INFERIOR VENA CAVA FILTER PLACEMENT FOR PREVENTION OF PULMONARY THROMBOEMBOLISM: CASE SERIES FROM NORTHWESTERN NIGERIA

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Submission Date: 6th Sept., 2023
Date of Acceptance: 30th Dec., 2023
Publication Date: 30th Jan., 2024

ABSTRACT

Background: **Inferior vena cava (IVC) filter placement is an image-guided procedure aimed at primarily preventing pulmonary thromboembolism in patients with lower limb venous thromboembolic (VTE) disease. In Northern Nigeria with a relatively high incidence of thromboembolic disease such as Deep vein thrombosis, reports on IVC filter placement are largely low. We report the feasibility of IVC filter placement on eight patients for the first time in a typical low-resource setting in Northern Nigeria.**

Case Presentations: **We had an equal number of males and females of the eight patients. Their ages ranged from 20 to 80 years. Five patients presented with bilateral lower limbs Deep vein thrombosis (DVT) of which one had a pulmonary embolism. Two other patients had extensive left femoral DVT and one had extensive IVC, iliac, femoral, and popliteal veins thrombosis. The medical records of seven patients, who had IVC filter placement in our department, were reviewed. The IVC filter was deployed with the aid of a C-arm fluoroscopic unit. In a single case, access was secured via an indwelling dialysis catheter.**

Conclusions: **All the patients had successful deployment with satisfactory post-procedure conditions. The intended benefit of pulmonary embolism prevention was achieved in the series of procedures that were performed. Indicating the value of IVC filter even in resource-poor settings and effort should be made towards exploring such intervention.**

Keywords: Case report, Inferior vena caval filter, Deep vein thrombosis

BACKGROUND

Inferior vena cava (IVC) filters are devices, deployed in the infrarenal segment of the inferior vena cava, to mechanically prevent lower limb and pelvic venous thrombi from reaching the pulmonary circulation.[1] Deep vein thrombosis (DVT) is the formation of clots in the deep veins, mainly in the lower limbs and pelvic cavity.[2] In Africa, the prevalence of venous thromboembolism (VTE) risk was up to 50.4% overall, 62.3% in medical, and 43.8% in surgical patients.[3] We have earlier found that up to 55.8% (95) of patients presenting with leg swelling for vascular ultrasound have DVT while 44.2% (75) had normal ultrasound findings.[4] The most important complication of DVT is pulmonary thromboembolism, which can cause high mortality due to sudden interruption of gaseous exchange in the lungs.[5]

Anticoagulation and thrombolysis, the common pharmacological treatment of lower limb DVT, are beneficial in preventing pulmonary thromboembolism.[6] Inferior vena cava (IVC) filter has been used to manage patients with pulmonary embolism and deep venous thrombosis. Its ease of use and the expansion of relative indications have led to a dramatic increase in IVC filter placement globally.[7]

Despite the high prevalence of DVT and eligible patients for IVC filter placement, the utilization of IVC filter placement in Nigeria is low, even though there is relative availability of interventional radiology services in the region.[8] We, therefore, report the series of eight patients with DVT and contraindications to anticoagulation who had IVC filter placement; to document the feasibility, patients' characteristics and the availability of such life-saving services in a low-resource setting.

Due to the need for active management of venous thromboembolism (VTE), an internal jugular or femoral access is mostly used to place the IVC filter Irrespective of the access vessel, a right-sided approach is preferred due to the direct path to the inferior vena cava and minimal tilt.[9] Comfort, ease, and a comparatively straight course make the right internal jugular vein the more common choice; this approach also decreases the risk of interference with a thrombus, if present in the femoral or iliac vein. However, the femoral vein approach is preferable for patients with central venous catheters, intubated patients, or when using intravascular ultrasound.[10]

CASE PRESENTATIONS

The medical records of seven patients, who had IVC filter placement in our department and another at Prime Specialist Clinic Kano, were reviewed. We had an equal number of males and females of the eight patients. Their ages ranged from 20 to 80 years. All the patients had a successful deployment of the caval filters, as summarized in Table 1.

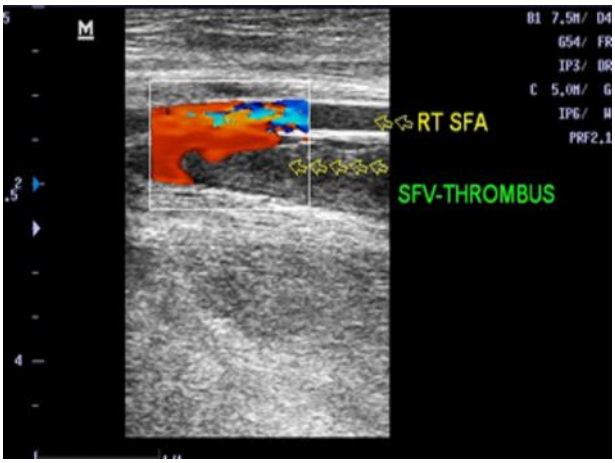

Figure 1: A longitudinal colour Doppler sonogram of the groin, showing dilated superficial femoral vein (SFV) and absence of colur flow within its lumen due to thrombus

Procedure: After baseline vitals (pulse rate of 76 beats per minute, blood pressure of 143/91 mmHg and a respiratory rate of 21 cycles per minute) were taken using a multi-parameter monitor and IV access secured, the right groin was prepared with a povidone-iodine solution in a sterile technique. This was followed with skin and subcutaneous tissue infiltration by 10mls of 2% lignocaine, after draping the patient. The common femoral vein was accessed via blind puncture and the guide wire passed to the right common iliac vein. After removal of the guide wire, the anatomy of the infra-renal segment of the IVC was demonstrated by opacifying its lumen with injection of 20 ml of low-osmolar iodinated contrast medium (Iohexol®). The IVC diameter measured up to 23 mm and there is no evidence of vena cava filling defect or duplication.

Thereafter, the IVC filter (7F sheath, ALN IVC filter) was inserted into its delivery catheter by connecting

Table 1: Summary of the characteristics of the eight patients

SN	Age	Sex	Indication for IVC filter placement	DVT	Type of filter	Venous Access
1	80	M	Hemorrhagic stroke	Left iliofemoral	OpEase	Right femoral
2	20	M	Recurrent DVT	Bilateral	ALN	Right jugular
3	25	M	Penetrating thigh injury with poor renal function	Left iliofemoral	ALN	Right femoral
4	68	F	Huge right ovarian tumor	Right femoral	OpEase	Right jugular
5	58	M	Hemorrhagic transformation of ischaemic stroke	Left iliofemoral	OpEase	Right femoral
6	41	F	PV bleeding from multiple uterine fibroids and anaemia	Left femo-popliteal	OpEase	Right femoral
7	50	F	Multiple injuries with pelvic and forearm fractures	Bilateral iliofemoral	OpEase	Right jugular
8	63	F	Hemorrhagic stroke	Right femo-popliteal	OpEase	Left femoral

Case 1

An 80-year-old man with background cancer of the prostate presented to our hospital with left leg swelling and pain. The Duplex ultrasound showed extensive thrombosis of the left superficial and common femoral veins (figure 1). He was placed on Warfarin 5 mg daily. He was on this dose with the last international normalized ratio (INR) of 2.8 within 2 weeks of DVT. He developed a hemorrhagic stroke (confirmed by non-contrast computed tomographic scan of the brain) with dense left hemiplegia. Warfarin was stopped. In view of the need to stop the anticoagulation and the additional risk of worsening DVT by the sudden onset of stroke, IVC filtration was considered. Pre-procedure informed consent was taken.

the filter holder to the hub of the delivery catheter. When the IVC filter was within the delivery catheter, the filter was pushed/advanced with the help of the pusher device, until when the collapsed IVC filter was advanced (with the guidance of intermittent fluoroscopy) within this delivery catheter until when the tip of the filter reached the level of the third lumbar vertebra. At that moment, the filter was released and the delivery catheter and the pusher were removed. At that level, the filter then expands and attaches itself to the walls of the IVC.

The patient has been on follow-up. He is clinically stable. He was on compression stocking and physiotherapy.

Case 2

A 20-year-old man was referred to the Department of Radiology Aminu Kano Teaching Hospital (AKTH) for IVC filter placement. He sustained a left foot injury two months earlier, following which he developed a bilateral leg swelling following prolonged immobilization. A bilateral lower limb Doppler ultrasound examination revealed bilateral femoral DVT. Thereafter, he was placed on subcutaneous Clexane®.

In view of the bilateral lower limb thrombi, the interventional Radiology team resolved to use the right jugular access for the IVC filter placement. Following informed consent and baseline investigations of (renal function test, fasting blood glucose, and complete blood count), informed consent was obtained. The patient's peripheral oxygen saturation, pulse rate, and non-invasive blood pressure were monitored every five minutes after baseline parameters were taken and peripheral intravenous access was secured. The right jugular access was obtained with local anesthesia and ultrasound guidance using the Seldinger technique. The C- arm fluoroscopy system was used to monitor the advancement of the guide wires and, cavogram, as well as the delivery catheter. The FJ HOOK ALN IVC filter® was inserted and deployed at the level of the third lumbar vertebra which was below the entry point of the renal vein (figure 2).The procedure was well tolerated and the patient was observed overnight and was found to have stable vital signs with no procedure-related complaints. He was seen on follow-up at 6 months for a filter checkup using plane abdominal x-ray and surveillance of the iliofemoral thrombi using Doppler ultrasound.

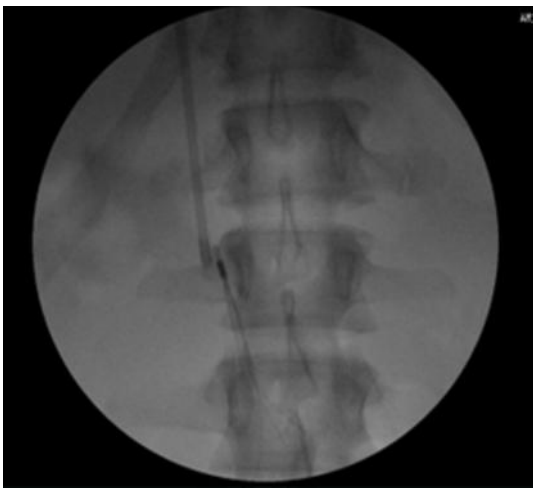

Figure 2: A spot film fluoroscopic image in the mid-lumbar region, showing the deployed ALN IVC filter, via the right jugular access

Case 3

A 25-year-old man was referred from Usman Danfodio University Teaching Hospital on account of left lower limb swelling, following a penetrating leg injury. Initial assessment revealed a huge thigh abscess and an extensive sub-acute thrombus, occluding the left iliofemoral veins. As a result of the initial massive bleeding, he developed oliguria and acute kidney injury, necessitating salvage sessions of haemodialysis. He had minimal abscess drainage but adequate exploration of the thigh was not done due to poor reserve, anemia and sepsis.As a result, the managing physicians discussed with the Interventional Radiology team, and an IVC filter was recommended.The procedure was carried out under local anesthesia and C-arm fluoroscopy control. Following the preliminary assessment, consent was obtained from the patient. The right femoral access was used to obtain a cavogram using the existing right femoral dialysis access over a guide wire.The ALN® IVC filter was inserted and deployed at the level of the third lumbar vertebra which was below the entry point of the renal vein.The procedure was well tolerated and the patient was discharged after a 12-hour observation with no complaints.

Case 4

A 68-year-old female with a huge pelvic tumor developed gradual bilateral lower limb swelling. Abdomino-pelvic ultrasound confirmed a highly suspicious right ovarian tumor with massive ascites, right hydronephrosis, and peritoneal wall thickening. Further vascular ultrasound scan of the lower limb revealed extensive mixed echogenic thrombi within the right femoral and popliteal veins. The gynaecologists were preparing her for surgery but were worried about embolization of the right lower limb DVT to pulmonary circulation once the tumor was resected. As a result, the option of an IVC filter was agreed upon.

The right internal jugular puncture was done using the Seldinger technique under ultrasound guidance with

local anesthesia. Through a series of exchanges of catheters and guide wires, the IVC filter was deployed at the level of the third lumbar vertebra using with C-arm fluoroscopy guide (figure 3).

The procedure was well tolerated and the post-procedure condition was satisfactory. The patient eventually had a successful tumor resection without evidence of pulmonary VTE.

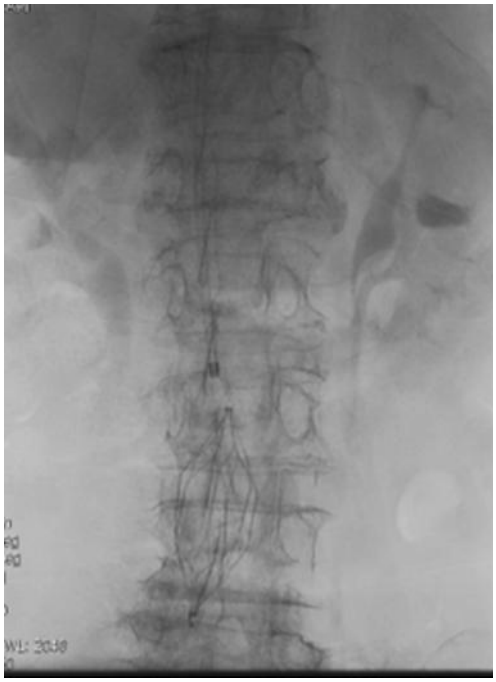

Figure 3: A collimated abdominal radiograph, showing the deployed OptEase IVC filter, via the right jugular access

Case 5

A 58-year-old man developed one week history of sudden onset of left lower leg swelling and pain. He was being managed for a left hemispheric ischemic stroke. He was also hypertensive (poorly controlled) with worsening features of right hemiparesis.

On examination, the middle-aged man was drowsy with severe right hemiplegia and facial asymmetry. There was left non-tender lower limb pitting oedema, up to the thigh. He was afebrile, not pale with no digital clubbing. He had a pulse rate of 75 beats per minute and blood pressure of 174/94 mm Hg. His apex heartbeat was at the 6th intercostal space and heaving. Other systems reviewed were normal. A clinical diagnosis of recurrent stroke and a left lower limb DVT was made. A repeat computed tomography revealed the hemorrhagic transformation of the earlier noted left parietal lobe ischemia (territory of the left middle cerebral artery). Lower limb vascular ultrasound revealed extensive dilated and non-compressible left iliofemoral veins. Their lumen was filled with hypoechoic material, with an absence of blood flow. The clinical diagnosis of left lower limb DVT was therefore confirmed radiologically. Considering the hemorrhagic transformation of the ischemic stroke, the neurologist recommended him for IVC filter placement, before the recommencement of physiotherapy.

The right groin was prepared with an antiseptic solution in a sterile technique. Local anaesthesia of the entry point was achieved by infiltration of 10mls of 1% lignocaine after draping the patient. The common femoral vein was accessed via blind puncture and the guide wire passed to the right common iliac vein. The infra-renal segment of the IVC was located with the injection of 20 ml of low-osmolar iodinated contrast medium (Iohexol®). The IVC diameter measured 23 mm and there was no evidence of vena cava filling defect or duplication (figure 4). The IVC filter (6F OptEase® IVC filter) was placed at the level of the third lumbar vertebra, (infra-renal segment of the inferior vena cava). The procedure was uneventful.

Figure 4: Inferior cavogram via the right femoral vein, showing normal diameter and contrast filling of the inferior vena cava

The procedure was well tolerated and the patient was transferred to the neurology unit for continued care.

Case 6

A 41-year-old woman with symptomatic multiple uterine fibroids (prepared for myomectomy) suddenly developed left lower leg pain and swelling after 12-

hour long-distance travel. She also had excessive cyclical vaginal bleeding, associated with dizziness.

Physical examination revealed a pale middle-aged woman who was afebrile. There was marked left lower limb swelling up to the thigh. Her pulse rate was 95 beats per minute with a blood pressure of 110/76 mmHg. Other systems were normal. The laboratory results revealed microcytic anaemia with Haemoglobin of 6.5g/dl. Her renal function test and fasting plasma glucose were within normal limits.

Abdominal ultrasound revealed a bulky uterus with more than seven myometrial mixed echogenic masses with foci of calcifications. Their sizes ranged from 34 mm to 67 mm in diameter. There was associated extrinsic compression on the urinary bladder but there was no evidence of upper renal tract obstruction. Lower limb vascular ultrasound revealed extensive dilated and non-compressible left femoral-popliteal veins. Their lumen was filled with hypoechoic material, causing the absence of blood flow. The diagnosis of multiple uterine fibroids complicated by anaemia and left lower limb DVT was made. She was resuscitated and had four pints of blood transfused and IVC filter placement was considered due to the vaginal bleeding and plans for myomectomy, which would increase the risk for DVT.

The right groin was prepared with an antiseptic solution in a sterile technique. This was followed by infiltration of the site of puncture with local anesthesia. The common femoral vein was accessed via blind puncture and the guide wire passed to the right common iliac vein. The infra-renal segment of the IVC was located with the injection of 20 ml of low osmolar iodinated contrast medium (Iopamidol®). The IVC diameter measured 23 mm and there was no evidence of vena cava filling defect or duplication. The IVC filter (6F OptEase® IVC filter) was placed at L3, (infra-renal segment of the inferior vena cava). The procedure was well tolerated and the patient was transferred to the gynaecology ward and had an uneventful myomectomy.

Case 7

A 50-year-old woman sustained a pelvic fracture from a road traffic accident. She also sustained a fracture in the forearm. She was resuscitated and had four pints of whole blood. Thereafter, her forearm fracture was reduced and the patient was prepared for corrective pelvic surgery. On the second day of admission, she suddenly developed bilateral leg swelling and pain. Further vascular ultrasound scan of the lower limbs revealed extensive mixed echogenic thrombi within the ilio-femoral veins bilaterally. Given the recent polytrauma and the need to have pelvic surgery, the surgeon referred the patient for IVC filter placement. The right internal jugular puncture was done using the Seldinger technique under ultrasound guidance with local anesthesia. Through a series of exchanges of catheters and guide wires, the IVC filter was deployed with the aid of a C-arm fluoroscopic unit.

The procedure was well tolerated and the post-procedure condition was satisfactory. The patient eventually had a successful pelvic surgery without an episode of pulmonary VTE.

Case 8

A 63-year-old woman developed a ten-day history of sudden onset of right lower leg swelling and pain. She was being managed for right hemispheric ischemic stroke and had poorly-controlled hypertension.

On examination, an ill-looking middle-aged woman with dense left hemiplegia. There is right tender lower limb pitting oedema, up to the thigh. Her pulse rate was 72 beats per minute. His blood pressure was 180/100 mm Hg. The apex beat was at the 6th intercostal space and heaving. Other systems are normal. Computed tomography revealed hyperdense collection (density of 62 HU) in the right basal ganglia and thalamus. Lower limb vascular ultrasound revealed an extensive dilated and no-compressible right left femoral and popliteal veins. Their lumen is filled with hypoechoic material, causing the absence of blood flow. The diagnosis of hemorrhagic stroke and right femoro-popliteal DVT was made. Considering the hemorrhagic stroke, the neurologist recommended her for IVC filter placement, before the recommencement of physiotherapy.

The left groin was prepared with an antiseptic solution in a sterile technique. This was followed by infiltration with local anaesthesia after draping the patient. The common femoral vein was accessed via blind puncture and the guide wire passed to the right common iliac vein. The infra-renal segment of the IVC was located with the injection of 20 ml of low osmolar iodinated contrast medium (Iohexol®). The IVC diameter measured 22.5 mm and there is no evidence of vena cava filling defect or duplication. However, numerous venous collaterals were noted, connecting to the IVC. The IVC filter (6F OptEase® IVC filter) was placed at L3, (infra-renal segment of the inferior vena cava). The procedure was well tolerated and the patient was transferred to neurology unit for continued care.

DISCUSSION

Venous thromboembolism is a continuum of a single disease process, which occurs within the veins that

drain blood to the right-sided heart and continue to the pulmonary artery that ends their distribution within the lung parenchyma. The combination effects which comprises Deep Venous Thrombosis (DVT) and pulmonary embolism (PE), with DVT of the lower limb shown to be more frequent than PE.[11] Deep Vein thrombosis (DVT) is the presence of a thrombus within the deep veins of the upper and lower limbs. It is of clinical importance because it is now known to be the leading cause of pulmonary embolism (PE) which is the most dreaded and life-threatening complication. Venous thromboembolism (VTE) is a major cause of morbidity and mortality worldwide. It is also the most common complication in hospitalized patients in high-income settings.[12,13]

The pattern of the epidemiology of VTE in Sub-Saharan Africa is comparable to that reported in the Asian sub-continent.[13-15] The incidence of VTE has been shown to increase with age and emergency surgical procedures have been shown to be associated with higher rates of VTE.[15] In this study only two patients were less than 40 years of age, which is in keeping with the epidemiology of VTE in Caucasians. Moreover, one of the less than 40 years patient had a traumatic injury with renal impairment as possible confounding factors for the recurrent DVT. Additionally, our study had shown vascular disease was a major indication for the insertion of prophylactic IVF while pelvic tumor and polytrauma were less frequent indications for the procedure.

The mainstay of treatment of DVT and pulmonary embolism is systemic intravenous anticoagulation with intravenous heparin followed by oral warfarin or Non-Vitamin K antagonist oral anticoagulants (NOAC). However, as many as 33% of patients will develop a second PE while receiving adequate anticoagulation therapy.[15] Case 2 in this report had developed bilateral DVT despite being on clexane which necessitated the use of IVC to prevent the possibility of pulmonary embolization in the patient. Additionally, the use of systemic anticoagulants limited its use in certain groups of high-risk patients, including patients at high risk for falling, hemorrhagic stroke, metastatic disease, or bleeding diathesis. In this article, the first case had a hemorrhagic stroke following the use of an anticoagulant in a patient with prostatic cancer hence, the limitations of treatment in the patient made the insertion of an IVC filter the only available preventive modality.

The indications for IVC filter placement have expanded over the years. However, the main indications remain DVT or PE in a patient for whom anticoagulation therapy is contraindicated, accounting for 38-77% of patients undergoing IVC filter placement. In our case series, we had 3 cases where IVC was inserted prophylactically to patients with high risk of developing DVT and or PE. Additionally, we reported IVC placed in patients who were not stable enough to undergo surgical intervention despite the increased risk of VTE. IVC filters are indicated in cases with the contraindications to anticoagulation therapy as follows: hemorrhagic stroke, recent neurosurgical procedures, major or multiple trauma, active internal bleeding (such as upper or lower gastrointestinal bleeding, hematuria, hemobilia and intracranial neoplasm. Bleeding diathesis (secondary thrombocytopenia, idiopathic thrombocytopenic purpura and hemophilia).[15]

The concern about the possibility of IVC filters precipitating renal vein thrombosis has prompted many to recommend that vena cava filters be placed in the infrarenal portion of the inferior vena cava.[14]

CONCLUSION

Insertion of IVC filers via percutaneous image-guided access is an important therapeutic option in the management of selected patients with VTE. As new devices have become available and clinicians have become more familiar and comfortable with IVC filters, the indications for filter placement have continued to evolve and the intended benefit of pulmonary embolism prevention can be done in resource-limited settings.

Authors' contributions

AMT was the main supervisor of the study and contributed to its design. AI directed the data and led insertions of most of the IVC filters. ABU, NU, and ARM were responsible for collecting, organizing, and analyzing the data; and wrote the initial draft. JIA and MMH contributed to the data collection, care of the patients, and review of the draft. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the staff of the Radiology and Anesthesia departments of our teaching hospital, as well as the staff of Prime Specialist Clinic, for their kind support in taking care of the patients and in writing this manuscript.

LIST OF ABBREVIATIONS

AKTH: Aminu Kano Teaching Hospital
DVT: Deep vein thrombosis
IVC: Inferior vena cava
PE: Pulmonary Embolism
VTE: Venous thrombo-embolism

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