RESULTS OF SURGICAL TREATMENT OF CHILDREN WITH PRIMARY HYPERPARATHYROIDISM

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Abstract. *The article describes the results of surgical treatment of primary hyperparathyroidism in children. On the basis of a thorough study of the long-term results of parathyroidectomy, the author found that in the overwhelming majority of patients, there is a positive dynamic of clinical manifestations and the normalization of biochemical parameters. The data obtained indicate the restoration of calcium-phosphorus metabolism and bone tissue in the majority of operated children with primary hyperparathyroidism in the long term after treatment.*
Keywords: *primary hyperparathyroidism; children; surgery; long-term results; parathyroidectomy.*

Purpose of the problem: Primary hyperparathyroidism (PHPT) is manifested by multiple organ disorders of varying severity, and as a result, can lead to a significant decrease in the quality of life, disability of patients, and an increased risk of premature death. Today, PHPT is considered the third endocrine epidemic worldwide, along with diabetes mellitus and other thyroid diseases. The prevalence of PHPT increases with age, but the disease can affect people of all ages, including children. According to medical statistics, in families where there are patients with hyperparathyroidism, in 30% of cases the disease manifests itself in children. This group of patients, in the long term, represents the greatest value for society, therefore, the question of the fullness of recovery and the degree of convalescence is very important.

According to the authors, PHPT in children is more severe than in adults. Apparently, when establishing the diagnosis of PHPT in children, systematic errors occur due to subjective factors or different pathobiology of Parathyroid glands (PTG) in children. The prognosis of PHPT is favorable with timely diagnosis of hyperparathyroidism and adequate surgical treatment. Removal of hyperfunctioning Parathyroid glands (PTG) is the only pathogenetically substantiated treatment method for PHPT, which allows eliminating disturbances in calcium-phosphorus metabolism, neutralizing clinical manifestations, and also reducing the risk of stone formation in patients with urolithiasis.

Over the last decade of the 11th century, innovative advances in the field of PHPT have been achieved in world medicine. A review of the literature showed that today the recommendations of the European and American Society of Endocrinologists on PHPT have been widely implemented, in which standards for diagnosing forms of PHPT and differentiating its forms are approved and accepted by the world community. In connection with the development of new computer technologies, great opportunities are opening up for studying the long-term results of surgical treatment of PHPT and conducting their multifactor analysis, creating a diagnostic algorithm and developing criteria for the effectiveness of parathyroidectomy, however, this only applies to adults, and in children the issue is still relevant.

Scientists of our country (Ismailov S.I., Uzbekov K.K., Rakhimjonov O.M.) have conducted a number of studies on the diagnosis and treatment of primary hyperparathyroidism. However, the selection of effective methods for treating primary hyperparathyroidism in children

and studying its impact on the quality of life of patients remains an urgent problem from a scientific and practical point of view. The variety of clinical symptoms of the disease, its long "latent" period, delay in diagnosis, and the presence of diagnostic errors during the initial examination determine the development of severe complications of the disease. This creates the basis for further research into this problem in children.

Purpose of the study: To evaluate the immediate and long-term results of surgical treatment of children with primary hyperparathyroidism.

Materials and methods: The source of the study was 90 sick children who applied to the Republican specialized scientific and practical medical center of endocrinology clinic in 2001-2016, who, based on the diagnosis of primary hyperparathyroidism, were treated in an inpatient setting and were under outpatient observation. At the first stage of the study, in order to study the frequency of occurrence of clinical forms and clinical manifestations of primary hyperparathyroidism by appeal, a questionnaire was filled out for each examined child, which recorded anamnesis data, as well as clinical, laboratory and instrumental data.

Surgical treatment (parathyroidectomy) was performed in 50 patients (main group), 40 patients (comparison group) were under outpatient observation (had contraindications to surgery, refused surgery). Patients in this group were recommended to reduce foods rich in calcium in their diet, drink 1.5-2 liters of fluid per day, and take vitamin D supplements in the required dose. The control group consisted of 20 healthy children without pathology of the thyroid and parathyroid glands.

Inclusion criteria: children aged 3 to 15 years with a confirmed diagnosis of primary hyperparathyroidism.

Exclusion criteria: children with severe somatic diseases, children under 3 years of age and over 15 years of age, patients with diabetes mellitus and severe renal failure. The duration of the study was 1-3-6 months in the near future and 1-5-10 years in the long term (Fig. 1).

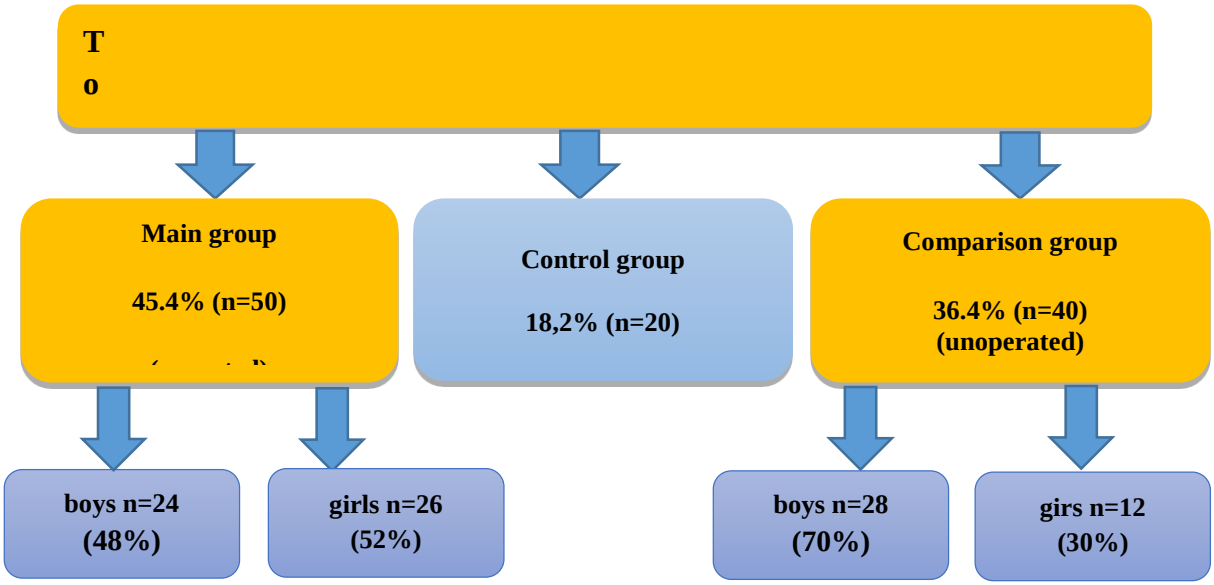


Figure 1. Study design.

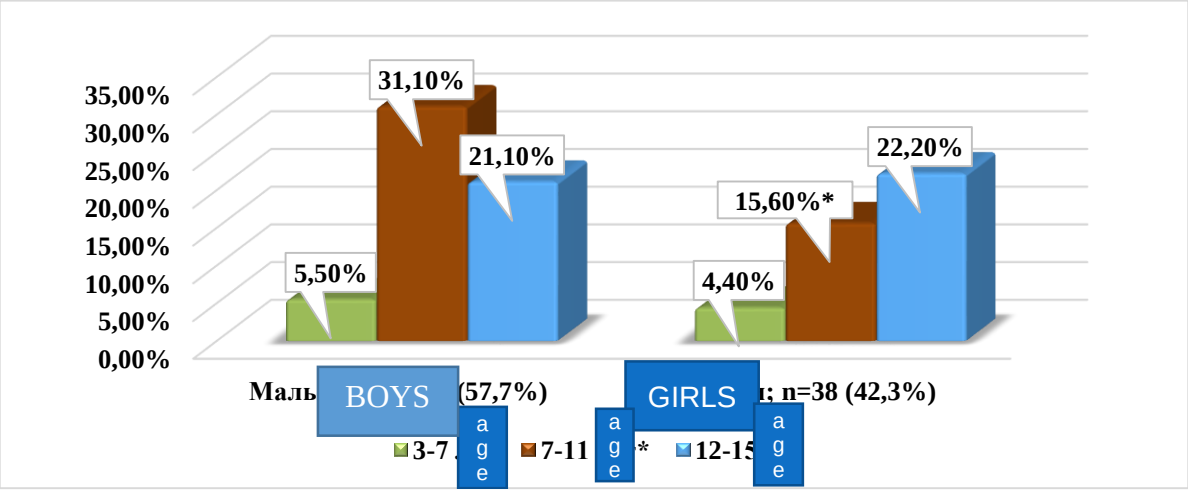
At the second stage of the study, all patients underwent ultrasound examination of the thyroid gland, parathyroid glands, and kidneys. The level of parathyroid hormone in the blood, vitamin 25(OH)-D, total and ionized calcium, phosphorus, alkaline phosphatase, and the level of calcium and phosphorus in the urine were determined. To study bone mineral density, radiography,

echo-osteometry and X-ray densitometry were performed, parathyroid gland scintigraphy was performed to identify adenoma, and PAS and SF-36 questionnaires were used to assess parathyroid symptoms and quality of life.

Statistical analysis. The results obtained during the research were calculated on the basis of "Exel" arithmetic functions in the WINDOWS XP "Pentium-IV" Microsoft systems window.

Research results. All patients (n-90) were divided into age groups and the incidence of primary hyperparathyroidism among children of different ages was studied according to presentation. Primary hyperparathyroidism was reported in 57.7% (52) of boys and 42.3% (38) of girls. The ratio between boys and girls was 1.3:1 (Fig. 2.).

Fig 2. Incidence of primary hyperparathyroidism among different age groups.



Note: * - p < 0.05 - the difference between the indicators of both groups is significant.

The duration of the disease was several years from the first clinical symptoms of hyperparathyroidism to diagnosis in the examined patients. One of the reasons for the underestimation of primary hyperparathyroidism is the lack of a system for its detection. In our study, the duration of the disease was 4-5 years in 53.3% of patients (Table 1).

Table 1

Distribution of patients with primary hyperparathyroidism by disease duration

Duration of disease, years	Boys n=52	Girls n=38	Total
0-1	19	14	33
2-3	5	4	9
4-5	28	20	48

The frequency of clinical forms of primary hyperparathyroidism was determined based on the rate of occurrence. In children, a characteristic feature of the disease was noted - the prevalence of the manifest form (96.7%) of hyperparathyroidism, with the renal form (38.9%) being more commonly observed than the skeletal form (33.4%) and the mixed form (24.4%). The asymptomatic form of primary hyperparathyroidism was registered in 1.1% of cases, the normocalcemic form in 1.1%, and the mildly symptomatic form in 1.1% (Figure 3).

During the study, we identified a group of symptoms characteristic of the disease in children with primary hyperparathyroidism and analyzed the frequency of occurrence of clinical signs. Children with manifest primary hyperparathyroidism (87 patients) had delayed physical development in 72.4% (63), nephrolithiasis - 24.1% (21), bone deformation - 45.9% (40),

pathological bone fractures - 28, 7% (25), pain in bones and joints – 71.2% (62); 47.1% (41) of patients had hair loss and 44.8% had brittle nails (39) (Table 2).

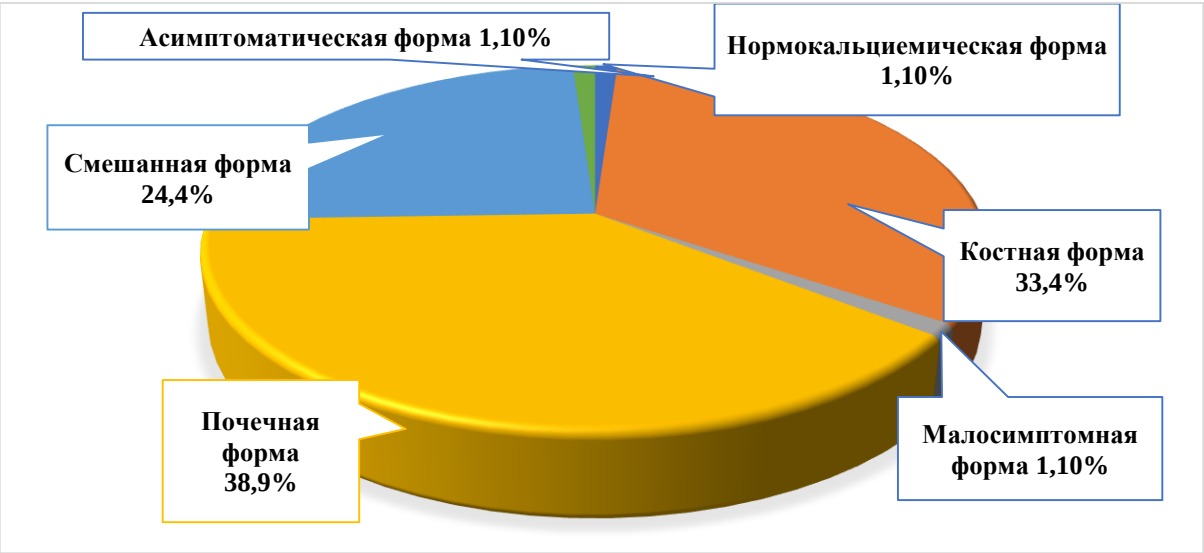


Fig.3. Frequency of occurrence of nosological forms of primary hyperparathyroidism in children according to referral rates; n=90

Tab 2

Frequency of clinical signs of primary hyperparathyroidism in children.

Clinical signs	Nosological forms of primary hyperparathyroidism					
	Kidney form n=35		Bone form n=30		Mixed form n=22	
	abs	%	abs	%	abc	%
Polydipsia	26	74,2	11	36,3	9	40,2
Polyuria	24	68,5	13	43,3	8	36,3
Nephrolithiasis	16	45,7	-	-	5	22,7
Attacks of renal colic	31	88,5	-	-	6	27,3
Hair loss	13	37,1	19	63,3	9	40,9
Pain in bones and joints	25	71,4	26	86,6	11	50,1
Bone fractures	1	2,8	17	56,6	7	31,8
Bone deformity	1	2,8	27	90	12	54,5
Delayed physical development	24	68,5	25	83,3	14	63,6
Loose teeth	11	31,4	13	43,3	7	31,8
Brittle nails	7	20	23	76,6	9	45,4

In 26 patients with renal and mixed forms of the disease, the main and comparative groups revealed severe pathologies in renal function, including kidney anomalies in 5 (19.2%) patients, a “dry” kidney in 2 (7.6%), non-functioning kidney - in 2 (7.6%), single kidney (after nephrectomy) - in 3 (11.5%), nephrostomy was found in 3 (11.5%) patients. Chronic renal failure was registered in 11 (42.3%) patients. This, in turn, confirms the late diagnosis of the disease and the development of severe complications of urolithiasis in patients.

The hormonal and biochemical parameters of children who underwent parathyroidectomy for primary hyperparathyroidism were analyzed in the long-term and immediate period. Before treatment in the main group, 49 (98%) children had hypercalcemia, 47 (94%) hyperparathyrinemia; high levels of ionized calcium were noted in 44 (88%), alkaline phosphatase in 39 (78%).

In the main group of children who underwent parathyroidectomy, one month after surgery, the level of calcium in the blood (2.33±0.09 mmol/l; p<0.01) was significantly reduced compared to the preoperative level (2.81±0.11 mmol/l;) and was close to control in the early observation period (3-6 months) (2.32±0.08 mmol/l; 2.34±0.09 mmol/l; p<0.01). Hypercalciuria was observed in 66% of patients. The level of calcium in urine was significantly different from the control group (2.46±0.25 mmol/day) before surgery (3.42±0.27 mmol/day), after 3 months (2.46±0.14 mmol/day through; p<0.01) were equal to the values of the control group (Table 2). Hypophosphatemia was observed in 78% of patients. 3 months after surgery, blood phosphorus (2.12±0.12 mmol/l) was significantly closer to the values of the control group (Table 3).

Table 3

Dynamics of biochemical parameters in the early stages before and after surgical treatment of patients in the main group.

Indicators	Control, n=20	Before surgery, n=50	In 1 month п/о, n=50	After 3 months п/о, n=50	о/к 6 month, n=50
Ca (in blood) mmol/l	2,34±0,11	2,81±0,11	2,33±0,09 ^	2,32±0,08 ^	2,34±0,09 ^
Ca (in urine) mmol/day	2,46±0,25	3,42±0,27	2,47±0,21 ^	2,46±0,14 ^	2,45±0,16 ^
P (in blood) mmol/l	2,18±0,13	1,94±0,16	1,96±0,12	2,12±0,12	2,16±0,15
P (in urine) mmol/day	12,3±0,70	17,1±1,3	13,9±2,8	12,9±0,87 ^	12,3±0,80 ^
Ca++ mmol/l	0,76±0,03	1,31±0,06	1,16±0,05 *	0,77±0,10 ^	0,76±0,01 ^
Alkaline phosphatase µm/l	0,82±0,05	1,99±0,08	1,03±0,07 * ^	0,81±0,06 ^	0,79±0,07 ^
PTH pg/ml	60,2±2,4	81,7±3,3	64,2±2,4 ^	60,4±2,2 ^	60,1±1,3 ^
25 (OH) vit D nmol/l	75,0±2,45	61,7±2,1	62,1±2,3 * ^	70,3±2,5 ^	72,6±1,7 ^

Note: * - the difference compared with the control group is significant (p<0.01); ^ - the difference compared with preoperative indicators is significant (p <0.01).

76% of patients had hyperphosphaturia before surgery. A significant decrease in phosphorus in urine was observed 1 month after surgery (13.9±2.8 mmol/l/day), which was equal to the control values after 3 months (12.9±0.87; p<0.01). Ionized Ca++ levels were significantly higher preoperatively (1.31 ± 0.06 mmol/L) than in the control group (0.76 ± 0.03 mmol/L). 3 and (0.77±0.10 mmol/l; p<0.01;) 6 months after surgery, a (0.76±0.01 mmol/l; p<0.01) decrease in parameters was recorded compared with preoperative level. The level of parathyroid hormone was higher before treatment (81.7±3.3 pg/ml; r<0.01) compared to the control (60.2±2.4 pg/ml), and

in the immediate period after treatment (1- 3-6 months) there was a decrease. a trend was noted (64.2±2.4 pg/ml; r<0.01), (60.4±2.2 pg/ml; r<0.01), (60.1±1.3 pg/ ml; r<0.01). Alkaline phosphatase activity was high in 78% of patients in our study. Before surgery, its level (1.99±0.08 μm/l) was statistically significantly higher than in the control (0.82±0.05 μm/l). 1 month after surgery, alkaline phosphatase activity decreased (1.03±0.07 μm/l; p<0.01), and after 3 months (0.81±0.06 μm/l; p<0.01) reached the control value. The level of 25(OH)vitamin D was lower before surgery (61.7±2.1 nmol/l) compared to the control (75.0±2.45 nmol/l) and 1-3-6 months after surgery (62.1±2.3; p<0.01); (70.3±2.5; p<0.01); (72.6±1.7; p<0.01)) increased significantly, but did not reach the control value.

In the comparison group without parathyroidectomy, during the initial examination, a high level of blood calcium was noted in 39 (97.5%) patients, alkaline phosphatase in 35 (87.5%), ionized calcium in 36 (90%) patients, an increase in the level of parathyroid hormone in 37 (92.5%) patients. Blood hypophosphatemia was registered in 33 (82.5%) and hyperphosphatemia in 34 (85%) patients. During the initial examination, the Ca level (2.90±0.03 mmol/l) was significantly higher than in the control group (2.34±0.11 mmol/l), and after 3-6 months (2.91±0 .02 mmol/l, p <0.01; 2.92 ± 0.03 mmol/l, p <0.01) there was a tendency to increase. In this group, a high level of calcium in the urine was noted (3.41±0.12 mmol/day), and within 3-6 months (3.42±0.21 mmol/day, p<0.01; 3.44 ±0.26 mg/day, p<0.01;) a significant increase was noted (Table 4).

Table 4

Dynamics of biochemical parameters of patients in the comparison group

Indicators	Control group n=20	Indicators during the initial examinationn=40	After 1 month n=40	After 3 months n=40	After 6 months n=40
Ca (in blood) mmol/l	2,34±0,11	2,90±0,03	2,90±0,03 *	2,91±0,02 *	2,92 ±0,03 *
Ca (in urine) mmol/сут	2,46±0,25	3,41±0,12	3,41±0,14 *	3,42±0,21 *	3,44±0,26 *
P (in blood) mmol/l	2,18±0,13	1,88±0,07	0,89±0,11 *	0,86±0,18 *	0,85±0,06 *
P (in urine) mmol/day	12,3±0,70	16,1±1,2	16,3±1,3 *	16,7±0,9 *	16,8±1,1 *
Ca++ mmol/l	0,76±0,03	1,34±0,03	1,34±0,05 *	1,34±0,06 *	1,37±0,09 *
Alkaline phosphatase km/l	0,82±0,05	1,98±0,09	1,98±0,11 *	2,01±0,08 *	2,03±0,09 *
PTH pg/ml	60,2±2,4	82,3±3,5	80,9±4,9 *	82,4±3,9 *	84,1 ±2,4 *
25 (OH) D nmol/l	75,0±2,45	61,4±2,0	60,4±0,01*	57,1±0,02*	56,3±0,01*

Note: * - significant difference compared to the control group (p<0.01)

A decrease in the level of phosphorus in the blood was detected during the initial examination (1.88±0.07 mmol/l) and within 3-6 months (0.86±0.18 mmol/l, p<0.01; 0.85± 0.06, p<0.01).) there was a statistically significant decrease. During the initial examination, phosphorus in the urine (16.1±1.2 mmol/l) was higher than the control value (12.3±0.70 mmol/l); upon repeated examination after 1-3-6 months, its increase was observed. (16.3±1.3mmol/l, p<0.01; 16.7±0.9mmol/l, p<0.01; 16.8±1.1mmol/l, p<0.01). The level of ionized Ca++ was initially elevated (1.34±0.03 mmol/l) and after 6 months increased compared to the control (1.35±0.09 mmol/l; p<0.01). The level of alkaline phosphatase at the initial examination was 1.98±0.09 μm/l,

after 3-6 months (2.01±0.08 μm/l, r<0.01; 2.03±0.09 μm/l, r<0.01) was higher than control values (0.82±0.05 μm/l). The PTH level was initially elevated (82.3±3.5 pg/ml) from the control value (60.2±2.4 pg/ml). After 3-6 months (82.4±3, p<0.01; 84.1±2.4 pg/ml, p<0.01; p<0.05) a statistically significant increase was detected compared to the control. The level of 25 (OH)-D nmol/l during the initial examination was 61.4±2.0 pg/ml, and after 6 months its values decreased significantly (56.3±0.01 pg/ml; p<0.01). Thus, compared with the initial examination parameters, patients in the comparison group without PTE after 6 months had increased levels of calcium in the blood and urine, a decrease in phosphorus in the blood, as well as increased levels of alkaline phosphatase and PTH. Long-term dynamic observations (1-5-10 years) after parathyroidectomy in children with primary hyperparathyroidism showed that the levels of calcium, phosphorus, PTH, 25 (OH) and vitamin D in the blood after surgery were equal to normal values (Table 5).

Table 5

Dynamics of biochemical parameters in the main group of patients before and after surgical treatment in the long term.

Indicators	Control, n=20	Before surgery, n=50	After 1 year p/o, n=50	After 5 years p/o, n=50	After 10 years p/o, n=50
Ca (in blood) mmol/l	2,34±0,11	2,81±0,11	2,29±0,03*	2,27±0,04 *	2,33±0,05 *
Ca (in urine) mmol/day	2,46±0,25	3,42±0,27	2,42±0,11 *	2,40±0,13 *	2,16±0,37 *
P (in blood) mmol/l	2,18±0,13	1,94±0,16	2,18±0,13	2,16±0,07	2,18±0,06
P (in urine) mmol/day	12,3±0,70	17,1±1,3	12,2±0,83 *	12,3±0,2 *	12,3±0,1 *
Ca++ mmol/l	0,76±0,03	1,31±0,06	0,77±0,02 *	0,77±0,01 *	0,76±0,01 *
Alkaline phosphatase μm/l	0,82±0,05	1,99±0,08	0,78±0,02 *	0,77±0,02 *	0,76±0,02 *
PTH pg/ml	60,2±2,4	81,7±3,3	60,1±1,1 *	60,2±0,01 *	60,3±0,02 *
25 (OH) vit – D nmol/l	75,0±2,45	61,7±2,1	73,2±2,3	74,6±1,5	75,3±1,05

Note:* - the difference compared with preoperative values is significant (p<0.01)

It was noted that in children of the comparison group with primary hyperparathyroidism, the levels of calcium, PTH, and alkaline phosphatase in the blood increased statistically significantly during a long-term examination (1-5-10 years) (Table 6).

Long-term follow-up after parathyroidectomy showed a positive effect of parathyroidectomy on Ca-F metabolism in patients of the main group.

On the contrary, in patients in the comparison group who did not undergo pathogenetic therapy, the results for these parameters during the observation period were unsatisfactory.

Table 6

Dynamics of biochemical parameters of patients in the comparative group in the long term

Indicators	control n=20	Indicators during the initial examination n=40	After 1 year n=40	After 5 years n=40	After 10 years n=40
Ca (in blood) mmol/l	2,34±0,11	2,90±0,03	2,92 ±0,01 *	2,92±0,02 *	2,93 ±0,01 *
Ca (in urine) mmol/day	2,46±0,25	3,41±0,12	3,49±0,11 *	3,54 ±0,09 *	3,56 ±0,12 *
P (in blood) mmol/l	2,18±0,13	1,88±0,07	0,85±0,07 * ^	0,80 ±0,03 * ^	0,80 ±0,01 * ^
P (in urine) mmol/day	12,3±0,70	16,1±1,2	17,3±0,1 *	17,6 ±0,2 *	17,8 ±0,4 *
Ca++ mmol/l	0,76±0,03	1,34±0,03	1,35±0,08 *	1,35±0,09 *	1,36 ±0,02 *
Alkaline phosphatase μm/l	0,82±0,05	1,98±0,09	2,06±0,02 *	2,11 ±0,11 *	2,12 ±0,02 *
PTH pg/ml	60,2±2,4	82,3±3,5	83,6 ±1,1 *	84,3 ±1,2 *	86,7 ±2,2 *
25(OH)vit-D nmol/l	75,0±2,45	61,4±2,0	54,2±0,02 * ^	52,3±0,01 * ^	51,1±0,03 * ^

Note: *- significant difference compared to the control group (p<0.001).

^ - the difference compared with the indicators at the initial examination is significant (p<0.001)

Bone mineral density was studied in children with primary hyperparathyroidism. To study changes in bone mineral density, patients were examined using X-ray densitometry and echo-osteometry. According to the results of X-ray densitometry, bone mineral density in patients of the main group showed a decrease in compact and cancellous bone by 64% and 72%, respectively. A year after surgery, follow-up showed that bone mineral density had recovered and approached control values. In the long term, the mineral density of bone tissue of the compact (94.1±0.5; p<0.05; 94.2±0.4; p<0.05) and cancellous (55.2±0.5; p <0.05), (55.7±0.3; p<0.05) bone substances remained stable (Table 7).

Table 7

Indicators of bone mineral density in children of the main group

Field of study		Control group n=20	Before surgery n=50	After 6 months by n=50	After 1 year p/o n=50	After 5 year p/o n=50	After 10 year p/o n=50
mg/mm3	Compact substance	94,1±0,3	91,7±0,4*	93,4±0,1*^	93,9±0,4^	94,1±0,5^	94,2±0,4^
	Spongy substance	55,0±0,3	51,2±0,6*	54,3±0,4^	54,8±0,5^	55,2±0,5^	55,7±0,3^

Note: *- significant difference compared to the control group (p<0.05)

^ - the difference compared with the values before surgery is significant (p<0.05)

During the initial examination in children of the comparison group, the mineral density of compact (91.4±0.3; p<0.05) and cancellous (51.2±0.4; r<0.05) bone substance decreased by 62.5% and 65% respectively. In long-term observations, a rapid decrease in the mineral density of compact and cancellous bone was noted (Table 8)

Table 8

Indicators of bone mineral density in children of the comparison group

Field of study		Control group n=20	Indicators during the initial examination n=40	After 6 months n=40	After 1 year n=40	After 5year n=40	After 10 year n=40
мг/мм^3	Компактное вещество	94,1±0,3	91,4±0,3*	91,6±0,1*	91,2±0,4*	84,1±0,3^	88,3±0,5^
	Губчатое вещество	55,0±0,3	51,2±0,4*	51,9±0,4*	51,1±0,5*	50,8±0,5^	50,1±0,4^

Note: *- significant difference compared to the control group (p<0.05)

^ - the difference compared to the initial examination is significant (p<0.05)

According to the results of echoosteometry before treatment in the main group of children with primary hyperparathyroidism, a decrease in the propagation of the ultrasonic wave was observed in 60% of patients in the tibia, in 52% in the ulna, in 52% in the clavicle and in 76% in the lower jaw. A year after parathyroidectomy, significant restoration of bone tissue structure was noted in the ulna (3438.8±105.6 m/s; r<0.05) and tibia (3465.2±108.5 m/s; r<0.01). (3465.2±108.5; p<0.01). By the 5th year of observation, the bone tissue structure was restored in the clavicle (3319.1±102.1; p<0.05) and lower jaw (3293.6±106.6; p<0.01) (Table 9).

In children of the comparison group with primary hyperparathyroidism, during the initial examination, a decrease in the propagation of the ultrasonic wave was noted by 75% in the tibia, 65% in the ulna, 55% in the clavicle and 80% in the mandible. Over the course of 5 years, a trend toward a decrease in bone mineral density was noted (Table 10).

Table 9

Dynamics of echo-osteometry indicators before and after parathyroidectomy in children of the main group

Field of study	Control group n=20	Before surgery n=50	After 6 months p.o. n=50	After 1 year p/o n=50	After 10 year p/o n=50
Lower jaw m/s	3293,3±15,4	2998,3±98,5	3173,2±96,4	3186,7±104,5	3293,6±106,6^
Clavicle, m/s	3318,3±22,9	3070,1±53,7	3202,9±103,3	3226,7±102,4	3319,1±102,1^
Ulna, m/s	3440,4±29,9	3122,2±34,6*	3349,8±108,9^	3438,8±105,6^	3440,5±108,6^^
Tibia m/s	3451,0±21,5	3131,1±34,6*	3385,5±105,8^	3465,2±108,5^^	3459,2±109,1^^

Note: * - reliability in relation to the control group (p<0.01).

^ - the difference compared to the values before surgery is significant (^-p<0,05; ^^ - 0,01)

Table 10

Dynamics of echo-osteometry indicators in the long-term follow-up period in children of the comparison group

Measuring area	Control group n=20	Indicators during the initial examination n=40	After 6 months n=40	After 1 year n=40	After 5 years n=40
Lower jaw, m/s	3293,3±15,4	3150,7±24,5	3005,2±83,4	2989,8±96,8*	2789,8±96,8**^
Spine, m/s	3318,3±22,9	3271,7±24,4	3102,9±43,3	3001,8±97,5*	2801,8±97,5**^
Ulna, m/s	3440,4±29,9	3315,8±40,5	3249,8±38,9	3165,4±100,7*	2965,4±100,7**^
Tibia, m/s	3451,0±21,5	3365,2±25,8	3285,5±45,8	3157,1±95,9*	2957,1±95,9**^

Note: * - reliability in relation to the control group (p<0,01).

^ - the difference compared to the initial examination is significant - (^-p<0,05; ^^ - 0,01)

Thus, restoration of the bone structure of the long tubular bones (tibia and ulna) after parathyroidectomy was noted after 1 year. At the 5th year, complete restoration of the bone structure of the lower jaw and clavicle was observed. In children in the comparison group, 2 years after diagnosis, 17.5% of bone fractures and 57.1% of recurrent fractures were registered. Cystic changes in the pelvic bones and extremities (15%) caused severe deformities that subsequently required surgical intervention.

At the same time, we conducted an integral assessment of a number of risk factors leading to death and disability in primary hyperparathyroidism.

	RR	**max – min**
Chronic renal failure	9,57	19,84 - 2,07
Presence of kidney stones	4	5,82 - 1,45
High levels of PTH in the blood	2,93	4,27-1,45
Presence of bone fractures	2,19	2,84 - 1,29
Ca over 2.9 mmol/l	1,73	2,05 - 1,18
Clinical forms: renal form	1,67	10,1 - 1,60
bone form	1,27	1,83 - 0,74
mixed form	1,24	1,32 - 0,74
Presence of adenoma	1,23	1,26 - 0,94
Polyuria	1,08	1,14 - 1,05
Abdominal pain	1,02	1,17 - 1,02
Weight loss	1,01	1,04 - 1,01

Figure 4. Integral assessment of risk factors for mortality in primary hyperparathyroidism

According to the results obtained, the presence of chronic renal failure increases the risk of death by 9.57 times, the presence of kidney stones - by 4 times, the presence of bone fractures - by 2.19 times, a high level of PTH - by 2.93 times, an increase in Ca by more than 2 .9 mmol/l 1.73 times. When analyzing the clinical forms of primary hyperparathyroidism, it was noted that the risk of death was 1.67 times higher in patients with the renal form, 1.27 times higher in the bone form and 1.24 times higher in the mixed form. The occurrence of adenomas, polyuria, abdominal pain, and weight loss increased the risk of death by 1.23, 1.08, 1.02, 1.01 times, respectively.

	RR	max – min
Clinical forms: renal form	3,22	3,74 - 1,24
bone form	3,22	3,45 - 0,36
mixed form	3,18	3,22 – 0,36
Chronic renal failure	3,11	8,01 – 2,48
High levels of PTH in the blood	2,90	3,27 – 1,22
Presence of kidney stones	2,30	2,91 – 1,26
Presence of pathological fractures	1,78	2,52 – 1,41
Ca over 2.9 mmol/l	1,50	1,70 – 1,13
Presence of adenoma	1,23	1,70– 1,02
Polyuria	1,06	1,19 - 1,06
Pain in bones and joints	1,02	1,36 - 0,41
Weight loss	1,01	1,25 - 0,14

Figure 5. Integral assessment of risk factors for disability in primary hyperparathyroidism

When assessing the risk factors leading to disability in primary hyperparathyroidism, the following was found: the renal form of primary hyperparathyroidism had an increase in the risk of disability by 3 times, the bone form - by 3.22 times, the mixed form - by 3.18 times. Also, chronic renal failure significantly increased the risk of disability by 3.11 times, a high level of PTH by 2.90 times, the presence of kidney stones by 2.30 times, bone fractures by 1.78 times, and a Ca level above 2.9 mmol/l 1.50 times. The occurrence of adenomas, polyuria, pain in bones and joints, and loss of body weight increased the risk of disability by 1.23, 1.06, 1.02, 1.01 times, respectively. A total of 8 patients out of 90 (8.89%) had a fatal outcome, and 15 patients out of 82 (18.3%) had a disability (in the group without PTE).

Conclusion:

1. The incidence of primary hyperparathyroidism in children according to referral rates is 57.7% in boys and 42.3% in girls. Primary hyperparathyroidism develops more in boys (31.1%) than in girls (15.6%) of primary school age (7-11 years). Late diagnosis led to an increase in the duration of the disease (4-5 years) in 53.3% of patients.

2. Parathyroidectomy resulted in recovery in 88% of patients. Based on reliable positive dynamics of clinical signs, positive dynamics of phosphorus-calcium metabolism was noted in 84% (3-6 months) and hormonal status in 76% (1-3 months) of cases. In patients who did not undergo pathogenetic therapy, the results of Ca-F metabolism and hormonal parameters during the observation period were unsatisfactory.

3. 1 year after parathyroidectomy, restoration of the bone structure of the long tubular bones (femur and ulna) was noted. Bone fractures were observed in 17.5% of patients, and repeated bone fractures were observed in 57.1% of children without surgery. Cystic changes in the pelvic bones and extremities (15%) led to gross deformities and subsequently required surgical corrections.

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