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Deep Infiltrating Endometriosis: Mechanisms and Emerging Treatment Strategies

Deep infiltrating endometriosis (DIE) is a severe form of Endometriosis in which endometrial like tissue grows deeply into surrounding pelvic organs such as the bowel, bladder, and pelvic ligaments. This condition is strongly associated with chronic pelvic pain, infertility, and significant reductions in quality of life. Current research shows that DIE is a complex disease influenced by hormonal imbalance, immune dysfunction, chronic inflammation, and fibrotic tissue formation. Estrogen plays a major role in stimulating lesion growth, while progesterone resistance prevents normal regulation of endometrial tissue. These factors allow lesions to persist, invade surrounding tissue, and produce inflammatory molecules that contribute to pain and disease progression. Recent studies have investigated several biological mechanisms underlying DIE development, including oxidative stress, immune dysregulation, and aberrant cellular signaling pathways. Increased levels of inflammatory cytokines, reactive oxygen species, and fibrotic signaling molecules such as transforming growth factor beta have been observed in endometriotic lesions. These processes promote tissue invasion, collagen remodeling, and nerve growth within lesions, which may explain the severe pain associated with the disease. Additionally, emerging research suggests that gut microbiota imbalance may influence estrogen metabolism and systemic inflammation, potentially contributing to lesion progression. Current treatments primarily focus on symptom management and hormonal suppression. Hormonal therapies, such as progestin based medications, aim to reduce estrogen stimulation and slow lesion growth. Surgical excision remains the most common treatment for severe DIE, particularly when lesions affect the bowel or bladder. However, recurrence rates remain relatively high, highlighting the need for alternative treatment approaches. Emerging therapies under investigation include targeted immune modulation, microbiome based interventions, and minimally invasive technologies such as High-Intensity Focused Ultrasound (HIFU), which may destroy endometriotic lesions using focused ultrasound energy without the need for invasive surgery. Understanding the biological pathways involved in DIE may lead to improved diagnostic tools and more effective treatment strategies. Continued research into hormonal regulation, inflammatory pathways, and novel noninvasive therapies could contribute to better long-term management of the disease and improved quality of life for affected individuals.