Annals of the Rheumatic Diseases
The EULAR Journal

Leaders

EULAR and its journal

The June 2001 Congress in Prague is the second annual Congress of the European League against Rheumatism (EULAR), following the first successful congress in Nice last year. This is also the second year with the *Annals* as the official EULAR journal. It therefore seems appropriate at this moment to give some information to the readership about the performance of the journal during its first year as the EULAR journal. Our goals have been, and will continue to be, to produce a high quality scientific journal as well as a usable source of educational information. The marriage between EULAR and the BMJ Publishing Group has proved to be a happy one, providing great support towards reaching these goals. In the past year the circulation of the journal and the readership have increased impressively. In addition, the BMJ Publishing Group has guaranteed good technical support and fruitful contacts with the editorial teams of other specialist journals. In the year 2000 the number of manuscripts submitted was higher than ever, being well over 500. The acceptance rate has stayed around 35%, reflecting the efforts of the editorial team to maintain high scientific quality.

To mention a few highlights of the past year: the "Series on education" was well received, and the supplement on "Advances in targeted therapies II" was timely and of great interest to the clinical and scientific community. For scientific journals this era is a fascinating one because of the rapidly changing possibilities in communication, including the internet. In this respect the *Annals* is "up to date", having its own web site and being fully readable and searchable on the web. Furthermore, the editorial team is keen to monitor new developments in this area for the benefit of the journal and its readership.

With an established annual congress and its own journal, EULAR is now prepared for rheumatology in the third millennium. The executive committee of EULAR and the editorial team of the *Annals of the Rheumatic Diseases* wish you a fruitful and enjoyable stay at the second annual EULAR congress in Prague.

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Markers of joint destruction: principles, problems, and potential

Twenty years ago, Verna Wright commented, "clinicians may all too easily spend years writing 'doing well' in the notes of patients who become progressively more crippled before their eyes." Thankfully much of this has changed. Clinicians increasingly understand the advantages of early intervention, particularly in inflammatory joint diseases,[1 2] and we now have better, more targeted treatments. During this time, however, our methods of objectively assessing and quantifying joint damage have remained largely unchanged. As a result, it is likely that early joint damage in patients goes undetected and untreated.

Although magnetic resonance imaging initially promised much, it has delivered little outside highly specialised centres, where software, coils, and scan sequences change with every passing season. The "gold standard" for assessing joint damage is still the plain radiograph. This mainly images only the bone and is insensitive to change, with reliable differences requiring at least 12 months to evolve. The scoring of radiographs is also time consuming and it does not lend itself to routine monitoring. Importantly, all imaging techniques also only provide a historical view of damage that has already occurred. Even after repeated measures, they are of limited use in informing the clinician of continuing or future damage. Existing serological measures, such as erythrocyte sedimentation rate or C reactive protein, also fall short of requirements.[3] They are neither specific to joint disease nor of much use in non-inflammatory conditions. Known genetic and environmental factors that have been associated with various arthritic diseases might also be considered to be markers, but they are often not modifiable nor do they provide any direct information on the extent of joint disease. There is an urgent need for reliable, quantitative, and dynamic tests that will detect damage early and allow the response of treatments targeted at joint destruction to be measured.

Joints are complex organs where bone, cartilage, and synovial tissue are destroyed or altered in disease. Collagen types I, II, and III are present with associated proteoglycan molecules and other glycoproteins (reviewed in detail by Garnero *et al* and Goldring[4 5]). These components are organised into a highly structured matrix whose composition varies with anatomical site and age. Our knowledge of

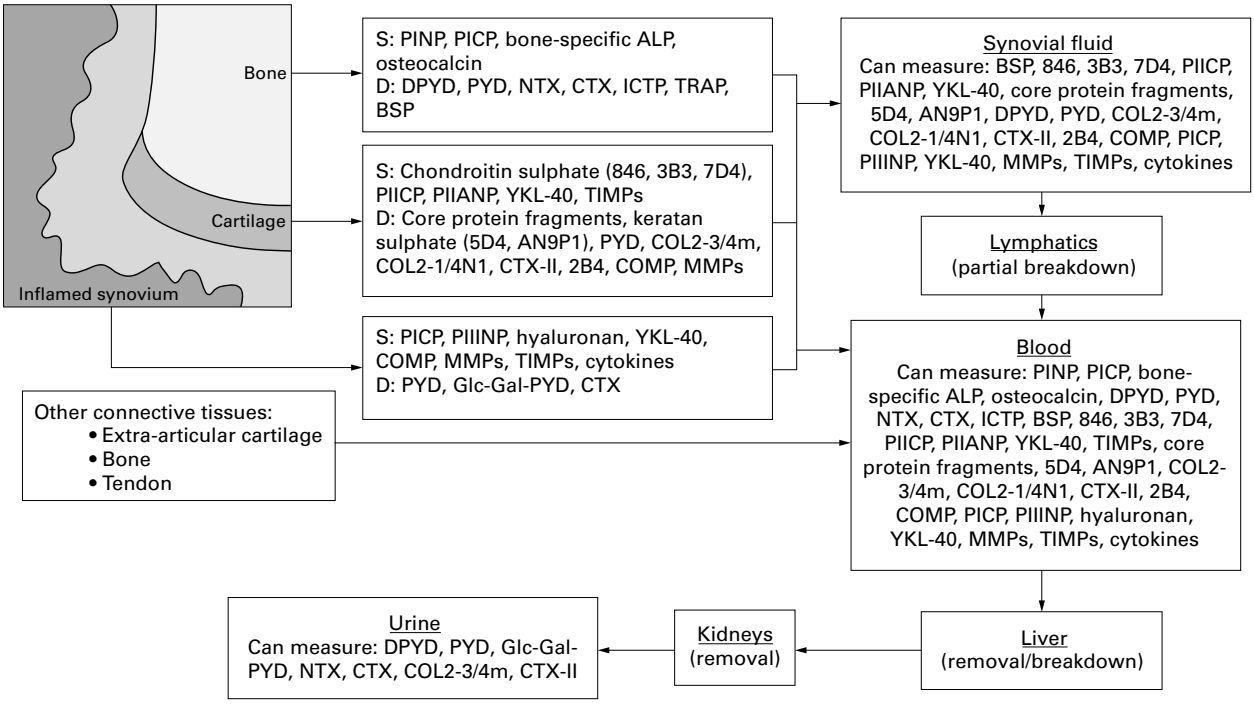

Figure 1 Biochemical markers of tissue destruction, inflammation, and repair. Abbreviations and examples of references referring to the use of these markers: S = synthesis marker; D = degradation marker. PINP = amino-terminal type I procollagen propeptide[11]; PICP = carboxy-terminal type I procollagen propeptide[11]; bone-specific ALP = bone-specific alkaline phosphatase[12]; osteocalcin[13]; DPYD = deoxypyridinoline[14]; PYD= pyridinoline[15]; Glc-Gal-PYD = glucosyl-galactosyl-pyridinoline; NTX= type I collagen N-terminal telopeptide[16]; CTX = type I collagen C-terminal telopeptide-2[17]; ICTP = type I collagen C-terminal telopeptide-1; TRAP = plasma tartrate resistant acid phosphatase[18]; BSP = bone sialoprotein[19]; chondroitin sulphate epitopes 846, 3B3, and 7D4[20 21]; PIICP = carboxy-terminal type II procollagen propeptide[20]; PIIANP = amino-terminal type IIA procollagen propeptide; YKL-40[22]; aggrecan core protein fragments[23]; keratan sulphate epitopes 5D4[24] AN9P1[25]; collagen type II neoepitopes COL2–3/4m, COL2–1/4N1[26]; CTX-II = type II collagen C-terminal telopeptide; COMP = cartilage oligomeric protein[27]; MMPs = matrix metalloproteinases[28]; TIMPs = tissue inhibitors of matrix metalloproteinases[28]; PIIINP = amino-terminal type III procollagen propeptide.[13]

individual components that make up joint tissues is increasing. We are beginning to understand how matrix components interact with collagens and proteoglycans and how the matrix is dismantled by a variety of proteinases that are up regulated by different cytokines and growth factors in disease. If this release of matrix components could be reliably measured then it might be possible to detect early synovial expansion and the early destruction of cartilage and bone.

A variety of different proteins have been proposed as candidate markers and these include matrix components, products of matrix degradation, cytokines, proteinases (for example, matrix metalloproteinases (MMPs)), and enzyme inhibitors.[4 5] Such a diverse range of molecules may eventually be needed to answer a variety of clinically relevant questions. For instance, the characteristics of a biological prognostic marker that predicts future damage will be subtly different from a marker that reflects continuing tissue destruction. A prognostic marker should correlate with modifiable, fundamental control points in tissue destruction, whereas a marker of continuing joint damage should reflect the rate at which tissue is lost. In the future, markers may also help us resolve the apparent heterogeneity of existing clinical conditions.

Early studies of biological markers looked at the gross amounts of either proteoglycan or collagen that were released and established that proteoglycan components were usually released before collagen fragments and that the byproducts of collagen assembly into fibrils could be distinguished from those that resulted from degradation.[6] It became clear that the synthesis of new matrix was also increased in disease as the tissue attempted repair and so specific markers that could distinguish between repair and degradation were important. An early success was the use of specific cross links to follow degradation of collagen type I in bone, and an early application was to correlate bone loss in osteoporosis with the release of these cross links detected in urine.[7] Subsequently our knowledge has increased and assays have become more sophisticated.

However, problems need to be overcome and these are illustrated in fig 1 and have been described in previous reviews.[8 9] When a matrix component is released from cartilage, bone, or synovium the most reliable measure can be obtained from synovial fluid. However, this only gives information on a single joint and in a large proportion of patients joint aspiration may not be appropriate or feasible. Urine can be problematic and patients often have difficulty collecting 24 hour urine specimens. Serum is the most convenient body fluid. The passage of molecules from the joint to body fluid is complex and can involve the modification or metabolism of the marker. It is likely that differential processing by the liver or kidneys occurs before such markers reach a steady state in body fluids, and this metabolism may not occur reproducibly in all patients, particularly in the presence of systemic disease.[8] In addition, there is a general dilution of components in the serum and urine, and some components are only present at very low concentrations that cannot be measured reliably. The normal extra-articular turnover of connective tissue matrix may also mean that any contribution from affected joints is small and may not significantly alter the overall level. The interpretation of marker levels may also be complex as decreased levels may equally reflect reduced matrix breakdown, decreased synthesis, or impaired marker release from tissues, and in late stage disease, joint tissues such as cartilage may be absent, resulting in misleadingly low levels of certain markers.

Ideally, it would be helpful to be able to distinguish the precise components that are released by the separate

Table 1 Biochemical markers for tissue turnover (see fig 1 for abbreviations)

	Synthesis	*Breakdown*
Bone		
Type I collagen	• Procollagen propeptides - PINP, PICP	• Crosslinks - DPYD, PYD • Telopeptides - NTX, CTX, ICTP
Non-collagenous proteins	• Bone-specific ALP • Osteocalcin	• TRAP • BSP
Cartilage		
Aggrecan	• Chondroitin sulphate - 846, 3B3, 7D4	• Core protein fragments • Keratan sulphate - 5D4 - AN9P1
Type II collagen	• Procollagen propeptides - PIICP, PIIANP	• Crosslinks - PYD • Collagenase epitopes - COL2-3/4m - COL2-1/4N1 • Collagen II telopeptides - CTX-II
Other proteins	• YKL-40	• COMP
Synovium		
Types I and III collagens	• Procollagen propeptides - PICP, PIIINP	• PYD - Glc-Gal-PYD • CTX
Non-collagen protein	• Hyaluronan • YKL-40 • COMP • MMP-1, -2, -3, -9 • TIMP-1, -2	

tissues of the joint—namely, bone, cartilage, and the synovium. Table 1 lists the current markers that are thought to indicate either the synthesis of new matrix or the destruction of matrix from these three tissues. For example, the breakdown of collagen in bone can be followed by deoxypyridinoline cross links derived from type I collagen, whereas specific collagenase induced neoepitopes may be used to follow the cleavage of type II collagen from cartilage.

In this issue of the *Annals* Garnero *et al* use a panel of markers of bone, cartilage, and synovium in patients with knee osteoarthritis (see p 619). They report that these patients have decreased bone turnover but increased cartilage and synovial metabolism. This interesting paper describes levels of urinary type II collagen telopeptide, serum procollagen fragments, and urinary Glc-Gal-PYD in association with cartilage loss. A urinary level of Glc-Gal-PYD, a modified form of the collagen cross link pyridinoline and a putative marker of synovial metabolism, was also shown to be the best predictor of pain and physical function. In osteoarthritis, synovial involvement is usually considered mild, if present at all. The finding that a synovial marker correlates best with symptoms may suggest that synovial involvement is significant.

These studies are interesting and, although limited, do suggest that it may be possible to follow specifically the activity of individual tissues within the joint in different diseases.

The potential for reliable and responsive markers is large. This and other recent studies have suggested that it is possible to separate inflammatory events from destructive events. For example, Cunnane *et al* showed that following changes in serum levels of MMP-3 allowed inflammatory events to be studied in rheumatoid arthritis (RA), whereas changes in serum MMP-1 levels followed the destruction of cartilage and bone.[10] Although the current study is in osteoarthritis it will be interesting to see if the new markers described in this study have a role in RA and whether levels in early joint disease allow the reliable prediction of those patients whose cartilage and bone will eventually be destroyed. Early warning of the initiation of matrix breakdown would prompt earlier treatment so preventing much of the destruction of cartilage and bone that leads to subsequent disability. Further studies, and particularly prospective studies, are still required to validate this and other markers as these are proposed/discovered.

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Stem cell transplantation: limits and hopes

The clinical course and severity of inflammatory rheumatic diseases vary considerably. A large proportion of patients have mild to moderate activity of the inflammatory process which can be successfully controlled by conventional therapeutic measures: traditional disease modifying antirheumatic drugs (DMARDs) for rheumatoid arthritis (RA) and some other forms of chronic arthritides, intermediate steroid doses or mild immunomodulatory agents for systemic lupus erythematosus (SLE) and other connective tissue diseases. Also, control of more severe disease is often manageable by more aggressive, established means, such as high dose methotrexate and combination treatment for RA, or pulse cyclophosphamide treatment and steroids in SLE. For most of these therapeutic approaches significant evidence has accumulated in randomised controlled trials.[1–3]

Without the possibility of making individual predictions, there are many patients whose diseases are not sufficiently responsive to the traditional measures. At least for RA, the armamentarium has recently been significantly enriched by new means of intervention,[4–6] among them biological agents which specifically target a key mediator of inflammation, tumour necrosis factor α (TNFα); more targets are currently being studied. The TNF blockers also appear to be quite efficient therapeutic agents for diseases which were often less easy to control, such as psoriatic arthritis,[7] or ankylosing spondylitis, which was regarded as intractable when treated with traditional DMARDs.[8]

However, despite some success of modern antirheumatic treatment, groups of patients exist, familiar to every rheumatologist, whose disease is resistant to therapeutic measures. This is still the case for a significant proportion of patients with RA whose continuing disease activity, refractory to traditional and new DMARDs, combination treatment, and biological agents, leads to a relentless progression of joint destruction; approximately 30–40% of patients with RA do not have clinical responses even when receiving the new agents. This is also the case for a significant number of patients with SLE or vasculitis, whose renal, pulmonary, or other organ disease does not respond to, or even recurs during, treatment with high dose immunosuppression. This is particularly true for patients with systemic sclerosis (SSc), for whom there is currently no remedy at all, except for some symptomatic measures. These patients, once vital organs or even the skin are severely affected, run a relentlessly bad and often rapidly fatal course. Although open trials have sometimes elicited hope,[9 10] controlled clinical investigations are rare in SSc and usually lead to negative results.[11] All these unfavourable situations constitute a major challenge not only for the caring rheumatologist but also for the whole rheumatological community and its clinical and basic scientists.

In the 1980s, remissions or dramatic improvement of pre-existing autoimmune rheumatic diseases were occasionally seen in patients treated with high dose chemotherapy and subsequent bone marrow transplantation for their leukaemia or bone marrow aplasia.[12–15] These observations fostered the idea that such therapeutic approach might be generally useful to treat or even cure autoimmune disorders. The idea was generated that high dose chemotherapy would eradicate the immunocompetent cells, including those B and T cells responsible for the destructive autoimmune process, while (autologous) bone marrow would allow reconstitution of a functioning but naive immune system, naive also towards the putative (eliciting) autoantigens. Because autoimmune diseases do not appear to pre-exist and the concurrence of disease in monozygotic twins of usually <30% suggested important environmental involvement in the aetiopathogenesis of these disorders, such an idea appeared compelling.

The fear of the relatively high procedure related risk of autologous bone marrow transplantation, initially hampering a more widespread acceptance of the above idea, was significantly reduced after peripheral blood derived autologous stem cell transplantation (ASCT) became established.[16 17]

In this issue of the *Annals*, Binks *et al* report on more than 40 patients with SSc in whom ASCT was performed (see p 577). This phase I/II trial report constitutes a first presentation of a multinational effort to assess the value of ASCT in systemic sclerosis and has been led for several years by Dr Alan Tyndall from Basel on behalf of the EULAR Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT) in collaboration with the European Group for Blood and Marrow Transplantation (EBMT). SSc was selected as model disease for such evaluation because, as detailed above, no treatment has been established for this disease to date. It is only fair to allow patients with an intractable condition, as severe as SSc, a last chance, given the lack of other therapeutic options.[18] Interpreting this open study, one finds good news and bad news.

Let us start with the bad news. In general, there was no improvement in major organ involvement. In particular, alveolar diffusion capacity deteriorated in many more patients (approximately 40%) than it improved in (approximately 10%); moreover, two patients died from rapidly progressive interstitial pneumonitis early after conditioning. Renal and cardiac disease did not appear to improve after the procedure. Skin disease deteriorated in some patients who had an initial improvement. Finally, procedure related mortality was of the order of 17% and overall mortality was 27% at one year, which may not be lower than expected from the natural course of the disease.[19]

However, there is also good news. Skin disease improved considerably in a large proportion of the patients, though the procedure did not cure the disease. In some, though few patients, there was an improvement in lung function. Moreover, all patients were apparently high risk patients, mostly with rapidly progressive diffuse scleroderma, and their life expectancy at one year might have been lower than 73%. And, finally, such treatment also constitutes a last resort for the caring physicians, helpless in their desire to

assist patients whose disease is not responsive to therapeutic measures, a disease without established standard treatment, and is a last resort for the desperate patient.

On the other hand, important questions arise from the results presented, and these questions will have to be addressed in co-operative studies between clinicians and basic scientists: How can patient selection be improved to (*a*) reduce treatment related mortality and (*b*) offer the procedure to the patients with the best chance of responding? How different is the immunological repertoire after ASCT from that before? When there is recurrence of disease, as is indicated by renewed progression in several patients, has the repertoire been "deranged" anew? Also, is microchimerism[20] still present after the procedure? New technologies, such as DNA and peptide microarrays,[21 22] may be helpful in resolving such questions.

The difficulty in curing scleroderma by an aggressive therapeutic regimen that is commonly successful in malignant haematological disorders also elicits the question, whether the cell populations eliminated by the procedure are really the most important players in the pathogenetic events or whether, rather, these events are driven by resident cells resistant to chemotherapy and radiation treatment, or by environmental factors, which even after ASCT affect the genetically still susceptible immune system of the host.

Although its spontaneous course is so diverse, SSc is probably rheumatology's most ominous disorder. Any promising attempt to alter the fate of this disease or to improve our understanding of its pathophysiology deserves full support by the rheumatological community.

Given the heterogeneity of the clinical presentation and course of scleroderma as well as the lack of established treatment options, the data presented now call for a randomised double blind sham controlled trial in patients who primarily have rapidly progressive skin disease. Careful patient selection and detailed description of the therapeutic protocol are mandatory. In the course of such a study, the above scientific questions ought to be considered. Additionally, in the course of such a study quality of life issues should also be investigated: How do patients perceive the burden of the procedure and its risks? How do they judge the actual change in their condition?

But what about disorders other than SSc? In some patients with RA who received allogeneic bone marrow transplantation, recurrence of disease, albeit milder, developed despite absence of residual haemopoiesis.[23 24] Conversely, donor stem cells from autoimmune patients did not necessarily transfer disease to the recipient.[25] Thus it has been speculated that host or environmental factors, retransplanted immunocompetent cells or, as discussed above, resident cells, may be important.[25] However, such factors probably differ in different disorders. SLE is yet another disease for which ASCT holds promise. In fact, given its commonly successful control by treatment with cytotoxic agents, high dose myeloablative treatment with autologous stem cell rescue may become a future choice in patients who resist more traditional treatments or whose disease still recurs severely after several conventional treatment cycles, provided that this can be proved in clinical trials.[26]

Thus ASCT may become an interesting option for patients with inflammatory rheumatic disease refractory to conventional treatment. The data of Binks *et al* provide important insights into the approach and degree of efficacy of ASCT in SSc in the recent past. These data also call for and reveal the need for well designed trials to prove its efficacy (and its long term success). However, already now we know that ASCT may be helpful only in a proportion of patients and may be curative in even fewer. Therefore an important aim must be to attempt to define those patients with the best chances for improvement. Additionally, the search for other remedies must go on.

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Ann Rheum Dis 2001 60: 548-549
doi: 10.1136/ard.60.6.548