IMPLANTATION OF SUPERIOR VENA CAVA FILTERS

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ABSTRACT The purpose of this review is to evaluate the results of superior vena cava filters placement in order to prevent pulmonary embolism associated with upper extremities deep vein thrombosis. The central venous catheter, malignancy and lower extremities deep venous thrombosis are main risk factors of upper extremities deep venous thrombosis. The placement of the superior vena cava filter is a safe and effective method for preventing pulmonary embolism in patients with acute upper extremities deep vein thrombosis where therapeutic anticoagulation is contraindicated or appeared to be ineffective.
Keywords: superior vena cava, cava filter
For citation Prozorov S.A. Implantation of superior vena cava filters. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2018; 7(1): 53–56. DOI: 10.23934/2223-9022-2018-7-1-53-56 (In Russian)
Conflict of interest Author declare lack of the conflicts of interests
Acknowledgments The study had no sponsorship

CF – cava filter
DVTUE – deep vein thrombosis of upper extremities
IVC – inferior vena cava
PE – pulmonary embolism
SVC – superior vena cava

Implantation of a cava filter (CF) into the superior vena cava (SVC) is a rare endovascular operation. In, 2010 *C.A. Owens et al.* [1] found only 21 publications reporting installaiton of 209 CF into SVC, most of specialists had only single experience of implantation. *Maimonides Medical Center* in New York has the greatest experience of 154 cases of CF implantation into SVC [2].

Indications for CF implantation. CF is installed into SVC if anticoagulant therapy is contraindicated or ineffective in patients with deep vein thrombosis of upper extremities (DVTUE) [2-4]. DVTUE may be a serious life-threatening condition, cause pulmonary embolism and result in postthrombotic syndrome or venous gangrene of extremities.

DVTUE occurs 14.7 times less than deep vein thrombosis of lower extremities. At the same time, pulmonary embolism (PE) occurs in 25.1% of deep vein thrombosis of lower extremities [1]. Different incidence of PE associated with deep venous thrombosis of upper and lower extremities is explained by a number of factors: another fibrinolytic activity, mechanical forces, and rate of venous blood flow [5].

CF can be installed prior to embolectomy with Fogarty catheter from the central veins [6], or temporarily before surgery [7]. *J.T. Heng et al.* [8] implanted CF to create a barrier in drainage embolization into the coronary sinus.

Risk factors for venous thrombosis: venous catheter or pacemaker in 60% of cases, malignant neoplasms in 37%, deep vein thrombosis of lower extremities in 19%, deep vein thrombosis of lower extremities in history — 3% of patients; more than one risk factor — 38% of patients [9].

A. Hingorani et al. [10] also described another risk factors in acute thrombosis of the internal jugular/subclavian/axillary vein: the presence of a central venous catheter or pacemaker in 60% of cases and cancer in 22% cases. There were 60% of female patients. In 5% of patients, PE was diagnosed .

In patients on hemodialysis, DVTUE in varying degrees of severity was identified in 61.1% of cases [11]; prevalence of thrombosis in the internal jugular, brachiocephalic, subclavian and SVC was 61.1%, 44.4%, 16.7%, 5.6% respectively; the involvement of 1,2,3,4 vessel was -27.3%, 45.4%, 18.2%, 9.1% respectively; 36.4% patients had clinical symptoms.

Patients with central venous catheter or within 14 days after removal of the catheter are at risk and the most frequent localtion of thrombosis is internal jugular vein [12].

The increase in the number of DVTUE occurs due to the increased use of venous catheters. Secondary thrombosis was catheter-related in 60% of cases and in 53% of all cases of thrombosis. PE rate was 6% in primary thromboses, 13% in the secondary thrombosis and 17% in catheter associated thrombosis. The risk of PE with catheter-related deep vein thrombosis in relation to other cases of thrombosis was 3.4 [5] .

Mortality in patients with DVTUE. The mortality within 1, 3, 12 months was 13%, 31% and 40%, respectively, in the group of patients with subclavian and/or axillary vein thrombosis; 14%, 33%, 42% respectively in patients with thrombosis of internal jugular vein; 23% , 44%, 59%, respectively, in the group of patients with thrombosis of the subclavian/axillary and internal jugular vein [9]. Mortality within 2 months in patients with DVTUE reached 29.6% [10].

The diagnosis of DVTUE is based primarily on the results of ultrasound methods. It is possible to use computed tomography with contrast enhancement.

Methods of implantation. Although CF is mainly implanted into SVC by endovascular methods, the case of implantation under ultrasound guidance without a contrast agent is described [13] and also intraoperatively [14].

A cava filter is placed into SVC so that its legs were immediately after the site of the confluence of the brachiocephalic veins, and the top of the CF was located in the distal section of SVC.

In rare cases pulmonary embolism risk, when anticoagulant therapy is contraindicated, CFs are simultaneouslyplaced into the superior and inferior vena cava (IVC). *R. F. Sing et al.* [15] implanted 855 CF to 853 patients, of which 12 were installed in the suprarenal IVC and 4 into SVC. In 2 patients, cava filters were placed simultaneously into the SVC and IVC.

Challenges may occur during the placement of CF. *F. Usof et al*. [2] implanted 154 CF, but in 7 patients, implantation failed because of the extension of venous thrombosis.

In most cases, interventional radiologists place CF. General surgeons perform it rarely, it depends on the particular institution [15].

Results of CF implantation into SVC. *Z. Liang et al*. [16] investigated the role of implantation of CF in the prevention of fatal PE in patients with symptomatic thrombosis of the main SVC branches . The study included 40 patients, taking into account the severity of symptoms, cases of PE. Patients were observed for 3 years. One week after CF implantation, the severity of the symptoms was assessed and there was no significant difference between the groups. In the group without CF 4 patients died from PE. The were no cases of PE among patients with CF. The survival rate of patients within 1,2,3 years after implantation of CF (72.9%, 50%, 27.1%, respectively) was higher than in the control group without CF (47.6%, 19%, 14.3%). The life expectancy of patients with bronchogenic lung cancer and implanted CF (18±2 months) was longer than in patients with the same diagnosis without CF (12±2 months).

In the treatment of patients with venous complications of malignant neoplasms, the combination of methods is performed: CF implantation, direct catheter thrombolysis, recanalization, balloon angioplasty and stents. *L. Xiao et al*. [17] implanted cava filters *OptEase* (*Cordis*, USA) and *Günther Tulip* (*Cook*, Denmark) in 18 patients with thrombosis into SVC or IVC and administered urokinase at a dose of 7.42±1.49 (4.5x10) million units. Symptoms of thrombosis completely disappeared in 15 patients and partially disappeared in 3 patients. The clots were completely lysed in 2 cases, almost completely in 8 patients, partially in 6 patients; thrombosis remained unchanged in 2 cases. There were no cases of PE in these patients.

It is advisable to use temporal removable CFs, which can be retreived when becoming unnecessary [18, 19]. *S. Watanabe et al*. [20] implanted CF into SVC in a patient with DVTUE and PE, and then it was removed after thrombectomy; authors believe that use of removable CFs it is especially indicated in young patients with DVT when the prevention of PE may be temporal. When traditional techniqus fail, or there are some technical difficulties, rigid bronchoscopic forceps may be used [21].

According to the authors, implantation of CF into SVC rarely has complications. *L.D. Spence et al.* [22] placed 4 types of CF in 41 patients and there were not any complications during implantation and in the nearest post surgery period. *S. M. Hussain et al.* [23] described cardiac tamponade after implantation of CF *TrapEase*, which required the rapid evacuation of blood from the pericardium. The were also cases of erosion of CF elements in the aorta [24, 25]. Serious filter - associated complications [1] occurred in 3.8% of cases (209 cases): 4 cases of cardiac tamponade, 2 aortic perforations, 1 pneumothorax.

Of all 154 cases of CF implantation there were 3 cardiac tamponades (1.9%), 1 case of CF placement into the brachiocephalic vei instead of SVC. All cases of SVC perforation occurred in male patients over 60 [23, 24]. When monitoring survived patients from 1 to 3750 days, no cases of pulmonary embolism, occlusion of SVC, pneumothorax, migration of CF were noted.

The mortality after implantation of CF is associated with the underlying disease. CF is implanted into SVC in patients in a serious condition: the lethality after CF in hospital or within a month after implantation was 43.1% [1]. *F. Usoh et al*. [2] installed CF in 154 patients (*TrapEase* 38, *Greenfield* 116), 58 of them lived more than 60 days (628.4 days on the average), 114 patients (74%) died due to chronic processes or complications of malignant neoplasms.

CONCLUSION

Deep vein thrombosis of upper extremities develops in severe patients. Risk factors for thrombosis are the presence of a central venous catheter, cancer, deep vein thrombosis of lower extremities. In patients with deep vein thrombosis thrombosis and risk of PE, the cava filter is implanted into the superior vena cava, which is an effective method of preventing pulmonary embolism. The level of implantation complications is relatively low.

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Received on 22.06.2017
Accepted on 14.08.2017