ISSN: 3029-0732

Review Article

Journal of Cardiovascular and Cardiology

Surgical Treatment of Postinfarction Left Ventricular Aneurysms Using The "Drop" Technique

KGBUZ KKB Krasnoyarsk, Pustovoytov AV, Erakhtin PE, Kaptyk GI, Kuznecov VA, Utmanova IV, Pevnev AA, Bilous EA and Vlasov PN*

Regional Clinical Hospital, Anesthesiologist-resuscitator, 3A Partizana Zheleznyaka Str, 660022, Krasnoyarsk, Russian Federation

***Corresponding author**
Vlasov PN, Regional Clinical Hospital, Anesthesiologist-resuscitator, 3A Partizana Zheleznyaka Str, 660022, Krasnoyarsk, Russian Federation.

Received: January 27, 2025; **Accepted:** February 10, 2025; **Published:** February 15, 2025

ABSTRACT

Overview and Goals: Cancer cells are more likely to survive when they are not constrained by feedback control mechanisms. Chemosis and persistent side effects from chemotherapy might make cancer treatment more difficult to manage tumor cells' ability to survive. In this study, we looked at how platelets affect the survival and death of cancer cells treated with chemotherapy AN EXPERIMENTAL METHOD: Human adenocarcinoma cells, namely colonic (Caco-2) and ovarian (59 M) cells, were cultured for 1, 24, or 72 hours with or without platelets (1.5 · 108 mL-1). The drugs used were 5-fluorouracil (1–300 mg·mL–1) or paclitaxel (1–200 mg·mL–1). After incubation, cancer cells were isolated and used flow cytometry, Western blotting, real-time PCR, TaqMan® Gene Expression Assays, and proteomics to determine if the cells had survived or died ESSENTIAL OUTCOMES: Human platelets multiplied the ability of colonic and ovarian adenocarcinoma cells treated with 5-fluorouracil and paclitaxel, two common anticancer medications, to survive. Cancer cells expressed more cyclins, DNA repair proteins, and MAPKs when platelets were present. They also down- and up-regulated pro- and anti-apoptotic genes, increased the number of cells synthesizing DNA, and decreased the number in the quiescent phase. The thrombospondin-1, TGF-b, clustering, and chemokine RANTES were released, according to an investigation of the platelet-Caco-2 secretum. Lastly, thrombospondin-1 and human recombinant RANTES increased the ability of Caco-2 cells exposed to paclitaxel to survive SUMMARY AND IMPLICATIONS These findings show that platelets boost the survival, growth, and chemoresistance of adenocarcinoma cells to conventional anticancer medications. Changing the connections between cancer cells and platelets may be a fresh approach to raising the effectiveness of chemotherapy.

Relevance

The incidence of circulatory system diseases remains the leading cause of disability and mortality among the working-age population both in Russia and worldwide. In 2022, the mortality rate in the Russian Federation was 159.9 per 100 thousand people, which in percentage terms is 54.2% of the overall mortality structure. The proportion of patients with coronary heart disease whose cause of death was myocardial infarction is 34.2% [1]. This allows us to say that even at the present time the problem of coronary heart disease, circulatory system diseases and their complications, as well as the search for new methods of treatment, remains relevant. The severity of myocardial infarction lies in its complications. Of course, thanks to the improvement of medical care and the emergence of early reperfusion methods, their impact has been significantly reduced, but a significant percentage of complications still remains. Among them, aneurysm and pseudoaneurysm of the left ventricle are distinguished. In approximately 90% of cases, the localization of LV aneurysms is the apex and anterior-septal region, 5% of aneurysms are localized in the region of the posterior wall of the LV/ Approximately an equal proportion of this number are true and false aneurysms, the proportion of saccular aneurysms is even less [2]. The incidence of postinfarction left ventricular aneurysms varies from 10 to 35%, depending on the diagnostic method used [3]. The 5-year survival rate for drug-treated patients with LAVA varies from 47 to 70%. The following causes of mortality are distinguished: cardiac arrhythmia - 44%, progression of heart failure - 33%, recurrent MI - 11%, non-cardiac causes - 22% [4-7]. The average mortality after surgery for postinfarction LV aneurysm was 2.91%, of which after resection of LV aneurysm - 3.13% [1,8].

Citation: KGBUZ KKB Krasnoyarsk, Pustovoytov AV, Erakhtin PE, Kaptyk GI, Kuznecov VA, et al. Surgical Treatment of Postinfarction Left Ventricular Aneurysms Using The "Drop" Technique. J Cardiovas Cardiol. 2025. 3(1): 1-4. DOI: doi.org/10.61440/JCC.2025.v3.27

Definitions

To present the author's method of surgical treatment of postinfarction left ventricular aneurysms. To analyze the immediate results of surgical treatment of postinfarction left ventricular aneurysm using the "Drop" method. To conduct a comparative analysis of the immediate results of surgical treatment of postinfarction aneurysms using the classical method of linear left ventricular plastic surgery using the "Colley" method and the "Drop" method.

Materials and Methods. From 2010 to 2023, the Department of Cardiac Surgery at Krasnoyarsk Regional Clinical Hospital performed 2186 surgical treatments for coronary heart disease. Of these, 366 (16.7%) patients underwent resection of postinfarction left ventricular aneurysm using various techniques. The characteristics of the patients are presented in Table 1 and 2.

Table 1

Sex	%	n
Male	90,2%	330
Female	9,8%	36
Age	61,4	
EchoCG (average indicatores)		
EDD (cm)	6,1±1,1	
EDV (ml)	178,2±37,4	
EFLV (%Simpson)	39,2±5,8	
Heart failure (NYHA)		
	%	**n**
I	0%	0
II	16,2%	59
III	69,9%	256
IV	13,9%	51

The average age of patients was 61.4±10.9 years. Among them, there were 330 (90.2%) men and 36 (9.8%) women. All patients had a history of one or more AMI. Heart failure was manifested by NYHA FC II in 59 (16.2%) patients, NYHA FC III – 256 (69.9%), NYHA FC IV – 51 (13.9%) patients. According to echocardiography (EchoCG): the average left ventricular ejection fraction according to Simpson (LVEF) is 39.2±5.8%. End-diastolic dimension (EDD LV) is 6.1±1.1 cm (from 6.1 to 8.5 cm). End-diastolic volume (EDV LV) is 178.2±37.4.

The most common localizations of aneurysms were anteroseptal-apical and anteroseptal (21.3% and 22.1%, respectively). Bifocal and apical aneurysms occurred in 7.7% of cases. Anterolateral localization occurred in 21% of cases.

Table 2: Localization of AneurysmsLV

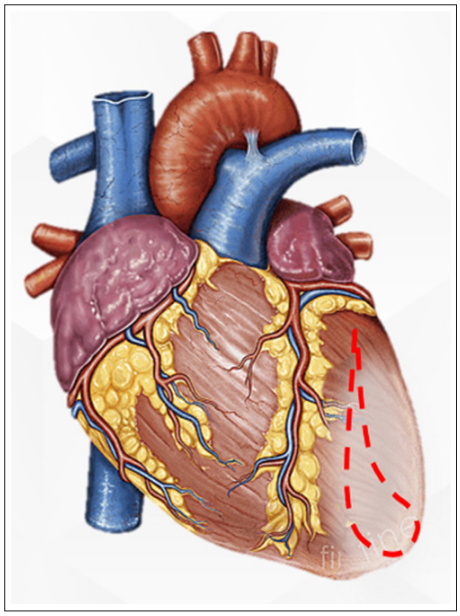
Localization of AneurysmsLV	
Bifocals	28 (7,7%)
Posterior	36 (9,8%)
Apical	28 (7,7%)
Anteroseptal	38 (10,4%)
Anteroseptal apical	78 (21,3%)
Anterior-apical	81 (22,1%)
Anterolateral	77 (21,0%)

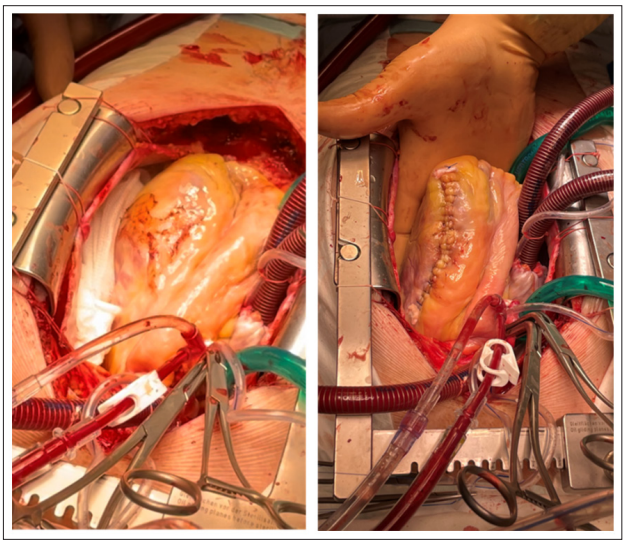
Isolated resection of the post-infarction left ventricle aneurysm was performed in 1.6% (6) of patients. Resection of the aneurysm and coronary artery bypass grafting were performed in 66.4% (243) of patients. In 31.9% (117) of patients, in combination with resection of the left ventricle and coronary artery bypass grafting, additional types of surgical correction were used, such as endarterectomy from the internal carotid artery 1.4% (5); thrombectomy from the left ventricle 5.2% (19); mitral valve plastic surgery for stage II-III insufficiency 11.2% (41); mitral valve replacement 6.8% (25); aortic valve replacement in 3.1% (11) of patients. Resection and subsequent plastic surgery of the left ventricle were performed using the following methods: Endo ventriculoplasty of the LV using a synthetic patch according to Dor was performed in 18.6% (68) of patients, linear plastic surgery of the LV according to Colley in 51.6% (189), and auto septoplasty according to Stoney in 2.2% (8). In 27.6% (101) of cases, we also used the original method of left ventricular plastic surgery of the “Drop” type, developed at the Krasnoyarsk Regional Clinical Hospital (Certificate No. 20240008 registered in the register under No. 104 dated 08.05.2024).

Technique of Operations

Surgical treatment is carried out under conditions of artificial circulation, pharmaco-cold cardioplegia and spontaneous cooling to 34 degrees Celsius. Access is via a median sternotomy. The periosteum edges are coagulated, the spongy substance is treated with wax. Six sutures are placed on the pericardium, in the central part and on the pericardial edges on both sides.The artificial blood circulation apparatus is connected using the classical method with occlusion of the vena cava. If the patient does not have aortic insufficiency, the cardioplegic solution "Custodial" is supplied to the aortic root. If there is aortic insufficiency, the first liter of cardioplegia is supplied to the aortic root, and then separately to the ostia of the coronary arteries. After cardiac activity has stopped and cardioplegia has been completed, the heart is exposed, and several Gauze pads are placed under it, which allow the aneurysm to be positioned in the anterior, anterolateral, and apical zones. If the aneurysm is localized in the posterior orposterolateral region, positioning is performed using the assistant's hands.

Having visualized the aneurysm zone and examined it by palpation on the drained cavities of the heart, the resection zone is marked. Using a coagulator, the central line is marked from the apex towards the basal part of the left ventricle. The line has an oblique direction repeating the anatomical location of the myocardial fibres. Then, the resection edges are marked to form a drop-shaped zone, with the tail directed towards the basal segments of the left ventricle and the head towards the apex. The angle of the drop is formed based on the anatomical and physiological features of myocardial formation. The resection zone should end 1-1.5 cm before the anterior interventricular artery (LAD) and the 1st diagonal branch (D1). Preservation of the LAD and D1 is one of the foundations of successful surgical treatment and myocardial remodelling in the postoperative period.





The aneurysm sac is opened along the central line, then the left ventricular cavity is inspected to exclude the presence of thrombi in the cavity that were not visualized by echocardiography. Resection of the aneurysm according to previously made markings along the edge of the intact myocardium 1-1.5 cm before the LAD and 1 diagonal branch. The left ventricle is sutured with a two-row multidirectional wrap suture using 2/0 – 3/0 thread, depending on the condition of the left ventricle wall, with a single U-shaped pad stitched at the corners of the suture. The method excludes the use of felt strips or synthetic pads along the resection zone. The stitching is done through the fibrous layer, with the trabeculae of the left ventricle being picked up in the suture zones. The step of the punctures is 7-8 mm. The first layer is stitched with a thread with the needle pointing "towards the surgeon". When tightening the suture, the tension of the thread is average. The edges of the left ventricle are matched when tightening "edge to edge". The second layer of suture is carried out more superficially, approximately on 2/3 of the wall of the left ventricle with the needle direction "away from the surgeon". The needle pricks of the second suture are carried out between the previous pricks in an oblique direction. Thus, the line of threads forms a cross, and the line of the suture forms an arc with the direction towards the apex of the left ventricle between the LAD and the diagonal branch. The "drop" shape of myocardial resection allows for intraoperative remodelling of the left ventricle and giving it an elliptical shape. After completion of resection, coronary artery bypass grafting is performed. The bypass volume is determined at the preoperative stage during visual assessment of coronary angiography. The technique involves choosing the tactics of complete myocardial revascularization at the time of surgical treatment. The remaining stages of coronary bypass grafting are performed according to the classical technique. At the end of the main stage, before removing the aortic clamp, the heart cavities are filled, aero prophylaxis is performed with drainage of blood and gas bubbles through the aortic root and left ventricular drainage installed in the right upper lobe pulmonary vein. Weaning off artificial circulation begins after the end of the reperfusion period at a rate of 1/3 (reperfusion time/aortic occlusion time).

Disconnection of the CPB apparatus, control of haemostasis of the surgical aggression sites, installation of drains using the classical method. Osteosynthesis of the sternum using surgical metal or fishing line depending on the condition of the bone fragments of the sternum. Soft tissues are sutured layer by layer. Cosmetic suture on the skin according to Halsted.

Results and Discussion

We analyzed the results of surgical treatment of aneurysms of anterior and anterolateral localization, performed using the classical method of linear plastic surgery of the left ventricle according to Colley and the "Drop" method. Patients were divided into 2 groups. The exclusion criteria were any pathology of the valve apparatus, any localization of left ventricular aneurysms except for the anterior and anterolateral. Group 1 included 38 patients who underwent linear left ventricular plastic surgery using the classic Colley technique. Group 2 included 54 patients who underwent modified linear left ventricular plastic surgery using the "Drop" technique. (Table 3)

Table 3: EchoCG characteristics of patients before and after surgery

		Cooley (n=38)		"Drop" (n=54)	
		Before the surgery	After the surgery	Before the surgery	After the surgery
EchoCG (avg.indicators)	EDD	6,5	5,9	6,2	5,8
	УО	47,8	54,0	61,6	70,8
	EDV	188,3	165,0	195,8	169,4
	КСО	140,5	111,0	134,2	98,6
	EF LV Simpson	39,5	41,9	36,0	40,6
	EF LV Teicholz	41,9	45,0	40,5	42,2

According to echocardiography data before discharge, a significant increase in the LV ejection fraction (LVEF) and a significant decrease in the LV end-diastolic volume were noted in both groups.

And also, an increase in the stroke volume of the left ventricle due to the shutdown of the ineffective part of the myocardium.

Table 4: Postoperative period

	№1 Cooley (n=38)	№2 "Drop" (n=54)
Coefficient Shunt	1,9	2,5
Artificial circulation	108,9	118,5
Aorticocclusion	72,1	69,2
Cardiotonicsupport	1,6	1,2
Artificial Ventilation of the Lungs	1,1	0,8
Hospital stay Resuscitation	3,7	2,2
Hospital stay General	17,7	16,8

In group No. 2, a significantly higher coronary artery bypass grafting ratio of 2.5 to 1.9, respectively, was noted due to the preservation of the Diagonal and LAD, which corresponds to the specific features of the technique. Despite this, the time of CPB and aortic occlusion was shorter in group Table 2. The time of mechanical ventilation and hospital stay in intensive care was also shorter in the second group. The total hospital stay did not differ significantly (Table 4).

		№1 Cooley (n=38)		№2 "Drop" (n=54)	
		n	%	n	%
COMPLICATIONS	Mortality	1	2,6	0	0,0
	Pleurisy	6	15,8	4	7,4
	Bleeding	3	7,9	0	0,0
	CVA	0	0,0	0	0,0
	Covid-19	1	2,6	0	0,0
	AMI	1	2,6	0	0,0
	MOFS	1	2,6	0	0,0

In the first group, there was 1 fatal outcome due to the development of multiple organ failure and sepsis in the early postoperative period. It is also necessary to note a reliable difference in bleeding after surgery. In the first group, 3 cases of bleeding were noted: 1 from the suture of the left ventricle, 2 cases of diffuse bleeding due to a violation of the haemostasis system, while there was no bleeding in the second group.

Conclusions

1. Modified linear resection of the left ventricle using the "Drop" technique allows for adequate and sufficient resection of the left ventricle, and due to the specific features of the resection shape, for intraoperative modelling of the left ventricle shape as an ellipse.
2. The data obtained indicate the effectiveness and safety of this technique in patients with aneurysms of the left ventricle of the anterior and anterolateral walls.

References

1. Bockeria LA, Milievskaya EB, Pryanishnikov VV, Yurlov IA. Cardiovascular surgery – 2022. Diseases and congenital anomalies of the circulatory system. 2022.
2. El Ouazzani J, Jandou I. Aneurysm and pseudoaneurysm of the left ventricle. Ann Med Surg. (Lond.). 2022. 75: 103405.
3. Chon LH. Cardiac Surgery in the Adult. Third edition. New York: Mc Graw Hill. 2008. 803-815.
4. Benediktsson R, Eyjolfsson O, Thorgeirsson G. Natural history of chronic left ventricular aneurysm: A population-based cohort study. J. Clin. Epidemiol. 1991. 44: 1131.
5. Dor V, Kreitmann P, Jourdan J. Interest of physiological closure (circumferential plasty on contractile areas) of left ventricle after resection and endocardectomy for aneurysm or akinetic zone. Comparison with classical technique about a series of 209 left ventricular resections. J Cardiovasc Surg. 1985. 26: 73.
6. Faxon DP, Ryan TJ, David KB. Prognostic significance of angiographically documented left ventricular aneurysm from the Coronary Artery Surgery Study (CASS). Am J Cardiol. 1982. 50: 157.
7. Dor VJ. Left ventricular reconstruction: The aim and the reality after twenty years. Thorac Cardiovasc Surg. 2004. 128: 17-20.
8. Tarasov DG, Chernov II, Gordeev ML, Pavlov AV. Issues of general and private surgery “Bulletin of Surgery”. Results of Surgical Treatment on The Beating Heart of Post-Infarction Aneurysms of The Left Ventricle. 2013.