CHOICE OF OPTIMAL TREATMENT POLICY IN PATIENTS WITH DESCENDING AORTIC DISSECTION

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Contemporary approaches to treatment of patients with dissection of the descending aorta (DA), as well as the data of international registries and guidelines are contradictory. The endovascular method of treatment of patients with descending aortic dissection has been recognized to be revolutionary. However, there seems to be no commonly accepted concept concerning appropriate use of currently available techniques of treating patients with DA dissection.

This study was aimed at analysing the experience gained in using various methods of treatment of patients with descending aortic dissection (DAD).

We retrospectively examined the results of surgical treatment of 78 patients with DAD. Of these, 45 patients were found to have Stanford type B dissection and 33 patients had type A dissection, who underwent treatment during ten years from January 2008.

The decision concerning the type of care for patients with DAD (conservative, surgical, endovascular or combined methods of treatment) directly depends on the patient's state stability, technical feasibility of the intended procedure, and the presence of concomitant pathology.

The findings obtained in our study demonstrated better immediate outcomes of the endovascular approach compared with the hybrid and surgical ones.

In order to achieve complete haemodynamic correction of the pathology, to minimize the risk of aortic remodelling and the development of aorta-related complications, the treatment should not be limited to endoprosthetic repair of the thoracic portion of the DA with a stent graft, but should rather be supplemented with stenting of more distal segments, including with uncoated stents at the level of the visceral branches. Only such staged approach may provide better conditions for obliteration of the aortic false lumen and formation of a "neo-frame" of the aortic wall.

Key words: *descending aortic dissection, aortic surgery, aortic endoprosthetic repair, aortic stenting.*

INTRODUCTION

Descending aortic dissection (DAD) remains a dangerous, life-threatening condition, however, with the beginning of «aggressive» antihypertensive therapy and implementation of endovascular treatment into wide practice lethality of patients had dramatically decreased over the past decade [1–3]. Modern approaches to treatment of patients with DAD are ambiguous. On the one hand, medicamentous therapy being the gold standard of treatment does not provide promising results in the remote period, with high figures of immediate lethality in surgical treatment, on the other. Endovascular method of treatment of patients with DAD has been recognised as revolutionary, however there is currently no common tactical conception of using various techniques.

The purpose of our study, based on retrospective assessment of immediate and remote results of various techniques of invasive (surgical and/or endovascular) treatment of DAD, was to substantiate optimal treatment policy in patients with the pathology concerned.

PATIENTS AND METHODS

Analysed were the outcomes of invasive treatment of 78 patients with DAD during the period from January 2008 to January 2018. Of these, 45 had type B dissection and 33 had type A dissection according to the Stanford classification. The characteristics of patients are shown in Table 1.

Acute stage of the disease was diagnosed in 60% of patients with type B dissection. Nine patients due to visceral malperfusion endured emergency interventions: stenting of the aortic visceral branches in 3, fenestration of the abdominal aorta in 2 (in all 5 cases followed by surgical or endovascular treatment), with endoprosthetic reconstruction and stenting of the DA performed in 4 patients.

Table 1

Characteristics of patients

Parameter	Type B	Type A
Mean age, years	54±6	49±6
Male gender, %	60	93.9
Arterial hypertension, %	86.7	93.9
Genetic anomalies, %	6.7	6.1
Injury, %	6.7	-
Malperfusion, %	20	12.1
Pain syndrome, %	91.1	81.8

Table 2

Structure of interventions in treatment of patients with type B aortic dissection

Structure of interventions	Number
Prosthetic repair of the descending aorta	21
including with implantation of uncoated stents (1–2) in distal portions of the descending aorta and the abdominal aorta	7
Endovascular repair of the descending aorta	23
including with implantation of uncoated stents (1–2) in distal portions of the descending aorta and the abdominal aorta	10
Crawford-type operation	1

Table 3

Structure of postponed interventions in staged treatment of patients with type A aortic dissection

Structure of the intervention	Number
Prosthetic repair of the descending aorta	7
including with implantation of uncoated stents (1–2) into distal portions of the descending aorta and the abdominal aorta	4
Endovascular repair of the descending aorta	12
including with implantation of uncoated stents (1–2) into distal portions of the descending aorta and the abdominal aorta	6
Implantation of uncoated stents into the descending and abdominal portions of the aorta	1

36 patients with no evidence of malperfusion were subjected to surgical treatment carried out in either a postponed or elective manner. The structure of operations in all patients with type B aortic dissection is shown in Table 2.

33 patients with type A aortic dissection as the first stage endured emergency prosthetic repair of the ascending aorta (AA), including in combination with interventions on the aortic valve (AV) and/or aortic arch. In 14 patients, the intervention on the AA was supplemented by intervention on the DA or conditions were created for it to be performed in the future: 5 patients underwent switching of the brachiocephalic arteries to the graft of the AA (debranching) followed (after 1–3 days) by implantation of a stent graft to the aortic arch and distally; in 6 patients, reconstruction of the AA and aortic arch was combined with anterograde implantation of the E-vita Open Plus hybrid stent graft («frozen elephant trunk»); in 3 patients, the distal anastomosis was formed with plasty of the aortic wall with closure of the «typical» fenestration in the area of aortic isthmus and leaving the free graft in the proximal portions of the DA according to the Borst's technique.

Subsequent invasive interventions on the descending aorta in 20 patients with type A aortic dissection were performed electively in chronic or (less often) subacute stage of the disease. The structure of postponed interventions on the descending portion of the aorta is shown in Table 3.

The indications for invasive treatment of DAD were as follows: malperfusion syndrome, pain syndrome, uncontrolled arterial hypertension, an enlargement of the DA diameter by more than 25% of the previous measurements (after 6–12 months).

The immediate goals of the treatment were defined as follows: exclusion of the proximal fenestration from blood flow, redirection of blood flow to the true lumen, creation of conditions for obliteration of the false lumen, prevention of malperfusion events.

Treatment was planned with the help of bolus contrast-enhanced multispiral computed tomography (MSCT) of the aorta, ECG synchronization followed by 3D modelling.

Prosthetic repair of the DA proximal portions of the DA was performed in conditions of assisted circulation (AC). With the remaining dissection in the zone of anastomosis, we performed plasty of the aortic wall according to the «sandwich» technique.

When the proximal fenestration was located in the zones Z_1–Z_2, endovascular treatment inevitably involved occlusion of the left subclavian artery ostium, requiring subclavian-carotid transposition on the left in 3 cases preventively and in a further 2 cases after endoprosthetic repair. The diameter of the endograft was chosen to overlap the diameter of the proximal "landing zone", but not more than by 10%.

In the majority of patients during 1–3 days cerebrospinal drainage was used for monitoring the fluid pressure which was maintained at the baseline level ± 10–15%. No cases of critical fluctuations of the CSF pressure were observed.

Most patients underwent check bolus contrast-enhanced multislice computed tomography (MSCT) of the aorta prior to discharge from hospital, as well as were given recommendations on tomographic control (magnetic resonance imaging or MSCT) after 6, 12 months and annually thereafter.

In the remote period (up to 7 postoperative years) a total of 40 patients were examined: 21 with type B aortic dissection and 19 with type A dissection.

Table 4

Causes of in-hospital lethal outcomes (number of patients)

Causes	Type B			Type A		
	Surgical treatment	Hybrid treatment	Endovascular treatment	Surgical treatment	Hybrid treatment	Endovascular treatment
Multiple organ failure syndrome	1	1	1	4	1	1
Aortic rupture	-	-	1	-	-	1
Cerebral oedema	-	-	-	2	-	-
Other	1	1	1	-	1	-
TOTAL	2	2	3	6	2	2

Table 5

Types of in-hospital complications (number of patients)

Groups	Type B			Type A		
	Surgical treatment	Hybrid treatment	Endovascular treatment	Surgical treatment	Hybrid treatment	Endovascular treatment
Multiple organ failure syndrome	3	1	-	-	2	-
Acute impairment of cerebral circulation	-	-	3	2	-	-
Infectious	1	1	-	-	1	-
Other	1	1	1	1	-	-
TOTAL	5	3	4	3	3	0

Table 6

Immediate results of various types of treatment of DA dissection (false-lumen status)

Results	Surgical treatment	Endovascular treatment	Combined treatment
Partial thrombosis of the false lumen distal to the graft/endograft	35.7%	34.8%	12.5%
Complete thrombosis of the false lumen distal to the graft/endograft	7.1%	26.1%	87.5%

RESULTS

The overall in-hospital mortality rate amounted to 24.4%. In the groups of patients with type B (n=45) and type A (n=33) aortic dissection nine (20.0%) and ten (30.3%) patients died, respectively. The causes of lethal outcomes are shown in Table 4.

The main cause of lethal outcomes was multiple-organ failure syndrome, the predictor of whose development in 100% of cases was the presence of malperfusion events at baseline.

Non-lethal complications after interventions on the DA were observed in 18 (30.5%) of the 59 surviving patients. The types of complications are shown in Table 5.

In the early terms we examined 30 patients with type B aortic dissection and 15 patients with type A aortic dissection. The false-lumen status in the early postoperative period is shown in Table 6.

Mention should be made that complete thrombosing of the false lumen was observed in cases when uncoated stents were implanted distal to the vascular graft or endograft of the DA.

In the remote period (after 1–7 years) we examined 40 patients: 11 after surgical treatment, 24 after endovascular treatment and 5 after combined (surgical + endovascular) treatment. All patients demonstrated complete thrombosis of the false lumen in the proximal segments to the level of the subsequent fenestration. In the distal segments, complete thrombosis of the false lumen was present in only 30% of patients, with the remaining 70% of patients found to have partial thrombosis. In all patients with complete thrombosis in the DA and abdominal aorta, the previously performed intervention on the thoracic DA (surgical or endovascular) was combined with implantation of uncoated stent(s) at the level of the visceral branches. Neither dilatation of the aortic diameter nor other aorta-related complications were observed in the remote period.

DISCUSSION

Different approaches to treatment of patients with type A and B aortic dissection are determined by the localization of the primary entry tear: the ascending portion of the aorta appears to be more rupture-prone than the descending one. However, some authors distinguish between the primary and consequent fenestrations not only by localization but by other characteristics (size, direction, etc.) [4]. Thus, closure of the primary fenestration may be followed by the anticipated «domino» effect, when the false lumen progressively collapses. From these positions, type A aortic dissection may be monitored by long-term dynamic follow up of the false-lumen status in the DA after prosthetic repair of the ascending aorta, whereas appropriate management of type B aortic dissection should in all cases envisage the need for intervention on the DA.

The consensus currently accepted by the majority of authors consists in the fact that uncomplicated

DA dissection is liable to conservative treatment, while complicated one should be treated surgically or endovascularly [2, 5]. Endovascular treatment has become an attractive alternative to surgery in recent years and is associated with significantly less number of complications (11.1 vs 40%) [5].

Non-invasive treatment remains the «gold standard» for managing uncomplicated DA dissection with (favourable) survival rates between 85 and 95% after the initial hospital admission [6]. The term "uncomplicated dissection" is defined differently by different authors. It is underestimation of the patient's severity state that results in unfavourable long-term survival (5-year mortality of up to 50%) [7]. The International Registry of Aortic Dissection (IRAD) reported progressive aortic dilatation in 59% of medically treated patients, with a mean expansion rate of 1.7±7 mm/year [7]. Spontaneous complete thrombosis of the false lumen in medicamentous treatment occurs very rarely (in less than 4% of patients), the remaining blood flow in the false lumen is a predictor of aortic diameter growth and the development of aorta-related complications [8]. Along with it, 5-year complications rate in patients receiving conservative treatment amounts to 50% [9].

A traditional indication for operation is the DA diameter of more than 6–6.5 cm, and in the presence of Marfan syndrome – 5.5–6 cm, with the aneurysmal growth rate exceeding 1 cm/year [10]. In malperfusion, intervention is indicated even in a smaller diameter. Other authors lean toward treating DA dissection with the DA diameter of more than 4.5 cm and with the functioning false lumen, explaining it by the fact that in this case dilatation of the aorta occurs in all patients and the extent of the operation is enlarged [10].

Different authors choose different scope of surgical intervention for DA dissection: it may be local or complete prosthetic repair of the DA [10]. The weakest points in DA dissection are the isthmus and proximal portion of the DA. It is this segment that demonstrates the most dilated diameter of the aorta and the most thickened wall, while intention of surgeons to reconstruct only this segment of the aorta is justified by better results due to a shorter duration of the operation, decreased aortic cross-clamping time, and lesser blood loss [10]. Local prosthetic repair of the DA envisages performing plasty of the dissected aortic wall with redirection of blood flow to the true lumen of the aorta, which opens prospects for hybrid techniques. Thus, open antegrade intraoperative implantation of uncoated stents to the abdominal aorta (at the level of the visceral branches) is of great importance for prevention of aortic dilatation in the remote period, since it makes it possible to restore the "carcass" of the aorta and to create conditions for obliteration of the false lumen.

Along with it, despite modern achievements in surgery, anaesthesiology and perfusiology, open surgery in patients with DAD is associated with significant risk of in-hospital mortality [11]. Endovascular intervention has unquestionable advantages over open surgery, as well as yields the most favourable 5-year results in uncomplicated patients compared with conservative treatment [11, 12].

Therapeutic decision-making in patients with DA dissection (conservative, surgical, endovascular or combined methods of treatment) directly depends on the patient's clinical status, the technical feasibility of the intended procedure, and concomitant pathology. Thus, patients with connective tissue diseases are considered "ineligible" for endovascular treatment (due to the increased risk of additional aortic wall lesion), but in case of unstable haemodynamics in aortic rupture endoprosthetic repair may become the only possible method to save the life [11]. The indications for endovascular repair should include enlarged aortic diameter, impending rupture, end-organ malperfusion, pain syndrome, uncontrolled arterial hypertension [11].

The feasibility of bare metal stenting as a method of aortic dissection repair was proved by morphological and experimental data, being essentially the layer-by-layer reconstruction and restoration of aortic wall elasticity, preventing the occlusion of peripheral branches and retaining the aortic own intima inside the circulation. The latter is very important as the aortic dissection is always accompanied by considerable haemostatic disorders [13]. Apart from clinical and physiological benefits, implantation of bare metal stent for management of aortic dissection has several technical advantages. Among those are the lack of necessity to carefully select stent size, easy to handle placement, possibility of stent delivery either through the aortic lumen during open surgical repair or using the roentgen-assisted endovascular procedure, in an antegrade or retrograde or manner, as well as no need in choosing suitable landing zones [13].

In our study we demonstrated better immediate results of the endovascular approach compared with surgical and combined approaches, including the hybrid one with the interval between surgical and endovascular intervention up to 24 hours, and the staged one with the interval exceeding 24 hours. Thus, the complications rate in the group of endovascular treatment amounted to 11.1% (4 cases) vs 54.5 (6) and 44.4% (8) for combined and surgical treatment, respectively. The mortality rates were distributed as follows: 5.1% vs 7.7 and 10.3%, respectively. These differences were statistically significant ($t_{calc} > t_{emp}$ at $p < 0.05$).

CONCLUSIONS

The endovascular approach in treatment of DA dissection demonstrated better immediate and remote

results compared with the surgical and combined methods. However, in order to achieve complete haemodynamic correction of the pathology, to minimize the risk of aortic remodelling and the development of aorta-related complications, treatment should not be always limited to endoprosthetic repair of the aorta with a stent graft, but should be supplemented (if indicated) by stenting of more distal segments, including at the level of the visceral branches with uncoated stents. Only such a staged approach may provide better conditions for obliteration of the aortic lumen and formation of a "neo-frame" of the aortic wall.

Conflict of interest: none declared.

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