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EVOLUTION OF THE APPROACHES TO ARTERIAL CANNULATION IN OPERATIONS FOR ACUTE TYPE A AORTIC DISSECTION

Abstract. *The acute aortic dissection is the most serious life threatening condition of all pathological processes that impair the thoracic aorta. Earlier operations of choice for the type A acute aortic dissection (AAD) were the classical Bentall dé Bono operation with Cabroll's anastomosis and the supracoronary replacement of the ascending aorta. Nowadays much more sophisticated techniques of surgical interventions on the ascending aorta, aortic arch, aortic roots, coronary arteries, and the aortic valve proper are developed and introduced into clinical practice. The question of choosing an optimal method for surgical treatment of various anatomical variants of the AAD and arterial cannulation to provide antegrade perfusion of the true lumen remains to be debatable and topical. 154 operations for AAD were performed in Lviv Cardiovascular Surgery Center in the period from 2010 to 2017. For arterial cannulation to connect extracorporeal circulation different sites such as superficial femoral artery, aortic arch, ascending aorta, left common carotid artery, brachiocephalic trunk or cannulation of the true lumen of aorta were used. The optimal cannulation site in operation for AAD should be chosen according to patient's status. In really emergencies, especially in ongoing rupture of ascending aorta, direct true lumen cannulation is quick and safe method. Every approach for AAD was associated with an acceptable mortality rate. Theoretically, no cannulation technique can completely avoid the risk of a malperfusion vascular event.*

Key words: *type A acute aortic dissection, arterial cannulation, perfusion of true lumen.*

Introduction. The acute aortic dissection occurs in 30% of cases of all pathological processes that impair the thoracic aorta and is the most serious life threatening condition. Without surgery 33% of patients in this category die within the first 24 hours and 50% of such patients die within 48 hours [1].

Only 5-7 years ago operations of choice for the type A acute aortic dissection (AAD) were the classical Bentall dé Bono operation with Cabroll's anastomosis and the supracoronary replacement of the ascending aorta (inclusion method) [2]. The expansion of knowledge of the aortic root surgical anatomy, appearance of the new AAD classification, availability of modern non-penetrating vascular and valve prostheses inspired surgeons to develop and introduce into clinical practice much more sophisticated techniques of surgical interventions on the ascending aorta, aortic arch, aortic roots, coronary arteries, and the aortic valve proper.

These operations were performed mainly with the use of deep hypothermia (18±C) and applying distal anastomosis under a complete circulatory arrest. The use of this technique threatens the onset of ischemic complications on the part of the brain and the ischemic impairment of the vital organs [3]. Besides, already at the stage of perfusion with the aid of the extracorporeal circulation there may occur a hypoperfusion or ischemia of vital organs in case of perfusion of a false lumen.

It should be noted, that one of the most extensive studies in Europe, GERRADA conducted to study the results of AAD treatment of 1500 cases, established that in case of surgery for AAD there can be applied every technique, for the main thing at that time is to save the patient's life [4]. This is why the question of choosing an optimal method for surgical treatment of various anatomical variants of the AAD and arterial cannulation to provide antegrade perfusion of the

true lumen remains to be debatable and topical.

Objective: to evaluate the safety and efficacy of different cannulation sites of the dissected ascending aorta in acute type A dissection.

Material and methods. 154 operations for AAD were performed in Lviv Cardiovascular Surgery Center in the period from 2010 to 2017. The patients were represented by 85 males and 69 females aged from 31 to 72, average age 53 ± 19 years. Applying NYHA classification we attributed 11 patients to the functional class II, 111 patients to the functional class III, and the remaining 32 patients were attributed to NYHA class IV.

In 43 cases the superficial femoral artery (right or left) was used for arterial cannulation to connect extracorporeal circulation with cannulation performed mainly not only in the central end of the artery, but in the peripheral as well – in order to avoid a prolonged ischemia of the lower extremity. In 12 cases the aortic arch was used for cannulation with pre assessment indicating no dissection of the aortic arch. Cannulation was performed directly of the ascending aorta for 13 patients applying the Seldinger method using the EOP Medtronic arterial cannula without the preliminary purse-string suturing in cases of hemodynamically unstable patients [5]. In cases of doubt cannulation of the true lumen was made using transepical echocardiography. For 16 patients the left common carotid artery was used for the arterial connection, and the brachiocephalic trunk was used in 8 more cases. In all of these cases the method of end-to-side anastomosis was applied between the vascular prosthesis Vascutec 8-10 mm and the corresponding arteries. Then aortic cannula 18-20 Fr was implanted into the vascular prosthesis. Cannulation of the true lumen of aorta was used in 62 cases under the visual control. To accomplish that, the left atrial appendage was cannulated first, then 500 to 1000 ml of blood was taken into the coronary reservoir of the artificial blood circulation apparatus, thus achieving a controlled hypotension. Then the ascending aorta separately or together with the pulmonary artery were bypassed applying a tourniquet to the given tissular strips and with the passive desanguination of the patient in the Trendelenburg's position through the venous line, at first the false, and then the true lumen of the aorta were dissected, following which a cannula was inserted in the true lumen under the visual control with the controlled blood supply through the arterial line, gradually

achieving the rated efficacy of the extracorporeal circulation. Japanese authors call this method the "Samurai technique". Then tourniquets were placed around the cannula. The axillary artery was not used to connect the bloodstream.

Duplex scanning of the aortic arch branches, femoral arteries was made on all patients at the preoperative stage to verify dissection of these vessels as well as the presence of hemodynamically significant stenosis, for the possibility of using the best vessel for the arterial cannulation. On 149 patients operations were performed under the conditions of the complete arrest of circulation and a deep hypothermia 18°C for the placement of the "open" distal anastomosis. Replacement of the ascending aorta of the other 5 patients, the was performed with cross-clamping of the aorta under a moderate total body hypothermia. Aside from the deep hypothermia to protect the brain antegrade cerebral perfusion was done on 67 patients. 2 different methods of the brain protection were used for 149 patients with deep hypothermia: for 67 patients – selective antegrade cerebral perfusion (SACP), and for 82 patients – deep hypothermia. Mean time of circulatory arrest was 31 ± 17 minutes. Mean time of selective cerebral perfusion was 25 ± 9 minutes. Operations that were performed: Supracoronary replacement of the ascending segment of the aorta – 77; Supracoronary replacement of the ascending segment of the aorta and resuspension of the aortic valve – 15; Supracoronary replacement of the ascending segment of the aorta + hemiarch aortic replacement – 30; Bentall operation applying full root button technique – 25; David E. operation – 7.

Results of the study. Arterial cannulation in the main artery to ensure blood-flow in the true lumen gives the surgeon confidence and peace of mind to provide an adequate perfusion of the vital organs till the moment of complete stoppage of extracorporeal circulation under the deep hypothermia. In the case of a hemodynamically unstable patient or an intraoperative rupture of the aorta it is advisable to cannulate immediately the ascending aorta applying Seldinger method, while it does not always matter whether to use the true or false lumens. In such cases, it is worthwhile to immediately cool the patient to deep hypothermia without clamping the aorta and begin reconstruction of the aorta from the distal anastomosis. In case of stabilization of the

situation, it is possible to use the intraoperative transoesophageal or transepical echocardiography to verify position of the cannula. In stable situations, as well as in cases of non-extension of dissection to the aortic arch branches and in case of absence of separate atherosclerotic lesions of the carotid arteries, it is possible to use appropriate vessels for the arterial connection. The advantage of this method of arterial cannulation is perfusion in the true lumen with the simultaneous use of this vascular access for the antegrade cerebral perfusion to protect the brain. A certain disadvantage of this technique is always a somewhat prolonged time of the operation for exposing this artery and placement an appropriate anastomosis with the vascular prosthesis, as well as manipulations with the carotid arteries, that in the event of a surgical error may lead to neurological complications. As to the femoral cannulation, this method continues to be the method of choice for such type of operations. We would only note, that we continue to use on a wider scale cannulation of the femoral artery in its central and peripheral segments. In 2016 and 2017 we performed 80% of the operations for acute aortic dissection using central cannulation of the true aortic lumen applying the "Samurai technique" [6], observing the principle proposed by J. Bavaria "All in chest" [7]. Our observations in the course of applying this method show that practically with each variant of aortic dissection we manage to ensure an adequate antegrade blood-flow, and if not eliminate, to reduce considerably malperfusion of internal organs and, besides, this technique is practically indispensable in case of an intraoperative rupture of the aorta.

Discussion. Nowadays much more sophisticated techniques of surgical interventions on the ascending aorta, aortic arch, aortic roots, coronary arteries, and the aortic valve proper are developed and introduced into clinical practice. The question of choosing an optimal method for surgical treatment of various anatomical variants of the AAD and arterial cannulation to provide antegrade perfusion of the true lumen remains to be debatable and topical. But the key point is to provide an adequate perfusion of the vital organs.

Conclusions. The optimal cannulation site for the repair of AAD should be chosen according to patient's status. When choosing the method of arterial cannulation in operations for acute aortic dissection one should follow the principle of

antegrade perfusion in the true lumen. The use of carotid arteries for the arterial connection of extracorporeal circulation in most cases provides the opportunity to ensure antegrade blood-flow with simultaneous use of that vascular access for protection of the brain. The use of central cannulation in the true lumen of the type A acute aortic dissection observing the principle "all in chest" provides the opportunity to ensure a sufficiently reliable blood-flow in the internal organs and is suitable for the widest range of variants of surgical treatment.

Prospects for further research. Presented results of the study are a part of the scientific-research work dealing with investigation of the different sites of arterial cannulation in operations for acute type a aortic dissection. The results obtained in the study can be used to search and analyze the best site of arterial cannulation to ensure an adequate antegrade blood-flow and to reduce considerably malperfusion of internal organs.

References.

1. Criado FJ. *Aortic dissection: a 250-year perspective. Texas Heart Institute Journal. 2011;38(6):694.*
2. Wahlberg E, Goldstone J. *Acute Aortic Dissection. In Emergency Vascular Surgery 2017 (pp. 103-114). Springer, Berlin, Heidelberg.*
3. Di Eusano M, Tan ME, Schepens MA. *Surgery for acute type A dissection using antegrade selective cerebral perfusion (experience with 122 patients). Ann Thorac Surg. 2003;75:514-9.*
4. Okita Y. *The sooner the better? Early strategies of peripheral vascular intervention for patients with acute aortic dissection complicated by the organ malperfusion. J Thorac Cardiovasc Surg. 2018. doi:10.1016/j.jtcvs.2018.04.015*
5. Ueda Y, Miki S, Kusuhara K, Okita Y, Tahata T, Yamanaka K. *Surgical treatment of aneurysm or dissection involving the ascending aorta and aortic arch, utilizing circulatory arrest and retrograde cerebral perfusion. J Cardiovasc Surg. 1990;31:553-8.*
6. Kitamura T, Nie M, Horai T, Miyaji K. *Direct True Lumen Cannulation ("Samurai" Cannulation) for Acute Stanford Type A Aortic Dissection. Ann Thorac Surg. 2017;104(6):e459-61.*
7. Bavaria JE, Brinster DR, Gorman RC, Woo YJ, Gleason T, Pochettino A. *Advances in the treatment of acute type A dissection (an integrated approach). Ann Thorac Surg. 2002; 74:1848-52..*