DOI: 10.23934/2223-9022-2019-8-2-132-137

Staged and Simultaneous Approaches in the Surgical Treatment of Multisystem Disorders of the Carotid and Coronary Blood Flow

A.M. Khadzhibayev, M.A. Obeid, R.N. Akalayev, A.A. Abdurakhmanov*, O.A. Mashrapov, I.A. Abdukhalimov, N.M. Rakhimov, U.S. Ganiyev

Department of Cardiac Surgery
Republican Scientific Center of Emergency Medicine (RSCEM)
2 Kichik Xalqa Yo'li, Tashkent 100081, Republic of Uzbekistan

*** Contacts:** Sergey G. Tereshchenko, Dr. Med. Sci., Head of Endoscopy Department M.F. Vladimirsky Moscow Regional Research and Clinical Institute. Email: endoscopia.monika@mail.ru

AIM OF STUDY A comparative analysis of the early outcomes of simultaneous and staged methods of revascularization in patients with a combined coronary and carotid artery stenosis.

MATERIALS AND METHODS The study included 45 patients with combined carotid and coronary artery stenosis, operated at the Republican Research Centre of Emergency Medicine in 2014–2018. Patients were divided into two groups: "simultaneous", 20 patients (simultaneous interventions on the carotid and coronary arteries were performed) and "staged", 25 patients (carotid and coronary artery stenoses were operated in a staged manner). In all cases, surgical intervention was performed on the beating heart.

RESULTS According to the results of work in the postoperative period, the incidence of neurological complications in the group of staged interventions and in the group of simultaneous interventions was 4.0% vs 5.0%, respectively. In the group of staged interventions, no deaths were observed, whereas in the group of simultaneous interventions, one lethal outcome was observed (5%) associated with pulmonary complications.

CONCLUSION According to the results of the work, the simultaneous and staged approaches in the treatment of combined lesions of the carotid and coronary arteries did not differ statistically significantly regarding to cerebral and cardiovascular outcomes.

Key words: carotid endarterectomy, coronary artery bypass grafting, coronary artery disease, stenosis of carotid arteries

For citation Khadzhibayev A.M., Obeid M.A., Akalayev R.N., et al. Staged and simultaneous approaches in the surgical treatment of multisystem disorders of the carotid and coronary bloodflow. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2019; 8(2): 132–137. DOI: 10.23934/2223-9022-2019-8-2-132-137 (In Russian)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments The study had no sponsorship

Affiliations

Abdukhakim M. Khadhzibayev	Dr. Med. Sci., Professor, Deputy Minister of Health of the Republic of Uzbekistan, General Director of the Republican Scientific Center of Emergency Medicine
Mustafa A. Obeyd	Leading Cardiac Surgeon of the Department of Cardiac Surgery, Republican Scientific Center of Emergency Medicine
Rustam N. Akalayev	Dr. Med. Sci., Professor, Head of the Scientific and Clinical Department of Toxicology Republican Scientific Center of Emergency Medicine
Abdusalom A. Abdurakhmanov	Cand. Med. Sci., Head of Department of Cardiac Surgery Republican Scientific Center of Emergency Medicine
Oybek A. Mashrapov	Cardiac Surgeon of the Department of Cardiac Surgery Republican Scientific Center of Emergency Medicine
Ilkhom A. Abdukhalimov	Cardiac Surgeon of the Department of Cardiac Surgery Republican Scientific Center of Emergency Medicine
Nodir M. Rakhimov	Cardiac Surgeon of the Department of Cardiac Surgery Republican Scientific Center of Emergency Medicine
Nataliya G. Dadamyants	Dr. Med. Sci., the Department of Ultrasound and Functional Diagnostics, Republican Scientific Center of Emergency Medicine
Ulugbek S. Ganiyev	Cardiologist of the Department of Cardiac Surgery, Republican Scientific Center of Emergency Medicine

AC – artificial circulation
ACVE – acute cerebrovascular event
CABG – corornary artery bypass grafting
CAD – coronary artery disease
CCD – cerebral circulation disorder
CDS – color duplex scan
CEA – carotis entarterectomy
ECHO-CG – echocardiography
MI – myocardial infarction
TCCD – transient cerebral circulation disorder
TIA – transient ischemic attack

The ischemic stroke and myocardial infarction are a serious threat to health and the leading causes of disability and mortality in the population. The survivors have a high risk of recurrent myocardial infarction or stroke, and death [1]. Among patients over 65, carotid artery stenosis of more than 50% is revealed in 17%, and the stenosis of more than 80% is revealed in 5.9% cases [2]. According to a number of authors [3], carotid arteries stenosis is an additional risk factor worsening the postoperative prognosis after coronary artery bypass grafting (CABG).

In Uzbekistan, coronary artery disease (CAD) affects about 11% of the adult population.

The incidence of cases revealed in Uzbekistan is more than 40,000 strokes per year. In this case, the mortality rate is 44.6%. The incidence of angina is 1,300,000 people annually, acute myocardial infarction (MI) — 180,000 people annually. Each year, about 65,000 people die of these diseases [4].

Simultaneous carotid endarterectomy (CEA) and CABG were performed in 15 patients with carotid and and coronary arteries lesions for the first time [5]. The results of simultaneous and staged interventions remain controversial primarily due to the lack of randomized studies. Thus, some proponents of a staged approach pay attention with the high frequency of complications after simultaneous operations [6]. According to the results of the meta-analysis, the incidence of stroke with a staged approach was 3.5% and 5.4% after simultaneous surgeries. According to some authors, such data were obtained as the meta-analysis included the results of non-randomized studies [7–8]. For example, other authors note a low incidence of stroke after simultaneous interventions, 2.8% versus 14% after reverse staged treatment [8–11]. The attention is drawn to the fact that patients with simultaneous interventions on carotid and coronary arteries have a higher risk, and the results of surgical treatment are more influenced by the risk factors associated with multifocal lesions than by simultaneous surgery [7].

A uniform routine approach to surgical treatment has not yet been developed [7]. The choice of the sequence of stages is based on the severity of a lesion of one or another vessel. When carotid stenosis prevails, the first stage is CEA and then CABG, when coronary lesion prevails and carotid stenosis is asymptomatic, the first step is CABG and then CEA [12, 13].

The aim of the study is a comparative analysis of the direct results of simultaneous and staged methods of revascularization in patients with a lesion of coronary and carotid vessels.

MATERIAL AND METHODS

This prospective study included 45 patients operated on at the RSCEM in the period from 2014 to 2018. Patients were divided into two groups: Group 1 (20 patients) of simultaneous CEA and CABG on the working heart *(off-pump)* or under conditions of artificial blood circulation *(on-pump)*; Group 2 — 25 patients, staged CEA and CABG. Both groups were comparable by gender and age, there were 14 (70%) male patients in the simultaneous group and 18 (72%) male patients in the staged group; the average age was 67.2±3.5 and 64.3±2.5 years in Group 1 and 2, respectively.

The demographic and clinical indicators are presented in Table 1.

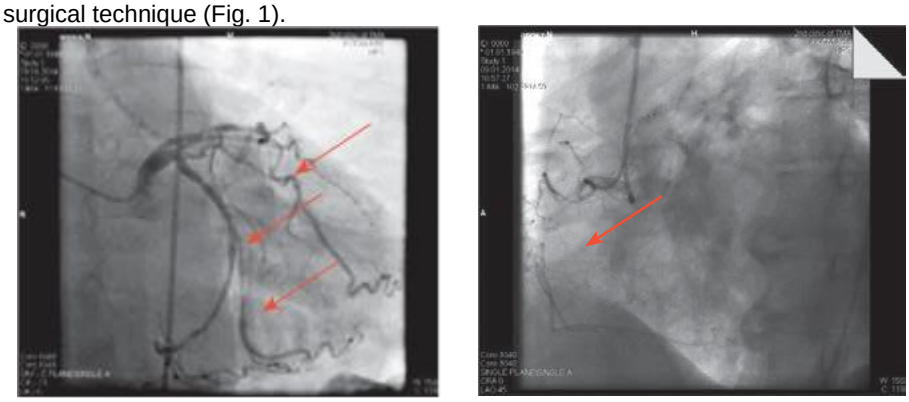
Table 1

Demographic and clinical parameters of patients

Group	Total	Male	Female	Mean age
Simultaneous group	20	14 (70%)	6 (30%)	67.2±3.5
Staged group	25	18 (72%)	7 (28%)	64.3±2.5

The degree of coronary and carotid damage, as well as the severity of symptoms were the criteria for the choice of surgical treatment tactics. The incidence of cardiovascular and cerebral complications and the duration of postoperative stay in the clinic were evaluated in the postoperative period.

Patients were examined according to the standard, including echocardiography (EchoCG) and color duplex scan (CDS) of extracranial vessels. Coronary angiography was performed to verify the anatomy, coronary lesion as well as surgical technique (Fig. 1).



A B

Fig. 1. Coronary angiography. Patient M. Stenosis of AIVA, CA, OMB (A). RCA (B) occlusion (arrows)

In assessing the state of extracranial vessels, the special attention was given to cerebral angiography (Fig. 2.)

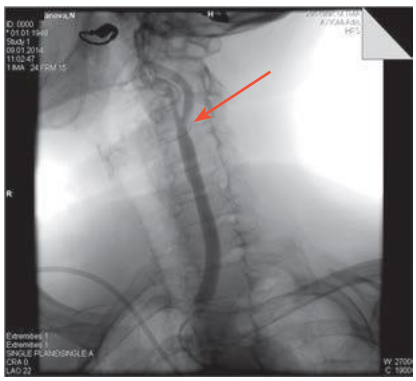
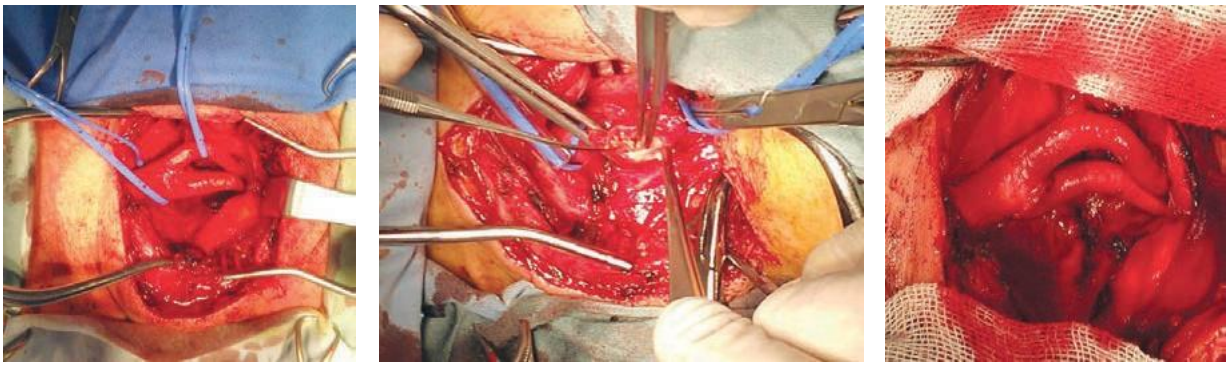


Fig. 2. Cerebral angiography of the same patient. The left CCA 70% bifurcation stenosis (showed with an arrow)

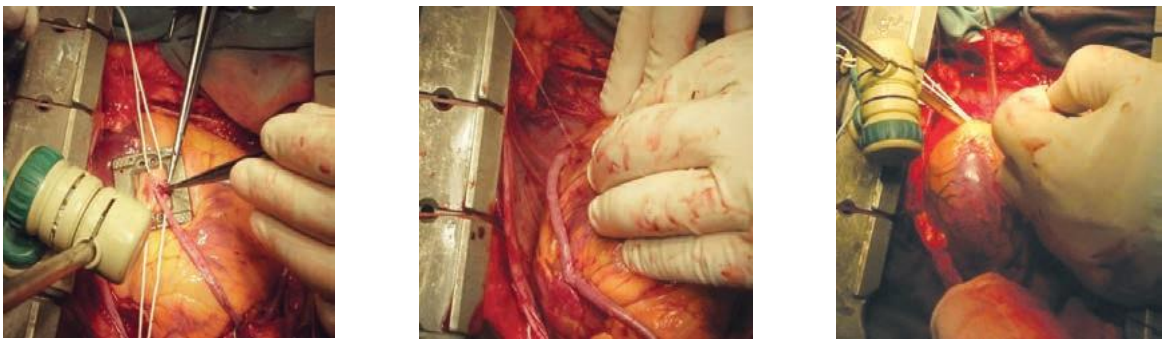
In all cases of simultaneous interventions, CEA was performed first. An atherosclerotic plaque and the affected endothelium were removed according to an open (classical) technique. In cases of existing *S*-shaped deformation of carotid arteries, it was removed and redressed (eversion method), the artery wall defect was replaced by an autovenous patch. The stages of CEA operation are presented in Fig. 3



A B C

Fig. 3. Stages of eversion carotid endarterectomy: A — general view of the left carotid arteries; B — the stage of eversion carotid endarterectomy; C — the stage after restoration of integrity of carotid arteries

After the vascular stage was completed, the cardiac stage was initiated, the operation was performed on a working heart. Autovenous-coronary anastomoses were formed: first proximal, then distal ends. The stages of CABG operation on a working heart are showed in Fig. 4.



A B C

Fig. 4. Stages of the operation of coronary bypass grafting on the beating heart: A — the stage of imposing the distal anastomosis “aorta-anterior interventricular artery”; B — sequential anastomosis “aorta-intermediate artery-circumflex artery”; C — the stage of imposing the distal anastomosis “aorta-posterior interventricular branch”

In patients with carotid stenosis in the presence of stable angina, the first stage was CEA. The second stage of the operation was carried out in terms from 1 to 4 months, 2.5±1.2 months averagely.

RESULTS

The main indications for simultaneous operations were the necessity of myocardial revascularization against the background of a concomitant symptomatic (transient ischemic attack (TIA) and/or transient cerebral circulatory disorders in history) of the carotid artery of more than 70% without contralateral damage (12 patients, 60%) or symptomatic (3 patients, 15%) and asymptomatic bilateral carotid stenosis of more than 50% (5 patients, 25%). The characteristics of patients, cases of carotid stenosis of more than 50% are presented in Table 2.

Table 2

Patients specific, carotid arteries stenosis more than 50%

Coronary arteries stenosis	Simult. group Abs.(%)	Staged group Abs.(%)
Unilateral carotid artery stenosis with symptoms	12 (60%)	5 (20%)
Unilateral carotid artery stenosis without symptoms	-	6 (24%)
Bilateral carotid artery stenosis with symptoms	3 (15%)	9 (36%)
Bilateral carotid artery stenosis without symptoms	5 (25%)	5 (20%)

A total of 13 patients (65%) of Group 1 had early post-infarction angina, 5 (25%) patients had new-onset progressive angina, and 2 (10%) patients had a progressive course of angina refractory to medical treatment. In 11 cases (44%) in patients of Group 2, there was a multi-vascular lesion of coronary arteries and a progressive course of angina on the background of asymptomatic unilateral (6 patients, 24%) or bilateral (5 patients, 20%) carotid stenosis, which required the first stage to perform myocardial revascularization. In the remaining 14 cases (56%), symptomatic unilateral (5 patients, 20%) or bilateral (9 patients, 36%) carotid lesion was observed. The characteristics of patients with coronary artery disease are presented in Table 3.

Table 3

Patients specifics, CAD

Diagnosis	Simult. group Abs.(%)	Staged group Abs.(%)
Early post-infarction angina	13 (65%)	11 (44%)
New onset progressive angina	5 (25%)	-
Progressive angina	2 (10%)	-
Stable exertional angina	-	14 (56%)
MI in history	15 (75%)	11 (44%)

During surgical treatment in Group 1, CEA was first performed, then CABG on the working heart followed (19/95%), in one case (5%), CABG was performed under artificial circulation due to unstable hemodynamics. In the Group 2, the CABG stage was performed *off-pump* in all 25 cases (100%). The bypass index was 3.6 for the Group 1 and 3.4 for the Group 2. The data on the operations carried out in simultaneous and stage groups are presented in Table 4.

Table 4

The type of interventions

Group	Total	Off-pump	On-pump	Bypass index
Simultaneous group	20	19 (95%)	1 (5%)	3.6
Staged group	25	25 (100%)	0 (0%)	3.4

In the early postoperative period, CCD were observed in both groups and differed statistically insignificantly (one patient in the Group 1 (5%) versus one patient in the Group 2 (4%); $p>0.1$). There was 1 lethal case in the group of simultaneous interventions associated with pulmonary complications.

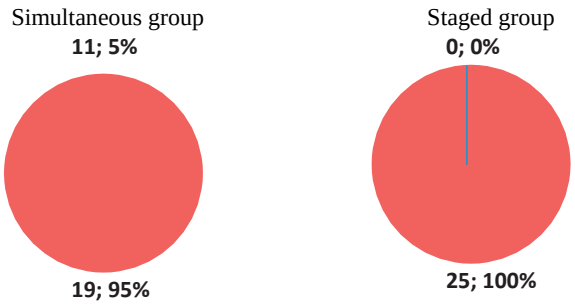
The types complications are presented in Table 5.

Table 5

Postoperative complications

Complication	Simult. group	Staged group
Cerebral circulation disorder	1 (5%)	1(4%)
ARDS	1(5%)	-

The lethal outcome associated with the development of pulmonary complications on the background of cardiovascular insufficiency was observed in one (5%) case in the Group 1. There were no deaths in the Group 2. The mortality rate is presented in Fig. 5.



Other cardiovascular and cerebral complications (MI, heart failure, TIA, transient cerebral circulation disorders) were not observed in any of the studied groups. The average duration of the postoperative hospital period was 8.8±1.2 days for the Group 1. The Group 2 needed a longer hospitalization with a total postoperative hospital stay of 13.2±1.5 days.

In the early postoperative period, no stenosis was detected at the surgical intervention level at the control CDS of the extracranial vessels, laminar blood flow was visualized. No pathological abnormalities were detected on the echocardiography. The assessment of the state of extracranial vessels on the CDS is shown in Fig. 6.

Fig. 6. Patient N. Color duplex scan of the main arteries of the head. The left ICA lumen is echo-free, the laminar flow is max. 76.4 cm/sec., bifurcation stenosis up to 44% in diameter on the right, going to the ICA with the stenosis up to 37% in diameter

Patients did not complain in terms of 16 months averagely after the operation, check CDC of extracranial vessels and EchoCG also revealed no pathological abnormalities.

DISCUSSION AND CONCLUSION

The incidence of the carotid and coronary lesions, according to various authors, ranges from 6 to 20.5%. Thus, according to *C.W. Akins* [3, 4], in 8.7% of patients examined by non-invasive methods, a concomitant lesion of the carotid vessels was detected, resulting in more than 75% stenosis of the carotid arteries. The incidence of lesions increases from 3.8% among patients under 60 to 11.3% in patients over 60. According to other authors [10], among patients over 65, 17% had carotid stenosis more than 50% and 5,9% had the stenosis of more than 80%. According to our data, in 3.2% of the patients examined by non-invasive methods, a concomitant vascular lesion of the carotid vessels was detected, resulting in more than 70% stenosis of the carotid arteries.

According to the recommendations of the European Society of Cardiology (ESC) 2017, *Guidelines for the management of acute myocardial infarction in patients presenting*, 2017, *Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases*, 2017, there are three tactics of surgical revascularization for combined lesions:

1) staged tactics (1 — CEA; 2 — CABG) with the predominance of carotid pathology (TIA, TCCD, ACVE, bilateral hemodynamically significant damage + stable angina);

2) reverse staged tactics (1 — CABG; 2 — CEA) with the predominance of coronary pathology (progressive angina, lesion of the left main artery) + asymptomatic unilateral carotid lesion).

3) simultaneous tactics — the even lesion of the carotid and coronary blood flows (progressive angina pectoris, lesion of the coronary trunk, unstable angina + unstable plaque in the coronary arteries, TIA, TCCD, ACVE in history, bilateral hemodynamically significant lesion).

According to one of the latest meta-analyses [5], the incidence of stroke was 3.5% with a staged approach and 5.4% with a simultaneous approach. According to some authors, these data have been obtained due to the fact that a meta-analysis included the results of non-randomized studies [1, 2]. Thus, other authors have noted a low incidence of stroke after simultaneous interventions, 2.8% versus 14% after reverse staged treatment [11]. Single-step interventions on carotid and coronary arteries have a higher risk profile, and the results of surgical treatment are more influenced by risk factors than simultaneous operation on the carotid artery [12, 13]. The staged surgical treatment of patients with atherosclerotic lesions of the coronary and carotid arteries has several disadvantages. The biggest problem is that the main complication when performing CABG is CCD, and myocardial infarction when performing CEA in patients with coronary artery disease [4, 10]. The advantage of simultaneous operations is that the patient undergoes one anesthesia and hospitalization, the disadvantage is that the risk of complications in the postoperative period increases. According to the largest American 10-year-study *(Gopaldas RR)*, which included 16,639 patients, the results of staged and

simultaneous interventions were not statistically significantly different. The frequency of neurological complications in the group of interventions was 3.5% and 3.9% in the group of simultaneous interventions, the mortality rate was 4.2% vs 4.5%. According to the results of our work, in the group of staged interventions and in the group of simultaneous interventions the incidence of neurological complications was 4.0% vs 5.0%, and the mortality rate 0% vs 5.0%. Thus, simultaneous and staged approaches in the treatment of combined lesions of the carotid and coronary blood flows do not differ statistically significantly with respect to cerebral and cardiovascular outcomes. The mortality observed in the group of simultaneous treatment may be associated with the initial more severe condition of patients in this group. The staged approach was accompanied by a cumulatively longer postoperative stay of patients in the clinic.

REFERENCES

1. Bacci MR, Santos JA. Stroke and myocardial infarction: a terrible association. *BMJ Case Rep*. 2012 Nov 9; 2012. pii: bcr2012007089. PMID: 23144345. PMCID: PMC4543709. DOI: 10.1136/bcr-2012-007089.
2. Darling R.C., Dylewski M., Chang B.B., et al. Combined carotid endarterectomy and coronary bypass grafting does not increase the risk of perioperative stroke. *Cardiovasc Surg*. 1998; 6(5): 448–452. PMID: 9794262.
3. Aydin E., Ozen Y., Sarikaya S., Yukseltan I., et al: Simultaneous carotidendarterectomy and coronary revascularization. *Cardiovasc J Afr*. 2014; 25(3): 130–133. PMID: 25000443. PMCID: PMC4120123. DOI: 10.5830/CVJA-2014-018.
4. Madzhidova E.N., Sagatov D.R., Rasulova Kh.A. *Risk factors and prediction of ischemic stroke in young people*. Tashkent, 2010: 6–7. (In Russian).
5. Bernhard V.M., Johnson W.D., Peterson J.J. Carotid artery stenosis: Association with surgery for coronary artery disease. *Arch Surg*. 1972; 105(6): 837–840. PMID: 4639781.
6. Borger M.A., Fremes S.E., Weisel R.D., et al. Coronary bypass and carotid endarterectomy: Does a combined approach increase risk? A meta-analysis. *Ann Thorac Surg*. 1999; 68(1): 14–20. PMID: 10421108.
7. Belov Yu.V., Stepanenko A.B., Bazylev V.V. Surgical decision-making in concomitant intrathoracic lesion of the aortic brachiocephalic branches and coronary arteries. *Angiologiya i sosudistaya khirurgiya*. 2007; 13(2): 113–118. (In Russian).
8. Cambria R.P., Ivarsson B.L., Akins C.W., et al. Simultaneous carotid and coronary disease: Safety of the combined approach. *J Vasc Surg*. 1989; 9(1): 56–64. PMID: 2783467.
9. Hill M.D., Shrive F.M., Kennedy J., et al. Simultaneous carotid endarterectomy and coronary artery bypass surgery in Canada. *Neurology*. 2005; 64(8): 1435–1437. PMID: 15851737. DOI: 10.1212/01.WNL.0000158477.55659.FE.
10. Khaitan L., Sutter F.P., Goldman S.M., et al. Simultaneous carotid endarterectomy and coronary revascularization. *Ann Thorac Surg*. 2000; 69(2): 421–424. PMID: 10735674.
11. Takach T.J., Reul G.J., Cooley D.A., et al. Is an integrated approach warrante for concomitant carotid and coronary artery disease? *Ann Thorac Surg.* 1997; 64(1): 16–22. PMID: 9236329.
12. Brown K.R., Kresowik T.F., Chin M.H., et al. Multistate populationbased outcomes of combined carotid endarterectomy and coronary artery bypass. *J Vasc Surg*. 2003; 37(1): 32–39. PMID: 12514575. DOI:10.1067/mva.2003.60.
13. Akins C.W., Hilgenberg A.D., Vlahakes G.J., et al: Late results of combined carotid and coronary surgery using actual versus actuarial methodology. *Ann Thorac Surg*. 2005; 80(6): 2091–2097. PMID: 16305851. DOI: 10.1016/j.athoracsur.2005.05.029.

Received on 13.12.2018

Accepted on 25.12.2018