Research Article

Evaluation of Dependence between Left Atrial Appendage Flow Velocity Examined in Transoesophageal Echocardiography (TTE) and CHA_2DS_2-Vasc Score in Patients with Atrial Fibrillation (AF)

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Summary

Objectives: The objective of the paper was evaluation of link between 1) left atrial appendage flow velocity (LAA) in patients with Atrial Fibrillation (AF) examined during transoesophageal echocardiography and 2) CHA2DS2-VASc score obtained by the patient.

Methods and results: There were 450 people examined (N=450). Transoesophageal echocardiography with doppler sample placed 1 centimetre below LAA ostium was performed in all the patients. Pulse Wave doppler technique (PW) was used. It was determined that there is a key dependence between examined features (p=0,012). The content is weak and negative though. Left atrial appendage flow Velocity (V) is expected to be lower for each next class.

Conclusions: The dependence between two parameters (the left atrial appendage flow velocity

and the points in CHA2DS2-VASc score) was indicated. In future it may be possible to use the left atrial appendage flow velocity as a new factor qualifying patients for oral anticoagulation therapy.

Keywords: Atrial fibrillation (AF); CHA2DS2-Vasc Score; Left atrial appendage (LAA)

1. Introduction

In Poland around 600.000-700.000 people suffer from atrial fibrillation. The occurrence increases along with age. In the age group <50 it affects 0,15 of population, >75 it occurs in around 10% of population and increases to around 18% of affected after the age of 85 [1]. The frequency of AF occurrence changes dependently on age and sex. AF is present in 0,12- 0,16 % in the age below 49, 3,7-4,2 % in the age of 60-70 and 10-17% for people in the age of 80 and older [2-5]. AF occurs more often in men than in women (frequency indicator is 1,2:1). Despite higher frequency in men, women are majority of patients suffering from AF due to their longevity [6-10]. The main clinical issue, besides symptoms linked to arrythmia are its complications. Framingham examination indicated that the risk of stroke is 17 times higher in patients with rheumatic valvular disease, the risk of thromboembolism is 5 times higher in patients with nonvalvular atrial fibrillation, there is 2-3 times increase in occurrence of symptomatic congestive heart failure and the frequency of hospitalisation as well as 2 times increase in deaths. The most frequent locations of thromboembolism, besides ischaemic stroke, are: renal artery, mesenteric artery, upper and lower limbs arteries and arteries around pelvic organs. The most frequent complication of atrial fibrillation is stroke which is characterised by worse course and prognosis in comparison to stroke with different etiology. It was proven that the risk of next stroke in patients with AF is 4 times higher and the risk of death is 2 times higher. Atrial fibrillation is confirmed in 15,6% patients with stroke whereas the diagnosis in the half on them is based on a routine electrocardiography [11]. According to data provided, among the most essential therapies in AF patients are not only rhythm-control and rate-control strategy but also preventing thromboembolism by using oral anticoagulation therapy.

1.1 Etiopathogenesis of thromboembolism incidents

In etiopathogenesis of increased thromboembolism risk in AF patients all 3 factors described in Virchow's triad are involved. In patients with AF there is both, significant lower blood flow and vascular wall disfunction (atrium in this case) as well as increased blood coagulability. In consequence such factors result in increased risk of embolism. Very fast chaotic atrium systole, typical to AF, leads to significant decrease of blood flow within atriums and in Left Atrial Appendage (LAA). This causes the spontaneus echo contrast phenomenon observed in echocardiographic examination. In patients with AF increased plasma concentration of prothrombotic factors such as: fibrinogen and d-dimer was observed. It proves that those patients had higher blood coagulability. Overexpression of von Willebrand factor and tissue factor in atriums endocardia is also observed in patients with AF with thromboembolism. It is mainly activation of coagulation system that is responsible for thromboembolism during AF in atria, in contrary to arterial bed where dominant role is played by platelets. This different mechanism of creating embolic material has significant clinical importance. It explains higher effectiveness of oral anticoagulants rather than antiplatelet therapy to prevent thromboembolism in patients with AF [12,13].

1.2 Risk factors of thromboembolism

The risk of stroke in patients with AF, just as in all populations, increases along with age. Moreover, it was stated that in patients with AF left atrium is enlarged and left atrial appendage flow velocity is slower along with age. Such phenomenon strongly predisposes to formation of thromboembolic material. Arterial hypertension intercurrent with AF is also linked to lower blood flow in left atrium and it fosters the spontaneus echo contrast phenomenon in the left atrial appendage. Arterial hypertension increases the risk of stroke in patients with AF two times. Diabetes can predispose to formation of thromboembolic material by increased concentration of substances with prothrombotic features in blood. Based on available data it is estimated that diabetes increases the risk of stroke 1,5-2 times in patients with AF and diabetes. Chronic heart failure can also significantly increase proclivity to formation of thromboembolic material. Patients with heart failure have significantly increased concentration of von-Willebrand factor, dissoluble thrombomodulin and E-selectine. In SPAF trial heart failure was independent risk factor of thromboembolism complications in patients with AF (7%/year) [13,14]. Stroke is the most frequent complication of AF. Stroke/TIA is also the strongest independent risk factor of next thromboembolic incident occurrence, increasing the risk of next stroke 5 times. On one hand, stroke is a consequence of prothrombotic condition, whereas on the other hand it is caused by increased predisposition to forming thromboembolic material in patients with AF resulting from balance between pro-anticoagulation factors [14].

1.3 Risk factors of thromboembolism evaluation

The risk of thromboembolic incident occurrence in patients with AF is not homogenous and is dependant on age, sex and other intercurrent diseases mentioned in previous chapter of the paper. Scientists from „The Stroke In Atrial Fibrillation" task force included prior stroke/ TIA (RR –relative risk 2,5), old age (RR 1,5/10years), arterial hypertension (RR 2,0), diabetes (RR1,8), female sex (RR 1,6) to stroke risk factors. Based on very similar clinical parameters members of Scientific Project SPAF (Stroke Prevention In Atrial Fibrillation) created widely known point scale for stroke risk evaluation - $CHADS_2$ Score (Congestive Heart Failure, Hypertension, Age>75, Diabetes mellitus, Stroke/TIA). Each parameter has 1 point assigned in this Score. Only prior stoke/transient ischemic attack has 2 points assigned. The Score, however, does not enable isolating very low stroke risk group. What is more, its positive predictive value in stroke evaluation is 0,58. Extended Score CHA_2DS_2-VASc (Table 1) increases its positive predictive value and allows strong predictive negative value [14-16]. CHA_2DS_2-VASc Score has many advantages. It is simple and based mainly on information gathered during the interview and physical examination of the patient. Is was also validated.

CHA_2DS_2-VASc Score	**Condition**	**Points**
C-congestive heart failure/LV dysfunction	Congestive heart failure (or Left ventricular systolic dysfunction)	1
H - hypertension	Hypertension	1
A-age	Age≥75	2
Diabetes mellitus	Diabetes	1
Stroke/TIA/Thromboembolism History	Prior stroke/TIA /Thromboembolism	2
V - vascular disease history	Vascular disease, peripheral artery disease, myocardial infraction, aortic plaque	1
A-age	Age 65-74	1
Sc-sex category	Female sex	1

Table 1: CHA_2DS_2-VASc Score

Estimated risk of stroke in CHADS VASc Score was presented in (Table 2) [16].

Points in CHA_2DS_2-VASc Score	**Number of examined patients**	**Percentage of stroke by age (%/year)**
0	1	0%
1	422	1,3%
2	1230	2,2%
3	1730	3,2%
4	1718	4,0%
5	1159	6,7%
6	679	9,8%
7	294	9,6%
8	82	6.7%
9	14	15,2%

Table 2: Estimated risk of stroke based on CHA2DS2-VASc Score.

Stroke risk evaluation with this Score enables identification of low risk patients as well as patients that can benefit more from oral anticoagulation. On the other hand, oral anticoagulation therapy is linked to increased risk of bleedings, hemorrhagic stroke included. It is important to be advised that guidelines for oral anticoagulation therapy and the choice of medication are not unambiguous for patients burdened with medium stroke risk or with high probability of haemorrhage. In such patients, evaluation of risk factors in echocardiography can be useful because the presence of such factors will indicate necessity of inclusion chronic oral anticoagulant therapy (Table 3) [17,18].

Echocardiographic Risk Factors of Embolism in Artial Fibrillation
EF< 35%
Thick, spontaneous contrast in left atrial appendage
Left atrial appendage thrombus
Left atrial appendage disfunction (blood flow below 20cm/s)
Complex aortic plaque

Table 3: Echocardiographic factors of embolism in atrial fibrillation

According to Virchow, by interfering blood flow, atrial fibrillation fosters creation of thrombus inside atriums – most frequently in left atrial appendage (LAA). The most significant is the left atrial appendage shape, that is usually very complex, as well as its satellite location against left atrium. These are additional factors for thrombus creation especially in situations with impairment of mechanical activity, like in arrhythmia. Due to high sensitivity and specificity transoesophageal echocardiography is considered a golden standard in detecting embolic material in LAA as well as symptoms of atrial appendage disfunction fostering thrombus creation [18-21]. Those include: spontaneous contrast in left atrial appendage and left atrial appendage flow velocity (evaluated by pulse wave doppler technics) below 20cm/s [22-25]

2. Objectives of This Work

The subject of this trial was to determine dependence between the number of points obtained in CHA_2DS_2-VASc Score and the left atrial appendage flow velocity marked in transoesophageal echocardiography.

3. Materials and Methods

There were 450 persons examined (195 women, 255men) with atrial fibrillation. Average age of patients was 71. Each patient was evaluated in CHA2DS2-VASc Score receiving 0-9 points. Average points were 3,6. Transoesophageal echocardiography with doppler sample placed 1 centimetre below LAA ostium was performed in all the patients. Pulse wave doppler technics (PW) was used. The measurement was done by setting doppler gate collaterally to blood flow in 1/3 closer part of atrial appendage around 1 centimetre below ostium [22-26]. When LLA function was maintained, the rates were recorded as oscillatory above and below isoelectric line. When there was systolic atrial appendage disfunction, lower values were recorded. According to available bibliography, recorded rates velocities below 20 cm/s indicate atrial appendage disfunction fostering thrombus creation [26-28].

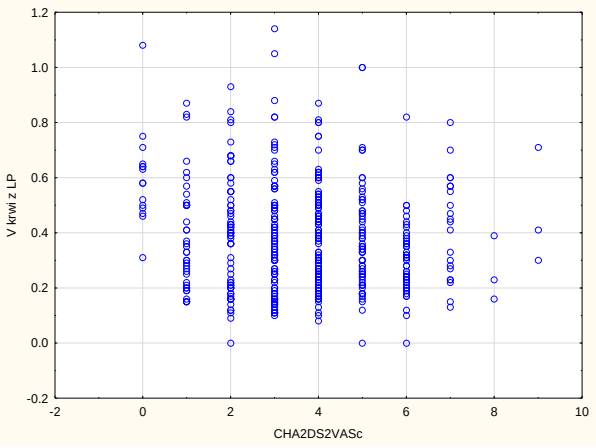
In this paper, the dependence between the number of points obtained in CHA_2DS_2-VASc Score and lowered left atrial appendage flow velocity was evaluated.

4. Results

Nonparametric test of Spearman rank

Statistical significance Alpha = 0,05

Variable pair	Spearmna;s Rank correlation (Sheet2) BD deleted by pairs Correlation coefficients are significant when p<.050000			
	N Valid	R Spearman	t(N-2)	p
CHA2DS2VASc & V blood from LP	450	-0.118730	-2.53095	0.011717



It was stated that there is statistically significant dependence between examined features (p=0,012). This dependence is weak and negative though. For each next class, the expected V value of left atrial appendage flow velocity is lower.

4. Conclusions

Obtained results proved correlation between the left atrial appendage flow velocity and points obtained in CHA_2DS_2-VASc Score. Therefore, the evaluation of left atrial appendage flow velocity in transoesophageal echocardiography examination could potentially be used as individual or supportive parameter in qualifying patients for oral anticoagulation therapy in the future.

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