Incorporation of the Microbiome into Precision Medicine

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Precision medicine has already had a big impact on the diagnosis and treatment of diseases across a multitude of therapeutic fields. Oncology is one of the main disciplines benefitting from the installation of a precision medicine infrastructure. The field of allergy and immunology is one of many fields that would benefit from taking a precision medicine approach to patient care. Recently, the microbiome, dynamic communities of microbes that colonise the body, has been introduced into precision medicine and has already illuminated aspects of the relationship between the microbiome and numerous diseases.[1]

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Independent studies, including the Human Microbiome Project, have proved that disruptions in the normal balance of the microbiome results in dysbiosis.[2] The resilience, yet plasticity, of the microbiome is a very important factor; it is much more mutable than human cells.[3] An imbalance in the microbiome has been associated with numerous diseases, for example chronic diseases, autoimmune disorders, inflammatory bowel disease, neurodevelopmental disorders, and more.[2] With such a diverse influence over disease, it is no surprise that many hours are being invested into researching the microbiome and including the data in precision medicine approaches.

Evidence is mounting that disruptions in the microbiome in early life contributes to the establishment of food allergies.[3] Progressing our knowledge on this interaction may allow us to predict or even prevent food allergies from a young age, avoiding unnecessary reactions and hospital stays, and possibly even deaths. Before this is possible, in-depth knowledge about the relationship between specific colonies in the microbiome and specific allergies need to be identified.

The three major subtypes of inflammatory bowel disease (ulcerative colitis, Crohn's disease, and indeterminate colitis) not only differ in their presentation but all require different treatments for optimal dampening of symptoms.[4] There is an importance for the precise diagnosis of the individual subtypes and the microbiome can be used to achieve this. The gut microbiome signatures differ between all three and have even been associated with surgical outcomes in Crohn's disease, in which increases in *Faecalibacterium prausnitzii* in the ileal mucosa are associated with decreased disease recurrence

at 6 months post-surgery.[4] Familiarity with the composition of the gut microbiome of each specific disease will allow physicians to monitor the progression or improvement of each of the conditions, allowing informed decisions about treatment regimens to be made.

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The gut microbiome is not the only localised biome that needs to be characterised; lung and skin microbiome also play an important role in the pathogenesis of allergic disease by modulating immune responses in their respective organs. In the lung, by adjusting the balance between Th2 and Th17 patterns, the microbiome plays a role in driving allergic asthma endotype polarisation.[5] Bacteria that reside on the skin modulate inflammation, with dysbiosis influencing chronic inflammatory diseases such as atopic dermatitis and psoriasis.[5] By quantitating the changes that lead to allergic reactions and inflammation in these organs, the diagnosis and treatment of these diseases can be optimised leading to better overall patient care and quality of life.

Inclusion of microbiome studies into the infrastructure of precision medicine approaches to the allergy and immunology field will benefit and improve all aspects of patient care. This was a hot topic at the EAACI congress held in Lisbon, Portugal, this year and will continue to be for many years. Characterising localised microbiomes has already helped the prediction of treatment outcome; the progression of the knowledge of the relationship between the microbiome and diseases will remain of interest in all fields of medicine, including allergy and immunology.

References

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