Supplementary Information

Cardiovascular Imaging in Psoriasis: A Critical Review of Current Evidence, Techniques, and Therapeutic Implications

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Table S1. Cardiovascular imaging in moderate-to-severe psoriasis: Study-level details of the quantitative findings in the reviewed literature.

Reference, study design	Diagnosis (n), observations	Outcomes	Effects of treatments
Transthoracic Doppler Echocardiography (TTE)			
Osto et al. [13] **Cohort study**	Psoriasis, (56) mean age 37 years	CFR: 3.2 vs 3.7 (p = 0.02) in psoriasis vs controls PASI: 11 vs 7 (p = 0.006) with CFR ≤2.5 vs CFR > 2.5 Predictors of CMD: Disease duration > 6 years (OR 1.9; p = 0.03) and PsA (OR 2.9; p = 0.03)	NA
Gullu et al. [27] **Cross-sectional study**	Psoriasis (36)	CFR: 2.19 vs 2.60 (p<0.0001) in psoriasis vs controls Inverse correlation between CFR and PASI (r = -0.359) Inverse correlation between CFR and disease duration (r = −0.418; p = 0.01)	NA
Ikonomidis et al. [21] **Cross-sectional study**	Psoriasis (185), PsA (126)	CFR: 2.19 vs 3.4 (p<0.05) in psoriasis vs controls 2.75 vs 2.96 (p=0.045) in PsA vs psoriasis alone	NA
Jain et al. [25] **Meta-analysis**	Psoriasis (557)	CFR impairment: pooled SMD −0.71 (95% CI: −0.97 to −0.45; p < 0.00001)	NA
Piaserico et al. [10]	Psoriasis (153)	CMD:	NA

Retrospective study		Risk of MACE: OR 9.9 (95% CI 6.1–15.8; p < 0.0001) in patients with CFR ≤2.5 CMD associated with: severe psoriasis (OR 3.1, p = 0.03), psoriatic arthritis (OR 2.9, p = 0.03), disease duration >6 years (OR 1.9, p = 0.03). Patients with CFR ≤2.5 had a lower survival free from events (p < 0.0001)	
Piaserico et al. [23] Prospective study	Psoriasis (37)	Baseline CFR was impaired, with a substantial proportion of patients showing CMD (CFR ≤2.5)	TNF inhibitor therapy: CFR from 2.2 to 3.02 (p < 0.0001) CFR from 1.88 to 2.74 (p < 0.0001) in patients with baseline CFR ≤2.5
Piaserico et al. [24] Cohort study	Psoriasis (448)	CMD: 31.5% of patients Associated with PASI, disease duration and PsA (+1 point PASI and +1 year of psoriasis duration associated with 5.8% and 4.6% increased risk of CMD, respectively)	NA
Coronary Computed Tomography Angiography (CCTA)			
Lerman et al. [46] Prospective study	Psoriasis (105)	Total plaque burden vs controls: 1.22 vs 1.04 (p = 0.001) non-calcified burden vs controls: 1.18 vs 1.03 (p = 0.004) non-calcified burden vs hyperlipidemic controls: 1.18 vs. 1.11 (p=0.02)	Systemic/biologic therapies (methotrexate, TNF, IL-12/23, and IL-17 inhibitors): improvements in total and non-calcified plaque burden in patients whose PASI decreased (β = 0.45 and β = 0.53, respectively; p < 0.001)
Joshi et al. [47]	Psoriasis (190)	Non-calcified plaque burden:	NA

Cross-sectional study		β = 0.49 (p < 0.001)	
Elnabawi et al. [8] Prospective study	Psoriasis (215)	Non-calcified plaque burden: Independent correlation with PASI score (β = 0.20; p < 0.001)	Biologic therapy for 1 year: non-calcified plaque burden -6% (p = 0.005) necrotic core volume decreased (p = 0.03). Plaque regression Δ -0.07 mm^2 vs. 0.06 mm^2 (p = 0.02) in biologic-treated patients compared to non-biologics
Chen et al. [53] Meta-analysis	Psoriasis (1287)	EAT on echocardiography: Increased in psoriasis (SMD 2.45; 95% CI 0.73–4.17), EAT on single-slice CT: enlarged EAT area in psoriatic patients (SMD 0.45; 95% CI 0.14–0.76). EAT on CT: no difference in EAT volume between patients and controls (SMD 0.32; 95% CI −0.06 to 0.70)	NA
Bao et al. [9] Prospective study	Psoriasis (98)	PFAI: −80.19 vs −78.14 HU (p < 0.001) in psoriasis vs controls	NA
Elnabawi et al. [57] Prospective study	Psoriasis (134), moderate to severe	Low traditional cardiovascular risk; moderate-to-severe psoriasis; similar baseline PFAI and plaque prevalence in treated and untreated groups	One year of biologic therapy: PFAI −71.22 to −76.09 HU (p < 0.001)
O'Hagan et al. [52]	Psoriasis (66)	Following biologic therapy, a trend toward reduced EAT volume was observed (p = 0.053)	Biologic therapy: total arterial plaque burden 1.24 to 1.13 mm^2 (p = 0.035) non-calcified plaque 1.19 to 1.07 mm^2 (p = 0.040)

Longitudinal study			fibrous burden 0.88 to 0.82 mm^2 (p = 0.006)
Positron Emission Tomography (FDG-PET/CT)			
Naik et al. [63] Prospective case-control study	Psoriasis (60) with mild–moderate disease; low traditional cardiovascular risk	FDG uptake: elevated in aortic segments compared to controls (mean β = 0.33; p < 0.001) aortic target-to-background ratio correlating with PASI score (β = 0.41; p = 0.001),	NA
Kaiser et al. [64] Cross-sectional study	Psoriasis (83), half had established CVD	PET-PASI: strong correlation with clinical PASI (r = 0.53; p < 0.001)	NA
Groenendyk et al. [66] Longitudinal cohort study	Psoriasis (165)	AWT: Correlation with PASI (ρ = 0.20; p = 0.01). Correlation with FDG uptake in the aortic wall at baseline (unadjusted β = 0.27; p = 0.001; adjusted β = 0.21; p = 0.01)	Treatment for 1 year: decreased AWT associated with reduced FDG uptake (β = 0.33; p = 0.02)
Rose et al. [65] Cross-sectional study	Psoriasis (10), RA (5)	Mean metabolic volumetric product: Elevated with β = 0.31–1.47 (p < 0.001) and β = 0.15–0.69 (p < 0.05) in psoriasis and in RA, respectively, compared to healthy controls	NA
Cardiovascular Magnetic Resonance (CMR)			
Gröschel et al. [11] Prospective study	Psoriasis (60), using systemic immunomodulators and with median PASI 2.6	Global radial and circumferential strain: reduced (p < 0.001) Global T1 times and ECV: elevated LGE: 28.3% non-ischemic fibrosis T2 mapping: no active inflammation	NA

Goldenberg et al. [82] Retrospective study	Psoriasis (47), including with suspect cardiac disease	Adjusted septal T2 time: increased compared to controls (p = 0.048)	NA
Carotid and Femoral Ultrasound			
Gonzalez-Juanatey et al. [84] Cohort study	PsA (50)	FMD% on brachial ultrasound: mean, median [range] 6.3%, 6.1% [0.3-13.4%] vs 8.2%, 8.2% [0.0-21.2%] (p = 0.008) vs controls	NA
Eder et al. [86] Case-control study	PsA (40)	CIMT: mean +/- standard deviation, 1.04 +/- 0.35 mm vs 0.88 +/- 0.29 (p = 0.03) vs controls Carotid plaque index: 2.3 +/- 2.6 vs 1.12 +/- 2.09 (p = 0.03) vs matched controls	NA
Enany et al. [87] Cross-sectional study	Psoriasis (50), moderate-to-severe	CIMT: increased compared to healthy controls correlation with PASI and with disease duration and PASI	NA
Bańska-Kisiel et al. [88] Cross-sectional study	Psoriasis (74), mild or moderate	mean CCA CIMT: mean 1.03 ±0.37 mm correlation with PASI (r = 0.33; p = 0.007) but not with disease duration	NA
Piros et al. [90] Prospective study	Psoriasis (31), severe	Baseline carotid, brachial and femoral IMT frequently above age-adjusted normal; non-	IL-17 inhibitors for 6 months: CIMT from 1.1 mm to 0.8 mm (p < 0.001) and from 1.1 mm to 0.7 mm (p < 0.001) in the right and in the left carotid, respectively

		calcified plaques present in a substantial proportion of patients.	
Gonzalez-Cantero et al. [91] Cross-sectional study	Psoriasis (70), moderate to severe	Prevalence of femoral plaques: 44.64vs 19.07% (p<0.005) vs controls Prevalence of carotid plaques: numerically higher in psoriasis, not significant (p = 0.30)	NA
Arterial stiffness and arterial tonometry			
Ikonomidis et al. [20] Cross-sectional study	Psoriasis (59)	cf-PWV: 10.4 vs 8.6 m/s (p < 0.001) compared to healthy controls	NA
Gisondi et al. [95] Cross-sectional study	Psoriasis (39), moderate to severe	higher cf-PWV: 8.88 vs 7.57 (unadjusted p = 0.001; adjusted p = 0.03) vs controls with other skin diseases Arterial stiffness and psoriasis duration positively correlated (r = 0.58; P = 0.0001)	NA
Makavos et al. [96] Prospective study	Psoriasis (298), moderate to severe, 4-year follow up for MACEs	PWV at baseline: Average 10.75 ± 2.5 m/s Higher PWV associated with increased MACE risk: HR 1.16 (p = 0.049 with univariate Cox regression analysis)	Biologic therapy for 6 months: PWV 10.20 ± 1.8 m/s (p < 0.001) PWV from 10.67 to 10.13 (p < 0.001) in patients free from MACE PWV from 11.50 to 11.02 m/s (p = 0.05) in patients with MACE
Agoglia et al. [97] Cross-sectional study	Psoriasis (80)	cf-PWV ≥10 m/s (increased arterial stiffness) in 21.2% Arterial stiffness associated with: older age OR = 1.21 (p = 0.003)	NA

		cumulative methotrexate exposure > 1500 mg OR = 0.18 (p = 0.033)	
Cohen-Barak et al. [99] Prospective study	Psoriasis (26), moderate-to-severe	Baseline RHI frequently abnormal; short-term antipsoriatic treatment improved PASI but not RHI	Systemic treatment or phototherapy for 8-12 weeks: RHI: 1.73 ± 0.48 vs. 1.66 ± 0.35 (p = n.s.) despite clinical improvement; trend toward worsening in patients with normal baseline RHI
Nakao et al. [100] Prospective study	Psoriasis (15)	Overall RHI unchanged despite PASI improvement; early decline in RHI identified long-term nonresponders	Two infliximab infusion: median RHI 2.31 to 1.96 (p = 0.49) Decline in RHI predicted non-response (100% specificity)
Ortolan et al. [101] Prospective study	PsA (32)	Over 5 years, carotid IMT and plaque burden increased in the first 2 years then stabilized; FMD values showed no significant change	Anti TNF for 5 years: FMD: stable despite reductions in CRP and disease activity
Von Stebut et al. [102] Randomized trial	Psoriasis (151)	Baseline FMD lower in psoriasis vs volunteers; no significant FMD difference vs placebo at 12 weeks; FMD increased at 52 weeks	Anti-IL-17A for 1 year: FMD modestly improved

Abbreviations:

AWT, aortic wall thickness; CAC, coronary artery calcium; CCA, common carotid artery; CCTA, coronary computed tomography angiography; CFR, coronary flow reserve; cf-PWV, carotid–femoral pulse wave velocity; CI, confidence interval; CIMT, carotid intima-media thickness; CMD, coronary microvascular dysfunction; CMR, cardiovascular magnetic resonance; CT, computed tomography; CVD, cardiovascular disease; EAT, epicardial adipose tissue; FDG, fluorodeoxyglucose; FDG-PET/CT, fluorodeoxyglucose positron emission tomography/computed tomography; FMD, flow-mediated dilation; FMD%, flow-mediated dilation percentage; HU, Hounsfield unit; IL, interleukin; IMT, intima-media thickness; MACE, major adverse cardiovascular events; NA, not assessed; OR, odds ratio; PASI, psoriasis area and severity index; PET, positron emission tomography; PFAI, perivascular fat attenuation index; PsA, psoriatic arthritis; PWV, pulse wave velocity; RA, rheumatoid arthritis; RHI, reactive hyperemia–peripheral arterial tonometry index; SMD, standardized mean difference; TNF, tumor necrosis factor.