This is the accepted manuscript of the article, which has been first published online 24 April, 2020.
The final version published in *Journal of Vascular Surgery: Venous and Lymphatic Disorders*,
2021, 9(1), 54-61. http://dx.doi.org/10.1016/j.jvsv.2020.03.016

Risk of symptomatic venous thromboembolism after abdominal aortic aneurysm repair in long-term follow-up of 1021 consecutive patients

Short title: Venous thromboembolism after abdominal aortic aneurysm repair

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Funding: This study was financially supported by non-commercial grants from the Tampere Tuberculosis Foundation and Academy of Finland (#310618, #310617).

Conflict of interest statement: The authors report no conflicts of interest.

Keywords: Abdominal aortic aneurysm, deep vein thrombosis, endovascular aortic repair, pulmonary embolism, venous thromboembolism

Article Highlights

Type of research: Retrospective analysis of prospectively collected single-center registry data and the Finnish Institute of Health and Welfare database.

Key findings: Following AAA repair, symptomatic venous thromboembolisms (VTEs) had occurred in 1.6% of all patients, in 1.0% after endovascular repair, in 2.4% after open repair, and in 2.6% after urgent or emergency procedures at three months. The long-term occurrence of VTEs was increased as well when compared to a reference cohort.

Take home message: Extended thromboprophylaxis after AAA repair may be considered in high-risk cases.

Table of Contents Summary

Symptomatic venous thromboembolisms, particularly pulmonary embolisms, were relatively frequent in patients undergoing open or urgent repair for AAAs and uncommon after EVAR in this retrospective review of 1021 patients with comprehensive and extended follow-up. The study suggests that some patients might benefit from extended thromboprophylaxis which should be considered in the treatment of these patients and in future studies.

Abstract

Objective: Venous thromboembolisms, including deep vein thromboses and pulmonary embolisms, are infrequent but consequential and potentially preventable complications following major surgical procedures. The aim of the study was to describe the long-term occurrence of symptomatic venous thromboembolism in patients undergoing abdominal aortic aneurysm repair and to ascertain patient-specific risk factors as well as to compare the rate to that of a reference population.

Methods: The study included all patients that had undergone endovascular or open abdominal aortic aneurysm repair, both elective and urgent/acute cases, at the Tampere University Hospital, Finland, between February 2001 and December 2016. Fifty-nine percent of patients had undergone endovascular and 41% open repair, and 23% of all cases had required urgent or emergency treatment. Information regarding later treatment episodes for symptomatic venous thromboembolism as well as survival data were obtained from national registries. The reference population was obtained from national registries with a random sample of inhabitants matched for age, sex, and the location of residence with a 4:1 ratio and was analysed similarly.

Results: Altogether 1021 patients and 4065 controls were included (88% male, median age 74 in both groups). The high-risk period for venous thromboembolisms lasted for approximately three months, and during that time, their occurrence was highest in in patients with coronary disease (2.5%), following open repair (2.4%) and in urgent or emergency setting (2.6%), while the rate was low after endovascular aortic repair (1.0%). The cumulative incidence of venous thromboembolism at three months, one year, three years, and five years was 1.1%, 1.6%, 2.7%, and 4.5% in patients and 0.1%, 0.3%, 1.0%, and 1.8% in the reference population, respectively,

$p<0.001$ each. Most venous thromboembolisms were pulmonary embolisms in the patient group. The five-year mortality rates were 37.9% in patients and 23.8% in controls, $p<0.001$.

Conclusions: The incidence of symptomatic venous thromboembolisms, particularly pulmonary embolisms, after abdominal aortic aneurysm repair is significant, both in short- and long-term follow-up. Open surgery, acute setting, and concomitant coronary disease appear to increase the risk.

Introduction

Venous thromboembolisms (VTE) comprising both deep vein thromboses (DVT) and pulmonary embolisms (PE) are infrequent but consequential and potentially preventable postoperative complications associated with increased mortality, morbidity and treatment costs[1–4]. Despite prophylactic measures, the incidence of early symptomatic postoperative VTEs is estimated to be approximately 0.7% in mixed surgical patient cohorts and 2-3% following major procedures that are considered to entail a high risk of VTE and in which extended thromboprophylaxis is recommended, such as total hip arthroplasty and abdominal cancer surgery[1,2,5]. With regards to vascular surgery, the 30-day incidences of VTE after open surgery for abdominal aortic aneurysms (AAA), lower extremity bypass procedures, amputations and carotid endarterectomies have been estimated to be up to 1.7%, 1.0%, 0.6% and 0.2%, respectively[1,4]. The available data on the occurrence of postoperative VTEs after AAA repair is mainly limited to the first postoperative months and elective cases. Due to limited evidence, there are currently no clearly established recommendations for the type and duration of postoperative prophylactic anticoagulation after AAA repair beyond the primary hospitalisation and/or patient ambulation[6]. Importantly, open repair (OR) and endovascular aortic repair (EVAR) are very distinct procedures and the impact of the treatment modality on the risk of postoperative VTEs has not been thoroughly discussed in the literature.

The authors hypothesize that the rate of VTE is significant following AAA repair and that they may occur in relevant numbers even after the immediate postoperative period in these patients.

The aim of the present study was to ascertain the early- and long-term occurrence of symptomatic VTE events following the treatment of AAA, compare the rates between surgically and endovascularly treated patients as well as acute and elective cases, and to identify patient-specific risk factors for VTE. To further illustrate the magnitude of the VTE-related disease burden of these patients, the long-term incidence of VTEs was also compared to that of age and sex -matched reference population.

Methods

Study patients and setting

The study was performed according to the Helsinki Declaration and institutional review board approval was obtained. Due to the retrospective registry-based study setting, informed patient consent was not required. All patients that underwent AAA repair in the Tampere University Hospital, Tampere, Finland, a tertiary referral centre with a catchment area exceeding one million inhabitants, between February 2001 and December 2016 were included. Over the study period, all EVAR procedures and most open surgeries for AAAs were performed at the study hospital. The patients were identified from institutional prospective databases in which relevant data regarding patient demographics, medical history and the indication, urgency and type of treatment given for AAAs was recorded. The material comprised both surgically and endovascularly treated patients. Aneurysms extending to the supra-diaphragmatic thoracic aorta and descending aortic dissection -related aneurysms were excluded. The clinic standard for post-procedural medical thromboprophylaxis entailed low molecular weight heparin (LMWH), most

commonly enoxaparin 40mg or tinzaparin 4500 IU, administered twice daily over the hospitalisation period until discharge. If the patient was on oral anticoagulants, they were re-instituted during the hospitalisation when deemed safe by the attending vascular surgeon. There was no routine imaging to screen for VTEs following aortic repair. All patients underwent a clinical control one month postoperatively during which symptoms and clinical findings suggestive of VTEs would have prompted further diagnostics.

Reference population and data acquisition

The reference population was obtained by requesting four controls randomly selected and matched for age, sex, and the location of residence, for each patient, from the Finnish Population Register Centre, a national registry that also provides demographically matched control materials for research purposes, from which survival data for the patients and the reference population was also obtained. Information regarding later thromboembolic complications – defined as treatment periods associated with International Statistical Classification of Diseases and Related Health Problems, 10th revision, (ICD-10) diagnosis codes “I26”, “I80” and/or “I82” or any subclass of these codes - was then requested from the Finnish Institute for Health and Welfare database, which contains data on each specialised medical care event in Finland. The database offers robust and comprehensive health-care related information as reporting each in-patient and out-patient specialised medical care episode is mandatory in the country. The follow-up lasted until the 31st December 2016.

Statistical analyses

The occurrence and types of VTE events during the follow-up was ascertained and compared between patient subgroups and between patients and the reference population using statistical methods. The delay between the treatment of AAA in patients - and the corresponding index date in the reference population – and the first treatment episode for VTE was measured, and the cumulative number of in-hospital days related to VTEs was calculated for each case. In the cumulative incidence analysis, at each time point all study subjects not completing the corresponding follow-up time were excluded from the analysis unless death or venous thromboembolism had already occurred. To discern possible changes in the VTE rates over the study period, the cumulative incidence rates of patients and patient subgroups that were treated between 2001-2006, 2007-2011 and 2012-2016 were compared. As the study method could not discern whether later episodes were related to the same or separate thromboembolic event, only the first episode was included in the cumulative incidence analyses. The study was partly descriptive by nature and no power calculations were thus performed. The statistical analyses were performed using IBM SPSS statistical software version 25 (IBM Corp. Armonk, NY, USA). Categorical variables were compared using the Chi square and Fishers Exact test and non-parametric scale variables were compared using the Mann-Whitney U-test. Kaplan-Meier curves and the Log-Rank test were used to illustrate and compare the occurrence of VTEs in patients and the reference population. Multivariable Cox regression analysis was performed to identify patient characteristics independently associated with the occurrence of VTEs.

Results

The majority of patients were elderly men who typically underwent elective EVAR. Altogether nine patients had less than four but at least one suitable reference subject available and were included in the study. The details regarding the demographic information of patients and the reference population included in the study, as well as the pertinent medical history of patients, is shown in Table I. The median follow-up time in the study was 80 (range 0-190) months.

The incidence of venous thromboembolism

The main results of the study are shown in Table II and Figure 1. There was a statistically significantly higher occurrence of VTEs in patients compared to the reference population. The difference was mostly due to a clearly higher rate of PEs, but there appeared to be a slight trend towards a higher incidence of DVTs as well. The treatment of AAA had a clear impact, as a significant proportion of VTEs in the patient group occurred in conjunct with or in proximity to the primary treatment episode. The rate appeared somewhat increased in the patient group in long-term follow-up as well (Figure 1). The number of in-hospital days related to VTE was approximately threefold in patients when compared to the reference population. There were no statistically significant differences in the cumulative VTE incidence rates according to the time period of treatment in any patient subgroup. The overall mortality rate was considerable in both patients and reference subjects but significantly higher in patients. The five-year mortality rates were 50% vs. 34%, $p<0.001$, in patients who underwent urgent/emergency and elective procedures, and 36% vs. 40%, $p=0.340$, in patients that underwent OR and EVAR, respectively.

Risk factors

In subgroup analyses, there were no clear and consistent associations between the various patient characteristics and the incidence of VTEs (Table III). There was a slightly higher early - but not overall – occurrence of VTEs in patients with coronary disease, and a near-significant trend towards a higher early incidence in patients that had undergone OR when compared to those treated with EVAR (2.4% vs. 1.0% within 90 days, p=0.088), but at five years, the rate was non-significantly higher in the group that was treated endovascularly, both in acute and elective cases. In multivariable regression analysis, only urgent or emergency indication for AAA repair was independently and statistically significantly associated with a higher hazard ratio for VTEs during a five-year follow-up, Table IV. The mortality rate of patients with VTEs was not statistically significantly increased when compared to those without in short- or long-term follow-up and the rates at five-years were 42% vs. 38%, p=0.625, respectively.

Discussion

Individuals treated invasively for AAAs can be regarded as high-risk surgical patients due to their age, comorbidities and critical condition in acute cases. Particularly open interventions for AAA are major surgical procedures, which often entail considerable operative times, postoperative intensive care treatment and immobilisation, with significant rates of blood transfusions, prolonged ventilator support, and kidney injury. All these factors significantly predispose AAA patients to postoperative VTEs which, in turn, may contribute to the patients’

outcomes. Furthermore, due to advancements in surgical and endovascular techniques and the evolution of perioperative care, contemporary abdominal aortic repair may be offered to increasingly old and morbid patients with acceptable procedural risks but perhaps a higher occurrence of relevant complications. In recent meta-analyses extended thromboprophylaxis with LMWH for 14 days or longer postoperatively as opposed to treatment restricted to the in-hospital period significantly reduced the risk of postoperative VTEs without predisposing to increased bleeding complications or mortality after major abdominal surgery in cancer and non-cancer patients[7,8]. Factor Xa inhibitors and direct thrombin inhibitors have also been increasingly applied for postoperative thromboprophylaxis in other patient cohorts with promising results when compared to LMWHs, but have not been validated for prophylactic use after vascular surgery[9]. Evidence regarding the occurrence of postoperative VTEs in AAA patients is scarce, particularly in the long-term, and the current guidelines do not offer clear recommendations for thromboprophylaxis in these patients. In the present study with a large material and extensive follow-up the authors report a significant occurrence of symptomatic VTEs, particularly PEs, in patients undergoing abdominal aortic repair. The early incidence of VTEs was relevant and the rate was also considerably higher in long-term follow-up when compared to a large age- and sex matched reference population. Particularly following OR and urgent or emergency surgery the occurrence of VTEs was high and comparable to that following procedures that are considered to induce a significant risk for VTEs and after which extended thromboprophylaxis has been recommended.

The early incidence rates after OR (2.4%) and EVAR (1.0%) were marginally higher than in preceding studies, though most of them reported the occurrence of VTEs during the first 30 days

as opposed to the first 90 days as in the present study[1,4,10]. Based on the present analysis it would appear, that the early high-risk period for VTEs following AAA repair extends well beyond the first month, which should be considered in future research. Also, previous studies mostly included elective cases, while the present analysis also included urgent and emergency patients. There was a nigh-significant trend towards a lower early incidence of VTEs following EVAR when compared to OR, which has been observed in earlier studies as well[4,10]. However, during long-term follow-up, the rates of VTEs appeared somewhat higher in patients treated with EVAR when compared to those who underwent OR. While the difference did not reach statistical significance, probably due to limited statistical power, it seems plausible that as patients treated with EVAR were older and more morbid they would also exhibit a higher rate of VTEs during extended follow-up. It must be remembered that several factors that might impact the occurrence of VTEs such as statin use were not controlled for[11,12]. Patients that needed urgent or emergency aortic repair mostly underwent OR, which probably partly explains the high occurrence of VTEs in this patient group. It is also likely that in many acute cases, due to bleeding issues, the postoperative use of anticoagulants was temporarily restricted and that the duration of intubation and intensive care unit treatment as well as the overall hospitalisation and immobilisation periods were longer in these patients. Furthermore, even after ambulation and hospital discharge, the degree of relative immobilisation was probably significantly higher in these patients. It could also be postulated that the retroperitoneal space was more haematomatous and oedematous when compared to electively treated cases which, via mechanical compression of the iliac veins and inferior vena cava, might contribute to an increased risk of VTEs. The overall incidence of VTEs and related hospitalisations in patients that underwent AAA repair was significantly higher than in the age- and sex-adjusted reference population at each time point, probably implying a

significantly higher overall disease burden in the AAA cohort in addition to the consequences of AAA treatment.

Mortality rates were considerably higher in patients treated for AAA when compared to the reference population at each time point, which again is likely to reflect the frequent comorbidities in these patients. Somewhat surprisingly and contrary to some earlier studies, the short- and long-term prognosis in the AAA group was not clearly associated with VTEs[3]. While PEs in general are associated with significant mortality, it is important to remember that not all deaths in these patients are caused by PEs themselves and may, to a considerable extent, be related to the diseases, such as cancers, which subjected to the development of VTEs in the first place. It may be that in a population with a considerable prevalence of comorbidities, such as those undergoing AAA repair, the development of VTEs does not as clearly identify the most morbid patients when compared to unselected cohorts. Also, malignancies which are important risk factors for VTEs and greatly impact the prognosis of afflicted patients are probably not prominent in the present study material as virtually all patients underwent preoperative work-up including computed tomography imaging in which most neoplasms would have been identified and prophylactic AAA repair consequently postponed until their treatment or even denied in some cases.

The majority of VTE cases at all time points were PEs in AAA patients, whereas in the reference population PEs and DVTs were equally common. Previously, DVTs have been found to account for the majority of VTEs in general, as well as early postoperative VTEs in elective mixed and

vascular surgical patient cohorts and patients treated for AAA[1,4,10,13]. It is probable that in some cases if a patient was diagnosed with concomitant DVT and PE, only the diagnosis code for PE was used. Furthermore, DVTs - which are frequently asymptomatic - were not actively screened for in these patients and some presenting after hospital discharge may have been completely undiagnosed or treated in primary health care and thus missed in the study as the analysis included only the symptomatic cases that were diagnosed and/or cared for in special medical care[14]. All in all, the study should accurately reflect the proportion of patients with symptomatic PEs but may significantly underestimate the occurrence of DVTs following AAA repair as well as in the reference population.

Except urgent or emergency indication for AAA treatment, clear risk factors strongly and consistently associated with later VTEs were not evident in patients that underwent AAA repair, probably due to limited statistical power in the subgroup analyses caused by the relative rarity of VTEs despite the large material. Coronary disease was statistically significantly associated with a higher early occurrence, but there were no evident long-term differences when compared to other patients. Heart disease and atherosclerosis in general as well as perioperative myocardial infarction and cardiac arrest have been associated with increased occurrence of VTEs in earlier literature. Other previously established consequential risk factors for early VTEs in various cohorts include advanced age, high American Society of Anaesthesiologists (ASA) class, diagnosed malignancy, morbid obesity and a previous history of VTE. In addition, long operative times, ventilator dependence, blood transfusions, steroids, the postoperative occurrence of renal and infectious complications, as well as prolonged hospitalisation have been associated with

increased risk.[1,2,4,5,15–18] In contrast, high preoperative albumin levels may be associated with a decreased risk[1].

Study limitations

The present study has some inherent limitations due to its retrospective nature. Firstly, data on some factors potentially affecting VTE risk such as body mass index, smoking history and details regarding the postoperative course of the patients was not available. In previous studies smoking has not been found to be a significant independent risk factor for postoperative VTEs in AAA patients despite the high prevalence – approximately one third of patients – of active smoking in these cohorts[4,10]. Secondly, some deviations from the protocol regarding the postoperative anticoagulation probably occurred infrequently but were not recorded and the postoperative use of oral anticoagulants was not known. This shortcoming regarding the reporting of anticoagulation regimes is also evident in most other studies that have analysed the occurrence of VTEs after vascular surgery. The incidence of DVTs may be significantly underestimated due to study methodology, which probably identified only symptomatic cases. Furthermore, because VTEs are rare complications, sufficient statistical power is challenging to obtain for subgroup analyses. The proportion of patients treated with EVAR has been rising and contemporary EVAR patients probably differ from those treated during the first years of the series as endovascular treatment has been increasingly offered for younger and healthier patients as well as for acute cases, possibly causing some bias since the follow-up time was limited for the most recent cases. Also, contemporary EVAR devices and accesses have evolved and the patients are mobilised and discharged earlier. However, no significant changes in the VTE rates of these patients were observed over the study period. The strengths of the study include a large

material of consecutive patients, the inclusion of acute cases and the comprehensive national registries available in Finland allowing for the accurate identification of symptomatic VTEs irrespective of whether they were diagnosed and treated at the study hospital. In addition, the study included a large reference population and an estimate for the incidence of VTEs in the standard population with corresponding demographics, when previous studies have reported only the incidences rates of patients without any reference values. While the medical history of the reference subjects was not known, they should, due to the large sample size and random inclusion, reflect the standard population with presumably average prevalence of comorbidities and similar age- and sex distribution than those of the patients. While it would have been optimal to include a reference population with complete data on comorbidities, no such material with sufficient numbers and otherwise corresponding demographics and follow-up data was available. Furthermore, the authors did not aim at demonstrating that patients treated for AAAs more frequently suffer from VTEs than the reference population or completely healthy individuals, which is obvious, or to compare the rates to those of other surgical cohorts, but rather to further illustrate the magnitude of VTE-related morbidity and disease burden of AAA patients. When considering the long-term incidence of VTEs in any cohort, it is important to remember that some occur in the general population as well and the inclusion of the reference population better illustrates the differences.

In conclusion the authors report a significant incidence of symptomatic venous thromboembolisms, particularly pulmonary embolisms, after abdominal aortic aneurysm repair during both short- and long-term follow-up. The procedure-related acute risk appears to last for approximately three months, which should be considered in the treatment and follow-up of these

patients as well as in further studies. Open surgery, treatment in an acute setting and concomitant coronary disease seem to increase the early risk, while after endovascular treatment early thromboembolic events are rare, which may be considered when planning the treatment of these patients. During long-term follow-up, the occurrence of venous thromboembolism is approximately two-fold when compared to a matched reference population.

Acknowledgements: This study was financially supported by non-commercial grants from the Tampere Tuberculosis Foundation and Academy of Finland (#310618, #310617).

Conflict of interest statement:

The authors report no conflicts of interest.

Author Contributions

All authors significantly contributed to the manuscript. N.K. was the principal writer of the manuscript and contributed to the conception and design of the study. J.K. contributed to the design of the study, statistical analyses, and writing of the manuscript. N.O., J.L., and V.S. contributed in the study design and took part in the critical revision of the paper. N.K., V.S. and D.V. contributed in the curation of the data.

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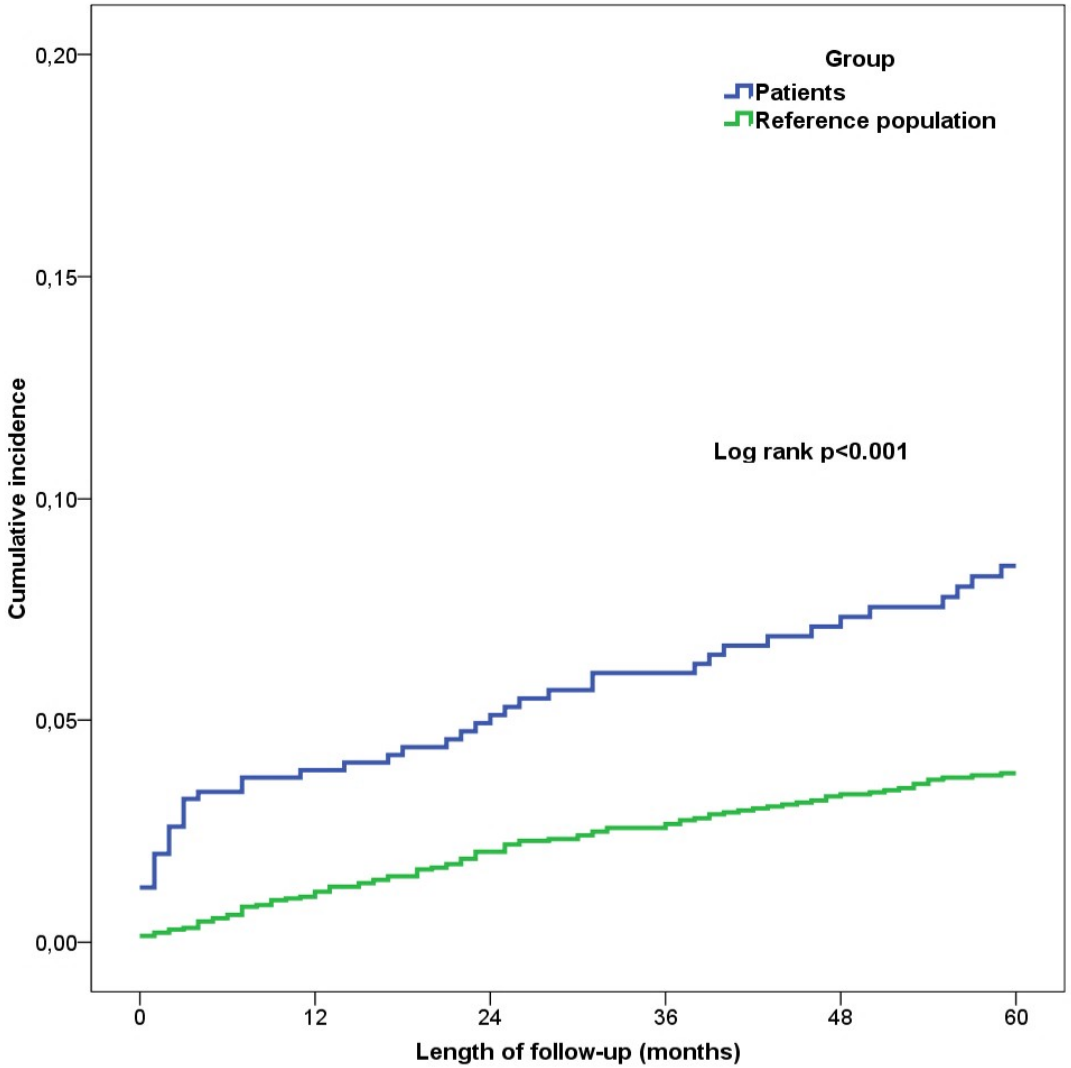

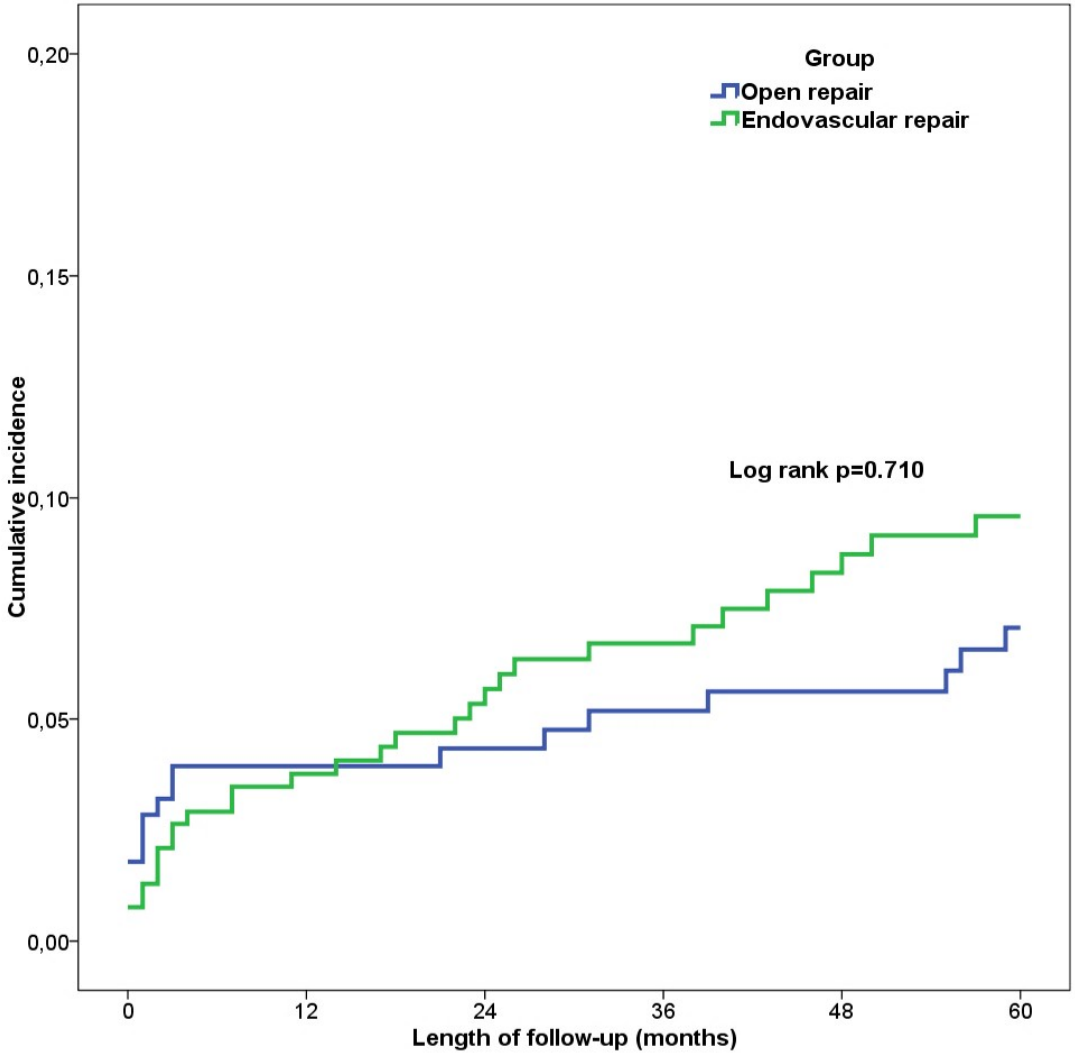

Study subjects at risk during follow-up

Months	0	12	24	36	48	60
All patients	1021	832	715	602	499	410
Reference population	4065	3676	3234	2800	2347	1997

	0	12	24	36	48	60
Open repair	423	331	292	259	229	201
Endovascular repair	598	501	423	343	270	209

Tables

Table I.

	All patients	**Endovascular aortic repair**	**Open surgery**	**Reference population**
Number	1021	598 (59%)	423 (41%)	4065
Male	88%	88%	88%	88%
Median age	74	**76*** **	**70*** **	74
Coronary heart disease	44%	**51%*** **	**34%*** **	
Hypertension	61%	63%	58%	
Dyslipidaemia	36%	**39%** **	**31%** **	
Previous stroke or transient cerebral ischemia	11%	13%	8.7%	
Renal insufficiency	9.4%	**11%***	**6.9%***	
Diabetes	16%	17%	14%	
Elective	77%	**92%*** **	**57%*** **	
Urgent or emergency	23%	**8.4%*** **	**43%*** **	

Table II.

Patients treated for abdominal aortic aneurysms		Reference population	
	Cumulative occurrence	**Cumulative occurrence**	**p**
Pulmonary embolism			
3 months	1.1% (0.5-1.7%)	0.1% (0.0-0.2%)	<0.001
1 year	1.6% (0.8-2.3%)	0.3% (0.1-0.5%)	<0.001
3 year	2.7% (1.6-3.8%)	1.0% (0.7-1.3%)	<0.001
5 year	4.5% (3.0-6.0%)	1.8% (1.3-2.2%)	<0.001
Deep vein thrombosis			
3 months	0.5% (0.1-0.9%)	0.1% (0.0-0.2%)	0.018
1 year	1.1% (0.5-1.8%)	0.4% (0.2-0.7%)	0.011
3 year	1.8% (0.9-2.7%)	1.1% (0.7-1.4%)	0.105
5 year	2.3% (1.2-3.4%)	1.7% (1.2-2.2%)	0.245
Any venous thromboembolism			
3 months	1.6% (0.8-2.4%)	0.2% (0.01-0.03%)	<0.001
1 year	2.7% (1.7-3.7%)	0.7% (0.5-1.0%)	<0.001
3 year	4.5% (3.1-5.9%)	2.0% (1.6-2.5%)	<0.001
5 year	6.7% (4.9-8.5%)	3.4% (2.7-4.0%)	<0.001
Mortality			
3 months	9.0% (7.3-10.8%)	0.7% (0.5-1.0%)	<0.001
1 year	13.4% (11.3-15.6%)	3.9% (3.3-4.5%)	<0.001
3 year	25.8% (22.8-28.8%)	13.3% (12.1-14.5%)	<0.001
5 year	37.9% (34.2-41.6%)	23.8% (22.2-25.5%)	<0.001
In-hospital days for venous thromboembolism			
	Mean	**Mean**	
1 year	0.48 (0.03-0.93)	0.05 (0.02-0.09)	<0.001
3 year	0.80 (0.22-1.38)	0.23 (0.10-0.35)	<0.001
5 year	1.10 (0.42-1.78)	0.34 (0.19-0.49)	<0.001

Table III.

Characteristics	**Cumulative incidence of venous thromboembolism (%)**			
	90-day	**One year**	**Three years**	**Five years**
All patients	1.6	2.7	4.5	6.7
Male	1.6	2.7	4.2	6.3
Age ≥70	1.7	2.7	4.7	6.7
Coronary heart disease	**2.5***	2.8	5.2	6.9
Hypertension	1.5	2.6	4.6	6.3
Dyslipidaemia	1.7	2.3	4.0	6.1
Previous stroke or transient cerebral ischemia	1.8	2.9	5.7	6.1
Renal insufficiency	0	2.2	3.5	4.3
Diabetes	0	1.3	2.4	5.1
Open surgery	2.4	2.9	4.1	5.7
Endovascular repair	1.0	2.5	4.9	7.6
Elective	1.3	2.2	3.8	6.3
Urgent or emergency	2.6	4.4	6.6	7.9
Age ≥70 and open surgery	2.7	3.2	4.1	4.8
Age ≥70 and urgent or emergency	2.7	4.8	7.4	7.9
Age ≥70 and urgent or emergency open surgery	3.6	4.5	5.8	5.9

Table IV.

Characteristics	**HR**	**p**
Age ≥70 years	0.97 (0.50-1.89)	0.937
Female	1.66 (0.79-3.51)	0.181
Diabetes	0.83 (0.33-2.11)	0.696
Dyslipidaemia	0.87 (0.45-1.69)	0.688
Hypertension	0.88 (0.49-1.58)	0.670
Coronary heart disease	1.06 (0.59-1.92)	0.845
Previous stroke or transient cerebral ischemia	0.89 (0.35-2.29)	0.814
Renal insufficiency	0.74 (0.23-2.42)	0.623
Elective	0.49 (0.24-0.99)	0.046
Urgent or emergency	2.04 (1.01-4.11)	0.046
Open aortic repair	0.58 (0.29-1.15)	0.117
Endovascular aortic repair	1.73 (0.87-3.45)	0.117