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Venous Thromboembolism Among Nursing Home Residents: The Role of Selected Risk Factors

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Abstract

Background—Nursing home (**NH**) residency confers increased venous thromboembolism (**VTE**) risk; however, risk-stratification/prevention guidelines currently rely on non-NH data.

Objectives—Provide NH-specific estimates to assess whether VTE risk factors identified for the general population apply to NH residents.

Design—Population-based case-control study

Setting—Olmsted County, MN

Participants—All County residents with symptomatic objectively-diagnosed incident VTE while a NH resident 1988–2000 (N=182); two age- sex- calendar-year-matched non-VTE Olmsted County NH residents per case (N=364)

Measurements—Provider-linked medical records were reviewed to obtain information on active malignancy; recent hospitalization, surgery, or trauma/fracture as of index (case's VTE date; respective date for controls). Risk factor prevalence and VTE-associated odds ratios (**OR**) were estimated and compared with previously obtained data for all Olmsted County residents 1988–2000. For analyses, both groups were limited to age ≥65 years.

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Author Contributions:
Leibson: Study concept and design; Interpretation of findings; Manuscript preparation; Funding
Petterson: Data analysis; Interpretation of findings; Manuscript preparation
Smith: Data analysis; Interpretation of findings; Manuscript preparation
Bailey: Study concept and design; Data analysis; Interpretation of findings; Manuscript preparation
Ashrani: Interpretation of findings; Manuscript preparation
Heit: Study concept and design; Interpretation of findings; Manuscript preparation; Funding

Results—Among NH residents, active malignancy, recent hospitalization and recent surgery conferred significantly increased VTE risk, but the magnitude of risk appeared much lower than general population estimates-- e.g., OR (95% CI) for major surgery was 2.5 (1.4–4.3) for NH residents versus 11 (7.0–17) for general population. In general, the prevalence of all evaluated VTE risk factors appeared much higher among NH controls compared to general population controls. Thromboprophylaxis rates appeared higher for NH cases/controls compared to the general population; disconcertingly, 47% of NH cases received prophylaxis.

Conclusion—While general population VTE risk factors (active cancer and recent hospitalization or surgery) can identify NH residents at increased risk for VTE, these exposures do not adequately stratify VTE risk for thromboprophylaxis recommendations. Further research into NH-specific risk factors and prophylaxis effectiveness is required.

Keywords

Venous thromboembolism; nursing home; long-term care; deep vein thrombosis; pulmonary embolism

INTRODUCTION

Venous thromboembolism (**VTE**), consisting of deep vein thrombosis (**DVT**) and pulmonary embolism (**PE**), is a relatively common condition associated with serious and costly outcomes.[1–5] To reduce VTE, characteristics that contribute to VTE risk need to be identified. In our previous studies of VTE among all Olmsted County, Minnesota, residents, recent hospitalization (with or without major surgery), recent trauma (including fracture), and active cancer exhibited exceptionally high odds ratio (**OR**) estimates, ranging from 3.86 for trauma/fracture to 17.05 for major surgery, even after adjusting for other factors.[6,7] These few factors accounted for the vast majority of VTE events within the population.[8] NH residency conferred additional risk; adjusted odds of VTE for NH residents were 5.6 times those for non-NH residents.[6] Moreover, NH residency accounted for 13% of all incident VTE cases within the population.[8]

Despite growing recognition of the need for risk assessment and appropriate targeting of prophylaxis within the NH setting,[9–11] the data needed to inform recommendations specific to that setting are scarce. The evidence-base for the few published recommendations for VTE risk stratification within the NH setting has been restricted to investigations of community-dwelling or hospitalized individuals.[12–16] The underlying assumption that risk estimates for selected characteristics observed in these other populations also apply to nursing home residents is the focus of this brief report.

METHODS

Study Design/Setting

This population-based retrospective study was conducted in Olmsted County, Minnesota (2010 census population=144,248). Rochester, the county seat, is geographically isolated from other urban centers and home to Mayo Clinic, one of the world's largest private medical centers. Thus, County residents receive medical care from very few providers, primarily Mayo Clinic with its two affiliated hospitals, and another group practice, Olmsted Medical Center, with its affiliated hospital. Since 1907, every Mayo Clinic patient has been assigned a unique identifier; all information (medical history, clinical assessments, consultation reports, surgical procedures, dismissal summaries, laboratory and radiology results, correspondence, death certificate, and autopsy reports) from every contact (office, nursing home, emergency room, hospital inpatient, hospital outpatient, etc.) is contained

within a unit medical record. Under auspices of the Rochester Epidemiology Project (**REP**), this records-linkage system was expanded to include non-Mayo providers of care to County residents.[17]

VTE Cases

This study took advantage of the previously constructed REP cohort consisting of all Olmsted County residents who experienced symptomatic objectively-diagnosed incident VTE 1976–2000.[6–8] The previously constructed cohort included all County residents, regardless of age, sex, or location at time of VTE (i.e., including community, hospital, and NH). Determination of VTE was based on explicit criteria following labor-intensive review of complete provider-linked medical records by trained experienced nurse abstractors under direction of a board certified vascular medicine specialist (JA Heit). Records were reviewed from date first seen by a REP provider until the earliest of either death or last REP encounter. Variables abstracted included method of diagnosis and event type (DVT, PE, or both; chronic thromboembolic pulmonary hypertension). DVT was considered objectively-diagnosed when acute symptoms/signs were present and confirmed by venography, compression venous duplex ultrasonography, impedance plethysmography, computed tomographic venography, magnetic resonance imaging (**MRI**), pathology examination of thrombus removed at surgery, or autopsy. PE was considered objectively-diagnosed when acute symptoms/signs were present and confirmed by pulmonary angiography, a ventilation/perfusion lung scan interpreted as high probability for PE, computed tomographic pulmonary angiography, MRI, pathology examination of thrombus removed at surgery, or autopsy.[6–8]

NH VTE cases were limited to all Olmsted County residents who experienced symptomatic objectively-diagnosed incident VTE 1988 through 2000 sometime after admission to and before discharge from a local NH, regardless of location of VTE (hereafter referred to as NH cases). The 1988 start date, versus 1976 for the general population, reflects difficulties with enumerating potential NH controls using REP medical-records resources alone. Identification of NH controls was facilitated after 1987 with access to NH assessments available within the Centers for Medicare and Medicaid (**CMS**) Minimum Data Set (**MDS**)[18] and its precursor, the Minnesota Case Mix Review Program (**MCMRP**) Public Research Files;[19] MCMRP files were first available in 1988..

Non-VTE controls

Similar to control selection in our studies of VTE risk factors within the general population,[6,7] for each NH case, we identified all Olmsted County residents who were same sex and similar birth year (±1 year) as the case and had a REP encounter within ±1 year of the case's VTE. From these potential controls, we then used data available within REP, MDS, and MCMRP files on sex, birth date, Social Security number, and other information to select two individuals who were resident of a local NH at time of their REP encounter.

The present study was approved by Mayo Clinic and Olmsted Medical Center Institutional Review Boards. As of 1/1/1997, a Minnesota statute requires providers to 1) notify all persons seeking care on or after that date that their medical records may be used in research and 2) offer the opportunity to decline authorization for such use.[20] The requirement does not apply to persons who either died before or never sought care after 12/31/1996. Records of individuals who declined authorization for use of medical records in research (typically <6% in REP studies)[20] were excluded from review.

Risk factor data

For this brief report, VTE risk factors under consideration were limited to hospitalization (categorized as “with major surgery”, “without major surgery”, or “no hospitalization”); trauma (defined as major fracture requiring immobilization or severe soft tissue injury requiring hospital admission); and active malignancy (excluding nonmelanoma skin cancer). Definitions were those used in Olmsted County general population studies.[6,7] Information was also abstracted on use of thromboprophylaxis, categorized as “pharmacologic” (any heparin or warfarin), “mechanical” (pneumatic compression or foot pump), “both”, or “neither”. Provider-linked medical records were reviewed 3 months before index (i.e., VTE date for cases and respective REP encounter date for controls) for evidence of each risk factor; review for cancer extended 3 months after index.

Statistical analysis

To assure greater comparability between the NH and general populations, we limited analyses of both groups to age ≥65 years and calendar years 1988 through 2000. Demographic and clinical data were summarized using descriptive statistics. Conditional logistic regression was used to assess the univariate association (i.e., unadjusted for other risk factors) of each risk factor with VTE.

RESULTS

One hundred eighty-two Olmsted County residents experienced a first lifetime symptomatic, objectively-diagnosed VTE while a resident of a local NH from 1/1/1988 through 12/31/2000. Table 1 provides characteristics for NH VTE cases and 364 NH non-VTE controls. Data on characteristics for VTE cases and non-VTE controls within the general Olmsted County population are provided for comparative purposes. For both NH and general populations, age-sex-distributions were similar between cases and controls by design. Even after limiting both populations to age ≥65 years, the mean age and percent female appeared higher for NH residents compared to the general population. Except for major surgery and active malignancy among cases, the proportion of individuals with each factor appeared higher for NH cases/controls than for general population cases/controls; differences were especially marked for controls. Every risk factor, except trauma/fracture, was associated with significantly increased risk of VTE among NH residents (Table 1). However, OR estimates for each factor appeared much lower than general population estimates, e.g., OR (95% confidence interval [**CI**]) for major surgery was 2.5 (1.4–4.3) for NH residents versus 11 (7.0–17) for the general population.

Table 2 provides rates of thromboprophylaxis among cases and controls, stratified by risk factor categories, for both NH residents and the general population. Data for both groups are limited to calendar years 1988 through 2000 and age ≥65 years. Matching between cases and controls is lost when stratified by risk factor categories. Overall, the proportion of NH cases/controls with any thromboprophylaxis appeared higher than that for general population cases/controls. The difference was not accounted for solely by a higher proportion of NH residents with selected risk factors, as thromboprophylaxis was generally higher for NH residents compared to the general population within each risk category. Among NH residents especially, the proportion of individuals treated only with mechanical prophylaxis was small. Higher rates of pharmacologic prophylaxis among NH residents compared to the general population were apparent for both cases and controls; the difference appeared greatest for controls.

DISCUSSION

This study explored possible mechanisms underlying previous observations that NH residency is associated with increased risk of VTE.[6,7] The investigation focused on selected risk factors that have been shown to account for a large majority of VTE events in studies of the population generally (hospitalization with and without surgery, trauma/fracture, and active malignancy).[6,7] Within the NH population, the prevalence of each risk factor was higher for cases than controls, and the associated odds of VTE were elevated. Comparisons between NH VTE cases and controls and general population VTE cases and controls suggest that the overall prevalence of each risk factor is higher within the NH setting. However, the difference in prevalence was more marked for controls than for cases, and the estimated odds ratio for each characteristic was much lower for NH residents (range=1.5–2.5) than for the general population (range=3.6–11.0), reinforcing the need for further investigation of NH-associated risk.

Within the NH population, anticoagulation rates in each risk category were generally lower for cases compared to controls. Comparisons between NH residents and the general population revealed higher anticoagulation rates for NH residents within each risk category. These findings provide encouraging evidence that Olmsted County clinicians were not selectively avoiding prophylaxis among persons at high risk of VTE who either were, or were soon likely to become, a NH resident. While the proportion of NH residents within each risk category who did not receive prophylaxis was relatively low, the proportion of NH residents who received prophylaxis but experienced VTE was disturbingly high. Of 182 NH residents age ≥65 years who developed VTE 1988 through 2000, 85 (47%) received prophylaxis within 3 months before the event. Study findings reveal room for improvement in geriatric practice in characterizing and reducing VTE risk among NH residents.

Strengths

This study provides some of the first reliable data on selected VTE risk factors specific to the NH population. The estimates are population-based and controlled for age, sex, year of NH residency, and county of residency. Comparison with estimates for the general population is afforded with data on individuals drawn from the same geographical area, over the same period, using the same approach to case ascertainment and risk factor identification. In previous studies of VTE risk factors among all NH residents by our group and others,[21,22] case identification relied on diagnosis codes obtained from administrative data. The present study identified cases based on labor-intensive review of clinically detailed provider-linked medical records.

Limitations

Cases were limited to symptomatic objectively-diagnosed VTE. Compared to the general population, misclassification of VTE cases as controls may be higher among NH residents due to lower rates of symptom reporting, diagnostic testing, and autopsy.[23] To partially address this limitation, we conducted additional analyses for the NH population, in which NH VTE cases also included individuals who failed to meet the objective criteria described above but met criteria for possible VTE (i.e., physician diagnosis of DVT/PE plus recorded signs/symptoms consistent with DVT/PE and anticoagulant treatment (heparin sodium, warfarin sodium, or a similar agent) or surgical procedure for DVT/PE).[5] When the 13 possible VTE cases were included, OR p-values were similar or only slightly more significant, and OR estimates appeared similar or very slightly higher than those in Table 1, but remained well below those for the general population (data available upon request).

It is often assumed the association between NH residency and VTE reflects high rates of immobility among NH residents; this assumption is largely based on studies conducted outside the NH setting.[15,24–26] This brief report focused on risk factors with very high odds ratios within the general population; we did not include degree/duration of immobility. Future studies will obtain standardized measures of mobility from MDS data and combine with additional clinical data from REP resources (e.g., neurologic disease with leg paresis, prior superficial vein thrombosis, infections, etc.). Analyses will adjust for all important covariates jointly in multivariable models, and test for interactions.

Our investigation was limited to a single geographical region that is predominantly white. Compared to US whites, the age- sex-distribution is similar; income and education are higher.[27] No geographic area is representative of all others; however, the under-representation of minorities and relatively few providers compromises the generalizability of findings to other racial/ethnic groups and different health care environments.

Implications

With respect to thromboprophylaxis, only 72% of members of the general population age ≥65 years who experienced VTE after major surgery had received prophylaxis within 3 months before VTE. Although higher than rates from other studies,[16,28] it is consistent with the conclusion that prophylaxis for VTE is likely underutilized, especially in the elderly population.[24,29,30] It is suggested that compliance with existing recommendations for VTE prophylaxis is particularly low among NH residents.[9,16] This concern is not supported by our observation that the proportion of NH residents with selected risk factors for VTE who received thromboprophylaxis was consistently higher than that for members of the general population with similar risk factors and that differences appeared greatest for pharmacologic prophylaxis and for control subjects. We did not address duration. Additional information is needed regarding prophylaxis type, dosage, and duration for constructing guidelines specific to the NH population.

The markedly lower OR estimates for specified risk factors among NH residents compared with the general population reflects our previous finding that NH residency confers increased risk of VTE, even after adjusting for other risk factors.[6] Findings suggest the higher baseline risk experienced by NH residents results from factors other than those known to contribute substantially to VTE risk in the general population. Between-study comparisons of odds ratios should be interpreted in light of marked between-study differences in exposure. Moreover, comparison of OR estimates across settings assumes the risk factor effect is multiplicative, whereas it may be additive (i.e., percentage increase in risk above baseline). Because the baseline risk is higher for NH residents compared to the general population, even if OR estimates are lower for NH residents, the additive effect may be the same or higher than in the general population. Our study findings and these methodological issues reinforce the limitations of using results from non-NH studies to stratify risk within and construct guidelines for the NH population.

Although lower than anticipated, the odds of VTE for each specified risk factor was elevated among NH residents, reinforcing that NH residents with these factors should be further assessed as potential candidates for VTE prophylaxis. Additional assessment is needed because the number of NH residents with these factors is large, and the cost/benefit of universal prophylaxis undeniably low. Which additional factors to assess and how various factors combine to impact risk requires further study. It is also recognized that targeting VTE risk is necessary but insufficient. Other factors (e.g., clinical contraindications, reduced life expectancy, patient/care-giver wishes, and quality of life issues) merit special consideration within the NH population.

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Table 1

Subject Characteristics and Odds Ratios for Selected Risk Factors among Olmsted County Residents Age ≥65 Years With and Without Symptomatic Objectively-Diagnosed Incident VTE while a Resident of a Local Nursing Home 1988 through 2000. Unpublished Data For All Olmsted County Residents Age ≥65 Years With and Without Symptomatic Objectively-Diagnosed Incident VTE 1988 through 2000 Are Provided for Comparative Purposes.

Subject Characteristics	Olmsted County Residents in a Nursing Home Age≥65 Years 1/1/1988 through 12/31/2000				Entire Olmsted County Population Age≥65 Years 1/1/1988 through 12/31/2000			
	Cases N=182	Controls N=364	OR (95% CI)	P value	Cases N=734	Controls N=830	OR (95% CI)	P value
Age (yrs), mean (± SD)								
Mean (± SD)	84.8 (7.3)	84.8 (7.3)	NA	NA	78.8 (8.2)	78.7 (8.2)	NA	NA
Median, range	84, 69–103	84, 68–104			78, 65–103	78, 65–103		
Female sex, n (%)	133 (73%)	266 (73%)	NA	NA	424 (58%)	480 (58%)	NA	NA
Hospitalization [*,†], n (%)								
With surgery	35 (19%)	49 (14%)	2.5 (1.4 – 4.3)	0.002	179 (24%)	35 (4.2%)	11 (7.0 – 17)	<0.001
Without surgery	85 (47%)	122 (34%)	2.2 (1.5 – 3.2)	<0.001	236 (32%)	82 (9.9%)	6.2 (4.5 – 8.7)	<0.001
No hospitalization	62 (34%)	193 (53%)	1.0	NA	319 (43%)	713 (86%)	1.0	NA
Trauma/fracture [*], n (%)	35 (19%)	51 (14%)	1.5 (0.92 – 2.5)	0.100	95 (13%)	33 (4.0%)	3.6 (2.4 – 5.5)	<0.001
Active malignancy [‡], n (%)	33 (18%)	33 (9.1%)	2.3 (1.4 – 4.0)	0.002	196 (27%)	45 (5.4%)	5.8 (4.0 – 8.3)	<0.001

[*] Within 3 months before index

[†] Modeled jointly with 2 degrees of freedom and 'no hospitalization' as the reference group

[‡] Within 3 months before or 3 months after index

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Table 2

Prevalence of Thromboprophylaxis Within 3 Months Before Index, Stratified by Selected VTE Risk Factors, among Olmsted County Residents Age ≥65 Years With And Without Symptomatic Objectively-Diagnosed Incident VTE while a Resident of a Local Nursing Home 1988 through 2000. Unpublished Data For All Olmsted County Residents Age ≥65 Years With and Without Symptomatic Objectively-Diagnosed VTE 1988 through 2000 Are Provided for Comparative Purposes.

Subject Characteristics	**Olmsted County Residents in a Nursing Home Age≥65 Years 1/1/1988 through 12/31/2000**		**Entire Olmsted County Population Age≥65 Years 1/1/1988 through 12/31/2000**	
	Cases N=182	**Controls N=364**	**Cases N=734**	**Controls N=830**
Any thromboprophylaxis *, n (%)	85 (47%)	125 (34%)	275 (37%)	87 (10%)
Pharmacologic only, n (% of any)	66 (36%)	104 (29%)	186 (25%)	75 (9.0%)
Mechanical only, n (% of any)	3 (1.6%)	7 (1.9%)	44 (16%)	4 (0.5%)
Both, n (% of any)	16 (8.8%)	14 (3.8%)	45 (6.1%)	8 (1.0%)
Hospitalization with surgery *, n	35	49	179	35
Any thromboprophylaxis, n (%)	27 (77%)	46 (94%)	129 (72%)	23 (66%)
Pharmacologic only, n (%)	13 (37%)	30 (61%)	66 (37%)	14 (40%)
Mechanical only, n (%)	3 (8.6%)	4 (8.2%)	32 (18%)	4 (11%)
Both, n (%)	11 (31%)	12 (24%)	31 (17%)	5 (14%)
Hospitalization without surgery *, n	85	122	236	82
Any thromboprophylaxis, n (%)	54 (64%)	71 (58%)	136 (58%)	32 (39%)
Pharmacologic only, n (%)	49 (58%)	66 (54%)	110 (47%)	29 (35%)
Mechanical only, n (%)	0 (0.0%)	3 (2.5%)	12 (5.1%)	0 (0.0%)
Both, n (%)	5 (5.9%)	2 (1.6%)	14 (5.9%)	3 (3.7%)
No hospitalization *, n	62	193	319	713
Any thromboprophylaxis, n (%)	4 (6.5%)	8 (4.2%)	10 (3.1%)	32 (4.5%)
Pharmacologic only, n (%)	4 (6.5%)	8 (4.2%)	10 (3.1%)	32 (4.5%)
Mechanical only, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Both, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Trauma/fracture *, n	35	51	95	33
Any thromboprophylaxis, n (%)	24 (69%)	41 (80%)	60 (63%)	16 (48%)
Pharmacologic only, n (%)	14 (40%)	31 (61%)	32 (34%)	13 (39%)

Subject Characteristics	Olmsted County Residents in a Nursing Home Age≥65 Years 1/1/1988 through 12/31/2000		Entire Olmsted County Population Age≥65 Years 1/1/1988 through 12/31/2000	
	Cases N=182	Controls N=364	Cases N=734	Controls N=830
Mechanical only, n (%)	3 (8.6%)	4 (7.8%)	15 (16%)	1 (3.0%)
Both, n (%)	7 (20%)	6 (12%)	13 (14%)	2 (6.1%)
Active malignancy†, n	33	33	196	45
Any thromboprophylaxis, n (%)	14 (42%)	17 (52%)	72 (37%)	9 (20%)
Pharmacologic only, n (%)	10 (30%)	15 (45%)	42 (21%)	5 (11%)
Mechanical only, n (%)	0 (0.0%)	0 (0.0%)	15 (7.7%)	2 (4.4%)
Both, n (%)	4 (12%)	2 (6.1%)	15 (7.7%)	2 (4.4%)

*Within 3 months before index

†Within 3 months before or 3 months after index