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Prophylactic Use Of The Angel® Catheter In A Patient With Paraneoplastic Syndrome Scheduled For Surgical Tumor Resection. A Case Report And Literature Review

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Abstract

**Introduction:** 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 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 removal, 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 use of the Angel® IVC filter / 3-lumen central catheter combination could be a reasonable option for pulmonary embolism prophylaxis in patients at high risk for DVT, such as patients with malignant disease, paraneoplastic syndrome and chemotherapy who need to undergo surgery.

**Key words**
Deep Venous Thrombosis, Pulmonary Embolism, Vena Cava Filter, Central Line, Anticoagulation, Trauma, Paraneoplastic Syndrome, Prophylaxis
Introduction

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

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

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 PE risk [1]. Published data suggest that the Angel® Catheter is safe and effective for short-term PE prophylaxis in high-risk patients with contraindications to anticoagulation [14]. Angel® Catheter placement may also benefit 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 patient approval.

**Case report**

A 53 year-old man with hypertension and chronic gastritis was admitted for open radical nephrectomy. Multi-slice computerized tomography (MSCT) revealed a 39x42x46 mm tumor in the right kidney with central vascularization and necrosis, a subdiaphragmatic 11 mm mass in the liver and a 32x27 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 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 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 this patient had renal cancer, 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, the patient started Low Molecular Weight Heparin (LMWH) nadroparin
0.6 ml subcutaneously and discontinued warfarin, in preparation for tumor resection. One month before surgery, the patient had right renal vein embolization (AZUR®Peripheral Embolization System; Terumo Corporation, Tokyo, Japan). Preoperative laboratory evaluation showed elevated LDH (243 IU/L), CRP (29.7 mg/L), close to normal creatinine (126 umol/L = 1.43mg/dL) and mild leukocytosis (11.35 10^9/L).

Because of concern about the risk from documented DVT and calculated Caprini score 12 [18], we decided to use the Angel® Catheter in order to reduce the risk of PE and to have central venous access. The patient was informed that the Angel® Catheter is 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 stopped with 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, pre-removal cavagram done based on manufacturer recommended removal protocol [19,20] revealed large vena cava filter thrombus (Fig.1). Therefore, because of 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 catheter removal, large thrombi located in the vein and the vena cava filter were also removed.

Figure 1 near here
**Discussion**

We report the use of the Angel IVC filter-central line catheter in a patient with renal cancer and paraneoplastic syndrome with 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 Angel® Catheter placement and confirmation of appropriate position with ultrasound and abdominal radiography, we proceeded with planned nephrectomy. Although, based on current literature, indications for placement of the Angel® Catheter are debatable, 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, femoral vein thrombus formation occurred despite preoperative anticoagulation and LMWH prophylaxis. The incidence of venous thromboembolism (VTE) is 117/100 000 in the general population, but risk is markedly higher in cancer, with postmortem studies demonstrating VTE in 50% of cancer patients [25,26]. Compared to the general population, 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 risk by 50-60% [27-29], thrombosis can still occur [30,31].

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

Table 1 shows published data on Angel catheter use. There are no data on IVC filter placement in patients with paraneoplastic syndrome, history of DVT and risk for gastric bleeding. Our patient did not have indication for 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 high risk for postoperative thromboembolic complications [33]. Therefore, we believe 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, placement of the Angel catheter has not been associated with the serious complications reported with 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 poor peripheral IV access and the risk of intraoperative bleeding was high, 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, published data suggest that when the Angel catheter is placed in accordance with current recommendations for 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 traditional IVC filter complications, such as vena cava perforation, filter tilting, filter migration, and irretrievability, Angel® Catheter use seems reasonable and deserves further investigation. Angel® Catheter use could also be reasonable in 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 risk for postoperative bleeding complications, including GI bleeding and postoperative bleeding and also at risk for PE due to known DVT.

Table 1 near here

Conclusions
The Angel® Catheter is a novel, less invasive device that combines IVC filter and three-lumen central venous catheter for temporary use in patients at risk for DVT and PE with contraindications to anticoagulation. Preliminary data suggest the Angel® Catheter is safe and easy to place and could broaden indications for 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 PE prophylaxis in different patient populations, including patients with malignancy, risk of postoperative bleeding and paraneoplastic syndromes.
List of Abbreviations

DVT = Deep Venous Thrombosis
FDA = Food and Drug Administration
IVC = Inferior Vena Cava
LMWH = Low Molecular Weight Heparin
MSCT = Multi-Slice Computerized Tomography
PE = Pulmonary Embolism
VTE = Venous Thromboembolism
Table 1. Published data on the clinical use of the Angel® Catheter.

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

Declarations

Consent for publication: Before the procedure, the patient was fully informed that the Angel® Catheter is a new device that has not been extensively evaluated, and gave written informed consent. A copy of the written consent is available for review by the Editor-in-Chief of the journal. This work was supported solely by Department funds.

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