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Lung Microbiome: The essential to know

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Definition

- The microbiota , is defined as all microorganisms that inhabit a particular site or place, eg, the gastrointestinal (GI) tract, skin, or airways.(mostly bacteria, but also virus, protozoa and fungi)
- The term microbiome consists of the genes these cells harbor. This term was coined by Joshua Lederberg in 2001.

how ever the two terms are used interchangeably[1].

Historic

The Human microbiome project(HMP), had been launched in the 21st century, as an outcome of the Genome Wide Survey. Beside human genes, the new generations gene sequencing methods, surprisingly demonstrated the presence of huge number of other genes characterizing commensal microbes living in symbios with human genes[2].

- First sequencing of gene 16s rRNA was performed in the gut(GI). Then Skin, and oropharynx .
- Lungs were not initially selected for the HMP , They were originally believed to be sterile because germs were not discovered by traditional methods of culture of Broncho -Alveolar Lavage(BAL) , or brushing or lung tissue. But Genotyping and sequencing of 16s rRNA in BAL &Brushing during endoscopy, surprisingly discovered a huge microbiota.
- Microbiome projects for lungs have been launched with the goal of understanding the roles that these symbionts play and their impacts on human health[2,3].

Core research and findings

- In a state of the art article of the ATS 2014: Authors highlighted that: Characterization of the microbiome can be done by sequencing regions of a conserved gene, such as the hypervariable regions of the 16S r RNA gene. This lead to different sequences in different microbes. The unit for research is the taxon, each microbe has taxons , characterized by operational taxonomic unit(OTU) [3]. The microbiota plays a particularly important role in the development and functional integrity of the immune system. Shifts or perturbations in the microbiota can lead to disease[4]

The lung microbiome varies in health and disease . And there is daily interaction between lung microbiome and environmental microbiome[2,3,4].

Following we will highlight microbiome involvement in different lung diseases

1) Asthma and allergies : Interaction of lung microbiome with the environmental microbiome, has now been shown to be associated with the development of asthma and other allergic respiratory disorders, the diversity and abundance of microbial exposure correlates inversely with the development of childhood asthma[3,5]; This could explain the hygiene hypothesis: hypothesizing that individuals with a higher number of older siblings and thus living under "less hygienic" conditions have less asthma.

- Microbiome could also have a protective role: Maternal exposure to Acinetobacter lwoffii also protected offspring from asthma .

- Antibiotic overuse:

In the ISAAC study , antibiotic use during the first year of life is correlated with higher incidence of asthma onset[6], Antibiotic are shown to alter the GI microbiome which plays a role in immunity and inflammation,leading to more atopy and asthma[7].

2) COPD, may be associated with perturbations of the lung microbiome[4]:

COPD is in part mediated by dysregulated immune responses to cigarette smoke and other environmental insults. Recent reports have identified diverse bacterial communities in the human lung that may change in COPD. And that perturbation in microbiome explains why inflammation persists after stopping smoking

3) Cystic fibrosis: Microbiome alteration plays a role in cystic fibrosis[4].

Outcomes and limitation of the HMP

Microbiome studies are expected to help to develop markers for diseases diagnosis and follow up, and new therapeutic options , helping on personalized medicine[5].

The limitation is: It is challenging to have 100% contaminant free DNA, in BAL-Brushing and tissue of the lung during fibroscopy[3,4].

Conclusion

Sequencing of 16s rRNA gene surprisingly showed that Lungs are not sterile. The lung microbiome as well as environmental microbiome may all be important in lung health and disease. The microbiota plays a particularly important role in the development and functional integrity of the immune system. Shifts or perturbations in the microbiota can lead to disease. Microbiome manipulation is expected to play important role in personalized medicine: new biomarkers for diagnosis, But also Targeted therapy (like for IPF), and for asthma and allergies treatment and prevention

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