

COMPARATIVE ESTIMATION OF ANESTHESIA VARIANTS AND CORRECTION THERAPY IN PATIENTS WITH LOW EJECTION FRACTION UNDERWENT CORONARY SURGERY

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Çalışmanın amacı, koroner arter bypass-greftleme yapılan, düşük kardiyak debili (output) hastalarda anestezi tekniklerini karşılaştırmaktır.

İskemik kalp hastalıklı, düşük ejeksiyon fraksiyonlu -konu ile ilgili- hastalarda cerrahi girişim sonrası yüksek perioperatif mortalite riski vardır. Nitrik oksit inhalasyonu ve yüksek torasik epidural anestezi uygulaması nedeniyle, düşük kardiyak debili hastalarda, pulmoner arteriospazm ve vasküler direnç artmıştır

Çalışmaya kardiyopulmoner bypass ile miyokardiyal revaskularizasyon planlanan 130 iskemik kalp hastalıklı kişi alınmıştır. Bunlardan 60'ında geleneksel sıvıların kullanıldığı genel anestezi uygulanmıştır. 20 hastada genel anestezi ve L-arjinin kombinasyonu kullanılmıştır. 50 hastaya genel anestezi ve L-arjinin ile yüksek torasik epidural anestezi kombinasyonu uygulanmıştır. Anestezi ve operasyon boyunca hemodinamik parametrelerdeki değişimler izlenmiştir.

INTRODUCTION

Pathogenesis of acute left ventricle insufficiency (LVI) in ischemic heart disease (IHD) patients with low ejection fraction (EF) is insufficiently investigated till now. Some researchers consider it is origin for functional insufficiency "worn out" of myocardium and serve multivascular lesion of coronary arteries, endothelium cells dysfunction, and pathological changes in lung vessels with a pulmonary hypertension, circulatory hypoxia and inadequate perioperative protection¹⁻⁴. Nevertheless, the problem of high perioperative lethality after coronary surgery in IHD patients with low EF remains actual.

To reduce pulmonary arteriospasm and vascular resistance during cardiac surgery inhalations of nitric

L-arjinin ile yüksek torasik epidural anestezi kombinasyonu kullanılan hastalarda pulmoner arter direnci %32, periferik vasküler direnç %32,8 daha düşüktür. Sol ventrikül atım (strok) indeksi, kardiyopulmoner bypass öncesi %26,7 ve sonrası %32,3 artmış bulundu. Düşük kardiyak debili hastalarda 3 kat daha az gelişmiştir ve inotropik ajan gereksinimi 1,5 kat daha azdır.

L-arjinin uygulaması ile kombine yüksek torasik epidural anestezi kardiyak fonksiyonları geliştirmekte; düşük ejeksiyon fraksiyonlu hastalarda, kardiyopulmoner bypass ile yapılan kardiyak cerrahi sonrası, kardiyak çıktı ve kardiyak indekste artış sağlamaktadır.

Anahtar kelimeler: L-arjinin, Koroner arter greftleme, Yüksek torasik epidural anestezi

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oxide (NO)^{3,4} and high thoracic epidural anesthesia (HTEA) are applied^{5,6}. NO is most powerful of endogenous vasodilating agents, witch has an ability to reduce proliferation of smooth muscle cells, platelets adhesion and aggregation and to render cytoprotective action. Favorable results have been received applying of L-arginine in diabetes patients with chronic cardiac insufficiency⁷. The combination of HTEA and applying of L-arginine as a component of anesthesiology management in coronary surgery patients is a very perspective and actual problem.

The purpose of research: to compare of general anesthesia variants (GA) with combination of GA and HTEA and applying of L-arginine in coronary artery grafting patients with low cardiac output.

MATERIALS and METHODS

We studied 130 IHD patients (III-IV NYHA) with low ejection fraction underwent myocardium revascularization procedure with cardiopulmonary bypass (CPB). The average patients weight was 82,6±3.9 kg. EF

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Table 1: Haemodynamic indices during coronary artery grafting bypass with cardiopulmonary bypass

Indices/stages/ groups		1 M±s	2	3	4	5
PVR (dyne/s/sm ⁵)	1	1976±278	1880±212 _↓	1512,7±85,7*** _↓	992±155 _↓	1424±209*** _↓
	2	1975±392	1861±200*	1448±104* _↓	996,4±367,3 _↓	1300±90* _↓
	3	2048±318	1762±65,5*** _↓	1376,5±92*** _↓	998±158 _↓	1222±98*** _↓
PAR (dyne/s/sm ⁵)	1	140±30,5	132±35 _↓	131,4±17,6***	106,8±31,6 _↓	156,5±41,5*** _↓
	2	148±46	138±34	117±20* _↓	102,1±25 _↓	119±16,8* _↓
	3	148±27,3	136,7±31 _↓	101±21,7*** _↓	100±22 _↓	108±13,6*** _↓
Ppulm (mmHg)	1	15,3±2,8	15,3±2,7**	17,2±3,7*** _↓	19,8±4,43*** _↓	20,5±3,64*** _↓
	2	15,6±2,1	14,9±3	14,6±2,1*** _↓	15,1±2***	15,6±2,4***
	3	15,3±2,4	13,2±1,7* _↓	13,5±1,1* _↓	13,6±1,9* _↓	14,2±1,5* _↓
MeanBP (mmHg)	1	85,8±11,7	83,6±10 _↓	83,5±10,8	78,8±10,8*** _↓	83,9±11,5**
	2	81,9±11	81,7±8,3	87±8,5	85,4±7,35***	84,2±10,2
	3	86,1±8,5	85±7,2 _↓	87,3±12,8	93±8,6* _↓	89,8±2,7* _↓
HR (b/min)	1	61,5±12,2	62,8±11 _↓	73,5±14*** _↓	89,8±13*** _↓	90,3±13,3*** _↓
	2	56,9±9,8	60,1±8,1 _↓	67,8±8,9 _↓	81,9±6*** _↓	82,6±3,2*** _↓
	3	61,8±10	62,9±10	64±13	80±6,4 _↓	82,7±5,7 _↓
CVP (mmHg)	1	4,5±1,7	4,5±1,6	6,1±1,8*** _↓	7,9±2,1 _↓	8,5±1,46*** _↓
	2	3,9±0,74	3,1±0,73*** _↓	4±0,8***	6,5±1,8*** _↓	6,6±0,6*** _↓
	3	4±1,6	3,7±1,4 _↓	5,1±1,4* _↓	7,7±1,4* _↓	7,2±1,9 _↓
CO (l/min)	1	3,7±0,5	3,64±0,54**	4,6±1*** _↓	6,1±0,54*** _↓	5,1±0,9*** _↓
	2	3,7±0,8	3,6±0,7 _↓	5,3±0,7*** _↓	6,5±0,5*** _↓	5,8±0,38*** _↓
	3	3,5±0,42	3,3±0,44 _↓	5,1±0,4 _↓	6,8±0,32* _↓	6,3±0,17* _↓
CI (l/min/m ²)	1	1,9±0,25	1,9±0,21**	2,35±0,4*** _↓	3,1±0,58*** _↓	2,62±0,4*** _↓
	2	1,9±0,42	1,87±0,4 _↓	2,7±0,3*** _↓	3,3±0,06*** _↓	3±0,17*** _↓
	3	1,7±0,5	1,68±0,4	2,5±0,15* _↓	3,3±0,3 _↓	3,1±0,14* _↓
DO ₂ (ml/min/m ²)	1	410,9±73	421,3±83,9	440±154,2	453±116*** _↓	426,8±140,6**
	2	391±95	393±89	406,9±60	481,2±84 _↓	414,1±76,1
	3	368,6±112	382±119 _↓	447±149 _↓	555±103* _↓	500±76* _↓
VO ₂ (ml/min/m ²)	1	90,5±13,5	90±16	90,2±14,7	93,4±15,4	98,4±16,7 _↓
	2	91,4±11,1	91,2±9,4	87±10	94,4±13,3	92,9±12
	3	88±13	87±12,5	87±12	95±13 _↓	96±15,6 _↓
LVSI (g·m/m ²)	1	43±11,5	43,2±11,4	42,5±13,4**	42±13,8**	40,6±11
	2	40,8±12,2	40±9,4	41,9±8,9*	44,1±6,4*	38,9±3,1*
	3	39±9,7	41,2±11,3 _↓	49,4±9,1 _↓	51,6±11,8 _↓	44,6±7,4 _↓
SV (ml)		68±14,5	72,3±15,4 _↓	66,8±22	68,5±19,4***	63,2±16,6
		66,7±12,8	67±11,2	62,7±13,4	80,7±10,9 _↓	63,3±11,8
		60,8±10,7	62,1±10,4 _↓	72,1±16 _↓	79,3±17,2*** _↓	67,7±10 _↓
PCWP (mmHg)	1	9,2±4	10,1±4,2	11,8±4,6 _↓	12,9±4 _↓	12,6±3,5 _↓
	2	8,2±4,5	7,4±4,2	8,7±4,4	11,3±3,4 _↓	10,2±2,8***
	3	9,1±3,7	10±2,4	11,8±0,8* _↓	13,9±0,9* _↓	12,6±2,2* _↓

* - difference between group 2 and 3; ** - difference between group 1 and 3; *** - difference between group 1 and 2; ↓ - difference in compare with stage1 (P<0,05).

46,8±3,6 %. Patients have been randomly divided into 3 groups. In 1 group (n=60) GA was applied with traditional fluid therapy controlling central venous pressure (CVP), in 2 group (n=20) combination of GA with applying of L-arginine, in 3 group (n=50) combination of GA and HTEA with applying of L-arginine. As a source of L-arginine we used infesol-40 (Berlin ?hemie, Menarini, Germany). Infusion of infesol-40 rate during surgery was 2 mg/kg/hour. Standard monitoring of haemodynamic was realized. Cardiac output (CO) was measured by thermodilution method. The cardiac index (CI), pulmonary artery

resistance (PAR) and peripheral vascular resistance (PVR) were calculate. All results presented as mean value ± standard deviation, t-test was applied to determine difference between patients groups.

All studied indices were registered at 5 stages of operation: 1 stage - induction of anesthesia, 2 stage - after sternotomy, 3 stage - before CPB, 4 stage - after CPB, 5 stage - skin sutures.

RESULTS and DISCUSSION

Changes of central haemodynamic indices during coronary surgery in studied patients are reflec-

ted in Table 1.

In 1 group PVR authentically decreased from 1976 ± 278 up to $1512,7 \pm 85,7$ dyne/s/sm⁵ at stage 3 (23 %), authentically differing from group 2 where PVR decreased in 26,7 % and group 3 where PVR decreased in 32,8 %. At stage 5, in group 1 PVR decreased in 28 %, authentically differing from 2 (34 %) and 3 (40 %) groups. PAR in group 1 decreased up to $131,4 \pm 17,6$ dyne/s/sm⁵ (6 %) at stage 3, it is authentic less than in 2 (21 %) and 3 (32 %) groups. At stage 5 PAR increased up to $156,5 \pm 41,5$ dyne/s/sm⁵ (11,8 %), authentically differing from 2 and 3 groups where PAR decreased up to 20 and 27 % accordingly. Thus Ppulm increased from $15,3 \pm 2,8$ mmHg (at stage 3) up to $17,2 \pm 3,7$ mm Hg (12,4 %) in 1 group, authentically differing from 2 and 3 groups, where Ppulm decreased up to 6,4 and 8,4 % accordingly. At 4 and 5 stages in 1 group Ppulm authentically increased unlike in 2 and 3 groups where Ppulm decreased as reaction to applying of L-arginine.

In 1 group CO has authentically increased from $3,7 \pm 0,5$ up to $4,6 \pm 1$ l/min (24 %) at stage 3, authentically differing from group 2 where CO increased from $3,7 \pm 0,8$ up to $5,3 \pm 0,7$ (43 %). After myocardium reperfusion at stage 4 increasing of CO in 1 group up to 65 % was marked, but this is authentic low than in 2 and 3 groups where increasing of CO was up to 76 and 94 % accordingly. At stage 5 CO was authentically higher in 2 (57 %) and 3 (80 %) groups, than in group 1 (37 %), that testifies the functional viability of myocardium after applied methods of anesthesia.

CI authentically increased from $1,9 \pm 0,25$ up to $2,35 \pm 0,4$ l/min/m² (24 %) at stage 3, it is also authentic lower than in group 2, where CI has increased up to $2,7 \pm 0,3$ (42 %) l/min/m² and $2,5 \pm 0,15$ (42 %) l/min/m² in group 3. This allows to prepare myocardium for anoxia during aorta cross-clamping period. After myocardium reperfusion CI in group 1 increased for 63 % at stage 4, but it is authentic lower than in group 2 (74 %) and 3 (94 %). At the end surgery CI was authentically above in 3 (82 %) and 2 (57 %) groups, than in 1 (38 %) group that testifies about effectiveness of surgery and adequate anesthesia management.

Increasing of stroke volume was incredibly higher after CPB in group 2 (up to 21%) and 3 (up to 30,4%), than in group 1. That demonstrates proper left ventricle function which provides optimal level of CI and prevents myocardium ischemia.

HTEA with L-arginine applying results in left ventricle contractility and increases LVSI. In group 3 LVSI increased to 26,7% before CPB and 32,3%

after CPB. That is authentic higher than in group 1 and 2.

Inotropic agent requirement in group 1 was in 46,7%, in group 2 - 15% and in group 3 - 16%. Dose of dopamine in group 1 was $9,7 \pm 5,7$ µg/kg/min, in group 2 - $6,5 \pm 2,8$ µg/kg/min, in group 3 - $6,3 \pm 2,7$ µg/kg/min. Applying of HTEA decreased fentanyl requirement up to 2,5 times during anesthesia. Duration of ventilation support after operation decreased in group 3 up to 2,5 times.

CONCLUSIONS

1. Applying of general anesthesia and traditional fluid therapy during coronary surgery in low cardiac output patients causes pulmonary hypertension at stage 3 and at the end of surgery. That can cause hypoxia, myocardium dysfunction, alveolar and interstitial lungs edema and result in low cardiac output syndrome in 46,7 %.

2. Application of L-arginine during general anesthesia allows to control peripheral vessels resistency before myocardium revascularisation, reduces PVR for 26,7 %, PAR for 21 %, decreases pulmonary artery pressure for 6,4 % that improves heart function, increases CI and CO up to 42 and 43 % accordingly before CPB.

3. Application of L-arginine and combined high thoracic epidural anesthesia reduces myocardium preload and postload that improves heart function and increases cardiac index and cardiac output, prevents development of low cardiac output syndrome and allows to execute myocardium revascularisation in more favorable conditions and to improve results of surgical treatment of ischemic heart disease.

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