

Inferior Vena Cava Filters in Elderly Patients with Stable Acute Pulmonary Embolism

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ABSTRACT

BACKGROUND: Patients aged >60 years with pulmonary embolism who were stable and did not require thrombolytic therapy were shown to have a somewhat lower in-hospital all-cause mortality with vena cava filters. In this investigation we further assess mortality with filters in stable elderly patients.

METHODS: In-hospital all-cause mortality according to use of inferior vena cava filters was assessed from the National (Nationwide) Inpatient Sample, 2003-2012, in: 1) All patients with pulmonary embolism; 2) All with pulmonary embolism who had none of the comorbid conditions listed in the Charlson Comorbidity Index; 3) Patients with a primary (first-listed) diagnosis of pulmonary embolism, and 4) Patients with a primary diagnosis of pulmonary embolism and none of the comorbid conditions listed in the Charlson Comorbidity Index.

RESULTS: From 2003-2012, 2,621,575 stable patients with pulmonary embolism were hospitalized in the US. Patients aged >80 years showed lower mortality with vena cava filters (all pulmonary embolism, 6.1% vs 10.5%; all pulmonary embolism with no comorbid conditions, 3.3% vs 6.3%; primary pulmonary embolism, 4.1% vs 5.7%; primary pulmonary embolism with no comorbid conditions, 2.1% vs 3.7%; all $P < .0001$). In the all-patient category, patients aged 71-80 years showed somewhat lower mortality with filters, 6.3% vs 7.4% ($P < .0001$), and those without comorbid conditions, 2.5% vs 2.8% ($P = .04$). Those aged 71-80 years with primary pulmonary embolism, irrespective of comorbid conditions, did not show lower mortality with filters.

CONCLUSION: At present, in the absence of a randomized controlled trial, it seems prudent to consider a vena cava filter in very elderly (aged >80 years) stable patients with acute pulmonary embolism.

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KEYWORDS: Elderly; Mortality; Pulmonary embolism; Vena cava filters

Among patients with pulmonary embolism who were stable (not in shock or on ventilatory support) and did not receive thrombolytic therapy, in-hospital all-cause mortality was marginally lower in those who received an inferior vena cava filter compared with those who did not, 21,420 of 297,700 (7.2%), compared with 135,240 of 1,712,800 (7.9%).¹ This observation was based on administrative data from the Nationwide Inpatient Sample.¹ Subsequently, a

randomized controlled trial of inferior vena cava filters in acute pulmonary embolism, Prévention du Risque d'Embolie Pulmonaire par Interruption Cave2 (PREPIC2), showed no reduction of mortality with filters in stable patients with pulmonary embolism.² However, with only 200 patients included in the treatment arm and 199 patients in the control arm, it was not possible to stratify according to age or any other category.

An investigation of vena cava filters in elderly patients (≥ 65 years of age) based on a national cohort study of Medicare beneficiaries, showed no lower all-cause mortality at 30 days with inferior vena cava filters.³ This prompted us to assess our published in-hospital data in older patients (>60 years) with pulmonary embolism who were stable and did not require thrombolytic therapy.⁴ A somewhat lower in-hospital all-cause mortality was shown in such patients with vena cava filters 1999-2008, 8.0% with filters,

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compared with 10.2% without filters.⁴ This led us to further assess whether there might be lower in-hospital mortality with vena cava filters in stable elderly patients, particularly the very elderly, which is the purpose of this investigation.

METHODS

We analyzed administrative data from the National (Nationwide) Inpatient Sample (NIS), Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality, 2003-2012.⁵ Each year of the NIS provides information on approximately 8 million inpatient stays from about 1000 hospitals. The NIS is designed to approximate a 20% sample of US non-Federal, short-term, general, and other specialty hospitals.⁵

Beginning with data from 2012, the NIS was redesigned to improve national estimates. To highlight the design change, beginning with 2012 data, the database was renamed from the “Nationwide Inpatient Sample” to the “National Inpatient Sample.” The NIS is now a sample of discharge records from all Healthcare Cost and Utilization Project-participating hospitals, rather than a sample of hospitals from which all discharges were retained.⁵

We determined the in-hospital all-cause mortality according to age among stable patients with pulmonary embolism, defined as those not in shock or on ventilatory support. We analyzed 4 categories of stable patients: 1) All patients with pulmonary embolism, 2) All patients with pulmonary embolism who had none of the comorbid conditions listed in the Charlson Comorbidity Index,⁶ 3) Patients with a primary (first-listed) diagnosis of pulmonary embolism, and 4) Patients with a primary diagnosis of pulmonary embolism and none of the comorbid conditions listed in the Charlson Comorbidity Index.

Included patients were adults (aged ≥ 18 years) of both sexes and all races hospitalized in short-stay hospitals from all regions of the US. We assume that patients with a first-listed diagnosis were admitted to the hospital because of pulmonary embolism, and we define this as primary pulmonary embolism.

Excluded patients were those in shock or on ventilatory support, who we define as unstable. Unstable patients previously were shown to have a lower in-hospital mortality rate with vena cava filters.¹ Patients administered thrombolytic therapy or who underwent pulmonary embolectomy were also excluded. Such patients also were shown to have a lower in-hospital all-cause mortality with vena cava filters.^{1,7} Patients younger than age 18 years were excluded.

The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes for pulmonary embolism, vena cava filter, and conditions for

which patients were excluded are shown in **Table 1**. We were unable to determine if the filters were temporary or permanent.

Comorbid conditions listed in the Charlson Comorbidity Index⁶ as well as the ICD-9-CM codes used to identify these comorbid conditions are shown in **Table 2**.

CLINICAL SIGNIFICANCE

- The vast majority of patients with acute pulmonary embolism are stable.
- In-hospital all-cause mortality of stable patients with acute pulmonary embolism decreased during 2003-2012 in patients with and without vena cava filters.
- Very elderly (aged >80 years) patients with stable acute pulmonary embolism showed lower in-hospital all-cause mortality with vena cava filters.

Statistical Methods

Differences in mortality rates (case fatality rates) were assessed by Fisher’s 2-tailed exact test using GraphPad Software (San Diego, CA). Relative risk and 95% confidence intervals were calculated using calculator for confidence intervals of relative risk (www.sign.ac.uk/methodology/risk.xls). Linear regression analyses were performed using SPSS Version 22 for Windows (SPSS Inc, Chicago, IL).

RESULTS

All Stable Patients with Pulmonary Embolism

From 2003-2012, 2,765,640 patients were discharged from short-stay hospitals in the US with pulmonary embolism. Among these, 2,621,575 (94.8%) were stable and did not receive thrombolytic therapy or a pulmonary embolectomy. Women were 54.0% ($P < .0001$). Mortality was 5.8% in women and 6.1% in men ($P < .0001$). Most patients (75.0%) were White. Mortality among the races ranged from 5.8% to 8.7%. The majority of all stable patients with pulmonary embolism, 59.5%, were aged 61 years or older, and 17.9% were age >80 years.

Among stable patients of all ages, in-hospital mortality in those who received a vena cava filter was 5.5%, compared with 6.0% who did not receive a vena cava filter ($P < .0001$) (**Table 3**). Among patients aged 61-70 years, mortality in those who received a vena cava filter was marginally lower than in those who did not, 5.5% compared with 5.8% ($P < .001$) (**Figure 1, Table 3**). In patients aged 71-80 years, mortality in those who received a filter was 6.3%, compared with 7.4% in those who did not ($P < .0001$). In patients aged >80 years, in-hospital all-cause mortality was 6.1% with a vena cava filter, compared with 10.5% in those who did not receive a filter ($P < .0001$). Among patients aged 60 years or younger, in-hospital mortality was not lower with vena cava filters (**Figure 1**).

Among patients of all ages, in-hospital mortality decreased from 2003-2012 in those who received a vena cava filter and in those who did not (**Figure 2**). In those aged >80 years, relative risk with a vena cava filter, 2003-2012, ranged from 0.4 to 0.7, even though mortality in both groups decreased (**Table 4**).

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