Clinical and Experimental Rheumatology 2002; 20: 833-836.

A cluster of inflammatory rheumatic diseases in a moisture-damaged office

R. Myllykangas-Luosujärvi[1], M. Seuri[2], T. Husman[3], R. Korhonen[4], K. Pakkala[5], K. Aho[6]

[1]*Department of Medicine, Kuopio University Hospital;* [2]*Kuopio Regional Institute of Occupational Health, Kuopio;* [3]*National Public Health Institute, Kuopio;* [4]*Local Occupational Health, Säveri Medical Center, Kuopio;* [5]*Merita Bank Occupational Health, Helsinki;* [6]*National Public Health Institute, Helsinki, Finland.*

Riitta A. Myllykangas-Luosujärvi, MD, Consulting Rheumatologist; Markku Seuri, MD, Head of Medical Section; Tuula M. Husman, MD, Senior Researcher; Riitta Korhonen, MD; Kirsti Pakkala, MD, Head of Merita Bank Occupational Health; Kimmo Aho, Professor.

Please address correspondence and reprint requests to: Riitta Myllykangas-Luosujärvi, MD, Department of Medicine, Kuopio University Hospital, P. O. Box 1777, FIN-70211 Kuopio, Finland.
E-mail: riitta.myllykangas-luosujarvi@kuh.fi

Received on January 16, 2002; accepted in revised form on September 4, 2002.

Key words: Disease clusters, inflammatory rheumatic diseases.

ABSTRACT

Objective. *To describe a cluster of inflammatory rheumatic diseases in an office workplace that suggests the presence of an environmental trigger.*

Methods. *There had been an indoor air problem in the workplace since the early 1990s. Large areas of the outer walls of the building were found to be moisture-damaged and contaminated by microbial growth. Case histories of the personnel were studied, and their working areas were related to the areas with highest microbial contamination. The incidence of inflammatory rheumatic diseases was compared with the statistics of the same geographic area.*

Results. *Ten patients with inflammatory rheumatic diseases (3 rheumatoid arthritis, 4 ankylosing spondylitis, 2 Sjögren's syndrome, and one of psoriatic arthritis) entitled to specially reimbursed medication were diagnosed in 1987-2000 (seven cases in 1995-1998). The incidence density ratio computed for the period 1987-2000 was 6.8 (95% confidence interval 3.6.-13.0) for all office personnel and 13.2 (6.0-29.0) for those working close to the wall sustaining the worst damage.*

Conclusion. *The accumulation of chronic inflammatory rheumatic diseases in a single workplace suggests that some environmental exposure in this damp office had triggered the diseases.*

Introduction

Both genetic and environmental factors play a part in the etiopathogenesis of chronic inflammatory rheumatic diseases. Much is already known of the genetic factors involved, whereas the study of environmental triggers is still in its beginning (1,2). Arthralgias have been associated with mould exposure, both in occupational (3, 4) activities and in buildings (5,6), but frank arthritis is to our knowledge rare. Patients with chronic rheumatic diseases have been shown to have elevated levels of *Aspergillus fumigatus* antibodies but these are more probably a consequence rather than a cause of arthritis (7).

In 1996, a local occupational physician noted an exceptional cluster of various inflammatory rheumatic diseases among the employees of an office in which the employees had suffered from indoor air problems for years. Subsequently, three additional cases were diagnosed. The study described here deals with the rheumatological aspects; a more detailed account on the structural damages, environmental studies and some background information on the diseases will be reported elsewhere.

Materials and methods

Office building

The office building consists of a higher section with six floors above the ground level and a lower section with only two floors over the ground level. In addition, there were two floors below the ground level. The office rooms of the problem company occupy the two lowest floors over the ground level and some smaller facilities in the higher floors. The remaining parts of the building are occupied by other companies.

The building was mainly heated with ventilated warm air without any humidifiers. Employees working in the office rooms of the problem company had complained of indoor air problems since 1992. Samples collected in 1996 revealed moisture and mould damage in the outer-wall insulation material. The working area close to the most damaged wall structures was regarded as the problem area. The worst damage was repaired in a limited area, but indoor air complaints continued. Technical, microbiological and physical reinvestigations still revealed moisture and mould damage. Indoor air and outer-wall insulation material samples contained microbes, indicating mould contamination. The total number of colony forming units in the three indoor air samples was low (range 99-255 cfu/m^3) but they contained microbes (*Streptomyces, Aspergillus versicolor* and *A. ochraceus*) which are considered to indicate mold growth in a building. Some insulation material samples contained yeast. New repairs were performed in 2000.

Personnel

The number of employees in the office rooms of the problem company, in gen-

eral occupying only the two lowest floors, varied from 83 to 131 during the study period from 1987 to 2000. Due to a business merger in 1995 the number of employees grew suddenly from 83 to 131. In late 1998 there were 93 (86%) female employees and only 15 (14%) men. The mean age of the women was 46 years and of the men 41 years. The employees did mainly paper work and many of them saw customers. In the same year the number of employees in the other companies located in floors 3-6 over the ground level was 85.

Diagnostic procedures

Diagnostic procedures used at the rheumatological clinic of Kuopio University Hospital are shown in Table I. Rheumatoid arthritis (RA) was diagnosed if four or more American College of Rheumatology classification criteria (8) were fulfilled and psoriatic arthritis (PsA) if the patient had psoriatic rash with arthritis. In patients with ankylosing spondylitis (AS) the criteria were chronic inflammatory back pain for more than 3 months with limitations in back movements and changes compatible with AS in X-rays or magnetic resonance imaging and/or scintigraphy. Sjögren's syndrome (SS) was diagnosed if patients had chronic sicca manifestations with chronic sialadenitis diagnosed by biopsy in small salivary glands or clinically as swelling in parotid glands. All patients were entitled to specially reimbursed medication for their rheumatic disease. Eligibility requires a comprehensive medical certificate written by the attending specialist and approved by an expert adviser on behalf of the sickness insurance scheme. The certificates are not keyed to any specific criteria but are written to provide evidence that a subject has a certain disease and needs treatment (9).

Incidence density ratios

A priori the working area close to the most damaged outer wall was regarded as the problem area, and working there for two years before diagnosis of rheumatic disease was considered decisive. This time interval was arbitrary; however, most subjects working in the problem area had been working there most of the time.

The incidence density ratio was computed by comparing incidence of the rheumatic diseases in the problem office and in Eastern Finland. Ratios were computed separately for all office personnel and for those working in the problem area. Person-years from 1987 (when the first case had been diagnosed) to 2000 were used. The incidence of new cases entitled to specially reimbursed medication for chronic inflammatory rheumatic diseases from eastern Finland in the age-group 20-59 years and total person-years in the same group were used. These data were provided by the Social Insurance Institution through the courtesy of Dr Timo Klaukka.

Table I. Diagnostic procedures used in the present study.

Suspected diseases	Procedures
Peripheral arthritis	Rheumatoid factor (RF) X-rays of hands and feet Ultrasonography of hip joints Registration of the duration of morning stiffness and the joints involved X-rays and ultrasonography of other joints according to the symptoms
Ankylosing spondylitis (AS)	Registration of back movements X-rays of the lumbar region of the spine X-rays of other parts of the spine when needed Magnetic resonance imaging and/or scintigraphy of the spine when needed HLA-B27 testing when needed
Sjögren's syndrome	Testing for SS-A and SS-B antibodies,antinuclear antibodies (ANA), and RF Ophthalmological and oral medicine consultations Biopsy of small salivary gland if no parotid swelling

Results

A total of 10 subjects (1 man, 9 women) had been diagnosed among the personnel of the office as having some inflammatory rheumatic diseases that made them eligible for specially reimbursed medication (Table II). Three had RA, 4 had AS, 2 had SS, and one PsA. The first diagnosis was made in 1987 and the next in 1993. Seven further cases were found during 1995-1998 and one case in 2000. Two cases of peripheral arthritis have been recorded in 2001, but their diagnostic evaluation has not yet been completed.

All of the RA patients had an erosive disease and all were RF positive. In one patient (case 2), the disease commenced in the 1980s before attention had been focused on the indoor air problems. One patient (case 7) developed proteinuria with amyloidosis within 3 years following the diagnosis of RA.

All the AS cases had chronic back pain and stiffness and all had X-ray evidence of at least grade 2 bilateral sacroiliitis. In addition, one (case 1) had squaring of the vertebral bodies in the dorsal region. Only one patient (case 5) was HLA-B27 positive.

The patients with SS had dry eyes (Schirmer and Rose-Bengal tests were positive) and mouth and both also had Raynaud's symptom. One (case 9) had recurrent parotid gland swelling and the other (case 3) had lymphocytic infiltrates in biopsy specimens from the small salivary glands. One patient (case 3) had chronic interstitial cystitis and nodular eosinophilic pneumonia. Both patients were positive for ANA, and one (case 3) had SS-A and SS-B antibodies.

The case with PsA had had skin rash diagnosed by a dermatologist as psoriasis for years. Later she developed RF negative peripheral arthritis and dactylitis. At the time of diagnosis she already had erosions typical of PsA in

Table II. Basic demographic data of patients working in the problem office.

Case number	Diagnosis	Employed in building	Onset of symptoms	Year of diagnosis	Age at diagnosis	Works in problem area
1	Ankylosing spondylitis	1977	1994	1996	41	No
2	Rheumatoid arthritis	1977	1985	1987	44	Yes
3	Sjögren's syndrome	1977	1989	1996	57	Yes
4*	Ankylosing spondylitis	1977	1990	1998	62	No
5	Ankylosing spondylitis	1977	1992	1993	42	Yes
6	Rheumatoid arthritis	1980	1996	1996	54	Yes
7	Rheumatoid arthritis	1989	1995	1995	48	No
8	Ankylosing spondylitis	1992	1996	1996	41	Yes
9	Sjögren's syndrome	1993	1998	1999	50	Yes
10	Psoriatic arthritis	1997	2000	2000	53	No

*male case

the toes.

At the end of follow-up 8 patients were on disease-modifying antirheumatic drugs, six received glucocorticoids and all but one nonsteroidal anti-inflammatory drugs. The incidence density ratio for all subjects working in the office was 6.8 (95% confidence interval 3.6 – 13.0). The corresponding figure for those working in the problem area was 13.2 (6.0. – 29.0). One patient (case 2) had moved to another place but is still working, one (case 3) is on work disability for SS and one patient (case 4) is retired because of age. The remaining patients are still employed at the office.

Discussion

A high incidence of chronic inflammatory rheumatic diseases was found among the personnel working at the office under study. The principles used to compute the incidence density ratios were somewhat arbitrary. We started counting the person-years from the year 1987 when the first case was diagnosed. However, the first indoor air measurements were performed in 1992 and the second case was diagnosed only in 1993. It is thus possible that the first case did not belong to the etiological cluster. For comparison, we used incident cases from the age group 20-59 years from Eastern Finland. Most people in Finland start work at ages of 20-25 years and the average retirement age due (either to sickness or age) is currently 59 years. Whatever year limits were used, the fact remains that there was an unusual cluster of chronic inflammatory rheumatic diseases diagnosed within a short period of time. Moreover, the cases tended to accumulate among subjects working close to the wall that sustained the worst microbial damage.

There is evidence for familial clustering of different autoimmune diseases (10, 11) and coexistence of more than one autoimmune disease in the same individual (12). Indeed, it has been suggested that autoimmunity is a Mendelian dominant trait (10) and that other genes, including those in the major histocompatibility region, confer specificity for the phenotype. However, none of the subjects working at the office and diagnosed as having inflammatory rheumatic diseases were related.

There is increasing evidence pointing out that different rheumatic and related disease conditions can have risk factors in common. Smoking is an established risk factor for RA (13, 14), and it has also been associated with an increased risk for systemic lupus erythematosus (SLE) (15) and worsening of AS symptoms (16). Occupational exposure to silica has been associated with increased risk for RA (17) and SLE (18). Low serum antioxidant levels have been reported to be predictive for RA (19) and SLE (20). Case reports are accumulating, suggesting association of vaccinations with a number of rheumatic or related diseases, although the issue remains controversial (21).

RA and SLE are typically preceded by a long-lasting immunological process (22-24), and in AS the time period from the onset of first symptoms to the established diagnosis is frequently long. Likewise, SS is a slowly developing illness, and only a proportion of the subjects with vague symptoms may develop manifest disease. Thus, there is room for triggering factors operating at different levels of pathogenesis. Most likely, some agent in the office environment played a major role. There was water damage in the building, and the employees had been exposed to moulds as evidence by development of IgG antibodies (data not shown). Yet the role of moulds is at present elusive. Whatever the causative factor may be, keen epidemiological observations are needed to formulate hypotheses for further testing.

References

1. KAUFMAN LD, VARGA J: *Rheumatic Diseases and the Environment*. New York, Oxford University Press, Inc., 1999.
2. MILLER FW, HESS EV, CLAUW DJ *et al*.: Approaches for identifying and defining environmentally associated rheumatic disorders. *Arthritis Rheum* 2000; 43: 243-9.
3. O'BRIAN IM, BULL J, CREAMER B, SEPULVEDA R, HARRIES M, BURGE PS, PEPYS J: Asthma and extrinsic allergic alveolitis due to *Merulius lacrymans*. *Clin Allergy* 1978; 8: 535-42.
4. SIERTED HC, GRAVESEN S: Extrinsic allergic alveolitis after exposure to the yeast *Rhodotorula rubra*. *Allergy* 1993; 48: 298-9.
5. PHILLIPS MS, ROBINSON AA, HIGENBOTTAM TW, CALDER IM: Mushroom compost worker's lung. *J R Soc Med* 1987; 80: 674-7.
6. JOHARD U, EKLUND A, DAHLQVIST M, AHLANDER A, ALEXANDERSON R, EKHOLM U *et al*.: Signs of alveolar inflammation in non-smoking Swedish wood trimmers. *Br J Int Med* 1992; 49: 428-34.
7. SCHÖNHEYER H, ANDERSEN I, ANDERSEN P: Serum antibodies to *Aspergillus fumigatus* in patients with rheumatic diseases. *Saborau* -

dia 1983; 21: 149-57.
8. ARNETT FC, EDWORTHY SM, BLOCH DA *et al*.: The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum* 1988; 31: 315-24.
9. KAIPIAINEN-SEPPÄNEN O, AHO K: Incidence of chronic inflammatory rheumatic diseases in Finland in 1995. *J Rheumatol* 2000; 27: 94-100.
10. BIAS WB, REVEILLE JD, BEATY TH, MEYER DA,ARNETT FC: Evidence that autoimmunity in man is a Mendelian dominant trait. *Am J Hum Genet* 1986; 39: 584-602.
11. LIN J-P, CASH JM,DOYLE SZ *et al.*: Familial clustering of rheumatoid arthritis with other autoimmune diseases. *Hum Genet* 1998; 103: 475-82.
12. LORBER M, GERSHWIN ME, SHOENFELD Y: The coexistence of systemic lupus erythematosus with other autoimmune diseases:the kaleidoscope of autoimmunity. *Semin Arthri - tis Rheum* 1994; 24: 105-13.
13. HELIÖVAARA M,AHO K,AROMAA A,KNEKT P, REUNANEN A: Smoking and risk of rheumatoid arthritis. *J Rheumatol* 1993; 20: 1830-5.
14. WILSON K, GOLDSMITH CH: Does smoking cause rheumatoid arthritis ? *J Rheumatol* 1999; 26: 1-3.
15. HARDY CJ, PALMER BP, MUIR KR, SUTTON AJ, POWELL RJ: Smoking history, alcohol consumption, and systemic lupus erythematosus: A case-control study. *Ann Rheum Dis* 1998; 57: 451-5.
16. AVERNS HL, OXTOBY J, TAYLOR HG, JONES PW, DZIEDZIC K, DAWES PT: Smoking and outcome in ankylosing spondylitis. *Scand J Rheumatol* 1996; 25: 138-42.
17. KLOCKARS M, KOSKELA R-S, JÄRVINEN E, KOLARI PJ, ROSS A: Silica exposure and rheumatoid arthritis: a follow up study of granite workers 1940-81. *Br Med J* 1987; 294: 997-1000.
18. PARKS CG, COOPER GS, NYLANDER-FRENCH L *et al*.:Association between occupational exposure to crystalline silica and systemic lupus erythematosus. *Arthritis Rheum* 2000; 43 (Suppl): 130.
19. HELIÖVAARA M, KNEKT P, AHO K, AARON R-K,ALFTAN G, AROMAA A: Serum antioxidants and risk of rheumatoid arthritis. *Ann Rheum Dis* 1994; 53: 51-3.
20. COMSTOCK GW, BURKE AE, HOFFMAN SC *et al.*: Serum concentrations of alpha tocopherol, beta carotene and retinol preceding the diagnosis of rheumatoid arthritis and systemic lupus erythematosus. *Ann Rheum Dis* 1997; 56: 323-5.
21. SHOENFELD Y, ARON-MAOR A: Vaccination and autoimmunity – 'Vaccinosis':A dangerous liaison ? *J Autoimmun* 2000; 14: 1-10.
22. AHO K, PALOSUO T, KURKI P: Marker antibodies of rheumatoid arthritis:diagnostic and pathogenetic implications. *Semin Arthritis Rheum* 1994; 23: 379-87.
23. AHO K, KOSKELA P, MÄKITALO R, HELIÖ-VAARA M, PALOSUO T: Antinuclear antibodies heralding the onset of systemic lupus erythematosus. *J Rheumatol* 1992; 19: 1377-9.
24. ARBUCKLE MR, DENNIS GJ, NEAS BR, JAMES JA, HARLEY JB: Autoantibodies are commonly present before the onset of clinical illness in lupus. *Arthritis Rheum* 1999; 42 (Suppl): 383.