

Prevalence of Ambulatory Hypertension, Hemodynamic Phenotypes, and Subclinical Myocardial Dysfunction After Coarctation of the Aorta Repair

Prévalence de l'hypertension artérielle ambulatoire, des phénotypes hémodynamiques et de la dysfonction myocardique infraclinique après correction chirurgicale de la coarctation de l'aorte

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ABSTRACT

Introduction: Arterial hypertension is the leading long-term complication after coarctation of the aorta (CoA) repair. Ambulatory blood pressure monitoring (ABPM) phenotyping combined with speckle-tracking echocardiography remains undercharacterized in pediatric and young adult cohorts, with no data from North Africa.

Aim: To describe the prevalence and hemodynamic phenotypes of ABPM-defined hypertension, evaluate subclinical myocardial dysfunction by global longitudinal strain (GLS), and identify independent predictors of ambulatory hypertension after CoA repair.

Methods: A cross-sectional study at CHU Sahloul, Sousse, Tunisia, included 30 patients aged 5 to 30 years after isolated CoA repair. ABPM was classified using age-appropriate guidelines. Speckle-tracking-derived GLS was assessed in all patients. Predictors of ABPM-defined hypertension were identified by multivariable logistic regression.

Results: ABPM-defined hypertension was identified in 13 patients (43.3%): sustained ambulatory hypertension in 11 (36.7%) and masked hypertension in 2 (6.7%). White-coat hypertension was absent. Left ventricular hypertrophy (LVH) was present in 7 patients (23.3%) and reduced GLS in 8 (26.7%) despite universally preserved left ventricular ejection fraction (LVEF, mean $57.5 \pm 3.1\%$). The peak isthmus Doppler gradient was the sole independent predictor of ABPM-defined hypertension (adjusted OR 1.16 per mmHg; 95% CI 1.03 to 1.31; $p = 0.016$).

Conclusion: ABPM reveals a substantial hypertension burden after CoA repair characterized by complete absence of white-coat hypertension. The peak isthmus Doppler gradient independently predicts ambulatory hypertension and should be systematically quantified at follow-up echocardiography. Speckle-tracking echocardiography identifies subclinical myocardial dysfunction in patients with preserved LVEF.

Keywords: Aortic Coarctation, Blood Pressure Monitoring, Ambulatory, Hypertension, Hypertrophy, Left Ventricular, Echocardiography, Child

RÉSUMÉ

Introduction: L'hypertension artérielle est la principale complication à long terme après correction de la coarctation de l'aorte (CoA). La caractérisation des phénotypes tensionnels par mesure ambulatoire de la pression artérielle (MAPA) combinée à l'échocardiographie de déformation reste sous-étudiée, en particulier en Afrique du Nord.

Objectif: Décrire la prévalence et les phénotypes hémodynamiques de l'hypertension définie par MAPA, évaluer la dysfonction myocardique infraclinique par le strain longitudinal global (SLG), et identifier les prédicteurs indépendants de l'hypertension ambulatoire après correction de CoA.

Méthodes: Étude transversale au CHU Sahloul, Sousse, Tunisie, incluant 30 patients âgés de 5 à 30 ans après correction chirurgicale isolée de CoA. La MAPA a été classée selon les recommandations adaptées à l'âge. Le SLG par speckle-tracking a été évalué chez tous les patients. Les prédicteurs indépendants ont été identifiés par régression logistique multivariée.

Résultats: Une hypertension définie par MAPA a été identifiée chez 13 patients (43,3 %) : hypertension ambulatoire soutenue chez 11 (36,7 %) et hypertension masquée chez 2 (6,7 %). L'hypertension blouse blanche était absente. Une HVG était présente chez 7 patients (23,3 %) et un SLG réduit chez 8 (26,7 %) malgré une FEVG préservée chez tous ($57,5 \pm 3,1\%$). Le gradient Doppler isthmique était le seul prédicteur indépendant (OR ajusté 1,16 par mmHg ; IC 95 % 1,03–1,31 ; $p = 0,016$).

Conclusion: La MAPA révèle une charge hypertensive substantielle après correction de CoA, caractérisée par l'absence totale d'hypertension blouse blanche. Le gradient Doppler isthmique prédit indépendamment l'hypertension ambulatoire et devrait être quantifié systématiquement à l'échocardiographie de suivi. L'échocardiographie de speckle-tracking identifie une dysfonction myocardique infraclinique chez des patients à FEVG préservée.

Mots-clés : Coarctation de l'aorte, Surveillance ambulatoire de la pression artérielle, Hypertension artérielle, Hypertrophie ventriculaire gauche, Échocardiographie, Enfant

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What is known ?

Arterial hypertension affects 20 to 70% of patients after coarctation of the aorta repair and is the leading cause of long-term cardiovascular morbidity. Ambulatory blood pressure monitoring (ABPM) detects hypertension phenotypes not captured by office measurement. Speckle-tracking echocardiography identifies subclinical myocardial dysfunction before ejection fraction deterioration.

What this article adds ?

This is the first study from North Africa combining ABPM phenotyping with speckle-tracking-derived global longitudinal strain (GLS) in children and young adults after coarctation repair. White-coat hypertension was completely absent, and the peak isthmus Doppler gradient emerged as the sole independent predictor of ambulatory hypertension. Reduced GLS was identified in 26.7% of patients despite universally preserved ejection fraction.

INTRODUCTION

Coarctation of the aorta (CoA) is a congenital narrowing of the aortic arch accounting for 5 to 8% of all congenital heart defects (1). Despite successful surgical or transcatheter repair, arterial hypertension develops or persists in 20 to 70% of patients and represents the leading cause of long-term cardiovascular morbidity (2). A systematic review reported a mean hypertension prevalence of 47.3% by office measurement, rising to 57.8% when 24-hour ABPM was applied (3).

ABPM enables classification into distinct hemodynamic phenotypes including sustained ambulatory hypertension, masked hypertension, and white-coat hypertension, each carrying different prognostic implications (4). Sendzikaite et al. reported hemodynamic phenotypes and LVH in 90 children after CoA repair using ESH 2016 guidelines (5), while Agbas et al. identified masked hypertension in 40% of 25 Turkish children after early repair (6). Neither study assessed subclinical myocardial dysfunction by speckle-tracking echocardiography, and no data exist from North Africa.

In Tunisia, published data on CoA remain limited to studies describing neonatal presentation and early surgical outcomes (7), and epidemiological reports on the overall burden of congenital heart disease (8). No prior Tunisian study has addressed late ambulatory hypertension, hemodynamic phenotyping, or cardiac remodeling after CoA repair. The present study directly addresses this gap. Conventional LVEF lacks sensitivity for early myocardial dysfunction. GLS derived from two-dimensional speckle-tracking echocardiography detects subclinical dysfunction independently of LVEF (9). The peak isthmus Doppler gradient, even below the conventional recoarctation threshold, may reflect residual hemodynamic burden relevant to late hypertension risk (10, 11).

This study aimed to describe ABPM-defined hypertension prevalence and phenotypes in children and young adults after isolated CoA repair, evaluate subclinical myocardial dysfunction by GLS, and identify independent predictors of ambulatory hypertension. To our knowledge, this is the first report of ABPM phenotyping and speckle-tracking echocardiography after CoA repair from a North African

center. AI-assisted tools (Claude, Anthropic) were used for language editing of this manuscript under full author oversight and control.

METHODS**Study design and population**

A cross-sectional study was conducted at the Cardiology Department of CHU Sahloul, Sousse, Tunisia. Patients with repaired CoA treated between 2003 and 2024 were systematically screened. Ethical approval was obtained from the Institutional Review Board of the Sousse University Institute of Medical Sciences (reference number to be provided upon editorial request). Written informed consent was obtained from all participants or their guardians. Our study included a vulnerable population (minors aged 5 to 18 years); informed consent was obtained from parents or legal guardians, and assent was obtained from children aged 7 years and older in accordance with institutional ethical standards.

Inclusion criteria: age 5 to 30 years, isolated CoA repair, residual arm-leg systolic gradient less than 20 mmHg, no diastolic tail on continuous-wave Doppler. Exclusion criteria: obesity, recoarctation, secondary hypertension, moderate-severe valvular disease, genetic syndrome, chronic kidney disease.

Blood pressure assessment

Office blood pressure was measured in the right arm after 5 minutes rest using a validated oscillometric device (Edan Elite V5). ABPM was performed using a validated device (Contec ABPM50) every 20 minutes daytime and 30 minutes nighttime. Recordings were valid if lasting at least 20 hours with at least 80% successful readings. For patients under 16 years, ABPM values were classified according to the 2016 ESH pediatric guidelines; for those 16 years or older, the 2024 ESC adult thresholds were applied. Phenotypes defined: sustained ambulatory hypertension, masked hypertension, white-coat hypertension, and controlled hypertension.

Echocardiographic assessment

Transthoracic echocardiography was performed by a single experienced cardiologist using a Vivid E95 ultrasound system (GE Healthcare) equipped with 2.5 and 5 MHz transducers. All image acquisition and measurements were performed in strict accordance with the joint recommendations of the American Society of Echocardiography and the European Association of Cardiovascular Imaging (12, 13). Global longitudinal strain was assessed offline using EchoPAC software (GE Healthcare) from three standard apical views (apical 4-chamber, 2-chamber, and 3-chamber), averaged across three consecutive cardiac cycles, with a target frame rate of 50 to 80 frames per second to optimize speckle-tracking accuracy. The lower limit of normal for LV endocardial GLS was defined as -18% in accordance with current consensus recommendations (14).

LVH was defined using age-specific LVMI z-scores for patients under 16 years or adult sex-specific cutoffs for patients 16 years or older (12, 13). LVEF was assessed by Simpson biplane method. Peak isthmus Doppler gradient was measured by continuous-wave Doppler from the suprasternal notch.

Statistical analysis

Continuous variables are presented as mean $\pm$ SD or median [IQR]. Categorical variables as n (%). Group comparisons by Student t-test or Mann-Whitney U test and Fisher exact test as appropriate. Multivariable logistic regression identified independent predictors of ABPM-defined hypertension; model complexity was restricted to one to two predictors given 13 events. All analyses performed using SPSS version 26.0.

RESULTS

Study population

Of 80 screened patients, 30 were included in the final analysis (Figure 1). The final cohort comprised 30 patients: median age 14.0 years (IQR 9.0 to 25.0), 17 female (56.7%), 17 aged under 16 years (56.7%). Initial repair was surgical in 19 (63.3%) and percutaneous in 11 (36.7%). Median age at repair was 5.0 years (IQR 0.2 to 18.0). Reintervention for recoarctation was required in 10 (33.3%). Bicuspid aortic valve was identified in 14 (46.7%). Demographic and procedural characteristics are presented in Table 1.

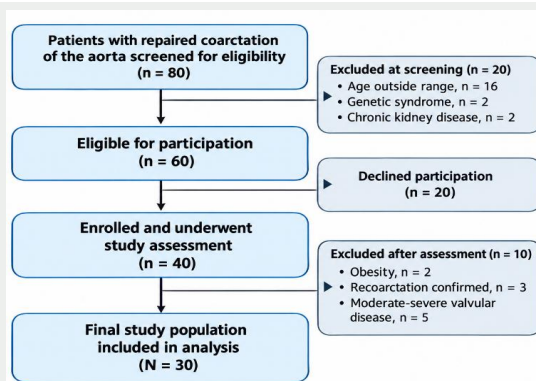


Figure 1. Flow diagram of patient selection and study enrollment. CoA, coarctation of the aorta; CKD, chronic kidney disease.

Ambulatory blood pressure phenotypes

Mean office systolic blood pressure was 114.8 ± 18.0 mmHg; median arm-leg difference was -0.5 mmHg (IQR -7.0 to 4.0). ABPM was completed in all 30 patients. Normotension was present in 17 patients (56.7%), sustained ambulatory hypertension in 11 (36.7%), and masked hypertension in 2 (6.7%). White-coat hypertension was absent in all patients. Overall ABPM-defined hypertension prevalence was 43.3%. Non-dipper or riser nocturnal patterns were more frequent in hypertensive patients (61.5% vs 23.5%, $p = 0.007$). ABPM parameters are presented in Table 2.

Table 1. Baseline demographic, anthropometric, clinical, and procedural characteristics of the study population (N = 30)

Patient characteristics	Values
Demographics	
Number of patients, n (male/female)	30 (13/17)
Age at enrollment (years), median [IQR]	14.0 [9.0–25.0]
Pediatric group (<16 years), n (%)	17 (56.7)
Adult group (≥ 16 years), n (%)	13 (43.3)
Anthropometric data	
Weight (kg), mean $\pm$ SD	49.5 $\pm$ 24.1
Height (m), median [IQR]	1.63 [1.27–1.69]
BMI (kg/m ²), median [IQR]	18.5 [16.1–24.7]
Body surface area (m ²), mean $\pm$ SD	1.42 $\pm$ 0.44
Clinical presentation at diagnosis	
Heart murmur, n (%)	10 (33.3)
Arterial hypertension, n (%)	9 (30.0)
Heart failure, n (%)	8 (26.7)
Bronchopulmonary infection, n (%)	2 (6.7)
Subarachnoid hemorrhage ^a , n (%)	1 (3.3)
Hypertension at enrollment	
Known arterial hypertension, n (%)	11 (36.7)
On antihypertensive treatment, n (%)	11 (36.7)
Monotherapy, n (%) ^b	5 (45.5)
Dual therapy, n (%) ^b	5 (45.5)
Triple therapy, n (%) ^b	1 (9.1)
Type of initial repair	
Surgical repair, n (%)	19 (63.3)
Percutaneous repair, n (%)	11 (36.7)
Age at intervention	
Age at first repair (years), median [IQR]	5.0 [0.2–18.0]
Age at first repair <1 year, n (%)	11 (36.7)
Age at first repair 1–9 years, n (%)	9 (30.0)
Age at first repair >9 years, n (%)	10 (33.3)
Surgical repair details (n = 19)	
Crafoord end-to-end anastomosis, n (%)	12 (63.2)
Modified Crafoord technique, n (%)	5 (26.3)
Patch angioplasty, n (%)	1 (5.3)
Resection with tube interposition, n (%)	1 (5.3)
Concomitant ductus arteriosus ligation, n (%)	16 (84.2)
Percutaneous repair details (n = 11)	
Balloon angioplasty without stent, n (%)	1 (9.1)
Stent implantation, n (%)	10 (90.9)
Bare-metal stent only, n (%) ^c	4 (40.0)
Covered stent only, n (%) ^c	5 (50.0)
Combination bare/covered stents, n (%) ^c	1 (10.0)
Pre-dilation before covered stent implantation, n (%) ^e	2 (20.0)
Hemodynamic effect of percutaneous repair (procedures with invasive gradient data, n = 10)	
Pre-procedural peak-to-peak gradient (mmHg), median (range)	44 (10–90)
Post-procedural peak-to-peak gradient (mmHg), median (range)	7.5 (0–25)
Procedural complications	
Vascular complications during transcatheter procedures, n (%) ^f	3 (27.3)
Reinterventions for recoarctation	
Patients with ≥ 1 reintervention, n (%)	10 (33.3)
Balloon angioplasty as reintervention, n (%) ^d	10 (100.0)
Delay since initial repair (months), range	5–37
Bicuspid aortic valve, n (%)	14 (46.7)

Data are presented as mean $\pm$ SD, median [IQR], or n (%), as appropriate. IQR: interquartile range; SD: standard deviation; BMI: body mass index. ^aThe case of subarachnoid hemorrhage was secondary to a ruptured intracranial aneurysm. ^bAmong treated patients (n = 11). ^cAmong stented procedures (n = 10). ^dAmong covered stents (n = 5). ^eAll recorded vascular complications were peripheral vascular complications; no other major immediate procedural complications were documented. ^fAmong patients with reintervention (n = 10).

Table 2. Office blood pressure, ambulatory blood pressure monitoring, and echocardiographic characteristics at follow-up (N = 30)

Variable	Value
Office blood pressure (right arm and leg)	
Office SBP, right arm (mmHg), mean $\pm$ SD	114.8 $\pm$ 18.0
Office DBP, right arm (mmHg), mean $\pm$ SD	56.9 $\pm$ 13.9
Office SBP, right leg (mmHg), mean $\pm$ SD	115.7 $\pm$ 19.7
Office DBP, right leg (mmHg), mean $\pm$ SD	58.2 $\pm$ 16.7
Arm-leg systolic BP difference (mmHg), median [IQR]	-0.5 [-7.0–4.0]
Ambulatory blood pressure monitoring (ABPM)	
Recording duration (hours), median [IQR]	25.0 [24.0–26.0]
Number of valid readings, median [IQR]	65 [56.7–70.0]
Daytime SBP (mmHg), mean (median; range)	114.3 (113; 94–140)
Daytime DBP (mmHg), mean (median; range)	65.0 (64; 53–88)
Daytime systolic BP load (%), mean (median; range)	17.6 (12; 0–60)
Nighttime SBP (mmHg), mean (median; range)	102.6 (102.5; 80–133)
Nighttime DBP (mmHg), mean (median; range)	55.4 (53; 42–89)
Nighttime systolic BP load (%), mean (median; range)	20.6 (15; 0–60)
Nocturnal dipping	
Systolic dipping (%), mean $\pm$ SD (range)	9.0 $\pm$ 7.5 (-15.0 to 19.2)
Diastolic dipping (%), mean $\pm$ SD (range)	13.7 $\pm$ 11.4 (-14.0 to 39.5)
Dipper, n (%)	16 (53.3)
Non-dipper, n (%)	10 (33.3)
Extreme dipper, n (%)	2 (6.7)
Riser, n (%)	2 (6.7)
Ambulatory BP phenotype	
Normotension, n (%)	17 (56.7)
Ambulatory hypertension (sustained or masked), n (%)	13 (43.3)
Sustained ambulatory hypertension, n (%)	11 (36.7)
Masked hypertension, n (%)	2 (6.7)
White-coat hypertension, n (%)	0 (0.0)
Hypertension treatment status (treated patients, n = 11)	
Controlled hypertension, n (%)	7 (63.6)
Uncontrolled hypertension, n (%)	4 (36.4)
Left ventricular structure and geometry	
LV mass (g), mean $\pm$ SD	104.6 $\pm$ 50.3
LVMI (g/m ^{2.7}), median [IQR] (<16 y)	28.40 [25.31–37.65]
LVMI (g/m ²), median [IQR] ($\geq$ 16 y)	80.4 [64.3–97.2]
LVH, n (%)	7 (23.3)
Normal LV geometry, n (%)	20 (66.7)
Concentric remodeling, n (%)	3 (10.0)
Concentric hypertrophy, n (%)	5 (16.7)
Eccentric hypertrophy, n (%)	2 (6.7)
Left ventricular systolic function	
LVEF (%), mean $\pm$ SD	57.5 $\pm$ 3.1
GLS (%), median [IQR]	-20.8 [-21.4 to -17.6]
Reduced GLS, n (%)	8 (26.7)
Left atrial parameters	
LA volume index (mL/m ²), mean $\pm$ SD	28.5 $\pm$ 7.0
Left atrial enlargement, n (%)	7 (23.3)
Diastolic filling pattern (N = 29)	
Type II filling pattern, n (%)	23 (79.3)
Type III filling pattern, n (%)	6 (20.7)
Aortic valve characteristics	
Bicuspid aortic valve, n (%)	14 (46.7)
Peak LV-Ao gradient (mmHg), mean $\pm$ SD	12.0 $\pm$ 3.8
Aortic regurgitation – none, n (%)	19 (63.3)
Aortic regurgitation – minimal, n (%)	10 (33.3)
Aortic regurgitation – moderate, n (%)	1 (3.3)

Data are presented as mean $\pm$ SD, median [IQR], or n (%), as appropriate. ABPM: ambulatory blood pressure monitoring; SBP: systolic blood pressure; DBP: diastolic blood pressure; BP: blood pressure; LV: left ventricle; LVMI: left ventricular mass index; LVH: left ventricular hypertrophy; LVEF: left ventricular ejection fraction; GLS: global longitudinal strain; LA: left atrium; Ao: aorta; IQR: interquartile range.

Echocardiographic findings

LVH was present in 7 patients (23.3%). LVEF was preserved in all patients (mean 57.5 $\pm$ 3.1%). Reduced GLS was identified in 8 patients (26.7%), with median GLS -20.8% (IQR -21.4 to -17.6). Mean peak isthmic Doppler gradient was 26.2 $\pm$ 9.7 mmHg (range 11 to 49). Residual isthmic hypoplasia was present in 4 of 17 patients under 16 years (23.5%) and 6 of 13 patients 16 years or older (46.2%).

Between-group comparison and predictors of ambulatory hypertension

Hypertensive patients had higher BMI (26.5 vs 18.0 kg/m², $p = 0.002$), higher LVMI ($p = 0.020$), higher LVH prevalence (46.2% vs 5.9%, $p = 0.025$), higher daytime SBP load (33.0% vs 8.1%, $p = 0.017$), higher nighttime SBP load (43.0% vs 7.0%, $p < 0.001$), and higher isthmic gradient (27.5 vs 24.0 mmHg, $p = 0.007$). GLS did not differ significantly between groups ($p = 0.152$). These comparisons are illustrated in Figure 2.

On univariable logistic regression, isthmic Doppler gradient (OR 1.15 per mmHg, 95% CI 1.03 to 1.29, $p = 0.016$) and LVH (OR 13.71, 95% CI 1.38 to 136.21, $p = 0.025$) were significantly associated with hypertension. In the multivariable model, the isthmic Doppler gradient remained the sole independent predictor (adjusted OR 1.16 per mmHg, 95% CI 1.03 to 1.31, $p = 0.016$); age at repair group was no longer significant after adjustment ($p = 0.171$). Results are presented in Table 3.

Table 3. Univariable and multivariable logistic regression analysis for predictors of ABPM-defined hypertension (N = 30)

Variable	OR	95% CI	p-value
Univariable logistic regression			
Age at repair 1–9 years vs <1 year	1.33	0.20–9.08	0.769
Age at repair $\geq$ 9 years vs <1 year	6.22	0.94–41.38	0.059
Isthmic Doppler gradient (per 1 mmHg)	1.15	1.03–1.29	0.016
Left ventricular hypertrophy (present vs absent)	13.71	1.38–136.21	0.025
Primary multivariable model (adjusted OR)			
Isthmic Doppler gradient (per 1 mmHg)	1.16	1.03–1.31	0.016
Age at repair group (overall)	—	—	0.171 ^f
1–9 years vs <1 year	0.98	0.13–7.38	0.986
$\geq$ 9 years vs <1 year	3.84	0.49–30.07	0.199

OR: odds ratio (univariable); adjusted OR derived from the primary multivariable logistic regression model including age at repair group and isthmic Doppler gradient (continuous). Reference category for age at repair was <1 year. CI: confidence interval. ^fGlobal p-value for the age at repair variable (Wald test).

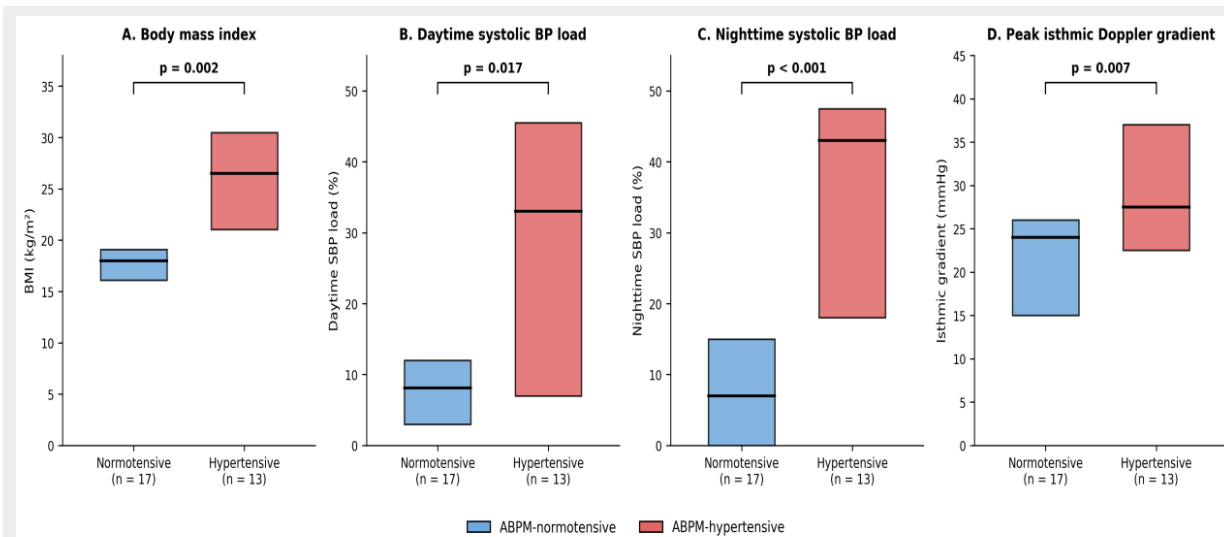


Figure 2. Comparison of key clinical and hemodynamic parameters between ABPM-normotensive and ABPM-hypertensive patients after coarctation repair of the aorta repair. (A) Body mass index. (B) Daytime systolic blood pressure load. (C) Nighttime systolic blood pressure load. (D) Peak isthmic Doppler gradient. Boxes represent the median and interquartile range. ABPM, ambulatory blood pressure monitoring; SBP, systolic blood pressure.

Discussion

To our knowledge, this is the first Tunisian study to characterize ambulatory blood pressure phenotypes and speckle-tracking echocardiographic findings after CoA repair. The only prior Tunisian CoA publication focused on neonatal presentation and early surgical outcomes (7), leaving the long-term cardiovascular burden in this population entirely undocumented in the regional literature.

This cross-sectional study of 30 patients after isolated CoA repair demonstrates a 43.3% prevalence of ABPM-defined hypertension, with a complete absence of white-coat hypertension and predominance of sustained ambulatory and masked phenotypes. The peak isthmic Doppler gradient was the sole independent predictor of ambulatory hypertension, with each 1-mmHg increment associated with a 16% increase in hypertension odds.

Our hypertension prevalence is comparable to Sendzikaite et al. (46.7% in 90 Baltic children) (5) and Agbas et al. (40% masked hypertension in 25 Turkish children) (6). The complete absence of white-coat hypertension in our cohort has not been previously reported and underscores the clinical primacy of ABPM over office monitoring. Our study extends prior work by identifying the isthmic Doppler gradient as a continuous independent predictor of ambulatory hypertension, a relationship not previously demonstrated using ABPM as the outcome. Lee et al. and Ylinen et al. similarly reported arch hemodynamic parameters as predictors of late hypertension (10, 11), collectively suggesting that sub-recoarctation gradients carry incremental risk across their full range.

Speckle-tracking echocardiography identified reduced GLS in 26.7% of patients despite universally preserved LVEF, consistent with Egbe et al. who demonstrated GLS impairment in adults after CoA repair (9). LVH was present in 23.3% overall and 46.2% of hypertensive patients, comparable to prior reports (5, 6).

The identification of ABPM-defined hypertension and

reduced GLS in asymptomatic patients carries direct clinical implications at two levels. At the surveillance level, the present findings support systematic integration of ABPM into every follow-up visit regardless of office blood pressure normality, as office measurement alone missed hypertension in 43.3% of affected patients in this cohort. The peak isthmic Doppler gradient independently predicted ambulatory hypertension, with each 1-mmHg increment associated with a 16% increase in hypertension odds. These findings suggest that routine quantification of the isthmic gradient as a continuous variable at every follow-up echocardiographic assessment may provide clinically relevant hemodynamic information beyond its conventional use as a binary threshold for reintervention (15, 16). Patients with reduced GLS despite preserved LVEF represent a subgroup at risk of progressive myocardial dysfunction who would be entirely missed by ejection fraction assessment alone, supporting annual speckle-tracking reassessment in this population. At the therapeutic level, masked hypertension detected exclusively by ABPM warrants antihypertensive treatment initiation regardless of office BP normality, in accordance with current ESH recommendations (17, 18). The association between sub-recoarctation isthmic gradients and ambulatory hypertension raises the question of whether the conventional reintervention threshold of 20 mmHg arm-leg gradient remains adequate for identifying all patients at hemodynamic risk, and whether closer surveillance or lower intervention thresholds should be considered in patients with persistent sub-threshold gradients and ambulatory hypertension.

Although this study was conducted at a single tertiary referral center, all patients with repaired CoA in active follow-up at CHU Sahloul were systematically contacted and screened for eligibility during the study period, constituting a consecutive exhaustive recruitment strategy that minimizes selection bias within the constraints of a single-center design. Nevertheless, as a tertiary referral center, CHU Sahloul may preferentially follow patients with more complex hemodynamic

profiles or greater cardiovascular burden, potentially overestimating hypertension prevalence relative to community-managed populations. The highly selective inclusion criteria — excluding recoarctation, obesity, secondary hypertension, and significant valvulopathy — strengthen internal validity by minimizing confounding but limit generalizability to unselected CoA repair cohorts. The cross-sectional design precludes causal inference, and the observed associations should be interpreted as hypothesis-generating rather than definitive.

All echocardiographic measurements were performed by a single experienced operator using a standardized protocol and validated software in strict accordance with current recommendations. Formal reproducibility analysis was not performed, which represents a limitation. In conclusion, ABPM reveals a substantial hypertension burden after CoA repair characterized by complete absence of white-coat hypertension. The isthmus Doppler gradient should be systematically quantified as a continuous variable at follow-up echocardiography. Speckle-tracking echocardiography identifies subclinical dysfunction in patients with preserved LVEF. These findings, the first from North Africa, support routine ABPM and GLS assessment in post-repair surveillance.

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