Journal of Biosciences and Medicines, 2026, 14(4), 360-375
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Pediatric Takayasu Arteritis Unmasked by Serial FDG-PET/CT: A Case-Based Comprehensive Review and Practical Diagnostic Algorithm

Ricardo Donado-Botero[1*], Clara-Castiblanco Arroyave[1,2*], Jorge Lujan-Pinzón[3], Ana Hernandez-Villadiego[4], Juliana Cardoso-Prada[5], Camila Duran-Naizir[6], María Camila Rodriguez-Acosta[6], Andrés Ahumada-Uribe[6], Carolina Polo-Batista[6], Emil Fonseca-Padilla[6], Alexa Pinto-Mejia[6], Daniela Zuluaga-Ramos[6]

[1]Fundación para la investigación en Dermatologia (FUNINDERMA), Bogota, Colombia
[2]Universidad Libre, Barranquilla, Colombia
[3]Universidad del Sinú, Cartagena, Colombia
[4]Universidad de Cartagena, Cartagena, Colombia
[5]Department of General Medicine, Universidad CES, Medellín, Colombia
[6]Department of General Medicine, Universidad del Sinú, Cartagena, Colombia
Email: *rdonadob11@gmail.com, *claracastiblanco1@hotmail.com

How to cite this paper: Donado-Botero, R., Arroyave, C.-C., Lujan-Pinzón, J., Hernandez-Villadiego, A., Cardoso-Prada, J., Duran-Naizir, C., Rodriguez-Acosta, M.C., Ahumada-Uribe, A., Polo-Batista, C., Fonseca-Padilla, E., Pinto-Mejia, A. and Zuluaga-Ramos, D. (2026) Pediatric Takayasu Arteritis Unmasked by Serial FDG-PET/CT: A Case-Based Comprehensive Review and Practical Diagnostic Algorithm. *Journal of Biosciences and Medicines*, **14**, 360-375.
https://doi.org/10.4236/jbm.2026.144026

Received: March 9, 2026
Accepted: April 27, 2026
Published: April 30, 2026

Abstract

Background: Pediatric Takayasu arteritis (TA) often begins with nonspecific systemic inflammation, while classic vascular manifestations may be absent during the early inflammatory phase. This frequently results in diagnostic delay and exposes patients to progressive vascular injury. Structural imaging modalities such as magnetic resonance angiography (MRA) may be unrevealing before luminal compromise develops. In contrast, metabolic imaging with fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) can detect early vessel-wall inflammation. **Case Presentation:** We reported a 12-year-old male presenting with persistent systemic inflammatory symptoms and elevated acute-phase reactants. Initial diagnostic evaluation, including contrast-enhanced MRA of the aorta and its major branches, did not demonstrate definitive structural abnormalities. Despite negative structural imaging, clinical suspicion for large-vessel vasculitis remained high due to sustained inflammatory markers and evolving clinical features. An initial FDG-PET/CT was nondiagnostic; however, a repeat FDG-PET/CT performed in the context of ongoing inflammation demonstrated increased metabolic uptake along the aorta and primary branch vessels, consistent with active Takayasu arteritis. High-dose glucocorticoids were initiated

followed by steroid-sparing immunosuppression with methotrexate, resulting in clinical and laboratory improvement. **Review Aim and Methods:** Using this case as a framework, we conducted a comprehensive narrative review focusing on early pediatric TA presentation, diagnostic pitfalls, comparative imaging strategies (Doppler ultrasound, CTA, MRA, and FDG-PET/CT), and the role of serial metabolic imaging in cases with persistent inflammatory activity and inconclusive structural studies. **Key Insights:** Evidence suggests that FDG-PET/CT may detect inflammatory vascular activity preceding structural luminal changes. Serial metabolic imaging may therefore be particularly valuable in pediatric patients with sustained systemic inflammation and nondiagnostic initial MRA, helping reduce diagnostic delay and prevent irreversible arterial damage. **Conclusion:** In children with persistent inflammatory markers and high clinical suspicion for large-vessel vasculitis, a negative initial MRA should not exclude Takayasu arteritis. Serial FDG-PET/CT can unmask early inflammatory-phase disease and should be considered within a pragmatic diagnostic algorithm to facilitate timely diagnosis and treatment.

Keywords

Takayasu Arteritis, Pediatric Vasculitis, Large-Vessel Vasculitis, Positron Emission Tomography Computed Tomography, Magnetic Resonance Angiography, Vascular Inflammation, Early Diagnosis, Immunosuppressive Agents

1. Introduction

Takayasu arteritis (TA) is a chronic granulomatous large-vessel vasculitis primarily affecting the aorta and its major branches, with potential involvement of the pulmonary and coronary arteries. Although traditionally described in young adult women, pediatric-onset disease represents a distinct and particularly challenging clinical entity characterized by diagnostic delay, heterogeneous presentation, and a high risk of irreversible vascular damage at diagnosis [1].

The current classification framework most widely applied in children derives from the EULAR/PRINTO/PRES Ankara 2008 criteria, which require angiographic abnormalities of the aorta or its main branches plus at least one supporting clinical feature such as pulse deficit, blood pressure discrepancy, bruits, hypertension, or elevated acute-phase reactants [1]. Importantly, these criteria rely on imaging-confirmed vascular involvement, underscoring the central role of imaging in diagnosis.

Epidemiological data in children are limited but suggest that pediatric TA is rare, with reported annual incidence rates as low as 0.4 cases per million children in certain European populations [2]. Despite its rarity, TA represents the most common large-vessel vasculitis in childhood [2]. The principal clinical difficulty lies not in frequency but in recognition: early disease often manifests with nonspecific systemic inflammation—including prolonged fever, fatigue, weight loss,

and elevated erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP)—while classical vascular signs frequently emerge only after structural arterial damage has occurred.

Diagnostic delay in pediatric TA is well documented and clinically consequential. In a tertiary UK cohort, the median time to diagnosis was reported as 17 months, with hypertension present in approximately 73% of patients at diagnosis, suggesting that many cases are identified only after hemodynamically significant vascular involvement has developed [3]. More recent cohorts indicate that diagnostic delay may vary substantially depending on access to subspecialty care; a contemporary retrospective study evaluating childhood Takayasu arteritis and polyarteritis nodosa reported a median diagnostic delay of 13 weeks, though delays remained strongly associated with systemic inflammatory presentations and absence of overt vascular findings [4]. Systematic reviews further highlight the heterogeneity of reported delays and emphasize that laboratory biomarkers lack sufficient sensitivity and specificity to reliably distinguish active disease from other inflammatory conditions [5].

Imaging therefore plays a decisive role not only in classification but also in early detection. Conventional structural imaging modalities—including magnetic resonance angiography (MRA) and computed tomography angiography (CTA)—are designed to detect luminal stenosis, occlusion, aneurysm formation, or mural thickening. However, these findings may be absent during the early inflammatory phase, when vascular wall inflammation precedes measurable luminal compromise. Updated EULAR recommendations for imaging in large-vessel vasculitis (2023 update) endorse MRI/MRA as the preferred modality for Takayasu arteritis while recognizing that fluorodeoxyglucose positron emission tomography (FDG-PET), CT, or ultrasound may provide complementary information depending on clinical context [6].

FDG-PET/CT offers functional imaging by detecting increased glucose metabolism within inflamed vessel walls and may identify active disease before structural abnormalities become apparent. A systematic review and meta-analysis evaluating FDG-PET/CT in large-vessel vasculitis demonstrated pooled sensitivity of approximately 77% and specificity of 71% for detecting active disease, although heterogeneity in methodology and interpretation was noted [7]. Recent nuclear medicine literature further emphasizes standardized acquisition protocols and careful interpretation to distinguish inflammatory uptake from atherosclerotic or physiologic patterns [8].

We report the case of a 12-year-old male presenting with persistent systemic inflammation and sustained elevation of acute-phase reactants in whom initial contrast-enhanced MRA of the aorta and its major branches did not reveal definitive structural abnormalities. Despite negative structural imaging, clinical suspicion for large-vessel vasculitis remained high. Serial FDG-PET/CT ultimately demonstrated metabolically active large-vessel inflammation, establishing the diagnosis of Takayasu arteritis in its early inflammatory phase. Using this case as a

framework, we provide a comprehensive and practice-oriented review of pediatric Takayasu arteritis, focusing on early diagnostic pitfalls, limitations of laboratory markers, comparative imaging strategies, and a pragmatic algorithm for cases with persistent inflammatory activity and inconclusive initial studies.

2. Case Presentation

A previously healthy 12-year-old male was referred for evaluation of persistent systemic inflammation of unclear origin. The clinical course began approximately six weeks prior with intermittent low-grade fever, progressive fatigue, decreased physical endurance, and unintentional weight loss. There was no initial history of limb claudication, chest pain, focal neurological deficits, or visual disturbances. Physical examination at first evaluation revealed no pulse deficits or audible bruits, and peripheral pulses were symmetrical. Blood pressure measurements were within the upper-normal range for age.

Initial laboratory studies demonstrated marked systemic inflammation, with erythrocyte sedimentation rate (ESR) persistently elevated between 65 and 85 mm/h and C-reactive protein (CRP) levels ranging from 5 to 7 mg/dL. Mild normocytic anemia was present (hemoglobin 10.8 g/dL), while leukocyte and platelet counts remained within normal limits. Renal and hepatic function tests were unremarkable. Extensive infectious evaluation—including blood cultures, viral serologies, tuberculosis screening, and inflammatory infectious markers—was negative. Autoimmune testing, including antinuclear antibodies, anti-double-stranded DNA antibodies, antineutrophil cytoplasmic antibodies, and complement levels, did not reveal evidence of systemic autoimmune disease.

Differential diagnoses included occult infection (such as tuberculosis or endocarditis), malignancy—particularly lymphoma—and systemic inflammatory conditions such as systemic juvenile idiopathic arthritis. These were considered unlikely given negative microbiological studies, absence of suggestive imaging findings, and lack of disease-specific clinical or laboratory features.

Given the persistence of inflammatory markers and constitutional symptoms without an identifiable source, large-vessel vasculitis was considered in the differential diagnosis. Contrast-enhanced magnetic resonance angiography (MRA) of the thoracic and abdominal aorta and its major branches was performed to assess for structural vascular abnormalities. The study did not demonstrate significant luminal stenosis, aneurysmal changes, or clear mural thickening. No angiographic abnormalities meeting classification criteria for Takayasu arteritis were identified. At this stage, structural imaging was considered nondiagnostic.

Due to ongoing inflammation and absence of a definitive diagnosis, a short empirical course of systemic glucocorticoids was initiated (oral prednisone at approximately X mg/kg/day for X days). The initial FDG-PET/CT was performed shortly after this exposure. The patient experienced transient improvement in constitutional symptoms and partial reduction in CRP levels; however, inflammatory markers rebounded upon tapering, and systemic symptoms recurred. This

steroid-responsive but relapsing pattern strengthened suspicion of an underlying immune-mediated inflammatory process and raised the possibility that prior glucocorticoid exposure could have influenced early metabolic imaging findings.

In light of sustained inflammatory activity and nondiagnostic structural imaging, ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) was obtained to evaluate for occult malignancy or metabolically active inflammatory disease. FDG-PET/CT interpretation was based on visual grading comparing vascular uptake to hepatic uptake. The initial PET/CT study (**Figure 1**) demonstrated vascular uptake not exceeding liver background (visual grade ≤ 2), and was therefore considered nondiagnostic. No definitive evidence of active large-vessel vasculitis was established at that time. This result illustrated the potential limitation of single-time-point metabolic imaging in early inflammatory-phase disease, particularly in the context of recent glucocorticoid exposure.

Over the subsequent weeks, the patient continued to demonstrate persistent elevation of ESR and CRP, along with recurrent fatigue and intermittent fever. Serial blood pressure measurements began to reveal mild systolic hypertension, raising concern for evolving vascular involvement despite previously negative imaging. The coexistence of sustained inflammatory markers, partial glucocorticoid responsiveness with relapse upon taper, newly emerging hypertension, and absence of an alternative diagnosis created a clinically significant discordance between laboratory findings and imaging studies.

Recognizing that early Takayasu arteritis may manifest with active vascular inflammation prior to the development of detectable luminal changes, and that metabolic activity may evolve over time, repeat FDG-PET/CT was performed several weeks after steroid tapering and in the context of persistent inflammatory activity. The follow-up study (**Figure 2**) demonstrated increased FDG uptake greater than hepatic activity (visual grade ≥ 3) along the thoracic and abdominal aorta as well as the proximal segments of the subclavian and carotid arteries. The distribution and intensity of vascular hypermetabolism were consistent with active large-vessel vasculitis.

These findings, in conjunction with persistent systemic inflammation and evolving clinical features, established the diagnosis of Takayasu arteritis in its inflammatory phase. Although initial imaging did not fulfill EULAR/PRINTO/PRES classification criteria due to absence of angiographic abnormalities, the diagnosis was ultimately made based on integrated clinical, laboratory, and metabolic imaging findings, highlighting the distinction between clinical diagnosis and classification frameworks.

High-dose intravenous methylprednisolone pulses were administered, followed by oral glucocorticoid therapy. Given the risk of disease progression and the need to limit cumulative steroid exposure, methotrexate was initiated as steroid-sparing immunosuppressive therapy. Low-dose aspirin was introduced for vascular protection, and antihypertensive therapy was implemented to control blood pressure.

Within eight weeks of treatment initiation, the patient demonstrated complete resolution of constitutional symptoms, normalization of inflammatory markers, and stabilization of blood pressure. Clinical remission was achieved, and structured imaging surveillance was planned to monitor disease activity and prevent structural vascular progression.

This case illustrates the diagnostic complexity of pediatric Takayasu arteritis in its early inflammatory phase and underscores the importance of serial metabolic imaging when structural studies are initially inconclusive. In selected pediatric cases with persistent clinical suspicion, the diagnostic yield of repeat FDG-PET/CT may outweigh potential risks related to radiation exposure, particularly when early diagnosis can prevent irreversible vascular damage.

Table 1. Key characteristics of Takayasu arteritis in pediatric patients.

Feature	Pediatric Takayasu arteritis
Epidemiology	Rare; up to 20% - 30% of cases have onset in childhood or adolescence
Sex predominance	Female predominance
Initial presentation	Constitutional symptoms (fever, fatigue, weight loss)
Hypertension	Very common; often due to renal artery involvement
Pulse deficits	Often absent at early stages
Laboratory findings	Elevated ESR and CRP; nonspecific
Most affected vessels	Aorta and its main branches
Role of imaging	Central to diagnosis; serial imaging often required
FDG-PET/CT	Useful for detecting active inflammation, especially early disease
Pulmonary artery involvement	Less frequent than in adults
Prognosis	Generally better than adults with early diagnosis
Main causes of morbidity	Vascular damage, hypertension, delayed diagnosis

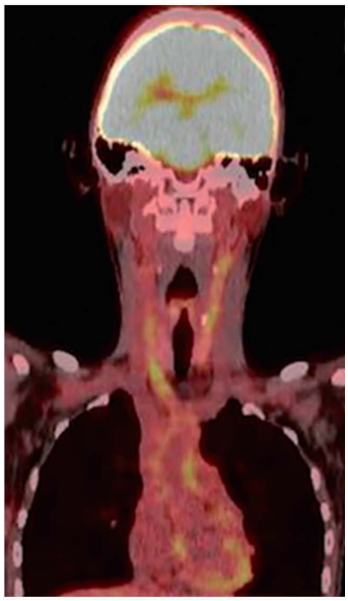

Figure 1. Initial FDG-PET/CT at first diagnostic evaluation.

Schematic representation adapted from FDG-PET/CT imaging obtained during the initial diagnostic workup, showing absence of significant ^{18}F-fluorodeoxyglucose uptake along the aorta and its major branches. This finding illustrates the limited sensitivity of early single-time-point imaging in pediatric Takayasu arteritis despite ongoing systemic inflammation.

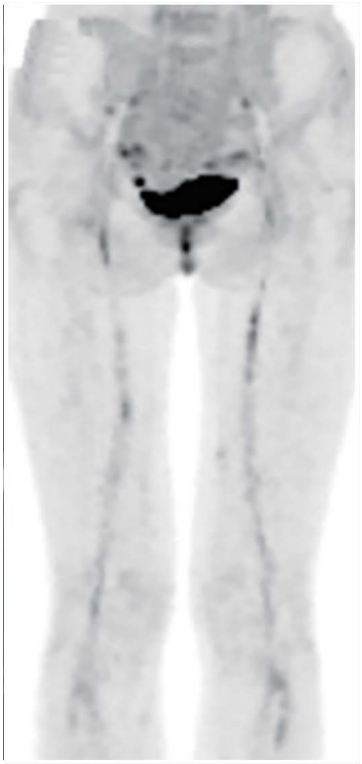

Figure 2. Follow-up FDG-PET/CT revealing active large-vessel vasculitis.

Adapted schematic representation of follow-up FDG-PET/CT demonstrating increased metabolic uptake along the carotid, subclavian, and aortic segments, consistent with active large-vessel vasculitis. Serial imaging was pivotal in establishing the diagnosis of Takayasu arteritis after initially negative studies.

3. Discussion

3.1. Pathophysiology and Immunopathogenesis of Pediatric Takayasu Arteritis

Takayasu arteritis (TA) is a chronic granulomatous vasculitis characterized by immune-mediated inflammation of large elastic arteries, predominantly the aorta and its major branches. Although its exact etiology remains incompletely understood, current evidence supports a complex interplay between genetic susceptibility, innate immune activation, and adaptive immune dysregulation leading to progressive vascular injury [9].

Histopathologically, TA is marked by panarteritis involving all layers of the vessel wall. Early inflammatory lesions are characterized by adventitial and medial

infiltration with mononuclear cells, including macrophages, CD4+ T lymphocytes, and natural killer cells. These immune cells promote granulomatous inflammation with multinucleated giant cells, elastic lamina destruction, and progressive medial necrosis [10]. As inflammation advances, intimal hyperplasia and fibrosis lead to luminal narrowing, stenosis, and, in some cases, aneurysm formation.

From an immunologic perspective, T helper 1 (Th1) and T helper 17 (Th17) pathways play a central role. Elevated levels of interferon-γ, interleukin-6 (IL-6), interleukin-17, and tumor necrosis factor-α (TNF-α) have been documented in active disease, supporting a cytokine-driven inflammatory cascade [11]. IL-6, in particular, correlates with systemic inflammatory activity and has emerged as a therapeutic target, as demonstrated by the efficacy of IL-6 receptor blockade in refractory large-vessel vasculitis [12].

In addition to adaptive immune activation, innate immune mechanisms contribute significantly to vascular injury. Dendritic cells located at the adventitial-medial junction appear to act as antigen-presenting cells, initiating T-cell-mediated responses within the vascular wall. Activation of toll-like receptors may further amplify inflammatory signaling [13]. Vascular smooth muscle cells and endothelial cells also participate in perpetuating inflammation through production of chemokines and adhesion molecules, promoting leukocyte recruitment and sustaining chronic vascular remodeling.

The disease course is often conceptualized in two overlapping phases: an early inflammatory phase and a later occlusive phase. During the inflammatory phase, systemic symptoms predominate and vascular wall inflammation may be present without significant luminal compromise. Structural imaging modalities may therefore appear normal or minimally altered. As the disease progresses, chronic inflammation leads to intimal proliferation, fibrosis, and irreversible luminal stenosis, which manifest clinically as pulse deficits, bruits, hypertension, and ischemic complications [14].

This biphasic model is particularly relevant in pediatric patients. Children frequently present during the inflammatory phase, when constitutional symptoms and elevated acute-phase reactants are prominent but classical vascular findings are absent. The absence of overt structural abnormalities on early angiographic imaging, as observed in the present case, likely reflects this pathophysiologic stage in which metabolic inflammation precedes measurable luminal remodeling.

Metabolic imaging with FDG-PET/CT capitalizes on increased glucose uptake by activated inflammatory cells within the vessel wall. Macrophage-rich granulomatous inflammation demonstrates heightened metabolic activity, enabling detection before structural damage becomes radiographically evident [15]. The evolution from an initially nondiagnostic PET/CT to subsequent demonstrable vascular hypermetabolism in this patient may reflect temporal progression of inflammatory burden to a threshold detectable by metabolic imaging.

Understanding this immunopathogenic sequence provides a mechanistic explanation for diagnostic delay and imaging discordance in early pediatric TA. It

also reinforces the rationale for serial imaging in cases where clinical suspicion remains high despite initially negative structural studies.

3.2. Clinical Manifestations and Early Diagnostic Pitfalls in Pediatric Takayasu Arteritis

Pediatric Takayasu arteritis frequently presents with a clinical phenotype distinct from that observed in adults. In children, early manifestations are predominantly systemic and inflammatory rather than ischemic. Prolonged fever, fatigue, malaise, and weight loss may precede overt vascular findings by weeks or even months, contributing to diagnostic uncertainty and delayed recognition [15]. This early inflammatory pattern often overlaps with infectious or hematologic conditions, complicating initial assessment.

Hypertension is among the most common and clinically significant findings in pediatric cohorts, frequently secondary to renal artery involvement. However, blood pressure elevation may initially be mild or intermittent and therefore overlooked, particularly in the absence of pulse deficits or bruits [16]. Classical vascular signs such as limb claudication, diminished pulses, or audible arterial bruits typically reflect more advanced structural disease and are often absent during early stages.

Elevated acute-phase reactants, particularly ESR and CRP, are consistently reported laboratory abnormalities in pediatric series. Nevertheless, these markers lack specificity and do not reliably correlate with the degree of vascular involvement or structural progression [17]. Moreover, inflammatory indices may transiently decrease with partial corticosteroid exposure, potentially obscuring underlying disease activity. In the present case, persistent elevation of inflammatory markers despite transient steroid responsiveness heightened suspicion for ongoing immune-mediated vascular inflammation.

A central diagnostic pitfall lies in the reliance on structural imaging modalities that primarily identify luminal abnormalities. During the early inflammatory phase, vascular wall inflammation may precede measurable stenosis or aneurysmal change, resulting in normal or inconclusive MRA or CTA findings. Such clinicoradiologic discordance has been described in pediatric cohorts and underscores the need for careful longitudinal evaluation [18].

The concept of "clinical-imaging discordance" is therefore fundamental in early pediatric Takayasu arteritis. Persistent unexplained systemic inflammation, steroid-responsive but relapsing disease, new-onset hypertension, and absence of alternative diagnoses should prompt consideration of inflammatory large-vessel vasculitis even in the context of initially negative angiographic studies. Failure to recognize this temporal mismatch may contribute to progression toward irreversible vascular remodeling.

Our patient exemplified these diagnostic challenges. The absence of luminal abnormalities on contrast-enhanced MRA initially reduced diagnostic certainty. However, sustained inflammatory activity, steroid dependence with relapse upon

tapering, and emerging blood pressure abnormalities maintained a high index of suspicion, ultimately justifying further metabolic investigation.

3.3. Imaging in Pediatric Takayasu Arteritis: Structural versus Metabolic Assessment and the Role of Serial Evaluation

Imaging plays a pivotal role in the diagnosis and longitudinal management of pediatric Takayasu arteritis. As summarized in **Table 1**, vascular involvement in children most commonly affects the aorta and its major branches, while classical vascular signs may be absent during early inflammatory stages. Consequently, imaging frequently becomes the primary diagnostic determinant.

Structural imaging techniques, including Doppler ultrasound, CTA, and MRA, remain fundamental for identifying luminal stenosis, aneurysm formation, and vessel wall thickening. MRA is often preferred in pediatric populations due to the absence of ionizing radiation and its ability to assess mural characteristics. However, these modalities are intrinsically limited to detecting anatomical changes and may fail to identify isolated mural inflammation without significant luminal compromise [19].

Metabolic imaging with ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) provides functional assessment by detecting increased glucose uptake within inflamed vessel walls. Activated macrophages and T lymphocytes demonstrate heightened metabolic activity, enabling visualization of inflammatory burden prior to irreversible structural remodeling. Studies evaluating FDG-PET/CT in large-vessel vasculitis have demonstrated its utility in identifying active inflammation and monitoring treatment response [20].

The comparative strengths and limitations of structural and metabolic imaging modalities in pediatric large-vessel vasculitis are summarized in **Table 2**. While structural techniques define anatomical consequences of disease, FDG-PET/CT offers insight into inflammatory activity. Importantly, sensitivity of PET imaging may be influenced by disease stage and prior immunosuppression. Very early disease or partial corticosteroid exposure may reduce detectable metabolic signal, potentially explaining nondiagnostic initial studies.

Serial imaging is therefore of particular importance in cases characterized by persistent inflammatory markers and inconclusive structural evaluation. Disease activity in Takayasu arteritis is dynamic, and inflammatory burden may evolve over time. In the present case, the initial FDG-PET/CT did not demonstrate definitive vascular hypermetabolism. However, continued elevation of inflammatory markers, steroid-dependent relapse, and emerging hypertension supported ongoing inflammatory activity. Repeat FDG-PET/CT subsequently revealed metabolically active large-vessel inflammation, thereby establishing the diagnosis.

This case reinforces the importance of integrating clinical, laboratory, and imaging findings rather than relying on single time-point studies. In pediatric patients with sustained systemic inflammation and high clinical suspicion for large-vessel vasculitis, repeat metabolic imaging should be considered even when initial

structural and functional evaluations are nondiagnostic. A pragmatic imaging-based diagnostic approach, incorporating complementary modalities and serial assessment, is outlined in Table 3.

Table 2. Comparative imaging modalities in pediatric Takayasu arteritis.

Modality	Primary Target	Strengths	Limitations	Best Clinical Use
Doppler Ultrasound	Superficial arteries (carotid, renal)	No radiation; bedside availability; hemodynamic assessment	Operator-dependent; limited deep vessel visualization; limited thoracic aorta assessment	Initial screening in suspected renal or carotid involvement; hypertension evaluation
Computed Tomography Angiography (CTA)	Luminal anatomy	High spatial resolution; rapid acquisition	Ionizing radiation; limited inflammatory wall characterization	Assessment of stenosis, aneurysm, and surgical planning
Magnetic Resonance Angiography (MRA)	Luminal and mural anatomy	No radiation; wall thickening and edema evaluation	May miss isolated early inflammatory activity; longer acquisition time	First-line structural imaging in pediatric patients
Conventional Angiography	Luminal detail	Gold standard for luminal stenosis; interventional capability	Invasive; radiation; does not assess inflammation	When endovascular intervention is planned
FDG-PET/CT	Metabolic inflammatory activity	Detects early vascular inflammation before luminal change; whole-body assessment	Radiation exposure; cost; interpretation variability; reduced sensitivity after steroids	Persistent inflammatory markers with nondiagnostic structural imaging; assessment of disease activity; suspected relapse

Table 3. Proposed pragmatic diagnostic algorithm for suspected pediatric Takayasu arteritis.

Step	Clinical Scenario	Recommended Action	Rationale
1	Persistent systemic inflammation without clear etiology	Exclude infection, malignancy, and systemic autoimmune disease	Rule out more common causes before considering vasculitis
2	Elevated ESR/CRP ± constitutional symptoms	Assess blood pressure, pulse symmetry, bruits	Identify early vascular "red flags"
3	Clinical suspicion of large-vessel involvement	Perform contrast-enhanced MRA (preferred)	Evaluate structural abnormalities
4	Nondiagnostic MRA but persistent inflammation	Consider FDG-PET/CT	Detect inflammatory-phase disease before structural damage
5	Initial PET/CT nondiagnostic but high suspicion persists	Repeat metabolic imaging	Disease activity may evolve over time
6	Confirmed metabolic or structural vascular involvement	Initiate high-dose glucocorticoids ± steroid-sparing agent	Prevent irreversible vascular remodeling
7	Established diagnosis under treatment	Serial clinical, laboratory, and imaging monitoring	Detect relapse and prevent progression

3.4. Treatment Strategies and Long-Term Monitoring in Pediatric Takayasu Arteritis

The therapeutic management of pediatric Takayasu arteritis aims to suppress active vascular inflammation, prevent irreversible structural damage, control hypertension and ischemic complications, and minimize long-term treatment-related toxicity. Early recognition and prompt initiation of immunosuppressive therapy are critical to reducing cumulative vascular injury and improving long-term outcomes.

High-dose systemic glucocorticoids remain the cornerstone of initial therapy. Intravenous methylprednisolone pulses are frequently administered in cases with significant inflammatory activity, followed by oral prednisone with gradual tapering. Although most pediatric patients demonstrate rapid clinical and biochemical improvement, relapse during tapering is common, and prolonged steroid exposure is associated with substantial morbidity, particularly in children, including growth impairment, metabolic complications, and bone demineralization [21].

For this reason, early introduction of steroid-sparing immunosuppressive agents is generally recommended. Methotrexate is among the most frequently used first-line adjunctive therapies in pediatric cohorts and has demonstrated efficacy in maintaining remission and reducing cumulative glucocorticoid dose [22]. Pediatric cohort studies further support early immunosuppressive therapy in childhood-onset Takayasu arteritis, showing improved disease control and reduced relapse rates when treatment is initiated promptly [23]-[25]. Alternative conventional immunosuppressive agents include azathioprine and mycophenolate mofetil, particularly in cases with intolerance or suboptimal response.

In refractory or relapsing disease, biologic therapies targeting specific inflammatory pathways have emerged as important therapeutic options. Tumor necrosis factor inhibitors and interleukin-6 receptor blockade have shown promising results in controlling disease activity and achieving sustained remission in patients with inadequate response to conventional therapy [12]. Importantly, pediatric-specific data increasingly support the use of targeted biologic therapies in children with refractory Takayasu arteritis, reinforcing their role beyond extrapolation from adult populations [24].

Adjunctive management is equally essential. Hypertension, frequently secondary to renal artery involvement, requires aggressive control to reduce long-term cardiovascular risk. Low-dose antiplatelet therapy is commonly employed for vascular protection, although high-quality pediatric-specific evidence remains limited [25].

Long-term monitoring requires an integrated approach combining clinical evaluation, laboratory markers, and serial imaging. While ESR and CRP are useful for detecting systemic inflammation, they do not reliably reflect vascular wall activity. Structural imaging is necessary to monitor progression of stenosis or aneurysm formation, whereas metabolic imaging may provide additional information regarding inflammatory activity, particularly in cases of clinical uncertainty. The

optimal frequency and modality of surveillance imaging remain individualized and guided by disease severity and therapeutic response [26]. Pediatric cohort data emphasize the importance of early detection of disease activity and structured follow-up to prevent long-term vascular sequelae [23].

The present case illustrates the importance of early steroid-sparing therapy and structured longitudinal monitoring. Prompt initiation of high-dose glucocorticoids followed by methotrexate resulted in rapid normalization of inflammatory markers and stabilization of blood pressure. Planned serial imaging aims to detect potential recurrence or structural progression at an early stage.

Taken together, therapeutic management of pediatric Takayasu arteritis requires timely immunosuppression, careful tapering strategies, aggressive cardiovascular risk control, and individualized imaging surveillance to prevent long-term vascular sequelae. Importantly, pediatric disease should not be considered a mere extension of adult Takayasu arteritis, as differences in presentation, disease course, and treatment response underscore the need for age-specific diagnostic and therapeutic approaches.

4. Conclusions

Pediatric Takayasu arteritis represents a diagnostic challenge driven not only by its rarity but by its pathophysiologic timing. Children frequently present during the early inflammatory phase, when systemic manifestations and elevated acute-phase reactants precede overt structural vascular abnormalities. In this context, reliance on single time-point structural imaging may result in false reassurance and diagnostic delay.

This case illustrates the critical importance of maintaining a high index of suspicion in children with persistent unexplained systemic inflammation, steroid-responsive but relapsing disease, and emerging vascular features such as hypertension. The absence of luminal abnormalities on initial MRA did not exclude active large-vessel vasculitis. Serial FDG-PET/CT imaging ultimately demonstrated metabolically active vascular inflammation, thereby unmasking disease during its inflammatory phase and allowing timely initiation of targeted immunosuppressive therapy.

Early recognition and integration of clinical, laboratory, and complementary imaging findings are essential to prevent progression toward irreversible vascular remodeling. A pragmatic diagnostic approach incorporating structural and metabolic imaging, particularly in cases of clinicoradiologic discordance, may reduce diagnostic delay and improve long-term outcomes in pediatric Takayasu arteritis.

Clinical Takeaways

1) Persistent systemic inflammation in children without an identifiable cause should prompt consideration of large-vessel vasculitis, even in the absence of classic vascular signs.

2) A negative structural imaging study (MRA or CTA) does not exclude early

inflammatory-phase Takayasu arteritis.

3) Steroid-responsive but relapsing inflammatory patterns may signal underlying immune-mediated vascular disease.

4) Emerging or unexplained hypertension in a child with systemic inflammation is a critical red flag for possible renal artery involvement.

5) FDG-PET/CT provides functional assessment of vascular inflammation and may detect disease activity before structural luminal changes are apparent.

6) Serial imaging should be considered when clinicobiochemical activity persists despite nondiagnostic initial studies.

7) Early steroid-sparing immunosuppression and structured longitudinal monitoring are essential to prevent irreversible vascular damage.

Ethical Considerations

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent for publication was obtained from the patient's legal guardians, and ethics committee approval was obtained/waived according to local regulations.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ozen, S., Pistorio, A., Iusan, S.M., Bakkaloglu, A., Herlin, T., Brik, R., *et al.* (2010) EULAR/PRINTO/PRES Criteria for Henoch-Schönlein Purpura, Childhood Polyarteritis Nodosa, Childhood Wegener Granulomatosis and Childhood Takayasu Arteritis: Ankara 2008. Part II: Final Classification Criteria. *Annals of the Rheumatic Diseases*, **69**, 798-806. https://doi.org/10.1136/ard.2009.116657

[2] Aeschlimann, F.A., Twilt, M. and Yeung, R.S.M. (2020) Childhood-Onset Takayasu Arteritis. *European Journal of Rheumatology*, **7**, S58-S66. https://doi.org/10.5152/eurjrheum.2019.19195

[3] Eleftheriou, D., Varnier, G., Dolezalova, P., McMahon, A., Al-Obaidi, M. and Brogan, P.A. (2015) Takayasu Arteritis in Childhood: Retrospective Experience from a Tertiary Referral Centre in the United Kingdom. *Arthritis Research & Therapy*, **17**, Article No. 36. https://doi.org/10.1186/s13075-015-0545-1

[4] Ercan Emreol, H., Başaran, O., Bayındır, Y., Cam, V., Ünal, D., Erkan, M.O., *et al.* (2026) Clinical and Laboratory Predictors of Diagnostic Delay in Childhood Takayasu Arteritis and PAN: A Retrospective Cohort Study. *Rheumatology*, **65**, keaf661. https://doi.org/10.1093/rheumatology/keaf661

[5] Peremans, L., Twilt, M., Benseler, S.M., Grisaru, S., Kirton, A., Myers, K.A., *et al.* (2024) Real-World Biomarkers for Pediatric Takayasu Arteritis. *International Journal of Molecular Sciences*, **25**, 7345. https://doi.org/10.3390/ijms25137345

[6] Dejaco, C., Ramiro, S., Bond, M., Bosch, P., Ponte, C., Mackie, S.L., *et al.* (2024) EULAR Recommendations for the Use of Imaging in Large Vessel Vasculitis in Clinical Practice: 2023 Update. *Annals of the Rheumatic Diseases*, **83**, 741-751. https://doi.org/10.1136/ard-2023-224543

[7] van der Geest, K.S.M., Treglia, G., Glaudemans, A.W.J.M., Brouwer, E., Sandovici,

M., Jamar, F., *et al*. (2021) Diagnostic Value of [^{18}F]FDG-PET/CT for Treatment Monitoring in Large Vessel Vasculitis: A Systematic Review and Meta-analysis. *European Journal of Nuclear Medicine and Molecular Imaging*, **48**, 3886-3902. https://doi.org/10.1007/s00259-021-05362-8

[8] Slart, R.H.J.A., Nienhuis, P.H., Glaudemans, A.W.J.M., Brouwer, E., Gheysens, O. and van der Geest, K.S.M. (2023) Role of ^{18}F-FDG PET/CT in Large Vessel Vasculitis and Polymyalgia Rheumatica. *Journal of Nuclear Medicine*, **64**, 515-521. https://doi.org/10.2967/jnumed.122.265016

[9] Weyand, C.M. and Goronzy, J.J. (2003) Medium- and Large-Vessel Vasculitis. *New England Journal of Medicine*, **349**, 160-169. https://doi.org/10.1056/nejmra022694

[10] Arnaud, L., Haroche, J., Mathian, A., Gorochov, G. and Amoura, Z. (2011) Pathogenesis of Takayasu's Arteritis: A 2011 Update. *Autoimmunity Reviews*, **11**, 61-67. https://doi.org/10.1016/j.autrev.2011.08.001

[11] Misra, D.P., Wakhlu, A., Agarwal, V. and Danda, D. (2019) Recent Advances in the Management of Takayasu Arteritis. *International Journal of Rheumatic Diseases*, **22**, 60-68. https://doi.org/10.1111/1756-185x.13285

[12] Nakaoka, Y., Isobe, M., Takei, S., Tanaka, Y., Ishii, T., Yokota, S., *et al*. (2018) Efficacy and Safety of Tocilizumab in Patients with Refractory Takayasu Arteritis: Results from a Randomised, Double-Blind, Placebo-Controlled, Phase 3 Trial in Japan (the TAKT Study). *Annals of the Rheumatic Diseases*, **77**, 348-354. https://doi.org/10.1136/annrheumdis-2017-211878

[13] Pryshchep, O., Ma-Krupa, W., Younge, B.R., Goronzy, J.J. and Weyand, C.M. (2008) Vessel-Specific Toll-Like Receptor Profiles in Human Medium and Large Arteries. *Circulation*, **118**, 1276-1284. https://doi.org/10.1161/circulationaha.108.789172

[14] Kerr, G.S., Hallahan, C.W., Giordano, J., Leavitt, R.Y., Fauci, A.S., Rottem, M., *et al*. (1994) Takayasu Arteritis. *Annals of Internal Medicine*, **120**, 919-929. https://doi.org/10.7326/0003-4819-120-11-199406010-00004

[15] Brunner, J., Feldman, B.M., Tyrrell, P.N., Kuemmerle-Deschner, J.B., Zimmerhackl, L.B., Gassner, I., *et al*. (2010) Takayasu Arteritis in Children and Adolescents. *Rheumatology*, **49**, 1806-1814. https://doi.org/10.1093/rheumatology/keq167

[16] Szugye, H.S., Zeft, A.S. and Spalding, S.J. (2014) Takayasu Arteritis in the Pediatric Population: A Contemporary United States-Based Single Center Cohort. *Pediatric Rheumatology*, **12**, Article No. 21. https://doi.org/10.1186/1546-0096-12-21

[17] Tombetti, E. and Mason, J.C. (2019) Takayasu Arteritis: Advanced Understanding Is Leading to New Horizons. *Rheumatology*, **58**, 206-219. https://doi.org/10.1093/rheumatology/key040

[18] Goel, R., Kumar, T.S., Danda, D., Joseph, G., Jeyaseelan, V., Surin, A.K., *et al*. (2014) Childhood-Onset Takayasu Arteritis—Experience from a Tertiary Care Center in South India. *The Journal of Rheumatology*, **41**, 1183-1189. https://doi.org/10.3899/jrheum.131117

[19] Tso, E., Flamm, S.D., White, R.D., Schvartzman, P.R., Mascha, E. and Hoffman, G.S. (2002) Takayasu Arteritis: Utility and Limitations of Magnetic Resonance Imaging in Diagnosis and Treatment. *Arthritis & Rheumatism*, **46**, 1634-1642. https://doi.org/10.1002/art.10251

[20] Belhocine, T., Blockmans, D., Hustinx, R., Vandevivere, J. and Mortelmans, L. (2003) Imaging of Large Vessel Vasculitis with 18 FDG PET: Illusion or Reality? A Critical Review of the Literature Data. *European Journal of Nuclear Medicine and Molecular Imaging*, **30**, 1305-1313. https://doi.org/10.1007/s00259-003-1209-y

[21] Koster, M.J., Matteson, E.L. and Warrington, K.J. (2015) Large-Vessel Vasculitis: Di-

agnosis and Management. *Rheumatic Disease Clinics of North America*, **41**, 33-46.

[22] Comarmond, C., Biard, L., Lambert, M., Mekinian, A., Ferfar, Y., Kahn, J., *et al*. (2017) Long-Term Outcomes and Prognostic Factors of Complications in Takayasu Arteritis: A Multicenter Study of 318 Patients. *Circulation*, **136**, 1114-1122. https://doi.org/10.1161/circulationaha.116.027094

[23] Batu, E.D., Sönmez, H.E., Hazırolan, T., Bilginer, Y. and Özen, S. (2017) Long-Term Follow-Up Results and Disease Outcome of Children with Takayasu Arteritis. *The Journal of Rheumatology*, **44**, 1328-1335.

[24] Goel, R., Danda, D., Kumar, S., Joseph, G. and Jeyaseelan, V. (2018) Childhood-Onset Takayasu Arteritis: Long-Term Outcome and Prognostic Factors. *Seminars in Arthritis and Rheumatism*, **47**, 900-905. https://doi.org/10.1016/j.semarthrit.2017.09.014

[25] Mason, J.C. (2010) Takayasu Arteritis—Advances in Diagnosis and Management. *Nature Reviews Rheumatology*, **6**, 406-415. https://doi.org/10.1038/nrrheum.2010.82

[26] Slart, R.H.J.A., *et al*. (2018) FDG-PET/CT(A) Imaging in Large Vessel Vasculitis and Polymyalgia Rheumatica: Joint Procedural Recommendation of the EANM, SNMMI, and the PET Interest Group (PIG), and Endorsed by the ASNC. *European Journal of Nuclear Medicine and Molecular Imaging*, **45**, 1250-1269. https://doi.org/10.1007/s00259-018-3973-8