



Retrievable vena cava filters to protect from venous thromboembolism: do not overuse them, and do not forget to retrieve them!

Stavros V. Konstantinides^{1,2}

¹Center for Thrombosis and Hemostasis, University Medical Center of the Johannes Gutenberg University, Mainz, Germany; ²Department of Cardiology, Democritus University of Thrace, Alexandroupolis, Greece

Correspondence to: Stavros V. Konstantinides, MD, PhD. Center for Thrombosis and Hemostasis, University Medical Center Mainz, Langenbeckstrasse 1, Building 403, 55131 Mainz, Germany. Email: stavros.konstantinides@unimedizin-mainz.de.

Comment on: Brown JD, Raissi D, Han Q, *et al.* Vena Cava Filter Retrieval Rates and Factors Associated With Retrieval in a Large US Cohort. *J Am Heart Assoc* 2017;6. pii: e006708.

Received: 17 January 2018; Accepted: 28 January 2018; Published: 13 July 2018.

doi: 10.21037/dmr.2018.07.02

View this article at: <http://dx.doi.org/10.21037/dmr.2018.07.02>

Venous thromboembolism (VTE), clinically presenting as deep vein thrombosis (DVT) with or without pulmonary embolism (PE), is globally the third most frequent acute cardiovascular syndrome behind myocardial infarction and stroke (1,2). Epidemiological studies point to high annual incidence rates, reported to range from 39 per 100,000 (in Hong Kong) to 115 per 100,000 population (in the United States) for PE, and from 53 per 100,000 (in Korea) to 162 per 100,000 population (in Sweden) for DVT (3). Cross-sectional data show that the incidence of VTE is almost eight times higher in individuals aged 80 years or older than in the fifth decade of life (40–49 years of age) (3). In parallel, longitudinal studies reveal a rising tendency in annual PE incidence (4,5) and PE-related mortality rates (6,7) over time. Taken together, these observations highlight the growing importance of PE and DVT for the life and health of ageing populations, and that the burden that VTE will increasingly represent for health systems worldwide in the years to come.

Today, pharmacological treatment, based on parenteral and/or oral anticoagulation regimens (2), is recognized by international guidelines and consensus statements as the cornerstone of all effective VTE management and prevention strategies (8–11). On the other hand, and in contrast to their dominant role in treating acute coronary syndromes or peripheral artery disease, percutaneous catheter-directed interventions are generally not a first line option for the majority of patients with PE or DVT (12).

There is, however, one exception: the widespread use, at least in some countries, of inferior vena cava filters in the ‘mechanical’ prevention of PE in patients with or without recent VTE. Following their introduction for permanent placement and interruption of the inferior vena cava almost half a century ago (13), filters began to gain in popularity in the late 80’s and early 90’s, and this trend was accentuated when they became available as retrievable devices in the past decade (14).

When should cava filters be inserted to prevent first or recurrent VTE? The persisting confusion surrounding their indications, and the overuse of filters often observed in clinical practice, are difficult to understand in view of expert consensus and guideline recommendations, which appear to be quite clear and consistent on this point. They all state, namely, that filters are indicated (*only*), (I) in patients who are at high risk of first or recurrent PE, but have contraindications to anticoagulant treatment; or (II) in patients in whom PE recurs despite therapeutic levels of anticoagulation (9,11,15). On the other hand, and importantly, routine use of cava filters is not recommended ‘on top’ of anticoagulant therapy (8). There are indeed good reasons and a solid rationale for this cautious, selective approach. The most recent supporting evidence comes from a systematic review and meta-analysis of the published reports on the efficacy and safety of cava filters, which was published in 2017 (16). Eleven studies, with a total number of 2,055 patients who received a filter versus

2,149 controls, were included. Cava filter placement was associated with a 50% decrease in the incidence of PE, but at the same time there was an approximately 70% increase in the risk of DVT over time. Of note, neither all-cause nor PE-related mortality differed between patients with and those without filter placement. Multiple sensitivity analyses suggested that only the adherence to current guideline recommendations (but none of the patients' baseline parameters tested) appeared able to identify those patients who might indeed benefit from cava filters (16). Overall, it must be acknowledged that the evidence for the use of cava filters has remained quite weak and non-conclusive over the past decades; this is due to the considerable limitations of existing studies, which were highlighted both by the authors of the recent meta-analysis (16) and by the accompanying editorial (17). These limitations result primarily from the marked heterogeneity in (I) the design of the studies, (II) the clinical indications and types of filters used, and (III) the concomitant VTE management (anticoagulation), all related to the fact that the existing studies span a more than 40-year time period! In addition, most studies [with the exception of a large randomized controlled trial (18)] lacked an independent adjudication of outcomes, and there is a strong possibility of under-reported procedure-related complications.

The findings mentioned above are also supported by 'real world' data. In fact, a retrospective analysis of (non-cancer) patients in California between 2005 and 2010 revealed that, among 80,697 patients with no contraindication to anticoagulation, filter use (9.6%) did not significantly reduce the 30-day risk of death or the risk of subsequent PE, while it did increase the risk of subsequent DVT by 50%. Only patients with active bleeding appeared to benefit from the insertion of a cava filter (19).

Is this evidence and the resulting guideline recommendations, which discourage indiscriminate use of cava filters for primary or secondary VTE prevention on top of standard anticoagulation, translated into clinical practice? Unfortunately, as already mentioned above, this does not appear to be the case. Between 2001 and 2006, their use increased threefold in the United States (14). Another national cohort study conducted in the same country between 1999 and 2010 found that, of 556,658 patients hospitalized with PE during this period, 94,427 patients, or approximately 16%, underwent cava filter placement (20). This high rate of cava filter use remained relatively steady over time, but their absolute number continued to increase since a growing number of patients were hospitalized

because of PE each year (20). It is really hard to believe that as many as 16% of all patients with a high risk of (recurrent) VTE had contraindications to anticoagulants, and thus inappropriate (over)use of filters in a number of cases is the most likely explanation for these numbers. This notion blaming rather arbitrary selection criteria is also supported by the wide variation in cava filter use between hospitals, even in geographically proximate areas (21).

Inserting a cava filter without a clear indication may generate unnecessary costs, and this in an era in which demonstration of cost effectiveness for every drug or procedure is becoming a top priority. Importantly however, it is also a major safety issue: even though filter placement may generally be considered a low-risk intervention, serious complications are always possible. More specifically, a systematic literature review revealed penetration of the venous wall in 1,699 (19%) of 9,002 procedures; of these cases, 19% showed adjacent organ involvement and at least 8% were symptomatic (22). Lethal complications were very rare (only 2 cases), but 5% of the patients required major interventions such as surgical removal of the filter, endovascular stent placement or embolization, endovascular retrieval of the permanent filter, or percutaneous nephrostomy or ureteral stent placement (22). Further reported complications include filter fracture and/or embolization, and of course, as already mentioned, the risk of DVT, occasionally extending up to the vena cava (23-25).

The risk of filter-related complications and adverse events has been associated, among others, with failure to remove them as soon as they are no longer needed (23,24). Therefore, one would expect steadily and effectively declining complication rates over time thanks to the use of retrievable filters since the beginning of the past decade. Surprisingly (and disappointingly) however, a national cohort study published in 2017 by Brown and co-workers in the *Journal of the American Heart Association* shows that, in the vast majority of cases, retrievable cava filters are not retrieved (as they should) within 90 days of their implantation, actually not even later (26). In a carefully conducted observational study based on administrative healthcare claims data (medical diagnostic and procedural information combined with pharmacy bills to the patients' health insurance), the authors analyzed the data of 54,766 patients who received a cava filter between 2010 and 2014. The cumulative rate of filter retrieval was only 18.4% in the overall population (26), meaning that, as a whole, more than 4 out of five filters were left in place! Certainly, there was a trend towards improved retrieval rates over time, rising

from 14% in 2010 to approximately 24% in 2014. Besides, the authors argue that ‘true’ retrieval rates may have been underestimated due to technical limitations of their study and probably lie closer to 30% in the United States. Nevertheless, these numbers are still light-years away from the >90% three-month retrieval rate recommended and implemented in the PREPIC (Prevention du Risque d’Embolie Pulmonaire par Interruption Cave)-2 randomized trial (18). If, in the indications for filter placement, clinical practice is not willing to follow evidence-based guidelines, in the indications for retrieval it also has difficulty following the recommendations of national health authorities such as the United States Food and Drug Administration (26). Another important piece of information from in the study by Brown *et al.* (26) is that the time to initiation of anticoagulation and the time to filter retrieval were poorly correlated in their cohort, suggesting that many filters were probably ‘simply forgotten’ during follow-up visits, or that the visits themselves were ‘forgotten’ and never took place. Retrieval rates were poorer in elderly patients over 75 years of age, and in those living far from major urban hospitals.

There are important lessons for clinicians to learn from the cohort study by Brown *et al.* (26) as well as from the meta-analysis by Bikdeli *et al.* (16), both published in 2017:

- ❖ First, evidence-based national and international guidelines are there for a reason. Although blind adherence to guidelines should never replace medical judgement and the clinician’s decision based on the assessment of the individual patient, it is generally a very good idea to be aware of guideline recommendations, and particularly to read and understand the efficacy, safety, and cost effectiveness aspects that lie beneath them. A treatment different from that recommended by guidelines may indeed be justified or even necessary in some cases, but the reasons for the physician’s decision should then be clearly documented.
- ❖ Second, unnecessarily used devices (or drugs) may not only be costly but also potentially harmful or even life-threatening for the patient. In the case of interventions and devices including cava filters, complications are more likely in the early phase of the learning curve, but this fact should, of course, not be used as an argument to deviate from guidelines and perform such procedures as liberally as possible in order to ‘gain experience’ at the operator or hospital level.
- ❖ Third, use of a retrievable cava filter should, as the

use of any other medical device, be accompanied by full compliance with the instructions of the manufacturer and the national health authorities. Retrievable filters should be retrieved as soon as patients are able to receive appropriate therapeutic or prophylactic anticoagulation. If there are important reasons not to do so, these should be documented in the patient’s record. Most of all, regular follow-up visits for evaluation of the patient’s clinical course after filter placement, and possible adjustment of the therapeutic plan, are mandatory and should never be forgotten.

- ❖ Finally, the recent data highlight again the responsibility of the medical research community to document, in prospective cohort studies fulfilling high methodological standards and excluding selection and reporting bias, the characteristics and the outcomes of patients receiving cava filters. Only high quality data, such as those provided by the two recent publications, help to advance our knowledge in the field. Based on them we can continue to optimize our strategies for prevention of PE including, whenever appropriate, the use of inferior vena cava filters.

Acknowledgments

Funding: The work of SV Konstantinides was supported by the German Federal Ministry of Education and Research (BMBF 01EO1003).

Footnote

Provenance and Peer Review: This article was commissioned and reviewed by the Section Editor Dr. Wan Zhang (Department of Vascular Surgery, Huadong Hospital Affiliated to Fudan University, Shanghai, China).

Conflicts of Interest: The author reports having received consultancy and lecture honoraria from Bayer HealthCare, Boehringer Ingelheim, MSD Sharp & Dohme, Daiichi-Sankyo, Pfizer—Bristol-Myers Squibb, and BTG Biocompatibles Group; and institutional grants from Boehringer Ingelheim, Bayer HealthCare, Daiichi-Sankyo, Pfizer, and Actelion.

Ethical Statement: The authors is accountable for all aspects of the work in ensuring that questions related

to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

1. Raskob GE, Angchaisuksiri P, Blanco AN, et al. Thrombosis: a major contributor to global disease burden. *Arterioscler Thromb Vasc Biol* 2014;34:2363-71.
2. Barco S, Konstantinides SV. Risk-adapted management of pulmonary embolism. *Thromb Res*. 2017;151 Suppl 1:S92-6.
3. Wendelboe AM, Raskob GE. Global Burden of Thrombosis: Epidemiologic Aspects. *Circ Res* 2016;118:1340-7.
4. de Miguel-Díez J, Jimenez-Garcia R, Jimenez D, et al. Trends in hospital admissions for pulmonary embolism in Spain from 2002 to 2011. *Eur Respir J* 2014;44:942-50.
5. Park B, Messina L, Dargon P, et al. Recent trends in clinical outcomes and resource utilization for pulmonary embolism in the United States: findings from the nationwide inpatient sample. *Chest* 2009;136:983-90.
6. Tsai J, Grosse SD, Grant AM, et al. Trends in in-hospital deaths among hospitalizations with pulmonary embolism. *Arch Intern Med* 2012;172:960-1.
7. Wiener RS, Schwartz LM, Woloshin S. Time trends in pulmonary embolism in the United States: evidence of overdiagnosis. *Arch Intern Med* 2011;171:831-7.
8. Kearon C, Akl EA, Ornelas J, et al. Antithrombotic Therapy for VTE Disease: CHEST Guideline and Expert Panel Report. *Chest* 2016;149:315-52.
9. Konstantinides SV, Torbicki A, Agnelli G, et al. 2014 ESC Guidelines on the diagnosis and management of acute pulmonary embolism: The Task Force for the Diagnosis and Management of Acute Pulmonary Embolism of the European Society of Cardiology (ESC) Endorsed by the European Respiratory Society (ERS). *Eur Heart J* 2014;35:3033-69.
10. Jaff MR, McMurtry MS, Archer SL, et al. Management of massive and submassive pulmonary embolism, iliofemoral deep vein thrombosis, and chronic thromboembolic pulmonary hypertension: a scientific statement from the American Heart Association. *Circulation* 2011;123:1788-830.
11. Mazzolai L, Aboyans V, Ageno W, et al. Diagnosis and management of acute deep vein thrombosis: a joint consensus document from the European society of cardiology working groups of aorta and peripheral circulation and pulmonary circulation and right ventricular function. *Eur Heart J* 2017. [Epub ahead of print].
12. Konstantinides SV, Barco S, Lankeit M, et al. Management of Pulmonary Embolism: An Update. *J Am Coll Cardiol* 2016;67:976-90.
13. Greenfield LJ, McCurdy JR, Brown PP, et al. A new intracaval filter permitting continued flow and resolution of emboli. *Surgery* 1973;73:599-606.
14. Stein PD, Matta F, Hull RD. Increasing use of vena cava filters for prevention of pulmonary embolism. *Am J Med* 2011;124:655-61.
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. *Surg Obes Relat Dis* 2006;2:200-12.
16. Bikdeli B, Chatterjee S, Desai NR, et al. Inferior Vena Cava Filters to Prevent Pulmonary Embolism: Systematic Review and Meta-Analysis. *J Am Coll Cardiol* 2017;70:1587-97.
17. Konstantinides SV. The Elusive Evidence for Inferior Vena Cava Filters to Prevent Pulmonary Embolism. *J Am Coll Cardiol* 2017;70:1598-600.
18. Mismetti P, Laporte S, Pellerin O, et al. Effect of a retrievable inferior vena cava filter plus anticoagulation vs anticoagulation alone on risk of recurrent pulmonary embolism: a randomized clinical trial. *JAMA* 2015;313:1627-35.
19. White RH, Brunson A, Romano PS, et al. Outcomes After Vena Cava Filter Use in Noncancer Patients With Acute Venous Thromboembolism: A Population-Based Study. *Circulation* 2016;133:2018-29.
20. Bikdeli B, Wang Y, Mingos KE, et al. Vena Caval Filter Utilization and Outcomes in Pulmonary Embolism: Medicare Hospitalizations From 1999 to 2010. *J Am Coll Cardiol* 2016;67:1027-35.
21. White RH, Geraghty EM, Brunson A, et al. High variation between hospitals in vena cava filter use for venous thromboembolism. *JAMA Intern Med* 2013;173:506-12.

22. Jia Z, Wu A, Tam M, et al. Caval Penetration by Inferior Vena Cava Filters: A Systematic Literature Review of Clinical Significance and Management. *Circulation* 2015;132:944-52.
23. Durack JC, Westphalen AC, Kekulawela S, et al. Perforation of the IVC: rule rather than exception after longer indwelling times for the Gunther Tulip and Celect retrievable filters. *Cardiovasc Intervent Radiol* 2012;35:299-308.
24. Angel LF, Tapson V, Galgon RE, et al. Systematic review of the use of retrievable inferior vena cava filters. *J Vasc Interv Radiol* 2011;22:1522-30.e3.
25. 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;112:416-22.
26. Brown JD, Raissi D, Han Q, et al. Vena Cava Filter Retrieval Rates and Factors Associated With Retrieval in a Large US Cohort. *J Am Heart Assoc* 2017;6. pii: e006708.

doi: 10.21037/dmr.2018.07.02

Cite this article as: Konstantinides SV. Retrievable vena cava filters to protect from venous thromboembolism: do not overuse them, and do not forget to retrieve them! *Dig Med Res* 2018;1:8.