Gut microbiome and surgical infections

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ABSTRACT

The microbiome is the microbial ecosystem of the body. The scientific community has moved from speaking about a cultured microbial species as a causative pathogen, to this expanded description of the diversity of a human microbial ecosystem, moving beyond simple culture and antibiotic sensitivity. The implications of GI surgery on the microbiome as well as the potential for the gut microbiota profile to lead to post-GI-surgical complications. Despite the paucity of studies of the microbiota and general surgery and vice versa many common interventions that are a necessary part of GI surgery also apply to all types of surgery. Further studies are needed to understand the theoretical basis underlying the relationship between gut microbiome and surgical infections.

Keywords: anesthesia, neurosurgery, gut microbiome, surgical infection spine, drugs.

TEXT

The microbiome is the microbial ecosystem of the body. The scientific community has moved from speaking about a cultured microbial species as a causative pathogen, to this expanded description of the diversity of a human microbial ecosystem, moving beyond simple culture and antibiotic sensitivity.[1-4] Recently, the neuropeptide oxytocin has been shown to be involved in surgical wound healing, and there is compelling evidence that the intestinal microbiota may play a significant role in this interaction.[5-8] The vast microbial communities that reside in the gut (and indeed in other niches in the body) coordinate critical functions for host survival and they have many complex interrelationships with other organs in the body, to the extent that the microbiota is now regarded an organ in its own right.[9-12] The gut's microbial ecology and intrinsic immune compartment are known to exert considerable influence over basal immunological activity, any perturbations to homeostatic conditions in the gut can therefore have a robust impact on immune function.[3,13-16] Therefore, continuous observation with daily clinical practice by physicians and surgeons, continuous scientific research and further discoveries can improve the knowledge of this topic. Orthopaedic, thoracic and open abdominal surgeries account for the greatest risk of severe postoperative

pain.[1,17-19] There is a negative correlation between age and postoperative pain and analgesic consumption which can be partially explained by pharmacokinetic and pharmacodynamic changes related to ageing.[1] Anxiety, psychological distress and the use of certain coping strategies correlate with postoperative pain and opioid consumption. The main neuroendocrine axis, the HPA axis, also plays a vital role in the two-way signaling between the brain and the gut microbiome.[19-24] Psychological stress causes release of cortisol systemically which impacts on the gut affecting the local environment including altering the microbiome composition. Furthermore, the communication between the gut microbiota and the HPA axis is complex as it is closely linked with other systems, including the gastrointestinal barrier, the immune system, the blood–brain barrier, microbial metabolites, and gut hormones.[25-27] The sensory and autonomic nervous systems are also involved in this communication. The complexity and number of interlinked systems with the HPA axis indicate the importance of the stress system in the microbiome gut brain axis.[25] Much of the studies on the gut microbiome and surgery focus on surgery associated with the GI tract.[27-29] Guyton and Alverdy[27] provided a comprehensive view of the implications of GI surgery on the microbiome as well as the potential for the gut microbiota profile to lead to post-GI-surgical complications. Despite the paucity of studies of the microbiota and general surgery and vice versa many common interventions that are a necessary part of GI surgery also apply to all types of surgery. These include for example the administration of antibiotics to prevent post-operative infection.[27-29] Furthermore, anxiety and fear of surgery itself leading up to a surgical intervention can modify the microbiome to induce a less resilient composition to deal with the trauma of surgery.[30,31] Fasting, reduced sleep and mobility also play roles in gut microbiome modification.[32-34] Moreover, while there is very little data or recommendations for pre-operative microbiota targeted strategies to maintain and promote a healthy, resilient gut microbiome further research is warranted given the impact of the numerous pre-operative interventions as well as surgery itself on the gut microbiome which is now being highlighted as playing a role in many systems essential to successful recovery after surgery.[1,25,27,35-37] To make surgery safer and further reduce complications, a molecular, genetic and functional understanding of the response of the gastrointestinal tract to alterations in its microbiota is needed. Although technology can now generate an overwhelming amount of genetic and metabolomic information on both host tissues and the microbiota that surround them, the costs and discriminative value of this type of megadata medicine remain to be determined. Methods can then be developed to preserve the health-promoting functions of the microbiota while at the same time suppressing their harmful effects. Further studies are needed to understand the theoretical basis underlying the relationship between gut microbiome and surgical infections.[35,38-40]

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