Synovium

Abstracts

Histochemical localisation of hyaluronan in healthy and diseased cartilage of knee joints

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Hyaluronan was identified and localised in biopsies from human articular cartilage of normal and osteoarthritic knee joints by use of a hyaluronan binding protein and the biotin-avidin peroxidase staining method. Fixation and decalcification of tissue samples were performed using a microwave oven technique.

Hyaluronan was localised predominantly in the superficial layers of the fibrocartilaginous articular cartilage. Free hyaluronan was scattered throughout the deeper zones of the cartilage. In cartilage biopsies from patients with osteoarthritis, superficial spurs of regenerating cartilage were devoid of hyaluronan staining, but in the underlying bone tissue, weak hyaluronan staining was present.

Hyaluronan synthesis in joint cavititation

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Intraarticular injection of hyaluronan into knee joints of rabbits was used to assess the effect of hyaluronan on joint fluid formation. Hyaluronan was detected in joint fluid by histochemistry and by immunohistochemistry. Hyaluronan was also detected in the synovial fluid of patients with knee synovitis.

Intravenous Gd-DTPA enhancement of joint fluid on magnetic resonance imaging: a measurement of trans-synovial flow?

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Joint fluid has been shown to enhance on magnetic resonance images after intravenous injection of gadolinium-diethylenetriamine pentaacetic acid (Gd-DTPA). We investigated the relationship between joint fluid enhancement and the rate of joint fluid enhancement in an antigen induced arthritis (AIA) rabbit model.

The knees of 13 New Zealand White rabbits were imaged before and 7 and 14 days after induction of AIA. Knee diameters were measured at each imaging session. Seven rabbits (treatment group) received 0.5 mg/kg methylprednisolone IV twice daily on days 10 to 14. Premedication T1-weighted (T1W) and T2-weighted images were obtained. Repeat T1W images were performed 1, 15, 30, 45, and 60 minutes after 0.1 mmol/kg Gd-DTPA. Enhancement of peripheral joint fluid at each time point was expressed as the percent of maximal enhancement.

All knees with AIA demonstrated swelling on day 7 (p < 0.001). The knees of the untreated group remained swollen on day 14, while those of the treatment group showed a reduction in swelling (p < 0.001). On day 14, the untreated group showed more rapid fluid reduction than the treatment group (78% of maximal at 15 minutes compared with 55% and 74%, respectively, before induction (p < 0.001). The treated group had less rapid enhancement at one minute (53%) than the untreated group (p = 0.07).

The rate of joint fluid enhancement following Gd-DTPA correlated with the degree of joint inflammation and was sensitive to pharmacological modulation. The method may prove useful for measurement of trans-synovial flow.

Measurement of synovial volume and rates of synovial enhancement with Gd-DTPA enhanced magnetic resonance imaging


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We aimed to devise a method to quantify synovial volume by magnetic resonance imaging. As part of the study, the pattern of synovial enhancement by intravenously administered gadolinium-diethylenetriamine pentaacetic acid (Gd-DTPA) was studied in patients with knee synovitis.

T1-weighted sagittal knee images were acquired in nine patients with synovitis using magnetisation prepared rapid acquisition gradient echo (MP-RAGE) (repetition, echo and inversion times = 110, 4, 20 ms, respectively; flip = 40°) before and after injection of 0.2 mmol/kg Gd-DTPA. Subtraction of non-enhanced from enhanced images allowed the calculation of synovial volume from the pixel counts and the known voxel volume. Data sets were processed on a Sun Sparc workstation using Analyze (BiR, Mayo). Additionally, a dynamic T1-weighted sequence was used during enhancement (2D fast low angle shot, every 15 seconds for five minutes then every five minutes for 60 minutes) and the ratio of post- to pre-enhancement synovial signal for each patient calculated at times up to one hour after injection.

Synovial enhancement was detected in all patients. Range of synovial volume (calculated in nine patients) was 93–271 ml. Variation in enhancement was not found to vary. The time to maximal signal intensity in seven of eight patients varied, but occurred within 500 seconds of Gd-DTPA injection, except for the patient with polyarthritis nodosa, in whom maximal signal was not detected until 60 minutes after Gd-DTPA injection. The pattern of reduction in signal intensity in seven of eight patients suggested Gd-DTPA elimination consistent with its clearance from the extracellular compartment. No significant synovial fluid enhancement was detected.

A simple method of measuring synovial volumes has been presented. Variations in the rate of synovial enhancement with Gd-DTPA occur and may reflect differences in synovial perfusion and vascularity.

Glycosaminoglycan concentration in rabbit synovium and its relation to pressure induced increased permeability

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The low hydraulic conductance of normal synovial interstitium helps to retain synovial fluid in the joint cavity. The conductance increases at pathological intraarticular pressures, and as this is only partly explained by stretching, we investigated if changes in matrix concentration also occur. One knee of an anesthetised rabbit was injected with saline to 25 cm H₂O over three hours, increasing the conductance of the lining 5:23 (SEM 1:5) times. The opposite unperfused knee served as control (n = 8). Synovium was then microdissected (1–2 mm², 25 per joint). Digested tissue was analysed for chondroitin 4 and 6 sulphate disaccharides (CS4s, CS6s) by capillary zone electrophoresis, hexuronate sulphate (HA) by capillary electrophoresis, hexuronic acid (HA), chondroitin sulphate A (CS-A) and chondroitin sulphate C (CS-C) by HPLC. The contents of synovial fluid measured at the same time (n = 1). The results showed that the synovial fluid content of HA and HA increased significantly, while CS-A and CS-C decreased. The changes were highly significant at 0.05 level.
Abstracts

Multinucleate cells in pigmented villonodular synovitis express osteoclast markers
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Pigmented villonodular synovitis (PVNS) and the related lesion, giant cell tumour of tendon sheath (GCTTS) are idiopathic proliferation of bone cyst formation and osteolysis. PVNS/GCTTS contain two predominant cell types: mononuclear histiocytic cells and multinucleate cells. Mononuclear cells (MNC) exhibit markers suggestive of derivation from a monocyte lineage. The derivation of the multinucleate cells and their relationship to osteoclasts is not defined; to define their phenotype, tissue sections from seven patients with PVNS and two patients with GCTTS were examined for osteoclast markers. Multinucleate cells in both lesions were strongly positive for vonronectin receptor, as were some MNC surrounding the multinucleate cells. Tissues from seven of the nine patients contained intensely tartrate resistant acid phosphatase (TRAP) positive multinucleate cells; fewer than 5% of the MNC were TRAP positive. These TRAP positive MNC also tended to surround multinucleate cells. To demonstrate the presence of calcitonin receptor, a definitive marker for osteoclasts, snap frozen sections from eight patients (six PVNS, two GCTTS) were incubated with $^{125}$I-labelled salmon calcitonin and examined by emulsion autoradiography. Multinucleate cells in four of six PVNS and two of two GCTTS samples demonstrated specific calcitonin binding that was competed by unlabelled calcitonin; no definite calcitonin binding was detected in the MNC. Calcitonin receptor expression was confirmed by polymerase chain reaction using calcitonin receptor specific primers on cDNA synthesised from PVNS total RNA (two samples), and RNA from tissue sections (seven PVNS, two GCTTS). All samples were positive for calcitonin receptor transcript.

The multinucleate-like multinucleate cells could provide the cellular mechanism for the osteolysis that characterises PVNS/GCTTS. These lesions may provide a useful model for defining factors involved in osteoclast differentiation.