

Anesthesia and Hyperparathyroidism

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Primary hyperparathyroidism, which has been considered a rare disease, has slowly increased and is now one of the most common endocrine disease encountered by the anesthesiologist and the surgeon¹⁻⁶. The reason that it is diagnosed in an increasing number of people is that the facilities available for serum calcium determination have increased, and there is a greater awareness of this disorder among physicians^{7,8}. The purpose of this paper is to give the clinical data that was collected in our hospital, and to discuss the preoperative problems, anesthetic management and postoperative evaluation of primary hyperparathyroidism.

Materials

We encountered 54 anesthetic cases of primary hyperparathyroidism from 1977 to 1988. All were undergoing surgery for the removal of the parathyroid gland. Of these, 18 were males and 36, females, and their ages ranged from 26 to 74 years, with a mean age of 56 years. It was two times more common in females. The distribution of age and sex is shown in table 1. In the incidence of the pathologic states of these cases, the most common cause of primary hyperparathyroidism was a single adenoma (87%). We saw two cases of acute hyperparathyroidism and five of multiple endocrine neoplasma which are both rare.

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In patients with multiple endocrine neoplasma type 1, there were tumors of the pancreatic islets and pituitary in addition to the hyperparathyroid tumor.

Signs and symptoms

The most characteristic symptoms were urinary symptoms such as renal colic, hematuria, a dull back pain and the passing of renal calculi. Renal stones were observed in 46 (85%) patients, but six patients were asymptomatic for urolithiasis. Osteoporosis and bone cysts were diagnosed by roentgenographic examination in 8 patients in our study. In those patients, these sometimes caused bone pain or pathologic fractures. Symptoms associated with hypercalcemia such as muscular weakness, anorexia, constipation, weight loss, tiredness, polyuria and polydipsia were observed in 11 percent of the patients. Peptic ulcers with bleeding or perforation, were reported in three patients with severe hypercalcemia. Hypertension was seen in 6 (11%) patients and they were receiving medication for hypertension. In 15 (28%) of the patients with hyperparathyroidism, there were no

Table 1. Age and sex distribution of the patients

Age (Years)	No. of men	No. of women	Total (%)
<40	2	10	12 (22%)
40-49	5	2	7 (13%)
50-59	7	15	22 (41%)
60-69	3	8	11 (20%)
>70	1	1	2 (4%)
Total	15	36	54 (100%)

Table 2. Presenting symptoms of the patients and preoperative complications

Symptoms and complications	No. of patients (%)
Urolithiasis	36 (67%)
Lumbago	18 (33%)
Peptic ulcer	12 (22%)
ECG abnormality	6 (11%)
Tiredness	6 (11%)
Diabetes Mellitus	6 (11%)
Hypertension	6 (11%)
Arthritis	3 (5%)
MEA type 1	5 (9%)

Table 3. Anesthetic techniques

Anesthetic techniques	No. of patients (%)
GOE	23 (43%)
GOF	12 (22%)
GO+mNLA	10 (19%)
GOE+mNLA	6 (11%)
GOF+mNLA	3 (6%)
	54 (100%)

symptoms. Their conditions were discovered by routine chemical screening. Table 2 presents the symptoms and preoperative complications in patients with primary hyperparathyroidism.

Laboratory Findings

In all the cases with primary hyperparathyroidism, hypercalcemia and hypophosphatemia were observed. The serum calcium level of the patients ranged from 10.9 mg/dl to 15.2 mg/dl (11.9 ± 0.2 mg/dl) and their phosphate level ranged from 1.6 mg/dl to 2.8 mg/dl (2.2 ± 0.2 mg/dl). Hypersecretion of parathyroid hormone, higher values than upper limit of 0.5 ng/dl, was recognized in 60 percent of the patients, but the remainder were within a normal range. In addition, plasma alkaline phosphatase activity was severe high in five patients with bone disease. In the cases with acute hyperparathyroidism, hypercalcemia progressed rapidly, and the serum

Table 4. Postoperative complications

Complications	No. of patients (%)
Paresthesia	21 (38%)
Posterior neck pain	10 (19%)
None	26 (48%)

calcium level was above 15 mg/dl before preoperative treatment. In an electrocardiogram, a shortening of the Q-T interval is found in one patient with hypercalcemia. Atrial fibrillation was found in one patient before operation, it may have been due to a valvular disease.

Anesthetic techniques

Anesthetic techniques are shown in table 3. All the patients were premedicated with atropine and hydroxidine or diazepam intramuscularly about 30 min before anesthesia. Anesthesia was induced by thiopental and SCC in 60 percent of the patients. GOF slow induction was used in 10% and the other was induced by fentanyl and diazepam. Anesthesia was maintained with nitrous oxide and enflurane in 43% of the patients. Modified NLA was employed in 35%. Nondepolarizing muscle relaxant (pancuronium bromide or diallyl-nor-toxiferine) was administered in 66% of the patients, and was maintained with mechanical ventilation. Antihypertensive drugs were used in five cases and positive inotropic drugs were used in two cases. No further problems occurred during anesthesia on the ECG, blood pressure, heart rate, acid base balance and PaO₂. The blood loss was 15-220 ml (mean 82 ± 21 ml) and the operative time was 55-175 min (mean 110 ± 35 min).

Postoperative process

Postoperative complications are shown in table 4. Serum calcium levels started to drop within 5 hr and reached their lowest level in about 48-72 hr after parathyroidectomy; they returned to normal within the next 2 to 3 days. In our cases, transient tetany was experienced in 38% of the patients following parathyroidectomy. The first symptoms after operation were circumoral and extremity, paresthesia. These symptoms

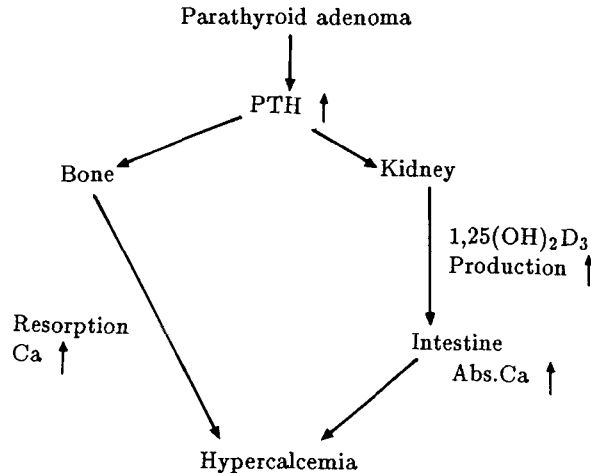


Fig. 1. Schema of the factors involved in the pathophysiology of primary hyperparathyroidism

of hypocalcemia appeared when serum calcium levels were 7 to 8 mg/dl. In these cases, 10 ml of 8.5% calcium gluconate was slowly administered intravenously to increase the plasma calcium concentration. Chvostek's sign and Trousseau's sign were exhibited in two cases. Ten patients complained of a posterior neck pain within 2 to 4 days after the operation. Fortunately, the postoperative course was usually very smooth, and carpopedal spasms, tonic convulsions, and laryngeal spasms, which may induce severe complications, did not occur.

Discussion

Primary hyperparathyroidism is growing recognition after the introduction of routine measurement of serum calcium. Hyperparathyroidism can be divided into two main types, primary and secondary hyperparathyroidism. Primary hyperparathyroidism is almost due to an adenoma and is characterized by hypersecretion of the parathyroid hormone, which leads to hypercalcemia and hypophosphatemia^{7,8}. In our cases, the most common cases (87%) was an adenoma. Rare cases of acute hyperparathyroidism also occur.

The schema of the factors involved in the pathophysiology of primary hyperparathyroidism is shown in figure 1. Symptoms

of primary hyperparathyroidism is mainly associated with renal disease, bone disease, disorders of the gastrointestinal tract, and hypercalcemia. Hypercalcemia is responsible for weakness, anorexia, fatigability, nausea and hypotonicity of the muscle. The most severe clinical manifestation of primary hyperparathyroidism is urolithiasis. In our series, about 67 percent of the patients had urinary stones. Renal damage is more common in patients with renal stones. Recently, the frequency of urolithiasis fell and the proportion of cases without symptoms or complications of parathyroid hormone rose⁸. There have been reports that hypertension is very common in primary hyperparathyroidism, but the reason for this is unclear^{8,11,12}. In our study, the incidence of hypertension was 11 percent; this is a lower percentage than that reported by sources⁸.

Proper preoperative management of patients with hypercalcemia is necessary. If serum levels exceed 15 mg % (3.74 mmol/l), cardiac standstill, mental confusion and a coma may occur. Therefore, a lowering of the serum calcium level is required, and careful attention to rehydration is a cardinal step in preoperative preparation^{1,7,9}. In all our cases of hypercalcemia, the serum calcium was maintained under 15 mg% in pre-operative prepara-

tion. In patients with acute hyperparathyroidism, hypercalcemia progresses rapidly and prolonged medical treatment is often fatal^{1,5,7,9}. Therefore, the operation should be performed after a preparation period of 24–36 hr. In patients who have been receiving digitalis, it may be necessary to reduce or stop the administration of digitalis because of the synergistic effect on the myocardium and conducting system of calcium and digitalis^{1,7}.

The diagnosis of hypercalcemia is one of the more common problems in medicine; a differential diagnosis of hypercalcemia should be done exactly. Hypercalcemia may be expressed in several metabolic, endocrine or malignant diseases other than primary hyperparathyroidism. The differentiation of primary hyperparathyroidism from a malignant disease associated hypercalcemia is particularly problematic^{7,10}. There was one case of malignancy-associated hypercalcemia which was treated as acute hyperparathyroidism.

The patients' heads should be positioned for a prolonged, tedious exploration of the neck because of the small size, the variable position, and the complex anatomy of all four parathyroid glands which must be identified. This can be problematic. The marked extension of the neck should be avoided as possible because it may occur kinking of the endotracheal tube or an accidental pneumothorax during anesthesia¹. Also, it may cause a posterior neck pain in the postoperative period.

In general, it is accepted that in clinical experience, circulatory and respiratory complications do not seem to have been frequent or severe during parathyroidectomy even in those patients with severe hypercalcemia¹. No particular anesthetic technique is preferable in parathyroid surgery¹. It is well known that hypercalcemia induces electrocardiographic changes, which include a slight prolongation of atrioventricular conduction, a shortening of QT intervals and a slight flattening of the T waves^{13–15}. Theoretically, hypercalcemia may be expected to increase the risks posed

by anesthesia because of its adverse effects on the cardiac rhythm. However, Bronsky and associates found no change in the cardiac rate or rhythm in 35 patients with hypercalcemia¹³. Gorst and Drop also found that even when arrhythmia of supraventricular origin was present before operation, major complications resulting from ventricular irritability did not occur during anesthesia or in the recovery phase¹⁶. In our clinical experience, no disturbances in the cardiac rhythm or electrocardiographic changes were seen during the operation.

We found no occurrence of altered effect of muscle relaxants in the presence of hypercalcemia. However, the potentiation of muscle relaxants in conjunction with hyperparathyroidism might have a variety of problems, theoretically. Calcium increases the release of acetylcholine from the motor nerve terminal and increases excitation-contraction coupling in muscle¹⁷. It has also been demonstrated that calcium stabilizes the postjunctional membrane¹⁷. Waud and Waud revealed that an increase in the concentration of either potassium and calcium produced a decrease in the sensitivity of the isolated nerve-muscle preparation to both tubocurarine and pancuronium; this was observed with relatively acute changes in the concentration of the ions¹⁸. Badola reported that a neuromuscular block, succinylcholine, was potentiated by the administration of calcium chloride in dogs; this may be due to a membrane stabilizing action¹⁹. It was reported that a case of primary hyperparathyroidism exhibited an increased sensitivity to succinylcholine, and a reduced duration of atracurium, which are both abnormal clinical responses²⁰. Patten reported that many patients with hyperparathyroidism have a treatable neuromuscular disease that is neuropathic in origin, and the anatomical location of the neuromuscular malfunction may be the same in amyotrophic lateral sclerosis and progressive muscular atrophy²¹. It would be worthwhile to monitor the neuromuscular function to study the effect of relaxants.

Transient tetany was the most common

complication of parathyroidectomy. This is the result of removal or damage of the parathyroid glands. Serum calcium levels diminish within a few hours after parathyroidectomy and returns to normal 2 to 3 days thereafter⁹. A transient hypocalcemia may occur, so a major objective in the treatment is to elevate the plasma calcium concentration to approximately 9 mg per 100 ml. If symptoms of hypercalcemia are controlled, excessive therapy with calcium is not advisable, because hypercalcemia in the postoperative period might tend to inhibit the recovery of the remaining parathyroid tissue^{1,6,7}. Therefore, it is necessary to measure the serum calcium levels frequently, and calcium should be administered as required.

We have reported fifty four cases in which anesthesia was administered for the treatment of primary hyperparathyroidism, and have discussed problems with the anesthetic management of patients with primary hyperparathyroidism, before, during, and after they were operated on. The clinical course was uneventful in general, but there are theoretically a variety of problems with anesthesia administered in conjunction with primary hyperparathyroidism.

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