

UREMIC IMMUNODEFICIENCY - THE MECHANISM

The term 'uremic immunodeficiency' describes a complex immune dysfunction that develops as CKD progresses and uraemic toxins accumulate. Uraemic toxins do not only affect the kidneys - they circulate throughout the body and affect the function of virtually every immune cell type. The specific effects are well-characterised: **NEUTROPHIL DYSFUNCTION** - neutrophils are the first line of immune defence against bacterial infections. In CKD patients, uraemic toxins impair neutrophil chemotaxis (their ability to migrate toward the site of infection), phagocytosis (their ability to engulf and destroy bacteria), and oxidative burst (their ability to kill engulfed pathogens with reactive oxygen species). The result: bacterial infections that a healthy immune system contains rapidly are allowed to spread, becoming more severe and more likely to cause systemic illness. **T-LYMPHOCYTE DYSFUNCTION** - T cells are the coordinators of adaptive immunity - the targeted response to specific pathogens. In CKD, T cell proliferation and function are impaired by uraemic toxins and by the chronic inflammatory state. This explains why vaccine responses are weaker in CKD patients (T cell-dependent antibody production is reduced) and why previously cleared viral infections can reactivate (CMV, EBV, varicella-zoster virus all reactivate more commonly in CKD patients). **B-LYMPHOCYTE AND ANTIBODY PRODUCTION DYSFUNCTION** - B cells produce antibodies. In nephrotic syndrome, antibody-containing immunoglobulins are lost in the urine - directly depleting the circulating antibody pool. In advanced CKD and dialysis, B cell function is impaired by uraemia. The combination means lower baseline antibody levels against pathogens and reduced vaccine-induced protection. **COMPLEMENT DYSFUNCTION** - the complement system is a set of proteins that enhance antibody-mediated bacterial killing and directly lyse pathogens. Multiple complement components are reduced in CKD - particularly important for defence against encapsulated bacteria (*Streptococcus pneumoniae*, *Haemophilus influenzae*, *Neisseria meningitidis*) - which is why pneumococcal vaccination is so critical for kidney patients.

THE PARADOX - IMMUNE SUPPRESSION ALONGSIDE IMMUNE ACTIVATION

CKD immune dysfunction is paradoxical: the CKD immune system is simultaneously immunodeficient (impaired defence against external pathogens) and chronically over-activated (persistent low-grade inflammation against the body's own tissues and uraemic stimuli). This chronic inflammation - reflected in elevated CRP, IL-6, TNF-alpha, and other inflammatory markers - contributes to cardiovascular disease, accelerated

atherosclerosis, muscle wasting, and fatigue. It is a fire burning in the wrong direction - consuming the body rather than defending it.

THE INFECTIONS THAT AFFECT KIDNEY PATIENTS MOST SEVERELY

Urinary tract infections: CKD patients have higher rates of UTI, more severe infections, and greater risk of UTI-triggered AKI. Prompt antibiotic treatment at the first symptom of UTI is essential - do not wait to see if it resolves. Respiratory infections: influenza and pneumococcal pneumonia carry significantly higher morbidity and mortality in CKD patients than the general population. This is the primary rationale for annual flu vaccination and pneumococcal vaccination. COVID-19: CKD patients were among the highest-risk groups throughout the pandemic - their immune dysfunction combined with the inflammatory response to severe COVID created a particularly dangerous combination. Sepsis: blood poisoning from any source is more likely and more severe in CKD patients - particularly those with dialysis access (fistulas and catheters that breach the skin barrier). Skin and wound infections: impaired neutrophil function means wounds are slower to clear bacterial contamination and more likely to develop serious infections.

WHAT TO DO WITH THIS INFORMATION

Take vaccinations seriously - you are not getting them for a theoretical risk. You are getting them because your immune system genuinely cannot protect you as effectively as a healthy person's. Take every infection seriously - a temperature above 38 degrees C with CKD warrants medical assessment, not watchful waiting at home. Protect dialysis access sites with scrupulous hygiene - the skin breach of a fistula or catheter is a direct route for bacteria to enter a bloodstream that cannot fight them as effectively. Do not self-treat infections longer than 24 hours without medical advice. And understand that when an infection does land harder for you than for those around you - that is not weakness. That is the biology of your disease, which you are managing more carefully than most people manage their health.

Have you noticed that infections hit you harder since your kidney diagnosis? Share your experience below - particularly if there was one illness that really showed you how differently your immune system was responding.

Follow The Kidney Disease Solution - because kidney disease affects every system in your body, and you deserve to understand all of them.

RESOURCES

- > Immune dysfunction in CKD: ncbi.nlm.nih.gov (search 'uraemic immunodeficiency CKD')
- > Infection risk in kidney disease: kidney.org/atoz/content/infection
- > Vaccinations for CKD patients: <http://kidney.org/.../vaccinations-people-kidney-disease>