Brain implant

The development of implanted neural devices to manage neurological and psychiatric disorders or to restore loss of physiological function is a rapidly advancing area of neuroscience research. Sierra-Mercado et al. from Houston considered whether investigators of brain implant studies have an obligation to facilitate device explantation for participants who request it at study conclusion [1].

Implant failure is a severe and frequent adverse event in all areas of neurosurgery. It often involves infection with biofilm formation, accompanied by inflammation of surrounding tissue, including the brain, and bone loss. The most common bacteria involved are Staphylococcus aureus.

Two titanium screws were implanted in the cranium of Sprague-Dawley rats, anesthetized with xylazine (4 mg/kg) and ketamine (75 mg/kg). Prior to the implantation of the screws, Staphylococcus aureus was given in the drill holes; controls received phosphate-buffered saline (PBS). Rats were euthanized 2, 10 and 21 days after surgery to remove the screws for analysis of biofilm formation with a confocal laser scanning microscope. The surrounding tissue composed of soft tissue and bone, as well as the underlying brain tissue, was evaluated for inflammation, bone remodeling, foreign body reaction and fibrosis after H&E staining.

Intraoperative application of Staphylococcus aureus leads to robust and stable biofilm formation on the titanium implants on days 10 and 21 after surgery, while no bacteria were found in controls. This was accompanied by a substantial inflammatory response of peri-implant tissue after infection, also affecting the underlying brain tissue.

Intraoperative infection of implants with Staphylococcus aureus in rats may be useful as a tool to model new implant materials and surfaces on biofilm formation and inflammatory tissue reaction in vivo [2].

1)
Sierra-Mercado D, Zuk P, Beauchamp MS, Sheth SA, Yoshor D, Goodman WK, McGuire AL, Lázaro-Muñoz G. Device Removal Following Brain Implant Research. Neuron. 2019 Sep 4;103(5):759-761. doi: 10.1016/j.neuron.2019.08.024. PubMed PMID: 31487526.
2)
Glage S, Paret S, Winkel A, Stiesch M, Bleich A, Krauss JK, Schwabe K. A new model for biofilm formation and inflammatory tissue reaction: intraoperative infection of a cranial implant with Staphylococcus aureus in rats. Acta Neurochir (Wien). 2017 Jun 25. doi: 10.1007/s00701-017-3244-7. [Epub ahead of print] PubMed PMID: 28647798.