UDC 616.124-008.46-072.7
PECULIARITIES OF MALFORMATIOM OF LEFT VENTRICLE AT APICAL ANEURYSMS

Moroz M.N. [1], Trembovetskaia E.M. [2] and Yuvchik E.V. [3]

[1,2,3] «Amosov National Institute of Cardiovascular Surgery»,
Kiev, Ukraine

The paper is the part of scientific investigation «Malformation, rotation and extrusion of myocardium of different types of postinfarction aneurysms of left ventricle (LV) ».

Abstract

The purpose of the research was to study the peculiarities of malformation of left ventricle in patient with apical aneurysm.

The study included 19 patients with aneurysm and 35 patients without cardiac pathology, which were carried out speckle-tracking echocardiography. Received information allows defining factors, which affected the longitudinal and circumferential malformation of left ventricle in patients of this group. In future, this will help to estimate functional status of patients and choose the tactics of surgery.

Key words: aneurysm of left ventricle, echocardiography, malformation.

Introduction

High morbidity rate of ischemic heart disease (IHD), increased number of patients who suffered from myocardial infarction and as a consequence of complication had aneurysm of left ventricle present intense significance to this group of patients.

Aneurysm of ventricle presents confined, thinned, uncontracted part of the wall, which consists of necrotic or cicatrical tissue. At apical aneurysm a- or cicatrical tissue places 2 or more segments and is situated lower papillary muscles [1].

An apex presents vortexually wrapping inside muscle fibers, which on the part of endocardium is divided into separate fascicles and passes into trabecula, having longitudinal orientation in healthy heart [2]. An apex is the place of direct blending of longitudinal and circular malformation.

Nowadays it was indicated and determined that real healthy myocardium is inhomogeneous each of electrically and mechanically. The best evidence of this fact is functional opportunities (possibilities) of myocardial apex [6]. An apex in contrast to medial and basal segments practically doesn't shift, wherein with high speed and other of sections is transformed in longitudinal and circular direction. Result of its malformation is drawing superposed (medial and basal) sections and "rings" of mitral valve downwards and single-step twisting of LV counterclockwise. So, apex takes part in supply of the main task of left ventricle is to achieve adequate needs of systolic discharge without intension of adaptation processes [3].

When there is apical aneurysm in ventricle small area, which doesn't take part in contraction it is convenient place for clots formation. According to information of one authors apical aneurysm doesn't affect contractive ability of LV, systemic and endocardiac haemodynamics [4,7]. According to others information there is influence, but not dramatic and difficult one as other aneurysm location. Minor decrease of ejection fraction, decrease of maximal speed of blood flow in LV, time increase during which can be reduced speed, although blood flow is involved, but chamber pressure decreases, receives maximum, that in healthy people are the main features of apical aneurysm [5].

In modern literature there is not clear information due to which processes these changes are noted and there is not information about changes of longitudinal and circular malformation of myocardium of apical aneurysm.

The aim of the investigation was to study peculiarities of movement of the walls of LV at apical aneurysms.

Material and methods of investigation

To diagnose aneurysms and also to detect functional condition of myocardium, method of complex echocardiography was used. All patients received echocardiography on ultrasound device of expert class VIVID E9 of company General Electric with sector detectors with variable frequency from 1,5 to 5,0 Mcps. All detectors independently of scanning frequency had shared regimen mode.

Terminal diastolic volume (TDV), terminal systolic volume (TSV) of LV were detected in two-chamber and four-chamber heart position, terminal diastolic indices and terminal systolic indices were calculated, systolic discharge and Simpson's ejection fraction were calculated.

Main attention was paid to new ultrasound technology (speckle tracking echocardiography). The principle indicates two-dimensional image is divided into small segments (mosaic). Combination of pixels of grey scale from segment is unique. It allows monitoring the movement of selected parts of myocardium structure during cardiac cycle. Received data presents graphic images: curve, coloured scale, vector tables.

Longitudinal movement of left ventricle was described by the following parameters:

- strain (malformation) – is the change of myocardial fiber size during one cardiac cycle, registered in percents;

- global longitudinal strain of LV – is medial size of longitudinal strain for 3 sections – basal, medial, apical [8,10,11,12].

Rotational movement of LV was described by the following parameters:

- rotation (^{0}), of angular displacement of myocardium segment through short axis (it is measured in one area);

- twisting (^{0}), is difference between rotation of apex and basal part of LV (it is measured in two transverse sections of LV through short axis).

Scheme of segmental division of LV, proposed by American Association of Echocardiography was used in this paper to investigate cardiodynamics and function of each segment of LV [9].

Statistic analysis was done after data base creation in Microsoft Excel, using method of variable statistics for average quantity. All meanings are presented in M ± m, where M – is average meaning of index, m is standard defect (error) of medial. To compare average quantity Student's index (t-criterion) was used to determine their accuracy. Difference between indices was accurate at $p < 0,05$.

19 patients were involved in this investigation; they treated in «Amosov National Institute of Cardiovascular Surgery» in 2010-2015. with ischemic heart disease (IHD), apical aneurysms of left ventricle (average age was 51,2 ± 6,1, men -100%). The diagnosis was made based on coronaroventiculography, echocardiography, and electrocardiogram. Clinic condition of patients corresponded to 1-2 functional class according to NYHA. Control group included 35 people, who did not complain of heart problems and other organs malformations, and their parameters of classic Doppler echocardiography were in norm (average age 48 years old ± 4,1, men - 86%).

Results and their discussion

After carrying out compared assessment of segmental contractility according to coronaroventriculography, echocardiography speckle tracking and echocardiography in patients with IHD and postinfarction apical aneurysm of LV it was determined decrease of longitudinal malformation. At acentric scarring longitudinal segmental malformation included -3,1± 2,9 (%), and at discinetic scarring contained 0,14±3,8 (%).

Malformation of segments of inaneurismal part, which was demonstrated according to ventriculography of satisfactory and good contractility it was also reduced that is connected with ischemia of subendocardial longitudinal layer of myocardium and good perfusion of circular and subepicardial layers. Ultimately, group of patients with small aneurysms who have satisfactory ejection fraction there is not dilatation LV cavity global longitudinal strain was reduced twofold (**table. 1, 2**).

Table 1

Patients' characteristics with postinfarction anterioapical aneurysms of LV

	TDI ml/m2	**TSI ml/m2**	**VE (ventricular ejection)ml/m2**	**EF %**	**FC according to NYHA**	**HF heart failure**
Norm n=35	60,9± 6,5	34,6 ± 8,2	39,4 ± 5,2	64,0±4,1	0	0
Anterior apical aneurysms n=19	70,0 ± 11,1	36,6 ± 6,7	31,1 ± 4,3	47,3± 3,1	1 — 2.	Ia - Iб

Table 2

Global longitudinal strain of LV in norm (n=35) and with apical aneurysms (n=19)

Group number	Global longitudinal strain (%)	Difference in (%) from norm
Norm n=35	-22,0 ± 2,4	0 %
Apical aneurysms n=19	-11,1 ± 1,1	-50,00%

Table 3

Indices of maximal segmental longitudinal strain of myocardium in different sections of LV in norm and with apical aneurysms

Region	Norm (n=35)	Apical aneurysms (n=19)	Difference in (%) from norm
Basal	-21,3±2,5	-16,0 ± 2,3	-25,00%
Medial	-22,7± 2,1	-12,3 ± 1,7	-46,00%
Apical	-25,9± 3,18	-3,1 ± 2,9	-88,00%

Displacement is the result of malformation; longitudinal displacement is the result of longitudinal circular malformation. In norm in systole when each segment malforms contracting in longitudinal direction and scales superjacent, and displacing atrioventricular barrier to almost immovable apex. Patients with IHD and apical aneurysms are noted by expressed decrease of displacement of all regions and also basal ones (**table 3**). It is necessary to note that a malformation decrease of basal regions in 25% (**table 4**) is marked by decrease of displacement on 67%. from norm (**table 5**), that demonstrates influence of regions' malformation on basal subjacent segments.

Table 4

Indices of maximal longitudinal displacement of myocardium of LV of longitudinal sections in norm (n=30) and with apical aneurysms (n=19).

Section	Wall	Segment	Norm	Apical aneurysm
4S	lower septal	basal	19,3 ±2,4	9,5 ± 2,1
		medial	13,5 ± 2,2	3,8 ± 1,9
		apical	5,3 ± 1,8	0,6 ± 1,3
	lateral	apical	3,2 ± 1,3	1,4 ± 1,7
		medial	10,9 ± 2,4	4,1 ± 2,6
		basal	17,3 ± 4,3	10,5 ± 2,3
3S	anteroseptal	basal	17,2 ± 1,9	9,6 ± 2,1
		medial	9,5 ± 2,4	3,7 ± 2,1
		apical	3,7 ± 1,4	0,6 ± 1,4
	posterior	apical	2,9 ± 1,3	1,0 ± 1,0
		medial	9,8 ± 2,2	4,0 ± 2,2
		basal	15,6 ± 2,8	8,9 ± 3,0
2S	anterior	basal	20,3 ± 3,2	10,7 ± 2,2
		medial	13,7 ± 2,7	3,3 ± 2,4
		apical	3,6 ± 1,8	0 ± 1,3
	inferior	apical	2,5 ± 1,3	0,3 ± 0,8
		medial	9,9 ± 2,7	2,9 ± 1,4
		basal	17,3 ± 3,2	9,3 ± 1,9

Table 5

Indices of maximal segmental longitudinal displacement (mm) of myocardium in different sections of LV in norm and with apical aneurysms

Region	Norm (n=35)	Apical aneurysm (n=19)	Difference in (%) from norm
Basal	17,8 ± 1,3	5,8 ± 2,3	--67,00%
Medial	11,4 ± 0,6	3,8 ± 2,4	-67,00%
Apical	3,7 ± 6,2	0,6 ± 0,4	-84,00%

Patients with IHD and postinfarction apical aneurysms had rotation decrease each of apical and basal regions, but total active twisting was not different from others (**table 6, 7**).

Table 6

Rotation of basal and apical regions of LV in norm (n=35) and in aneurysms (n=19)

Group	Basal region		Apical region	
	Rotation (degrees)	Difference in (%) rotation from norm	Rotation (degrees)	Difference in (%) rotation from norm
Norm n=35	-6,8 ± 1,3	0	11,8 ± 0,6	0%
Apical aneurysm n=19	- 5,9 ±3,5	-13%	9,6 ± 2,2	-19%

Table 7

Indices of maximal of rotation of myocardium of LV in norm (n=30) and with apical aneurysms (n=19)

	Rotation (grades)	Difference in (%) from norm
Norm n=35	20,8 ± 4,2	0 %
Apical aneurysms n=19	15,6 ± 4,6	-25,00%

Conclusions

1. It was marked decrease of longitudinal segmental strain to -3,1 ± 2,9 in the area of aneurysm. Received results as follows raucous decrease of segmental longitudinal malformation of LV can be used as markers of scar tissue.
2. Patients with IHD and apical aneurysms of LV had decrease of segmental longitudinal strain (in spite of good contractility of basal and medial regions according to ventriculography) to -16,0 ± 2,3 for basal and -12,3±1,7 for medial regions, that can indicate ischemia of subendocardiac longitudinal layer of myocardium and good perfusion of circular and subepicardial layers of LV.
3. Decrease of longitudinal malformation (-50,00%from norm), than circular (-25,00%from norm) is involved in apical aneurysms (**table 2, 7**).

4. Expressed decrease of global longitudinal malformation and also decrease of displacement of basal regions of LV (-67,00% from norm) is involved in apical aneurysms of LV with satisfactory contractility of inaneurismal part, that leads to significant decrease of contribution of longitudinal malformation of myocardium in pumping work of LV (left ventricle) of longitudinal axis.

Perspectives of further investigations

Based on received information it is necessary to determine the influence of aortocoronary shunting and resection of apical aneurysms on movement of basal regions of LV, as one of the main factor which affects ventricular ejection.

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