

Cardiac Involvement in Granulomatosis with Polyangiitis

Lucy McGeoch, Simon Carette, David Cuthbertson, Gary S. Hoffman, Nader Khalidi, Curry L. Koenig, Carol A. Langford, Carol A. McAlear, Larry Moreland, Paul A. Monach, Philip Seo, Ulrich Specks, Steven R. Ytterberg, Peter A. Merkel, and Christian Pagnoux, for the Vasculitis Clinical Research Consortium

ABSTRACT. Objective. To determine frequency and outcomes of granulomatosis with polyangiitis (GPA)–related cardiac disease in a North American GPA cohort.

Methods. Analysis was done of all patients in the Vasculitis Clinical Research Consortium Longitudinal Study of GPA. Demographic and clinical characteristics of patients with and without GPA-related cardiac involvement were compared.

Results. Of 517 patients with GPA, 3.3% had cardiac involvement. No differences were observed between patients with or without cardiac involvement in terms of demographics, antineutrophil cytoplasmic antibody positivity, or relapse rate.

Conclusion. Cardiac involvement in GPA is rare and heterogeneous. In this cohort, cardiac involvement was not associated with a higher rate of relapse or premature death. (J Rheumatol First Release May 1 2015; doi:10.3899/jrheum.141513)

Key Indexing Terms:

CARDIAC DISEASE

GRANULOMATOSIS WITH POLYANGIITIS

VASCULITIS

The clinical presentation of granulomatosis with polyangiitis (GPA; previously Wegener granulomatosis) is heterogeneous, and while involvement of the upper and lower respiratory tract and kidneys is typical, any organ system can be affected. Cardiac involvement in GPA has long been regarded as rare, yet a wide spectrum of abnormalities have been reported, including pericarditis, myocarditis, valvular lesions, coronary arteritis, and conduction system defects, with prevalence figures ranging from 5–90% of patients depending on the series and diagnostic methods applied^{1,2,3,4,5}.

The significance of cardiac involvement in GPA, besides being potentially life threatening, has been highlighted in some cohort studies. The European Vasculitis Study Group

determined that cardiovascular involvement [5.7% of 535 newly diagnosed patients with GPA, microscopic polyangiitis (MPA), or renal-limited vasculitis] was an independent risk factor for disease relapse¹. In the study by Koldingsnes and Nossent⁶, involving 56 Norwegian patients with GPA, 20% had cardiac involvement, and cardiac involvement was among several factors associated with an increased risk of initial treatment resistance and disease relapse. Similarly, the French Vasculitis Study Group, using multivariate analysis in a large cohort of patients with GPA and MPA, found that cardiac involvement was a risk factor for poor overall prognosis and increased relapse^{2,7}. However, in all of these studies, the precise nature of the

From the Division of Rheumatology, Mount Sinai Hospital, Toronto, Ontario, Canada; Health Informatics Institute, University of South Florida, Tampa, Florida; Center for Vasculitis Care and Research, Cleveland Clinic, Cleveland, Ohio, USA; Division of Rheumatology, McMaster University, Hamilton, Ontario, Canada; Division of Rheumatology, University of Utah, Salt Lake City, Utah; Division of Rheumatology, University of Pennsylvania, Philadelphia; Division of Rheumatology, University of Pittsburgh, Pennsylvania; The Vasculitis Center, Section of Rheumatology, and the Clinical Epidemiology Unit, Boston University School of Medicine, Boston, Massachusetts; Division of Rheumatology, Johns Hopkins University, Baltimore, Maryland; Division of Pulmonary and Critical Care Medicine, and the Division of Rheumatology, Mayo Clinic College of Medicine, Rochester, Minnesota, USA.

Sponsored by the Vasculitis Clinical Research Consortium, which has received support from the US National Institute of Arthritis and Musculoskeletal and Skin Diseases (U54AR057319 and U01 AR51874 04), the US National Center for Research Resources (U54 RR019497), and the US Office of Rare Diseases Research.

L. McGeoch, MD; S. Carette, MD, Division of Rheumatology, Mount Sinai

Hospital; D. Cuthbertson, MS, Health Informatics Institute, University of South Florida; G.S. Hoffman, MD, Center for Vasculitis Care and Research, Cleveland Clinic; N. Khalidi, MD, Division of Rheumatology, McMaster University; C.L. Koenig, MD, Division of Rheumatology, University of Utah; C.A. Langford, MD, Center for Vasculitis Care and Research, Cleveland Clinic; C.A. McAlear, MA, Division of Rheumatology, University of Pennsylvania; L. Moreland, MD, Division of Rheumatology, University of Pittsburgh; P.A. Monach, MD, PhD, The Vasculitis Center, Section of Rheumatology, and the Clinical Epidemiology Unit, Boston University School of Medicine; P. Seo, MD, Division of Rheumatology, Johns Hopkins University; U. Specks, MD, Division of Pulmonary and Critical Care Medicine; S.R. Ytterberg, MD, Division of Rheumatology, Mayo Clinic College of Medicine; P.A. Merkel, MD, MPH, Division of Rheumatology, University of Pennsylvania; C. Pagnoux, MD, MSc, MPH, Division of Rheumatology, Mount Sinai Hospital.

Address correspondence to Dr. C. Pagnoux, Mount Sinai Hospital, Division of Rheumatology, 60 Murray St., Suite 2-220, Toronto, Ontario M5T 3L9, Canada. E-mail: cpagnoux@mtsinai.on.ca

Accepted for publication March 5, 2015.

cardiovascular involvement and the diagnostic tools used were not specified.

We conducted our study to determine the prevalence and nature of cardiac manifestations in patients with GPA followed within a multicenter longitudinal cohort in North America.

MATERIALS AND METHODS

The data source was the Vasculitis Clinical Research Consortium (VCRC) Longitudinal Study of GPA and MPA. The VCRC is part of the Rare Diseases Clinical Research Network, funded by the US National Institutes of Health. Since 2006, the VCRC has conducted a series of observational longitudinal studies of patients with various systemic vasculitides in vasculitis centers in the United States and Canada. The VCRC database includes demographic, clinical, laboratory, and radiological data collected prospectively every 3 to 12 months on all enrolled patients.

Between May 2006 and January 2013, 517 patients with a diagnosis of GPA according to the modified American College of Rheumatology criteria⁸ were enrolled in 9 North American centers. For our study, patients with GPA were considered to have had cardiac manifestations if they had any documented history of cardiac disease deemed by the VCRC investigator to be secondary to GPA at any point over the course of their illness. VCRC investigators were contacted as needed to validate the cardiac GPA diagnosis and/or to obtain more information regarding the presentation and diagnostic tests used.

Patients with and without a history of cardiac involvement secondary to GPA were compared in terms of demographic variables, ANCA status, disease associations, and outcomes (relapses and deaths).

Comparisons between groups were done by means of 2 sample t tests for numerical data and chi-squared or Fisher’s exact test for binary datasets. Statistical analyses were performed using Minitab Statistical Software, version 16.1⁹.

RESULTS

Patient identification and characteristics. Mean disease duration, as of January 2013, for the 517 patients with GPA was 106 ± 71 months (median 94 mos, range 2–399 mos); 55 (11%) were enrolled within the first 3 months following the diagnosis of GPA.

There were 17 patients (3.3% of the total GPA cohort) documented to have had cardiac manifestations deemed secondary to GPA, and 16 of them had documented cardiac involvement prior to enrollment into the VCRC Longitudinal Study. Patient demographics are listed in Table 1. Nine patients had cardiac involvement as part of their initial presentation of GPA and 7 during disease relapses predating enrollment into the VCRC; the mean time from diagnosis to study enrollment for those 7 patients was 7.4 years (range, 1–18 yrs). Only 1 patient developed cardiac involvement during a disease relapse following study enrollment.

Cardiac manifestations and diagnostic methods. Pericarditis was the most common cardiac manifestation (n = 6, 35%), followed by cardiomyopathy (n = 5, 30%), coronary artery disease (CAD; n = 2, 12%), valvular disease (n = 1, 6%), concomitant CAD and valvular disease (n = 1, 6%), concomitant pericarditis and cardiomyopathy (n = 1, 6%), and severe conduction disorder (n = 1, 6%).

All patients with cardiac involvement presented with

Table 1. Demographics and disease manifestations of patients with granulomatosis with polyangiitis (GPA) with and without cardiac involvement.

Demographics	GPA with Cardiac Involvement	GPA without Cardiac Involvement	p
Total, n	17	500	
Female, n (%)	7 (41)	262 (52)	0.36
Mean age at diagnosis, yrs (± SD)	43.7 (16.5)	45.9 (20.3)	0.70
Race, n (%)			0.24
White	17 (100)	442 (88)	
Nonwhite*	0	58 (12)	
Time from symptom onset to diagnosis, mos (± SD)	21 (28)	14 (36)	0.48
Duration of followup, mos (± SD)	97 (67)	106 (71)	0.68
ANCA-positive, n (%)**	16 (94)	407 (81)	0.33
Anti-PR3-positive, n (%)#	11 (65)	338 (68)	0.68
Any history of flare†	9 (53)	325 (65)	0.31
Disease manifestations			
Constitutional	14 (82)	400 (80)	1.0
Musculoskeletal	10 (59)	334 (67)	0.49
Skin	8 (47)	158 (32)	0.12
Mucus membranes	1 (6)	57 (11)	1.0
Eyes	1 (6)	163 (33)	0.03
Ear, nose, and throat	13 (76)	431 (86)	0.28
Lung	14 (82)	351 (70)	0.42
Gastrointestinal	0	7 (1)	1.0
Kidney involvement	10 (69)	275 (55)	0.55
Nervous system involvement	4 (24)	109 (22)	0.76

* Asian/Black/African American/Unknown race/mixed race or American Indian/Native Alaskan. ** Antineutrophil cytoplasmic antibody (ANCA), including cytoplasmic ANCA or perinuclear ANCA. # Antiproteinase 3 antibody. †Any history of flare defined as disease activity after a period of remission, either prior to enrollment in the Vasculitis Clinical Research Consortium (VCRC) or during subsequent VCRC followup.

cardiorespiratory symptoms including chest pain, palpitations, syncope, or dyspnea. None of these manifestations were identified through routine cardiac investigations in asymptomatic patients. Diagnostic methods varied over time and between centers and included electrocardiogram, cardiac enzymes, transthoracic echocardiogram, thoracic computerized tomography, cardiac magnetic resonance imaging (MRI), and coronary angiography.

Association of cardiac manifestations with other disease manifestations. The characteristics of patients with and without cardiac involvement and the frequencies of their noncardiac manifestations were comparable (Table 1), except for eye manifestations, which were observed less frequently in the patients with GPA with cardiac involvement.

Treatment and outcomes. There were no differences between patients with and without cardiac involvement with regard to treatment with cyclophosphamide (CYC): 71% (n = 12) of patients with cardiac involvement versus 72% (n = 360) of those without cardiac involvement received this drug over

the course of their disease ($p = 1.0$). Of the 5 patients with GPA with cardiac involvement who did not receive CYC, the cardiac manifestations included pericarditis ($n = 2$), CAD ($n = 1$), CAD with valvular disease ($n = 1$), and cardiomyopathy with concomitant pericarditis ($n = 1$); none of these patients received rituximab (RTX), 2 received only glucocorticoids throughout their disease course, and 3 received at least 1 of methotrexate, azathioprine, or mycophenolate mofetil. There was no difference in the proportion of patients treated with RTX: 18% of the group with cardiac disease compared to 17% of the noncardiac disease group ($p = 1.0$). There was no difference in relapse rates between the 2 groups; 53% ($n = 9$) of the cardiac disease group had 1 or more relapses throughout the course of their disease compared to 65% ($n = 325$) of the noncardiac GPA group ($p = 0.31$). Similarly, there was no difference in mortality between the 2 groups; death was reported in 2% ($n = 12$) of the group without cardiac involvement and none of the GPA patients with cardiac involvement ($p = 1.0$).

DISCUSSION

In this large cohort of patients with GPA, cardiac involvement occurred in 3.3%. There were no obvious specific associations of cardiac disease with other disease manifestations and no difference in outcomes, compared to patients with no cardiac involvement.

The frequency of cardiac involvement observed in this cohort is comparable to that reported by the European Vasculitis Study Group¹ (5.7%) but notably lower than that reported by the French group (clinically evident cardiac disease was seen in 13% of patients with GPA)². Possible reasons for these differences include the heterogeneity of the cohorts, the definition of cardiac manifestations, and the diagnostic methods used. In our current study, the diagnosis of cardiac involvement in GPA was based on clinical, echocardiography, or electrocardiogram findings. With the emergence of readily available cardiac MRI, higher rates of subclinical cardiac involvement are likely to be observed; the clinical significance of these rates remains to be determined as does the appropriateness of performing these investigations in asymptomatic patients.

In contrast with previous European reports, cardiac involvement was not associated in this North American population with a higher rate of mortality or relapse of vasculitis. This finding may in part be explained by the lower frequency of cardiac manifestations observed in the VCRC cohort, thereby limiting statistical power. It is also possible that the global outcomes of patients with GPA have improved over the past decades, with more individually tailored therapeutic regimens and the more systematic use of potent agents such as CYC and RTX¹⁰.

A significant strength of our study is the large number of patients with GPA included in the cohort, the protocolized nature of data collection at expert centers, and the validation

of specific details of each patient's history from the treating VCRC investigator, as needed.

Our study had some limitations, including the non-uniform imaging modalities used in each participating center and the absence of systematic collection of electrocardiographic or echocardiographic data. It is also noteworthy that all cardiac manifestations, with the exception of 1, occurred prior to the patients being enrolled in the study.

The longterm followup and study of late cardiovascular complications in patients with GPA was not a specific endpoint of this study. Such late complications are likely more common in GPA than in the general population, as highlighted by a review of a Danish National Hospital register in which patients had an increased rate of myocardial infarction within 5 years of diagnosis of GPA when compared to the general population¹¹. This finding was further substantiated by another European retrospective study demonstrating an increased incidence of vascular events in patients with GPA and MPA when matched for renal function and other conventional cardiovascular risk factors¹². Further longterm observation of the ongoing VCRC cohorts will likely provide additional information on these cardiovascular complications of patients with systemic vasculitis.

GPA-related cardiac manifestations are rare and heterogeneous, with pericarditis being the most frequent. In this cohort, cardiac involvement was not associated with poorer outcomes, possibly as a result of aggressive treatment and close monitoring within vasculitis-specialized centers.

REFERENCES

- Walsh M, Flossmann O, Berden A, Westman K, Hoglund P, Stegeman C, et al. Risk factors for relapse of antineutrophil cytoplasmic antibody-associated vasculitis. *Arthritis Rheum* 2012;64:542-8.
- Guillemin L, Pagnoux C, Seror R, Mahr A, Mouthon L, Toumelin PL. The five-factor score revisited: assessment of prognoses of systemic necrotizing vasculitides based on the French Vasculitis Study Group (FVSG) cohort. *Medicine* 2011;90:19-27.
- Miszalski-Jamka T, Szczeklik W, Sokolowska B, Miszalski-Jamka K, Karwat K, Grzadziel G, et al. Cardiac involvement in Wegener's granulomatosis resistant to induction therapy. *Eur Radiol* 2011;21:2297-304.
- Morelli S, Gurgo Di Castelmenardo AM, Conti F, Sgreccia A, Alessandri C, Bernardo ML, et al. Cardiac involvement in patients with Wegener's granulomatosis. *Rheumatol Int* 2000;19:209-12.
- Oliveira GH, Seward JB, Tsang TS, Specks U. Echocardiographic findings in patients with Wegener granulomatosis. *Mayo Clin Proc* 2005;80:1435-40.
- Koldingsnes W, Nossent JC. Baseline features and initial treatment as predictors of remission and relapse in Wegener's granulomatosis. *J Rheumatol* 2003;30:80-8.
- Pierrot-Deseilligny Despujol C, Pouchot J, Pagnoux C, Coste J, Guillevin L. Predictors at diagnosis of a first Wegener's granulomatosis relapse after obtaining complete remission. *Rheumatology* 2010;49:2181-90.
- Leavitt RY, Fauci AS, Bloch DA, Michel BA, Hunder GG, Arend WP, et al. The American College of Rheumatology 1990 criteria for the classification of Wegener's granulomatosis. *Arthritis Rheum* 1990;33:1101-7.

9. Minitab 16.1 Statistical Software [computer software]. State College, Pennsylvania: Minitab Inc.
10. Holle JU, Dubrau C, Herlyn K, Heller M, Ambrosch P, Noelle B, et al. Rituximab for refractory granulomatosis with polyangiitis (Wegener's granulomatosis): comparison of efficacy in granulomatous versus vasculitic manifestations. *Ann Rheum Dis* 2012;71:327-33.
11. Faurschou M, Mellemkjaer L, Sorensen IJ, Svalgaard Thomsen B, Dreyer L, Baslund B. Increased morbidity from ischemic heart disease in patients with Wegener's granulomatosis. *Arthritis Rheum* 2009;60:1187-92.
12. Morgan MD, Turnbull J, Selamet U, Kaur-Hayer M, Nightingale P, Ferro CJ, et al. Increased incidence of cardiovascular events in patients with antineutrophil cytoplasmic antibody-associated vasculitides: a matched-pair cohort study. *Arthritis Rheum* 2009;60:3493-500.