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Childhood Antibiotics: Dysbiosis And Inflicted Damage

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Abstract:

Antibiotics are the most common type of medicine prescribed to children, including infants, in the Western world. Although the use of antibiotics has turned previously fatal infections into relatively mild illnesses, antibiotic treatment can also have adverse effects. It has been shown to dramatically alter endogenous microbial composition. Because the gut microbiota plays important roles in immunity, metabolism, and endocrinology, the impact of antibiotics on the microbiota may lead to additional health complications. This is an overview of the impact of antibiotics on the microbiome and associate it with long-term complications of obesity, behaviour, allergy, autoimmunity, and other diseases.

Keywords: antibiotics, microbiota, dysbiosis, infant, child.

Introduction:

Since the discovery of penicillin in 1928, antibiotics have revolutionized medicine and saved the lives of many patients who had previously died from infections. There is no doubt that antibiotics have proven to be highly effective against a wide range of bacterial species.

These are amoxicillin, azithromycin, and amoxicillin/clavulanic acid . However, there is ample evidence to suggest that widespread use of such antibiotics may come at a cost., has raised concerns about the effects of antibiotics on the healthy microbial composition of our bodies. Indeed, antibiotic treatment has been shown to dramatically alter the microbiome composition of both adults and infants. Although the type and duration of antibiotic treatment can modulate specific microbial changes, it has been shown that even short-term antibiotic treatment can have long-term effects on microbiota composition. Such microbiota alterations are microbial imbalances that correlate with poor health. Dysbiosis is associated with many disease states, including autoimmune diseases, metabolic diseases, malnutrition, and others. The microbiota has been shown to play a role in regulating the immune system, hormone secretion and response, and metabolism. In fact, early childhood exposure to antibiotics increases the risk of excessive weight gain, asthma, allergies, and autoimmune diseases such as inflammatory bowel disease (IBD).

The infant and child microbiome:

The infant microbiome differs from the adult microbiome, being more dynamic and less diverse in children up to 2 years of age. This dynamic is consistent with the varied encounters with microbes in the early postnatal period as infants acquire their first microbiome. Differences in delivery methods (vaginal vs. caesarean) and diet (breast milk vs. formula, infant vs. infant) produce different compositions in the infant's gut microbiota.

Furthermore, monitoring of one infant observed significant changes in microbial composition following dietary changes (from milk to grains and solids) and other environmental factors. In preterm infants (gestational age < 36 weeks), maintaining a healthy microbiome composition is paramount. This is because phylogenetic diversity is initially low and severe dysbiosis can lead to necrotic enteritis or late sepsis. Since infancy is a critical period for microbial colonization, the impact of antibiotics administered fairly liberally during this period should be evaluated. It has already been shown that antibiotic treatment of infants strongly affects microbiome composition. Further research is needed to determine whether the effects are temporary or long-lasting and to estimate the potential timeframe in which interventions are most damaging. It is also important to test whether and how perinatal antibiotics affect the microbiome later in life.

Antibiotics affect the infant and child microbiome:

Although there are similarities in the compositional effects of antibiotics on adult and infant microbiota, there are also some differences due to different microbiota characteristics in infants. A general trend of reduced microbial diversity with antibiotic treatment can be observed in both children and adults. Bacteroidetes and Proteobacteria phyla (including Enterobacteriaceae) these microbial alterations significantly reduce the expression levels of microbial bile salt hydrolases, which play an important role in suppressing host metabolism and weight gain. Administration of antibiotics such as meropenem, ticarcillin clavulanate and cefotaxime to preterm infants has been shown to significantly reduce species richness and increase expression of antibiotic resistance genes.

In conclusion, the short- and long-term effects of antibiotics on the microbiota of infants and children are clear. Some antibiotics cause more dramatic changes than others, and some infants, such as preterm infants, may be more sensitive to the antibiotic's effects on their microbiome.

Perinatal antibiotic exposure modulates infant microbiota:

Even perinatal exposure to antibiotics is sufficient to modulate infant microbiota. If mothers received intrapartum antibiotic prophylaxis (IAP) prenatally, their offspring may develop unique phenotypes persisting to 3 months of age, including overexpression of Enterococcus and Clostridium at the expense of Bacteroidetes and Parabacteroides spp. had a microbiome composition of . Similarly, perinatal antibiotics, including IAP regimens, alter the composition of the preterm gut microbiota and increase the number of Enterobacteriaceae species. Whether the effects of perinatal antibiotics are due to disruption of the maternal microbiota (thus transmitting the altered microbiota to offspring) or due to indirect effects on offspring (e.g., immune system Nonetheless, these results highlight the effects of maternal antibiotics during the third trimester of pregnancy on offspring microbiota.

Childhood antibiotics modulate the immune system:

Combined results from several large birth cohort studies and mouse studies show a strong association between childhood antibiotics, changes in microbial composition, and abnormal immune responses that lead to an increased risk of allergies and IBD. increase. Data show that the immune system is biased toward a Th2 phenotype early in life, promoting safer microbial colonization in a way that avoids excessive inflammation and tissue damage. The colonizing microbiota then redirects the immune response to a mature and balanced phenotype associated with Th1/Th17/Treg responses. When the dialogue between the microbiota and the immune system becomes destabilized, maintenance of an early childhood phenotype increases the risk of allergy, for example as a result of antibiotic use, or subtle tolerance increases due to uncontrolled inflammatory processes. Abolition increases risk of autoimmune disease., especially those affecting major sites of microbiota concern such as IBD.

Childhood antibiotics affect weight gain:

This weight gain was also associated with taxonomic changes in microorganisms, including abundant Clostridium, Akkermansia, and Enterococcus. Even foetal exposure to antibiotics administered to the mother during pregnancy can have long-term effects on growth. If administered, their offspring have been shown to have an 84% increased risk of childhood obesity by the age of 7 years.

Antibiotics and neurodevelopment:

Strong evidence exists in humans and rodents supporting the influence of the gut microbiota on CNS development, brain function, and mood/behaviour. Studies in germ-free animals have shown that the absence of gut bacteria alters brain neurochemistry, reduces anxiety, and alters social behaviour, the hypothalamic-pituitary-adrenal axis and the immature phenotype of microglia. Few studies have examined such effects. Neurocognition examined the results.

However, a recent study identified an association between antibiotic treatment in the first year of life and worsening cognitive, behavioural, and emotional outcomes throughout childhood. These behavioural changes were neurologically correlated with increased expression of cytokines and arginine vasopressin receptor 1B in the frontal cortex and altered blood-brain barrier integrity.

Antibiotic resistance:

The increase in antibiotic prescriptions is believed to be the main cause of the antibiotic resistance crisis. Various observations indicate that exposure to antibiotics leads to increased and long-lasting expression of antibiotic resistance genes in microorganisms and to increased abundance of resistant strains. Both selective pressure and alterations in innate immunity induced by antibiotic exposure are exploited by antibiotic-resistant bacterial pathogens to enable them to proliferate after antibiotic treatment.

The expression of antibiotic resistance genes and species is called the resistome. Characterization of intestinal resistance tumours in 22 healthy infants and children aged 0–19 years revealed that infants and children contain genes conferring resistance to 14 of the 18 antibiotics tested. Healthy childhood resistance is highly variable, with resistance genes emerging very early in life. Furthermore, even healthy premature infants have been found to harbour multiple resistant tumours.

Effects of probiotics and prebiotic treatments on children's microbiomes and overall health:

Prebiotics, such as short-chain fructo-oligosaccharides and galacto-oligosaccharides, are dietary factors that promote the growth of bacteria such as bifidobacterial and lactobacilli, and are therefore thought to help normalize the microbiota after antibiotic administration. Prebiotics have been shown to alter microbial populations in neonates and children. Administration of prebiotics to infants after administration of dairy antibiotics was found to increase faecal bifidobacterial compared to infants receiving antibiotics alone. Additionally, treatment with antibiotics and prebiotics or probiotics was found to improve symptoms of intestinal bacterial overgrowth syndrome (SIBO). Despite the need for further research to tailor precise prebiotic and probiotic treatments, it appears that these may be beneficial in post-antibiotic children.

Conclusion:

Antibiotics remain an essential treatment that saves millions of lives, but it is important to highlight the detrimental long-term effects associated with their use. It is clear that antibiotics in general, and antibiotics administered in early childhood in particular, have a profound effect on the composition of the microbiota. Although there are differences between antibiotic types and dosages, there are also some common effects. The most common effects include a dramatic decrease in overall species diversity, a significant increase in Proteobacterial abundance, and an increase in the Firmicutes/Bacteroidetes ratio. Many of these changes have also been observed in mouse studies that monitored host diet and genotype. These microbial changes usually persist for weeks to months after exposure to antibiotics. Studies have shown that different antibiotics have different effects on the composition of the microbiota or the severity of dysbiosis, so the specific antibiotic prescribed should be carefully considered. Antibiotics, along with associated altered microbial profiles, have

been associated with metabolic and immunodeficiency, leading to weight gain, allergies, and an increased risk of IBD. Although microbial effects are relatively short-lived, effects of perinatal or antibiotic exposure during infancy can have physiological effects that persist for years and possibly into adulthood. defined childhood as a period of particular susceptibility to antibiotic use. Therefore, antibiotics administered during late pregnancy and infancy should be evaluated critically and carefully, bearing in mind that adequate antibiotic treatment can save lives every day.

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