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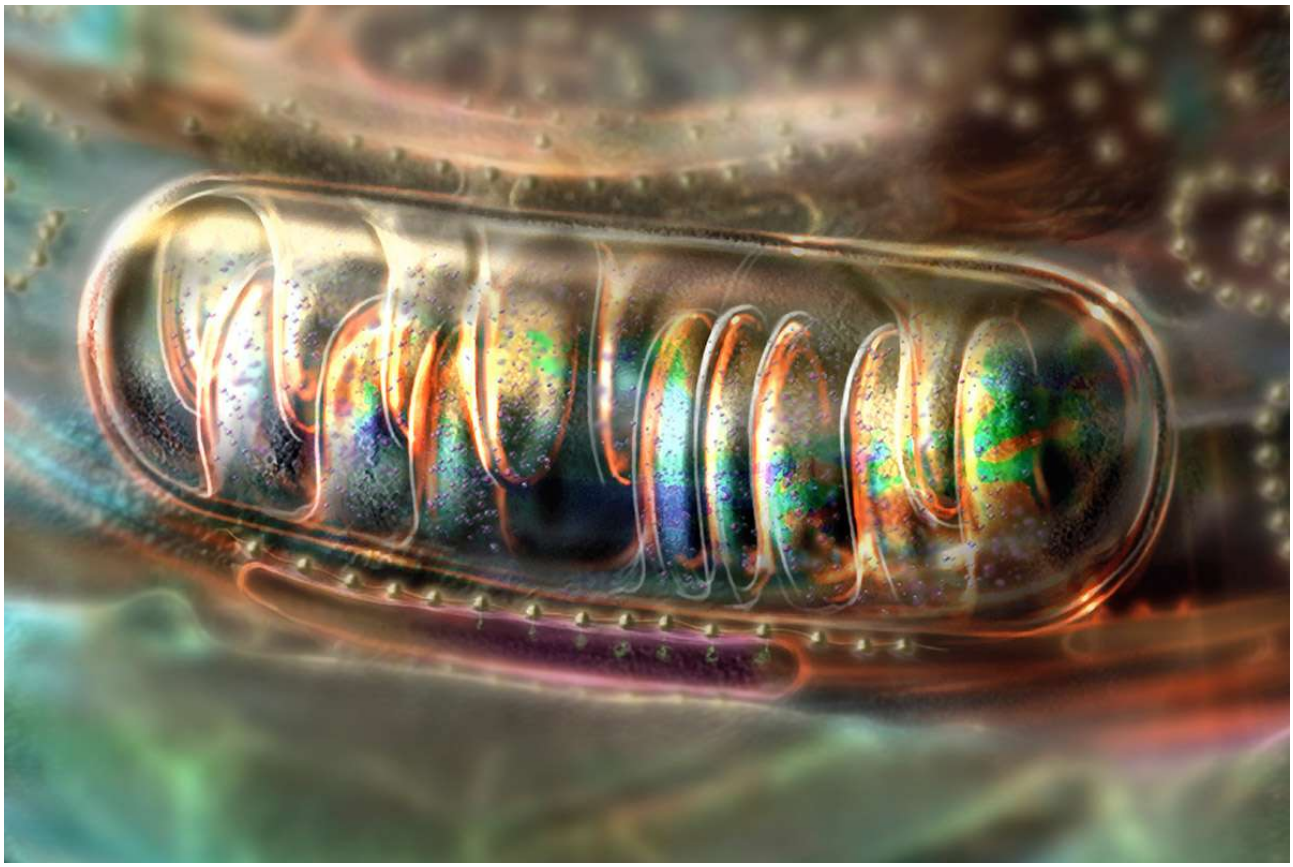
Some rare fathers pass on an extra kind of DNA to their children



In rare cases mitochondria can come from both the father and mother

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By Michael Le Page

The energy-producing structures found in every one of our cells are usually inherited solely from our mother. But doctors in the US have now identified more than a dozen individuals in three different families who have inherited mitochondria from both parents.

It appears that these individuals are very rare exceptions to the usual rule, likely because these families harbour mutations that disrupt the mechanism that normally prevents a father's mitochondria being passed to his children.

Mitochondria produce the energy cells need to function and every human cell, including sperm and eggs, contains lots of them. But though a father's mitochondria do enter the egg, in humans they have a chemical tag that marks them for destruction, so usually all mitochondria come from the mother.

However, in 2002 it was found that the cells of one man contained a mixture of mitochondria from his father and mother. But with no other cases being reported since, some have questioned whether the 2002 finding was correct.

Now a team at Cincinnati Children's Hospital Medical Center in the US say they have "unequivocal" evidence after identifying 17 such people with paternal inheritance.

More and more cases

The first individual was identified because he was suffering from fatigue and muscle pain, which was suspected to be caused by mitochondrial mutations. It turns out he inherited mitochondria from both parents, and a new mutation has arisen in the paternal mitochondria.

During their investigations, the team found other members of the family also have a mixture of maternal and paternal mitochondria in each of their cells. They then studied some other patients with symptoms of mitochondrial diseases, and found another two families as well.

"The surprise is really that we don't see more of this," says Nick Lane at University College London in the UK, author of a book on mitochondria. His team predicted last year that "paternal leakage" should be relatively common in all organisms with mitochondria.

Why? Because there are two conflicting evolutionary forces at work. In the short-term, mixing mitochondria can be beneficial to individuals because the father's mitochondria, say, can compensate for a harmful mutation in the mother's mitochondria. But in the long-term, this can impair evolution's ability to eliminate bad mutations as they are hidden from view.

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Lane thinks this is why organisms have an astonishingly wide variety of mechanisms for ensuring mitochondria are only inherited from the mother. During the course of evolution, species have repeatedly evolved such mechanisms, lost them and then evolved similar mechanisms again, his team has proposed.

Because mitochondrial DNA is the most common kind of DNA in cells – as each cell can contain hundreds of copies – it has been widely used in genetic studies, for instance for studying our evolutionary history. If paternal inheritance of mitochondria was very common it would undermine some of the conclusions of these studies, but it is likely still so rare as to make little difference.

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