Noninfectious Ascending Aortitis: A Case Series of 64 Patients

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ABSTRACT. *Objective.* To identify the clinical presentation and histopathologic characteristics of noninfectious ascending aortitis.

Methods. A retrospective medical record and histopathology review was performed of patients with histologic evidence of active noninfectious aortitis who underwent ascending aortic aneurysm resection at Mayo Clinic between January 1, 2000, and February 28, 2006. Clinicopathologic features were recorded, including demographics, clinical presentation, laboratory, imaging findings, histopathology, complications, treatment, and outcome.

Results. Sixty-four patients (50% women) were identified; the majority were Caucasian (83%) and elderly (mean age 69.1 yrs). Upon initial presentation, 45% had aneurysm-related symptoms, 33% were asymptomatic, 12.5% had constitutional symptoms, 4.7% had symptoms referable to cranial arteries, and 9.4% had polymyalgia rheumatica (PMR) symptoms. The majority (81%) were of "isolated" variant, with no rheumatologic history. Mean preoperative erythrocyte sedimentation rate was 16.2 ± 23.3 mm/h (n = 20). Additional vascular imaging abnormalities were present in 72% of patients, including stenoses and/or ectasia of major aortic branches and descending thoracic or abdominal aneurysms. Giant cells were seen in 71.9%. Median followup time was 15.4 months, during which 6 (9.4%) patients died. Only 22 (34%) patients received corticosteroids, with uncertain effect on development of recurrent aneurysms, rupture, or dissections.

Conclusion. Noninfectious ascending aortitis frequently occurs even in the absence of history, symptoms, or signs of giant cell arteritis (GCA) or PMR. When discovered, such patients should be followed closely, as a majority have additional vascular abnormalities. More studies are needed to determine optimal strategies for surveillance, detection, and treatment of ascending aortitis, which may represent a clinical entity distinct from classical GCA. (First Release Aug 1 2009; J Rheumatol 2009;36:2290–7; doi:10.3899/jrheum.090081)

Key Indexing Terms:
AORTITIS   GIANT CELLS   THORACIC AORTIC ANEURYSM   VASCULITIS

Aortitis is known to occur in a variety of vasculitides and connective tissue diseases, such as giant cell arteritis (GCA)[1,2], Takayasu arteritis[3,4], rheumatoid arthritis (RA)[5], and spondyloarthropathies[6,7], among others[8]. Large-artery

complications, including aneurysms due to giant cell aortitis, are detected in about 18%–27% of patients with a history of GCA[9,10].

Aortitis may also occur in patients without classical symptoms of GCA and is often diagnosed incidentally following ascending aneurysm repair, especially among elderly people[11]. Histologically, ascending aortitis is usually characterized by the presence of giant cells and/or lymphoplasmacytic infiltrates, granulomas, and laminar medial necrosis[11].

An increasing number of asymptomatic individuals with incidental idiopathic ascending aortitis have been seen at our institution over the past 6 years, likely related to a heightened awareness among vascular pathologists, an increase in ascending aortic repairs (including among the elderly), and an increase in the use of vascular imaging techniques for a variety of indications detecting incidental ascending aortic aneurysms. Yet little is known about the frequency of this entity or the clinical characteristics, including mortality, of these patients. The purpose of our study was to identify the clinical characteristics of patients

with noninfectious ascending aortitis and the histopathologic features of this condition.

MATERIALS AND METHODS

Identification of study subjects. A total of 766 ascending thoracic aneurysm surgical repairs were performed at Mayo Clinic Rochester from January 1, 2000, until February 28, 2006. These thoracic aneurysm surgical reports were cross-indexed with the Mayo Clinic pathology database, which was searched using the Systematized Nomenclature of Medicine (SNOMed) codes for organ site: "aorta" and diagnosis: "aortitis." All thoracic aortic aneurysm specimens are sent for pathologic review, allowing virtually complete ascertainment of all consecutive cases of aortitis at our institution (Figure 1).

Seventy-six cases of aortitis were identified during the study. Twelve patients were excluded; 7 had infectious aortitis (2 tuberculosis, 1 syphilis, 2 bacterial infections, 1 human immunodeficiency virus, 1 histoplasmosis), 4 were excluded after the pathology specimen was reclassified as "not aortitis," and 1 had old, inactive (healed) aortitis.

Data collection. We performed a retrospective medical record review of 76 consecutive cases of patients diagnosed with microscopic evidence of aortitis on surgical specimens obtained during ascending aortic aneurysm resection. Clinicopathologic features were recorded, including demographics, clinical presentation, laboratory and imaging findings, histopathology, complications, treatment, and outcome.

A cardiovascular pathologist (DVM) re-reviewed the histopathology of all cases and systematically evaluated the following findings: atherosclerosis; activity (graded 1–3 for mild to severe); adventitial predominant inflammation pattern; necrosis pattern; width of intima, media, and adventitia; giant cells; laminar medial necrosis; and medial degeneration.

Statistical analysis of data. Descriptive statistics were used to summarize patient demographics, signs, and symptoms at clinical presentation, laboratory and imaging findings, characteristics of aortic histopathology, treatment, and survival.

Differences in clinical characteristics between subsets of patients with different pathologic findings were tested using the chi-squared test for categorical variables and the t test for continuous variables.

The following clinical features were correlated with specific histopathologic features using Spearman methods: age at surgery; sex; ethnicity; cranial GCA symptoms; constitutional symptoms; polymyalgia rheumatica (PMR) symptoms; cardiovascular (CV) symptoms (e.g., chest pain, dyspnea); asymptomatic at presentation; abnormal vascular examination; aortic aneurysm with myocardial infarction (MI), cerebrovascular accident (CVA) or thromboembolism (TE); preoperative erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP); postoperative ESR and CRP; temporal artery biopsy positivity; giant cell aortitis; diagnostic imaging and findings; use of corticosteroids or other immunosuppressive therapy; previous CV surgery; coronary artery bypass grafting (CABG); and history of GCA, PMR, or other rheumatologic conditions.

RESULTS

Study group. Sixty-four cases of active, noninfectious aortitis were analyzed, representing 8.4% of all ascending thoracic aneurysm repairs performed during the study period.

Patient demographics. The majority of patients (53/64 = 82.8%) were Caucasian; the rest were of other (4/64 = 6.2%) or of unknown (7/64 = 11%) ethnicity/race. The majority of patients were elderly (mean age 69.1 ± 11.7 yrs). The male:female distribution was equal (50:50).

Clinical presentation. Symptoms at presentation are contained in Figure 2. As shown, the majority had only aneurysm-related symptoms including chest pain, dyspnea, or back pain (45.3%) or were asymptomatic, with incidentally discovered aneurysm on chest radiograph or echocardiography (32.8%). The majority (52/64 = 81.3%) of aortitis cases were of "isolated" variant, with no history of rheumatologic diseases. The remaining cases included a history of GCA (5/64 = 7.8%), PMR without GCA (5/64 = 7.8%), inflammatory arthritis (n = 1), and Crohn's disease (n = 1).

Peripheral vascular examination revealed abnormalities in 11/64 = 17.2% (mostly related to diminished pedal pulses), but only 1 patient had abnormal temporal artery findings (tenderness).

Imaging findings. Fifty-seven patients underwent vascular imaging, generally computed tomography (CT) angio-
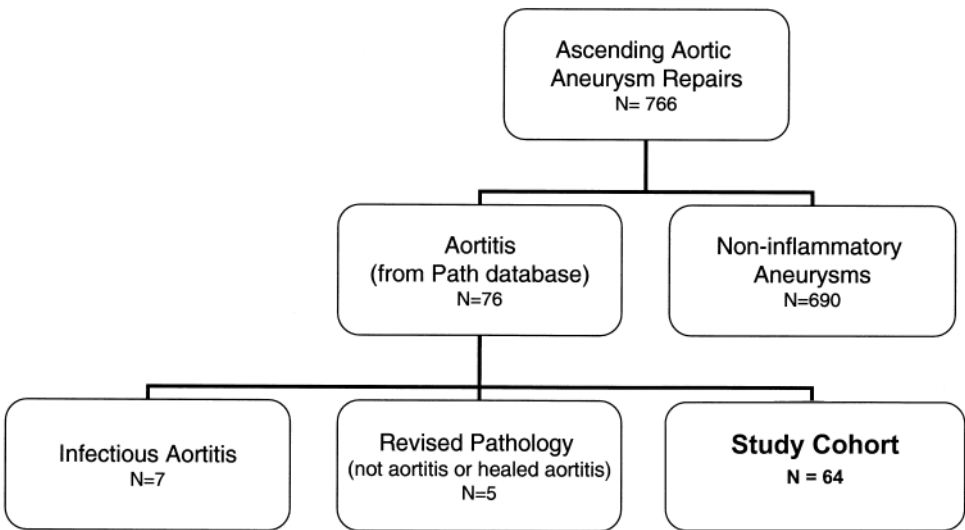

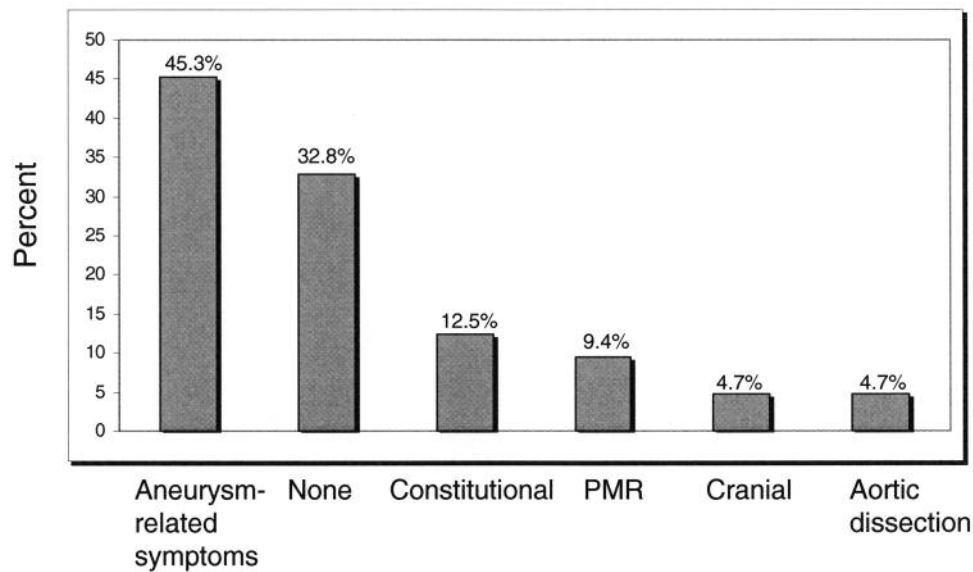*Figure 1*. The study group. Path: pathology.

Figure 2. Initial clinical presentation: 45.3% had aneurysm-related symptoms (chest pain, dyspnea, or back pain); 32.8% were asymptomatic (incidentally discovered aneurysm on chest radiograph or echo); 12.5% had constitutional symptoms (fevers, weight loss, malaise, or anorexia); 9.4% had polymyalgia rheumatica (PMR) symptoms; 4.7% had symptoms referable to the cranial arteries (headache, jaw claudication, diplopia, or blindness); and 4.7% had aortic dissection at presentation.

graphy and magnetic resonance (MR) angiography. Additional vascular abnormalities (other than ascending aortic aneurysm) were present in 41/57 = 72% (Figure 3). Figure 4 shows the MR angiogram of one patient who had stenoses of bilateral subclavian arteries, and the CT angiogram of another patient who had diffuse aneurysmal disease of the thoracic aorta and extending into the upper abdominal aorta.

Temporal artery biopsies (TAB) were performed in 6 patients, 4 preoperatively and 2 postoperatively, at the discretion of the consulting rheumatologist. Of the 4 who had preoperative TAB, 3 had findings of temporal arteritis; all 3 patients had a history of classic GCA. The biopsies were normal in the 2 patients who underwent postoperative TAB. Neither of these 2 patients had a history of GCA or PMR.

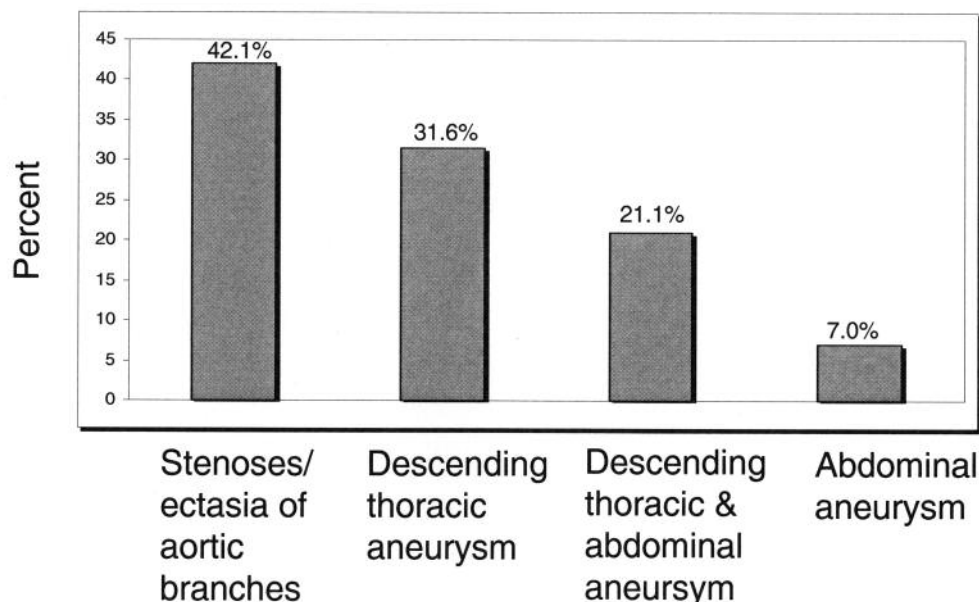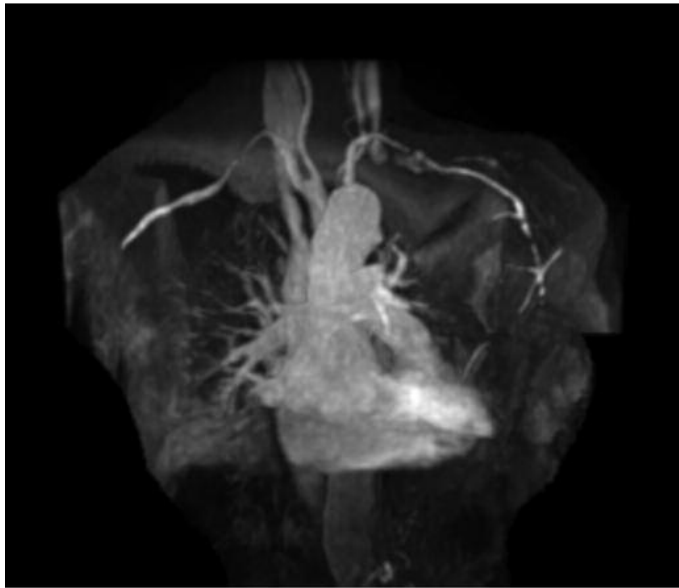*Histopathology of the aorta*. Giant cells were noted in 46/64

Figure 3. Vascular abnormalities. Among 57 patients who had vascular imaging, 41 (72%) had additional abnormalities: 42.1% stenoses and/or ectasia of the major aortic branches; 31.6% descending thoracic aneurysm; 21.1% descending thoracic and abdominal aneurysms; and 7.0% abdominal aneurysms.

Figure 4. Imaging. A. MR angiogram of the thoracic and abdominal aorta with and without gadolinium showing circumferential aortic wall-thickening measuring 4 mm within the mid and distal descending thoracic aorta, mild long-segment stenosis of the proximal right subclavian artery, and high-grade stenosis in the proximal left subclavian artery, as well as stenosis in the region of the left subclavian-axillary junction. Mid-descending thoracic aorta measures 3.5 cm luminal diameter and 3.0 cm at the aortic hiatus. B. CT angiogram using intravenous contrast with sagittal, coronal, and 3-D reformatted images of a patient showing diffuse tortuous aneurysmal disease of the thoracic aorta, with extension into the upper abdominal aorta. The greatest transverse diameters measured 6.3 cm at the mid-ascending thoracic aorta, 6.2 cm at the mid-descending thoracic aorta, 4.8 cm at the distal third of the thoracic aorta, and 4.0 cm at the upper abdominal aorta, which also had aneurysmal dilatation. The innominate artery was ectatic and measured 2 cm in maximum diameter.

= 71.9% of aortic specimens. The remainder showed lymphoplasmacytic inflammation without giant cells (Figure 5). In all included specimens, there was no evidence of infection (endocarditis or ring abscess) on histopathology. Five of the 64 patients did not have detailed pathologic specimen reevaluation, due to lack of full-thickness specimens. Table 1 summarizes the findings of detailed pathologic review of the remaining 59 subjects. Atherosclerosis was present in only about one-third (33.9%) of the specimens. Mild inflammatory activity was present in 42.4%, moderate activity in 40.7%, and severe activity in 16.9%. The vast majority of subjects did not have adventitial predominant inflammation (88.1%) or necrosis pattern (93.2%). Table 1 also summarizes the results of the width of intima, media, and adventitia; number of giant cells; laminar medial necrosis; and medial degeneration among the 59 aortic specimens. Thickness of the various layers of the aortic wall is a method

of assessing inflammation, as inflammation in the aortic wall results in loss of smooth muscle and replacement with fibrosis. Hence, the thicker the layer, the more inflammation has been present.

Laboratory. The mean preoperative ESR, available in 20 patients, was 16.2 ± 23.3 mm/h (range 0–102 mm/h). ESR was elevated in only 2 patients; the other 18 had ESR ≤ 25 mm/h.

Treatment. Only 22/64 = 34.4% patients received postoperative corticosteroids; and 5 of these received additional immunosuppressive medications (azathioprine, methotrexate, mycophenolate mofetil, infliximab). The proportion of patients receiving corticosteroids did not differ between the group with giant cells on histopathology and the group with lymphoplasmacytic inflammation. Although numbers were small, the majority of patients who presented with cranial
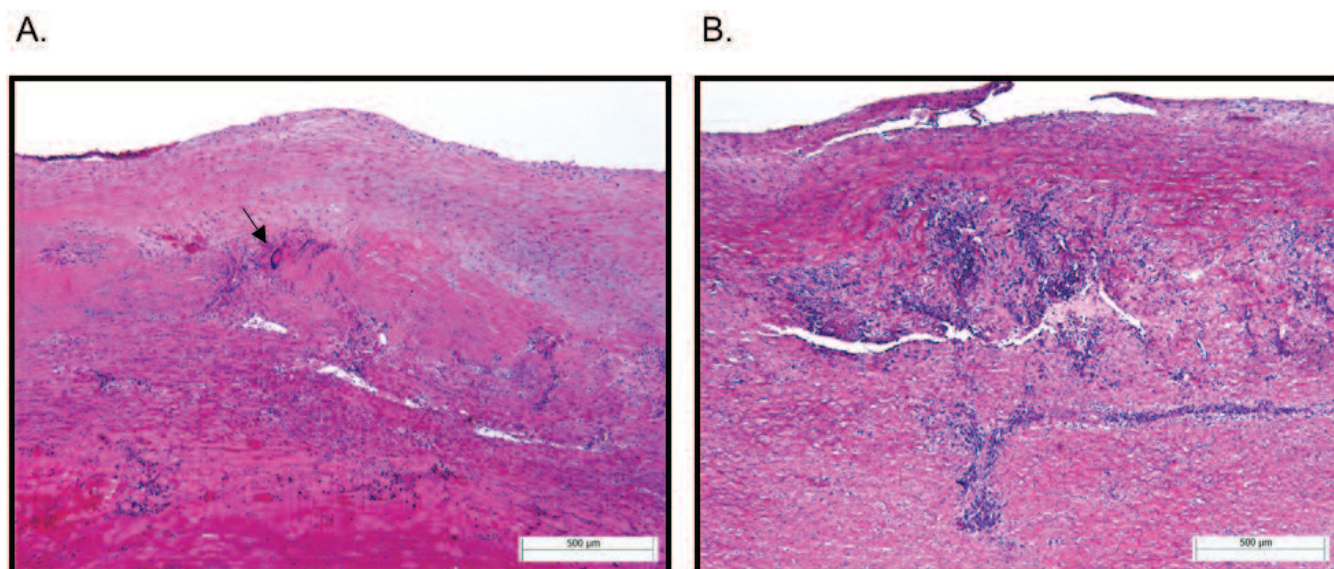
Figure 5. Histopathology: photomicrographs of noninfectious ascending aortitis from thoracic aneurysm specimens. A. Giant cell aortitis, showing focal medial destruction and medial multinucleated giant cells (arrow). B. Lymphoplasmacytic aortitis, showing patchy medial infiltrates of lymphocytes, plasma cells, and histiocytes (H&E stains).

Table 1. Histopathologic features of aortic specimens.

Pathologic Finding	Feature Present, n (%) N = 59
Atherosclerosis	20 (33.9)
Inflammatory activity	
Mild	25 (42.4)
Moderate	24 (40.7)
Severe	10 (16.9)
Adventitial predominant inflammation pattern	7 (11.9)
Necrosis pattern	4 (6.8)
	Mean ± SD n = 59
Intima, μm	665.9 ± 296.6
Media, μm	1373 ± 417.7
Adventitia, μm	1176 ± 856.3
Giant cells, no. per specimen	1.66 ± 1.51
Laminar medial necrosis, %	59.4 ± 29.8
Medial degeneration, %	33.8 ± 27.2

SD: standard deviation.

GCA symptoms were treated with corticosteroids. In contrast, out of the 61 patients without cranial GCA symptoms at presentation, only 20 patients (32.8%) were treated with corticosteroids, based on the discretion of the rheumatologist. Treatment with corticosteroids did not differ significantly between those with or without constitutional or PMR symptoms at presentation (data not shown). Out of the 41 patients with additional vascular abnormalities on imaging, only 12 were treated with corticosteroids. The use of corticosteroids was determined by the treating rheumatologist.

Among the 22 patients who received corticosteroid therapy, 1 patient (4.5%) died. Among the 42 patients who did not receive corticosteroid therapy, 5 patients (11.9%) died.

Correlation between clinical and histopathologic features. Comparing the clinical features in those with and without atherosclerosis on histopathology, we found the following: subjects with giant cell aortitis were less likely to have atherosclerosis on pathology (55% vs 84.6%; p = 0.013). Importantly, there were no significant differences in the proportion of subjects with atherosclerosis on pathology among those with additional vascular imaging abnormalities (stenoses, ectasia, descending thoracic aneurysms, and abdominal aortic aneurysms) versus those without these findings. As expected, those who had CABG performed were more likely to have ascending aortic atherosclerosis than those without CABG (50% vs 20.5%; p = 0.020). Those who presented with CV symptoms (13/20) were more likely to have atherosclerosis on pathology than those who did not present with CV symptoms (7/20; 65% vs 35%; p = 0.020).

Comparing the clinical features of those with mild, moderate, and severe activity on histopathology, there were no significant differences in activity between those with and without additional vascular abnormalities on imaging. We were also unable to detect a difference in most clinical features between those with and without adventitial predominant inflammation or between those with and without necrosis on histopathology. However, patients with adventitial predominant inflammation of the aorta were more likely to present with cranial GCA symptoms (2/5, 28.6%) versus those without adventitial predominant inflammation (1/52, 1.9%; p = 0.003).

Complications and outcomes. Median clinical followup time was 15.4 months (interquartile range 5.0, 28.5 mo), during which 6 (9.4%) patients died. Of the 6 who died, 1

patient died in the immediate postoperative period of a large stroke, and the other 5 patients died of other or unknown causes. Most patients had insufficient followup to evaluate subsequent vascular complications such as recurrent aneurysms, rupture, or dissections.

DISCUSSION

Although noninfectious ascending aortitis is known to occur in a variety of rheumatic diseases[8], there has increasingly been recognition of isolated idiopathic noninfectious ascending aortitis, incidentally discovered at the time of histopathologic review of resected thoracic aneurysm specimens. This entity may represent a form of single-organ vasculitis, with vasculitis isolated to the aorta. Alternatively, it may represent unrecognized late complications of large-vessel vasculitis such as GCA or Takayasu arteritis discovered incidentally. Of importance, in contrast to aortitis occurring in the setting of other rheumatic diseases and systemic vasculitides, patients are typically asymptomatic[12]. It has been suggested that isolated aortitis may be potentially cured by surgical resection alone; the value of corticosteroid or other immunosuppressive treatment is uncertain[11,12]. Because of the uncertain benefits of corticosteroid or other immunosuppressive treatment, and the known risks of these drugs, there is a wide variability in rheumatologists' practice patterns in managing this condition, but overall only a minority of such patients are treated. An understanding of the potential effects of treatment (if any) and natural history of this condition, including vascular outcomes and mortality, is critical.

Understanding of this disease entity is hampered by the lack of definitive epidemiologic and treatment studies, and lack of any standardized approach to the diagnostic techniques that should be employed to follow these patients in the long term. It has only been in the last several years that vascular imaging modalities such as CT and MR angiography, and in selected cases, positron emission tomography have been utilized to better assess the extent of vascular involvement in patients with incidentally discovered aortitis. Our case series, one of the largest to date (64 cases), is an attempt to address some of these issues, describing the clinicopathologic features of this condition, with potentially hypothesis-generating information regarding clinical features, vascular imaging findings, treatment, and survival in such patients. We also analyzed whether clinical features in these patients are associated with specific histopathologic findings on the aortic specimen.

The largest studies to date of incidental idiopathic aortitis have been retrospective chart and pathology reviews of aortic surgical specimens[11,13-16]. In all the reviews, the majority of patients were elderly women. In our study, most were elderly, but the female/male distribution was equal.

Rojo-Leyva, et al[13] reported the frequency of idiopathic aortitis to be 4.3% in a retrospective review of 1204 aortic specimens. In 96% of patients with idiopathic aortitis, there were no systemic symptoms at the time of aneurysm surgery, and only 31% of patients had aortitis associated with history of vasculitis, connective tissue diseases, or other systemic disorders. Recurrent aneurysms were not identified among 11 corticosteroid-treated patients, while new aneurysms were found in 6 of 25 patients who were not treated.

Kerr, et al[14] found 19 cases (a frequency of 1.8%) of incidental giant cell aortitis in a retrospective review of 1069 aortic aneurysm specimens. None had symptoms referable to the cranial arteries. Out of 17 cases of ascending aortic aneurysms, none received corticosteroids. There were 2 sudden deaths.

Miller, et al[11] recorded 45 cases (frequency of 8.8%) of incidental aortitis in a retrospective review of 514 ascending aortic specimens. The 2 largest groups were isolated aortitis (47%) and GCA (31%); others included Takayasu arteritis (14%), rheumatoid aortitis (4%), and unclassified (4%). Only 1 of 19 patients with isolated aortitis not treated with corticosteroids developed new aneurysms postoperatively.

Pacini, et al[16] recorded 39 cases (frequency 4.9%) of incidental active aortitis in a retrospective review of 788 patients who underwent thoracic aortic resection. Only 2 patients were affected by connective tissue disorders and one had constitutional symptoms; the majority (92.3%) were asymptomatic. Preoperative imaging (CT and MRI) did not show evidence of inflammatory disease. Giant cell aortitis was the most frequent (76.9%) histopathologic diagnosis. None received corticosteroid or immunosuppressive therapy. Survival rate was 80.7% and 47.1% at 5 and 10 years, respectively. One patient underwent aortic repair for development of new abdominal aortic aneurysm 2 years after the first operation.

Burke, et al[15] studied 52 cases of noninfectious ascending aortitis. The authors proposed histologic grouping based on presence or absence of medial laminar necrosis, rimmed by macrophages and giant cells, into necrotizing aortitis (NA) and non-necrotizing aortitis (NNA), respectively. There was a history of autoimmune disease in only 4 out of 43 patients with NA; in contrast, there was a history of GCA in 4 out of 9 patients with NNA. Dissection was significantly more frequent in NNA compared with NA. NNA was felt to be almost synonymous with giant cell aortitis, occurring exclusively in the elderly. However, the NA/NNA classification has not yet been endorsed widely by practicing pathologists, and hence this classification was not applied to our study analyses.

In our study, the frequency of aortitis was 8.4%. This frequency is similar to that reported by our institution from 1985 to 1999[11]. About one-third of patients were asymptomatic at the time of discovery of the aneurysm. Only about a third of patients received corticosteroids. The proportion of patients who received corticosteroids was higher among the few patients who presented with either cranial GCA or PMR symptoms, as expected.

It is not clear from this or other reports whether corticosteroids are beneficial in idiopathic ascending aortitis following resection of the diseased area or aneurysm. Due to the retrospective design of our study, treatment with corticosteroids was determined by the discretion of the rheumatologist. Followup and mortality data for our series was insufficient to allow definitive conclusions regarding effects, if any, of treatment. Future studies prospectively evaluating possible effects of treatment on both vascular outcomes and mortality are needed.

Ours is the first case series to present findings of additional vascular imaging in patients with incidental noninfectious ascending aortitis. Vascular imaging, i.e., CT and MR angiography, was performed in 57 (89%) patients. Notably, additional vascular abnormalities are frequent, present in 72% of imaged patients, including stenoses, ectasias, and/or additional aortic aneurysms. The clinical implications of these additional findings are uncertain, as we have insufficient followup data to determine the vascular outcomes of the additional vascular abnormalities present in the majority of these patients (e.g., development of new vascular lesions, rupture, dissection, need for repeat operation). Interestingly, the additional vascular abnormalities present in our case series are similar to the known large-vessel complications of classical GCA and Takayasu arteritis, namely, additional descending thoracic aneurysms or ectasias, abdominal aneurysms or ectasias, and stenoses of the superior branches of the aortic arch and occasionally of the lower aortic primary and secondary vessels[4,17]. These data suggest that, at least in some patients, the inflammatory process may extend beyond the area excised at surgery. Whether patients with more extensive vascular disease would benefit from corticosteroids is unknown.

The overall survival rate in our series was 90.6%, with median followup time of 15.4 months. This is similar to the 87% 1-year survival rate from a Swedish population-based cohort of patients undergoing aneurysm operations on the proximal thoracic aorta[18].

Our study underscores that there is a great need for additional studies of idiopathic noninfectious ascending aortitis because it is increasingly common, potentially lethal, and poorly understood. Although the histopathology of the aortitis is essentially indistinguishable from that of aortitis associated with GCA or Takayasu arteritis, the majority of these patients have no known history, signs, or symptoms of GCA or PMR and are not of the typical age range of patients with Takayasu arteritis. There have been no studies systematically reporting on whether such patients with incidental aortitis have positive TAB, as TAB are rarely performed on these asymptomatic individuals. In our series, only 3 patients had no history of GCA, but had a temporal artery biopsy performed (1 preoperative and 2 postoperative), all of which were normal. Similarly, although acute-phase reactants were not consistently checked preoperatively, in those who did have it performed, the results did not appear to have clinical consequence, as the vast majority were within normal limits; this is in contrast to classical GCA, PMR, and other vasculitides, where following acute-phase reactants is usually clinically helpful.

It is possible that this condition represents a clinical entity distinct from classical GCA. Could it perhaps represent long-unrecognized Takayasu arteritis or late complications of previous asymptomatic temporal arteritis in the elderly? If so, this would have implications on treatment. Although large-vessel complications of GCA and Takayasu arteritis are typically treated with corticosteroids and/or other immunosuppressive agents, most of these patients were not. The frequency of additional vascular abnormalities found on imaging raises the question whether they are changes of vasculitis in additional vascular territories, versus whether they are changes of atherosclerosis in these elderly patients. We were unable to find any significant differences in inflammatory activity or presence of atherosclerosis on histopathology between those with and without additional vascular abnormalities on imaging. Of note, it is well recognized that atherosclerosis is infrequent in the ascending aorta, in contrast to the abdominal aorta, and the presence of atherosclerosis in only a third of these generally elderly patients seems congruent with this[19,20].

Our study has several limitations, the most important of which are its retrospective design (relying on information recorded in the medical record) and the short followup period, which limit drawing any strong conclusions regarding treatment and outcomes. However, a prospective study that identifies these patients preoperatively with thorough rheumatologic evaluations is unlikely to be feasible, given the very large number of patients that would need to be evaluated due to the rarity of this condition and the practical difficulties in ensuring patients' followup at the given academic referral center where they had their CV surgery. Further, while a prospective longitudinal study of these patients with a standardized imaging approach is ideal, the results of such a study would take many years and multiple centers. We anticipate such an important study to be designed in the future by our group and others. In addition, the generalizability of our results to other populations is limited, as our institution may have referral bias. Our findings, although this study is limited by its retrospective design and relatively short followup, provide important insights into this condition that is now being recognized more frequently by cardiovascular surgeons and pathologists at academic referral centers.

Our study also has several strengths. First, besides being one of the largest series to date, it also includes patients with the most recent diagnoses of this condition (from 2000 to 2006). Previous series reviewed patients evaluated over very long periods of time, during which standards of medical care, followup, and data recording may have evolved.

Second, ours is the first study of ascending aortitis reporting on vascular imaging of the entire aorta in a substantial proportion of patients, revealing that in some, vascular abnormalities may not be confined to the thoracic aorta. Third, our study defined aortitis rigorously, using detailed pathologic review (and re-review) of surgical specimens and excluding those with infections and other secondary causes (e.g., bicuspid valve) or with either lack of full-thickness specimens or lack of definitive features of active aortitis. Finally, our study examined specific histopathologic features of these patients, including presence of atherosclerosis and specific patterns of inflammation.

Most patients with noninfectious ascending aortitis had no history, symptoms, or signs suggestive of GCA or PMR at presentation, and most did not receive corticosteroid or other immunosuppressant therapy. A majority of patients had additional vascular imaging performed, and of those patients, a majority had additional vascular abnormalities. Further studies are needed of the etiopathogenesis, radiographic features, management, requirements for longterm imaging followup (which modalities, how often, for how long?), and outcomes of this condition, which may represent a clinical entity distinct from classical GCA.

REFERENCES

1. Lie JT. Aortic and extracranial large vessel giant cell arteritis: a review of 72 cases with histopathologic documentation. Semin Arthritis Rheum 1995;24:422-31.
2. Lie JT. Illustrated histopathologic classification criteria for selected vasculitis syndromes. American College of Rheumatology Subcommittee on Classification of Vasculitis. Arthritis Rheum 1990;33:1074-87.
3. Hotchi M. Pathological studies on Takayasu arteritis. Heart Vessels Suppl 1992;7:11-7.
4. Kerr GS, Hallahan CW, Giordano J, et al. Takayasu arteritis. Ann Intern Med 1994;120:919-29.
5. Gravallese EM, Corson JM, Coblyn JS, Pinkus GS, Weinblatt ME. Rheumatoid aortitis: a rarely recognized but clinically significant entity. Medicine (Baltimore) 1989;68:95-106.
6. Tucker CR, Fowles RE, Calin A, Popp RL. Aortitis in ankylosing spondylitis: early detection of aortic root abnormalities with two dimensional echocardiography. Am J Cardiol 1982;49:680-6.
7. Bulkley BH, Roberts WC. Ankylosing spondylitis and aortic regurgitation. Description of the characteristic cardiovascular lesion from study of eight necropsy patients. Circulation 1973;48:1014-27.
8. Slobodin G, Naschitz JE, Zuckerman E, et al. Aortic involvement in rheumatic diseases. Clin Exp Rheumatol 2006;24 Suppl:S41-7.
9. Nuenninghoff DM, Hunder GG, Christianson TJ, McClelland RL, Matteson EL. Incidence and predictors of large-artery complication (aortic aneurysm, aortic dissection, and/or large-artery stenosis) in patients with giant cell arteritis: a population-based study over 50 years. Arthritis Rheum 2003;48:3522-31.
10. Garcia-Martinez A, Hernandez-Rodriguez J, Arguis P, et al. Development of aortic aneurysm/dilatation during the followup of patients with giant cell arteritis: A cross-sectional screening of fifty-four prospectively followed patients. Arthritis Rheum 2008;59:422-30.
11. Miller DV, Isotalo PA, Weyand CM, Edwards WD, Aubry MC, Tazelaar HD. Surgical pathology of noninfectious ascending aortitis: a study of 45 cases with emphasis on an isolated variant. Am J Surg Pathol 2006;30:1150-8.
12. Hernandez-Rodriguez J, Molloy ES, Hoffman GS. Single-organ vasculitis. Curr Opin Rheumatol 2008;20:40-6.
13. Rojo-Leyva F, Ratliff NB, Cosgrove DM 3rd, Hoffman GS. Study of 52 patients with idiopathic aortitis from a cohort of 1,204 surgical cases. Arthritis Rheum 2000;43:901-7.
14. Kerr LD, Chang YJ, Spiera H, Fallon JT. Occult active giant cell aortitis necessitating surgical repair. J Thorac Cardiovasc Surg 2000;120:813-5.
15. Burke AP, Tavora F, Narula N, Tomaszewski JE, Virmani R. Aortitis and ascending aortic aneurysm: description of 52 cases and proposal of a histologic classification. Hum Pathol 2008;39:514-26.
16. Pacini D, Leone O, Turci S, et al. Incidence, etiology, histologic findings, and course of thoracic inflammatory aortopathies. Ann Thorac Surg 2008;86:1518-23.
17. Bongartz T, Matteson EL. Large-vessel involvement in giant cell arteritis. Curr Opin Rheumatol 2006;18:10-7.
18. Olsson C, Eriksson N, Stahle E, Thelin S. Surgical and long-term mortality in 2634 consecutive patients operated on the proximal thoracic aorta. Eur J Cardiothorac Surg 2007;31:963-9.
19. Larson EW, Edwards WD. Risk factors for aortic dissection: a necropsy study of 161 cases. Am J Cardiol 1984;53:849-55.
20. Tobler HG, Edwards JE. Frequency and location of atherosclerotic plaques in the ascending aorta. J Thorac Cardiovasc Surg 1988;96:304-6.