Gene Editing - II

Click here for Part 1

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What is CRISPR?

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- CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats.
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- CRISPR - Cas9 is the most prominent genome editing technique .
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- It allows researchers to permanently modify genes in living cells and organisms.
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- This can be used to correct mutations at precise locations in the human genome to treat genetic causes of diseases.
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- Correcting the mutation in an embryo ensures that the child is born healthy and the defective gene is not passed on to future generations.
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How does it work?

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- The gene editing tool has two components :\n\n
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1. a **single-guide RNA (sgRNA)** that contains a sequence that can bind to DNA.
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2. the **Cas9 enzyme** which acts as a molecular scissor that can cleave DNA.
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- In order to selectively edit a desired sequence in DNA, the sgRNA is designed to find and bind to the target.
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- The genetic sequence of the sgRNA matches the target sequence of the DNA that has to be edited.
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- Upon finding its target, the Cas9 enzyme swings into an active form that cuts both strands of the target DNA.
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- One of the two main DNA-repair pathways in the cell then gets activated to repair the double-stranded breaks.
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- While one of the repair mechanisms result in **changes** to the DNA sequence, the other is more suitable for **introducing specific sequences** to enable tailored repair.
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- In theory, **the guide RNA will only bind to the target sequence** and no other regions of the genome.
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- But the CRISPR-**Cas9 system can also recognise and cleave different regions of the genome** than the one that was intended to be edited.
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- These “off-target” changes are very likely to take place when the gene-editing tool binds to DNA sequences that are very similar to the target one.
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- Though many studies have only found few unwanted changes suggesting that the tool is probably safe, researchers are working on safer alternatives.
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Why is CRISPR- Cas9 system significant?

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- Normally, if sperm from a father with one mutant copy of the gene is fertilized in vitro with normal eggs, 50% of the embryos would inherit the condition.
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- However, when the gene-editing tool was used, the **probability of inheriting the healthy gene increased** from 50 to 72.4%. There was also no off-target snipping of the DNA.

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- The edited embryos **developed similarly** to the control embryos indicating that editing does not block development.
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- Clinical trials are under way in many countries to use this tool for **treating cancer.**
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- It was shown in mice that it is possible to **shut down HIV-1 replication** and even **eliminate the virus** from infected cells.
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- In agriculture, a **new breed of crops** that are gene-edited will become commercially available in a few years.
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- Given all these, making gene editing possible in human reproductive cells deserves serious considerations in terms of legal, social and ethical consequences.
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Source: The Hindu

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