DCX Gene

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Doublecortin: The DCX gene provides instructions for producing a protein called doublecortin.

Keywords: genes

1. Normal Function

This protein is involved in the movement of nerve cells (neurons) to their proper locations in the developing brain, a process called neuronal migration. Doublecortin attaches (binds) to microtubules, which are rigid, hollow fibers that make up the cell's structural framework (the cytoskeleton). The binding of doublecortin promotes the stability of microtubules. Microtubules help propel neurons by forming scaffolding within the cell that elongates in a specific direction, altering the cytoskeleton and moving the neuron.

2. Health Conditions Related to Genetic Changes

2.1 Isolated Lissencephaly Sequence

More than 70 mutations in the *DCX* gene have been found to cause isolated lissencephaly sequence (ILS). This condition is characterized by abnormal brain development that results in the brain having a smooth surface (lissencephaly) instead of its normal folds and grooves. Individuals with ILS have severe neurological problems, including severe intellectual disability and recurrent seizures (epilepsy) that begin in infancy. Most of the *DCX* gene mutations that cause ILS change a single protein building block (amino acid) in doublecortin and usually result in a protein with little or no function. A lack of normal doublecortin affects the stability and organization of microtubules, impairing their ability to move neurons. Neurons in the developing brain are particularly affected, resulting in the neurological problems associated with ILS.

2.2 Subcortical Band Heterotopia

More than 100 mutations in the *DCX* gene have been found to cause subcortical band heterotopia. This condition causes abnormal brain development that is less severe than ILS (described above). In people with subcortical band heterotopia, some neurons that should be part of a certain region of the brain do not reach their destination. The neurons stop their migration process in areas of the brain where they are not supposed to be and form band-like clusters of tissue. The signs and symptoms of subcortical band heterotopia can vary from severe intellectual disability and seizures that begin early in life to normal intelligence with mild seizures that occur later in life.

Mutations in the *DCX* gene are the most common cause of subcortical band heterotopia. Most of these mutations change single amino acids in the doublecortin protein. *DCX* gene mutations that cause subcortical band heterotopia can impair the protein's function or alter the protein's structure or stability. As a result, the doublecortin protein has a reduced ability to bind to microtubules, impairing their ability to move neurons during neuronal migration. Without proper neuronal migration, neurons in the developing brain can be misplaced, leading to the neurological problems that occur in subcortical band heterotopia.

Females with a mutation in one copy of the DCX gene in each cell usually develop subcortical band heterotopia, while males with one *DCX* gene mutation generally have ILS. Females can develop ILS and males can develop subcortical band heterotopia, but these instances are rare. Most males with subcortical band heterotopia have a *DCX* gene mutation in only some of the body's cells, a situation known as mosaicism.

3. Other Names for This Gene

- DBCN

- DC
- DCX_HUMAN
- doublecortex
- doublecortex; lissencephaly, X-linked (doublecortin)
- lissencephalin-X
- LISX
- XLIS

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