Hyperparathyroidism, Causes and Treatment

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Etiology—What Causes This Disease?

Hyperparathyroidism is a disorder in which one or more parathyroid glands produce excessive parathyroid hormone, commonly abbreviated PTH. The original essay incorrectly defines the condition as a deficiency of PTH causing low calcium and high phosphate. That description belongs to *hypoparathyroidism*, a different disorder that can occur after neck surgery, autoimmune destruction, severe magnesium disturbance, radiation, or gland injury. Hyperparathyroidism usually produces a high or inappropriately normal PTH concentration in relation to the calcium level and is classified as primary, secondary, or tertiary according to its cause. (National Institute of Diabetes and Digestive and Kidney Diseases, 2024)

The parathyroid glands are usually four small glands located behind or near the thyroid. They regulate calcium and phosphate by responding to the concentration of ionized calcium in blood. When calcium falls, PTH increases calcium release from bone, promotes calcium reabsorption and phosphate excretion by the kidneys, and stimulates renal production of active vitamin D, which increases intestinal calcium absorption. When calcium rises, normal glands reduce PTH secretion. Hyperparathyroidism disrupts this feedback relationship.

Primary Hyperparathyroidism

Primary hyperparathyroidism begins within the parathyroid glands. In approximately eight out of ten cases, one gland contains a benign adenoma that secretes excess PTH. Many remaining cases involve hyperplasia affecting more than one gland, while multiple adenomas are less common. Parathyroid carcinoma is a rare cause but may produce very high calcium and severe symptoms. Some cases occur as part of inherited syndromes, including multiple endocrine neoplasia types 1 and 2A, hyperparathyroidism-jaw tumor syndrome, and familial isolated hyperparathyroidism.

Primary disease is often discovered through routine blood testing before obvious symptoms appear. It is more common in women and becomes more frequent with age. Previous radiation to the neck and certain genetic conditions can increase risk. Lithium therapy can alter calcium-sensing and contribute to hyperparathyroid physiology in some patients.

Secondary Hyperparathyroidism

Secondary hyperparathyroidism is an appropriate compensatory response to a chronic problem outside the parathyroid glands. Chronic kidney disease is a major cause. Diseased kidneys retain

phosphate, produce less active vitamin D, and may contribute to low or low-normal calcium. These changes stimulate the parathyroid glands. Over time, they enlarge and secrete more PTH in an attempt to maintain mineral balance.

Vitamin D deficiency, low calcium intake, malabsorption, bariatric surgery, celiac disease, and other conditions that reduce calcium absorption can also cause secondary hyperparathyroidism. In this form, PTH is high, while calcium is usually low or within the normal range rather than consistently high. Treatment focuses on the underlying cause and differs from the treatment of a single parathyroid adenoma.

Tertiary Hyperparathyroidism

Tertiary hyperparathyroidism can develop after prolonged secondary stimulation, most often in advanced kidney disease. The enlarged glands become partly autonomous and continue producing excessive PTH even after the original stimulus is reduced, such as after kidney transplantation. Both PTH and calcium may become high. The distinction is clinically important because persistent autonomous secretion may require medication or surgery.

What the Original Etiology Described

Postsurgical loss or damage of parathyroid tissue, autoimmune destruction, magnesium depletion, tumor invasion, and neck radiation are classic causes of low PTH or hypoparathyroidism, not ordinary hyperparathyroidism. Magnesium requires nuance because severe deficiency can suppress PTH secretion, while other mineral disturbances can stimulate it. Correct terminology is essential because the two disorders can have opposite laboratory findings and require very different treatment. Giving calcium and active vitamin D is a central chronic treatment for hypoparathyroidism, whereas primary hyperparathyroidism may require removal of an overactive gland. (Bollerslev et al., 2022)

Pathogenesis

What Happens at the Cellular, Tissue, or Organ Levels?

In primary hyperparathyroidism, an adenoma or hyperplastic gland secretes PTH despite a calcium concentration that should suppress secretion. The cells' regulation through the calcium-sensing receptor and related signaling becomes abnormal. The gland may enlarge, and one clone of cells can dominate within an adenoma. The excessive PTH acts mainly on bone and kidneys, while its effect on the intestine occurs indirectly through active vitamin D.

In bone, PTH receptors are located principally on osteoblast-lineage cells rather than on osteoclasts themselves. Continuous excessive PTH signaling increases factors that promote osteoclast formation

and bone resorption. Calcium and phosphate are released from the skeleton. Cortical bone, including the forearm, can be particularly affected, although bone-density patterns vary. Severe untreated disease may cause osteitis fibrosa cystica, subperiosteal resorption, and brown tumors, but these findings are now uncommon in settings where blood testing detects disease earlier.

In the kidneys, PTH increases calcium reabsorption in parts of the nephron but also raises the amount of calcium filtered because blood calcium is high. Urinary calcium may therefore be elevated and contribute to stones. PTH reduces phosphate reabsorption, causing phosphaturia and often low serum phosphate. It also stimulates 1-alpha-hydroxylase, increasing active vitamin D and supporting intestinal calcium absorption.

How Does That Alter the Function of the Associated System?

The parathyroid system normally maintains calcium within a narrow range required for nerve conduction, muscle contraction, cardiac function, coagulation, and cell signaling. Excessive PTH shifts mineral balance toward higher blood calcium and increased bone turnover. The skeleton becomes a source of calcium rather than a stable mineral reservoir, while the kidneys must filter and excrete a greater calcium load.

In secondary hyperparathyroidism caused by chronic kidney disease, the physiology differs. Phosphate retention, reduced active vitamin D, and disturbed calcium balance chronically stimulate the glands. High PTH contributes to renal osteodystrophy and broader chronic kidney disease–mineral and bone disorder. The goal is not merely to lower one laboratory number but to manage phosphate, calcium, vitamin D, bone health, vascular calcification risk, and kidney disease.

How Does It Impact the Function of the Body as a Whole?

Hypercalcemia can affect the kidneys, skeleton, gastrointestinal tract, muscles, and nervous system. Patients may develop kidney stones, increased urination, thirst, dehydration, constipation, nausea, fatigue, weakness, bone or joint discomfort, mood change, or difficulty concentrating. Severe hypercalcemia can produce marked confusion, cardiac rhythm disturbance, kidney injury, or a medical emergency.

The original list includes tingling, muscle spasms, seizures, laryngospasm, dry skin, hair changes, and wheezing. These are more characteristic of hypocalcemia and hypoparathyroidism than of typical hyperparathyroidism. Hyperparathyroidism can cause muscle weakness and neurocognitive symptoms, but tingling and tetany point toward low calcium. Separating these patterns prevents diagnostic confusion.

Clinical Manifestations

What Signs Will You Observe or Measure?

Many people with primary hyperparathyroidism have no visible signs and are diagnosed when routine chemistry shows elevated calcium. Observable findings may include dehydration, muscle weakness, reduced bone density, kidney stones, or complications discovered through imaging. Severe longstanding disease may produce skeletal tenderness, fracture, or physical effects of renal impairment. A neck mass is unusual because most adenomas are small and deep; a palpable mass with severe hypercalcemia may raise concern for rare parathyroid carcinoma or another neck lesion.

Blood pressure and cardiovascular findings may coexist, but their direct relationship to mild primary hyperparathyroidism is not always clear. Clinicians should avoid attributing every symptom to PTH without considering common alternatives. Fatigue and depression, for example, have many causes.

What Symptoms Will the Client Experience or Feel?

A person may feel entirely well. When symptoms occur, they can include fatigue, reduced energy, muscle weakness, depression, memory or concentration difficulty, bone and joint aches, constipation, nausea, loss of appetite, abdominal discomfort, excessive thirst, frequent urination, or pain from a kidney stone. The traditional phrase “stones, bones, abdominal groans, and psychic overtones” summarizes renal, skeletal, gastrointestinal, and neuropsychiatric effects, but it should not replace individualized assessment.

Symptoms depend on the severity and speed of calcium elevation. A patient with slowly developing mild hypercalcemia may have few complaints, while rapid or severe elevation can cause vomiting, dehydration, confusion, lethargy, and arrhythmia. Acute severe hypercalcemia requires urgent medical evaluation.

In secondary hyperparathyroidism, symptoms may arise from the underlying kidney disease or vitamin D deficiency and from bone-mineral complications. Bone pain, fracture, itching in advanced kidney disease, and muscle weakness may occur. Serum calcium may not be elevated, so the clinical pattern differs from primary disease.

What Symptoms Suggest Hypoparathyroidism Instead?

Tingling around the mouth or in the fingers, carpopedal spasm, tetany, seizures, laryngospasm, and prolonged QT interval suggest hypocalcemia. These findings fit the low-PTH disorder described in much of the original essay. They require prompt evaluation, especially after thyroid or neck surgery. The title and body must not mix these opposite conditions because treatment for one may be

inappropriate for the other.

What Abnormal Labs and Diagnostic Tests Confirm or Support the Diagnosis?

Primary hyperparathyroidism is usually diagnosed by repeated elevation of albumin-adjusted total calcium or ionized calcium together with an elevated or inappropriately normal intact PTH level. If calcium is high, normal glands should suppress PTH. A value within the laboratory reference range may therefore be abnormal in context. Serum phosphate is often low or low-normal, and kidney function and 25-hydroxyvitamin D should be measured.

The original statement that hypocalcemia confirms hyperparathyroidism is incorrect for primary disease. Low calcium with high PTH may support secondary hyperparathyroidism, while low calcium with low or inappropriately normal PTH suggests hypoparathyroidism. Interpretation requires the complete pattern.

A 24-hour urine calcium measurement or calcium-to-creatinine clearance ratio may help distinguish primary hyperparathyroidism from familial hypocalciuric hypercalcemia, an inherited condition in which blood calcium is elevated but urine calcium is relatively low. Familial hypocalciuric hypercalcemia usually does not benefit from parathyroid surgery, making this distinction important.

Bone density is assessed at the lumbar spine, hip, and distal one-third radius. Vertebral imaging may be performed when fracture is suspected. Kidney evaluation can include creatinine or estimated glomerular filtration rate, urinary calcium, and imaging for stones or nephrocalcinosis. These tests assess complications and determine whether surgery is recommended.

Normocalcemic Primary Hyperparathyroidism

Some patients have repeatedly normal total and ionized calcium with persistently elevated PTH after secondary causes have been excluded. This is called normocalcemic primary hyperparathyroidism. Diagnosis requires care because vitamin D deficiency, reduced kidney function, low calcium intake, malabsorption, medications, and urinary calcium loss can all raise PTH. One elevated result is insufficient.

Role of Imaging

Ultrasound, sestamibi scanning, four-dimensional computed tomography, and other imaging methods may be used to locate an overactive gland before surgery. Imaging does not establish the biochemical diagnosis. A negative scan does not exclude primary hyperparathyroidism, and a visible nodule does not prove that it is responsible. Localization is performed after the decision for surgery, helping the surgeon plan the approach.

Treatment Implications

Briefly Explain the Types of Treatments Used

Parathyroidectomy is the only definitive cure for primary hyperparathyroidism caused by an overactive gland or glands. An experienced surgeon identifies and removes the abnormal tissue while preserving sufficient normal parathyroid function. Focused surgery may be possible when one adenoma is localized, while bilateral exploration may be required in multigland disease or uncertain localization. Intraoperative PTH measurement can help confirm that hypersecreting tissue has been removed.

Surgery is generally recommended for symptomatic patients with kidney stones, fractures, or other significant disease and for asymptomatic patients who meet guideline criteria involving calcium elevation, skeletal involvement, kidney function, urinary calcium or stones, or age. Specific criteria should be applied by an endocrinologist and surgeon using current guidelines and the patient's health and preferences.

Observation

Some patients with mild asymptomatic primary hyperparathyroidism who do not meet surgical criteria may be monitored. Monitoring includes calcium, kidney function, bone density, symptoms, and assessment for stones or fracture. Observation is an active plan rather than ignoring the disorder. Surgery may become appropriate if calcium rises, bone density declines, kidney complications develop, or the patient chooses definitive treatment.

Hydration and Diet

Patients are generally advised to avoid dehydration because it can worsen hypercalcemia and stone risk. Calcium intake should not automatically be severely restricted, since very low intake can stimulate PTH and harm bone. Dietary recommendations should follow clinical guidance. Vitamin D deficiency may be corrected cautiously with monitoring because adequate vitamin D can reduce secondary stimulation, while excessive dosing can worsen calcium in some circumstances.

Medication for Primary Hyperparathyroidism

Cinacalcet is a calcimimetic that increases sensitivity of the calcium-sensing receptor and can lower serum calcium. It may be used when surgery is inappropriate, declined, or unsuccessful, and in selected severe conditions. It usually does not improve bone density as effectively as bone-directed therapy.

Bisphosphonates can increase bone mineral density in selected patients but generally do not cure the excessive PTH secretion or consistently normalize calcium. Denosumab may be considered in particular circumstances. Medication choice depends on whether the primary goal is lowering calcium, protecting bone, or managing another condition.

Acute Severe Hypercalcemia

Severe symptomatic hypercalcemia may require hospital treatment with intravenous fluids, calcitonin, antiresorptive medication, and management of the cause. Treatment depends on heart and kidney function and should be supervised urgently. This is different from routine outpatient management of mild disease.

Secondary Hyperparathyroidism

Treatment of secondary hyperparathyroidism addresses the underlying stimulus. Vitamin D deficiency may require replacement, while low calcium intake or malabsorption is corrected appropriately. In chronic kidney disease, management may include dietary phosphate control, phosphate binders, vitamin D analogues, calcimimetics, dialysis optimization, and treatment guided by nephrology standards. Calcium, phosphate, PTH, vitamin D, and bone disease must be considered together.

Tertiary Hyperparathyroidism

Tertiary disease may be treated with calcimimetics or parathyroid surgery when autonomous PTH secretion and hypercalcemia persist. The plan depends on kidney function, transplantation status, symptoms, and gland enlargement.

What Are the Goals of Treatment in Relation to the Pathophysiology?

For primary hyperparathyroidism, the goal is to stop inappropriate PTH secretion, normalize calcium, reduce kidney-stone risk, protect skeletal strength, and prevent severe hypercalcemic complications. Surgery directly addresses the source by removing abnormal gland tissue. When surgery is not performed, monitoring and medication target complications and biochemical abnormalities.

For secondary hyperparathyroidism, the goal is to correct the chronic stimulus and reduce excessive bone turnover without causing harmful calcium or phosphate levels. In kidney disease, simply normalizing PTH to a single target is not always appropriate because the hormone may reflect adaptation. Treatment follows trends, disease stage, and the overall mineral pattern.

The original essay states that hyperparathyroidism is usually a lifelong process treated by raising

calcium through supplements and active vitamin D. That description again fits chronic hypoparathyroidism. Primary hyperparathyroidism can often be cured surgically. Secondary disease may improve when vitamin D deficiency or malabsorption is corrected, while kidney-related disease may require long-term management.

Are We Seeking a Cure, Remission, or Palliative Care?

In primary hyperparathyroidism, clinicians usually seek cure through successful parathyroidectomy when surgery is appropriate. After surgery, calcium and PTH are monitored. Some patients develop temporary low calcium because bones begin taking up mineral rapidly, a condition called hungry bone syndrome, especially after severe disease. Calcium and vitamin D may be required during recovery. (Bilezikian et al., 2022)

Patients managed without surgery receive control and surveillance rather than remission in the oncological sense. Medication can lower calcium or improve bone density but may not remove the underlying adenoma. Parathyroid carcinoma is rare and requires specialist surgery and ongoing management.

Secondary hyperparathyroidism may be reversible when caused by correctable vitamin D deficiency or low calcium absorption. Chronic kidney disease–related disease is often managed over time, while tertiary disease may require definitive intervention. Palliative care is not the standard category for ordinary hyperparathyroidism, though symptom-focused care may be part of treatment for a person with advanced illness who cannot undergo surgery.

Complications

Untreated primary hyperparathyroidism can lead to kidney stones, nephrocalcinosis, reduced kidney function, osteoporosis, and fracture. Severe hypercalcemia can cause dehydration, confusion, arrhythmia, and acute kidney injury. Pregnancy requires specialist management because maternal hypercalcemia can affect both mother and fetus.

Secondary hyperparathyroidism in chronic kidney disease contributes to bone disease and may coexist with vascular and soft-tissue calcification through disturbed calcium-phosphate metabolism. Treatment must avoid oversuppression that could produce low-turnover bone disease.

Nursing and Patient-Education Considerations

Nurses and other clinicians should verify whether the diagnosis is hyperparathyroidism or hypoparathyroidism before providing education. Patients need an explanation of PTH, calcium, symptoms requiring urgent help, medication purpose, hydration, laboratory monitoring, and follow-up.

After surgery, monitoring for tingling, muscle cramps, or other signs of low calcium is important.

Medication reconciliation should identify lithium, thiazide diuretics, calcium, vitamin D, and other agents affecting mineral balance. Patients should not stop prescribed treatment or begin large supplement doses without professional advice. Education should be individualized for kidney function, stone history, bone density, diet, and treatment plan.

Conclusion

Hyperparathyroidism is caused by excessive PTH secretion or chronic stimulation of the parathyroid glands. Primary disease most often results from a benign adenoma and commonly produces high calcium with elevated or inappropriately normal PTH. Secondary disease usually arises from chronic kidney disease, vitamin D deficiency, low calcium absorption, or related conditions and often has low or normal calcium. Tertiary disease develops when longstanding secondary hyperparathyroidism becomes autonomous.

The original article confused hyperparathyroidism with hypoparathyroidism. Low PTH after neck surgery, low calcium, tingling, tetany, laryngospasm, and treatment with calcium and active vitamin D belong primarily to hypoparathyroidism. Correcting that distinction changes the etiology, clinical manifestations, laboratory diagnosis, and treatment.

Primary hyperparathyroidism is diagnosed biochemically, while imaging is used for surgical planning. Parathyroidectomy can provide a cure, and monitoring or medication may be appropriate for selected patients. Secondary and tertiary forms require treatment of their underlying physiology. Because calcium disorders can become serious, diagnosis and treatment should be directed by qualified healthcare professionals rather than by symptoms or supplements alone.

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