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Research progress in the application of inferior vena cava filter on acute venous thrombosis

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ABSTRACT

Anticoagulant therapy using heparins or *per os* vitamin K antagonists has been the treatment of choice in patients with venous thromboembolic disease for decades. However, the introduction of inferior vena cava (IVC) filters recently has provided new therapeutic choices appropriate for specific groups of patients with venous thromboembolic disease. This review aims to present all current evidence on the indications and precautions for the proper IVC filters utilization. There is still a great challenge in identifying the proper populations that would benefit from an IVC filter implantation or extraction. New randomized trials are needed to produce safe and clear guidelines of proper use.

1. Introduction

Venous thromboembolic disease, comprising deep vein thrombosis and/or pulmonary embolism (PE), is one of the commonest cardiovascular disorders as well as one of major causes for in-hospital morbidity and mortality worldwide[1]. Parenteral treatment with unfractionated heparin or low molecular weight heparin, followed by *per os* therapy with vitamin K antagonists has remained the therapeutic strategy of choice in the majority of patients for years. Recently, newer *per os* anticoagulants have been introduced showing promising results[2]. Castellucci *et al.* have concluded in an extensive meta-analysis of randomized studies that the newer anticoagulants have shown a similar efficacy and safety, although their bleeding risk seems to be lower[3].

The latest guidelines on acute venous thromboembolism (VTE) management recommend anticoagulant treatment duration of at least three months

initially, although the presence of certain risk factors could prolong treatment duration[4]. Patients with a transient and reversible risk factor (such as surgery, immobilisation, and recent trauma) show a lower annual risk of recurrent VTE after three months of oral anticoagulation and thus, they could safely discontinue treatment. Patients with an unprovoked VTE or with a proved permanent thrombotic factor (*e.g.* genetic mutation and antiphospholipid syndrome) have a higher risk of recurrence and hence could warrant longer anticoagulation treatment[5].

However, there is a subgroup of patients where anticoagulants are contraindicated or are not safe to use. For such patients, the indication for filter implantation should be carefully evaluated, and final decision should be based on full understanding of the filter's characteristics as well as consideration of the alternative choices. This study aims to collect and present all current data on proper selection and utilization of the inferior vena cava (IVC) filters.

2. Indications and contraindications for IVC filters

The presence of a proximal deep vein thrombosis

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in combination with an absolute contraindication for anticoagulative treatment, remains the only absolute indication for IVC filter placement^[4,6]. Table 1 demonstrates the most important indications for IVC filter placement.

Table 1

Indications for IVC filter placement.

Absolute indications	Relative indications
VTE and contraindications to anticoagulation	Unstable patients with VTE or patients with poor cardiopulmonary reserve with VTE
Failure of anticoagulation	Massive PE treated with thrombolysis
Complication of anticoagulation	Iliocaval DVT Floating proximal DVT Prophylaxis in patients undergoing high-risk surgery or after major trauma Floating proximal DVT Recurrent PE with filter in place

DVT: Deep venous thrombosis.

Based on international literature data, absolute contraindications for therapeutic dosage of anticoagulatives in patients with a recent proximal DVT include the following^[6]:

1. Active or recent bleeding that could not be addressed immediately;
2. Intracranial bleeding during the last five days;
3. Need for major surgical procedure within the following two weeks;
4. Severe prolonged thrombocytopenia.

However, there are also contraindications for IVC filter placement, such as the following:

1. Uncorrectable severe coagulation disorders;
2. Extended IVC thrombosis leading to impossible filter placement proximal to the thrombosis;
3. Bacteraemia;
4. No access route for IVC filter placement.

Trauma continues to be the leading indication for prophylactic filters in a number of series, but studies so far have demonstrated heterogenous results on the use of prophylactic filters in different populations. In a recent systematic review by Haut *et al.*, the authors showed that prophylactic placement of IVC filters is associated with lower incidence of PE and fatal PE in trauma patients, although the strength of evidence was low^[7]. However, the newer studies evaluating the use of IVC filters in bariatric patients show no benefits and no significant risks, and thus they do not encourage the use in this population^[8,9]. Additionally, studies referring to patients undergoing spine surgery have shown that filter placement is associated with a lower VTE-related events^[10,11]. The

IVC filter complication rate remains low; however, so does the retrieval rate for potentially removable filters^[12]. Overall, the use of IVC filters, especially in prophylactic situations, will remain controversial until randomized, controlled trials are performed within each specific patient population.

Finally the recommendations of the latest guidelines regarding the proper utilization of IVC filter placement are the following^[13]:

1. In adult patients with acute proximal DVT of the upper extremity and contraindication for anticoagulant use, placement of IVC filter is recommended (Grade 1B);
2. In adult patients with acute proximal DVT of the lower extremity and an already placed IVC filter as an alternative to anticoagulants, the typical anticoagulative treatment is recommended, if the risk for bleeding has passed (Grade 1B);
3. In adult patients with acute PE and contraindication for anticoagulant use, placement of IVC filter is recommended (Grade 1B);
4. In adult patients with acute PE and an already placed IVC filter as an alternative to anticoagulants, the typical anticoagulative treatment is recommended, if the risk for bleeding has passed (Grade 1B);
5. In patients that a temporary IVC filter has already been placed, the possibility of retrieval should be periodically evaluated (Grade 1C);
6. In patients with DVT or PE who will need long-term IVC filter protection, placement of a permanent IVC filter is justified (Grade 2C);
7. In patients with DVT or PE who will need IVC filter protection for a short term, placement of a temporary IVC filter is justified (Grade 2C);

However, the placement of a permanent IVC filter is not by itself an indication for prolonged use of anticoagulants.

3. Complications of IVC filters

As all other interventional procedures, placement of an IVC filter may be followed by potential complications that one should always take into consideration. These complications can be classified into two groups, namely early and late complications (Table 2)^[14]. Recent data indicate that complications occur with significantly higher frequency with retrievable IVC filters compared with permanent IVC filters^[15]. Especially long-term

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