



IVC filters - Indications for placement and retrieval trends—experience from a tertiary referral centre in India type of submission—full paper



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ABSTRACT

Objectives: There is wide variation in the practice of IVC filter placement and retrievals. We conducted a retrospective study to identify the trends in placement and retrievals of IVC filters in a tertiary referral centre in India.

Methods: The data of patients obtained from our hospital records, in whom IVC filter was placed between 2010 and 2018, were analysed for demographics, indications for placement of IVC filter, underlying comorbidities, characteristics of the filters as well as the retrieval rates.

Results: IVC filters were placed in 50 patients, and data was retrieved for 31 patients (mean - 51.24 years, 67.74% males). According to ACCP/AHA guidelines, 24 (77.42%) had an absolute indication for IVC filter. All 31 IVC filters were temporary, 23 (74.19%) of which were placed via femoral access. 29 (93.55%) patients had infrarenal IVC filter placement. The average tilt at deployment was 3.71°, whereas it was 5.3° at retrieval. There were no periprocedural complications or filter migrations during placement or retrieval. Retrieval was attempted in 11 (35.48%) patients and was successful in 10. The mean indwelling time in this group was 158.55 days (range 55–366 days).

Conclusion: Our study reveals low IVC filter implantation rates which are predominantly for absolute rather than relative indications. Though in sync with the worldwide trend, the poor retrieval rates reflect the urgent need for better patient and physician awareness. Periodic follow up is imperative to improve the IVC filter retrieval rate and to prevent complication rates.

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1. Introduction

IVC filter devices aim to prevent pulmonary thromboembolism in patients with lower limb deep venous thrombosis (DVT). Studies have revealed that close to one-third of DVT patients are associated with pulmonary embolism.¹ A study performed in the Indian population showed similar results, with 23% of patients diagnosed with DVT had associated pulmonary thromboembolism (PTE).² The mainstay of treatment of patients with venous thromboembolism (VTE) is anticoagulation (AC) therapy with IVC filters being indicated in patients with absolute contraindication to AC (recent surgery, a patient being planned for high-risk surgery, recent major

bleed etc.), response failure to AC therapy and complications arising from AC therapy (or the risk thereof). IVC filters may also be prophylactically placed in high-risk patients, e.g. malignancy and multiple comorbidities. We have conducted a retrospective study of patients requiring IVC filters over nine years in one tertiary care referral centre in India. We aim to study the trends over the years of IVC filter placement in this single centre retrospective study. The indications, patient demographics, including comorbidities, history of an adverse clinical event, history of prior episodes of DVT/VTE and IVC filter retrieval, were documented. The variant of IVC filter used, location of IVC filter and venous access site through which the filter was placed was also recorded.

2. Materials and methods

Patients who underwent IVC filter placement from 1st January 2010 till September 2018 were included in the study. Data of 31

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patients could be retrieved, and they were considered for the study while the rest of the patients with irretrievable records were only included in determining annual statistics. Demographic details with a detailed history of comorbidities including hypertension, diabetes mellitus, end-stage renal disease (ESRD), end-stage liver disease (ESLD), ischemic heart disease, stroke, history of smoking, connective tissue disorder and malignancy, history of recent chemotherapy was taken. The indications for placement of IVC filter and status of AC therapy at the time of insertion and after retrieval were recorded, including mean time between retrieval and the study date. Also, details of IVC filters, i.e. device, nature (permanent/retrievable), venous access site, IVC filter location, adjunct procedure (e.g. catheter-directed thrombolysis) performed and retrieval status, and reason for non-retrieval were noted. Current status of treatment, i.e. whether the patient is receiving AC therapy was also recorded.

3. Results

3.1. Patient demographics

Of the 50 filters placed between 2010 and 2018, the data and history of 31 patients were retrievable. Out of the 31 patients, 21 (67.74%) were male patients, and 10 (32.26%) were females. The mean age of the study population was 51.45 years (Range-17-80 years). Ten patients (32.26%) were suffering from hypertension, 6 (19.35%) patients had diabetes, 6 (19.35%) patients were chronic smokers, 3 (9.68%) were suffering from ESRD while none of them were suffering from ESLD. 1 (3.23%) patient had a history of stroke, while none had ischemic heart disease or connective tissue disorder (Table 1).

10 (32.26%) patients were undergoing treatment for cancer with 4 (12.90%) patients amongst them undergoing chemotherapy at the time of the procedure. Out of these ten patients, two patients had benign tumours (meningioma and pineal teratoma) while eight patients had malignant tumours (2 patients each with renal cell carcinoma and carcinoma colon; one each of carcinoma prostate, carcinoma ovary, carcinoma tongue and carcinoma cervix).

3.2. Indications for IVC FILTER placement

The indications for IVC filter placement were documented and stratified into absolute and relative indications according to the more stringent ACCP/AHA guidelines. Out of the 31 patients, 24 (77.42%) had an absolute indication for IVC filter placement, while 7 (22.58%) had relative indications. Table 2 shows the absolute and relative indications for IVC filter in the study population.

Table 1
Baseline Characteristics of the study population.

Characteristic	Study population (n)
Age, years (Range)	51.45 years (17–80years)
Sex, no. (%)	
Male	31(67.74)
Female	21(32.26)
History, no. (%)	
Hypertension	10 (32.26)
Diabetes	6 (19.35)
Chronic smokers	6 (19.35)
End stage renal disease	3 (9.68)
Stroke	1 (3.23)
Malignancy on treatment	10 (32.26)
Benign	2 (20.0)
Malignant	8 (80.0)
Ongoing chemotherapy	4 (12.90%)

All 31 (100%) patients had lower limb DVT when being considered for IVC filter, with 6 (19.35%) patients having a history of chronic deep venous thrombosis. DVT was unprovoked in 12 (38.71%) patients. The rest of the patients developed DVT either due to a pro-coagulant state or due to prolonged immobilization. 22 (70.97%) patients were undergoing AC treatment, which for reasons listed below, required cessation of AC and necessitating the need for IVC filter. 8 (25.81%) patients had a recent major bleed (intracranial bleed in 5 (16.13%) patients and massive hematuria in 3 (9.67%) patients). In these patients, IVC filter placement was an absolute indication as AC therapy was contraindicated. 7 (22.58%) patients with acute ileo-femoral DVT required an IVC filter placement with AC discontinuation before a major planned surgery. A mean interval of 7.77 days (Range- 0–20 days) was seen in patients between the placement of IVC filter and surgery. IVC filter placement was required in 8 (25.81%) patients who failed to respond to therapeutic AC and continued to have clinically significant recurrent PE.

One patient required an IVC filter because of massive gastrointestinal bleed developing after initiation of AC in a patient of Crohn's disease (a complication of AC therapy).

Three patients were posted for pulmonary endarterectomy or embolectomy for chronic pulmonary thromboembolic pulmonary hypertension and were considered as relative indications for IVC filter placement (according to ACCP/AHA guidelines). In one patient, IVC filter was placed prior to catheter-directed thrombolysis (CDT) for an ileo-femoral DVT. The patient developed DVT without PE 18 days after radio-frequency ablation for cardiac arrhythmia.

Two patients received a prophylactic IVC filter for high thrombus burden in the ileo-femoral/caval veins. One patient had disseminated intravascular coagulopathy with PE for whom IVC filter was placed despite therapeutic anticoagulation being obtained.

CDT was performed as an adjunct procedure in 3 patients. Two of these patients had developed PE despite therapeutic AC. Only one of the patients with a high thrombus burden for which an IVC filter was placed had a concomitant CDT as well.

3.3. IVC FILTER characteristics

All 31 (100%) IVC filters placed were temporary filters; 4-Gunther Tulip, 4-G2 RX Bard and 23 IVC Cook Celect filters. Majority of IVC filters were placed in infrarenal IVC, i.e. in 29 (93.55%) patients while in 2 (6.45%) patients it was placed in suprarenal locations. Filters were placed in the supra-renal location only in patients who had DVT, which extended to the infra-renal inferior vena cava. 23 (74.19%) IVC filters were placed through femoral venous access (14 through right femoral route and 9 through left femoral route) while 8 (25.81%) filters were placed through jugular venous access (7 through the right jugular and 1 through left jugular venous access). All the patients with jugular access had bilateral iliofemoral DVT precluding a femoral approach.

Out of the 31 patients, 2 (6.45%) patients required two attempts for IVC filter deployment. Rest of the 28 (93.55%) patients required a single attempt during deployment. The average tilt angle of IVC filters at deployment was 3.71° (range 1–10). Two patients had a tilt angle of 20–30° during deployment, and the second attempt was undertaken to deploy it. A Cook Celect filter was used in both patients with left femoral and right jugular access sites being used. None of the patients (0%) encountered access site complications.

3.4. Retrieval statistics

IVC filter retrieval was attempted in 11 (35.48%) patients and was successfully retrieved in 10 (32.26%) patients. The percentage

Table 2
Absolute and relative indications for IVC filter placement.

INDICATIONS (n = 31)		
ABSOLUTE INDICATIONS		n = 24
Contraindication to AC	Due to major bleed	8
	Patients on AC posted for major surgery	7
Failure of response to AC		8
Complication to AC		1
RELATIVE INDICATIONS		n = 7
Prior to CDT		1
Prior to CTEPH		3
Ileo-femoral DVT with high thrombus burden		3

Abbreviations: AC: Anticoagulation; CDT: Catheter directed thrombolysis; CTEPH: Chronic pulmonary thromboembolism induced pulmonary hypertension; DVT: Deep vein thrombosis.

of retrievals increased from 27% for filters placed between 2010–2014 to 35% for filters placed between 2015–2018. Though this upwards trend is encouraging, the overall rates of filter retrieval remain dismal. The mean interval between the date of IVC filter placement and IVC filter retrieval interval was 158.55 days (range 55–366 days). For the rest of the patients who did not undergo IVC filter retrieval, all 20 (64.52%) patients were informed about the need for filter retrieval during the placement as well as being specifically mentioned in the patient's copy of the procedural report. Reasons for non-retrieval of IVC filters in the 20 (64.52%) patients in whom filter retrieval was not attempted- 9 (29.03%) were due to patient demise while 11 (35.48%) were due to lack of clear instructions regarding follow up in the IR department. The average indwelling period in the patients in whom IVC filter retrieval was not performed was 868.9 days (from the date of IVC filter placement to the date of the study, Range-114–1969 days).

Of the patients in whom IVC filter retrieval was attempted, 9 (29.03%) patients had a perforation of IVC walls by the filter struts with an average of 3.11 mm (Range 2–5 mm) of caval wall penetration. Out of the nine patients, 6 (19.35%) patients had significant (>3 mm) caval wall penetration. Migration of IVC filter was not seen in any of the patients in whom retrieval was performed or undertaken. Retrieval was performed after ensuring the conversion of oral anticoagulation to intravenous anticoagulation with the omission of the routine dose on the day of the procedure. The average tilt angle at retrieval was 5.3° (Range 2–17°). Out of the ten patients in whom the IVC filter was retrieved, 4 (12.90%) patients required complex techniques. Residual thrombus, which was not significant (<25% of IVC filter volume) was seen in 4 (12.90%) patients during angiography prior to filter retrieval. Two attempts were made in a patient with unsuccessful retrieval of a Cook Select filter (device being placed 275 days before retrieval attempt) with multiple advanced retrieval techniques being used, with the exception of attempting a forceps retrieval (due to unavailability in our department at the time of the procedure). The tilt angle, in this case, was 17° with the presence of significant caval penetration. This patient was discharged with instructions for continuous oral AC. No periprocedural complications were encountered in any patient during the retrieval attempt. Figs. 1 and 2 depict a successful and an unsuccessful attempt at retrieval of IVC FILTER, respectively.

Out of 20 patients in whom filter retrieval was not performed, 11 patients were alive at the time of the study. Out of these 11 patients, nine patients were on therapeutic AC therapy (8 patients on warfarin and one on Rivaroxaban) while two patients were not on AC therapy. Out of the 10 patients in whom IVC filter was retrieved, seven patients were on AC therapy at the time of the study (6 on warfarin and one on Injection Clexane) while three patients were not on AC therapy. One patient in whom IVC filter retrieval was not successful was on warfarin therapy at the time of this study.



Fig. 1. Patient with successful retrieval of IVC filter. A, B. Computed tomography image and angiography image shows a tilt angle of 2° in a patient who underwent IVC filter removal. C. Fluoroscopy image shows the IVC FILTER being ensheathed. D. Post retrieval angiogram with visualisation of the left renal vein and no evidence of contrast leak from IVC.

Nine patients of the 31 patients expired during the study period. The cause of deaths in the nine patients were as follows- 4 due to advanced malignancy related complications, 1 due to complications arising due to traumatic SDH, 1 due to ICH and 1 due to advanced ILD related respiratory failure. The cause of death was unknown in one patient. None of the cause of death in the 8 patients were due to PE or suspected PE. There was no episode of recurrent DVT in the 31 patients with follow-up data.

4. Discussion

Pulmonary thromboembolic disease is a major cause of morbidity and mortality in patients with deep venous thrombosis

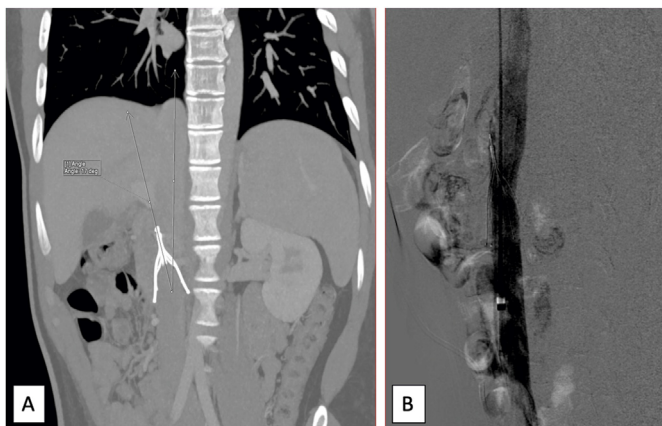


Fig. 2. Patient with unsuccessful retrieval of IVC filter. A. Computed tomography image in a patient referred for IVC filter retrieval shows an increased tilt angle (17°). B. Angiography image demonstrating the failure of capture of the IVC filter – likely due to endothelialisation of the tip caused by tilting.

of lower limbs. The mainstay of treatment in these patients is AC therapy. A previous Indian study² revealed up to 94% of VTE's were treated with AC therapy. However for patients who cannot be treated with AC therapy due to recent major bleed, recent major surgery or need for major surgery, the placement of IVC filters is supported by guidelines from American College of Chest Physician,³ American Heart Association⁴ Society of Interventional Radiology^{5,6} and American College of Radiology.⁷ In addition, failure of AC therapy is considered to be an absolute indication by guidelines of American Heart Association,⁴ Society of Interventional Radiology^{5,6} and American College of Radiology.⁷ The other indications, i.e. ilio-caval deep venous thrombosis, massive pulmonary embolism, concomitant malignancy, prior to CDT etc. are considered relative indications for IVC filter placement.

Our study shows increased IVC filter placement up to 2013 with a subsequent reduction in the number of patients undergoing this procedure. Similar trends are also seen in previous studies⁸ where there was a reduction in IVC filter placements. These trends can be attributed to the revised guidelines being made more stringent by the societies mentioned above.

Male patients form a larger proportion of patients of venous thromboembolism, similar to previous studies.^{1,2,9} One study¹⁰ has shown increased levels of homocysteine in males likely leading to increased frequency of venous thromboembolism. Our study reveals the percentage of male patients undergoing IVC filter placement (67.85%) was more than double the number of female patients (32.15%) undergoing IVC filter placement.

In a previous Indian study, the commonest comorbidities in patients developing VTE were hypertension (25%) followed by diabetes (19%) while only 7% of patients had a history of concomitant malignancy.² Another Indian study showed malignancy (31%) as a common risk factor for the development of VTE.¹¹ In our study, we found hypertension (28.57%), malignancy (28.57%) and diabetes (14.28%) as common comorbidities in patients who underwent IVC filter placement.

Contrary to previous studies that show a larger proportion of patients with relative indications for IVC filter placement, our study shows that most patients had absolute indications for IVC filter placement which can be attributed to the stringent patient selection criteria. The low number of procedures performed in our centre may also be in part explained by the unaffordability of the procedure by the vast proportion of the low-income population that our centre caters to.

The IVC filters used in our institute were all temporary, yet the retrieval rate was very low. This finding is in concordance with the previous studies. Reasons for poor retrieval rate was largely due to lack of proper guidance to the patient and poor follow up/referral back to the Intervention department. IVC filters should be removed as soon as the patient can be treated with therapeutic AC. Our study and multiple studies prove the fact that emphasis should be made on patient education regarding IVC filter retrieval and follow up. The complications of indwelling IVC filter are well known, and therefore retrieval of IVC filter once the patient can be administered with AC is imperative. One of the dreaded complications of long duration IVC filter placement is IVC thrombosis¹² which is more pronounced in patients with metastatic malignancy,¹³ which forms a major percentage of our patients. Although none of the patients in our study group developed these complications, this is likely due to the shorter period of follow up of this study. A proper record of IVC filter patients should be preserved and follow up to the intervention clinic should be mandatory. In non-compliant patients, reminder calls from the hospital should be made to emphasize the complications of IVC filter in situ and the need for its retrieval.

Our study is limited by small sample size, and it is not feasible to extrapolate the findings of this study to a larger population. Secondly, more patients with absolute indications underwent IVC filter placement in our institute. The low filter implantation rates and retrieval rates may be confounded by the relatively expensive procedure in a tertiary care facility predominately catering to the lower socio-economic strata of the population and also where implantation for a relative indication might not be financially feasible. With the rise of Government insurance schemes in India covering the procedure for the poor, the utilization of this procedure may improve in the future making effective communication between patients, referring clinicians and interventionists more important. The number of patients who might have chosen not to proceed with the procedure and their reasons could not be assessed in this retrospective study. Further data regarding thromboembolism scores and statistical comparisons with outcomes would have been ideal but was not the objective of the study.

5. Conclusion

Our single centre study reveals the trends of IVC filter placement in a tertiary referral centre in India, which is concordant with the observations made in previous studies except for more stricter patient selection leading to a larger percentage of patients with absolute indications undergoing IVC filter placement rather than those with relative indications. Poor retrieval rates of IVC filter are seen as with previous other studies, which need special attention to patient awareness to improve IVC filter retrieval rates. It should be emphasised that it is the responsibility of the interventionist placing the filter to educate the patient regarding the importance of filter retrieval and risks involved if the filter is not retrieved. Periodic follow up is imperative to improve the IVC filter retrieval rate.

Contributions

All the authors contributed equally in preparation, design and final approval of the manuscript.

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Informed consent and consent for publication

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Nil.

Declaration of competing interest

Nil.

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