Upper extremity deep vein thrombosis and pulmonary embolism after coronary bypass surgery: a case report and preliminary results from a prospective study evaluating patients during cardiac rehabilitation

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A 78-year-old woman with unstable angina underwent coronary bypass surgery with complete cardiac revascularization and no immediate postoperative complications. Six days after surgery, during hospitalization for cardiac rehabilitation, the patient developed severe respiratory distress and pulmonary embolism was diagnosed. Color duplex ultrasound revealed the presence of concomitant upper extremity deep vein thrombosis (UEDVT), ipsilateral to the site of placement of a central venous line, in the absence of lower extremity deep vein thrombosis. We describe this case and provide preliminary data from a prospective observational study evaluating the prevalence of catheter-related UEDVT and symptomatic pulmonary embolism (55 and 1.4% respectively) in a series of 71 consecutive coronary bypass surgery patients admitted to a cardiac rehabilitation facility.

Catheter-related UEDVT and pulmonary embolism may complicate coronary bypass surgery and should be taken into consideration when managing patients after surgery.

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Case report

A 78-year-old woman with a medical history including hypertension and unstable angina underwent elective coronary artery bypass graft (CABG) and was discharged 6 days after the procedure. Before surgery, the carotid arteries were studied by means of ultrasound which was not suggestive of concomitant alterations of the neck veins. Coronary surgery resulted in a complete cardiac revascularization. No intraoperative complications, such as myocardial infarction, hemodynamic instability or prolonged anesthesia, occurred. A central venous line was placed with access from the left jugular vein to ensure the perioperative infusion of medications, and was removed the day before discharge from the surgery unit. During the postoperative stay in the surgery unit, no major complication occurred. After discharge, the patient was immediately transferred to the Division of Cardiology of Pavia for cardiac rehabilitation.

At the time of admission to our facility, the patient was still bedridden and presented with left-sided neck discomfort and severe dyspnea. Color duplex ultrasonography revealed thrombosis of the left jugular vein that extended proximally to the ipsilateral subclavian, axillary and brachiocephalic veins (Fig. 1). An increased circulating D-dimer level, up to 1014 mg/ml, was observed. Ventilation/perfusion scanning revealed several mismatched perfusion abnormalities affecting both lungs and was considered highly suggestive of the presence of pulmonary embolism (Fig. 2). Echocardiography excluded the presence of right atrial thrombosis, right ventricular dysfunction, and elevated pulmonary pressures. A venous ultrasound of the lower limbs was normal.

A final diagnosis of post-CABG catheter-related upper extremity deep vein thrombosis (UEDVT) complicated by pulmonary embolism was established. We do not routinely perform extensive laboratory evaluation for hypercoagulable states with the exception of testing for homocysteine and antithrombin III levels, which were both negative. It was also unknown whether the patient had received heparin prophylaxis after surgery.

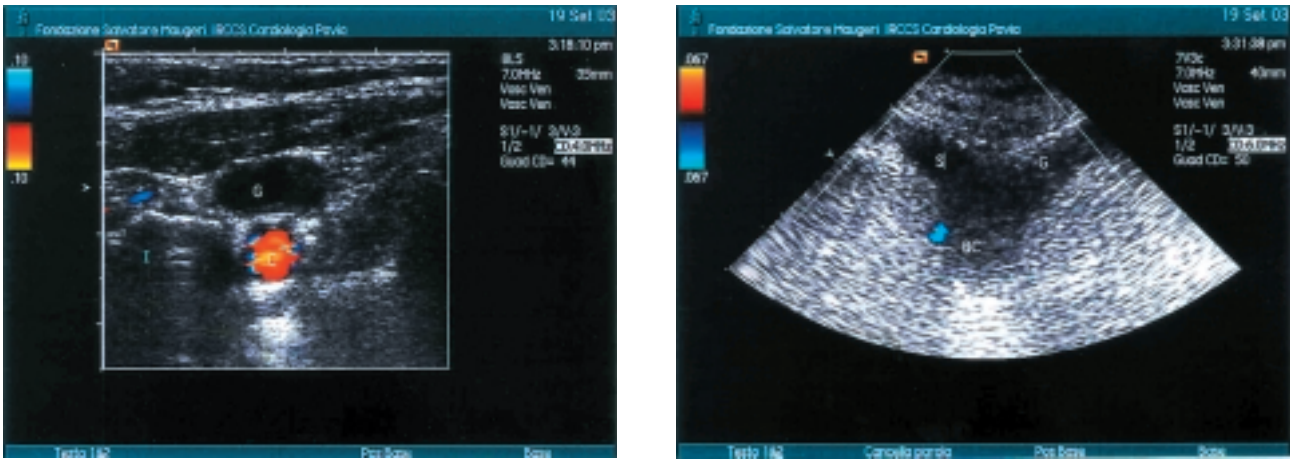

Figure 1. *Neck ultrasound testing demonstrating left jugular (G), subclavian (S), and brachiocephalic (BC) vein thrombosis. There is a lack of full compressibility without the intraluminal color Doppler signal* (left panel)*. Because the BC vein* (right panel) *cannot be tested for compressibility due to the presence of the clavicle, the only pathologic finding is no flow. C = carotid artery.*

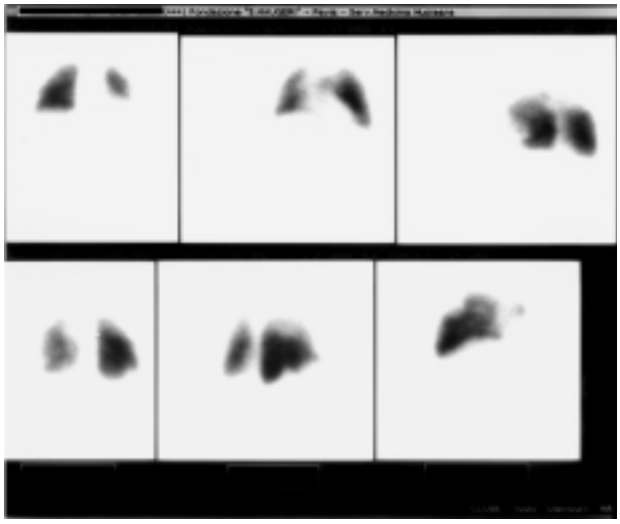

Figure 2. *Pulmonary scan showing a subsegmentary perfusion defect of the left lung and a loss of perfusion to the dorsal segment of the right upper lobe.*

Warfarin (with enoxaparin as a "bridge") was immediately started at a dose sufficient to maintain the INR between 2.0 and 3.0. During treatment, the respiratory symptoms rapidly ameliorated and the patient did not experience major hemorrhage or thrombocytopenia. Serial ultrasonographic testing showed progressive resolution of the UEDVT. After 3 months of anticoagulation, the patient was asymptomatic and no active cancer was newly detected.

Discussion

UEDVT, most commonly referred to thrombosis of the jugular, axillary, subclavian and/or brachiocephalic veins, has historically accounted for only 1-2% of deep venous thrombi[1]. However, largely owing to the wider use of central venous catheters, the incidence of secondary UEDVT is now substantially increasing, while primary thrombosis, either referred to effort thrombosis (the "Paget-Shroetter syndrome") or idiopathic UEDVT, still remains a rare disorder. Catheter-related thrombosis now accounts for up to 60% of UEDVT cases[2,3]. Accordingly, since the widespread adoption of central venous lines for surgery, chemotherapy, parenteral nutrition, and dialysis, the patient population has shifted toward older patients with severe underlying comorbidities.

Patients who undergo CABG are theoretically likely to develop catheter-related UEDVT, but unfortunately only a few studies on these patient populations have been published. The use of central venous instrumentation (sometimes required in the emergency setting) may *per se* predispose to UEDVT, as this procedure is often associated with iatrogenic damage to the vessel wall or local stasis. Secondly, several CABG-related conditions, such as cardiac catheterization and immobilization, have been proven to be significant risk factors for postoperative venous thromboembolism[4]. Thirdly, CABG has been reported to induce the release of platelet factor 4 and consequently increase the risk of heparin-induced type II thrombocytopenia and thrombus formation[5]. Therefore, the pathophysiologic factors conceptualized as early as 1860 by Virchow (the triad of stasis, vein wall damage, and hypercoagulability) as predisposing to venous thromboembolism could all be applied even to CABG patients.

Considering a generic population of 81 cardiac surgery patients, Wu et al.[6] reported, despite prophylactic anticoagulation, a rate of postoperative jugular vein thrombosis of 56% as a consequence of short-term venous catheterization.

We used ultrasonography to detect catheter-related UEDVT in all consecutive patients admitted to the Division of Cardiology of Tradate (Italy) for cardiac re-

habilitation after CABG from April through August 2002. This ultrasonographic screening was part of a preliminary study aimed at evaluating the feasibility of a controlled trial comparing different treatment strategies for postoperative UEDVT during cardiac rehabilitation. The characteristics of our study group, discharged from 24 surgery units are summarized in table I. Globally, 39 out of 71 patients (55%) were diagnosed as having catheter-related UEDVT, complicated in 1 case (1.4%) by symptomatic pulmonary embolism. The rate of UEDVT in our CABG population was surprisingly high and does not seem to be justified by the underlying conditions, nor could it be attributed to a trigger other than catheter placement. On the other hand, in our CABG group the rate of pulmonary embolism was lower than that reported in studies evaluating patients with other causes of catheter-related UEDVT[7]. Apart from the different patient population, this reduction in the rate of pulmonary embolism could be explained on the basis of the early detection of UEDVT, as confirmed by the low frequency of thrombosis dissemination below the clavicle. A limit of our study was the lack of information about the catheter size/material and about the adoption of heparin prophylaxis against venous thromboembolism after surgery. It is reasonable to presume that about 60% of our patients received postoperative heparin, as reported in a quite recent study specifically designed to address this point at our institution and based on the same network of surgery units[8].

Clinically, the presence of local pain, arm edema, supraclavicular fullness, and dilated cutaneous veins is generally ominous for UEDVT. In our series, a relevant percentage (70%) of patients was asymptomatic and this may be the reason why the diagnosis was missed in the surgery unit.

Ultrasonography has a high sensitivity and specificity for jugular, proximal subclavian and axillary thrombi but it is less accurate in detecting distal subclavian and brachiocephalic venous thrombosis. When a more complete evaluation of the superior vena cava and brachiocephalic veins is necessary, then magnetic resonance angiography and contrast venography provide more detailed information.

The treatment of UEDVT is not as well standardized as that of lower extremity deep vein thrombosis. Conventional anticoagulation, with a minimum duration of 3 months and an INR range of 2.0 to 3.0, should always be considered[9]. It remains controversial whether small thrombi confined to the jugular vein, without distal progression at repeated testing and evidence of permanent risk factors for venous thromboembolism, could be managed by means of short-term antithrombotic therapy or even by ultrasonographic surveillance alone. At the other end of the spectrum are persistently symptomatic patients in whom anticoagulation failed to resolve clots and a more aggressive multidisciplinary approach (including thrombolytic therapy, surgery, and balloon angioplasty) may be necessary. However, it seems that there is only a small role for aggressive treatment in patients with secondary UEDVT because chronic symptoms are not common[10] and, specifically in CABG patients, the risk of bleeding after cardiac surgery could exceed the benefit of treatment.

In conclusion, catheter-related UEDVT may complicate CABG surgery and, when managing postoperative patients, should be taken into consideration even during cardiac rehabilitation. Ultrasound screening could be helpful for the early detection of this postoperative complication and for the prevention of thrombus dissemination. Further research is needed to clarify the proper management of UEDVT after CABG, since the circumstance of recent major surgery could increase the hemorrhagic risk of anticoagulation or *a priori* exclude more aggressive therapies.

Table I. Characteristics of 71 coronary artery bypass graft (CABG) patients at the time of admission to the cardiac rehabilitation facility and detection of catheter-related venous thromboembolism (VTE).

Age (years)	66 ± 9
Male sex	53 (75%)
Time since CABG (days)	10 ± 4
Indwelling CVC	0
Duration of CVC insertion after surgery (days)	5 ± 2
Active cancer	0
Known thoracic outlet obstruction	0
Known hypercoagulable state	0
Personal history of previous VTE	1 (1%)
UEDVT cases	39 (55%)
Thrombus confined to jugular vein	32 (82%)
Thrombus extension into the subclavian or brachiocephalic vein	7 (18%)
Floating thrombosis	6 (15%)
Symptoms of UEDVT	12 (30%)
Concomitant lower extremity DVT	0
Symptomatic PE	1 (1.4%)

CVC = central venous catheter; DVT = deep vein thrombosis; PE = pulmonary embolism; UEDVT = upper extremity deep vein thrombosis.

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