NRAS Gene

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1. Introduction

The *NRAS* gene provides instructions for making a protein called N-Ras that is involved primarily in regulating cell division. Through a process known as signal transduction, the protein relays signals from outside the cell to the cell's nucleus. These signals instruct the cell to grow and divide (proliferate) or to mature and take on specialized functions (differentiate). The N-Ras protein is a GTPase, which means it converts a molecule called GTP into another molecule called GDP. The N-Ras protein acts like a switch, and it is turned on and off by the GTP and GDP molecules. To transmit signals, the N-Ras protein must be turned on by attaching (binding) to a molecule of GTP. The N-Ras protein is turned off (inactivated) when it converts the GTP to GDP. When the protein is bound to GDP, it does not relay signals to the cell's nucleus.

The *NRAS* gene belongs to a class of genes known as oncogenes. When mutated, oncogenes have the potential to cause normal cells to become cancerous. The *NRAS* gene is in the Ras family of oncogenes, which also includes two other genes: *HRAS* and *KRAS*. The proteins produced from these three genes are GTPases. These proteins play important roles in cell division, cell differentiation, and the self-destruction of cells (apoptosis).

2. Health Conditions Related to Genetic Changes

2.1. Giant congenital melanocytic nevus

At least two mutations in the *NRAS* gene have been found to cause giant congenital melanocytic nevus. This condition is characterized by a large, noncancerous patch of abnormally dark skin that is present from birth and an increased risk of a type of skin cell cancer called melanoma. The *NRAS* gene mutations that cause this condition are somatic, meaning that they occur during a person's lifetime and are present only in certain cells. The mutations occur during embryonic development in cells that will develop into pigment-producing skin cells (melanocytes). The mutations that cause this condition affect a single protein building block (amino acid) in the N-Ras protein. Specifically, the mutations replace the amino acid glutamine at position 61 with either lysine or arginine (written as Gln61Lys or Q61K and Gln61Arg or Q61R). These mutations lead to production of an N-Ras protein that is constantly turned on (constitutively active). Instead of triggering cell growth in response to particular signals from outside the cell, the overactive protein directs cells to grow and divide constantly. The uncontrolled cell growth of early melanocytes leads to a large patch of darkly pigmented skin characteristic of giant congenital melanocytic nevus. Uncontrolled cell growth of melanocytes after birth contributes to the risk of developing melanoma in people with giant congenital melanocytic nevus.

2.2. Cancers

Somatic mutations in the *NRAS* gene are involved in the development of several types of cancer. These mutations lead to an N-Ras protein that is constitutively active and can direct cells to grow and divide without control. Studies suggest that *NRAS* gene mutations are common in the aggressive skin cancer melanoma, including individuals without giant congenital melanocytic nevus (described above). Mutations in the *NRAS* gene have also been found in other types of cancer.

For reasons that are unclear, inherited mutations in the *NRAS* gene do not appear to increase the risk of cancer in people with Noonan syndrome.

3. Other Names for This Gene

- GTPase NRas
- GTPase NRas precursor
- N-ras
- N-ras protein part 4
- neuroblastoma RAS viral (v-ras) oncogene homolog
- neuroblastoma RAS viral oncogene homolog
- NRAS1
- NS6
- RASN_HUMAN
- transforming protein N-Ras
- v-ras neuroblastoma RAS viral oncogene homolog

References

1. Charbel C, Fontaine RH, Malouf GG, Picard A, Kadlub N, El-Murr N, How-Kit A,Su X, Coulomb-L'Hermine A, Tost J, Mourah S, Aractingi S, Guégan S. NRAS mutationis the sole recurrent somatic mutation in large congenital melanocytic nevi. JInvest Dermatol. 2014 Apr;134(4):1067-1074. doi: 10.1038/jid.2013.429.
2. Cirstea IC, Kutsche K, Dvorsky R, Gremer L, Carta C, Horn D, Roberts AE, LepriF, Merbitz-Zahradnik T, König R, Kratz CP, Pantaleoni F, Dentici ML, Joshi VA,Kucherlapati RS, Mazzanti L, Mundlos S, Patton MA, Silengo MC, Rossi C, ZampinoG, Digilio C, Stuppia L, Seemanova E, Pennacchio LA, Gelb BD, Dallapiccola B,Wittinghofer A, Ahmadian MR, Tartaglia M, Zenker M. A restricted spectrum of NRASmutations causes Noonan syndrome. Nat Genet. 2010 Jan;42(1):27-9. doi:10.1038/ng.497.
3. Eskandarpour M, Huang F, Reeves KA, Clark E, Hansson J. Oncogenic NRAS hasmultiple effects on the malignant phenotype of human melanoma cells cultured invitro. Int J Cancer. 2009 Jan 1;124(1):16-26. doi: 10.1002/ijc.23876.
4. Romano AA, Allanson JE, Dahlgren J, Gelb BD, Hall B, Pierpont ME, Roberts AE, Robinson W, Takemoto CM, Noonan JA. Noonan syndrome: clinical features,diagnosis, and management guidelines. Pediatrics. 2010 Oct;126(4):746-59. doi:10.1542/peds.2009-3207.