Chirurgia (2010) 105: 361-364
Nr. 3, Mai - Iunie

Extraluminal venous interruption for free-floating thrombus in the deep veins of lower limbs

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Rezumat

Întreruperea venoasă extraluminală în tromboza flotantă a venelor profunde ale membrelor inferioare

Tromboza flotantă (TF) reprezintă o formă particulară a trombozei venelor profunde cu un potențial de embolizare pulmonară fatală extrem de elevat. Scopul studiului a constat în evaluarea rezultatelor precoce ale abordului chirurgical agresiv al TF. Pe parcursul anilor 2005-2008 TF a fost diagnosticată la 13 pacienți. Caracteristica demografică a bolnavilor: vârsta (media) – 54.7 ani, bărbați – 76.9%, comorbidități semnificative – 5 (38.5%) pacienți. Localizarea TF: vena femurală superficială (VFS) – 5 (38.5%), vena femurală comună (VFC) – 4 (30.7%), vena iliacă externă (VIE) – 2 (15.4%), vena cavă inferioară (VCI) – 2 (15.4%). Manifestările embolismului pulmonar au fost documentate preoperator în 3 (23.1%) cazuri. S-au efectuat următoarele intervenții chirurgicale de urgență: ligaturarea – 3 (23.1%) sau plicația VFS – 2 (15.4%); plicația VFC – 5 (38.5%) pacienți, combinată în 4 cazuri cu trombectomia parțială (partea flotantă a trombului); plicația venei iliace comune – 1 (7.6%); plicația VCI – 2 (15.4%) cazuri. În perioada postoperatorie precoce cazuri de embolism pulmonar primar sau recurent, clinic semnificativ, nu au fost detectate. Experiența tratamentului chirurgical al bolnavilor cu TF relevă rolul important al ligaturării/plicației venelor profunde în prevenirea embolismului pulmonar fatal.

Cuvinte cheie: tromboza venelor profunde, tromboza flotantă, tratament chirurgical, întreruperea venoasă

Abstract

The free-floating thrombus (FFT) represents a particular form of deep vein thrombosis with extremely high potential of fatal pulmonary embolism. The purpose of the study was to evaluate the early results of aggressive surgical approach to FFT. During the period 2005-2008 years FFT was diagnosed in 13 patients. Demographic characteristics of patients: medium age – 54.7 years, male – 76.9%, significant comorbidity – 5 (38.5%) cases. Localization of FFT: superficial femoral vein (SFV) – 5 (38.5%), common femoral vein (CFV) – 4 (30.7%), external iliac vein (EIV) – 2 (15.4%), inferior cava vein (ICV) – 2 (15.4%). Manifestations of previous pulmonary embolism were documented preoperatively in 3 (23.1%) cases. The following emergency surgical procedures were performed: ligation – 3 (23.1%) or plication – 2 (15.4%) of SFV; plication of CFV – 5 (38.5%) patients, combined in 4 cases with partial thrombectomy (free-floating part of thrombus); plication of common iliac vein – 1 (7.6%); plication of ICV – 2 (15.4%) cases. Primary or recurrent cases of clinically significant pulmonary embolism were no detected in the postoperative period. The accumulated experience of surgical management of patients with FFT reveals the important role of deep vein ligation/plication in prevention of fatal pulmonary embolism.

Key words: deep vein thrombosis, free-floating thrombus, surgical treatment, venous interruption

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Introduction

The overall incidence of pulmonary embolus is estimated in about 139 per 100.000, or 347.000 per year – according to clinical data, and about 235.000 deaths per year – according to autopsy results (1). Deep vein thrombosis of lower limbs is the most important cause of pulmonary artery embolism. The free-floating thrombus (FFT) represents a particular form of deep vein thrombosis with extremely high potential of fatal pulmonary embolism. The FFT is referred to as a continuous oscillating movement (flotation) of the proximal end of the thrombotic masses in the stream of venous blood. Typically, formation of FFT have place in the region of major venous confluences – superficial-deep femoral, saphenofemoral, external-internal iliac, ilio-caval due to propagation of thrombus into the vein with largest caliber and with maintained venous flow. Above mentioned peculiarities of FFT are responsible for its instability and major risk of migration into pulmonary artery.

The purpose of the study was to evaluate the early results of aggressive surgical approach to FFT for prevention of the fatal pulmonary embolism.

Material and Methods

During the 2005-2008 years the FFT was diagnosed by means of duplex ultrasound in 13 patients with deep vein thrombosis of lower limbs. The patients included in the study ranged in age from 22 to 79 years (mean, 54.7 years). The group was composed of 10 (76.9%) men and 3 (23.1%) women. The significant comorbidity was present in 5 (41.6%) patients. Clinical manifestation of previous nonfatal pulmonary embolism (dyspnea, pleural pain, apprehension, cough, hemoptysis, syncope) and positive chest radiographic findings (pulmonary infarction) were documented preoperatively in 3 (23.1%) cases.

Duplex venous scanning was performed with Siemens SonoLine G60S ultrasound equipment, using a 5- to 7.5-MHz probe. Inferior cava vein (ICV), common, internal and external iliac veins (EIV), common femoral vein (CFV), superficial femoral vein (SFV), popliteal vein, tibial and peroneal veins were routinely examined. The standard findings of incompressibility of deep veins and absent or diminished Doppler signals were analyzed as well as signs of thrombus flotation. Positive diagnosis of FFT was made if continuous oscillating movements of the proximal end of the thrombotic masses were found, regardless of diameter, length and ultrasound characteristics of the thrombus. The following variants of anatomical localization of FFT were found according to results of duplex ultrasound: SFV – 5 (38.5%), CFV *(Fig. 1)* – 4 (30.7%), EIV – 2 (15.4%), ICV *(Fig. 2)* – 2 (15.4%) patients.

Presence of FFT in the deep veins of lower limbs was always considered as an indication for emergency surgical treatment for prevention of fatal pulmonary embolism. Fixed doses low-molecular-weight heparins, adjusted to body weight, were administered subcutaneously and elastic bandage was applied early in all cases.

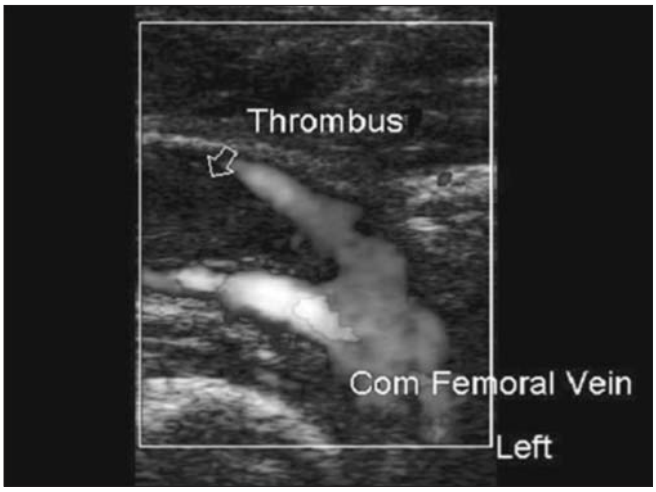

Figure 1. *Free-floating thrombus in the common femoral vein on duplex ultrasound examination*

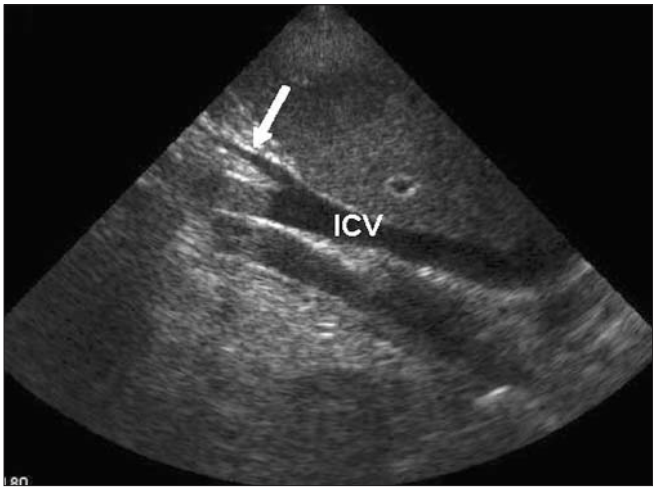

Figure 2. *Free-floating thrombus (↓) in the inferior cava vein (ICV) on duplex ultrasound examination (B-mode)*

Results

The following emergency surgical procedures were performed in the study group: ligation – 3 (23.1%) or plication – 2 (15.4%) of SFV close to the confluence with patent deep femoral vein *(Fig. 3)*; plication of CFV – 5 (38.5%) patients, combined in 4 cases with partial trombectomy (free-floating part of thrombus); plication of common iliac vein – 1 (7.6%); plication of ICV *(Fig. 4)* – 2 (15.4%) cases.

Plication or ligature of femoral veins was performed through standard access in the groin under local infiltrative or spinal anesthesia. If FFT was localized in the proximal part of CFV, protruding under inguinal ligament, the limited thrombectomy, with removing of free-floating part of the thrombus, was carried out. This procedure allows subsequent plication of CFV instead of more proximal venous interruption (EIV, ICV). The Rob's extraperitoneal access for plication of iliac vein and transperi-

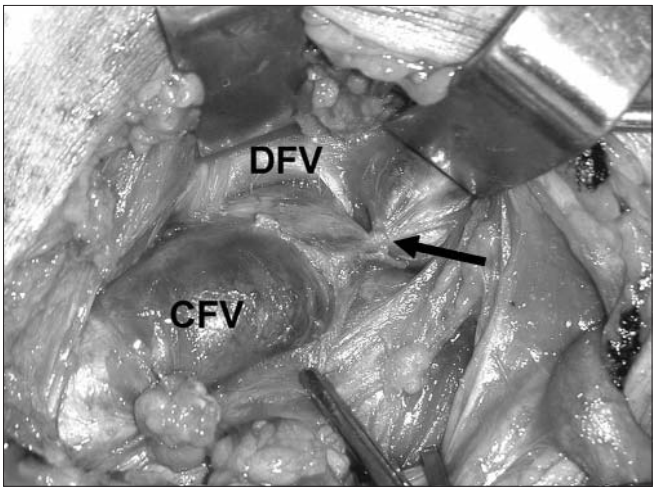

Figure 3. *Ligation (↓) of the superficial femoral vein distally to the confluence of patent deep femoral (DFV) and common femoral (CFV) veins*

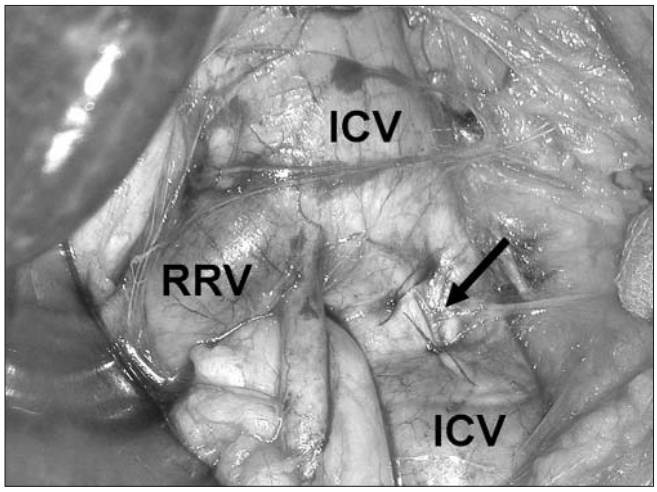

Figure 4. *Suture plication (↓) of inferior cava vein (ICV), modified Spencer procedure (RRV – right renal vein)*

toneal access through median xifoombilcal laparotomy for plication of ICV either were performed under general anesthesia.

Primary or recurrent cases of clinically significant pulmonary embolism were no detected in the postoperative period. Two patients (15.4%) died during the hospitalization: in one case due to acute transmural miocardic infarction caused by severe coronary arteries disease, and as a result of progressive pulmonary hypertension caused by preoperative embolism in another.

Discussion

The patients with FFT in the deep veins of lower limbs represent the group with major risk of pulmonary embolism due to instability of thrombus, which is not firmly attached to venous wall and situated in the continuous flow of venous blood. Norris et al. (2) retrospectively evaluated the risk of pulmonary embolism in hospitalized patients with venographically proved iliofemoral deep vein thrombosis. Venograms and clinical records of 78 patients were reviewed and the proximal intraluminal thrombus was characterized as free-floating (greater than 5-cm nonadherent segment) or occlusive (no free-floating elements). The incidence of pulmonary embolism confirmed by high-probability radioisotope ventilation-perfusion lung scanning within ten days following venography was 9% (7/78) and was associated with 60% (3/5) free-floating and 5.5% (4/73) occlusive phlebographic criteria. Therefore, in comparison with occlusive and parietal forms of deep vein thrombosis, FFT serves as a major positive prognostic criterion for subsequent pulmonary embolism.

Curative approach to the patients with FFT is not standardized yet and varies from conservative to surgical methods. This fact may be partially explained by variable definition of FFT, absence of strong criteria for prediction of thrombus detachment and pulmonary embolism, as well as by ethical and methodological difficulties in conducting of randomized trials.

Anticoagulation is standard treatment protocol widely accepted in case of deep vein thrombosis of lower limbs. However, in the patients with FFT anticoagulation alone can not prevent the detachment of free-floating part of the thrombus from the fixation point and development of pulmonary embolism. We suppose that conservative treatment in patients with FFT and reservation of more aggressive management for cases complicated with primary or recurrent pulmonary embolism only, represents a doubtful and even life-threatening approach. Absence of evidence based methods for prediction of fatal embolic events in patients with FFT serves as an argument for utilization of invasive treatment, even in spite of elevated periprocedural mortality. From our point of view, such additional characteristics of FFT as dimensions, floating part/base of thrombus diameter ratio, amplitude of oscillating movement and structure (hypoechoic/hyperechoic, homogeneous/inhomogeneous) requires further comprehensive investigation, and hypothetically may determine the real risk of embolism and precise indications for surgery.

Vena cava filtration is standard treatment for patients with thromboembolic disease, who are unable to receive anticoagulants or are at such risk from pulmonary embolism that additional protection is required (3). Unfortunately, modern endovascular surgical suites, required for implantation of cava filter, still not organized in many emergency medical services. As an alternative, the implantation of cava filter under duplex ultrasound guidance was proposed, although such approach requires high experience of operator and availability of endovascular equipment, portable duplex ultrasound machine and filters itself (4).

Surgical procedures which can serves as an alternative to implantation of endoluminal venous devices were proposed in the second half of XX century, and starts with ligation of ICV. Significant morbidity associated with ligation of ICV results in consequent development of techniques directed to

partial occlusion of the major veins by means of suture plication – Spencer, De Weese, stapling – Ravitch or application of serrated clips – Miles (5). Actually, vein ligation is reserved for FFT localized in the superficial femoral vein with confirmed patency of deep femoral vein. In the study of Louagie et al., ligation of the SFV was performed in 93 limbs and associated with hospital mortality rate 1.4% and 3 year survival, considering only PE related deaths – 95.3 ± 2.7% (6). In our study we use the suture plication of deep veins in all cases of localization of FFT proximally to superficial/deep femoral venous confluence with aim to prevent severe disturbances of blood outflow. Plication of SFV was performed in selected cases with uncertain data regarding patency of deep femoral vein. In case of suture plication of the ICV we slightly modified original Spencer's technique, carrying out the grid formation without circumferential mobilization of the vein. This modification prevents occasional damage of lumbar veins and allows easier and faster performing of surgical intervention. Although, surgical venous interruption is generally more invasive then endovascular techniques, this approach provides the effective protection against primary and recurrent pulmonary embolism in patients with FFT and can be performed as an emergency procedure in general surgical department.

The attractive method of treatment of FFT represents complete removing of thrombotic masses from deep veins with Fogarty's balloon catheter – "thrombus removing strategy". This procedure is potentially associated with prevention of severe postthrmbotic disease but not only with decreased risk of pulmonary embolism. From another hand, "ideal" surgical thrombectomy, combined, according to contemporary guidelines, with creation of temporary arteriovenous fistula, is a more complex and prolonged surgical intervention which should be reserved for young patients without significant comorbidities (7).

Conclusions

Our initial experience of surgical management of patients with FFT reveals the positive impact of deep vein ligation /plication upon prevention of fatal pulmonary embolism, especially in condition of unavailability of intraluminal techniques of venous interruption (cava filter implantation). Creation of an anatomic barrier on the way of venous embolus, in the patients with high probability of pulmonary embolism, seems to be more reasonable, than an uncontrollable "anticoagulate and wait" approach.

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