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Correlation Study of Aortic Velocity Propagation, Abdominal Aortic Intima-Media Thickness, and Epicardial Adipose Tissue Thickness in Subclinical Hypothyroidism Patients

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Abstract: *Objective:* To explore the correlation between epicardial fat thickness (EFT), aortic velocity propagation (AVP), and abdominal aortic intima-media thickness (AA-IMT) in patients with subclinical hypothyroidism (SH). Additionally, to compare these indicators between SH patients and healthy individuals, providing a new theoretical basis for the clinical prevention and treatment of cardiovascular diseases. *Method:* Clinical data from 50 SH patients (23 males and 27 females) and 50 healthy outpatient examinees (22 males and 28 females) were analyzed. The participants were selected from January 2022 to December 2023 at Loudi Central Hospital. EFT, AVP, and AA-IMT were measured, and their correlations were analyzed. *Results:* SH patients had significantly higher EFT and AA-IMT levels than the control group, while their AVP was significantly lower, with these differences being statistically significant ($P < 0.05$). Correlation analysis revealed a significant negative correlation between EFT and AVP ($P < 0.001$), a significant positive correlation between EFT and AAO-IMT ($P < 0.001$), and a significant negative correlation between AVP and AAO-IMT ($P < 0.001$). Multivariate binary logistic regression analysis identified increased EFT, decreased AVP, and increased AAO-IMT as independent risk factors for SH patients. *Conclusion:* In SH patients, EFT and AAO-IMT are elevated, whereas AVP is reduced. EFT and AVP are significantly correlated with AAO-IMT. EFT and AAO-IMT can serve as reliable indicators for evaluating subclinical atherosclerosis in SH patients, providing a diagnostic basis for clinical practice.

Keywords: Epicardial fat thickness; Aortic propagation velocity; Abdominal aortic intima-media thickness; Subclinical hypothyroidism

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1. Introduction

To investigate the relationship between epicardial fat thickness, aortic transmission velocity, and intima-media thickness of abdominal aorta in patients with subclinical hypothyroidism, the Hemodynamics index of aortic transmission velocity and the metabolic index of abdominal aortic intima-media thickness and epicardial fat

thickness were measured and their correlations were determined, future cardiovascular events can be used as an indirect indicator of arteriosclerosis in patients with subclinical hypothyroidism [1].

2. Materials and methods

2.1. General information

This study was approved by the Ethics Committee of Loudi Central Hospital (Approval Number: 2022-Renzhen (Research) -013), and all patients signed informed consent forms.

Fifty SH patients (23 males and 27 females) with TSH < 10 mU/L who first visited our hospital between January 2022 and December 2023 were selected. The patients were aged between 18 and 45 years, with an average age of 34.68 ± 8.22 years. Additionally, 50 individuals (22 males and 28 females) undergoing outpatient health check-ups, aged between 22 and 44 years with an average age of 32.94 ± 7.23 years, were included as the control group. All subjects with severe cardiovascular disease were excluded. The clinical data of the subjects were outlined and analyzed [2].

2.2. Methodologies

2.2.1. Aortic velocity propagation ultrasound measurement

The Philips EPIQ 7C color Doppler ultrasound diagnostic instrument was used. The subject was placed in a supine position, and color M-mode Doppler recording was obtained from the sternal fossa section (**Figure 1**) [3]. The direction of blood flow in the descending aorta was measured, aligning the flow direction as closely as possible to the cursor. The Nyquist limit was set between 30–50 cm/s, and M-mode was switched on with a scanning rate of 150 mm/s. The propagation velocity of the aorta was calculated by dividing the distance between the starting and ending points of the propagation velocity slope by the duration between the corresponding time points [4]. Aortic velocity propagation (AVP) corresponds to the velocity at which blood flows down an artery. The average of at least three measurements of AVP was recorded .

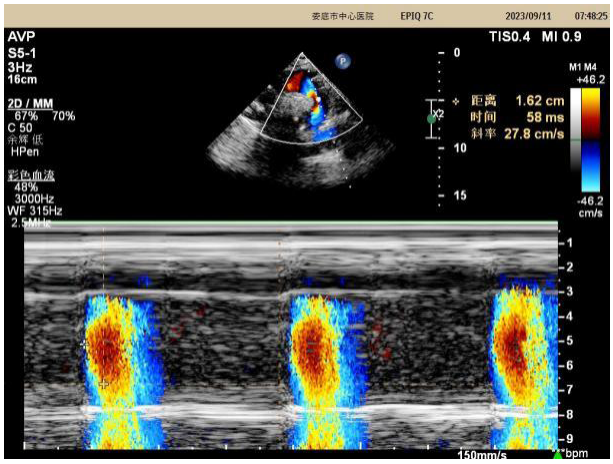

Figure 1. Aortic velocity propagation detection

2.2.2. Epicardial fat thickness ultrasound measurement

The method first described and validated by Iacobellis *et al*. was used [5]. A phased array probe was selected, and the image was placed at a depth of approximately 5 cm (**Figure 2**). At the end of the systolic phase of one cardiac cycle, the epicardial fat thickness (EFT) of three cardiac cycles was measured vertically on the free wall of the right ventricle. The aortic ring was used as a reference marker to standardize the measurement points, and

the average of at least three EFT measurements was recorded [5].

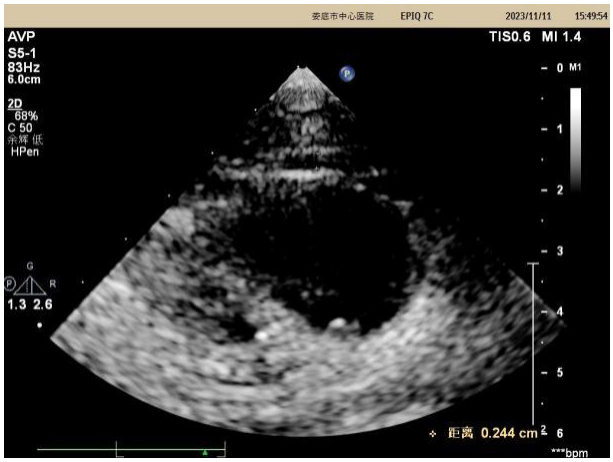

Figure 2. Epicardial fat thickness detection

2.2.3. Abdominal aortic intima-media thickness ultrasound measurement

According to the guidelines of the American College of Cardiology , a linear array probe was used to place the image at a depth of approximately 5 cm, measuring 1 cm to the right of the proximal segment of the abdominal aorta in front of the spine (**Figure 3**). At least three measurements of abdominal aortic intima-media thickness (AA-IMT) were taken, and the average value was recorded [6].

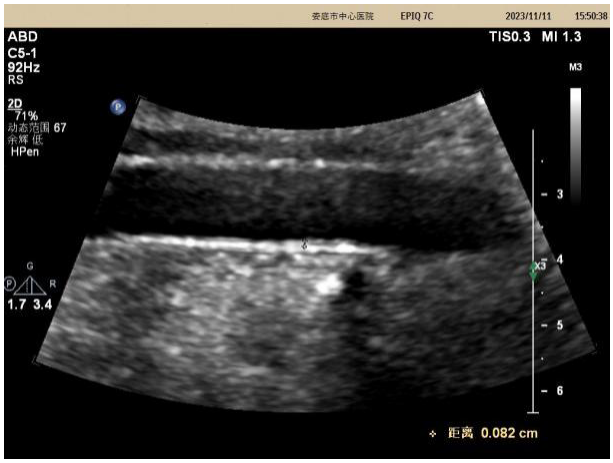

Figure 3. Abdominal aortic intima-media thickness detection

2.3. Statistical analysis

SPSS 25.0 statistical software was used for data analysis. EFT, AVP, and AA-IMT were treated as continuous variables, with SH (yes = 1, no = 0) and gender (female = 1, male = 0) as categorical variables [7]. The measurement data were expressed as mean ± standard deviation (SD), and comparisons between the two groups were analyzed using independent sample *t*-tests. Count data were represented by frequency and compared using the chi-squared test. Pearson correlation analysis was performed between EFT, AVP, and AA-IMT. Multivariate binary logistic regression analysis was conducted on EFT, AVP, and AA-IMT between the two groups. A *P*-value of < 0.05 was considered statistically significant, indicating a difference [8].

3. Results

3.1. General information

This study included clinical data from 50 patients diagnosed with SH at Loudi Central Hospital between January 2022 and December 2023, as well as 50 individuals who underwent outpatient health check-ups. There was no statistically significant difference in age (t = -1.124, P = 0.264) and gender (χ^2 = 0.040, P = 0.841) between the clinical SH patients and the control group (**Table 1**) [9].

Table 1. Comparison of data between the SH patient group and the healthy patient group

	Healthy patient group (n = 50)	SH patient group (n = 50)	t / χ^2 value	P value
Gender			0.040	0.841
Male	22	23		
Female	28	27		
Age (years)	32.94 ± 7.23	34.68 ± 8.22	-1.124	0.264
BMI (kg/m^2)	21.73 ± 1.54	21.61 ± 1.27	0.455	0.650
EFT (mm)	0.20 ± 0.08	0.24 ± 0.07	-2.777	0.007**
AVP (cm/s)	61.58 ± 14.11	37.84 ± 11.04	9.373	0.000***
AA-IMT (mm)	0.15 ± 0.05	0.24 ± 0.06	-8.726	0.000***

Abbreviation: BMI, body mass index; EFT, epicardial fat thickness; AVP, aortic velocity propagation; AA-IMT, abdominal aortic intima-media thickness. *P < 0.05, **P < 0.01, ***P < 0.001.

3.2. Preliminary results

The EFT and AA-IMT of SH patients were significantly higher than those of the control group, while the AVP of SH patients was significantly lower, with these differences being statistically significant [10]. Correlation analysis revealed a significant negative correlation between EFT and AVP, a significant positive correlation between EFT and AA-IMT, and a significant negative correlation between AVP and AA-IMT. Multivariate binary logistic regression analysis showed that an increase in EFT, a decrease in AVP, and an increase in AA-IMT were all independent risk factors for SH (**Table 2**).

Table 2. Binary logistics regression analysis of influencing factors of hypothyroidism

Variable	β	Standard error	Wald value	P value	OR value	95% confidence interval
EFT	-10.581	6.142	2.968	0.085	0.000	0.000–4.294
AVP	-0.130	0.035	13.693	< 0.001	0.878	0.820–0.941
AA-IMT	32.156	8.466	14.428	< 0.001	9.232×10^{13}	5.745×10^{6}–1.484×10^{21}

Abbreviation: EFT, epicardial fat thickness; AVP, aortic velocity propagation; AA-IMT, abdominal aortic intima-media thickness.

4. Discussion

Subclinical hypothyroidism (SH) is an endocrine disorder syndrome caused by an imbalance in the secretion and synthesis of thyroid hormones, leading to various bodily changes. Unlike overt hypothyroidism, SH often lacks obvious clinical symptoms and is frequently detected through routine health examinations, with diagnosis primarily relying on laboratory tests. Over the past few decades, the impact of SH on the cardiovascular system has been extensively studied. SH is recognized as a risk factor for ischemic heart disease, contributing to lipid

metabolism disorders and cardiac dysfunction [11].

Epicardial adipose tissue (EAT) is classified as a type of visceral adipose tissue. The abnormal accumulation of visceral fat is closely associated with metabolic and cardiovascular diseases, with both receiving blood supply from coronary arteries. Consequently, the thickening of EAT is closely linked to coronary atherosclerosis and cardiovascular disease [12]. The proliferation of EAT may lead to the secretion of increased levels of pro-inflammatory factors and lipophilic cytokines, which can directly affect myocardial cells, causing myocardial hypertrophy and cardiac dysfunction. This, in turn, directly damages vascular structures and leads to coronary and peripheral atherosclerosis. Epicardial fat thickness (EFT) is a significant indicator of cardiovascular disease risk and a crucial predictor of subclinical coronary atherosclerosis [13]. Research indicates that increased EFT is associated with the presence of coronary atherosclerotic heart disease, and plaque vulnerability, and can independently predict major adverse cardiovascular events. Numerous studies have reported that EFT, as measured by echocardiography, is linked to the occurrence of hypertension, metabolic syndrome, and coronary heart disease [14].

In summary, the results of this study demonstrate that EFT and AA-IMT are increased in SH patients, while AVP is decreased. Moreover, EFT and AVP are significantly correlated with AA-IMT. Thus, EFT and AAO-IMT can serve as reliable indicators for evaluating subclinical atherosclerosis in SH patients, providing a clinical diagnostic basis [15].

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Disclosure statement

The authors declare no conflict of interest.

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