BLM Gene

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BLM RecQ like helicase

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1. Normal Function

The *BLM* gene provides instructions for making a member of a protein family called RecQ helicases. Helicases are enzymes that attach (bind) to DNA and unwind the two spiral strands (double helix) of the DNA molecule. This unwinding is necessary for several processes in the cell nucleus, including copying (replicating) DNA in preparation for cell division and repairing damaged DNA. Because RecQ helicases help maintain the structure and integrity of DNA, they are known as the "caretakers of the genome."

When a cell prepares to divide to form two cells, the DNA that makes up the chromosomes is copied so that each new cell will have two copies of each chromosome, one from each parent. The copied DNA from each chromosome is arranged into two identical structures, called sister chromatids, which are attached to one another during the early stages of cell division. Sister chromatids occasionally exchange small sections of DNA during this time, a process called sister chromatid exchange. Researchers suggest that these exchanges may be a response to DNA damage during the copying process. The BLM protein helps to prevent excess sister chromatid exchanges and is also involved in other processes that help maintain the stability of the DNA during the copying process.

2. Health Conditions Related to Genetic Changes

2.1. Bloom syndrome

More than 70 *BLM* gene mutations have been identified in people with Bloom syndrome, an inherited disorder characterized by short stature, a skin rash that develops after exposure to the sun, and a greatly increased risk of cancer. One particular *BLM* gene mutation causes almost all cases of Bloom syndrome among people of Central and Eastern European (Ashkenazi) Jewish descent. This mutation deletes six DNA building blocks (nucleotides) and replaces them with seven others at position 2281 (written as 2281 delta 6ins7, or blmAsh). The blmAsh mutation results in the production of an abnormally short, nonfunctional version of the BLM protein. Other *BLM* gene mutations change single protein building blocks (amino acids) in the protein sequence or create a premature stop signal in the instructions for making the protein. These mutations also reduce the amount of functional BLM protein.

As a result of the lack of functional BLM protein, the frequency of sister chromatid exchange is about 10 times higher than average. Exchange of DNA between chromosomes derived from the individual's mother and father are also increased in people with *BLM* gene mutations. In addition, chromosome breakage occurs more frequently in affected individuals. All of these changes are associated with gaps and breaks in the genetic material that impair normal cell activities and cause the health problems associated with this condition. Without the BLM protein, the cell is less able to repair DNA damage caused by ultraviolet light, which results in increased sun sensitivity. Genetic changes that allow cells to divide in an uncontrolled way lead to the cancers that occur in people with Bloom syndrome.

3. Other Names for This Gene

- BLM_HUMAN
- Bloom syndrome
- Bloom syndrome protein
- Bloom syndrome RecQ like helicase
- Bloom syndrome, RecQ helicase-like

- BS
- MGC126616
- RECQL3

References

1. Amor-Guéret M, Dubois-d'Enghien C, Laugé A, Onclercq-Delic R, Barakat A,Chadli E, Bousfiha AA, Benjelloun M, Flori E, Doray B, Laugel V, Lourenço MT,Gonçalves R, Sousa S, Couturier J, Stoppa-Lyonnet D. Three new BLM gene mutationsassociated with Bloom syndrome. Genet Test. 2008 Jun;12(2):257-61. doi:10.1089/gte.2007.0119.
2. Amor-Guéret M. Bloom syndrome, genomic instability and cancer: the SOS-likehypothesis. Cancer Lett. 2006 May 8;236(1):1-12.
3. Arora H, Chacon AH, Choudhary S, McLeod MP, Meshkov L, Nouri K, Izakovic J.Bloom syndrome. Int J Dermatol. 2014 Jul;53(7):798-802. doi: 10.1111/ijd.12408.
4. Bugreev DV, Yu X, Egelman EH, Mazin AV. Novel pro- and anti-recombinationactivities of the Bloom's syndrome helicase. Genes Dev. 2007 Dec1;21(23):3085-94.
5. Cheok CF, Bachrati CZ, Chan KL, Ralf C, Wu L, Hickson ID. Roles of the Bloom'ssyndrome helicase in the maintenance of genome stability. Biochem Soc Trans. 2005Dec;33(Pt 6):1456-9. Review.
6. Flanagan M, Cunniff CM. Bloom Syndrome. 2006 Mar 22 [updated 2019 Feb 14]. In:Adam MP, Ardinger HH, Pagon RA, Wallace SE, Bean LJH, Stephens K, Amemiya A,editors. GeneReviews® [Internet]. Seattle (WA): University of Washington,Seattle; 1993-2020. Available from http://www.ncbi.nlm.nih.gov/books/NBK1398/
7. German J, Sanz MM, Ciocci S, Ye TZ, Ellis NA. Syndrome-causing mutations ofthe BLM gene in persons in the Bloom's Syndrome Registry. Hum Mutat. 2007Aug;28(8):743-53.
8. Guo RB, Rigolet P, Ren H, Zhang B, Zhang XD, Dou SX, Wang PY, Amor-Gueret M,Xi XG. Structural and functional analyses of disease-causing missense mutationsin Bloom syndrome protein. Nucleic Acids Res. 2007;35(18):6297-310.
9. Liu Y, West SC. More complexity to the Bloom's syndrome complex. Genes Dev.2008 Oct 15;22(20):2737-42. doi: 10.1101/gad.1732808.
10. Ouyang KJ, Woo LL, Ellis NA. Homologous recombination and maintenance ofgenome integrity: cancer and aging through the prism of human RecQ helicases.Mech Ageing Dev. 2008 Jul-Aug;129(7-8):425-40. doi: 10.1016/j.mad.2008.03.003.
11. Singh DK, Ahn B, Bohr VA. Roles of RECQ helicases in recombination based DNArepair, genomic stability and aging. Biogerontology. 2009 Jun;10(3):235-52. doi: 10.1007/s10522-008-9205-z.
12. Wu L. Role of the BLM helicase in replication fork management. DNA Repair(Amst). 2007 Jul 1;6(7):936-44.