Inferior Vena Cava Filters: Guidelines, Best Practice, and Expanding Indications

Elliot DeYoung, MD[1] Jeet Minocha, MD[1]

[1] Department of Radiology, Section of Interventional Radiology, University of California San Diego, San Diego, California

Address for correspondence Jeet Minocha, MD, Department of Radiology, Section of Interventional Radiology, University of California San Diego, 200 West Arbor Dr, #8756, San Diego, CA 92103-8756 (e-mail: jminocha@ucsd.edu).

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Abstract

Vena caval interruption, currently accomplished by percutaneous image-guided insertion of an inferior vena cava (IVC) filter, is an important therapeutic option in the management of selected patients with venous thromboembolism. The availability of optional (or retrievable) filters, in particular, has altered the practice patterns for IVC filters, with a shift to these devices and expansion of indications for filter placement. 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 expand. This article reviews current guidelines and expanding indications for IVC filter placement.

Keywords

- inferior vena cava filters
- indications
- guidelines
- interventional radiology

Objectives: Upon completion of this article, the reader will be able to describe current guidelines and expanding indications for inferior vena cava filter placement.

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Venous thromboembolism (VTE)—deep vein thrombosis (DVT) and pulmonary embolism (PE)—affects 1 to 2 individuals per 1,000 annually, and it is a leading cause of preventable hospital death in the United States.[1–3] Although DVT is diagnosed approximately twice as often as PE, the 1-month mortality rate of PE is twice that of DVT.[4]

Anticoagulation is the preferred treatment for VTE.[5,6] Vena caval interruption, currently accomplished by percutaneous image-guided insertion of an inferior vena cava (IVC) filter, is another important therapeutic option in the management of selected patients with VTE. Specifically, when anticoagulation is contraindicated, results in complications, or fails to protect patients adequately from thromboembolism, patients can be treated with insertion of an IVC filter.[7]

There are two general types of IVC filters currently available in the United States: permanent and optional (or retrievable). Permanent filters have been used since the 1970s and are placed in patients with a long-term need for mechanical prophylaxis against PE and absolute contraindications to anticoagulation.[8] Optional filters (i.e., filters that have the "option" of being retrieved) have been available since the late 1990s and are designed to be retrieved or left in place after the temporary risk of PE or contraindication to anticoagulation has resolved.[9] If retrieved, these devices offer the theoretical benefit of fewer long-term complications associated with permanent IVC filters, such as increased risk of subsequent DVT, filter migration/embolization, and IVC stenosis or occlusion.[10,11]

The availability of optional filters, in particular, has altered the practice patterns for IVC filters, with an increase in filter placement rates and shift to these devices and expansion of indications for filter placement.[9] For example, optional filters are now placed for prophylactic indications in patients who are at increased risk for the development of VTE and unable to tolerate prophylactic anticoagulation, such as in the setting of

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trauma.[12,13] As a result, the number of filter placements in the United States has increased steadily each year, with prophylactic indications now accounting for more than half of all filter placements.[14]

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 expand.[14] This article reviews current guidelines and expanding indications for IVC filter placement.

Indications for IVC Filter Placement

According to the Society of Interventional Radiology (SIR), IVC filters are typically placed in three clinical scenarios: (1) in patients with VTE and classic indications; (2) in patients with VTE and extended indications; and (3) in patients without VTE for primary prophylaxis against PE[15] (←**Table 1**).

Classic Indications

The classic indications for IVC filter placement include documented VTE and:

1. Absolute contraindication to anticoagulation
2. Complication of anticoagulation resulting in cessation of therapy
3. Failure of anticoagulation[15]

Contraindications to anticoagulation include conditions with a high risk of uncontrolled bleeding, such as major bleeding diathesis (e.g., coagulation defects, severe thrombocytopenia [platelet count < 50,000/μL]), uncontrollable active bleeding (e.g., gastrointestinal bleeding from any cause), acute hemorrhagic stroke, cerebral lesions at high risk of bleeding, severe uncontrolled hypertension, and severe renal and/or hepatic dysfunction. Complication of anticoagulation is a classic indication for filter placement if it necessitates stopping therapy. Spontaneous or significant unprovoked hemorrhage while on anticoagulant therapy is not uncommon in the elderly or in patients with comorbidities such as chronic kidney disease, in which the pharmacokinetics of anticoagulant drugs may be altered.[16] Failure of anticoagulation—defined as the inability to reach or maintain therapeutic levels of anticoagulation and/or documented progression of DVT or recurrent PE while on therapeutic anticoagulation—is also accepted as a classic indication for filter placement. A final traditional indication for filter insertion is massive PE that puts the patient at risk of death from further pulmonary emboli regardless of anticoagulation status.

Extended Indications

Extended (i.e., relative or "softer") indications have been introduced into clinical practice over time, as newer generations of IVC filters have become available and easier to place. These indications are based on specific risks for complications from VTE or anticoagulation, and include the following:

1. Iliocaval DVT or large, free-floating proximal DVT
2. Difficulty establishing therapeutic anticoagulation
3. Massive PE treated with thrombolysis/thrombectomy
4. Chronic PE treated with thromboendarterectomy
5. Thrombolysis for iliocaval DVT
6. VTE with limited cardiopulmonary reserve
7. Recurrent PE with filter in place
8. Poor compliance with anticoagulation
9. High risk of complication of anticoagulation (e.g., risk for frequent falls)

Many extended indications are attributable to the availability of optional filters, which has resulted in a lowering of thresholds for filter placement because of the perception that these devices can be retrieved. Until recently, however, the majority of optional filters were not retrieved.[9]

Table 1 Classic, extended, and prophylactic indications for IVC filter placement

Patients with documented VTE and classic indications	Patients with documented VTE and expanded indications	Patients without VTE
Contraindication to anticoagulation	Iliocaval or large free-floating proximal DVT	Trauma patient with high risk of VTE
Complication of anticoagulation necessitating cessation	Inability to achieve/maintain adequate anticoagulation	Surgical procedure in a patient at high risk for VTE
Failure of anticoagulation	Massive PE with residual DVT in a patient at risk for further PE	Medical condition with high risk of VTE
Propagation/progression of DVT during therapeutic anticoagulation	Chronic venous thromboembolism treated with thromboendarterectomy	
	Thrombolysis of iliocaval DVT	
	VTE with limited cardiopulmonary reserve	
	Recurrent PE with IVC filter in place (filter failure)	
	Poor compliance with anticoagulation	
	High risk of complication of anticoagulation (e.g., high fall risk)	

Abbreviations: DVT, deep venous thrombosis; IVC, inferior vena cava; PE, pulmonary embolism; VTE, venous thromboembolism.

Prophylactic Indications

Prophylactic indications for IVC filter placement are those in which a patient does not have VTE, but is at risk of developing DVT and/or PE and cannot receive anticoagulation or be monitored for the development of VTE.[15] For example, retrospective case series have suggested that the placement of prophylactic IVC filters in trauma patients may reduce symptomatic and fatal PE. However, there are currently no randomized trials to support the use of prophylactic IVC filters in any patient group.[17] Despite this, prophylactic indications now account more than half of all filter placements.[14]

Guidelines for IVC Filter Placement

Although filter utilization continues to increase,[14] the indications for IVC filter placement have not been derived from, nor studied with, the same methodological rigor that has been applied to anticoagulation. The distinctions among classic, extended, and prophylactic indications detailed earlier are based largely on historical practice patterns, "expert opinion," and case series, and not supported by prospective, randomized controlled trials. In fact, only one level I clinical trial has been conducted on the effectiveness of IVC filters in preventing PE.

The PREPIC (Prevention du Risque d'Embolie Pulmonaire par Interruption Cave) trial randomized 400 patients with proximal DVT to receive anticoagulation with an IVC filter versus anticoagulation alone.[18] Four different permanent filters were used in this study. Within the first 12 days, two patients in the filter group and nine patients in the anticoagulation group developed PE. After 2 years, symptomatic PE had occurred with twice the frequency in the nonfilter group, but the difference was not statistically significant. There were, however, significantly more symptomatic DVTs in the filter group. In follow-up data at 8 years, there were significantly fewer symptomatic PEs in the filter group, but there were also significantly more symptomatic DVTs in the filter group.[19] There was no survival difference between patients with or without filters at 12 days, 2 years, or 8 years.

Based on the current available data, guidelines for IVC filter placement from the American College of Radiology (ACR) in conjunction with SIR, American Heart Association (AHA), American College of Chest Physicians (ACCP), British Committee for Standards in Hematology (BCSH), and European Society of Cardiology (ESC) support IVC filter placement in patients with VTE and a contraindication to anticoagulation. While there is general consensus with respect to classic indications, guidelines on extended and prophylactic indications remain disparate given the lack of prospective data. ←**Tables 2–6** summarize the current guidelines on IVC filter placement from the ACR/SIR, AHA, ACCP, BCSH, and ESC.

Expanding Indications

The expanding indications for IVC filters are attributable, in part, to the availability of optional filters, which have resulted in a lowering of thresholds for filter placement.[9] Prophylactic indications, for example, account for the majority of new filter placements despite limited data supporting their use. Ongoing clinical research has focused on supporting these expanding indications for IVC filters in selected patient populations, including trauma patients, patients undergoing bariatric surgery, pregnant patients, and pediatric patients, among others.

Trauma Patients

Trauma patients complete Virchow VTE triad of endothelial injury, hemodynamic changes related to immobility, and hypercoagulability associated with severe trauma. VTE can occur in greater than half of all trauma patients who cannot receive prophylactic anticoagulation.[20] Although retrospective case series have suggested that prophylactic IVC filters in trauma patients may reduce symptomatic and fatal PE, there are no randomized trials to date that support this indication.

In 2002, the Eastern Association of Trauma (EAST) issued guidelines suggesting prophylactic IVC filters be considered for high-risk trauma patients with suspected prolonged immobilization who cannot receive prophylactic anticoagulation (Glasgow Coma Score < 8, incomplete spinal cord

Table 2 ACR/SIR guidelines

Patients with documented VTE	No documented VTE
Absolute or relative contraindication to anticoagulation	Severe trauma without documented PE or DVT
Complication of anticoagulation	Closed head injury
Recurrent PE despite adequate therapy	Spinal cord injury
Inability to achieve/maintain adequate anticoagulation	Multiple long-bone or pelvic fractures
Propagation/progression of DVT during therapeutic anticoagulation	Patients at high risk (e.g., immobilized or in an intensive care unit)
Massive PE with residual DVT in a patient at risk for further PE	
Free-floating iliofemoral or IVC thrombus	
Severe cardiopulmonary disease and DVT (e.g., cor pulmonale with pulmonary hypertension)	

Abbreviations: ACR, American College of Radiology; DVT, deep venous thrombosis; IVC, inferior vena cava; PE, pulmonary embolism; SIR, Society of Interventional Radiology; VTE, venous thromboembolism.

Table 3 American College of Chest Physicians guidelines

1. Vena caval filters for the initial treatment of DVT: for patients with acute proximal DVT, if anticoagulant therapy is not possible because of the risk of bleeding, placement of an IVC filter is recommended (grade 1C)
2. In children weighing >10 kg with lower-extremity DVT and a contraindication to anticoagulation, placement of a temporary IVC filter is suggested (grade 2C)
3. Vena caval filters for the initial treatment of PE: in patients with acute PE, if anticoagulant therapy is not possible because of risk of bleeding, placement of an IVC filter is recommended (grade 1C)
4. For patients with CTPH undergoing pulmonary thromboendarterectomy, placement of a permanent vena caval filter before or at the time of the procedure is suggested (grade 2C)

Abbreviations: CTPH, chronic thromboembolic pulmonary hypertension; DVT, deep venous thrombosis; IVC, inferior vena cava; PE, pulmonary embolism.

Table 4 AHA guidelines on IVC filter placement

1. Adult patients with any acute proximal DVT (or acute PE) with contraindications to anticoagulation or active bleeding complication should receive an IVC filter (Class I; Level of Evidence B)
2. Anticoagulation should be resumed in patients with an IVC filter once contraindications to anticoagulation or active bleeding complications have resolved (Class I; Level of Evidence B)
3. Patients who receive retrievable IVC filters should be evaluated periodically for filter retrieval within the specific filter's retrieval window (Class I; Level of Evidence C)
4. For patients with recurrent PE despite therapeutic anticoagulation, it is reasonable to place an IVC filter (Class IIa; Level of Evidence C)
5. For IFDVT patients who are likely to require permanent IVC filtration (e.g., long-term contraindication to anticoagulation), it is reasonable to select a permanent nonretrievable IVC filter device (Class IIa; Level of Evidence C)
6. For IFDVT patients with a time-limited indication for an IVC filter (e.g., a short-term contraindication to anticoagulant therapy), placement of a retrievable IVC filter is reasonable (Class IIa; Level of Evidence C)
7. For patients with recurrent DVT (without PE) despite therapeutic anticoagulation, it is reasonable to place an IVC filter (Class IIb; Level of Evidence C)
8. An IVC filter should not be used routinely in the treatment of IFDVT (Class III; Level of Evidence B)

Abbreviations: AHA, American Heart Association; DVT, deep venous thrombosis; IFDVT, iliofemoral deep venous thrombosis; IVC, inferior vena cava; PE, pulmonary embolism; VTE, venous thromboembolism.

Table 5 Summary of British Committee for standards in hematology IVC filter guidelines[34]

IVC filter Indicated
For patients with VTE and contraindication to anticoagulation
Consider IVC filter placement
In select patients with PE despite anticoagulation
In pregnant patient with VTE and contraindications to anticoagulation (including estimated delivery within 2 wk)
Preoperatively (retrievable) for patients with recent VTE (1 mo) and need to stop anticoagulation therapy for surgery
IVC filters not recommended for
Unselected patients with VTE who can receive anticoagulation
Free-floating thrombus
Thrombolysis

Abbreviations: IVC, inferior vena cava; PE, pulmonary embolism; VTE, venous thromboembolism.

injury, closed head injury, complex pelvic and long-bone fractures, and paresis) (►**Table 7**).[12] A systematic review of prophylactic IVC filters, including 24 studies with 2,492 patients, cited a lack of conclusive data to support prophylactic use in trauma patients.[21] However, a more recent meta-analysis found an association between IVC filter placement and lower rates of symptomatic and fatal PE in the trauma patient population in whom filters were placed.[22] Given the variability of existing data, it is not surprising that practice patterns vary widely in regard to prophylactic IVC filter use in this population. A study examining trauma quality collaborative data from 2011 to 2014 demonstrated hospital rates of IVC filter insertion ranging from 0.6 to 9.6%, all in trauma patients without VTE, signifying large variance in practice

Table 6 European Society of Cardiology Guidelines on venous filters

Indicated for
Documented VTE and contraindication to anticoagulation
Recurrent PE despite anticoagulation
Not recommended for
Prophylactic placement
Free-floating thrombus
Prior to systemic thrombolysis, surgical embolectomy, or pulmonary thromboendarterectomy

Table 7 EAST guidelines for prophylactic IVC filter placement in trauma patients

Prophylactic IVC filter insertion should be considered in very high-risk trauma patients:
1. Who cannot receive anticoagulation because of increased bleeding risk and
2. Who have an injury pattern rendering them immobilized for a prolonged period of time, including the following:
A. Severe closed head injury (GCS < 8)
B. Incomplete spinal cord injury with paraplegia or quadriplegia
C. Complex pelvic fractures with associated long-bone fractures
D. Multiple long-bone fractures

Abbreviations: EAST, Eastern Association for the Surgery of Trauma; GCS, Glasgow Coma Scale; IVC, inferior vena cava.

patterns across the United States.[23] The SIR has identified IVC filter use in trauma patients as a priority for future research.[14]

Bariatric Surgical Patients

VTE prophylaxis in bariatric surgical patients can be challenging, as morbid obesity is recognized as an independent risk factor for VTE. Following surgery, the associated immobility and endothelial injury place these patients at particularly high risk for VTE.[24] Except for sepsis from anastomotic leaks, VTE is the second leading cause of death in patients undergoing bariatric surgery.[25]

Although the overall rate of VTE in bariatric surgical patients is low (estimated to be between 0.5 and 1.5%), there remains a lack of clear consensus on how best to provide prophylactic anticoagulation for this population. Standard weight-based dosing calculations are not always accurate in the morbidly obese patient, and dosing based on ideal body weight is difficult and likely suboptimal because a high body mass index (BMI) also confers an increased risk of VTE. Prophylactic optional IVC filter placement has been shown to be safe and reduce the risk of PE in selected morbidly obese patients (BMI > 55).[26] However, there is conflicting evidence and heterogeneous data about prophylactic IVC filter placement in this population.[25] As is true for other subpopulations, there are no good prospective, randomized trails, and additional data are needed.[27]

Pregnant Patients

VTE during pregnancy is estimated to be five to six times greater than in the nonpregnant state.[28,29] Hypercoagulability associated with pregnancy begins in the first trimester and persists for up to 2 months postpartum. In the third trimester, the gravid uterus can cause flow-altering compression of the iliac veins and IVC, further increasing risk of VTE.[30] Anticoagulation, especially with impending childbirth, carries a risk of hemorrhage that is difficult to quantify. A smaller number of these patients may have complications for which anticoagulation is absolutely contraindicated (e.g., placenta previa). The use of optional filters in pregnant patients has been shown to be safe.[31] SIR guidelines recommend suprarenal IVC filter placement in pregnant patients, if the filter is clinically indicated.[15] Optimally, retrieval should be performed as soon as appropriate in the postpartum period.

Pediatric Patients

VTE has historically been considered rare in the pediatric population compared with adults. A recent review reports an increasing incidence of VTE in the tertiary pediatric hospital population, possibly related to advancements in care and survival rates in once fatal pediatric conditions.[32] Data on IVC filter use in pediatric patients is lacking and largely composed of single-center case series. Blevins et al published a large, multicenter, retrospective review in 2015 using the Pediatric Health Information System (PHIS), which includes data from 44 tertiary children hospitals in the United States.[32] The authors' concluded that IVC filter placement is rare in children (6 per 100,000 admission), and unlike in adults, the rate of IVC filter placement held relatively stable over the 8-year study period from 2004 to 2012. In this population, only a minority of filters were placed prophylactically. SIR has no specific guidelines regarding IVC filters in pediatric patients, although the ACCP guidelines recommend IVC filters be placed only in children weighing greater than 10 kg who have lower extremity DVT and a contraindication to

anticoagulation (in these guidelines, PE without lower extremity DVT is not considered an indication).[33] Further research is needed to better define the role of IVC filters in the pediatric population.

Summary

Vena caval interruption, currently accomplished by percutaneous image-guided insertion of an IVC filter, is an important therapeutic option in the management of selected patients with VTE. The availability of optional (or retrievable) filters, in particular, has altered the practice patterns for IVC filters, with a shift to these devices and expansion of indications for filter placement. 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 expand.

References

1 Silverstein MD, Heit JA, Mohr DN, Petterson TM, O'Fallon WM, Melton LJ III. Trends in the incidence of deep vein thrombosis and pulmonary embolism: a 25-year population-based study. Arch Intern Med 1998;158(6):585–593
2 Heit JA, Cohen AT, Anderson FA Jr. Estimated annual number of incident and recurrent, non-fatal and fatal venous thromboembolism (VTE) events in the US. Paper presented at ASH Annual Meeting Abstracts; 2005
3 Naess IA, Christiansen SC, Romundstad P, Cannegieter SC, Rosendaal FR, Hammerstrøm J. Incidence and mortality of venous thrombosis: a population-based study. J Thromb Haemost 2007; 5(4):692–699
4 White RH. The epidemiology of venous thromboembolism. Circulation 2003;107(23, Suppl 1):I4–I8
5 Segal JB, Streiff MB, Hofmann LV, Thornton K, Bass EB. Management of venous thromboembolism: a systematic review for a practice guideline. Ann Intern Med 2007;146(3):211–222
6 Bates SM, Jaeschke R, Stevens SM, et al; American College of Chest Physicians. Diagnosis of DVT: antithrombotic therapy and prevention of thrombosis: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141(2, Suppl):e351S–e418S
7 Kinney TB. Update on inferior vena cava filters. J Vasc Interv Radiol 2003;14(4):425–440
8 Greenfield LJ, Proctor MC. Twenty-year clinical experience with the Greenfield filter. Cardiovasc Surg 1995;3(2):199–205
9 Angel LF, Tapson V, Galgon RE, Restrepo MI, Kaufman J. Systematic review of the use of retrievable inferior vena cava filters. J Vasc Interv Radiol 2011;22(11):1522–1530.e3
10 Ray CE Jr, Mitchell E, Zipser S, Kao EY, Brown CF, Moneta GL. Outcomes with retrievable inferior vena cava filters: a multicenter study. J Vasc Interv Radiol 2006;17(10):1595–1604
11 Charles HW, Black M, Kovacs S, et al. G2 inferior vena cava filter: retrievability and safety. J Vasc Interv Radiol 2009;20(8):1046–1051
12 Rogers FB, Cipolle MD, Velmahos G, Rozycki G, Luchette FA. Practice management guidelines for the prevention of venous thromboembolism in trauma patients: the EAST practice management guidelines work group. J Trauma 2002;53(1):142–164
13 Karmy-Jones R, Jurkovich GJ, Velmahos GC, et al. Practice patterns and outcomes of retrievable vena cava filters in trauma patients: an AAST multicenter study. J Trauma 2007;62(1):17–24, discussion 24–25
14 Kaufman JA, Rundback JH, Kee ST, et al. Development of a research agenda for inferior vena cava filters: proceedings from a multidisciplinary research consensus panel. J Vasc Interv Radiol 2009; 20(6):697–707
15 Kaufman JA, Kinney TB, Streiff MB, et al. Guidelines for the use of retrievable and convertible vena cava filters: report from the Society of Interventional Radiology multidisciplinary consensus conference. J Vasc Interv Radiol 2006;17(3):449–459
16 Levine MN, Raskob G, Landefeld S, Kearon C. Hemorrhagic complications of anticoagulant treatment. Chest 2001;119(1, Suppl): 108S–121S
17 Girard TD, Philbrick JT, Fritz Angle J, Becker DM. Prophylactic vena cava filters for trauma patients: a systematic review of the literature. Thromb Res 2003;112(5–6):261–267
18 Decousus H, Leizorovicz A, Parent F, et al. A clinical trial of vena caval filters in the prevention of pulmonary embolism in patients with proximal deep-vein thrombosis. Prévention du Risque d'Embolie Pulmonaire par Interruption Cave Study Group. N Engl J Med 1998;338(7):409–415
19 Group PS; PREPIC Study Group. Eight-year follow-up of patients with permanent vena cava filters in the prevention of pulmonary embolism: the PREPIC (Prevention du Risque d'Embolie Pulmonaire par Interruption Cave) randomized study. Circulation 2005; 112(3):416–422
20 Geerts WH, Code KI, Jay RM, Chen E, Szalai JP. A prospective study of venous thromboembolism after major trauma. N Engl J Med 1994;331(24):1601–1606
21 Kidane B, Madani AM, Vogt K, Girotti M, Malthaner RA, Parry NG. The use of prophylactic inferior vena cava filters in trauma patients: a systematic review. Injury 2012;43(5):542–547
22 Haut ER, Garcia LJ, Shihab HM, 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
23 Hemmila MR, Osborne NH, Henke PK, et al. Prophylactic inferior vena cava filter placement does not result in a survival benefit for trauma patients. Ann Surg 2015;262(4):577–585
24 Anderson FA Jr, Spencer FA. Risk factors for venous thromboembolism. Circulation 2003;107(23, Suppl 1):I9–I16
25 Kaw R, Pasupuleti V, Abhishek D, Modha K, Hernandez A. IVC filters and postoperative outcomes in patients undergoing bariatric surgery: a meta-analysis. Chest 2013;144(4 Meeting Abstracts):1001
26 Gargiulo NJ III, Veith FJ, Lipsitz EC, Suggs WD, Ohki T, Goodman E. Experience with inferior vena cava filter placement in patients undergoing open gastric bypass procedures. J Vasc Surg 2006; 44(6):1301–1305
27 Rowland SP, Dharmarajah B, Moore HM, et al. Inferior vena cava filters for prevention of venous thromboembolism in obese patients undergoing bariatric surgery: a systematic review. Ann Surg 2015;261(1):35–45
28 Barbour LA; ACOG Committee on Practice Bulletins—Obstetrics. ACOG practice bulletin. Thrombembolism in pregnancy. Int J Gynaecol Obstet 2001;75(2):203–212
29 Eldor A. Thrombophilia, thrombosis and pregnancy. Thromb Haemost 2001;86(1):104–111
30 Chunilal SD, Bates SM. Venous thromboembolism in pregnancy: diagnosis, management and prevention. Thromb Haemost 2009; 101(3):428–438
31 Aburahma AF, Mullins DA. Endovascular caval interruption in pregnant patients with deep vein thrombosis of the lower extremity. J Vasc Surg 2001;33(2):375–378
32 Blevins EM, Glanz K, Huang YSV, Raffini L, Shinohara RT, Witmer C. A multicenter cohort study of inferior vena cava filter use in children. Pediatr Blood Cancer 2015;62(12):2089–2093
33 Hirsh J, Guyatt G, Albers GW, Harrington R, Schünemann HJ; American College of Chest Physicians. Executive summary: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). Chest 2008;133(6, Suppl):71S–109S
34 British Committee for Standards in Haematology Writing group, Baglin TP, Brush J, Streiff M. Guidelines on use of vena cava filters. Br J Haem 2006;134:590–595