# Tuberous Sclerosis

Tuberous sclerosis is a rare neurocutaneous autosomal dominant disorder characterized by nonmalignant tumors of the brain and other organs, including the kidneys, heart, eyes, and skin. It is caused by a mutation in tumor growth suppressor proteins, which are agents that regulate cell proliferation and differentiation. Defects in these tumor growth suppressor proteins lead to benign growths, called hamartomas, in the skin and CNS. In the brain, subependymal giant cell astrocytomas occur in one out of ten individuals and can block the flow of CSF, leading to increased intracranial pressure and hydrocephalus. The effect of the hamartomas in the brain can lead to seizures and intellectual disability. Multiple skin manifestations are also common, including adenoma sebaceum on the face, shagreen patches on the back, and ash-leaf spots throughout the body. The heart and kidney are also commonly affected by the presence of cardiac rhabdomyomas and renal angiomyolipomas.



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## Characteristics

**Autosomal Dominant**
Domino
This disease is inherited in an autosomal dominant fashion.

## Signs and Symptoms

**Hamartomas in CNS and Skin**
Hammerhead-shark with CNS-brain showing and stretching Skin
Hamartomas are hallmark findings in TS. They are focal malformations in tissues like skin and brain that resemble a neoplasm but are benign and grow at the same rate as surrounding tissues.

**Phakoma**
Fat-comma
Phakoma, also known as retinal phakoma or astrocytic hamartoma, is a gray or yellow plaque, single or multiple. Phakoma may be found in the retina, in or near the optic disc, or at a distance from it. It is most often caused by tuberous sclerosis.

**Subependymal Giant Cell Astrocytoma**
Sub-panda with Giant Shell Astronaut
These tumors occur in about one out of ten individuals with tuberous sclerosis. This brain tumor is noncancerous but can be very problematic due to the involvement of the brain. Subependymal refers to the region in the brain below the ependyma that lines the ventricles. Giant cells refer to large abnormal cells found on microscopic examination, and astrocytoma refers to the most prevalent cell type. These tumors can grow and block the flow of CSF, leading to increased pressure and hydrocephalus.

**Seizures**
Caesar
Seizures, which are defined as transient episodes of abnormal, excessive neuronal activity, are common in individuals with tuberous sclerosis due to growths of the brain and are more often seen in children with this disease.

**Intellectual Disability (Mental Retardation)**
Tar Covered Book
A large percentage of people with tuberous sclerosis have learning difficulties ranging from mild to severe intellectual disability, usually as a result of growths of the brain.Intellectual disability correlates with the extent of brain involvement, particularly cortical tubers.

**Facial Angiofibroma (Adenoma Sebaceum)**
Face of Angel-fiber
Facial angiofibromas, also called Adenoma sebaceum, are reddish spots or bumps that appear in a butterfly distribution on the nose and cheeks and consist of blood vessels and fibrous tissues.

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**Shagreen Patch**

Shaggy-green-tree

These are areas of leathery, thick skin usually found on the lower back or neck. The skin can dimple like an orange peel, which is a common finding in tuberous sclerosis.

**Ash-Leaf Spots**

Ash-leaves

Ash-leaf spots, also called hypomelanic macules, are white or lighter patches of skin on any part of the body caused by a deficiency of melanin. Ash-leaf spots are often the only visible sign of this rare disease at birth.

**Renal Angiomyolipoma**

Kidney-angel with big Muscles and Lips

Between 60 percent to 80 percent of individuals with tuberous sclerosis have angiomyolipomas on their kidneys. Angiomyolipomas are tumors composed of vascular tissue, smooth muscle, and fat. Although the growths are benign, the tumors can become relatively large and be a risk for catastrophic hemorrhage.

**Cardiac Rhabdomyoma**

Raptor-heart

Rhabdomyomas are benign tumors of striated muscle that are common in tuberous sclerosis. It is the most common primary cardiac tumor in children. Cardiac rhabdomyoma is more common in the ventricles of the heart. Problems due to this growth occur most often in utero or within the child's first year of life. The clinical presentation may include obstruction, arrhythmias, or murmurs. Most often, patients with cardiac rhabdomyoma due to tuberous sclerosis will display a mitral regurgitation murmur on physical exam. The development of this rare tumor can be a strong indicator of tuberous sclerosis in pediatric patients.

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