mg/dL, and on the six day  $4.89 \pm 2.02$  mg/dL and  $1.86 \pm 1.80$  mg/dL, respectively. Combined hypocalcemia and hypophosphatemia were found in 27 (73.0%) of 37 examined infants. The presence of severe condition in early neonatal period was positively correlated with calcium levels on the first and sixth days after birth. There were determined positive correlation between calcium and phosphorus levels on the first day after birth and severity of clinical symptoms in neonatal period and birth gestational age. Serum calcium level in preterm birth infants was positively correlated with respiratory failure on the sixth day. Correlation between calcium and phosphorus serum levels was observed for severe and stable infants on the first day, but on the six day only in preterm birth infants with stable condition. We have not found an association between phosphorus and calcium levels and markers of endothelial dysfunction in preterm birth infants. Serum phosphorus and calcium levels and studied markers of endothelial dysfunction have been found to be independent markers of the risk of developing a complicated early neonatal period in preterm infants.

## Keywords

Preterm birth infants, calcium, phosphorus, eNOS gene, endothelial dysfunction

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## Introduction

Newborns are a heterogeneous group not only in the indicators of health but also in terms of physical development and degree of maturity, which do not always correlate with gestational age. There are many causes of preterm birth, and there is often an interaction of a range of factors, among which is chronic intrauterine hypoxia, characterized not only by cerebral ischemia but also ischemic changes in kidneys, intestines, and liver, which lead to metabolic disorders, including phosphate and calcium exchange issues.<sup>1</sup> On the other hand, it is known that the system maintaining a sufficient level of calcium and phosphorus in the blood is formed only by the end of the first month of life, and in preterm infants even later, which creates special difficulties for them in phosphate-calcium homeostasis.<sup>2</sup> These elements play a crucial role in many physiological processes. For example, calcium involved in hormone secretion, transmission of nervous excitation, activates blood clotting factors, is involved in the stability of

cell membranes and regulates the transport of various ions across the cell membrane, while phosphorus serves to modify enzyme function required for energy metabolism, transmission of cell signals, and stabilization of phospholipids on the cell membrane.<sup>3,4</sup> According to the literature, phosphorus and calcium levels also affect vascular function, endothelium, and endothelial nitric oxide (NO) synthase.<sup>5–8</sup> Thus, it can affect the development of endothelial dysfunction—one of the mechanisms of complications (hypoxia, respiratory distress

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