SURGICAL TREATMENT OF TOTAL THROMBOSIS OF AN ABDOMINAL AORTIC ENDOGRAFT

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Described in the article is a clinical case report regarding successful surgical treatment of total thrombosis of a stent graft in a high-risk surgical patient, having previously undergone endovascular repair of an abdominal aortic aneurysm by means of a unilateral stent graft with suprarenal fixation of its crown and femorofemoral crossover bypass grafting. 5 months after the operation, the patient began complaining of rest pain in his right leg and trophic ulcers of the foot. The findings of MSCT angiography revealed total thrombosis of the stent graft, to be later on followed by operative intervention, i. e. resection of an infrarenal abdominal aortic aneurysm with the removal of the stent graft, aortofemoral bifurcation prosthetic repair and graft-renal prosthetic repair on the left. The postoperative period was complicated by a transitory ischaemic attack. On POD 29, the patient was discharged in a satisfactory condition. 8 months later, the findings of the control MSCT angiography revealed thrombosis of the graft of the left renal artery, with the left kidney secondarily shrunken. However, the clinical biochemistry data showed no evidence of renal failure, thus suggesting that renal function was compensated exclusively at the expense of the right kidney.

Key words: *stent graft thrombosis, endovascular repair, abdominal aortic aneurysm, stent graft removal, complications of EVAR.*

INTRODUCTION

Endovascular aortic aneurysm repair (EVAR) is an alternative to open surgical treatment. EVAR performed prior to open surgery has a series of advantages which are as follows: reduced time of the surgical procedure, less invasive nature of the intervention, decreased duration of the periods of both hospital stay and rehabilitation, as well as decreased lethality within the 30-day postoperative period, which all make it possible to consider this operation as a method of choice for patients with high surgical risk, taking into consideration favourable anatomy of the aorta [1, 2]. The remote results of survival and mortality rates at 5 years of follow up are comparable with those for open surgical procedure and have no considerable advantage. The main disadvantages of EVAR include the necessity of long-term follow up and the need for repeat interventions for treatment of such complications as endoleaks, stent-graft migration, collapse and fracture of the graft, thrombosis of the branches and infection of the graft, with the number of complications increasing with the duration of follow up [3, 4].

The majority of secondary interventions after EVAR are successfully performed by means of percutaneous interventional procedures. Repeat open operations are required for a small number of patients (0.7–9.0%), however, this proportion grows with the duration of follow up and increased number of the procedures, which is reflected in the EUROSTAR registry [5].

Total occlusion of a stent-graft according to the EUROSTAR data accounts for up to 4% of cases of the total number of complications. This complication can be caused by complicated anatomy of the abdominal aorta, graft kinking, technical errors and inaccuracies during implantation, as well as by poor outflow [6]. Presented hereinafter is a clinical case report regarding treatment of a patient with total thrombosis of a unilateral stent-graft with suprarenal fixation.

Case report

Male patient M., aged 62, in March 2017 presented to the Department of Vascular Surgery of the Municipal Multimodality Hospital No2 (Saint Petersburg) complaining of rest pain in his right leg and appearance of a trophic ulcer on the right heel area. Studying his medical history revealed that the patient had been suffering from atherosclerosis obliterans of lower-limb arteries for more than 20 years. In 1992, he endured left-sided lumbar sympathectomy. In late 2015, the findings of MSCT angiography revealed an infrarenal aortic aneurysm and occlusion of the right common iliac artery (CIA). In April 2016, at the Municipal Hospital of Moscow he underwent endovascular abdominal aortic repair by means

Fig. 1. MSCT angiography prior to operation. (a) – aorta and its bifurcation, femorofemoral bypass graft, front view; (b) – occlusion of the abdominal aortic endograft, the crown of the graft is located in the area of the ostia of the renal arteries; (c) – rear view of the aorta and its bifurcation, femorofemoral bypass graft

of a unilateral stent-graft Zenith (Cook Medical, USA) with the transition of the endograft to the left CIA. In June 2016, due to rest pain appearing in his right leg he underwent femorofemoral crossover bypass grafting and right-sided lumbar sympathectomy. Three months later, he developed critical ischaemia of the right leg with the formation of trophic alterations on the foot. The control MSCT angiography showed total thrombosis of the stent-graft (Fig. 1). It was also known that the patient had endured carotid endarterectomy on the left, angioplasty and stenting of the left internal carotid artery (ICA) for its restenosis, however later on he developed occlusion of the stent of the left ICA. Besides, the patient suffered insulin-dependent type 2 diabetes mellitus and first-degree obesity.

On March 29th, 2017 he endured operative intervention consisting in resection of the abdominal aortic aneurysm with the removal of the stent graft, aortofemoral bifurcation prosthetic repair and graft-renal prosthetic repair of the left renal artery. Under general anaesthesia by means of an approach via thoracophrenolumbotomy along the 8th intercostal space, retroperinoneally exposed were the distal portion of the descending thoracic aorta (DTA) and the entire abdominal aorta with visceral and renal arteries. Exposure of the abdominal aorta below the renal arteries was fraught with technical difficulties related to a periaortal inflammatory process. On revision: the DTA, abdominal aorta, visceral and renal arteries were pulsating, being not dilated, taken onto holders. At a distance of 10 mm below the renal arteries, the aorta was thrombosed and dilated, measuring 56×48×130 mm in size. Incisions made in the upper third of both thighs were used to expose the common femoral artery and its branches, as well as the anastomoses of the femorofemoral crossover bypass graft. The aorta was cross-clamped below the superior mesenteric artery.

Fig. 2. Intraoperative photos. (a) – stent graft in the aortic lumen; (b) – removal of the thrombosed main body of the stent graft from the abdominal aorta; (c) – the main body and distal limb removed

Fig. 3. Control MSCT angiography of the abdominal aorta at 8 months. The graft of the left renal artery originating from the right branch is thrombosed. (a) – front view; (b) – sagittal section; (c) – rear view, with the arrow indicating the old graft from the left renal artery to the right limb of the aortofemoral bifurcation graft

Opened was the lumen of the aorta under the ostia of the renal arteries. Exposed was the thrombosed stent graft with its crown tightly fixed above the ostia of the renal arteries, thus making it impossible to remove the graft, due to which fact the artery was cross-clamped above the celiac trunk, with aortotomy lengthened by 10 mm above the renal arteries, followed by removing the main body of stent-graft (Fig. 2). Uninterrupted suture was applied onto the femoral aorta in a "side-to-side" manner, with blood flow along its branches restored. An "end-to-end" proximal anastomosis was established between the aorta and the POLYMAILLE vascular graft below the renal arteries with the cuff from the same graft. The revision showed unsatisfactory pulsation of the left renal artery because of an atherosclerotic lesion of its ostium. After ligation near the ostium, the left renal artery was cut off and repaired with a synthetic reinforced graft measuring 6 mm in diameter with formation of an "end-to-side" anastomosis from the right limb of the bifurcation graft. Blood flow in the left kidney was maintained by means of the temporal BARD carotid bypass shunt deployed in the left renal artery and passed through the left limb of the bifurcation graft. The aneurysm's sac was opened and the distal extension of the endograft removed from left CIA. The right limb of the aortofemoral bifurcation bypass graft was anastomosed to the common and superficial femoral arteries in an "end-to-side" manner through an autovenous patch. Blood flow was restored through the arteries of the right leg and in the left kidney. The left limb was brought out onto the femur to be anastomosed in the same way as the right one. The old crossover bypass graft was removed (Fig. 2).

The duration of the operation was 290 minutes. The time of cross-clamping of the aorta and right renal artery was 10 minutes, with that of the iliac trunk, left renal artery and lower-extremity arteries amounting to 7,35 and 50 minutes, respectively. The total overall blood loss amounted to 1,300 ml, with 500 ml returned by the Cell Saver system.

According to the findings of dynamic control over the renal function parameters before and after the surgical procedure, the level of creatinine amounted to 75 and 100 μmol/l, respectively, and that of urea to 5.0 and 6.3 mmol/l, respectively. The level of arterial pressure (AP) before and after surgery was 130/80 and 140/80 mm Hg, respectively.

The patient was extubated on postoperative day 1, having on POD 2 developed transitory ischaemic attach in the basin of the occluded left internal carotid artery with evidence of mixed aphasia, however the symptoms subsided spontaneously 30 minutes after the onset of the fit. No evidence of renal insufficiency was observed. On POD 29, the patient was discharged in a satisfactory condition.

Eight months later, the control MSCT angiography of the abdominal aorta demonstrated thrombosis of the graft of the left renal artery, with the left kidney secondarily shrunken and not functioning (Fig. 3). The creatinine level amounted to 100 μmol/l and that of urea to 6.0 mmol/l, with AP of 130/80 mm Hg on the background of antihypertensive therapy, thus suggesting compensation of the renal function exclusively at the expense of the right kidney.

DISCUSSION

The EVAR procedure made a real revolution in modern surgery of aortic aneurysms [7]. In 1987, Soviet cardiovascular surgeon and scientist N.L. Volodos for the first time in the world invented and successfully implanted the first-ever stent graft into the thoracic aorta, which was the beginning of a new era of treatment of the most complicated surgical pathology [8]. This unique

invention has up to now in the world practice been a first-choice method for patients with suitable anatomy of the aorta.

Despite advances in endovascular techniques, late secondary open surgery due to failed EVAR was of frequent occurrence [9]. In 2002, the European centres of vascular surgery maintaining the EUROSTAR registry reported having performed EVAR in a total of 4,291 patients over the period from 1996 to 2002, with a one-year rate of secondary open surgical treatment after EVAR of 2%. A later review of 15 series over the period from 2002 to 2009 showed that delayed open conversion after EVAR had place in 0.4–22.0% of cases, with a total frequency of 1.9% [10, 11]. According to the findings of some authors, the coefficient of late conversion remained within the limits of 2% which corresponds to the results of both other series with long-term follow up [12, 5, 6].

Late open operations are indicated for many reasons: enlargement of an aneurysm with of without endoleak, stent migration or detachment of a stent-graft's modules, thrombosis, infection of the stent-graft zone and rupture of an aneurysm. Prosthetic repair of the abdominal aorta after EVAR is more complicated than in a standard elective operation and is determined by periaortic inflammatory reaction or inclusion of a stent-graft into the vascular wall [13]. According to the findings of a systematic survey with participation of 8,304 patients, the average composite mortality after late conversion amounted to 23% [11].

Literature sources reported various surgical strategies of late conversion after EVAR. An important point here is a surgical access to the aneurysm which may be performed both via mediastinal laparotomy and retroperitoneally. The transperitoneal approach provides excellent exposure of distal iliac arteries, whereas the retroperitoneal one makes it possible to carry out uninterrupted control over the aorta [10]. Kelso, et al. supposed that both approaches to the aneurysm are equally effective in cases of late conversion and their use depends on the surgeon's preference [13]. An important role is played by the place of application of an aortic clamp for control and convenience of work in the zone of proximal fixation of the stent-graft. According to the opinion of the authors of the present article, temporary cross-clamping of the aorta above the endograft is a procedure of choice, since it may ensure better mobilization of the fixed proximal end of the crown during removal of the stent-graft and renders greater flexibility for optimal reconstruction. Direct cross-clamping of the artery through a stent graft in not recommended, since insufficient control may lead to irreparable damage of the zone of renal arteries [14]. In the presented case report, removal of the stents graft was immediately followed by removing the supravisceral clamp to be placed infrarenally, thus making it possible to reduce the duration of renal and visceral ischaemia.

A strategic decision regarding complete or partial explantation of an endograft depends upon the indications for the operation and individual intraoperative situation. Traditionally, late open conversion includes complete removal of the stent graft and replacement of the aorta with a linear or bifurcation graft. It is supposed that complete explantation of the stent graft is the safest for the patient method of surgical intervention preventing possible late complications. Literature describes examples of using methods of partial preservation of the well-built-in components of an endograft, if free form infection. This is conditioned by the fact that after complete removal of the endograft, the arterial wall is sharply thinned, thereby hampering placement of a proximal anastomosis and increasing the likelihood of haemorrhage in this zone [15]. According to the reports of some authors, partial preservation of the endograft's walls leads to improvement of the postoperative results, if after removal of the endograft, its proximal and in some cases distal portions remain intact. Thus, an anastomosis with the inclusion of both the aortic walls and remnants of the endograft is safer and less prone to haemorrhage than an anastomosis of the graft with the destroyed and thinned aortic arc after stent removal. Potential advantages of partial removal of a stent graft include lower risk of an intraoperative lesion of the aorta and iliac arteries, decreased duration of aortic cross-clamping and, accordingly, that of the operation. An exclusion is infection of the stent graft, thus requiring complete explantation thereof [6, 16, 17]. In the case report presented herein above, complete removal of the stent graft was required due to the presence of subrenal thrombosis and high risk of embolism.

CONCLUSIONS

1. The factors influencing safety and success of delayed open intervention after EVAR are as follows: meticulous preoperative individual planning, skill and surgical technique of the operator in using the approach to the aorta, choice of the site of placing the proximal clamp, method of removal (complete/partial) of the stent graft depending on the type of complication.

2. The procedure of removing a stent graft should be entered into the registry of repeat vascular reconstructions, since this intervention is significantly more difficult than the primary operation of aortic aneurysm resection, in spite of the fact that open intervention is carried out for the first time.

3. To follow up the performance of EVAR and TEVAR (thoracic endovascular aortic repair) and complications having developed thereafter, it is necessary to create either a separate or general vascular registry in Russia.

4. In the authors' opinion, in this clinical case

it would have been more appropriate first to perform femorofemoral crossover bypass grafting to be followed by endovascular abdominal aortic repair. This would have made it possible to avoid cross-clamping of femoral arteries and to decrease the risk for thrombosis of the stent-graft zone.

The authors declare no conflict of interest.

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