Takayasu's Arteritis

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Abstract

A middle-aged male patient is described who suffered left hemiplegia because of occlusion of the brachiocephalic and right common carotid artery. He was found to have Takayasu's Arteritis.

An in-depth review of the history of arteritis, especially as related to nosology, is presented.

Literature is reviewed with emphasis on the neurologic and cardiovascular manifestations. Etiology and pathology are briefly discussed.

Key words: *Takayasu's arteritis, neurologic manifestations, cardiovascular manifestations, nomenclature, etiology, pathology.*

Takayasu's arteritis[1] is a well recognized, non-specific inflammatory condition of the large arteries. It is seen predominantly in young females but by no means it is limited to that age or sex. Many patients present with absent radial pulses but the clinical features depend largely on the site of the involvement of aorta and/or its branches. Most commonly involved arteries are the brachiocephalic, the subclavians, and the carotids. It is therefore not unusual for a neurologist to be involved with such cases. The following case illustrates this point.

Case report

A middle-aged normotensive, nondiabetic, white male who belongs to a family with Huntington's disease, presented in March of 1975 with rapidly developing left hemiplegia, and no history of headache, vomiting or visual disturbances. The past history was non-contributory.

Examination: The blood pressure was 140/82 mm Hg in the left and 116/76 mm Hg in the right arm (E.R. Nurse's readings). There were odd rhonchi heard in both lung fields. The cardiac examination revealed no abnormalities. Neurologic examination revealed a moderately dense left hemiplegia. There was a diminished carotid pulse, and absent superficial temporal pulsations on the right side. The right radial pulse was considerably decreased as compared to the left. The blood pressure in the right arm was only 90 mm Hg systolic while in the left arm it was 120/80 mm Hg. The rest of the examination was unremarkable. Opthalmologist's report showed left temporal pallor but no significant vascular abnormalities and no abnormalities of ocular tension.

Investigations: CBC, X-ray of chest and skull, EKG and EEG were normal. Sedimentation rate was 48 mm by Westergren method. The Tuberculin test was negative. CT scan of the head was not available. A radio-nucleotide brain scan done three weeks after admission showed a poorly circumscribed faint area of increased uptake in the right frontal-parietal region. Spinal tap and CSF analysis showed no abnormal cells and no abnormalities of the chemistry. Cerebral angiography revealed complete obstruction of the brachiocephalic artery and no visualization of the right common carotid artery. A right sided subclavian steal was demonstrated (Figure 1).

The patient underwent an operative procedure in which the origin of the innominate artery was connected by a graft to the right subclavian artery at its patent portion. The brachiocephalic vessel along with the proximal half inch of the thrombosed common carotid artery was excised. Postoperatively, the patient did well and the pulse and blood pressure in the right wrist improved considerably.

The pathology report indicated that both arteries (innominate and right common carotid) showed marked thickening of the intima and reduplication of internal elastic lamina. Scattered inflammatory cells were seen throughout the thick vessel wall and the

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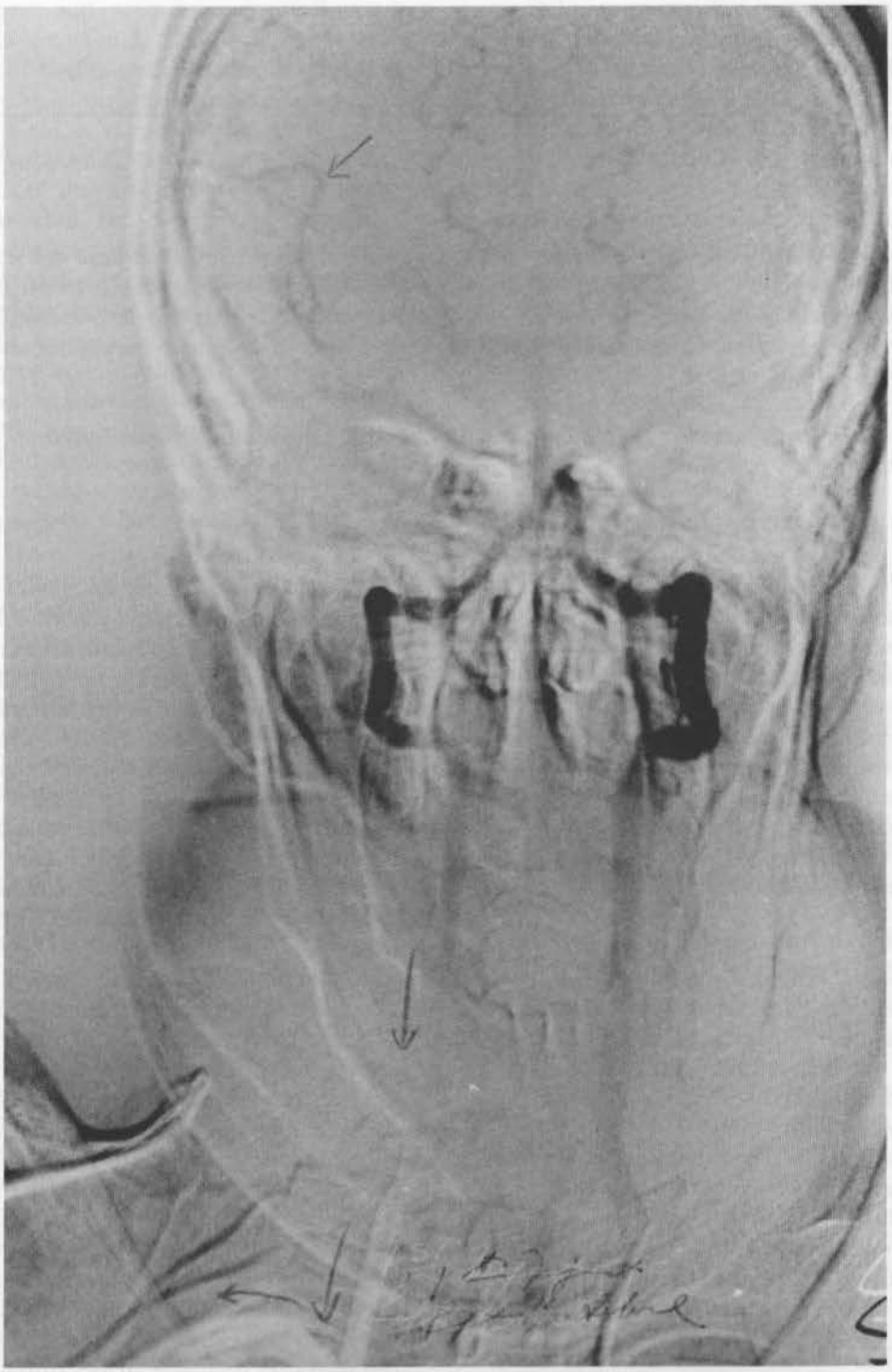

Figure 1. Vertebral Angiogram: Injection of left vertebral artery showing subclavian steal and also filling of the right middle cerebral artery. (Top oblique arrow)

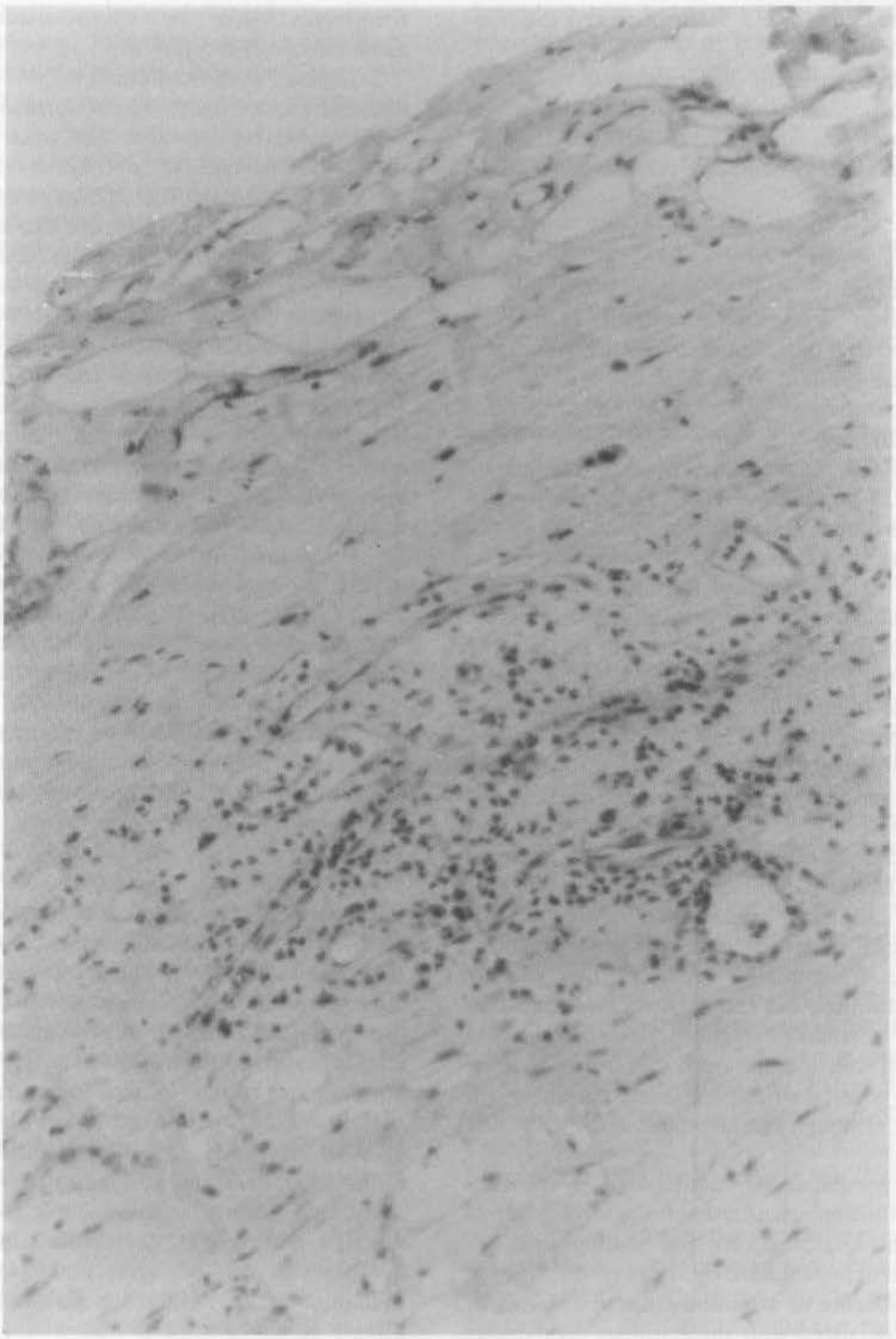

Figure 2: Transverse section of innominate artery under high power. Section of adventitia showing thickening, mononuclear cell infiltration, especially around vasa vasorum and junction of media.

adventitia showed marked thickening and focal aggregates of lymphocytes with occasional neutrophils and eosinophils. Some aggregates of acute inflammatory cells appeared around the vasa vasorum Multi-nucleated giant cells were observed less frequently (Figure 2).

Since then the patient has remained well with spastic left hemiplegia, and is able to walk with a cane. His blood pressure has remained 120/80 in the both arms and the sedimentation rate has come down to 5 mm.

Discussion

Historical and nosological considerations

It was Niimi[1] who used the term Takayasu's disease for the first time, but in the Western literature Caccamise and Okuda[2] introduced this term first in 1954. There being a lack of appropriate, pathologically or clinically descriptive term, Takayasu's name seems to have been accepted by more recent writers, even though there are valid reasons against such a name. I propose to trace the history of this type of arteritis and then bring out its relationship with Takayasu's original case in an attempt to elucidate the problem of nomenclature.

It seems that the first case of arteritis of this type was described by Morgagni in 1761 (a woman who was 40 at the time of her death was found to have thickened aorta and leaflets of the aortic valve and narrowing of the subclavian arteries at autopsy).[3] No mention was made of syphilis or other disease in the woman, therefore it seems reasonable to assume it was non-specific arteritis. Other first descriptions are in the 19th Century. For example, case reports of John Davy[4] or Savory[5]. There are many other individual cases[6-11] recorded, though admittedly all of them may not necessarily represent this specific arteritic syndrome. Ross and McKusick[12], discussing the causes of aortic arch syndrome, describe the case of Davy and consider it syphilitic, while that of Savory, was considered to be a dissecting aneurysm of the aorta, although not all would agree with their conclusion.

Takayasu presented his case in 1908 in the 12th Congress of the Japanese Opthalmological Society at Fukuoka. The English translation of that paper appears in the article published by Judge et al[14], who, in spite of the absence of arterial disease in Takayasu's description, persisted with the erroneus eponymous designation. He described bilateral fundal abnormalities consisting of peripapillary wreath-like arteriovenous anastomoses. Drs. Ohnishi[15] and Kagoshima[16] mentioned in the discussion the absence of radial pulses in the young girls who they had seen with similar fundal and ocular changes and that seems to be the reference and relation with arteritis.

The first histo-pathologic descriptions of a non-specific arteritis affecting the arch of the aorta and its stem arteries were reported by Beneke[17] in 1926, followed a year later by Raeder and Harbitz[18]. There were independent case reports by Raeder[19] and Harbitz[20] also, but these reports did not concern themselves with the characteristic wreath-like anastomoses of the fundus.

Japanese opthalmologists[21,22,23] continued to describe the opthalmologic abnormalities associated with arteritis of the arch and pulse abnormalities under various names, so that by 1940 we see in Oota's[23] description the ophthalmologic syndrome with special mention of wreath-like anastomoses of the fundus and the associated arteritis of large vessels. As indicated before, Niimi[1] in 1941 called it Takayasu's Disease for the first time. The first clinicopathologic correlation of aortic arch syndrome was published by Martorell and Fabre in 1944.[24]

During these decades, cerebral and ocular manifestations were increasingly recognized as being due to atherosclerotic or other diseases affecting the arteries of the neck or thorax. Arteritis as a cause of such syndromes and its relation with Takayasu's findings remained a curious syndrome and poorly understood[28] until Shimizue and Sano[29] described in detail their cases in 1948 and coined a catching term, "Pulse-less disease". They reviewed the Japanese literature collecting 25 case reports and added 8 of their own (thinking that the disease was limited to Japan). They described three characteristic signs: 1. absence of radial pulses. 2. hypersensitivity of carotid sinus. 3. the wreath-like peripapillary arteriovenous anastomoses (first described by Takayasu).

Ask-Upmark,[30] and Ask-Upmark and Fajers[31] elaborated on the clinical syndrome and concerned themselves with the cases reported outside Japan, collecting a total of 45, whereas Caccamise and Whitman reviewed 59 Japanese cases. Ask-Upmark used the term Takayasu's Syndrome and Caccamise and Okuda[2] called it Takayasu's Disease, thus introducing the name to the Western literature.

Here we must pause and reflect at the use of this eponym. It seems that the condition was poorly understood, its cause uncertain, patho-physiology inadequately known, its microscopic picture was non-specific; however, all clinical descriptions included involvement of the arch and ascending aorta, pulmonary artery, etc. Thus no single name of the disease could be applied that would be considered adequate. The resemblence to giant cell arteritis microscopically was recognized, but the disease was clearly different from "cranial" or "temporal arteritis". There were cases where the "pulse-less" stage was never reached. There were cases in men and older persons and the disease was not limited to the Orient, so the terms such as non-specific arteritis, aortoarteritis, or pulseless disease or aortic arch syndrome, etc., were all inadequate. Raeder-Harbitz

syndrome or Martorell's syndrome, Takayasu's syndrome, or Takayasu-Onishi disease were all similarly objectionable terminologies, but somehow Takayasu's name persisted.

More recently, thrombotic aortopathy (again an inadequate name) and Takayasu's disease have been commonly used in the Western literature. Thus, we have seen that Takayasu's name has been attached to this disease, not because he described the arteritis first, but because we do not have a more satisfactory name. Unfortunately, even in the late eighties of this century, the difficulty of naming this disease has not yet been resolved, unless we accept Cairns and Oleesky's[32] proposal that giant cell arteritis and Takayasu's disease are one and the same condition, with a clinical spectrum ranging from the very young (Takayasu) to the very old (over 60 years). We may have to wait until more studies of associated polymyalgia rheumatica are reported with "Takayasu' Arteritis" and more studies of "Giant Cell Arteritis" of the aorta and other large arteries[33] are described; or until a more critical analysis of the pathology of the two diseases is performed and perhaps etiopathogenic mechanisms are clarified, before accepting such a proposal.

However, it seems to me that there may be more reason to reject the term Takayasu's disease. Hirose[34] points out the problem of trying to prove that the ischemia of the upper part of the body is caused by wreath-like arteriovenous anastomoses around the papilla, and is not always present in the patients with this disease. He first advocated the name of Takayasu-Onishi disease, but has now dropped it after studying the original case records of both opthalmologists. He has studied this disease for over twenty-five years before coming to this conclusion, but the alternative he provides "aortic arch arteriostenosis" seems as inadequate as aortic arch syndrome," because in many cases, the disease is limited to the abdominal aorta[35].

Clinical Features

This disease has now been reported throughout the world[36] and is not limited to any race[36,37]. Although most common in young adults, it is also reported in children[38-40], the youngest case being seven months old;[40] also in middle-aged and older individuals.[30,31,42,43] It is more common in women than in men.[36,37] In a recent study in Mexico, review of 107 cases[44] showed 84% female and 16% males. But, in another study men and women were equally affected. The disease was reported to be more common in the Oriental, Black and Hispanic races than in those of Northern European origin.[45] Stttar et al claim the first report among the Arab females.[46] Thus, no race is immune.

Earlier reports[12,13,27,30,31] suggested that the disease was limited to the ascending aorta, arch and the major stem arteries arising therefrom. This is the reason for such names as aortic arch syndrome, chronic subclavian-carotid obstruction syndrome[47], syndrome of obliteration of supra-aortic branches[24], thromboarteritis obliterans subclavio-aortica[29], reversed co-arctation of the aorta and several other such names. Later, however, involvement of other parts of the aorta and pulmonary artery was recognized. It should be noted that early in 1954 Ask-Upmark[30] did describe pulmonary artery involvement.

Because of the varied nature of the disease, authors have attempted classifications of the disease, according to radiologic appearances,[49] clinical features,[50] or the different patterns of disease.[51] Basically, the clinicopathological grouping involves patients with the disease:

1. Limited to arch and its branches.
2. Generalized aortic involvement.
3. Lower abnorminal aortic involvement and its branches, such as the renal artery.
4. Any combination of the above with or without:
   a. Pulmonary artery lesions and/or
   b. Coronary artery lesions.

Then, of course, there is an acute stage and a chronic stage of the disease. During the acute phase, constitutional symptoms such as malaise, pyrexia, tiredness, headache, dizziness, and arthralgias occur. The raised sedimentation rate may point to some disorder of the immune system, and if the condition worsens, some hint may be provided by the appearance of vascular symptoms and signs, although bruits usually are associated with chronic obstructive arteriopathic stage when collateral circulations have become established. Symptoms of vascular insufficiency may then predominate and are related to ischemia of the upper half of the body of "middle-aortic syndrome"[52] or lower aortic syndrome." There are excellent clinical reviews given in the past since the publications of Shimizue and Sano[29] or those of Ask-Upmark and Fajers.[30,31] Notable amongst these are those of Strachan, Nakao et al,[53] Yoshitosku et al,[54] Klmansohn, Kuen-Soo et al,[38] Ueda et al,[57] Schirer and Asherson,[58] and the more recent reviews.[44,51,58-62]

The majority of patients exhibit symptoms and signs of ischemia of the head and face and upper extremities, but I shall discuss only the neurologic and cardiac manifestations to bring out certain features that are important to recognize, and then review renovascular hypertension resulting from renal artery involvement.

Syncope and neurologic manifestaions:

Earlier writers,[28-31,57] recognized syncope as a common and important symptom of the disease and gave various explanations of the symptom:[29,57]

1. Orthostatic hypotension due to hemodynamic ab-

normalities of the circulation of the head and neck.
2. Cerebral ischemia.
3. A combination of the two mechanisms.
4. Hypersensitivity of the carotid sinus causing bradycardia, hypotension and cerebral ischemia.

Shimizue and Sano[29] discussed the carotid sinus hypersensitivity at great length and indicated that it forces the patient to acquire a head forward and downward position so as to avoid blurred vision (retinal ischemia) or loss of consciousness (syncope), etc., on merely straightening the head.

It appears that there is marked parasympathecotonia in addition to vascular changes. More recently Takeshita et al[63] have made studies on baroreflex sensitivity and were not convinced that there is hypersensitivity of this reflex present in such patients.

Neurologic manifestations have been a subject of special study in the report of Currier et al[64] and more recently by Signal.[65] Currier et al collected forty cases of aortic arch syndrome in 1954 from the literature, but only 12 of those had nonspecific arteritis. Sigel[65] has reviewed granulomatous angitis of the nervous system in detail and has compared all the other vasculitic and rheumatologic syndromes affecting the nervous system including Takayasu's arteritis. According to him, 10-40% of these patients present with CNS manifestations. The neurologic manifestations can be summarized as follows:

1. The most common neurologic complaints recorded are headache and dizziness. It should be noted that the headache can be as distressing in arteritis of this type as it is in giant cell arteritis.
2. Syncope—has been discussed above.
3. Convulsive seizures and EEG abnormalities have not been frequently reported, but one may expect these in patients with cerebral ischemic disease.
4. Strokes,[66] transient or permanent hemiplegias and aphasias are all reported. Many of these were associated with obliteration of major arteries of head and neck and also intracerebral hemorrhages which may occur with or without hypertension. Ischemic myelopathy has recently been reported by Nair et al from India.[67]
5. Organic mental syndrome with dulling of affect, loss of cognitive abilities, etc., has been frequently noted, presumably related to diffuse cerebral ischemia or the more well known multiple infarct dementia, as may occur in hypertension.
6. Progressive visual failure or amaurosis fugax and ocular disturbances are described recently,[34,59] such as retinal and iris atrophy, peripapillary arteriovenous anastomoses (Takayasu's finding), cataracts, etc.
7. Facial muscular atrophy, claudication of masticatory muscles with effects on articulation and phonation from ischemic perforation of nasal septum or palate and even sensorineural hearing loss has been attributed to this arteritis.[68]

It would appear likely that the following mechanisms singly or in combination are responsible for the production of neurologic symptoms and signs:

A. Direct involvement of the large extracranial arteries. Arteritis results either in dilatation or stenosis from inflammatory thickening of the arterial wall and thrombus formation that may propagate from the site of origin to the termination or branching of an artery or be the source of embolization.
B. Collateral circulation. Loud bruits are frequently present and continuous murmurs, especially those resembling patent ductus arteriosus are produced. Circulatory stress or increased demand results in subclavian steal syndrome[69].
C. Renovascular hypertension due to arteritis affecting the renal arteries[35] is encountered in the so-called middle-aortic syndrome and lacunar strokes and intracerebral hemorrhages result from hypertension. Of note here is the fact that the retinae may show a hypertensive picture rather than that from hypotension, i.e., the Takayasu type.
D. Carotid sinus hypersensitivity may occur due to arterities affecting the carotid arteries, though all do not agree with this simple explanation.

Cardiovascular manifestations:

Involvement of the heart with or without hypertension has been the subject of several reports.[30,31,43,44,57,70] It is important to note that during the acute phase with constitutional symptoms, cardiovascular symptoms are common (half the cases reviewed).[44] Heart may be involved in several ways:

1. Direct involvement of endocardium[71] or myocardium and pericardium.[50]
2. Involvement of the valves. It is rare, and the most common valves affected are the aortic valves in which the inflammatory process results in the dilatation of the aortic ring[43,72] and incompetence or regurgitation.[73,76] Less commonly, mitral valve involvement producing prolapse or mital regurgitation is reported.[74]
3. Coronary osteal narrowing was noted early by Froving and Loken.[75] This is obviously related to the inflammatory process affecting the leaflets of the aortic valve and the sinus of valsalva[76,77] and is being reported with greater accuracy now.[78]
4. Direct involvement of the coronary arteries[78,79,80] in the inflammatory process has more recently been noticed[81,82,83] and perhaps one should suspect arteritis in a case of coronary artery disease when evidence for atherosclerosis or other diseases is lacking, as in a younger patient.[81,83]
5. Pulmonary artery involvement. More recently it has been recognized that pulmonary arteritis oc-

curs in quite a few cases;[44,49,84] 12% in our report,[85] and is amenable to surgical treatment.[86,87]

6. Renovascular hypertension has been reported more commonly in the Eastern literature[88] and also in patients of Eastern origin in the Western literature. Renal artery stenosis occurs with narrowing of the origin from aortitis or direct involvement of the renal arteries. Renal artery involvement is almost universally observed in aortitis affecting abdominal aorta either independently or as part of widespread aortic disease. Many cases have been described recently[89-95] with stenosis or aneurysm of renal arteries and demonstrating the role of renin in the production of hypertension. Some other kidney diseases such a glomerulonephritis or amyloidosis have recently been described[97-101] in association with the arteritis. The arteritis of abdominal aorta affects other branches too, for example mesenteric artery, femoral artery, etc., emphasizing the variety of symptoms and signs that may ensue.

Skin manifestations:

There have been recently recognised dermatologic features indlcuing erythema nodosum, erythema induratum,[50] postgranulomatous anetoderma,[102] cutaneous churgastrauss granuloma, etc.[103]

Etiology and pathology

Since earlier descriptions of the disease included patients with positive tuberculin tests,[29,38] tuberculosis either directly or by altering the immune mechanisms, was considered to be important etiologically. Recently its role has been re-evaluated.[104]

The vast majority of observers, however, believe that the mechanism responsible for this disease is likely to be auto-immune disturbance. Many arguments can be advanced in support of this hypothesis, e.g., clinical resemblance to other known auto-immune disorders,[31,53,55] especially giant cell arteritis;[32] association with diseases known to be auto-immune disturbances such as rheumatoid arthritis,[105] Still's disease,[106,109] juvenile rheumatoid arthritis,[110] Hasihmoto's disease,[111] sacro-ileitis,[112] seronegative polyarthritis,[113] ulcerative colitis,[114,116] to name a few. Some support for the auto-immune hypothesis is also derived from genetic and heredity studies,[117] especialy wth regard to HLA typing. Extensive studies have been published from Japan.[118] While investigating Takayasu's arteritis in monozygotic twin sisters, they found specifically HLA-Bw52 with higher frequency in the patients.[19] They felt that genetic and hereditary factors should be considered seriously in the etiology of this disease.[120,121] Other workers, both Japanese[122] and non-Japanese[123,46] studying HLA typing could not confirm the higher incidence of HLA-Bw52 in Takayasu's Arteritis patients. It seems that the genetic composition of these patients has close resemblance to those with well-known auto-immune disorders. Moriuchi et al[124] concluded that genes in HLA-D region play a major role in determining the susceptibility to this disease. Also, Kodama and his associates[117] recently expressed the view that genetic factors might be associated with the pathogenesis of Takayasu's arteritis through an auto-immune mechanism.

While classifying the various types of vasculitis, Fauci[125] grouped Takayasu's and cranial arteritis together, and Sigal[65] adds that granulomatous angiitis of the nervous system ranks with these giant-cell arteritides. It is clear that until more is known about the etiology and pathogenesis of these so called giant-cell arteritides, definite categorization is not possible. Nasu, who has made extensive studies[126,127] on the pathology of Takayasu's arteritis, does not feel comfortable with the idea of Cairns and Oleesky,[32] namely that cranial arteritis and Takayasu's arteritis are two expressions of the same disease.

The arteritis generally begins in the media and rapidly extends to adventitia. Eventually the intima gets involved and thus pan-arteritis ensues. The microscopic picture is that of granulomatous inflammation, associated with fibrosis with thickening of the arterial wall, reduplication of the internal elastic lamina and resultant narrowing of the lumen from intimal thickening leading to thrombosis. Aneurysm formation also occurs in other places where thrombosis does not occur from narrowing of lumen.
While reporting on 16 autopsied cases of Takayasu' arteritis, Rose et al[128] mention the difficulty in distinguishing rheumatic meso-arteritis from Takayasu's, and earlier, Kalmansohn and Kalmansohn[55] had studied these arteritides together without attempting to differentiate between these two.

Diagnostic studies

All the studies on blood, such as sedimentation rate and blood chemistries and other serum studies performed routinely for suspected auto-immune disorders should be performed. Confirmation, however, comes from arteriographic studies, whether by the direct method,[49,129,130] or by digital subtraction technique.[131] Other imaging modalities have been reported to be helpful such as CT,[132] echocardiography,[133] doppler study,[69] radionucleotide imaging[134] and even magnetic resonance imaging.[135,137] It is clear, however, that the best studies for diagnosis are direct aortagraphy and angiography.

Treatment

In the acute phase, corticosteroids and cytotoxic agents have been used with some success.[62,66,138,139]

In obstructive and chronic cases, surgical reconstruction, bypass, etc., have been used to improve the impaired circulation,[60,73,140,142] including surgical treatment of pulmonary artery stenosis.[86,87] Also, more recently, percutaneous angioplasty has been employed in many situations to afford relief of sysmptoms.[144,145]

References

1. Niimi Y: A case of Takayasu's disease. Sogo Ganka 1941;36:1404-10.
2. Caccamise W C Okuda, K: Takayasu's or pulseless disease, an unusual syndrome with ocular manifestations. Am J Ophthalmol, 1954; 37:748.
3. Digiacoma, V: A case of Takayasu's disease occured over two hundred years ago. Angiology, 1984; 35:750-4.
4. Davy J: Notice of a case in which the arteria innominata and the left subclavian and carotid arteries were closed without loss of life. Researches, Physiological and Anatomical, Vol. I, Smith, Elder and Co., London, 1839; 426.
5. Savory W S: Case of a young woman in whom the main arteries of both upper extemities and the left side of the neck were throughout completely obliterated. Med Chir Tr, 1856; 39:205.
6. Gull W: Thickening and dilatation of the arch of the aorta with occlusion of the innominata and the left carotid: Atrophic softening of the brain. Guy's Hosp. Rep. 1855; 16:12.
7. Kassmaul A: Zwei falle von spontaner allmahlicher veshliessung grosser Halsarterienstamme. Deutscher Klin, 1872; 24:461.
8. Parsons C: Case of occlusion of the arteries arising from the arch of the aorta: With aortic degeneration and aneurysms. Boston M. & Surg J, 1872; 86:400.
9. Broadbent W H: Absence of pulsation in both radial arteries, the vessels being full of blood. Tr Clin Soc London, 1875; 8:165.
10. Preisendorfer, P: Ueber einen fall bon bolldysnfihrt onliyrtsyion frt arteria anonyma, fast vollstandiger der carotis and subsclavia sinistra complieirt mit aneurysma der aorta and carcinom der oesophagus. Arch Path Anat 1878; 73:594.
11. Dejerine J, Huet E: Contribution a l'etude de l'aortite obliterante. Rev Med, Paris, 1888; 8:201.
12. Ross R S, NcJysucjm V A: Aortic arch syndromes, diminished or absent pulses in arteries arising from arch of aorta. Arch Int. Med. 1953; 92:701-40.
13. Takayasu M: On the unusual transformation of symptoms of retinal vessels. Acta Soc Opthalmol Jpn, 1908; 12:444-554.
14. Judge R D, Currier R D, Gracie W A,Figley MM: Takayasu's arteritis and the aortic arch syndrome. Am J Med 1962; 32: 379-92.
15. Ohnishi K: Discussion with Takayasu. Acta Soc Opthalmol Jpn, 1908; 12:555.
16. Kagoshima R: Discussion with Takayasu. Acta Soc Ophthalmol Jpn, 1908; 12:555.
17. Beneke R: Ein eigentumlicher fau schwieliger aortitis. Arch Path Anat 1925; 254:723.
18. Raeder, J G Harbitz F: Ansigts-ogoienatrofi (Praesenil katarkat og "glaucom") foraarsaket av symmetrisk karotisaffektion. Norsk Mag Laegevidansk, 1926; 87:529.
19. Raeder, J G: Ein fall von symetricher karotisaffektion graseniler katarakt und glaukom soivie gesichtsatrophie. A case of symmetrical affection of the carotid with presenile cataract and glaucoma as well as cerebral atrophy. Klin Monatsbl f Augent (Beilagehft), 1927; 78:63.
20. Harbitz F: Bilateral carotid arteritis. Arch. Path, 1926; 1:499.
21. Nakajima M: Uber einen fall von anastomose der netzhautgefasse mit verchiedenartigen congenitalen anomalien. Acta Soc Ophthalmol Jpn, 1921; 15:399, 487-92.
22. Okamura S: Progressive peripapillary anastomosis. Acta Soc Ophthalmol Jpn, 1938; 42:131-41.
23. Oota K: Rare case of bilateral carotid subclavian occlusion; contributions to pathology of peripapillary anastomosis of the eye with absence of radial pulse. Tr Soc Path Jpn, 1940; 30:680.
24. Martorell-Otzet F, Fabre-Terson J: El sindrome de obliteracion de los tronco supra-aorticos. Med Clin Barcelona, 1944; 2:26.
25. Marinesco G, Kreindler A: Progressive and complete obliteration of the two common carotids with epileptic fits. Presse Med, 1936; 44:833.
26. Glaston M, Govons S, Wortis S B, Steele J M, Taylor H K: Thrombosis of the common, internal and external carotid arteries: Report of two cases with a review of the literature. Arch Int Med, 1941; 67:1162.
27. Aggeler P M, Lucia S P, Thompson J H: A syndrome due to the occlusion of all arteries arising from the aortic arch: Report of a case featured by primary thrombocytosis and autohaemagglutination. Am Heart J, 1941; 22:833.
28. Lewis T, Stokes J A: curious syndrome with signs suggesting cervical arteriovenous fistula with pulses of neck and arms lost. Brit Heart J, 1942; 4:57.
29. Shimzue K, Sano K: Pulseless disease. J Neuropath & Clin Neurology, 1951; 1:37-47.
30. Ask-Upmark E: On "Pulseless Disease" outside of Japan. Acta Med Scandinav 1954;

149:161-78.
31. Ask-Upmark E, Fajers M D: Further observations on Takayasu' syndrome. Acta Med Scandinav, 1956; 155:275-91.
32. Cairns S A, Oleesky, S: Takayasu's disease and cell arteritis - a single disease? (Letter) Br Med J 9:2(6079):127.
33. Klein R G, Hunder G G, Stanson A W, Sheps S G: Large artery involvement in giant cell (temporal) arteritis. Annals of Int Med 1975; 83:806-12.
34. Hirose K: The term Takayasu's disease should be abolished. Jpn J Ophthalmol 1983; 27:236-47.
35. Danaraj J T, Wong H W: Primary arteritis of abdominal aorta in children causing bilateral stenosis of renal arteries and hypertension. Circulation 1959; 20:856-63.
36. Titus J L, Han-Sed K: "Takayasu's Arteritis" in Aderson's Pathology edited by J M Kissare, 8th Edition Vol. 1. C.V. Mosby Co., 1985; 703.
37. Sen P K: "Non-specific Arteritis of the aorta and its branches" introduction in "Cardiology, Current Topics and Progress". Edited by H Eliakim and H N Nenfeld. Academic Press, New York. 1968; 317.
38. Kuen-Soo L, Ki-Yong S, Chank-Yee H, Suk-Rin, K Knut, B: Primary arteritis (pulseless disease) in Korean children. Acta Pediat Scandinav 1967; 56:526-36.
39. Cremin B J, Wiggelinkhuizen J: Takayasu's arteritis in childhood. A case report. Annal of Radiol (Paris) 1978; 21: 179-82.
40. Grovemeyer P S, deMello D E Takayasu's disease with aneurysm of right common iliac artery and ilio-canal fistula in a young infant; case report and review of literature. Pediatrics 1982; 69:626-31.
41. Eke F, Balef J W, Hardy B E: Three patients with arteritis. Arch Dis Child 1984; 59: 877-83.
42. DiGiacomo V, Meloni F, Transi M G, Nigro D, Sciacca V: Takayasu's disease in middle aged woman; a clinicopathologic study. Angiology, 1985; 36:2-4.
43. Morooka, S, Saito, Y, Nonaka, Y, Gyotoko Y, Sugimoto T: Clinical features and course of aortitis syndrome in Japanese women older than 40 years. Am J Cardiol 1986; 53:859-61.
44. Lupi-Herrera E, Sanches-Torres G, Marcushamer J, Mispirada J, Horowitz S, Vela J E: Takayasu's arterities, clinical study of 107 cases. Am Heart J 1977; 93:99-103.
45. Deutch V, Wexler L, Deutch H: Takayasu's arterities, an angio-graphic study with remarks on ethnic distribution. Israel J of Roentgen Radiol and Nucl Med 1974; 122:13-28.
46. Sattar M A, White A G, Elkof B, Fenech F F: Takayasu's disease in Arabs. Post Grad Med J 1985; 61:387-90.
47. Bustamante R A, Milanes B, Casas R, De-LaTorre R: The chronic subclavian-carotid obstruction syndrome (Pulseless disease). Angiology 1954; 5:479.
48. Giffin H M, Dry T J, Horton B T: Reversed coorctation and vasomotor gradient: Report of a cardiovascular anomaly with symptoms of Brain Tree. Proc Staff Meet Mayo Clinic 1939; 14:561.
49. Sheikhzadeh A, Ghabussi P, Razi M: "Occlusive Thromboaortopathy (Takayasu's Disease): Clinical Findings and Angiographic Classification. Herz 7(5):325-30.
50. Strachan R W: "The Natural History of Takayasu's Arteriopathy". Qtly J Med New Series 33 1964; 129:57-69.
51. Ishikawa K: Natural history and classification of occlusive thrombo-aortopathy (Takayasu's disease). Circulation 1978; 57:27-35.
52. Sen P K, Kinare S G, Engineer S D, Parulkar G B: Middle aortic syndrome. Brit Heart J, 1963; 25:610.
53. Nakao K, Ikeda M, Kimato SL, et al: Takayasu's arteritis: Clinical report of eighty-four cases and immunologic studies of seven cases. Circulation, 1957; 15: 239-44.
54. Yoshitoshi Y, Masujama Y, Koide K: Aortitis syndrome, clinical features and characteristics in Japan In: Cardiology, Current Topics and Progress. H. Eliakim and H.N. Neufeld. Academic Press, Inc. N.Y. 1938; 318-9.
55. Kalmansohn R B, Kalmansohn R W: Thrombotic obliteration of branches of aortic arch. Circulation, 1957; 15:237-44.
56. Ueda H, Ho I, Saito Y: Studies on arteritis with special reference to pulseless disease and its diagnosis. Naika (Jap) 1965;15:239.
57. Schrire V, Asherson R A: Arteritis of aorta and its major branches. Quart J Med, 1964; 33:439-63.
58. Ishikawa K: Patterns of symptoms and prognosis in occlusive thromboaortopathy (Takayasu's disease). J Am Coll Cardiol, 1986; 8:10141-6.
59. Ishikawa K, Uyama M, Asayama K: Occlusive thromboaortopathy (Takayasu's disease), cervical arterial stenosis, retinal arterial pressure, retinal microaneurysms and prognosis. Stroke 1983; 14:730-5.
60. Polrpvslu A V, Sultanalier, T A, Spiridonov A A: Surgical treatment of vasorenal hypertension in non-specific aorto-arteritis (Takayasu's disease). J Cardiovasc Surg (Torino) 1983; 24:111-8.
61. Hall S, Barr W, Lie J T, Stanson A W, Kazmier F J, Hunder G G: Takayasu's arteritis: A study of 32 North American patients. Medicine

(Baltimore) 1985; 64:89-99.
62. Arabidze G G, Abugova S P, Dombe G G: Nonspecific aortoarteritis, clinical course and long term medical treatment. Int Angiol, 1985; 4:165-70.
63. Takeshita A, Tanaka S, Onta Y, Kanaide H, Nakamura M: Baro-reflex sensitivity in patients with Takayasu's arteritis. Circulation, 1977; 55:803-6.
64. Currier R G, DeJong R B, Bole, G C: Pulseless disease: Central nervous system manifestations. Neurology, 1954; 4:818-830.
65. Sigal L H: The neurologic presentation of vasculitic and rheumatologic syndromes: A review. Medicine: 1987; 66:157-80.
66. Kott H S: Stroke due to vasculitis. Primary Care, 1979; 6:771-80.
67. Nair K R, Bhaskaran R Ratnakumari S, Madhusoodana M: Ischemic myelopathy in Takayasu's disease. J Assoc Physicians India, 1985; 33: 735-6.
68. Siglock T J, Brookler K H: Sensorneural hearing loss associated with Takayasu's disease. Laryngoscope, 1987; 97:797-800.
69. Yoneda S, Nukada A T, Kunikiko T, Imaizumi M, Takaho T, Abe H: Subclavian steal in Takayasu's arteritis. A hemodynamic study by means of ultrasonic Doppler flowmetry. Stroke, 1977; 8:264-68.
70. Schamroth C L, Sareli P, Behr A, Grieve T P: Takayasu's arteritis and myocardial dysfunction. Am Heart J 1987; 113:1240-3.
71. Chhetri M K, Pal N C, Neelakantan C, Chowdhury N D, Mullick K C: Endocardial lesion in a case of Takayasu's arteriopathy. Br Heart J 1970; 32:859-62.
72. Akikusa B, Konda Y, Muraki N: Aortic insufficiency caused by Takayasu's arteritis without usual clinical features. Arch-Pathol Lab Med 1981; 105:650-1.
73. Nakano T, Isaka N, Takezawa H, Kusagana M: Successful treatment of acute severe aortic regurgitation caused by Takayasu's arteritis: A case report. Angiology 1986; 37:524-9.
74. Morooka S, Tanaka S, Ohya T, et al: Mitral regurgitation associated with aortitis syndrome. Jpn Heart J 1983; 24:471-80.
75. Frovig A G, Loken A C: The syndrome of obliteration of the arterial branches of the aortic arch due to arteritis. Acta Psychiat et Neurol Scandinav 1951; 26:313.
76. Altieri P I, Martinez Toro J, Castillo N: Localized Takayasu's disease producing coronary osteal lesions. Bol Assoc Med PR 1984; 76:168-9.
77. Cipriano P T, Slverman J F, Perlroth M G, Giriepp R P, Wexler L: Coronary arterial narrowing in Takayasu's aortitis. Am J Cardiol May, 1977; 39:744-50.
78. Chun P K, Jones R, Robinowitz M, Davia J E, Lawrence P J: Coronary osteal stenosis in Takayasu's arteritis. Chest 1980; 78:330-1.
79. Aufderheide A G, Henke B W, Parker E H: Granulomatous coronary arteritis (Takayasu's disease) Arch Pathol Lab Med 1981; 105:647-9.
80. Makimo N, Orita Y, Takeshita A, Nakamura M, Matsui K, Takunaga K: Coronary arterial involvement in Takayasu's disease. Jpn Heart J 1982; 23:1007-13.
81. Sciagra T, Tebbe U, Rahlf G, Neuhause K L, Kreuzer H: Fatal out-come of aortocoronary bypass grafting in a 72-year old man with unsuspected coronary arteritis. Clin Cardiol 1986; 9:583-6.
82. Balakrishnan K G, Pillai V T, Sasidharan K, Mahadevan P: Nonspecific arteritis of the coronary arteries. Indian Heart J 1984; 36:178-81.
83. Payan H M, Gilbert E F: Granulomatous coronary arteritis. Arch Pathol Lab Med 1984; 108:136-7.
84. Hass A, Stiehmer: Takayasu's arteritis presenting as pulmonary hypertension. Am J Dis Child 1986; 140:372-4.
85. Ishikawa T: Systemic artery-pulmonary artery communication in Takayasu's arteritis. Am J Roentgenol. 1977; 128:389-93.
86. Moore J W, Reardon J J, Cooley D A, Vargp T A: Severe Takayasu's arteritis of the pulmonary arteries. Report of a case with successful surgical treatment. J Am Coll Cardiol 1985; 5:369-73.
87. Chauvand S, Mace L, Brunewald P, Tricot J L, Camilleri J T, Carpentier A: Takayasu's arteritis with bilateral pulmonary artery stenosis. Successful surgical correction. J Thorac Cardiovasc Surg 1987; 94:246-50.
88. Teoh P C, Tan L K, Chia B L, Chao T D, Tambyah H A, Feng P H: Nonspecific aorto-arteritis in Singapore with special reference to hypertension. Am Heart J 1978; 95:683-90.
89. Sen P K, Kinare S G, Engineer S D, Parulkar G B: Middle aortic syndrome. Br Heart J 1963; 25:610.
90. Simon D, Ledoux F, Lagneau P, et al: Takayasu's aortitis with renovascular hypertension: Successful complex re-vascularization. J Urol. 1981; 125:91-4.
91. Yoneda S, Nukada T, Imaizumi M, Miyai M, Abe H: Hemodynamic and volume characteristics and peripheral plasma renin activity in Takayasu's arteritis. Jpn Circ J 1980; 44:950-6.
92. Wiggelinkhuizen J, Ccrein B G, Cywes S: Spontaneous recanalization of renal artery stenosis in childhood Takayasu's arteritis: A case report. S Afr Med J 1981; 57:96-8.

93. Conti S, Wagner C, Fitpatrick H F: Abdominal aortic coarctation and pregnancy. J Cardiovasc Surg (Torino) 1980; 21:379-86.
94. Cook P G, Wells I P, Marshal A J: Case report: Renovascular hypertension in Takayasu's disease treated by percutaneous transluminal angioplasty. Clin Radiol 1986; 37:583-4.
95. Huddle K R, Doodha M I, MacKenzie M: Captopril in the treatment of renovascular hypertension secondary to Takayasu's arteritis: A case report. S Afr Med J 1986; 69:58-60.
96. Larneau P, Micheal J B: Renovascular hypertension and Takayasu's disease. J Urol 1985; 134:876-9.
97. Yoshimura M, Kida H, SaITO Y, et al: Peculiar glomerular lesions in Takayasu's arteritis. Clin Nephrol 1985; 24:120-7.
98. Green N B, Baughman R P, Kim C K: Takayasu's arteritis associated with interstitial lung disease and glomerulonephritis. Chest 1986; 89:605-6.
99. Lai K B, Chan K W, Ho C P: Glomerulonephritis associated with Takayasu's arteritis. Report of three cases and review of literature. Am J Kidney Dis 1986; 7:197-204.
100. Dash S C, Sharma R K, Malhotra K K, Bhuyan U N: Renal amyloidosis and non-specific aortoarteritis - a hitherto undescribed association. Post Grad Med J 1984; 60:626-8.
101. Takagi M, Ikeda T, Kimura K, et al: Renal histological studies in patients with Takayasu's arteritis. Report of three cases. Nephron 1984; 36:68-73.
102. Taieb A, Duffilot D, Pellegrincarloz B, et al: Postgranulomatous anetoderma associated with Takayasu's arteritis in a child. Arch Dermatol 1986; 123:796-800.
103. Perniciaro C, Winkleman R K: Cutaneous extravascular necrotizing granulomas in a patient with Takayasu's arteritis. Ach Dermatol 1986; 122:201-4.
104. Pantel R H, Goodman B W JR: Takayasu's arteritis: The relationship with tuberculosis. Pediatrics Jan 1981; 67:84-8.
105 Rush P J, Inman R, Reynolds W J: Rheumatoid arthritis after Takayasu's arteritis. J Rheumatol 1986; 13:427-30.
106. Ehrlich G: Takayasu's arteritis and Still's disease (letter). Arthritis Rheum 1979; 22:1422.
107. Rosser E: Takayasu's arteritis as a differential diagnosis of systemic juvenile chronic arthritis. Arc Dis Child 1979; 54:798-800.
108. Wilson W A, Morgan O S, Bain B, Taylor J E: Takayasu's arteritis: Association with Still's disease in an adult. Arthritis Rheum 1979; 22:634-8.
109. Hayes M M, Gwata T, Gelfand M: Takayasu's disease in association with probable Still's syndrome in a nine year old African male. Cent Afr Med 1978; 24:144.
110. Hall S, Nelson A M: Takayasu's arteritis and juvenile rheumatoid arthritis. J Rheumatol 1986; 13: 431-3.
111. Shimokawa H, Koiwaya V, Kaku T: Armuloaortic ectasia in case of Takayasu's arteritis associated with Hashimoto's disease. Br Heart J, 1983; 49:96-7.
112. Cowley M L, Hickling P, Wells I P, Marshall A J: Takayasu's disease and bilateral sacro-ilietis. Clin Exp Rheumatol 1983; 5:67-70.
113. Sketchler J J, Waxman J: Takayasu's arteritis diagnosed in a patient with long standing arthralgias and arthritis South Med J 1987; 80:516-8.
114. Achar K N, Al-Nakib B: Takayasu's arteritis and ulcerative colitis. Am J Gastroenterol 1986; 81:1215-17.
115. Miwa Y, Nagasako K, Sasaki H, et al: Aortitis syndrome associated with ulcerative colitis: Report of a case. Gastroenterol. Jpn 1979; 14:492-5.
116. Chapman R, Dawe C, Whorwell P J, Wright R: Ulcerative colitis in association with Takayasu's disease. Am J Dig Dis 1978; 23:660-2.
117. Kodama K, Kida O, Morotomi Y, Tanaka K: Male siblings with Takayasu's arteritis suggest genetic etiology. Heart Vessels 1906; 2:51-4.
118. Numano, F, Isohisa I, Maezawa H, Juji T: HLA-antigens in Takayasu's disease. Am. Heart J. 1979; 30:53-5.
119. Isohisa I, Numano F, Maezawa H, Sasazuki T: HLA-Bw52 in Takayasu's disease. Tissue Antigens 1978; 12:246-8.
120. Numano F, Isohisa I, Kishi U, Arita M, Maezawa H: Takayasu's disease in twin sisters. Possible genetic factors. Circulation 1978; 58:173.
121. Isohisa I, Numano F, Maezawa H, Saszuki T: Hereditary factors in Takayasu's disease. Angiology 1982; 33:98-104.
122. Makino N, Senda Y, Yamaguchi Y: Takayasu's disease in two brothers. Analysis of HLA types. Br Heart J 1981; 46:446-8.
123. Castro G, Chavez-Peon C, Sanches-Torres G, Reyes P A: HLA-A and B antigens in Takayasu's arteritis. Rev Invest Clin 1982; 34:15-17.
124. Moriuchi J, Wakisada A, Aizawa M, et al: HLA-linked susceptibility gene of Takayasu's diseaseHum Immunol 1982; 4:87-91.
125. Fauci A S, Haynes B G, Katz P: The spectrum of vasculitis, clinical, pathologic, immunologic and therapeutic considerations. Annals Int Med 1978; 89:660-76.
126. Nasu T: Pathology of pulseless disease. Angiology 1963; 14:225-42.

127. Nasu T: Takayasu's trunco-arteritis, pulseless disease or aortitis syndrome. Acta Pathol Jpn 1982; 32:1175-315.
128. Rose A G, Halper J, Factor S M: Primary arteriopathy in Takayasu's disease. Arch Pathol Lab Med 1984; 108:644-8.
129. Golding R L, Perri G, Cremin B J: Arteriographic manifestations of Takayasu's arteritis in children. Pediatr Radiol 1977; 5:224-30.
130. Yamato M, Lecky J W, Hiramatsu K, Kohda E: Takayasu's arteritis: Radiographic and angiographic findings in 59 patients. Radiology 1986; 161:329-34.
131. Lacombe P, Frija G, Kieffer E, et al: Eur J Radiol 1986; 6:202-5.
132. Stollman A, Mendelson D: Non-specific aotitis and large vessel arteritis in a 16-year old girl: CT and angiographic diagnosis. Mt Sinai J Med (NY) 1987; 54:337-40.
133. Tanaka H, Mihara K, Ookura H, et al: Echocardiographic findings in patients with aortitis syndrome. Angiology 1979; 30:620-33.
134. Hardoff R, Halon D, Front A: Radionucleotide demonstration of systemic arterial supply to the lungs in Takayasu's arteritis. Clin Nucl Med 1987; 12:479-81.
135. Amparo E G, Higgins E B, Hoddick W, et al: Magnetic Resonance Imaging of aortic disease: Preliminary results. AJR 1984; 143:1203-9.
136. Miller D L, Rrinig I W, Volkman D J: Vascular imaging with MRI: Inadequacy in Takayasu's arteritis compared with angiography. AJR 1986; 146:949-54.
137. Glazer H S, Gutierrez F R, Levitt R G, Lee J K, Murphy W A: The thoracic aorta studied by MR Imaging. Radiology 1985; 157:149-55.
136. Miller D L, Rrinig I W, Volkman D J: Vascular imaging with MRI: Inadequacy in Takayasu's arteritis compared with angiography. AJR 1986; 146:949-54.
137. Glazer H S, Gutierrez F R, Levitt R G, Lee J K, Murphy W A: The thoracic aorta studied by MR Imaging. Radiology 1985; 157:149-55.
138. Shelhmer J H, Volkman D J, Parrillo J E, Lawley T J, Johnston M R, Fauci A S: Takayasu's arteritis and its therapy. Annals Int Med 1985; 103:121-6.
139. Ishikawa K, Yonekawa Y: Regression of carotid stenosis after corticosteroid therapy in occlusive thromboaortopathy (Takayasu's disease). Stroke 1987; 18:677-9.
140. Lagneau P, Michael J B, Vuong P N: Surgical treatment of Takayasu's disease. Ann Surg 1987; 205:157-66.
141. Pajari R, Hekali P, Harjola P T: Treatment of Takayasu's arteritis: An analysis of 29 operated patients. Thorac Cardiovasc Surg 1986; 34:176-81.
142. Robbs J V, Human R R, Rajuruthnam P: Operative treatment of non-specific aortoarteritis (Takayasu's arterities). J Vasc Surg 1986; 3:605-16.
143. Moore J W, Reardon M J, Cooley D A, Vargo T A J Am Coll Cardiol 1985; 5:369-73.
144. Hodgins G W, Dutton J W: Subclavian and carotid angioplasties for Takayasu's arterities. J Can Assoc Radiol 1982; 33:205.
145. Tsai F Y, Matovich V, Hieshima G, et al: Percutaneous transluminal angioplasty of the carotid artery. AJNR 7:349-58.