

# PARATHYROID GLAND

## What is the Parathyroid Gland?

The body has four parathyroid glands that are located just behind the thyroid gland (which is the center of the neck at the front). They have nothing to do with the function of the thyroid. (PARA is derived from a Greek word meaning beside, alongside of, by.)

Very simply, these glands act as a type of thermostat or regulator that controls the blood level of calcium. It is essential to keep the blood level of calcium under tight control because calcium is needed inside just about every cell in the body in order to keep that cell functioning properly. When the blood level of calcium is too high or too low bad things can happen, even to the point of being life-threatening. Fortunately for most people, most of the time these parathyroid glands do their job very well.

## Signs & Symptoms

### How do I know if my parathyroid glands are working properly?

Most of the time you won't notice anything wrong unless your doctor happens to order a blood calcium test and finds that the level is too high (not uncommon) or too low (quite uncommon).

Slightly high blood calcium caused by over-active parathyroid glands can be present for many years without your being aware of it. That does not mean that it might not be doing you any harm.

There can be gradual weakening of your bones causing you to be at increased risk for having a fracture. There might also be an increased loss of calcium through the kidneys, increasing your chances of having a kidney stone. In fact, everyone with a fracture that isn't the result of major trauma and everyone who has a kidney stone should have blood calcium and parathyroid hormone measured.

There are even more subtle changes that might be linked to over-active parathyroids. These include an increased risk of high blood diabetes, and very subtle changes in your thinking capacity. These are all very common, even in people with normal parathyroid glands, so the link between the parathyroids and these conditions in any individual patient is not always very clear. Only occasion-

ally are these conditions made better by correcting the abnormal parathyroids.

## Prevention

### PRIMARY HYPERPARATHYROIDISM

Primary hyperparathyroidism cannot be prevented.

### SECONDARY HYPERPARATHYROIDISM

Secondary Hyperparathyroidism cannot be prevented unless one was able to prevent the cause of the secondary hyperparathyroidism – something that is not usually possible.

Chronic kidney disease is usually silent and the secondary hyperparathyroid develops during this silent phase. Renal leak hypercalciuria (too much calcium being excreted in the urine) is silent unless the patient has a kidney stone resulting from the hypercalciuria so this cause of secondary hyperparathyroid is also not preventable.

Chronic vitamin D deficiency will lead to secondary hyperparathyroidism and this is obviously preventable if vitamin D nutrition is always adequate. In people with normal gastro-intestinal function, nutritional D deficiency is always preventable. In patients with bowel disease (e.g. Crohn's disease, sprue) when the GI symptoms are present, the secondary hyperparathyroidism may well be present.

In brief, hyperparathyroidism is essentially not a preventable condition. However, both primary and secondary hyperparathyroidism are very treatable and the "cure" is the anticipated result in most patients with the exception of late stage chronic kidney disease.

## Conditions

To help you understand parathyroid conditions, let's first understand how the parathyroid works. Attached to the cells of these parathyroid glands is a newly discovered molecule called the Calcium Sensing Receptor (CaSR). This CaSR responds to very small changes in the blood level of calcium to turn the parathyroid glands on and off when needed. The CaSR is working as the thermostat.

If the body is not getting enough calcium from the diet, for example, the CaSR senses a need to get calcium from somewhere. The immediate response is for the parathyroid glands to make and secrete more of their active hormone – parathyroid hormone (PTH). This sets off a chain of events that get more calcium into the bloodstream.

First, PTH goes to the calcium bank – namely your bones where 98% of the body's store of calcium is warehoused. This is good for the blood calcium and for the cells that need calcium but not good for the bones themselves.

The second line of defense against a need for more calcium is the kidneys. Here PTH does two things. First, they limit the kidneys from excreting too much calcium thereby keeping the blood levels up. Next they work on the kidney to produce another hormone called calcitriol or “active vitamin D”.

#### **What does calcitriol do?**

Actually it does many things, but the important one as far as the parathyroid glands and blood calcium are concerned is to help the gut absorb just as much calcium as possible.

The end result is that a limited absorption of calcium from the gut triggers a cascade, in which the parathyroid glands get turned on and produce more PTH, which takes needed calcium from the skeleton and limits excretion of calcium in the urine. PTH also activates the vitamin D system to help the gut absorb as much calcium as possible. Once the levels of calcium have been brought back to normal the system slows down and waits for the next call.

Interestingly, and perhaps surprising to most, this chain of events happens without us knowing about or feeling anything wrong. Even the changes in blood calcium that set the whole system in motion are too small to be measured most of the time. The need to keep the blood calcium constant is so great that, when everything is working properly, even the minutest change triggers a response from the parathyroid glands.

*Yes, vitamin D is actually a hormone not a vitamin.*

The vitamin D you get from your multi-vitamins, your diet, or that is made by the action of sunlight on your skin is not very active at all. First, it has to go to the liver where it is turned into calcediol, which is more active than vitamin D but still not good enough. This calcediol is then carried in the blood to the kidneys where it is converted to calcitriol. This change from calcediol to calcitriol is controlled by PTH.

## **LOW BLOOD CALCIUM**

Low blood calcium is much less common, particularly when caused by a parathyroid gland problem. There are some conditions that are present from birth and are quickly detected and treated immediately. The treatment must be lifelong! Gradually the body adapts to this lower calcium level and symptoms can be minimal even if you are not always faithful about taking your medicine. Forget to take it for too long and bad things happen starting with tingling around the lips and in the fingers and toes. If you don't do anything about this you will likely develop severe painful cramps in your hand. This is known as tetany – sounds like the infection tetanus but it is not at all related. A more common cause of low blood calcium due to a parathyroid problem is seen in patients who have major neck operations for conditions such as throat or thyroid cancer. In order to remove as much as the cancer as possible from the neck it is sometimes necessary to remove the parathyroid glands as well, even though they are not directly involved in the cancer. If not checked, this can cause a rapid drop in calcium and the development of tingling and cramps in the hands and feet. This does not happen often because the surgeon will be carefully monitoring your blood calcium if he or she has done extensive neck surgery. Making sure you get plenty of calcium by mouth and intravenously is always done and many times there is also treatment with the active vitamin D, calcitriol. Patients who are left with under-active parathyroids after such surgery do not really adapt well to this and are at much increased risk of having symptoms from their low calcium. The medicines cannot be skipped!

## **Treatment**

### **OVERACTIVE PARATHYROID DISEASE**

This condition is known as Primary Hyperparathyroidism and the only treatment is surgical removal of the abnormal gland. About 1 in 600 to 1 in 1000 people have primary hyperparathyroidism. In 85-90% of these patients only one of the four glands is involved and only that one is removed by the surgeon. Once that is done successfully the disease is essentially cured and only rarely does it come back. In 10-15% of cases all four glands are involved. Most often this is seen in people with a genetic or family history of hyperparathyroidism. In that case the surgeon will remove three and a half glands and the remaining small piece of parathyroid gland tissue is enough to get by with. A recurrence of hyperparathyroidism is more common in such cases but here too it is uncommon.

**If the glands are so small and hidden behind the thyroid how does the surgeon know which one to take out?**

That's an easy question. First of all removal of any abnormal parathyroid glands should only be done by an experienced parathyroid surgeon – most large cities have one or more such talented surgeons and most of these doctors belong to the Endocrine Surgeons' Association – a group that you can only join if you are indeed an experienced endocrine surgeon.

Sometime before the surgery is scheduled you would have a test called a Sestamibi scan or a different test called an ultrasound. For the scan you would be injected with a minute amount of radio-active material that goes directly to the abnormal parathyroid tissue and an image can be taken to guide the surgeon where to look. Like any test, this is not 100% perfect but it is pretty good, particularly if the person doing the scan has had lot of experience. The ultrasound test does not involve any radioactivity but is simply what it says – an ultrasound probe is passed over your neck looking for one or more parathyroids that appear to be larger than normal. Different surgeons favor one of these tests over the other, depending on their experience. Sometimes if one of the tests doesn't give a clear cut answer you will also have the other test done to help the surgeon decide what to look for during the operation. The surgery itself is very straightforward when done by someone who knows what he or she is doing. Many centers are now doing this surgery without the patient needing to be admitted to the hospital.

### **How will I feel after the surgery?**

For less than a day you will feel the effects of the anesthetic and having a breathing tube placed down your throat. You will also have some pain from the surgery itself and this can last up to a week but it is usually mild and tolerable for most patients.

### **Who should I contact if I have any more questions?**

The parathyroid glands are part of the body's Endocrine System and the most knowledgeable doctors in this field are known as Endocrinologists. They are the best doctors to seek advice from if the initial information you get leaves you with some unanswered questions. All endocrinologists who see patients with primary hyperparathyroidism work very closely with their surgical colleagues and together this team can answer most of your questions and concerns. If you have a child with one of the low blood calcium disorders, the person you should consult is a pediatric endocrinologist. If you have low blood calcium after a major operation on your neck, you should also follow-up with an endocrinologist.

*Written by Michael Kleerekoper, MD, MACE*

