PATHOGENESIS OF JOINT ALTERATIONS IN EXPERIMENTAL ERYSIPELAS POLYARTHRITIS

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Joint alterations in the chronic phase of erysipelas polyarthritis in pigs have been studied widely (Sikes et al., 1966, Schulz et al., 1975, Trautwein et al., 1976). However, little morphological information is available concerning the initial acute phase of arthritis. In spite of extensive literature on this subject, the pathogenesis of polyarthritis has not been completely elucidated. Thus, the mechanism of polyarthritis with ankyloses in the final stage can not be explained satisfactorily.Some aspects of erysipelas arthritis, f.e. the slowly progressive course and the morphologic changes,are comparable to human Rheumatoid Arthritis.

Material and Methods: In our experiment, 18 gnotobiotic piglets and 20 specific pathogenfree piglets were infected into the left tarsal joint with viable Erysipelothrix bacteria,type B, strain T 28. The gnotobiotic animals were killed 1-28 days post infect.,and the specific pathogenfree pigs 3-25 months post infect. I want to demonstrate articular lesions in joints that were not infected directly, and I shall particularly refer to lesions in the carpal, elbow, stifle, and the right tarsal joint. Using light microscopy, transmission-,and scanning electron microscopy the pathogenesis of the early cartilage alterations and their possible significance for the perpetuation of arthritis were studied.

Results: Macroscopically alterations of the cartilage surface are not detectable during the first 17 days post infection, except for slight irregularities close to 28 days post infection. At 10 days post infection first defects become detectable using the stereomicroscope. However, with a combination of light-,transmission-and scanning electron microscopy focal or diffuse changes at the cartilage surface and the synovial lining cells (SLC) may be detected. In the secondary chronic phase we are able to demonstrate the destructive effect of the pannus which leads to additional macroscopic cartilage defects.

In the bacteremic phase 1-3 days post infect. we observe large numbers of Erysipelothrix bacteria on the endothelial surface of vessels.These bacteria induce a vascular syndrome with severe disturbance of permeability.During this phase the bacteria penetrate through the vascular wall and invade the perivascular tissue. 2-3 days post infect.,the bacteria invade the superficial cartilage layers; at this stage the chondrocytes appear normal.Electron microscopically,the bacteria are located between collagen fibrils of the superficially loosened ground substance.4-5 days post infect.the bacteria are seen in the cartilage ground substance and also in the cytoplasm of chondrocytes of the superficial cartilage layer that shows degenerative changes.These changes suggest direct damage by the bacteria.At the same time polymorphnuclear leucocytes (PMLs) invade the cartilage matrix and are in close contact with chondrocytes.This cartilage surface becomes covered by a thin layer of fibrin.Using the scanning electron microscope we recognize under the fibrin layer the beginning unmasking of collagen fibrils; superficial cartilage lacuna are broken up and usually no longer contain chondrocytes. Often PMLs are located within cartilage lacuna. This crescent position is a typical localisation.The chondrocyte shows severe degenerative changes. In the loose cartilage matrix fibrin incorporation can be demonstrated. In the deeper layers of the cartilage there is marked loss of chondrocytes. Often larger areas of cartilage become free of cells. It seems very difficult to visualize that PMLs are a factor in this cartilage degeneration; as PMLs can not be demonstrated using HE-stained paraffin section or even semi-thin sections. This may also be the explanation why most authors consider PMLs unimportant in the degradation of cartilage. Mohr et al.(1980, 1981) identified PMLs within the cartilage in human chronic polyarthritis by demonstrating histochemically Naphthol-AS-D-chloracetate-Esterase and electron microscopically.

Since the joint is considered a functional unit, a severe activation and proliferation of synovial lining cells occurs parallel to the cartilage changes. In the synovial lining cells the bacteria seem to occur only in the acute phase 1-15 days post infection of arthritis, as shown by immunofluorescence and electron microscopy. The highly active type A and I lining cells phagocytize and destroy bacteria quickly. Morphometrically the SLC types A and I show a significant increase in the number and size of the lysosomes per normed area of cytoplasm and an enormous expansion of the cytoplasmic volume as compared with the control animals (Drommer et al.,1980). 20 days and later the destructive effect of the pannus gets involved that eventually leads to deep erosions and fibrous pannus with ankyloses. The degeneration of chondrocytes and the decreased synthesis of ground substance lead to the formation of cavities underneath the cartilage surface.Eventually these aspects lead to halos free of fibrils around the chondrocytes. Mechanical factors may destroy such an area with a deep cartilage erosion which finally appears.

We believe that Erysipelothrix bacteria cause direct damage to the cartilage. In the deeper cartilage layers the bacterial antigen may persist. Besides cartilage, the subsynovial connective tissue layer pretends to be another side for bacterial persistence in chronic arthritis. Using preliminary studies the direct immunoperoxidase-technique at the electron microscopic levels indicate that we can expect extracellular and intracellular bacteria or bacterial fragments. In three cases of experimental chronic arthritis of 1 1/2 years duration we have seen in the cytoplasm of single chondrocytes (middle and deep layer) these bacteria and fragments of bacteria. It is interesting to note that these joints had been negative bacteriologically. Therefore, we presume that bacteria persist in the cartilage and thus contribute to the perpetuation of polyarthritis.Persistence of bacteria and bacterial antigen seems to occur predominantly in tissues with minor blood circulation,formerly called bradytrophic tissues.The letter apparently represent an excellent location for persistence of arthritogenic bacteria.

Conclusion. The initial cartilage alteration,seen in experimental erysipelas arthritis is caused by direct action of bacteria,correlated with polymorphnuclear granulocytes and fibrin incorporation. Important early changes are demasking of collagen fibrils and degeneration of chondrocytes.In this early phase the cartilage surface appears normal macroscopically.Severe cartilage alterations,which can be seen macroscopically, are associated with severe proliferation of SLC and invasive pannus.

Selected references:Drommer,W.,Langer,I.,Schulz,L.-Cl., and Trautwein,G.:Schweiz.Arch.Tierheilk.1980,122:1; Drommer,W.in Otte,P. Gelenkdestruktion bei Polyarthritis,1981,15-21,D.Steinkopff Verlag,Darmstadt;Mohr.W., Endres-Klein,R.,and Bell,B.:Med.Welt 1980,31:1618; Mohr,W.,Köhler,G.,and Wessinghage,D.:Rheumatol.Int. 1981,1:21; Sikes,D.,Fletcher,O.,and Papp,E.:Am.J.Vet. Res.1966,27:1017;Schulz,L.-Cl.,Drommer,W.,Seidler,D., Ehard,H.,v.Mickwitz,G.,Hertrampf,B.,and Böhm,K.:Beitr.Path.1975,154:1;Trautwein,G.,Seidler,D.,Schulz,L.-Cl.,Drommer,W.,Weiß,R., and Böhm,K.:Z.Rheumatol.1976, 35:217.