Venous Thromboembolic Disease

Comparison of the Diagnostic Process in Men and Women

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Background: There has been concern that women may be limited to fewer major diagnostic tests than men. Whether this applies to patients with pulmonary embolism (PE) or deep venous thrombosis (DVT) has not been determined.

Objective: To assess whether there is a sex disparity in the application of diagnostic tests for PE or DVT, in reaching a diagnosis, or in using medical facilities.

Design: A study of cross-sectional samples of hospitalizations from 21 separate years using data from the National Hospital Discharge Survey.


Patients: The National Hospital Discharge Survey abstracts demographic and medical information from the medical records of inpatients. For 1979 through 1999, the number of patients sampled ranged from 181,000 to 307,000.

Measurements: The number of sampled patients with DVT and with PE and the number of diagnostic tests performed were determined from the International Classification of Diseases, Ninth Revision, Clinical Modification codes at discharge. A multistage estimation procedure gave an estimation of values for the entire United States.

Results: Age-adjusted rates of the diagnosis of PE per 100,000 population and of DVT per 100,000 population were not lower in women. Rates of the use of ventilation-perfusion lung scans, venous ultrasonography of the lower extremities, and contrast venography were not lower in women. Durations of hospitalization for PE or DVT were comparable in men and women.

Conclusion: Data from the National Hospital Discharge Survey do not support a sex bias in the diagnosis of PE or DVT, the use of diagnostic tests, or the duration of hospitalization for PE or DVT.

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There has been concern that women have less access to major diagnostic tests and therapeutic interventions than men, although women receive more health care services overall than men, receive more health care services overall than men, and women are 0.6 times as likely as men to have cytologic studies of sputum for lung cancer, although women and men with similar smoking practices are at essentially an equivalent risk for lung cancer. Among patients who needed dialysis, 16% fewer women than men received it. Female patients receiving dialysis are 25% to 30% less likely to receive a kidney transplant. Because there may be a sex disparity in access to some major health care services, we explored whether such a disparity applies to pulmonary thromboembolic disease. Our goal was to determine whether there is a sex disparity in the application of diagnostic tests for pulmonary embolism (PE) and deep venous thrombosis (DVT), in reaching a diagnosis, or in the use of medical facilities. Data on trends in the use of diagnostic tests were obtained from the National Hospital Discharge Survey (NHDS).
METHODS

DATA SOURCES

Data from the NHDS were used for this study. Data from this survey are available on CD-ROM, and much are available in hard copy. The NHDS is based on data abstracted from a national probability sample of discharges from short-stay non-federal hospitals in the 50 states and the District of Columbia. Hospitals with an average length of stay for all patients of less than 30 days or those whose specialty is general medicine or general surgery, regardless of length of stay, are included in the survey. Hospitals with an average length of stay of 30 days or more were excluded from the NHDS before 1988. Hospitals must have 6 or more staffed beds to be considered in the survey.

The number of responding hospitals and sampled patient abstracts in the survey for 1979 through 1999 ranged from 400 to 480 and 181 000 to 307 000, respectively. The NHDS samples include about 8% of hospitals and about 1% of discharges. The annual hospital response rate for the NHDS generally exceeds 90%. The survey includes all discharges, including newborns and patients discharged dead.

The survey design and sampling and estimation procedures were planned to produce calendar-year estimates. Trained medical personnel coded diagnoses and procedures using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). A minimum of 1 and a maximum of 7 diagnostic codes were assigned for each sample abstract. If an abstract included surgical and/or diagnostic procedures, a maximum of 4 procedure codes were assigned.

NHDS SAMPLING SCHEME

The NHDS is based on a national probability sample of discharges from noninstitutional hospitals located in the 50 states and the District of Columbia, exclusive of federal, military, and Department of Veterans Affairs hospitals. A 3-stage sampling plan was introduced in 1988 and replaced an earlier, similarly designed 2-stage sampling plan. Both designs included a probability sample of hospitals and a systematic sampling procedure to select discharges within hospitals. The changes introduced with the 1988 redesign do not compromise the ability to conduct trend analysis.

First-Stage Sampling: Primary Sampling Units

There were 112 primary sampling units, including counties, groups of counties, county equivalents (such as parishes or independent cities), or towns and townships.

Second-Stage Sampling: Hospitals

Hospitals in the primary sampling unit that had 1000 or more beds were always selected for inclusion in the survey and termed certainty hospitals. A systematic random sample was made of hospitals with less than 1000 beds. These were selected from the primary sampling units with a probability proportional to their annual number of discharges.

Third-Stage Sampling: Discharges

A sample of discharges from each hospital was selected by a systematic random sampling technique.

ESTIMATION PROCEDURES

Estimates of patients with DVT, those with PE, and the total number of diagnostic tests performed in the United States were derived from numbers of sampled patients with DVT, patients with PE, and the number of diagnostic tests performed in sampled patients. This was done using a multistage estimation procedure that produces essentially unbiased national estimates and has the following 3 basic components: inflation by reciprocals of the probabilities of sample selection, adjustment for nonresponding hospitals and missing discharges within hospitals, and population-weighting ratio adjustments. As the statistics from the survey are based on a sample, they may be different from the figures that would have been obtained if a complete census had been taken.

IDENTIFICATION OF VENOUS THROMBOEMBOLISM CASES

We screened all available diagnostic code fields for specific codes to identify patients with DVT or PE. Since 1979, the ICD-9-CM diagnostic codes have been used for classifying diagnoses and procedures in the NHDS. Although the ICD-9-CM has been modified annually, the diagnostic codes for PE, infarction, phlebitis, and thrombophlebitis of deep vessels of lower extremities have changed little. The specific ICD-9-CM codes that we used for identification of patients with PE are 415.1 and 634.6, 635.6, 636.6, 637.6, 638.6, and 673.2. The ICD-9-CM codes that we used for the identification of patients with DVT are 415.1, 451.2, 451.8, 451.9, 453.2, 453.8, 453.9, 671.3, 671.4, and 671.9. Five-digit codes, such as 415.11 (included under the code 415.1), were not listed separately, as they were included under the corresponding 4-digit codes.

IDENTIFICATION OF DIAGNOSTIC PROCEDURES FOR VENOUS THROMBOEMBOLISM

Patients who underwent diagnostic procedures for DVT or PE were identified by screening the following procedure codes: 88.66 (phlebography of femoral and other lower extremity veins using contrast material), 88.43 (arteriography of pulmonary arteries), 92.15 (pulmonary radioisotope scan), and 88.77 (DVT ultrasonic scanning).

STATISTICAL ANALYSIS AND METHODOLOGICAL CONSIDERATIONS

Age-adjusted rates of diagnosis of PE and DVT according to sex were obtained as follows: The population of a given sex was stratified according to decade of age. The number of cases recorded for each decade of age by sex was divided by the population of that sex in that decade of age. This gave the crude (unadjusted) case rate per decade according to sex. We adjusted this rate to a standard population of the year 2000 as follows: We multiplied the crude case rate for each decade of age by the percentage of the population in the year 2000 that was in that decade of age. This gave the age-adjusted rate for that decade of age. The sum of the age-adjusted rates for each decade of age gave the age-adjusted rate for the entire population.

We obtained rates of use of diagnostic tests in a given sex by dividing the number of diagnostic tests performed in the United States during a year by the census counts, or intercensal or postcensal estimates of each sex. Rates of use of diagnostic tests were not adjusted for age.

We used descriptive statistics to graphically display trends over time in rates of diagnosis of DVT and PE and rates in use of diagnostic tests for PE. Hospital discharge data incompletely capture many diagnoses and procedures. Therefore, trends in rates of diagnosis in patients with DVT or PE and trends in rates of use of specific diagnostic tests will be the focus rather than absolute values. Methodological issues that include the phenomena of diagnosis related group (DRG) "creep," changes...
The rate of diagnosis of PE per 100,000 population, not adjusted for age, was higher in women than men ($P = .04$) (Figure 1A). The rate ratio (the rate for women divided by the rate for men) during the period of survey ranged from 0.90 to 1.61. From 1979 to 1992, the rate of diagnosis of PE declined in women (slope, $-2.50$ PE/100,000 population per year; $r = 0.65$; $P < .001$) and in men (slope, $-2.14$ PE/100,000 population per year; $r = 0.78$; $P = .004$) but not in men.

The age-adjusted rates of diagnosis of PE per 100,000 population in men and women were comparable (Figure 1B). The rate ratio of women to men ranged from 1.13 to 1.64. Among women, the rate of diagnosis of DVT declined from 1979 to 1989 (slope, $-3.16$ DVT/100,000 population per year; $r = 0.82$; $P = .002$). After 1989, the rate increased (slope, 5.72 DVT/100,000 population per year; $r = 0.95$; $P < .001$). In men, the rate of diagnosis of DVT was unchanged from 1979 to 1991. The rate of diagnosis of DVT increased in men from 1991 to 1999 (slope, 4.58 DVT/100,000 population per year; $r = 0.92$; $P < .001$).

The age-adjusted rate of diagnosis of DVT per 100,000 population was higher in women ($P = .003$) (Figure 1D). The rate ratio of women to men ranged from 0.91 to 1.40. Women showed a decreasing rate of diagnosis from 1979 to 1989 (slope, $-4.38$ DVT/100,000 population per year; $r = 0.90$; $P < .001$). Men showed no change in the rate of diagnosis during this period. From 1989 through 1999, the rates of diagnosis increased in women (slope, 4.81 DVT/100,000 population per year; $r = 0.93$; $P < .001$) and in men (slope, 4.08 DVT/100,000 population per year; $r = 0.91$; $P < .001$).

The use of pulmonary angiograms was low among men and women. The frequency of use of pulmonary angiograms among women was too low to calculate rates. However, inspection of the data showed no suggestion of a disparity of use between men and women.
The rate of use of ventilation-perfusion lung scans per 100,000 population was higher among women than men (P = .006) (Figure 2). The ratio of use of lung scans comparing women with men ranged from 1.17 to 1.60. The rates of use were unchanged from 1979 to 1981. From 1981 to 1986, the rates of use increased for women (slope, 10.08 lung scans/100,000 population per year; r = 0.97; P < .001) and men (slope, 7.00 lung scans/100,000 population per year; r = 0.98; P = .001). From 1986 to 1999, the rates decreased in women (slope, −3.98 lung scans/100,000 population per year; r = 0.98; P < .001) and men (slope, −3.03 lung scans/100,000 population per year; r = 0.98; P < .001).

The rates of use of contrast venography per 100,000 population among men and women were comparable (Figure 3A). The ratio of the rates of use (women to men) ranged from 0.48 to 2.06. The rates of use increased sharply from 1979 to 1987. From 1987 to 1997, the rates of use decreased for women (slope, −4.33 venograms/100,000 population per year; r = 0.99; P < .001) and men (slope, −3.66 venograms/100,000 population per year; r = 0.96; P < .001). From 1997 to 1999, the rates of use were constant.

The rate of use of venous ultrasonography of the lower extremities per 100,000 population was higher among women (P < .001) (Figure 3B). The ratio of use of ultrasonography in women to men ranged from 0.39 to 1.56. The rates of use increased from 1979 to 1993 in women (slope, 3.87 ultrasonograms/100,000 population per year; r = 0.98; P < .001) and in men (slope, 2.92 ultrasonograms/100,000 population per year; r = 0.98; P < .001). From 1993 to 1999, the rate of use of ultrasonography in women decreased slightly (slope, −1.92 ultrasonograms/100,000 population per year; r = 0.81; P = .03). In men, the rate of use remained unchanged.

The duration of hospitalization for men and women with a primary discharge diagnosis of PE was comparable (Figure 4A). The duration of hospitalization decreased over time in women (slope, −0.36 d/y; r = 0.89; P < .001) and men (slope, −0.24 d/y; r = 0.91; P < .001).

The duration of hospitalization for men and women with a primary discharge diagnosis of DVT was comparable (Figure 4B). The duration of hospitalization decreased over time in women (slope, −0.26 d/y; r = 0.96; P < .001) and men (slope, −0.22 d/y; r = 0.91; P < .001).

Data from the NHDS during a 21-year span do not support a sex bias adverse to women in the diagnosis of PE or DVT, in the use of diagnostic tests, or in the duration of hospitalization for PE or DVT. The comparable age-adjusted rate of diagnosis of PE among women and men and an even higher age-adjusted rate of diagnosis of DVT among women indicate no sex bias in reaching a diagnosis. This finding is concordant with some previous investigations of PE and DVT but the previous literature is not uniform. Pulmonary embolism has also been reported more frequently in men or older men, and objectively diagnosed DVT has been reported to be more frequent in men.

We provided crude and adjusted rates of diagnosis for PE and DVT. Both types of rates are informative. The crude rates convey the actual hospitalization rates for men and women, indicating what actually happened. Given that PE and DVT are conditions that increase in incidence with age, the adjusted rates indicate the hospitalization rates for men and women, assuming identical age distributions for both populations. Therefore, age is removed as a potential confounder of the association between sex and rates of PE and DVT.

Contrast venography was used with comparable frequency among men and women. Noninvasive diagnostic tests (ventilation-perfusion lung scans and venous ultrasonography of the lower extremities) were used more frequently in women than men, indicating no bias toward withholding tests. A more frequent use of venous ultrasonography for the diagnosis of DVT has been observed in women. The comparable duration of hospitalization among men and women indicated one aspect of comparable care once the system has been accessed. The decreasing duration of hospitalization among both sexes reflects the use of protocols that assist in reaching a therapeutic level of heparin therapy promptly, a shorter duration of use of unfractionated heparin, and use of low-molecular-weight heparin.

The use of venography increased in men and women from 1979 to the late 1980s as the need for an objective diagnosis of DVT became apparent. The use of contrast venography then declined as noninvasive testing with venous ultrasonography increased in use. Use of Doppler ultrasonography in the 1990s tended toward more frequent use in women than men. The use of ventilation-perfusion lung scans increased from 1979 to a peak in the mid-1980s, when it became apparent that lung scanning alone did not give a definitive diagnosis in many patients, and that diagnostic leg testing was a valuable adjunct. Thereafter, the use of lung scans declined concordantly with an increased use of venous ultrasonography.

The number of diagnostic procedures is underreported because of an imperfect sensitivity of ICD-9-CM codes for capturing diagnostic procedures. However, the directional trends of the curves and their relative positions are likely to be correct. Regarding acute PE, review and reabstraction of a sample of Medicare hospitalizations from late 1984 and early 1985 showed that for PE, 92% of codable cases were on the abstract.
potential for variation of sensitivity of coding over time represents a possible threat to the validity of our findings. In particular, the following 2 phenomena may have introduced variability into the sensitivity of coding: DRG creep and changes over time of the ICD-9-CM coding system. Diagnosis related group creep is an artifact of coding that might have increased the sensitivity of coding when reimbursement became dependent on the coding. The decline of some procedures in the middle to late 1980s suggests that DRG creep is unlikely to be a major confounder of the evidence. As for changes over time to the ICD-9-CM coding system, there were no confounding changes of the coding scheme for PE or for DVT.

CONCLUSIONS

Diagnostic tests for PE and for DVT were not performed less frequently in women compared with men, and there is no evidence of a failure to reach a diagnosis in women with PE or DVT. A comparable effort was shown in the United States for the diagnosis of PE and DVT, irrespective of sex.

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REFERENCES


Figure 3. Rates of venography and venous ultrasonography (US) during a 21-year period. A, Rates of use of contrast venography per 100000 population. The rates of use among men and women were comparable. B, Rates of use of venous US in the lower extremities per 100000 population. The rate of use was higher among women (P<.001).

Figure 4. Duration of hospitalization for men and women with a primary discharge diagnosis of pulmonary embolism (PE) or deep venous thrombosis (DVT). A, Duration of hospitalization for PE. Duration was comparable between the sexes. B, Duration of hospitalization for DVT. The duration of hospitalization was comparable between the sexes.

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