

DIRECT RESULTS OF CORONARY BYPASS GRAFTING OF PATIENTS WITH THE REDUCED MYOCARDIAL CONTRACTILITY IN TERMS OF MYOCARDIAL PERFUSION SCINTIGRAPHY AND ECHOCARDIOGRAPHY

MPHTI 76.29.30
<https://doi.org/10.35805/BSK2021III005>

Mansurov A.
orcid.org/0000-0003-4392-1558

Khalikulov Kh.
orcid.org/0000-0001-7075-8798

Akhmedov U.
orcid.org/0000-0001-8373-0188

Mirzaev Kh.
orcid.org/0000-0002-0680-8428

Murtazaev S.
orcid.org/0000-0002-6406-5503

Aliev Sh.
orcid.org/0000-0002-4113-8095

Chernov D.
orcid.org/0000-0001-5889-7090

Ilkhomov O.
orcid.org/0000-0001-5900-9761

Mansurov A., Khalikulov Kh., Akhmedov U., Mirzaev Kh., Murtazaev S., Aliev Sh., Chernov D., Ilkhomov O.

Republican Specialized Scientific Practical Medical Center of Surgery named after academician V. Vakhidov, Tashkent, Uzbekistan

Corresponding author:
Khalikulov Kh. – Senior Researcher of the Department of CHD Surgery and Its Complications, "Republican Specialized Scientific Practical Medical Center of Surgery named after academician V. Vakhidov". Tashkent, Uzbekistan.
E-mail: hq27@mail.ru

Conflict of interest
The authors declare that they have no conflicts of interest

Abstract

This article provides an analysis of the results of surgical treatment of patients with various forms of coronary artery disease, the study of the quality and reliability of myocardial revascularization, assessment of patency and functional viability of coronary grafts in the early postoperative period using echocardiography and myocardial perfusion scintigraphy.

The retrospective material of our study is based on the results of surgical treatment of 130 patients with coronary artery disease who were operated on in the IHD department over the past year. All patients underwent examination according to a standard protocol: electrocardiography, 24-hour Holter monitoring, selective coronary ventriculography and shuntography, echocardiography, perfusion scintigraphy before and after surgery, drug stress test to assess myocardial perfusion and contractility and its differentiation (ischemia, scarring) with hypoperfusion.

Keywords
ischemic heart disease, coronary artery bypass grafting, assessment of myocardial perfusion

Перфузиялық сцинтиграфия мәліметтері бойынша миокардтың жиырылу қабілеті төмендеген науқастардың тәж артерияларын шунттаудың ерте нәтижелері

Мансуров А., Халикулов Х., Ахмедов У., Мирзаев Х., Муртазаев С, Алиев Ш., Чернов Д., Илхомов О.

Акад. В. Вахидов атындағы Республикалық мамандандырылған ғылыми-практикалық медициналық хирургия орталығы, Ташкент қ., Өзбекстан

Аңдатпа

Бұл мақалада ЖИА-ның түрлі формалары бар науқастарды хирургиялық емдеудің нәтижелерін талдау, миокард реvascularизациясының сапасы мен сенімділігін зерттеу, миокардтың эхокардиографиясы мен перфузиялық сцинтиграфиясын қолдану арқылы операциядан кейінгі ерте кезеңдегі коронарлық шунттардың өткізгіштігі мен функционалды өміршеңдігін бағалау келтірілген.

Біздің зерттеуіміздегі ретроспективті материал соңғы жыл ішінде ЖИА бөлімшесінде ота жасалған, жүректің ишемиялық ауруы бар 130 науқасты хирургиялық емдеудің нәтижелеріне негізделген. Науқастардың барлығы стандартты хаттама бойынша қарап-тексерулерден өтті: электрокардиография, тәуліктік Холтер мониторингі, селективті коронаровентрикулография және шунтография, эхокардиография, операцияға дейінгі және одан кейінгі перфузиялық сцинтиграфия, миокардтың перфузиясын және жиырылуын және гипоперфузиясы бар миокард аймағындағы оның жіктелуін (ишемия, гипертрофия, тыртық) бағалауға арналған медикаментоздық жүктеме тесті.

Хат алысатын автор:
Халикулов Х. – акад. В. Вахидов атындағы республикалық мамандандырылған ғылыми-практикалық медициналық хирургия орталығы, Ташкент қ., Өзбекстан
E-mail: hq27@mail.ru

Мүдделер қақтығысы
Авторлар мүдделер қақтығысының жоқтығын мәлімдейді

Түйін сөздер
жүректің ишемиялық ауруы, коронарлық шунттау, миокардтың перфузиясын бағалау

Непосредственные результаты коронарного шунтирования пациентов со сниженной сократительной способностью миокарда по данным перфузионной сцинтиграфии

Автор для корреспонденции:
Халикулов Х. – старший научный сотрудник отделения хирургии ИБС и её осложнений, ГУ «Республиканский специализированный научно-практический медицинский центр хирургии имени акад. В. Вахидова», Ташкент, Узбекистан.
E-mail: hg27@mail.ru

Мансуров А., Халикулов Х., Ахмедов У., Мирзаев Х., Муртазаев С, Алиев Ш., Чернов Д., Илхомов О.

Республиканский специализированный научно-практический медицинский центр хирургии им. акад. В. Вахидова, г. Ташкент, Узбекистан

Конфликт интересов

Авторы заявляют об отсутствии конфликта интересов

Аннотация

В данной статье приведен анализ результатов хирургического лечения больных с различными формами ИБС, изучение качества и надежности реваскуляризации миокарда, оценка проходимости и функциональной жизнеспособности коронарных шунтов в раннем послеоперационном периоде путем использования эхокардиографии и перфузионной сцинтиграфии миокарда.

Ретроспективный материал нашего исследования основан на результатах хирургического лечения 130 пациентов с ишемической болезнью сердца, оперированных в отделении ИБС за последний год. Все пациенты проходили обследование по стандартному протоколу: электрокардиография, суточный холтеровский мониторинг, селективная коронароангиография и шунтография, эхокардиография, перфузионная сцинтиграфия до и после операции, медикаментозный нагрузочный тест для оценки перфузии и сократимости миокарда и его дифференциации (ишемия, гибернация, рубец) в зона миокарда с гипоперфузией.

Ключевые слова

ишемическая болезнь сердца, коронарное шунтирование, оценка перфузии миокарда

Introduction

Nowadays, Ischemic heart disease is still challenging problem and remains the dominant pathology among diseases of the cardiovascular system. The most radical way of treating patients with ischemic heart disease is surgical myocardial revascularization [3, 4, 7].

In recent years, due to the “popularization” of endovascular methods of the treatment, the contingent of patients in cardiac surgery departments has significantly changed: the number of patients with severe multi vascular lesions of coronary arteries has increased. The expansion of indications for CABG led to the increase the percentage of complicated forms of IHD: acute coronary syndrome, concomitant valvular dysfunction of the heart, severe heart failure [1,8,10].

There is also an increase in the number of patients with severe concomitant pathology: diabetes mellitus, a malignant arterial hypertension (AH) damaging target organs, multifocal atherosclerosis, cerebrovascular disease, and renal failure [2].

Currently, there is an opinion, in which the number of formed shunts is not less than the number of affected coronary arteries. To control the quality of CABG and PCI of the coronary arteries, it will be a very informative to use of endovascular techniques that require hospitalization and preparation of patients for examination [6,7,11]. Existing methods of assessment blood flow velocity through shunts (ultrasound and electromagnetic flowmetry) allow just only indirectly assess the adequacy of myocardial revascularization. An ideal way to assess the adequacy of the performed

anastomoses and the completeness of myocardial revascularization could be the method of intraoperative coronarography [5,9,15]. It allows real-time monitoring of perfusion zones through each shunt and to determine the presence of intra and inter-system collaterals, as well as assess the quality of performed anastomoses [8,12,14]. Thus, a truly adequate revascularization can be achieved when blood flow is restored throughout the myocardium. An alternative method for examining the quality of revascularization may be myocardial perfusion scintigraphy (MPS), which is also possible on an outpatient basis.

Aim of the study

Study of the quality and reliability of myocardial revascularization, assessment of patency and functional viability of mammary-coronary and aortocoronary shunts in the early postoperative period.

Material and methods

The retrospective material of our research is based on the results of surgical treatment of 130 patients with ischemic heart disease who underwent surgery in the IHD department over the past year.

The age of patients ranged from 40 to 72 (mean 52.5±7.2) years, 16 were female (13%) and 114 were male (87%), respectively.

All patients had along ischemic heart disease-history, who also suffered from one or more myocardial infarction. 120 patients had class II – III of angina, 6 patients had unstable angina, and 2 patients had class IV of angina. 86 patients had a concomitant pathology – hypertension (most of them

drug resistant), 30 patients had type II diabetes mellitus, at the state of subcompensation.

All patients are examined by standard protocol: electrocardiography, daily Holter monitoring, selective coronaroveniculography and shuntography, echocardiography, perfusion scintigraphy before and after the surgery, drug induced load test to assess perfusion and contractility of the myocardium and its differentiation. (ischemia, hibernation, scar) in hypoperfused areas. According to echocardiography, in the preoperative period, the average EDVLV was 175.5 ± 48 ml, the average EF LV was $45.8 \pm 5.1\%$, respectively (Table 1). In 8 patients, aneurysm of the left ventricle was diagnosed. According to perfusion scintigraphy (PS), all patients had defects in myocardial perfusion of varying severity, the average perfusion defect was $41\% \pm 9.6$.

Localization of foci of hypoperfusion areas in all patients matched with angiographic data. On the one hand, according to MPS, in all cases (100%), there were a lesion of the anterior wall and apex, while, in isolated septal segments ranged from 47 to 69%, in lateral segments from 27 to 43%, in segments of the lower wall from 14 to 37%, respectively. On the other hand, according to coronaroveniculography (CVG), a subtotal stenosis of the LCA trunk was 17%, proximal stenosis of the right coronary artery in 27.4% cases, multiple lesions of the right coronary artery in 23.7% cases and three-vessel lesion in 87% cases, respectively. All operations were performed using multicomponent anesthesia under cardiopulmonary bypass and pharmacological cold cardioplegia (Del Nido). All affected coronary arteries were shunted. By the number of performed shunts: 4 shunts for 10 patients, 3 shunts for 60 patients, 2 shunts for 48 patients and 1 shunt for 8 patients, respectively. The anterior descending branch of the left coronary artery was bypassed in 94% of cases, the right coronary artery in 68% of cases. The circumflex branch of the left coronary artery was bypassed in 66% of patients, the diagonal branch of the anterior descending artery in 38% of patients, the intermedia artery in 15% of patients (Table 2). The total number of shunts per patient was 3.2 ± 0.9 .

In the postoperative period, control echocardiography and perfusion myocardial scintigraphy were performed on days 6-7 (Table 3). The results of echocardiography showed an improvement of left ventricular contractility. There is an increase in EF LV to 49.5 ± 5.7 , a decrease in EDV by 17% (135.1 ± 25 ml), respectively.

One of the most reliable research methods for direct assessing myocardial blood supply at the microcirculation level is myocardial perfusion scintigraphy (MPS). According to MPS, in the presence of a sufficient amount of hibernated myocardium, there

is a decrease in perfusion defect by $14.2 \pm 5.7\%$. Myocardial perfusion scintigraphy (MPS) is a radioisotope research method designed to assess myocardial blood supply at the level of microcirculation. The method is based on assessing the distribution of intravenously administered radiopharmaceutical (RP) in the heart muscle by accumulating of RP in intact cardiomyocytes.

Actually, regions of the myocardium with normal blood supply create a picture of equal distribution of RP, whereas, areas of the myocardium with a relative or absolute decrease in blood flow (due to ischemia or scarring) have a decrease in RP distribution due to perfusion defects. The distribution of RP in the myocardium depends on both, perfusion itself and the integrity of the sarcolemma and the preservation of cellular metabolism.

Currently, the method of perfusion scintigraphy (MPS) has already implemented into clinical practice in our department, and is used in the preoperative and postoperative period. According to MPS, all patients with IHD who underwent CABG showed improvement in myocardial perfusion.

Discussion

The clinical management of patients suspected of having angiographically significant coronary artery disease (ASCAD) is often aided by the performance of stress tests, such as myocardial perfusion scintigraphy (MPS), echocardiography, especially in patients with reduced myocardial contractility [16]. Myocardial perfusion scintigraphy (MPS) offers an accurate and robust tool to appraise the ischemic (i.e. clinical) impact of suspected coronary artery disease. Accordingly, patient stratification according to MPS results, not only clarify the association between ischemic burden and event rates in patients with or at risk for coronary artery disease [17], but also could avoid the surgeon (preoperatively performed MPS) from unexpected errors. Moreover, it allows to assess the quality of performed operation and identify ischemia (if it exists) in patients with previous revascularization. But, routine usage of MPS in patients who underwent myocardial revascularization is still challenging. As according to Nael Aldweib et al., MPS based study found no evidence that repeat revascularization provides a survival benefit, even in patients with inducible ischemia [18]. Thus, MPS should be used just in patients with reduced myocardial contractility or remaining ischemia after myocardial revascularization. As for transthoracic echocardiography, several studies has shown that the myocardium may regain contractile function after prompt revascularization if viable dysfunctional myocytes are presents, and transthoracic echocardiography is a cheaper and accessible way to assess it intra and postoperatively, using wall mo-

tion score index (WMSI) [19]. Rahimtoola claim that dysfunctional, ischemic myocardium may improve when perfusion is restored [20]. The improvement in WMSI can be explained by the revascularization procedure and suggests present viability, due to the existence of hibernating or stunned myocardium.

Conclusions

Coronary bypass surgery (CABG) is an effective method of myocardial revascularization in patients with severe lesion of coronary arteries and low ejection fraction. At the same time, noninva-

sive diagnostic methods have a high degree of reliability in determining the patency and functional condition of coronary shunts in patients with IHD. According to the MPS, there is a significant decrease in perfusion defect after CABG in patients with sufficient number of hibernated myocardium, which indicates the restoration of hibernated myocardium in early postoperative period. In the presence of a vital dysfunctional myocardium, these patients should undergo either, coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI).

Table 1.
Patient characterization

Indicator	Number and proportion of patients
Suffered from macrofocal MI with Q wave	30 (23 %)
Suffered microfocal MI without Q wave	112 (86,1 %)
Unstable angina	6 (4,6 %)
Angina pectoris: FC II - III	92 (70,7 %)
FC IV	2 (1,5 %)
Type II diabetes	30 (23 %)
Hypertonic disease	86 (66,1 %)
Postinfarct Aneurysm of LV	8 (6,15 %)
Ejection fraction (EF)	45,8±5,1 %
End Systolic Volume (ESV)	68,3±5,1 %
End-diastolic volume (EDV)	165,5±48,5 %

Table 2.
Surgeries performed on patients with IHD

Shunted coronary artery	LAD n (%)	RCA n (%)	LCX n (%)	DB n (%)	AI n(%)
The number of distal anastomoses	122 (94 %)	88 (68 %)	85 (66 %)	49 (38 %)	19 (15 %)

Table 3.
Comparative characteristics of indicators of Echocardiography

Indicator, unit	Before surgery (n=90)	After surgery (n=90)	P value
EDV, ml	165,5±48,8	135,1±25,9	P < 0,001
EF, %	45,8±5,1	49,5±5,7	P < 0,001

References

1. Akchurin R.S., Shiryaev A. A., Galyautdinov D. M. Indications for coronary bypass surgery in patients with various IHD/Cardiology, 2002, № 19: 593-596.
2. Akchurin R. S. Surgical treatment of coronary heart disease: history and modernity. "Microsurgery in Russia. 30 years of development", M., 2005.
3. Akchurin R.S., Shiryaev A.A., Brand Ya.B. et al. Reconstructive microsurgery of the coronary arteries: experience of the first 2000 operations// Modern technologies of surgery of coronary heart disease: Sat. Art. based on materials from All Russ. Scientific Conference. 2001; 13-5.
4. Agapov A.A., Shiryaev A.A., Tarasova L.V. et al. Prognosis of coronary bypass surgery in patients with ischemic heart disease with left coronary artery trunk lesions // Cardiology. – 1996. - №8. 64-69.
5. Babunashvili A.A., Ivanov V.A., Dundua D.P. et al. Treatment of coronary atherosclerosis: the effect of mass application of stents, immediate and long-term results of coronary angioplasty // Cardiology. –2004. - №5; 23-29.
6. Bokeria L.A., Alekyan B.G., Colombo A., Buziashvili Yu.I. Manual "Interventional methods of treatment of coronary heart disease" RAMS 2002. 314-321.
7. Boykachev D.V., Kondrashov K.V., Stepin A.V. et al. Bilateral mammary coronary artery bypass grafting - evaluation of direct results // Chest. And the heart-vessel surg. – 2004. - №4; 14-18.
8. Belenkov Yu.N., Mareev Yu.V. Cardiovascular Continuum // Heart Failure. – 2002. - №1; 7 – 11.
9. Sumarokov A.B., Rudenko B.A., Khodareva E.N., Yezhov M.V., Burgalova M.B., Veselova T.N. Occlusion of the main trunk of the left coronary artery. Cardiology 2001, №9; 94-96.
10. Shaenko O.Yu. A differentiated approach in choosing methods of revascularization in patients with ischemic heart disease with lesion of left coronary artery trunk. Abstract. dis. appl. sci. deg. cand. med. sciences M 1995. p.20.
11. Shiryaev A.A., Lepilin M.G., Agapov A.A., Tarasova L.V., Vlasova E.E., Akchurin R.S. The results of long-term follow-up of patients with left coronary artery

- trunk who underwent coronary artery bypass surgery. *Cardiology* 1995. Moscow. 34-36.
12. American Heart Association Heart Disease and Stroke Statistics – 2005 Update Dallas, TX. American Heart Association, 2004.
 13. Unal, B., Critchley, J. A., & Capewell, S. (2005). Modelling the decline in coronary heart disease deaths in England and Wales, 1981-2000: comparing contributions from primary prevention and secondary prevention. *BMJ (Clinical research ed.)*, 331(7517), 614. <https://doi.org/10.1136/bmj.38561.633345.8F>
 14. Gibbons RJ, Smith S, Antman E. American College of Cardiology/American Heart Association clinical practice guidelines/ Part I// *Circulation* 2003/ 107/ 2979 –2986.
 15. Sharoni E, Song HK, Peterson RJ et al. Off pump coronary artery bypass surgery for significant left ventricular dysfunction: safety, feasibility, and trends in methodology over time-an early experience // *Heart*. Apr 2006; 92 (4): 499-502.
 16. Berman DS, Hachamovitch R, Kiat H, et al. Incremental value of prognostic testing in patients with known or suspected ischemic heart disease: a basis for optimal utilization of exercise technetium-99m sestamibi myocardial perfusion single-photon emission computed tomography. *J Am CollCardiol*1995;26:639–47.
 17. Iskandrian, A.E. Myocardial perfusion imaging: Lessons learned and work to be done. *J. Nucl. Cardiol.* 21, 4–16 (2014). <https://doi.org/10.1007/s12350-013-9779-y>.
 18. Nael Aldweib, Kazuaki Negishi, Rory Hachamovitch, Wael A. Jaber, Sinziana Seicean, Thomas H. Marwick. Impact of Repeat Myocardial Revascularization on Outcome in Patients With Silent Ischemia After Previous Revascularization. *J Am CollCardiol*2013;61:1616–23. ISSN 0735-1097. <https://doi.org/10.1016/j.jacc.2013.01.043>.
 19. Lorusso R, La Canna G, Ceconi C, Borghetti V, Totaro P, Parrinello G, Coletti G, Minzioni G. Long-term results of coronary artery bypass grafting procedure in the presence of left ventricular dysfunction and hibernating myocardium. *Eur J Cardiothorac-Surg*2001;20:937–948.
 20. Rahimtoola SH. The hibernating myocardium. *Am Heart J* 1989;117:211–221.