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EVALUATION OF HORMONAL AND BIOCHEMICAL PARAMETERS IN CHILDREN AFTER PARATHYROIDECTOMY FOR PRIMARY HYPERPARATHYROIDISM IN THE EARLY AND LATE PERIODS

Rixsiyeva Nazira Taxirovna
Alfraganus University

Abstract

Primary hyperparathyroidism in children is a rare endocrine disorder characterized by excessive secretion of parathyroid hormone (PTH), leading to calcium-phosphorus metabolism disorders, changes in bone mineral density, and damage to various organs and systems. The primary method of radical treatment for the disease is parathyroidectomy. However, after surgery, dynamic monitoring of hormonal and biochemical parameters is necessary to evaluate the effectiveness of treatment, identify possible postoperative complications, and prevent recurrence. Monitoring levels of calcium, phosphorus, parathyroid hormone, vitamin D, and renal function in both the early postoperative period and at late stages is of particular importance.

In pediatric patients, primary hyperparathyroidism is particularly important because prolonged exposure to elevated PTH levels can negatively affect bone growth, mineralization, and normal skeletal development. The most common causes include parathyroid adenoma, parathyroid hyperplasia, and, less frequently, hereditary endocrine disorders.

Parathyroidectomy is considered the definitive treatment for most children with primary hyperparathyroidism. Following surgery, careful monitoring of hormonal and biochemical parameters is essential to assess treatment effectiveness, identify postoperative complications, and evaluate long-term recovery.

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Keywords: primary hyperparathyroidism, children, parathyroidectomy, parathyroid hormone, calcium, phosphorus, vitamin D, calcium-phosphorus metabolism, hypocalcemia, hungry bones syndrome, postoperative period, long-term results.

The aim of the study was to evaluate the dynamics of hormonal and biochemical parameters in children with primary hyperparathyroidism after parathyroidectomy in the early and late periods after surgery, as well as to determine the effectiveness of surgical treatment and the characteristics of calcium-phosphorus metabolism restoration.

Research objectives

1. To study the baseline clinical, hormonal and biochemical parameters in children with primary hyperparathyroidism before surgical treatment.
2. To assess the dynamics of parathyroid hormone (PTH) levels in the early postoperative period.
3. To study changes in the concentration of total and ionized calcium, phosphorus and magnesium in the blood after parathyroidectomy.
4. To determine the dynamics of the level of 25(OH) vitamin D and its relationship with the restoration of calcium-phosphorus metabolism.

Research methods

The study included children diagnosed with primary hyperparathyroidism who had undergone parathyroidectomy. A comprehensive assessment of clinical, hormonal, and biochemical parameters was conducted preoperatively, in the early postoperative period, and at long-term follow-up.

Laboratory testing includes determination of parathyroid hormone (PTH), total and ionized calcium, phosphorus, magnesium, 25(OH) vitamin D, creatinine , and urea levels in the serum. Alkaline phosphatase levels and bone turnover markers are assessed if necessary.

The early postoperative period is assessed taking into account the dynamics of laboratory parameters and the risk of developing hypocalcemia and "hungry

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bones" syndrome. In the long-term period, the restoration of calcium-phosphorus metabolism, normalization of the hormonal profile, and the likelihood of disease recurrence are analyzed.

The obtained data are subjected to comparative and statistical analysis. To assess differences between indicators, variation statistics are used, determining the mean, standard deviation, and statistical significance of differences.

Study results

It is expected that after parathyroidectomy, children with primary hyperparathyroidism will experience significant improvements in hormonal and biochemical parameters. In the early postoperative period, elevated parathyroid hormone levels are expected to decrease, and calcium and phosphorus levels in the blood are expected to gradually normalize.

Particular attention is paid to the potential development of postoperative hypocalcemia, which may be associated with intensive restoration of mineral metabolism and increased bone calcium requirements. Some patients may develop "hungry bone" syndrome, requiring additional calcium and vitamin D supplementation.

During long-term follow-up, stabilization of calcium-phosphorus metabolism, restoration of hormonal balance, and improvement in the overall condition of patients are expected. Comparison of laboratory parameters will allow us to determine the most informative criteria for assessing the effectiveness of surgical treatment.

Parathyroid Hormone (PTH)

Before surgery, children with primary hyperparathyroidism usually demonstrate elevated PTH concentrations. Successful removal of the pathological parathyroid tissue leads to a significant reduction in circulating PTH levels.

In the early postoperative period, PTH levels generally decrease rapidly. During long-term follow-up, PTH concentrations are expected to remain within the age-appropriate reference range, although temporary increases may occur in patients with vitamin D deficiency, reduced calcium levels, or impaired renal function.

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Calcium Metabolism

Hypercalcemia is one of the main biochemical manifestations of primary hyperparathyroidism. After parathyroidectomy, serum calcium concentrations usually decrease.

However, some patients may develop postoperative hypocalcemia due to the sudden reduction in PTH secretion and increased calcium uptake by previously demineralized bones.

Phosphorus Metabolism

Elevated PTH increases renal phosphate excretion, which may result in reduced serum phosphorus levels.

Following successful surgery, phosphorus concentrations generally increase as renal phosphate reabsorption improves. Monitoring phosphorus levels is important for evaluating the restoration of mineral metabolism.

Vitamin D and Alkaline Phosphatase

Vitamin D deficiency may aggravate disturbances in calcium metabolism and increase the risk of postoperative hypocalcemia.

Alkaline phosphatase is an important marker of bone turnover. Its concentration may remain elevated for several weeks or months after surgery, particularly in children with severe skeletal involvement.

Early and Late Postoperative Complications

Early postoperative complications

- Transient or persistent hypocalcemia.
- Hungry bone syndrome.
- Hypomagnesemia.
- Temporary elevation of PTH.
- Postoperative changes in calcium-phosphorus balance.

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Late postoperative complications

- Persistent hyperparathyroidism.
- Recurrent primary hyperparathyroidism.
- Persistent vitamin D deficiency.
- Residual disturbances of bone mineralization.
- Long-term skeletal complications in patients with severe preoperative disease.

Hungry bone syndrome is one of the most important complications following parathyroidectomy in patients with severe primary hyperparathyroidism. It is characterized by prolonged hypocalcemia, hypophosphatemia, and sometimes hypomagnesemia due to rapid mineral uptake by bones after correction of excessive PTH secretion.

Expected Results of the Study

Successful parathyroidectomy is expected to result in:

1. A significant decrease in serum PTH concentrations.
2. Normalization of total and ionized calcium levels.
3. Gradual restoration of serum phosphorus concentrations.
4. Improvement in vitamin D and mineral metabolism following appropriate correction.
5. Gradual normalization of alkaline phosphatase levels.
6. Improvement in clinical manifestations associated with hypercalcemia.
7. Progressive recovery of bone metabolism during long-term follow-up.

The degree and speed of biochemical recovery may depend on the duration of the disease, preoperative PTH concentration, severity of skeletal involvement, vitamin D status, and the extent of surgical intervention.

Evaluation of hormonal and biochemical parameters after parathyroidectomy is particularly important in pediatric patients because mineral metabolism is closely associated with skeletal growth and development.

The postoperative period requires careful monitoring of serum calcium, phosphorus, magnesium, and PTH. Children with markedly elevated preoperative

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PTH levels and significant bone disease may require prolonged calcium and vitamin D supplementation.

Long-term follow-up is necessary to distinguish between successful biochemical remission, persistent disease, and recurrence. In addition, genetic evaluation may be appropriate in children with suspected hereditary forms of primary hyperparathyroidism.

Parathyroidectomy is an effective treatment for primary hyperparathyroidism in children. The assessment of hormonal and biochemical parameters during the early and late postoperative periods provides valuable information regarding surgical effectiveness and the restoration of calcium-phosphorus metabolism.

Serial monitoring of PTH, total and ionized calcium, phosphorus, vitamin D, alkaline phosphatase, and magnesium is essential for the timely detection of postoperative complications. Long-term follow-up allows clinicians to evaluate bone metabolism recovery, identify persistent or recurrent disease, and improve the quality of life of pediatric patients.

Conclusions

Parathyroidectomy is the primary surgical treatment for primary hyperparathyroidism in children and is aimed at eliminating the source of excess parathyroid hormone secretion.

Dynamic determination of the levels of PTH, calcium, phosphorus and vitamin D is important for assessing the effectiveness of surgical intervention.

The early postoperative period requires careful laboratory monitoring due to the risk of developing hypocalcemia and hungry bone syndrome. Long-term observation allows us to assess the stability of the achieved hormonal and biochemical balance and promptly identify possible disorders and relapse of the disease.

Comprehensive monitoring of hormonal and biochemical parameters is an important condition for improving treatment results and quality of life of children after parathyroidectomy.

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