Correlation between sigmoid interventricular septum angle and presence of Q waves on the electrocardiogram

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INTRODUCTION

Nowadays, the widespread use of transthoracic echocardiography (TTE) as a routine checkup test, especially amongst the elderly population, has increased the prevalence of incidental findings, with one of the most frequent being the sigmoid interventricular septum (SIVS). According to data from the Framingham Heart study, the overall prevalence of SIVS in the general population is only 1.5% and significantly increases to 18% in the eighth decade [1, 4]. Furthermore, observational studies show a prevalence of 50%–80% of arterial hypertension in the SIVS population, proving their strong correlation [2, 3]. As far as the electrocardiogram (ECG) is concerned, SIVS can be indicated by abnormal Q waves, especially in V1–V2 precordial leads, voltage criteria for ventricular hypertrophy, and ST/T wave changes. Our study aimed to determine the echocardiographic features of SIVS that predispose the appearance of Q wave in V1–V2 leads of the surface ECG in a group of hypertensive and normotensive patients diagnosed incidentally with SIVS.

METHODS

Study population

Our study was conducted in the Department of Cardiology of the General Hospital of Chios, Greece. The study population included adult patients with an incidental finding of SIVS during a routine TTE. Both hypertensive and normotensive patients were studied. Patients with a history of hypertrophic cardiomyopathy, infiltrative heart disease, cardiac surgery, aortic/subaortic stenosis, or prior myocardial infarction with fibrosis/scar of the ventricular septum were excluded. Informed written consent was obtained from all patients, and the study was approved by the local ethics committee.

Echocardiographic analysis

The presence of SIVS was defined as a hypertrophied proximal focal area within the first third of the ventricular septum, with thickness >13 mm in men and >12 mm in women and a proximal-to-mid/distal septal thickness ratio of 1.3–1.5 [1, 2]. The mid-ventricular septum thickness (Mid IVS), the maximum thickness of the proximal part of the sigmoid septum (Max IVS sigmoid), as well as the thickness of the posterior wall of the left ventricle (LVPW) were measured from the parasternal long axis view at end-diastole. The aortoseptal angle (Asep), defined as the angle between the long axes of the aorta and the left ventricle, was also measured. Considering that the latter is highly dependent on the position of the transducer and thus is poorly reproducible, the aortosigmoid angle (Asig), which is less position dependent, was measured. It was defined as the angle between the long axis of the aorta and the tangent of the distal part of the sigmoid septum (Figure 1A). All angles were measured, as described in Figure 1, on the Digital Imaging and Communications in Medicine (DICOM) echo images of each patient with the use of the RadiAnt DICOM Viewer software (v.2021.2, Medixant, Poznań,

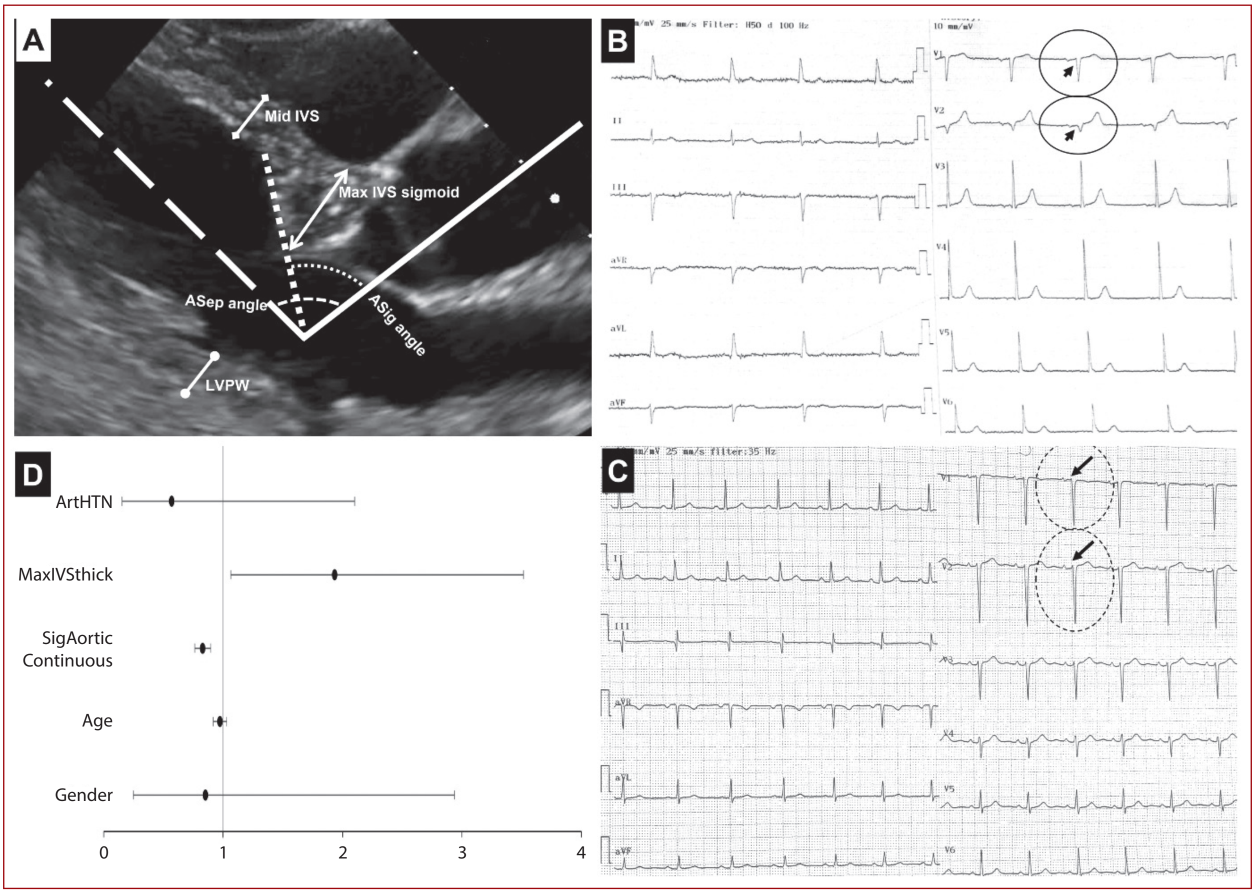

Figure 1. A. Measurements of angle and thickness on the echocardiographic image. All measurements performed at end-diastole. **B.** 12-lead surface electrocardiography (ECG) of a patient with sigmoid septum and Q waves in V1 and V2 leads. **C.** 12-lead surface ECG of a patient with sigmoid septum and non-Q waves in V1 and V2 leads (small initial r wave). **D.** Association between the aortosigmoid angle and the Q wave presence in V1–V2 leads, as analyzed in the second model. The odds ratio and 95% confidence interval are presented

Abbreviations: IVS, interventricular septum; LVPW, posterior wall of the left ventricle

Poland). The Max/Mid IVS ratio, Max/Posterior IVS ratio, Mid/Posterior IVS ratio, the Asig/Asep ratio, and the Asep-Asig subtraction were also calculated.

ECG analysis

All patients underwent a 12-lead surface ECG and were divided into the Q and non-Q groups based on the presence of Q waves in V1–V2 precordial leads (Figure 1 B, C).

Statistical analysis

Categorical variables were compared with the χ^2 test. Continuous variables were compared with the t-test or Mann–Whitney U test if normally or non-normally distributed, respectively. Statistical significance was defined as P <0.05. Multivariable regression analysis was performed to find the significant predictors of the presence of Q waves in leads V1 and/or V2 on 12-lead surface ECG. The analysis was performed with the IBM SPSS Statistics v.23 software. The Mann–Whitney test was not conducted.

RESULTS AND DISCUSSION

A total of 103 patients at a mean age of 68.5 (10.7) years were included in the analysis (52 male and 51 female).

Sixty patients (58.3%) were included in the Q group (36 males and 24 females), and 43 patients (41.7%) were included in the non-Q group (16 males and 27 females).

There were statistically significant differences betweent the two groups in terms of sex, Mid IVS, Max IVS, and LVPW thickness, Asep and Asig, Asep-Asig subtraction, the Asig/Asep ratio, and presence of arterial hypertension (Supplementary material, *Table S1*).

To confirm the last observation, a binomial logistic regression was performed to ascertain the effects of sex, age, Asig ≤90º, Max IVS thickness, and arterial hypertension (HTN) on the likelihood that patients display Q waves in leads V1 and/or V2 on 12-lead surface ECG. The logistic regression model was statistically significant, P <0.0001 and correctly classified 83.5% of cases. Sensitivity was 96.7%, specificity was 65.1%, positive predictive value was 79.5%, and negative predictive value was 93.3%. Of the five predictor variables, only two were strongly correlated with the presence of Q waves in V1–V2 ECG leads: Asig ≤90º (odds ratio [OR], 30.07; 95% confidence interval [CI], 5.97–151.43; *P* <0.001) and Max IVS thickness (OR, 1.99; 95% CI, 1.17–3.39; *P* = 0.011). An Asig ≤90º increased the likelihood of presenting a Q wave in leads V1 and/or V2 more than 30 times compared to an obtuse angle. Similarly, Max IVS thickness increased by 1 mm raising that likelihood by almost 2 times (Supplementary material, *Table S2*).

A second model was created to assess the effect of the Asig as a continuous variable, with all other variables remaining the same as in the previous model. This model was also statistically significant (*P* <0.0001) correctly classifying 80.6% of cases. Sensitivity was 85%, specificity was 74.4%, positive predictive value was 82.3% and negative predictive value was 78%. Of the five predictor variables, only two were strongly correlated with the presence of Q waves in V1–V2 ECG leads: Max IVS thickness (OR, 1.93; 95% CI, 1.06–3.52; *P* = 0.031) and Asig (OR, 0.8; 95% CI, 0.76–0.88; *P* <0.001) (Figure 1D). In the Q group, the mean Asig was 74.5 (10.5) degrees, and the Max IVS thickness was 14.7 (1.3) mm. In the non-Q group, these measurements were 94.6 (11.9) degrees and 13.5 (0.9) mm, respectively. An increase in the Max IVS thickness by 1 mm and a decrease in the Asig by 1 degree were associated with a higher likelihood, by 1.9 and 1.2 times respectively, of presenting a Q wave in leads V1 and/or V2. Age, arterial HTN, and sex were not independent predictors of Q waves on the ECG (Supplementary material, *Table S3*).

When comparing the OR between the two models, we observed that the Asig when assessed with a cut-off value of ≤90º (Model 1), resulted in a higher OR (and higher likelihood) of Q wave presence in V1–V2 leads than when assessed as a continuous variable (Model 2) (OR, 30.07 vs. 1.2 between the two models). On the other hand, the OR for the Max IVS thickness was quite similar in the two models (OR, 1.99 vs. 1.93).

SIVS is one of the most frequent incidental findings during TTE in asymptomatic populations. Most studies correlate SIVS and its relevant echocardiographic features with the presence of arterial HTN or subclinical hypertrophied cardiomyopathy/subaortic stenosis, with cardiac magnetic resonance imaging being the best diagnostic tool for further evaluation [4–6]. Thus, based on the lack of data from the existing literature our study aimed to highlight the predisposing clinical and echocardiographic parameters for the appearance of Q waves in leads V1 and/or V2 of the ECG in subjects with SIVS.

In our study, the Asig was an additional parameter that was measured in comparison to previous studies, making our results more dependent on SIVS characteristics. The latter, along with the Max IVS thickness, were the main predictive factors of the appearance of Q waves on the ECG. It is important that an Asig ≤90º increased the likelihood of presenting a Q wave in leads V1 and/or V2 more than 30 times compared to an obtuse angle as it was ascertained by the statistical analysis, making the acute Asig a strong predictor of the presence of Q waves on the surface ECG. This was highlighted by the fact that every decrease of the Asig by one degree increased the likelihood of the appearance of the Q waves in leads V and V2 by 1.2 times, so the presence of more acute angles resulted in a higher probability of appearance of Q waves on the ECG.

In conclusion, the measurement of the Max IVS thickness, and especially the finding of an acute Asig ≤90º, is a widely available and reproducible diagnostic tool for the evaluation of patients with incidental finding of SIVS. In clinical practice, it could assist cardiologists in distinguishing in which patients the presence of Q waves in V1 and V2 leads of the ECG are not associated with characteristics of the SIVS, so alternative etiologies should be sought.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

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