CASE REPORT

UDC: 617-089.5
https://doi.org/10.2298/VSP170115133S

Prophylactic use of the Angel® catheter in a patient with paraneoplastic syndrome scheduled for surgical tumor resection. A case report and literature review

Profilaktička primena Angel® katetera kod bolesnika sa paraneoplastičnim sindromom planiranim za hiruršku resekciju tumora – prikaz bolesnika i pregled literature

Dušica M. Stamenković*†, Vojislava Nešković*†, Ivan Marjanović*‡, Aleksandar Tomić*‡, Siniša Rusović§, Vlastimir Marinković‡, Vladimir Bančević*‖, Menelaos Karanikolas¶

University of Defence, *Faculty of Medicine of the Military Medical Academy, Belgrade, Serbia; Military Medical Academy, †Department of Anesthesiology and Intensive Care, ‡Department of Vascular Surgery, §Department of Radiology, ‖Department of Urology, Belgrade, Serbia; Washington University School of Medicine, ¶Department of Anesthesiology, St. Louis, Missouri, USA

Abstract

Introductio. The Angel® catheter (BiO2 Medical Inc, San Antonio, Texas, USA) is a novel device that combines a triple lumen central venous catheter with an inferior vena cava filter for prevention of pulmonary embolism (IVC filter-catheter). **Case report.** We present the case of a 53- year-old male patient with renal carcinoma and a history of recent deep venous thrombosis (DVT) on oral anticoagulation who was scheduled to undergo open radical nephrectomy. Because of concerns about the risks from documented pre-existing DVT, we decided to insert the Angel® catheter preoperatively in order to have central venous access during surgery and also to reduce the risk of perioperative pulmonary embolism. On the first postoperative day, active gastric bleeding was detected and nadroparine was stopped. Before removal of the Angel® catheter, a pre-removal cavagram revealed large thrombus mass in the catheter filter. Because of the presence of the thrombus mass, the catheter was removed surgically, after a permanent vena cava filter was inserted. **Conclusion.** This case suggests that the use of the Angel® IVC filter/3-lumen central catheter combination could be a reasonable option for pulmonary embolism prophylaxis in the patients at a high risk for DVT, such as the patients with malignant disease, paraneoplastic syndrome and chemotherapy who need to undergo surgery.

Key words:
neoplasms; para neoplastic syndromes; venous thrombosis; pulmonary embolism, vena cava filters; central venous catheters; anticoagulants.

Apstrakt

Uvod. Angel® kateter (BiO2 Medical Inc, San Antonio, Texas, USA) predstavlja kombinaciju trolumenskog centralnog venskog katetera i vena kava filtera koji se koristi u prevenciji plućnog embolizma (IVC filter-kateter). **Prikaz bolesnika.** U radu je prikazan bolesnik, starosti 53 godine, kod koga je planirana radikalna nefrektomija zbog dijagnostikovanog renalnog karcinoma. Duboka venska tromboza (DVT) je prethodila dijagnozi tumora, zbog čega je bolesnik bio na terapiji oralnim antikoagulantima. Uzevši u obzir rizike vezane za ranije tretiranu DVT, odlučili smo se za preoperativno plasiranje Angel® katetera u cilju obezbeđivanja centralnog venskog pristupa i sniženja rizika od nastanka plućne embolije. Prvog postoperativnog dana došlo je do pojave aktivnog gastričnog krvarenja, što je dovelo do ukidanja primene nadroparina. Kavagram urađen po protokolu, pre uklanjanja Angel® katetera, prikazao je veliku trombotičnu masu u filteru. Nakon plasiranja trajnog vena kava filtera, pristupilo se hirurškom uklanjanju Angel® katetera. **Zaključak.** Primena kombinovanog Angel® IVC filter/3-lumenskog centralnog venskog katetera, može predstavljati spasonosnu meru profilakse plućne embolije ukoliko je planiran hirurški zahvat kod bolesnika sa visokim rizikom nastanka DVT, kao što su bolesnici sa malignom bolešću, paraneoplastičnim sindromom i hemioterapijom.

Ključne reči:
neoplazme; paraneoplastički sindromi; tromboza, venska; pluća, embolija; v. cava filteri; kateteri, centralni venski; antikoagulansi.

Correspondence to: Dušica M. Stamenković, Military Medical Academy, Deepartment of Anesthesiology and Intensive Care, Crnotravska 17, 11 000 Belgrade, Serbia. E-mail: dusicastamenkovic@yahoo.com

Introduction

The Angel® catheter (BiO2 Medical Inc, San Antonio, Texas, USA) is a novel device that combines the inferior vena cava (IVC) filter with triple lumen central venous catheter (IVC filter-catheter). It is used as a temporary IVC filter for pulmonary embolism (PE) prevention and also provides central venous access in the critically ill patients where the routine PE prophylaxis methods, such as anticoagulation, or mechanical compression devices, are contraindicated [1, 2]. The Angel® catheter received United States Food and Drug Administration (FDA) approval for clinical investigation use in the United States in 2013, followed by FDA 510(k) clearance in 2016 as a medical device for protection of critically ill patients at a high PE risk when anticoagulation is contraindicated [3].

Current data support the use of a IVC filter in the patients with documented thromboembolism where anticoagulation is contraindicated, caused complications, or has failed, while a prophylactic IVC filter use is controversial [4–13].

The Angel® catheter advantages include less invasive placement and the convenience of bedside placement, thereby eliminating the need to transport patients to radiology, which can cause delays and increase deep venous thrombosis (DVT) and a PE risk [1]. Published data suggest that the Angel® catheter is safe and effective for short-term PE prophylaxis in the high risk patients with contraindications to anticoagulation [14]. The Angel® catheter placement may also bring benefit to the patients with major trauma, intracerebral hemorrhage, stroke, venous thromboembolic events or active bleeding [1, 14].

In this report we present a patient with renal carcinoma and documented recent DVT under oral anticoagulation who needed open radical nephrectomy. This case is published with the patient's approval.

Case report

A 53-year-old man with hypertension and chronic gastritis was admitted for open radical nephrectomy. Multislice computerized tomography (MSCT) revealed a 39 x 42 x 46 mm tumor in the right kidney with central vascularization and necrosis, a subdiaphragmatic 11 mm mass in the liver and a 32 x 27 mm left suprarenal gland enlargement. Although metastasis of renal cell carcinoma in the suprarenal gland are rare [15], with estimated incidence of 0.5% on the contralateral side based on the data from the European Association of Urology (EAU) [16], preoperative assessment in this case included hormonal measurements (metanephrin, normetanephrin, chromogranin A, cortisol level at 8 a.m.), and results were all within normal range. Because of the documented right superficial femoral and popliteal vein DVT, the patient started oral warfarin 5 mg daily. After two months of warfarin treatment and seven days before surgery, ultrasound with Doppler showed partial (20%) thrombus re-canalization in the superficial femoral and popliteal veins. Because the patient had renal cancer, a surgical treatment was indicated and it was not advisable to delay surgery until complete thrombus recanalization, since the process of thrombus recanalization is long and unpredictable, and "almost complete recanalization" can take up to 12 months [17]. Therefore, in preparation for tumor resection, the patient started low molecular weight heparin (LMWH) nadroparin 0.6 mL subcutanously and discontinued warfarin. One month before surgery, the patient had right renal vein embolization (AZUR®Peripheral Embolization System; Terumo Corporation, Tokyo, Japan). Preoperative laboratory evaluation showed elevated laktate dehydrogenase (LDH) (243 IJ/L), C-reactive protein (CRP) (29.7 mg/L), close to normal creatinine (126 umol/L = 1.43 mg/dL) and mild leukocytosis (11.35×10^9/L).

Because of concern about the risk from the documented DVT and calculated Caprini score 12 [18], we decided to use the Angel® catheter in order to reduce the risk of PE and have the central venous access. The patient was informed that the Angel® catheter was a new promising but not extensively evaluated device and gave written informed consent. The Angel® catheter was inserted through the left femoral vein. After appropriate catheter placement was confirmed with ultrasound and abdominal radiography in accordance with manufacturer instructions [19], the patient underwent uneventful right trans-peritoneal nephrectomy.

On postoperative day 1, after the patient reported malaise, vomited hemorrhagic content and became pale and hypotensive, nadroparin was discontinued and hypotension was treated with volume. Gastroscopy revealed anterior gastric wall ulceration with bleeding, which was stopped by the adrenalin injection. On postoperative day 2, the patient started to walk. On day 6, the patient was mobile and ready for discharge and we decided to remove the Angel® catheter. However, the pre-removal cavagram done based on the manufacturer recommended removal protocol [19, 20] revealed large vena cava filter thrombus (Figure 1). Therefore, because of the Angel® catheter filter thrombus, a permanent vena cava filter (ALN filter, Ghisonaccia, France) was placed via the right jugular vein and only then the Angel® catheter was removed surgically. After control of the proximal and distal femoral vein, the Angel® catheter was removed, a Prolene 4-0 suture was placed and the femoral vein was reconstructed. During the catheter removal, large thrombi located in the vein and the vena cava filter were also removed.

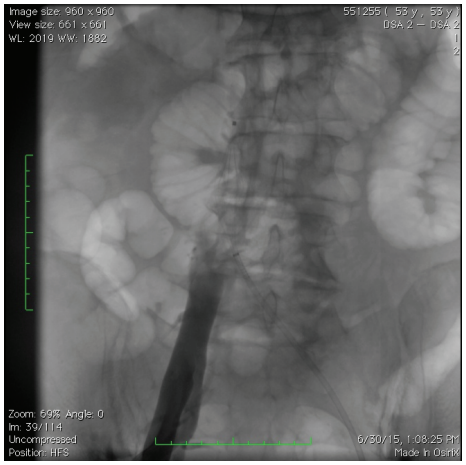

Fig. 1 – Phlebography showing thrombus in the vena cava filter.

Discussion

We report the use of the Angel® IVC filter-central line catheter in a patient with renal cancer and paraneoplastic syndrome with the documented DVT. We decided to place the Angel® catheter due to known DVT despite LMWH prophylaxis, in an attempt to reduce the risk of perioperative PE.

After the Angel® catheter placement and confirmation of appropriate position with ultrasound and abdominal radiography, we proceeded with planned nephrectomy. Although, based on the current literature, indications for placement of the Angel® catheter are debatable, the use of the Angel® catheter in this case allowed us to discontinue perioperative prophylactic LMWH while providing protection against PE.

Based on literature data, pancreas, lung and stomach cancers are associated with DVT, whereas renal cell carcinoma is not [21–23]. However, other studies show that incidence of DVT in renal cancer and paraneoplastic syndrome patients is 10%–40% [16, 24].

In our patient, the femoral vein thrombus formation occurred despite the preoperative anticoagulation and LMWH prophylaxis. The incidence of venous thromboembolism (VTE) is 117/100 000 in the general population, but the risk is markedly higher in cancer, with postmortem studies demonstrating VTE in 50% of cancer patients [25, 26]. Compared to the general population, the cancer patients undergoing chemotherapy have 6.5-fold higher VTE risk, so that 1 in 200 malignancy patients develop VTE [27]. Although prophylactic LMWH reduces the risk by 50%–60% [27–29], thrombosis can still occur [30, 31].

Although anti–factor Xa assay was used for monitoring anticoagulant therapy, we did not measure the anti-factor Xa levels because the routine anti-factor Xa level monitoring is not recommended in stable cancer patients with normal renal function. The anti-factor Xa level monitoring is recommended in the patients with renal dysfunction, but our patient had almost normal renal function [32].

Table 1 shows published data on the Angel® catheter use. There are no data on the IVC filter placement in the patients with paraneoplastic syndrome, history of DVT and a risk for gastric bleeding. In our patient, there were no indications for a permanent vena cava filter placement . However, we were concerned that, based on the history of deep venous thrombosis and calculated Caprini score = 12, this patient was at a high risk for postoperative thromboembolic complications [33]. Therefore, we believed that prophylactic placement of the Angel® catheter was appropriate in this case because the catheter can be easily placed preoperatively by the anesthesiologist and there is no need for surgical removal after surgery. Furthermore, the placement of the Angel® catheter was not associated with the serious complications reported regarding the standard IVC filters.

It is worth pointing out that when planning for this particular case, the anesthesiologist and the surgeon agreed that the risk of significant bleeding during surgery was high. Because this patient had a poor peripheral IV access and the risk of intraoperative bleeding was high, the placement of central venous catheter was indicated for IV access, intraoperative monitoring and administration of intravenous vasoactive infusions [34] regardless of whether or not the Angel® catheter would be used. Furthermore, the published data suggest that when the Angel® catheter is placed in accordance with current recommendations for the central venous catheterization, the risk of infectious complications is very low even in cases where the Angel® catheter remained in place for prolonged periods in the intensive care unit [2, 14].

Because the Angel® catheter could help avoid the traditional IVC filter complications, such as the vena cava perforation, filter tilting, filter migration, and irretrievability, the Angel® catheter use seems reasonable and deserves further investigation. The Angel® catheter use could also be reasonable in the patients who need postoperative LMWH prophylaxis discontinued because of bleeding or other concerns [1]. In this report, we used the IVC filter-catheter because the patient was at a risk for postoperative bleeding complications, including gastrointestinal bleeding and postoperative bleeding and was also at risk for PE due to known DVT.

Table 1

Published data on the clinical use of the Angel® catheter.

Author /Year	Patient number	Comorbidities	Duration (days)	Comments
Cadavid CA et al. 2013 [2]	8	Critical illness: multiple trauma, intracranial hemorrhage or PE	3.8 ± 1.6	Ultrasound guidance in 5 cases, no guidance in 3 cases. Large clot trapped in filter in one case, no complications.
Serednicki W et al. 2015 [1]	1	Critical illness: trauma after a fall	3	Thrombus lodged in the tip of the filter, uneventful catheter removal.
Taccone FS et al. 2015 [14]	60	Critical illness: major trauma, intracerebral hemorrhage, stroke or PE	6 (4–8)	Insertion without fluoroscopy in 90% of cases Reported problems: Guidewire kinked (1 case), filter migration > 2 cm (2 cases), inadvertent removal (4 cases), inability to visualize vena cava (1 case), death (12 cases).

PE – pulmonary embolism.

Conclusion

The Angel® catheter is a novel, less invasive device that combines the IVC filter and three-lumen central venous catheter for a temporary use in the patients at risk for DVT and PE with contraindications to anticoagulation. The preliminary data suggest the Angel® catheter is safe and easy to place and could broaden indications for the IVC filter placement. However, published clinical data are limited, and the true risks and benefits of this promising device are unknown. Large prospective multi-center studies are necessary to better define the role of the Angel® catheter for the PE prophylaxis in different patient populations, including the patients with malignancy, risk of postoperative bleeding and paraneoplastic syndromes.

Acknowledgement

Before the procedure, the patient was fully informed that theAngel® catheter is a new device that had not been extensively evaluated, and gave written informed consent. This work was supported solely by the Department funds.

R E F E R E N C E S

1. *Serednicki W, Dobrowolska E, Kałuża K, Kopacz M, Wordliczek J.* Angel(®) Catheter use for pulmonary embolism prophylaxis in a polytrauma patient. Injury 2015; 46(6): 1167–70.
2. *Cadavid CA, Gil B, Restrepo A, Alvarez S, Echeverry S, Angel LF,* et al. Pilot study evaluating the safety of a combined central venous catheter and inferior vena cava filter in critically ill patients at high risk of pulmonary embolism. J Vasc Interv Radiol 2013; 24(4): 581–5.
3. FDA. 510(k) Premarket Notification. Silver Spring, Maryland: U.S. Food & Drug Administration; 2016.
4. *Siskin GP, Bartholomew K.* Inferior vena cava filters. Available from: http://emedicine.com/radio/topic762.htm. [updated 2005 December]
5. *Montgomery JP, Kaufman JA.* Inferior Vena Cava Filters: Indications, Outcomes, and Evidence. Curr Treat Options Cardiovasc Med 2015; 17(9): 401.
6. *Stein PD, Matta F.* Vena cava filters in unstable elderly patients with acute pulmonary embolism. Am J Med 2014; 127(3): 222–5.
7. *Ozturk C, Ganiyusufoglu K, Alanay A, Aydogan M, Onat L, Hamzaoglu A.* Efficacy of prophylactic placement of inferior vena cava filter in patients undergoing spinal surgery. Spine (Phila Pa 1976) 2010; 35(20): 1893–6.
8. *Knudson MM, Ikossi DG, Khaw L, Morabito D, Speetzen LS.* Thromboembolism after trauma: an analysis of 1602 episodes from the American College of Surgeons National Trauma Data Bank. Ann Surg 2004; 240(3): 490–6; discussion 496–8.
9. *Spencer FA, Bates SM, Goldberg RJ, Lessard D, Emery C, Glushchenko A,* et al. A population-based study of inferior vena cava filters in patients with acute venous thromboembolism. Arch Intern Med 2010; 170(16): 1456–62.
10. *Moore PS, Andrews JS, Craven TE, Davis RP, Corriere MA, Godshall CJ,* et al. Trends in vena caval interruption. J Vasc Surg 2010; 52(1): 118–25.e3; discussion 125–6.
11. *Duszak R Jr, Parker L, Levin DC, Rao VM.* Placement and removal of inferior vena cava filters: national trends in the medicare population. J Am Coll Radiol 2011; 8(7): 483–9.
12. *Stein PD, Matta F, Hull RD.* Increasing use of vena cava filters for prevention of pulmonary embolism. Am J Med 2011; 124(7): 655–61.
13. *Haut ER, Garcia LJ, Shihab HM, Brotman DJ, Stevens KA, Sharma R,* et al. The effectiveness of prophylactic inferior vena cava filters in trauma patients: a systematic review and meta-analysis. JAMA Surg 2014; 149(2): 194–202.
14. *Taccone FS, Bunker N, Waldmann C, De Backer D, Brohi K, Jones RG,* et al. A new device for the prevention of pulmonary embolism in critically ill patients: Results of the European Angel Catheter Registry. J Trauma Acute Care Surg 2015; 79(3): 456–62.
15. *Paul R, Mordhorst J, Leyh H, Hartung R.* Incidence and outcome of patients with adrenal metastases of renal cell cancer. Urology 2001; 57(5): 878–82.
16. *Ljungberg B, Bensalah K, Canfield S, Dabestani S, Hofmann F, Hora M,* et al. EAU guidelines on renal cell carcinoma: 2014 update. Eur Urol 2015; 67(5): 913–24.
17. *Puskás A, Balogh Z, Hadadi L, Imre M, Orbán E, Kósa K,* et al. Spontaneous recanalization in deep venous thrombosis: a prospective duplex ultrasound study. Int Angiol 2007; 26(1): 53–63.
18. *Caprini JA, Arcelus JI, Hasty JH, Tamhane AC, Fabrega F.* Clinical assessment of venous thromboembolic risk in surgical patients. Semin Thromb Hemost 1991; 17 Suppl 3: 304–12.
19. BiO2 Medical I. Angel® Catheter & Angel® Catheter Accessory Kit Instructions for Use. 2016. Available from: http://www.bio2medical.com/angel-catheter. 2016.
20. BiO2 Medical I. Angel® Catheter Care & Maintenance Guidelines. 2016. Available from: www.aquilantinterventional.com/.../AD-023_Rev_A_Nursing
21. *Lee AY, Levine MN.* Venous thromboembolism and cancer: risks and outcomes. Circulation 2003; 107(23 Suppl 1): I17–21.
22. *Yokom DW, Ihaddadene R, Moretto P, Canil CM, Reaume N, Le Gal G,* et al. Increased risk of preoperative venous thromboembolism in patients with renal cell carcinoma and tumor thrombus. J Thromb Haemost 2014; 12(2): 169–71.
23. *González J, Ciancio G.* Increased risk of preoperative venous thromboembolism in patients with renal cell carcinoma and tumor thrombus: comment. J Thromb Haemost 2014; 12(4): 577–8.
24. *Palapattu GS, Kristo B, Rajfer J.* Paraneoplastic syndromes in urologic malignancy: the many faces of renal cell carcinoma. Rev Urol 2002; 4(4): 163–70.
25. *Heit JA, O'Fallon WM, Petterson TM, Lohse CM, Silverstein MD, Mohr DN,* et al. Relative impact of risk factors for deep vein thrombosis and pulmonary embolism: a population-based study. Arch Intern Med 2002; 162(11): 1245–8.
26. *Donnellan E, Kevane B, Bird BR, Ainle FN.* Cancer and venous thromboembolic disease: from molecular mechanisms to clinical management. Curr Oncol 2014; 21(3): 134–43.
27. Hull RD, Pineo GF, Brant RF, Mah AF, Burke N, Dear R, Wong T, Cook R, Solymoss S, Poon MC, Raskob G; LITE Trial Investigators. Long-term low-molecular-weight heparin versus usual care in proximal-vein thrombosis patients with cancer. Am J Med 2006; 119(12): 1062–72.
28. *Leizorovicz A, Cohen AT, Turpie AG, Olsson CG, Vaitkus PT, Goldhaber SZ.* PREVENT Medical Thromboprophylaxis Study Group. Randomized, placebo-controlled trial of dalteparin for the prevention of venous thromboembolism in acutely ill medical patients. Circulation 2004; 110(7): 874–9.
29. *Cohen AT, Zaw HM, Alikhan R.* Benefits of deep-vein thrombosis prophylaxis in the nonsurgical patient: The MEDENOX trial. Semin Hematol 2001; 38(2 Suppl 5): 31–8.
30. Kontny F, Dale J, Abildgaard U, Pedersen TR. Randomized trial of low molecular weight heparin (dalteparin) in prevention

of left ventricular thrombus formation and arterial embolism after acute anterior myocardial infarction: the Fragmin in Acute Myocardial Infarction (FRAMI) Study. J Am Coll Cardiol 1997; 30(4): 962–9.

31. *Simonneau G, Laporte S, Mismetti P, Derlon A, Samii K, Samama CM,* et al. FX140 Study Investigators. A randomized study comparing the efficacy and safety of nadroparin 2850 IU (0.3 mL) vs. enoxaparin 4000 IU (40 mg) in the prevention of venous thromboembolism after colorectal surgery for cancer. J Thromb Haemost 2006; 4(8): 1693–700.
32. *Easaw JC, Shea-Budgell MA, Wu CM, Czaykowski PM, Kassis J, Kuehl B,* et al. Canadian consensus recommendations on the management of venous thromboembolism in patients with cancer. Part 1: prophylaxis. Curr Oncol 2015; 22(2): 133–43.
33. *Laryea J, Champagne B.* Venous thromboembolism prophylaxis. Clin Colon Rectal Surg 2013; 26(3): 153–9.
34. *Spyropoulos AC, Douketis JD.* How I treat anticoagulated patients undergoing an elective procedure or surgery. Blood 2012; 120(15): 2954–62.

Received on January 15, 2017.
Revised on August 23, 2017.
Accepted on September 15, 2017.
Online September, 2017.