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Original Article

Outcomes of post-MI ventricular septal rupture surgical repair in-patients operated in different time periods upon acute myocardial infarction evolvement

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Abstract

Aim: The article highlights problematic issues of surgical treatment of mechanical complications of acute myocardial infarction (AMI), specifically, post-myocardial infarction ventricular septum rupture (post-MI VSR). Based on the study of the results of surgical treatment of post-MI VSR in patients with different terms of surgical intervention upon AMI evolvement, the most rational approach to ventricular septum defect (VSD) repair in such patients has been determined. Specifically, subject to hemodynamic stability in patients with post-MI VSR within the first two weeks after AMI evolvement, given the risk of mortality (42.1%), the wait-and-see tactics of surgical treatment is deemed a wise measure. Since the third week after AMI the stabilization of operative mortality rate (up to 10.5-15.8%) has been observed this lays the grounds for active surgical treatment tactics. Notably, analysis of the dynamics of echocardiographic characteristics and changes in the degree of tolerance to physical activity (PA) in patients with post-MI VSR who underwent surgery in different periods after AMI evolvement have been particularly addressed. It has been found that the probability of achievement the most favourable clinical condition corresponding to class I by New York Heart Association (NYHA) classification ($\chi 2$ (2, n=65) = 20,791; p<0,001) increases when patients performed are operated on in later periods after AMI. Thus, given the risk of mortality in the early post myocardial infarction period, the most appropriate measure in the tactics of managing patients with post-MI VSR is surgical intervention aimed at VSD repairing 2 weeks after AMI. Nonetheless, the decision on the necessity of emergency surgery patients with post-MI VSR must be also based on the potential stabilization of systemic hemodynamic system characteristics using drug therapy and endovascular practices.
Material and Methods: In the study we have presented the retrospectively analysis of data of 90 ischemic heart disease (IHD) patients with post-MI VSR complications. The age of post-MI VSR in-patients ranged from 29 to 81 (60.0 ± 9.6). Among such patients men prevailed (72.3%). Duration of hospitalization of those post-MI VSR from AMI onset varied from 1 to 462 days (n=90). Depending on the time of surgery to be performed after AMI suffered, all patients were divided into groups: group 1 – up to 28 days (n=28); group 2 – from 29 to 56 days n=26); group 3 – from 57 days (n=36). Among the 90 patients who participated in the study, the surgical treatment of post-MI VSR was used in 93.3% (n=84) of patients. LV aneurysm repair according to W. M. Dagget's technique (14) was performed in 54.8% of patients (n=46), according to T. E. David's technique (7) – in 36.9% of patients (n=31).
Results: Overall surgical mortality among 84 patients has been observed in 22.6% (n=19). In patients of group 1 there occurred 10 lethal cases, in group 2 there were 5, and in group 3 – there were 4 deaths (n=84)observed. Starting from the 3rd week after AMI onset, significant decrease in operative mortality from 42.1% to 10.5-15.8% has been observed. Study of the dynamics of echocardiography characteristics show less marked changes in LVESV and LVEDV in group 1 compared to groups 2 and 3 testify, in the latter, in favor of completed post-infarction "heart remodeling" with LV aneurysm formed.
Conclusion: 1. When planning the scope of surgical intervention at a later date from AMI evolvement, account must be taken of individual dynamics of post-myocardial infarction "cardiac remodeling". 2. Postoperative decrease in ECHO values of LVESV, LVEDV and LVSV in patients with post-MI VSR speaks for the effectiveness of surgical intervention aimed at repairing VSD and restoring LV geometry. 3. The probability of achieving the most favorable NYHA class I clinical state increases when surgery is performed in patients at the later time after AMI suffered.

Keywords: Post-myocardial infarction ventricular septum rupture, acute myocardial infarction, coronary artery atherosclerosis, ischemic heart disease

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INTRODUCTION

Post-myocardial infarction ventricular septum rupture (post-MI VSR) is one of the most life-threatening mechanical complications of AMI. The degree of post-MI VSR incidence makes up 0.2-3% of the total number of patients with AMI suffered (1,2). The occurrence of post-MI VSR is defined by an extremely unfavourable prognosis always leading to severe heart failure. Nowadays it is surgical repair of post-MI VSR that is the only efficient method since the possibilities of drug therapy for this complication of AMI are extremely limited and ineffective. However, despite low probability of the defect occurrence and successful development of cardiac surgery and pharmacology, the high mortality rate in patients including cases of VSD repair at the early stages after AMI evolvement leaves unsettled the matter of tactics as to this pathology surgical treatment (3-5).

Today, post-MI SVR repair, which, according to the Society of Thoracic Surgeons, occupies only 0.1% of all cardiac surgical procedures, makes for a complex set of surgical interventions with involvement of high surgical risks which determine the long-term survival of patients with this pathology (6,7). Surgical repair of post-MI SVR reduces the mortality rate to an average of 40-70% that is significantly affected by the patient's hemodynamic status which lines up with the term of AMI evolvement (8,9). Based on literature, post-operative mortality in the cases when surgery is performed at acute and sub-acute stages of myocardial infarction makes up 50% approx., and in case of cardiogenic shock it reaches 80% (6,10-12). Late post-MI SVR repair (more than 1-2 months after AMI onset) is associated with a lower mortality rate. Notably, according to the largest study to this date (2 876 patients in 12 years), mortality in patients operated on within the first 7 days after AMI evolvement made up 54.1%, and after 7 days – 18.4%, with the highest mortality observed in the first 6 hours, and the lowest – after 21 days and later (4-6). Other authors also speak in favour of delayed surgery and pre-stabilization of patients clinical condition, since the percentage of mortality in patients operated on in the first week after AMI onset and non-operated patients is the same (13). Nevertheless, according to some recommendations, the above wait-and-see tactics is not quite fully justified. Current ACC/AHA guidelines (2013) for the management of patients with AMI recommend emergency surgery for post-MI SVR irrespective of patient's clinical condition, allowing for the significant risk of acute hemodynamic deterioration even in stable patients (class I recommendations). At the same time, the ESC recommendations do not provide an unequivocal answer as to the timing of an operation while merely highlighting the need for full surgical repair of post-MI SVR prior to occurrence of cardiogenic shock.

One of the fundamental issues of post-MI VSR repair is optimal timing of surgical intervention which remains an item of numerous discussions. Some researchers consider it reasonable to use early aggressive tactics (11), while others suggest achieving complete stabilization of clinical condition and scarring at the edges of the defect which occurs approximately by the 3rd week after AMI onset (14). The grounds for the discussion mentioned are, on the one hand, the high mortality in patients in pre-operative period when applying wait-and-see tactics, and, on the other hand, the high risk of mortality when performing surgical intervention within the 1st week after AMI onset (15,16). Optimal timing of surgical intervention is crucial not only for minimization of mortality risk, but also for attaining the most positive results in patients with post-MI VSR. Therefore, it is of higher relevance and at the same time polemical to determine the optimal time for surgical intervention in patients with post-MI VSR.

Objective

Defining the optimal timing of post-MI VSR repair allowing for patients' survival and degree of their tolerance to PA in post-operative term.

MATERIAL AND METHODS

In the study we have presented the retrospectively analysis of data of 90 ischemic heart disease (IHD) patients with post-MI VSR complications operated at the Central Clinical Hospital (CCH) in Baku and at the National Institute of Cardiovascular Surgery named after. N. M. Amosova (NISSKh) NAMS of Ukraine covering the period of 2002-2019. The age of post-MI VSR in-patients ranged from 29 to 81 (60.0 ± 9.6 years; Z=0.729, p=0.663). Among such patients men prevailed (72.3%). Duration of hospitalization of those post-MI VSR from AMI onset varied from 1 to 462 days (n=90; Mo=1; Me=35.0 (Q1=15.5; Q3=72.0)).

Depending on the time of surgery to be performed after AMI suffered, all patients were divided into groups: group 1 – up to 28 days (n=28); group 2 – from 29 to 56 days n=26); group 3 – from 57 days (n=36).

As the IHD progresses and clinical condition in post-MI SVR patients require urgent surgery intervention and its prognosis, it is advisable to take a close look at clinical profile of post-MI SVR patients (Table 1).

Notably, according to pre-operative echocardiogram (ECHO) determining the scope of surgical intervention, the statistical frequency of ECHO changes was not significantly different in the groups sated above (Table 2).

Mean pulmonary artery pressure in patients of group 1 made up 55.91 ± 16.0 mm Hg (n=22; W=0.951, p=0.334), in patients of group 2 it was defined at 62.7 ± 16.9 mm Hg (n=20; W=0.962, p=0.592), in patients of group 3 – 61.6 ± 18.2 mm Hg (n=25; W=0.944, p=0.179), which had no statistically significant differences. Pre-operative data of left ventricular (LV) ejection fraction in study groups patients had no statistically significant differences (H=4.978 (2, n=87), p=0.083). Besides, the results of coronary angiography revealed the lack of differences between the study groups either in the severity of coronary atherosclerosis ($\chi 2$(4, n=162) = 1.189; p=0.879), and on the number of main branches of coronary arteries affected by atherosclerosis ($\chi 2$ (4, n=90) = 3.793; p=0.435) (Table 3).

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The results obtained confirm the occurrence of multivessel coronary artery disease in patients with post-MI VSR irrespective of the time period after AMI evolvement (Table 3).

Among the 90 patients who participated in the study, the surgical treatment of post-MI VSR was used in 93.3% (n=84) of patients, in 6.7% of patients (n=6) the operation was not performed due to preoperative mortality or due to patients' refusals. With a standard median sternotomy, access to post-MI VSR was carried out through LV infarction or the right atrium in 97.6% (n=82) and 2.4% of patients (n=2), respectively. Post-MI VSR plastics repair was performed using the defect exclusion technique. LV aneurysm repair according to W. M. Dagget's technique (14) was performed in 54.8% of patients (n=46), according to T. E. David's technique (7) – in 36.9% of patients (n=31). In 8.3% of patients (n=7) with apical post-MI VSR, the aneurysm and VSD were repaired according to V. Dor's technique (17).

Post-MI VSR in-patients' examination was carried out using general clinical research methods. Stable angina severity was determined according to NYHA classification. The stage of chronic renal failure in patients with post-MI VSR was determined by the glomerular filtration rate, which was calculated using the CKD-EPI Creatinine formula (18).

When doing statistical data analysis Fisher's Exact Test, Pearson's chi-squared test (χ2 test), Kruskal-Wallis H-test and two-sample (Z, p) Kolmogorov-Smirnov test were used. Comparison of two dependent samples (pre- and post-operative periods) was done using the non-parametric T-tailed Wilcoxon-test. All statistical calculations were carried out using the SPSS 11 programm for Windows.

Table 1. Clinical profile of post-MI VSR patients, n / %

Diagnosis		Group 1 (n=28)	Group 2 (n=26)	Group 3 (n=36)	Statistical significance
AMI		27/96.4	10/38.5	0/0	p<0.001
PC		0/0	4/15.4	18/50	p=0.007
NYHA Class	I	0/0	1/3.9	0/0	χ2 (2. n=62) = 8.350; p=0.015
	II	0/0	2/7.7	10/27.8	
	III	0/0	8/30.7	18/50.0	
	IV	28/100	15/57.7	8/22.2	
AHF by Killip	II	1/3.6	1/3.9	2/5.6	p<0.001
	III	10/35.7	1/3.9	0/0	
	IV	4/14.3	1/3.9	0/0	
Diabetes mellitus		13/46.4	12/46.2	6/16.7	χ2 (2. n=90) = 8.399; p=0.015
CKD	II (GFR= 60-89 ml/min/1.73 m^2)	6/21.4	6/23.1	2/5.6	p=0.131
	IIIa (GFR = 45-59 ml/min/1.73 m^2)	4/14.3	2/7.7	6/16.7	
	IIIb - IV (GFR= 15-44 ml/min/1.73 m^2)	10/35.7	1/3.8	4/11.1	

Note: FC – functional class; AMI – acute myocardial infarction; PC – postinfarction cardiosclerosis; AHF – acute heart failure; NYHA – the New York Heart Association Classification; CKD – chronic kidney disease; GFR – glomerular filtration rate

Table 2. Pre-operative echocardiogram data in patients with post-MI VSR, n / %

ECHO changes	Group 1(n=28)	Group 2 (n=26)	Group 3 (n=36)	Statistical significance
LV wall motion abnormality	7/25.0	4/15.4	7/19.4	χ2(2. n=90) = 0.791; p=0.673
LV aneurysm	13/46.4	19/73.1	25/69.4	χ2 (2. n=90) = 5.088; p=0.079
Thrombus in LV	2/7.1	3/11.5	2/5.6	p=0.793
VS multiple defect	6/21.4	2/7.7	1/2.8	p=0.051

Note: LV – left ventricular; VS – ventricular septum; ECHO – echocardiogram

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Table 3. CAD characteristics in patients with post-MI VSR, n / %

	Group			
CA	Group 1 (n=28)	Group 2 (n=26)	Group 3 (n=36)	χ2, p
1 vessel	7/25.0	5/19.2	6/16.7	χ2(4. n=90) = 3.793; p=0.435
2 vessels	6/21.4	10/38.5	16/44.4	
3 vessels	15/53.6	11/42.3	14/38.9	

Note: CAD – coronary artery disease

RESULTS

Overall surgical mortality among 84 patients has been observed in 22.6% (n=19). In patients of group 1 there occurred 10 lethal cases, in group 2 there were 5, and in group 3 – there were 4 deaths (χ^2 (2, n=84) = 7.577; p=0.023) observed. Thus, the number of lethal cases in operated patients with post-MI VSR decreased progressively with enlargement of the period after AMI onset (Figure 1).

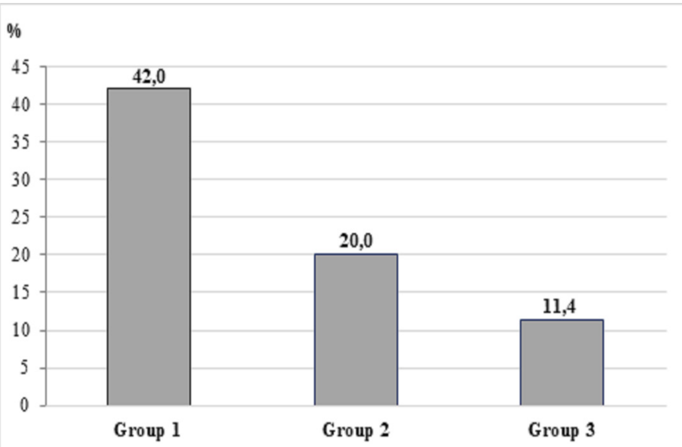

Figure 1. Operative mortality in patients with post-MI VSR

Division of patients into clinical study groups builds on long time intervals sufficient for post-infarction "cardiac remodeling". Notably, in each of the three groups there exist patients with unstable cardiac hemodynamics that requires urgent surgical intervention. In the meantime, clinical condition of other patients in these groups allows the delay of VSD-repair surgery. However, the enlargement of time period from the onset of post-MI VSR against the processes of post-infarction "heart remodeling" aids occurrence of biventricular insufficiency. Since not all patients can be stabilized for the surgery to be performed within the time periods corresponding to the evolvement of post-infarction cardiac sclerosis, it was deemed advisable to determine the most favourable time intervals for surgical intervention allowing for the risk of mortality (Figure 2).

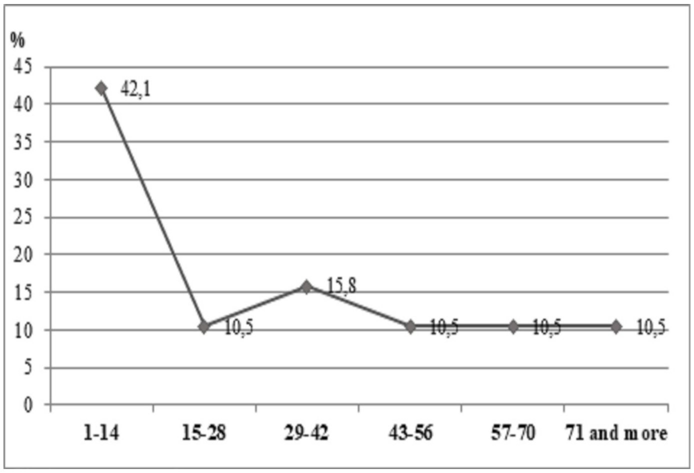

Figure 2. Mortality in patients with post-MI VSR depending on timing of surgical intervention after AMI evolvement (day)

According to the data shown in figure 2, starting from the 3rd week after AMI onset, significant decrease in operative mortality from 42.1% to 10.5-15.8% has been observed. At a later stage, with the enlargement of time period from the moment of AMI evolvement, no significant changes in mortality rate have been observed. It is safe to assume that the use of drug therapy, method of endovascular VSD repair and mechanical support of systemic hemodynamics are justified in patients in early stages after AMI occurrence. Such tactics of managing patients in the first 2 weeks after AMI evolvement opens up the possibility to postpone the operation until the most favourable prognostic time. Thus, according to our data, VSD repair surgery will be best performed, allowing for mortality risk, 2 weeks after AMI onset. Since the processes of post-infarction "heart remodeling" and the induction of decompensation run in parallel, any further dilatory management does not reduce operative mortality in group-1patients.

Study of the dynamics of echocardiography characteristics reflecting the LV condition in patients with post-MI VSR operated on in different time periods after AMI onset has revealed the trends compliant with the generally accepted concept of post-infarction "cardiac remodeling" (Table 4).

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Specifically, less marked changes in LVESV and LVEDV in group 1 compared to groups 2 and 3 testify, in the latter, in favor of completed post-infarction "heart remodeling" with LV aneurysm formed. This assumption confirms the occurrence of statistically significant differences between the 1st and 2nd, as well as the 2nd and 3rd groups as to the values of pre-operative LVESV rates (U1-2=9.5 (Z=2.169, p=0.03); U2-3=47.5 (Z=-2.521, p=0.012)). Increase of LV stroke volume (LVSV) speaks for the increased load on myocardium, connected, on the one hand, with the need to ensure the supply of an adequate volume of blood to aorta, and, on the other hand, with the discharge of certain amount of blood into venous heart.

Table 4. Pre-operative echocardiogram data in patients with post-MI VSR, n / %

Indicator		Group 1(n=28)	Group 2 (n=26)	Group 3 (n=36)	Statistical significance
LVEDV, ml (Normal range: 65-130)	A: Mo Me Q1; Q3	102.0 183.0 156.0; 219.5 (n=8)	250.0a 201.0 180.0; 250.0 (n=15)	194.0c 198.5 187.2; 242.2 (n=24)	H=1.966 (2, n=47), p=0.374
	Б: Mo Me Q1; Q3	135.0 165.5 141.7; 198.7 (n=8)	113.0 165.0 148.0; 183.0 (n=15)	165.0 173.5 160.2; 186.7 (n=24)	H=0.228 (2, n=47), p=0.892
LVESV, ml (Normal range: 40-60)	A: Mo Me Q1; Q3	59.0 110.0 71.0; 132.0 (n=6)	165.0b 159.0 124.5; 166.0 (n=10)	102.0d 114.0 98.7; 134.2 (n=22)	H=7.893 (2, n=38), p=0.019
	Б: Mo Me Q1; Q3	62.0 102.0 86.0; 114.7 (n=6)	71.0 95.5 82.2; 115.2 (n=10)	97.0 91.5 83.5; 97.7 (n=22)	H=1.969 (2, n=38), p=0.374
LVSV, ml (Normal range: 55-90)	A: Mo Me Q1; Q3	43.0 82.5 47.5; 110.5 (n=6)	25.0 85.5 59.7; 101.7 (n=10)	66.0e 96.0 75.0; 112.2 (n=22)	H=2.806 (2, n=38), p=0.246
	Б: Mo Me Q1; Q3	37.0 72.0 57.2; 97.2 (n=6)	49.0 68.5 55.7; 76.5 (n=10)	85.0 79.5 58.5; 95.5 (n=22)	H=1.039 (2, n=38), p=0.595
LVEF, % (Normal range: 55-60)	A: Mo Me Q1; Q3	40.0 43.0 40.5; 47.0 (n=8)	38.0 40.0 37.0; 46.0 (n=15)	38.0 45.0 39.0; 55.5 (n=25)	H=2.702 (2, n=48), p=0.259
	Б: Mo Me Q1; Q3	46.0 46.0 42.7; 47.0 (n=8)	38.0 41.0 38.0; 48.0 (n=15)	47.0 48.0 43.5; 51.5 (n=25)	H=4.983 (2, n=48), p=0.828

Note: ECHO – echocardiogram; LV – left ventricle; LVEDV – left ventricular end diastolic volume; LVESV – left ventricular end systolic volume; LVSV – left ventricular stroke volume; LVEF – left ventricular ejection fraction. A – indicators before surgery; B – indicators after surgery; N – total number of patients in a group; n – number of patients with ECHO done. Statistically significant differences (p < 0.05) in ECHO features before and after surgery: a – T=10.0; Z= -2.840; p=0.005; b – T=1.0; Z= -2.701; p=0.007; c – T=0; Z= -4.286; p<0.001; d – T=12.0; Z= -3.719; p<0.001; e – T=12.5; Z= -3.702; p<0.001

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Table 5. Dynamics of changes in NYHA classes in patients with post-MI VSR, n

NYHA class		Group 1(n=14)	Group 2 (n=20)	Group 3 (n=31)
I	A	0	1	0
	B	2	14	26
II	A	0	2	9
	B	10	6	4
III	A	0	8	15
	B	2	0	1
IV	A	14	9	7
	B	0	0	0

Note: NYHA – The New York Heart Association Classification. A – rates before surgery; B – rates after surgery; N – total number of patients in the group

DISCUSSION

Surgical intervention in patients with post-MI VSR fails to increase the number of effective cardiomyocytes and focuses on repairing post-MI VSR defect, maintaining LV myocardium function and creating optimal conditions for development of compensatory mechanisms. In the work of M. Di Summa et al. (1997) it is shown that patients operated on in the first 2-3 days after AMI had far worse results as to mortality rate – 87.5% (p=0.001) [20].Analysis of samples of post-MI VSR patients in each of the clinical groups highlights the lack of normal distribution in the values of individual pre- and post-operative ECHO characteristics of LV myocardium functional state (14,19). Pre-operative rate values Mo, Me, Q1 and Q3 of LV end systolic volume (LVESV) and LV end diastolic volume (LVEDV) in study groups of post-MI VSR patients have indicated the existence of individual differences in the rates of post-infarction "cardiac remodeling", which, in broad terms, is congruent with the literature data on IHD progression depending on the time of AMI evolvement (21). Post-operative changes in the rates of LVESV, LVEDV and LVSV in patients with post-MI VSR speak for effectiveness of surgical intervention in recovery of LV geometry. In each of the groups of patients, the expected post-operative decrease in LVESV, LVEDV, and LVSV values has been observed. Minor differences between the groups in Mo, Me, Q1 and Q3 values may be due to individual specifics of post-MI "cardiac remodeling", with formation of a different size LV aneurysm and differences in the scope of surgical intervention. At the same time, post-operative values of LV ejection fraction have not changed significantly, as expected, since post-MI VSR plastic repair made it possible to eliminate blood shunting into venous heart, while resection of LV aneurysm allowed the reduction of LVEDV (Table 4). Thus, the above statistical factors entirely fit into generally accepted concept of the clinical course of IHD in patients with AMI (21).

Unmasking of heart failure at a hospital stage and progressive post-infarction LV dilatation, occurring upon patient's discharge from hospital, are the factors determining the long-term survival of patients after AMI. Therefore, it is of relevance to consider the change in the degree of tolerance to PA in patients with post-MI VSR after surgery (Table 5).

The observed dynamics of changes in NYHA classes among patients of groups 1, 2, and 3 indicates the absence of class IV in these patients in post-operative period. Notably, in post-operative period, in most patients, the clinical condition corresponded to class I and II by NYHA (Figure 3).

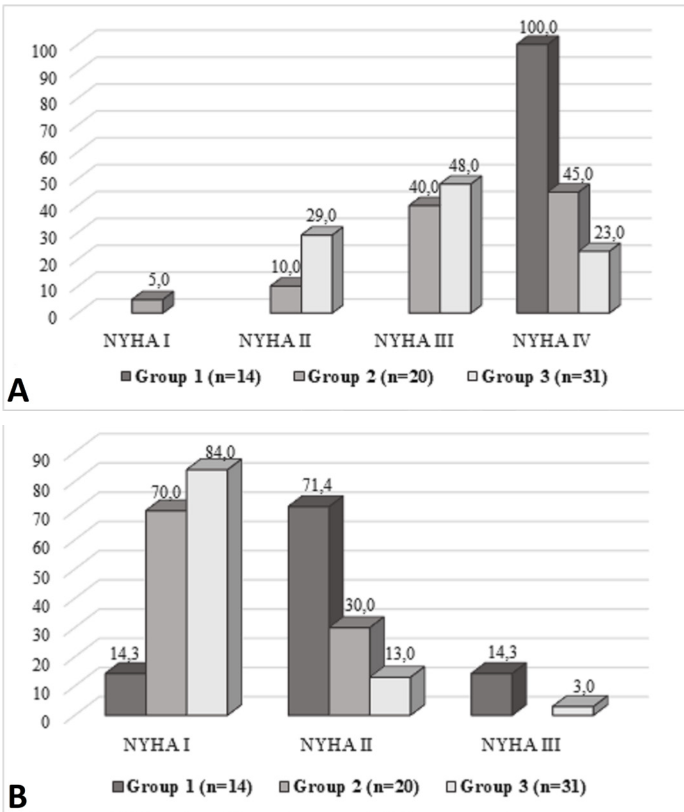

Figure 3. Ranking study groups of patients with post-MI VSR by NYHA classes. NYHA – The New York Heart Association Classification. A – before surgery; B – after surgery

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The most effective outcome of surgical intervention assessed according to NYHA classification is a significant improvement in the patient's clinical condition which corresponds to class I. We rated the frequency of achieving such clinical condition (NYHA class I) in each of the three clinical groups. Analysis of data on postoperative condition of patients according to NYHA classification specifies the presence of statistically significant differences between the groups in the frequency of achieving the most favorable clinical condition of class I ($\chi 2$ (2, n=65) = 20.791; p<0.001). The results obtained are in line with the general concept of the most favorable prognosis in patients with post-MI VSR when surgery is delivered to them at a later period after AMI suffered (22).

Before surgery, a significant number of patients in groups 2 and 3 and all patients in group 1 were in NYHA class IV. Patients in class IV have the lowest tolerance to PA. Hence, we assessed the effectiveness of surgical intervention slowing down progression of congestive heart failure and improving quality of life in the future through changing NYHA classes in patients of each of the clinical groups (Figure 4).

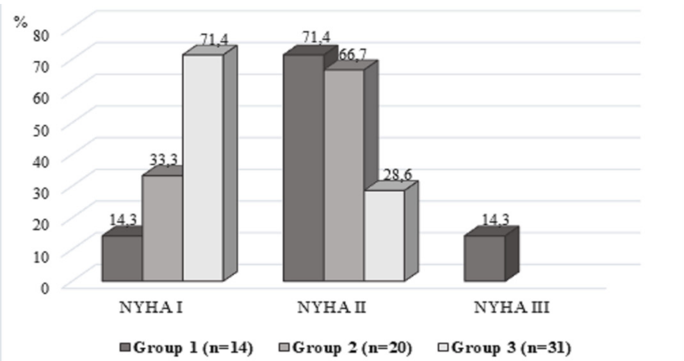

Figure 4. Reclassifying the study groups of post-MI VSR patients from class IV into other NYHA classes after surgical intervention performed

The data in figure 4 show that with the extension of the time period from AMI onset to surgery, the probability of a patient's moving from class IV to class I increases (p = 0.038). This is in line with the concept of a more favourable prognosis for surgical intervention performed against the established cardiosclerosis (22). Based on literature, formation of cardiosclerosis is completed by the end of the 1st month from AMI evolvement, which would explain the lack of statistically significant differences in pre-operative indices of tolerance to PA (class IV and higher NYHA classes) in patients of the 2nd and 3rd clinical groups ($\chi 2$ (1, n=51) = 2.838; p=0.921). However, given the tissues regenerative ability in patients of older age groups, it can be assumed that formation of cardiosclerosis is not limited to the first month and the probability of its completion by the end of 2 months is higher (22). Our results suggest that patients in group 3, compared to those in group 2, have a more favourable post-operative prognosis for transition to lower NYHA class I. The latter may also be connected with individual specifics of cardiosclerosis formation after AMI suffered.

According to many authors' data, 82-95% of patients with post-MI VSR who underwent surgery definitely referred to NYHA class I-II throughout the entire follow-up period. The results we obtained are consistent with the fundamental concept of the most favorable prognosis in patients with post-MI VSR when operative intervention is performed in a late period after AMI suffered (11,23).

CONCLUSION

1. Subject to hemodynamic stability of patients with post-MI VSR in the first 2 weeks after AMI evolvement, allowing for mortality risks (42.1%), the wait-and-see tactics is deemed reasonable. From the 3rd week after AMI onset, there is stabilization of operative mortality (10.5-15.8%) observed, which lays the grounds for active surgical treatment tactics. When planning the scope of surgical intervention at a later date from AMI evolvement, account must be taken of individual dynamics of post-myocardial infarction "cardiac remodeling".
2. Postoperative decrease in ECHO values of LVESV, LVEDV and LVSV in patients with post-MI VSR speaks for the effectiveness of surgical intervention aimed at repairing VSD and restoring LV geometry.
3. The probability of achieving the most favorable NYHA class I clinical state ($\chi 2$ (2, n=65) = 20.791; p<0.001) increases when surgery is performed in patients at the later time after AMI suffered.

Conflict of Interests: The author declares that there are no conflict of interests.

Financial Disclosure: There are no financial supports.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics committee approval : The approved this clinical study Central Hospital of Oil Workers.

REFERENCES

1. Khan MY, Waqar T, Qaisrani PG, et al. Surgical Repair of post-infarction ventricular septal rupture: Determinants of operative mortality and survival outcome analysis. Pak J Med Sci. 2018;34:20-6.
2. Maltais S, Ibrahim R, Basmadjian AJ, et al. Postinfarction ventricular septal defects: towards a new treatment algorithm? Ann Thorac Surg. 2009;87:687-93.
3. Poulsen SH, Praestholm M, Munk K, et al. Ventricular septal rupture complicating acute myocardial infarction: clinical characteristics and contemporary outcome. Ann Thorac Surg. 2008;85:1591-6.
4. Papadopoulos N, Moritz A, Dzemali O, et al. Long-term

DOI: 10.5455/azjcvs.2022.04.04

results after surgical repair of postinfarction ventricular septal rupture by infarct exclusion technique. Ann Thorac Surg. 2009;87:1421-5.

5. Jones BM, Kapadia SR, Smedira NG, et al.Ventricular septal rupture complicating acute myocardial infarction: a contemporary review. Eur Heart J. 2014;35:2060-8.
6. Arnaoutakis GJ, Zhao Y, George TJ, et al. Surgical repair of ventricular septal defect after myocardial infarction: outcomes from the Society of Thoracic Surgeons National Database. Ann Thorac Surg. 2012;94:436-43.
7. Sanders RJ, Kern WH, Blount SG. Perforation of the interventricular septum complicating myocardial infarction; a report of eight cases, one with cardiac catheterization. Am Heart J. 1956;51:736-48.
8. Crenshaw BS, Granger CB, Birnbaum Y, et al. Risk factors, angiographic patterns, and outcomes in patients with ventricular septal defect complicating acute myocardial infarction. GUSTO-I (Global Utilization of Streptokinase and TPA for Occluded Coronary Arteries) Trial Investigators. Circulation. 2000;101:27-32.
9. Deville C, Fontan F, Chevalier JM, et al. Besse P. Surgery of post-infarction ventricular septal defect: risk factors for hospital death and long-term results. Eur J Cardiothorac Surg. 1991;5:167-74.
10. Cummings RG, Reimer KA, Califf R, et al. Quantitative analysis of right and left ventricular infarction in the presence of postinfarction ventricular septal defect. Circulation. 1988;77:33-42.
11. David TE, Dale L, Sun Z. Postinfarction ventricular septal rupture: repair by endocardial patch with infarct exclusion. J Thorac Cardiovasc Surg. 1995;110:1315-22.
12. Prêtre R, Ye Q, Griienfelder J, et al. Role of myocardial revascularization in postinfarction ventricular septal rupture. Ann Thorac Surg. 2000;69:51-5.
13. Coskun KO, Coskun ST, Popov AF, et al. Experiences with surgical treatment of ventricle septal defect as a post infarction complication. J Cardiothorac Surg. 2009;4:3.
14. Daggett WM, Guyton RA, Mundth ED, et al.Surgery for post-myocardial infarct ventricular septal defect. Ann Surg. 1977;186:260-71.
15. Honda S, Asaumi Y, Yamane T, et al.Trends in the clinical and pathological characteristics of cardiac rupture in patients with acute myocardial infarction over 35 years. J Am Heart Assoc. 2014;3:e000984.
16. Moreyra AE, Huang MS, Wilson AC, et al.Trends in incidence and mortality rates of ventricular septal rupture during acute myocardial infarction. Am J Cardiol. 2010;106:1095-100.
17. Dor V, Saab M, Coste P, et al. Left ventricular aneurysm: a new surgical approach. Thorac Cardiovasc Surg. 1989;37:11-9.
18. Levey AS, Stevens LA, Schmid CH, et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009;150:604-12.
19. Pang PY, Sin YK, Lim CH, et al. Outcome and survival analysis of surgical repair of post-infarction ventricular septal rupture. J Cardiothorac Surg. 2013;8:44.
20. Di Summa M, Actis Dato GM, Centofanti P, et al.Ventricular septal rupture after a myocardial infarction: clinical features and long term survival. J Cardiovasc Surg (Torino). 1997;38:589-93.
21. Belov YuV, Varaksin VA. Modern understanding of postinfarction left ventricular remodeling. Cardiology. 2002;:469-471.
22. Rudenko ML. Diagnostics and treatment of postinfarction defect of the midshlunochkovy septum [dissertation]. Amosov National Institute of Cardiovascular Surgery; 2017. Ukrainian
23. Deja MA, Szostek J, Widenka K, et al.Post infarction ventricular septal defect - can we do better? Eur J Cardiothorac Surge. 2000;18:194-201.