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Fecal Transplant Technology: An Effective Therapeutic Method for Many Diseases

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Abstract
Taking antibiotics too often or for the wrong reasons can alter the infectious microenvironment and may reduce the ability of immune cells to kill bacteria therefore scientists were looking for alternatives to antibiotics. Faecal microbiota transplantation (FMT) is one of those. FMT is a procedure that delivers healthy human donor stool to a patient via colonoscopy, enema, nasogastric (NG) tube, or in capsule. FMT has emerged as highly effective, safe, and cost-effective treatment option at least for recurrent Clostridioides difficile infection (CDI) with a success rate around of 90%. In addition to Clostridioides difficile infection this technique is also effective in diseases such as Carbapenem-resistant Enterobacteriaceae (CRE), Alzheimer's, arthritis, diabetes mellitus, inflammatory bowel disease, autism, and obesity.

Keywords: Fecal microbiota; infection; antibiotics; alzheimer's; arthritis; diabetes mellitus; inflammatory bowel disease; autism and obesity

Introduction:

Fecal microbiota transplantation (FMT) itself is unappealing [1], nevertheless, as early as in Dong-jin dynasty 4th century A.D Ge Hong, a well-known traditional Chinese medicine doctor, described the use of human faecal suspension by mouth for patients who had food poisoning or severe diarrhoea [2]. Subsequently, FMT was used in the 16th century and in the 1950's to treat similar gastro intestinal (GI) tract disorders [3]. This technique has undergone drastic modification so as to be acceptable socially and by individual patient, in spite of social stigma attached to it.

Now, FMT is a procedure that delivers healthy human donor stool to a patient via colonoscopy, enema, nasogastric (NG) tube, or in capsule form (popularly called "poop pills"). FMT has been widely accepted for debilitating gasterointestinal infections, such as Clostridium difficile (C. diff), that keep recurring in spite of antibiotic therapy. FMT is no longer considered an "alternative," but, rather, gaining acceptance with a successful therapeutic value. Since, it is still considered as an experimental treatment, an attempt without medical supervision is not advisable. Patients who are recipient of immunosuppressant medication or have undergone a recent bone marrow transplant are under the risk of this treatment. Earlier, FMT was offered only in a few specialized centres globally, but in the last few years, there has been growing use of FMT, in therapeutics due to its efficacy in C. diff infections (CDI) and many reports recently published narrating its high success rates (around 90 %)and over 500 patients [4].

Modified FMT Methodology

FMT transplant material (TM), comes under the umbrella of human tissue category medically, derived from healthy donors, provided no risk factors for transmissible diseases or any issues that may alter the cellular composition due to antibiotic use. Published international guidelines by the FMT Working Group outline in detail the FMT donor selection criteria and screening tests [5].

Some institutions encouraged the option of anonymous donor(s) subsequently, though patients were given freedom to identify their own donors, from family or friends initially. This choice paved way for creating a pool of tested healthy donors with a track record of cure. Donors do not share genetic or environmental susceptibilities to the recipient in such procedures are an additional safety for the recipient. Donor stool is delivered to the institution to undergo the following procedure:

(1) dilution, generally with normal saline,
(2) homogenization with a blender to achieve a liquid slurry, and then
(3) filtration to remove particulate matter to facilitate administration within a few hours of passage .
(4) highly filtered human microbiota mixed with a cryoprotectant and then frozen for storage at −80 °C until required for transplant can also be used.

Hamilton et al. [6; 7] advocated that the processing method yields such a standardized, purified tissue with equivalent clinical efficacy in CDI similar to that of fresh, partly filtered faces as well as avoids the faecal smell and volume of the filtrate. Detailed microbiological studies with 16S rRNA gene sequencing demonstrated stable "engraftment" or "implantation" of donor microbiota with the frozen product with dramatic shifts in recipient gut microbial communities noted after transplantation.

Standardized Human Gut Microbiota and FMT Preparation

Once, rigorously screened donor volunteers to provided stool for all participants. The screening involves the review of medical history, serological examinations to screen infectious disease, stool examination, gut microbiota sequencing, and confirmation of the absence of gastrointestinal disorders and other neurodevelopmental problems, meanwhile, Helicobacter pylori was also detected through C13 breath tests. The serological examination was performed to exclude hepatitis A, B, and C infections, human immunodeficiency virus-1 infection, human immunodeficiency virus-2 infection, TB infection of T cells, TORCH virus infection, and syphilis infection. Fasting glucose levels, lipid levels, liver function, renal function, and C-reactive protein levels were also recorded. Donors stool was tested for the presence of bacterial pathogens (Escherichia coli , Shigella, Salmonella, Campylobacter, Staphylococcus aureus, Yersinia, Vibrio parahaemolyticus, and Vibrio cholera), infection with viruses (rotavirus A, adenovirus, and norovirus), infection with fungi (Candida albicans) and the presence of parasites (Giardia, Cryptosporidium, Cyclospora, and Isospora) .

Stool samples were collected under anaerobic and sterile conditions and mixed with sterile normal saline and then homogenized immediately. Homogenates were then filtered through 20 μm nylon filters to remove large particles and fibrous matter. The filtered suspensions were then centrifuged at 6000 g for 5 min at 4°C with a centrifuge (Sorvall SS-34). The precipitate was dissolved in normal saline after the supernatant was removed, finally, a faecal bacterial solution of 60 mg/mL was obtained and used for future manufacture of FMT capsules [8] or colonoscopic transplantation (10 g/50 kg per subject). Lyophilized protectant was added to the fecal bacterial solution and frozen at -80°C, which was then freeze-dried into powder using a cryogenic lyophilizer and placed in a capsule for further use.

The participants receive 2 liters of GOLYTELY (polyethylene glycol) the night before transplantation. Both the oral capsule administration group and the rectal administration group received the same dose (approximately 2 × 1014 CFU per patient) once a week for 4 weeks.

Preparing Patient for FMT

Consent from the guardian or patient is required since the long-term results of FTM which is still an enigma. The recipient should have an

empty GI tract meaning drinking only clear fluids and abstaining from eating for 24 hours before the procedure. In case of mild or moderate C. diff infection, they may also be advised to drink a liquid to encourage a bowel movement; though, the recipient with more severe infections will not follow this same protocol.

There are several different FMT techniques:

Colonoscopy: A thin, hollow tube with an attached camera is placed up the colon, and a catheter-tipped syringe is used to inject donor stool through the channel.

Enema: Although less invasive than a colonoscopy, a faecal enema often needs to be performed more than once, because the donor stool doesn't reach the colon.

Nasogastric (NG) tube: Using a thin, flexible feeding tube, doctors insert donor stool through a patient's nostril, down the throat, and into the stomach.

Oral capsules, known as "poop pills."

FMT had a success rate of 81 % following a single naso-duodenal infusion and 94 % following a second infusion, while vancomycin 500 mg QID for 2 weeks with or without bowel lavage had only 23 %–31 % efficacy for CDI [4]. These results proves FMT's superiority over the prescribed antibiotics. Now clinicians started using FMT as a standard therapeutic procedure for many other diseases, such as, Carbapenem-resistant Enterobacteriaceae (CRE), Alzheimer's , Arthritis, Diabetes mellitus, Inflammatory bowel disease, Autism,and Obesity.

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