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Spontaneous production of inflammatory cytokines, along with tissue-destructive enzymes, is one of the unique characteristics of rheumatoid arthritis (RA) synovial tissue. The discovery of this phenomenon by Brennan and colleagues in 1989 has led to the understanding of the central role of tumor necrosis factor-alpha (TNFα) and its position upstream of interleukin-1 (IL-1) and IL-6 in RA. As major mediators of joint inflammation and destruction, these cytokines have become targets of novel therapeutics in recent years; however, the factors driving their production remain largely unknown.

TLRs are a family of pattern recognition receptors evolved to recognize conserved microbe-associated molecular patterns. Signal transduction through TLRs controls the expression of a number of proinflammatory cytokines, including TNFα, IL-1 and IL-6, chemokines such as IL-8, and matrix metalloproteinases, factors that are spontaneously and chronically produced by dissociated RA synovial mononuclear cell cultures [2,3]. Some TLRs such as TLR2, TLR3, and TLR4 can be activated by endogenous 'danger' molecules associated with inflammation and tissue destruction, and many of these molecules have been found in joints and serum of patients with RA and show a positive correlation with disease activity scores [4,5]. As TLR-mediated inflammatory response may induce further tissue damage and promote the generation of additional endogenous ligands, it has been hypothesized that TLRs can engender a self-sustaining inflammatory loop responsible for chronic progression of RA [6,7].

Using synovial explant cultures in which tissue structure and complexity are preserved, Nic An Ultaigh and colleagues [1] introduced TLR2 as a driving force behind spontaneous cytokine production in RA. First, the authors showed that a monoclonal antibody against TLR2 can inhibit, as expected, cytokine production induced by a TLR2 agonist in RA peripheral blood and synovial fluid mononuclear cells. Importantly, this antibody significantly suppressed the spontaneous release of TNFα, interferon-gamma (IFN-γ), and IL-1β and IL-8 by synovial tissue explants to an extent comparable to that of the TNF inhibitor adalimumab. These observations support the hypothesis that TLR2 can engender a self-sustaining inflammatory loop responsible for chronic progression of RA.

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to the development of the highly pathogenic Th17 cells and IL-17 production and promotes severe autoimmune spontaneous arthritis in mice [8]. Along these lines, TLR4 blockade suppresses joint inflammation and destruction in experimental arthritis, even during the established phase [9].

Spontaneous production of proinflammatory cytokines and matrix metalloproteinases by RA synovial membrane cells can also be inhibited by overexpression of the dominant-negative form of MyD88 adaptor-like (Mal), an adaptor molecule specifically involved in TLR4 signaling and recently reported not to be essential for TLR2 signaling [10,11]. Furthermore, TNFα production by RA synovial membrane cells could be blocked by imiquimod and the serotonin receptor antagonist mianserin, compounds suggested to inhibit TLR8 [12].

So far, the only in vivo evidence supporting TLR involvement in the vicious inflammatory cycle in patients comes from a humanized model in which intact RA synovial explants were transplanted into severe-combined immunodeficient (SCID) mice. In this model, specific blockade of TLR4 markedly suppressed the spontaneous cytokine production and the severity of inflammation in the transplants to the same extent as spontaneous cytokine release from rheumatoid arthritis ex vivo synovial explant cultures. Arthritis Res Ther 2011, 13:R33.


Abdollahi-Roodsaz S, Koenders MI, Joosten LA, van de Loo FA, van den Berg WB. Toll-like receptor 4 blockade ameliorates murine and humanized arthritis, depending on the cells and the processes involved. However, the unambiguous proinflammatory function of TLR4 appears to provide a solid therapeutic target with consistent benefit.

In conclusion, the report by Nic An Ultaigh and colleagues supports the recently introduced concept of the involvement of TLRs in perpetuation of the chronic inflammatory loop in RA in which endogenous ligands serve as triggers. Unraveling the divergent functions of these receptors and their relative roles in subpopulations of patients with RA is just the dawn of TLR-targeted therapy.

Abbreviations
IFN-y, interferon-gamma; IL, interleukin; RA, rheumatoid arthritis; SCID, severe-combined immunodeficient; TLR, Toll-like receptor; TNFα, tumor necrosis factor-alpha; Treg, regulatory T cell.

Competing interests
WBvdB holds a patent on a TLR4 inhibitor. The other authors declare that they have no competing interests.

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