J Orthopaed Traumatol (2002) 2:99–103

ORIGINAL

L. Molfetta
A. Palermo
G. De Caro
F. Pipino

Temporary vena cava filters in the prevention of pulmonary embolism during total hip arthroplasty

Received: 5 November 2001
Accepted: 30 November 2001

L. Molfetta (✉) • A. Palermo • F. Pipino
Department of Motor and Rehabilitative Sciences,
Orthopedics Clinic,
University of Genoa,
Largo R. Benzi 10, I-16032 Genoa, Italy
Tel.: +39-010-5553918
Fax: +39-010-3538678
E-mail: lmolfetta@libero.it

G. De Caro
Institute of Radiology,
University of Genoa,
Genoa, Italy

Abstract Thromboembolism constitutes one of the most dangerous complications during the immediate postoperative period of prosthetic surgery. Pharmacological prophylaxis and mechanical vascular compression are not always sufficient to protect from this surgical complication. In patients at greatest risk for thromboembolism, often with a positive history for pulmonary embolism, temporary vena cava filters may be used to reduce the incidence of vascular and pulmonary complications. However useful, these filters cannot be routinely used in orthopedic surgery. We present our results with the use of Filcard RFO2 vena cava filters in an open, randomized study of 30 patients.

Key words Vena cava filters • Deep vein thrombosis • Pulmonary embolism • Hip arthroplasty

Introduction

Deep vein thrombosis (DVT) and pulmonary embolism (PE) represent serious complications of orthopedic surgery. The risk for these complications is greatest during surgery of the inferior limb, in particular of the hip and knee. The frequency of thromboembolic disease is difficult to specify, because its diagnosis is difficult on the basis of clinical data alone; as much as 70% of DVT and 20% of PE are asymptomatic, but these events are fatal in 1.0%–3.5% of cases [1–4].

In 1952, Stulz and Froelich [5] recommended systematic prophylaxis for thromboembolic complications in all traumatized patients. In 1959, Sevitt and Gallagher [6] underlined the prevention of these pathologies. In 1986, the NIH Consensus Conference [7], the first of its kind, recommended pharmacological prophylaxis with heparin, warfarin and dextran, according to the characteristics of the patient. Nevertheless, prophylaxis does not eliminate the risk of thromboembolism [4, 8–11]. Therefore it is necessary to identify patients at risk before operation, and to suspect its onset at the first symptoms.

When the risk of PE is high, in addition to pharmacological prophylaxis, vena cava filters may be used. The filters are inserted into the vena cava and arrest the migration of thrombi from the lower limbs. These mechanical systems for the prevention of pulmonary embolism were introduced in the 1970s [12]. By now, the clinical applications for vena cava filters are well defined, and they are indicated for use only in patients with: complete contraindications to the use of anticoagulants, recurrent PE despite the use of anticoagulants, previous massive PE, previous pulmonary embolectomy, previous ileal-caval thrombectomy and previous DVT with migrating thrombi.

We present the results of an open, randomized investigation into the use of Filcard RFO2 temporary vena cava filters in patients undergoing total hip arthroplasty. We evaluated the clinical efficacy and problems associated with the use of this filter in a homogeneous group of 30 patients.

Patients and methods

Patients

At the Orthopedics Clinic of the University of Genoa, we conducted an open, randomized clinical trial involving 30 patients undergoing total hip arthroplasty for coxarthrosis. Eligible patients were 65 years of age or older, and had medium to severe venous insufficiency of the lower limbs.

Vena cava filter

We used the teflon and gold Filcard RFO2 vena cava filter (Filcard International, Lille, France). The filter contains a distal basket of 30-mm diameter that catches thrombi in the vena cava. The filter allows the administration of fibrinolytic therapy and the performance of venocavography (Fig. 1).

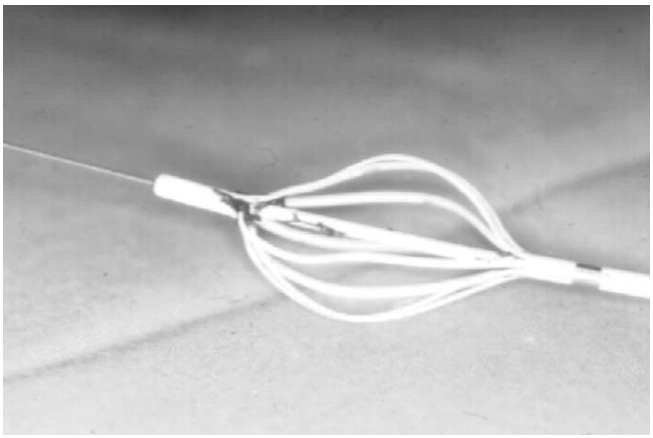

Fig. 1 Filcard RFO2 vena cava filter after removal. The basket contains thrombus-like material

Surgical procedure

Surgery was performed by the same surgeon (F.P.) who used, in all patients, an identical technique; similarly, the pre- and post-surgical protocols were the same for all patients. Two hours prior to operation, all patients received anti-thromboembolic prophylaxis consisting of calcium heparin or low-molecular-weight heparin. In addition, patients received mechanical prophylaxis consisting of compressive vascular bandaging of the lower limbs during and after the operation for two months.

The patients were randomly divided into two groups of 15 persons. In group A, the vena cava filter was employed during hip arthroplasty; group B served as a negative control and received no filter. The vena cava filter was introduced one hour before surgery, by percutaneous route and followed under radiographic control. In 5 patients, the filter was inserted through the cephalic vein. However, because of a few instances of filter migration, it was inserted in the remaining 10 patients through the femoral vein of the contralateral limb. This approach improved the placement of the filter tail with subsequent better stability of the basket within the vena cava. The filter's position was monitored daily using standard radiography of the abdomen. Additionally, we performed venocavography every 48 h through the actual filter to identify the eventual presence of thrombi within the basket, to monitor the flow of blood within the vein, and to check the position of the filter.

Patients received either general anesthesia (11 cases) or spinal anesthesia (19 cases). During anesthesia, the patients were maintained in controlled hypotension. We used the cemented total hip prosthesis LC (Samo, Bologna, Italy) in 14 patients and the noncemented prosthesis Antega (Aesculap, Tüttlingen, Germany) in 16 patients. Arthroplasty was performed using the lateral approach with the patients in lateral decubitus position. Access to the joint was through the musculi gluteus minimus and medius, the femoral head was in anterior luxation, and the limb dangled from the surgical bed in abduction and maximal external rotation.

Postoperative protocol

Patients were assisted in mobilizing the operated limb starting on the first postoperative day. Suction drains were removed from the surgical wound on day 3, and elastic stockings for vascular support were applied. Active mobilization was permitted on day 4. On the sixth postoperative day, after removal of the vena cava filter, the patients began weight-bearing and ambulation assisted with a walker. All patients underwent pulmonary perfusional scintigraphy on the seventh day following operation.

Results

The two groups of patients were similar in terms of postoperative outcome, time to weight-bearing, and subjective satisfaction. A total of 5 patients, all of whom received the vena cava filter, had a history of post-surgical PE. The operation lasted 45–65 min (mean, 50 min in Group A and 55 min in Group B) (Table 1).

On venocavography, the vena cava filter was found to be filled with thrombus-like material in 3 patients (Fig. 2). To prevent hemorraghic suffusion and lower limb edema, we chose to substitute the Filcard filter with another filter of the same characteristics (Angiocor, Cordis, J&J). This choice was motivated by the availability of the second filter type. Fibrinolysis was performed in only 1 of these 3 cases.

There was one case of DVT in group A, in an 83-year-old woman who had received a cemented prosthesis under general anesthesia. On the second postoperative day, after venocavography, we performed fibrinolysis of the material in the basket using urokinase (4000 IU/kg body weight). This resulted in increased bleeding with hemorrhagic suffusion and lower limb edema. On the fourth day, DVT was documented clinically and on Doppler ultrasonography. After

Table 1 Characteristics of the 30 patients who underwent total hip arthroplasty, by surgical group. Values are number (percent) of patients unless otherwise specified

	Group A (n=15)	Group B (n=15)
Age, years[a]	71 (66–83)	70 (65–78)
Men	8 (53)	8 (53)
Previous post-surgical PE	4 (26)	1 (6)
Prosthesis		
Non-cemented	7 (47)	7 (47)
Cemented	8 (53)	8 (53)
Anesthesia		
General	6	5
Spinal	9	10

[a] Values are median (range)

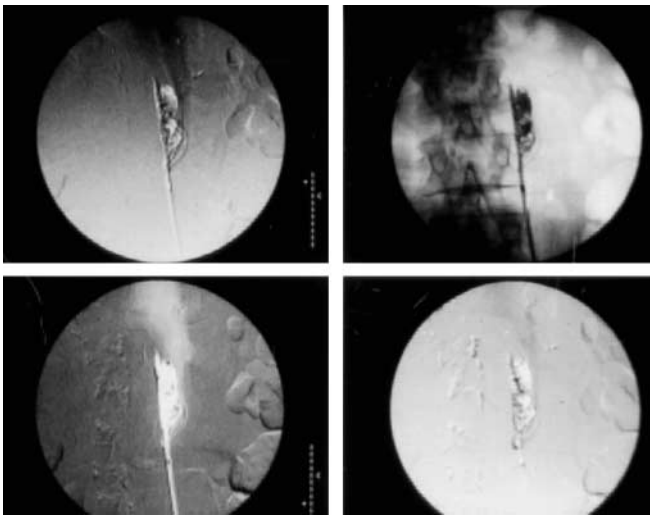

Fig. 2 Venocavogram show the incorrect width of the vena cava filter basket, with thrombus-like material

intravenous administration of heparin, there was complete recovery. The vena cava filter was removed on the fifth postoperative day.

As documented by pulmonary scintigraphy, there was no occurrence of PE in group A, but two occurrences in group B (control). In a 65-year-old woman who had received a non-cemented prosthesis under general anesthesia, PE occurred on day 6 in the basal lobe of the right lung. This patient did not have a history of post-surgical PE. The second case occurred in a 75-year-old woman with liver cirrhosis. She had experienced PE after abdominal surgery 2 years earlier. Five days after receiving a cemented prosthesis under spinal anesthesia, she experienced DVT with lower limb lymphangitis and subsequent PE. After intravenous

Table 2 Patient outcome, by surgical group. Values are number (percent) of patients unless otherwise specified

	Group A (n=15)	Group B (n=15)
Operation length, min[a]	50	55
Adverse events		
Thrombi in filter	3 (20)	NA
Pulmonary embolism	0 (0)	2 (13)
Deep vein thrombosis	1 (7)	1 (7)
Complications of filter use		
Phlebitis of the upper limb	1 (7)	NA
Inflammation around the insertion site	2 (13)	NA
Filter migration	3 (20)	NA
Filter bending	1 (7)	NA

[a] Values are mean
NA, not applicable

administration of heparin, her condition improved.

Postoperative complications due to the use of the vena cava filter (Table 2) occurred only in those patients in whom the filter was inserted via transbrachial access. As mentioned previously, the filter was obstructed in 3 cases, requiring substitution in 2 patients and fibrinolysis therapy in 1 patient.

Discussion

In prosthetic surgery, the risk of thromboembolic complications depends on the patient, the pathology, the type of intervention and the postoperative care. Generally the risk of DVT is greatest during the first 13 postoperative days [9]. The risk of PE is mostly correlated with surgery of the lower limb [5]; it manifests in the first week in 10% of cases, in the second week in 25%, and in the fourth and fifth weeks in 8% and 5% of cases, respectively [10].

There are various pharmacological approaches to thromboembolic prophylaxis. Paiement et al. [13] compared the outcomes of patients receiving pharmacological prophylaxis (i.e. acetylsalicylic acid (ASA), warfarin and dextran) with those receiving external pneumatic compression or placebo. They showed surprising and debatable results: proximal DVT was prevented successfully in 45% of cases receiving placebo, in 40% and 60% of patients receiving ASA (35 and 300 mg/day), and in 19% of cases with pneumatic compression.

Wolf et al. [14] reported an incidence of PE of 6.2% and 33.9% when using non-cemented and cemented prostheses, respectively. According to Francis et al. [15], there were no

cases of DVT when using non-cemented prostheses while DVT occurred in 40% of patients receiving cemented prostheses. A surgical procedure longer than 90 min increased the risk of PE [15]. Planes et al. [16] and Warwick et al. [17] showed that, during preparation of the femoral canal, the forced position of the inferior limb can lead to the complete blockage of the circulation.

The Filcard filter has been tested clinically. Galli et al. [18] reported no complications or recurrences. Santoro et al. [19] reported a successful management of 20 patients with DVT at 10 months of follow-up. Lefebvre et al. [20] presented a success rate of 76%–100% in an international multicentric study. Emanuelli et al. [21] used the RFO2 filter for the prevention of PE during urologic and gynecologic surgeries. Our results are in accordance with these. The use of vena cava filters in 15 high-risk patients accomplished total prevention of PE. In our study, PE only occurred in 2 patients (13%) of the control group, while DVT occurred in 1 patient (7%) of each group. Vena cava filters are an effective means of preventing PE when used in patients at high risk for DVT; however, they must only be used according to specific indications. The ideal vena cava filter is characterized by: athrombogenicity, high filtration capacity without blocking the circulation, adaptability to the vessel walls, rapid and atraumatic positioning, easy release, controllable repositioning and removal, and contained cost. Currently, no one filter has all these characteristics, so routine use of the temporary filter is dissuaded. It is instead useful to reserve the use of these filters for cases of recurrent PE or for patients with thrombotic pathology.

References

1. Prandoni P, Vigo M et al (1992) La diagnosi della trombosi venosa profonda e dell'embolia polmonare. Piccin, Padua
2. Bergqvist G (1983) Postoperative thromboembolism: frequency, etiology, prophylaxis. Springer Berlin Heidelberg New York
3. Barsotti J, Rosset P, Planes A, Marchal C, Robert C (1992) Prophylaxie de la malatie trombo-embolique en orthopéedie et traumatologie par les héparines de bas poids moléculair. Rev Chir Orthop Reparatrice Appar Mot 78[Suppl 1]:229–234
4. Adriani E et al (1995) La trombosi venosa profonda in ortopedia e traumatologia. Delfino, Rome
5. Stulz E, Froehlich C (1952) Les tromboses venouses post-traumatiques du membre inferieure. Presse Med 60:1432–1434
6. Sevitt S, Gallagher NG (1959) Prevention of venous thrombosis and pulmonary embolism in injured patients. A trial of anticoagulant prophylaxis with phenindione in middle-aged and elderly patients with fractured necks of femur. Lancet ii:981–989
7. – (1986) Prevention of venous thrombosis and pulmonary embolism. NIH Consensus Conference. JAMA 256:744–749
8. Molfetta L, Vavalle G, Grano G, Florian M (1995) Tecnica chirurgica e malattia tromboembolica nelle protesi d'anca. Presented at: VIII Congresso Nazionale della SPIGC, 12–13 May 1995, Rimini
9. Sikorski JM, Hampson WG, Staddon GE (1981) The natural history and aetiology of deep vein thrombosis after total hip replacement. J Bone Joint Surg Br 63:171–177
10. Johnson R, Green JR, Charnley J (1977) Pulmonary embolism and its prophylaxis following the Charnley total hip replacement. Clin Orthop 127:123–132
11. Molfetta L, Grano G, Priano F, Gatto P (1995) La complicanza tromboembolica nella chirurgia protesica dell'anca: rilievi clinici e medicolegali. Arch Ortop Reumatol 108:129–133
12. Mobin-Uddin K, Utley JR, Bryant LR (1975) The inferior vena cava umbrella filter. Progr Cardiovasc Dis 17:391–399
13. Paiement GD, Schutzer SF, Wessinger SJ, Harris WH (1992) Influence of prophylaxis on proximal venous thrombus formation after total hip arthroplasty. J Arthroplasty 7:471–475
14. Wolf LR, Hozack WJ, Balderston RA et al (1992) Pulmonary embolism. Incidence in primary cemented and uncemented total hip arthroplasty using low-dose sodium warfarin prophylaxis. J Arthroplasty 7:465–470
15. Francis CW, Pellegrini VD, Marder VJ et al (1978) Prevention of venous thrombosis after total hip arthroplasty. Antithrombin III and low-dose heparin compared with dextran-40. J Bone Joint Surg 64[Suppl 2]:143–148
16. Planes A, Vochelle N, Fagola M (1990) Total hip replacement and deep vein thrombosis. A venographic and necropsy study. J Bone Joint Surg Br 72:9–13
17. Warwick D, Martin AG, Glew D, Bannister GC (1994) Measurement of femoral vein blood flow during total hip replacement. J Bone Joint Surg Br 76:918–921

18. Galli M, Polini A, Bonini W et al (1993) Efficacy and tolerance of percutaneous vena cava filter in massive pulmonary embolism. Presented at: International Symposium of Cardiological Intensive Care, Venice
19. Santoro G, Pieri A et al (1993) Trombosi venosa profonda e rischio di embolia polmonare: utilità dei filtri cavali temporanei. Presented at: International Symposium of Cardiological Intensive Care, Venice
20. Lefebvre JM, Dievart F, Fourier JL et al (1994) New infusion removable inferior vena cava filter catheter (Filcard RF02) for protected thrombolytic treatment in deep venous thrombosis and pulmonary embolism: results of an international multicentric study. Presented at: American College of Cardiology, 43rd Annual Scientific Session, Atlanta
21. Emanuelli G, Segramora V, Bizzi R, Rossi (1998) Terapia endovascolare nella malattia tromboembolica venosa: i filtri cavali e la fibrinolisi protetta. In: La TVP e le sue complicanze in ortopedia. Scientific Press, Florence, pp 153–178