Manipulating the gut microbiome: the potential of poo

By Hannah Voak

Faeces, stool, poo—whatever you call it, the thought of transferring someone else’s into your own body certainly sounds disgusting. But for someone suffering from a Clostridium difficile infection, a potentially fatal bowel condition, a faecal transplant could save their life. So before you dismiss the idea, consider the reasoning behind this unusual medical treatment: stool contains one crucial component—beneficial bacteria. And the success rate for treating C. difficile infections with a faecal transplant is over 90%. What’s more, scientists at the European Molecular Biology Laboratory (EMBL) now think that careful matching of donors to patients could make faecal transplants still more effective and widely applicable.

Bacteria and the gut microbiome

When your doctor prescribes antibiotics, you expect the drugs to treat the infection, not to cause a new illness. As well as killing the target bacteria, however, antibiotics (particularly broad-spectrum antibiotics) destroy beneficial bacteria, causing an imbalance in the complex community of microorganisms in our intestines, known as the gut microbiome. C. difficile is present in soil, water and air, and lives harmlessly in the guts of roughly one in every 30 healthy adults. But when the normal balance of gut microbes is skewed and there are fewer beneficial bacteria to keep the gut in check, C. difficile can quickly spread. As it multiplies and grows in the gut, C. difficile produces toxins that cause diarrhoea. When the bacteria are passed...
out of the body, they can easily infect other people. This makes *C. difficile* a big problem in hospitals and a major healthcare-associated infection. Other common symptoms include abdominal pain and fever; in severe cases, *C. difficile* can cause dehydration, inflammation of the intestine, and even a ruptured colon.

For most patients, the infection can be treated with a course of antibiotics that specifically target *C. difficile*. But in about 20% of cases, the symptoms return, requiring further treatment. Treating recurrent *C. difficile* is becoming increasingly difficult, as new and resistant strains of the bacterium emerge. One final option for patients fighting the superbug is to undergo a faecal transplant.

**Poo to patient**

The screening process for potential stool samples is rigorous: only 3% of volunteers donating samples to the OpenBiome stool bank, for example, are accepted. A stool transplant carries the risk of passing on an infectious disease, and with growing evidence linking the microbiome to obesity, diabetes and allergies, it is possible that these conditions might also be transferred to the patient. In one case, a woman who was successfully treated for a *C. difficile* infection encountered a surprising side-effect after receiving a stool sample from an overweight donor: she rapidly gained weight herself (Alang & Kelly, 2015). Although the transplant may not have been the only cause, the case raises questions about the role of gut bacteria in metabolism and health.

If a stool sample is deemed suitable, it is liquidised and usually administered via a colonoscopy. The community of micro-organisms from the healthy donor, along with all their genes and metabolic functions, can then begin resetting the balance of the infected patient’s microbiome.

Although the success rate for curing *C. difficile* infections with faecal transplants is over 90%, the use is still rare – probably due to its unusual nature and our aversion to it. Our faeces, just like blood or vomit, can contain disease-causing organisms, so it’s no surprise that humans want to avoid it, let alone ingest it. Tighter rules on carrying out faecal transplants are also holding back its use, as is the treatment’s invasiveness compared to antibiotics.

**A personalised pill**

To improve their appeal, faecal transplants are moving away from, more invasive delivery methods. Instead, patients can swallow something more aesthetically pleasing and manageable: a pill, dubbed a ‘crapsule’. A recent study led by EMBL scientists, with collaborators at Wageningen University and the Academic Medical Centre, both in the Netherlands, and the University of Helsinki, Finland, has also highlighted the need for a tailored approach (Li et al., 2016).

Rather than looking at what species of bacteria inhabit a patient’s gut, the key is to go one step further and see what strains of each species are present. The study found that new strains of bacteria from the donor were more likely to colonise a patient’s gut if the patient...
already had that species. Simone Li, who carried out the work at EMBL, says the goal is to prescribe a “personalised bacterial cocktail, rather than a one-size-fits-all solution”. Carefully matching donors to patients could improve the effectiveness of faecal transplants.

The demand for faecal transplants doesn’t stop there. Scientists are trying to determine whether transplants could be used to treat other common conditions linked to a skewed microbiome, including allergies, obesity and type 2 diabetes (Bull & Plummer, 2014). And who knows? In the future, we could all be storing healthy poo for later use, and swallowing pills of frozen faecal matter from our personal stool banks.

References

Web reference
w1 EMBL is Europe’s leading laboratory for basic research in molecular biology, with its headquarters in Heidelberg, Germany. See: www.embl.org

w2 OpenBiome is a non-profit organisation dedicated to expanding safe access to faecal transplants. See: www.openbiome.org/impact/

Resources
Read more about the recent study on improving faecal transplants with a personalised approach on the EMBL news page. See: https://news.embl.de/science/1604-poo-transplants/
For more information on faecal transplantation, visit the Johns Hopkins Medicine website. See: www.hopkinsmedicine.org or use the direct link: http://tinyurl.com/kk9um5g
To learn more about faecal transplants, read the article ‘Medicine’s dirty secret’ published in Mosaic magazine. See: www.mosaicscience.com/story/medicine’s-dirty-secret
To understand humans’ dislike towards poo, read the article ‘Why do humans hate poo so much?’ from BBC Future. See: www.bbc.com/future or use the direct link: http://tinyurl.com/lpqrjxp

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