Venous Thromboembolic Disease

Comparison of the Diagnostic Process in Blacks and Whites

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Background: There has been concern that a disproportionate use of some health services exists among races. Whether this applies to patients with pulmonary embolism (PE) or deep venous thrombosis (DVT) has not been determined.

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

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

Setting: Noninstitutional hospitals in 50 states and the District of Columbia from January 1, 1979, through December 31, 1999.

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 annually 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 estimate of values for the entire United States.

Results: The age-adjusted rates of diagnosis of PE and of DVT per 100,000 population were not lower in blacks than in whites. Rates of use of radioisotopic lung scans, venous ultrasonography of the lower extremities, and contrast venography were comparable between races. The durations of hospitalization for patients with a primary discharge diagnosis of PE and of DVT were also comparable.

Conclusions: There is nothing to suggest that diagnostic tests are being withheld, and there is no evidence of a failure to reach a diagnosis in blacks with thromboembolic disease.

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nal Discharge Survey (NHDS). This survey consists of data obtained annually from 181,000 to 307,000 sampled patient abstracts from 400 to 480 hospitals in 50 states and the District of Columbia.12

### METHODS

#### DATA SOURCE

Data from the NHDS11 were used for this study. Data from this survey are available on CD-ROM,12 and much of it is available in hard copy.13-30 The NHDS is based on data abstracted from a national probability sample of discharges from short-stay nonfederal hospitals in 50 states and the District of Columbia. Hospitals with a mean length of stay for all patients less than 30 days and hospitals designated as general medical or surgical specialty hospitals regardless of length stay are included in the survey. Hospitals with a mean length of stay of 30 days or more were excluded from the NHDS before 1988. Hospitals must have 6 or more staffed hospital beds to be included 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 from 181,000 to 307,000, respectively.12 The annual hospital response rate for the NHDS generally exceeds 90%. The survey includes all patient discharges, including newborns and patients discharged dead.

The survey design, 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).11 A minimum of 1 and a maximum of 7 diagnostic codes were assigned for each sample abstract. If an abstract included a surgical and/or diagnostic procedure, 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 exclusive of federal, military, and Department of Veterans Affairs hospitals, located in 50 states and the District of Columbia. A 3-stage sampling plan was introduced in 1988 and replaced an earlier, similarly designed 2-stage sampling plan.11 For both designs, there is 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.11

**First Stage (Primary Sampling Units)**

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

**Second Stage (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.”12 All other hospitals were selected using systematic random sampling. These were selected from the primary sampling units with a probability proportional to their annual number of discharges.

**Third Stage (Discharges)**

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

#### ESTIMATION PROCEDURES

Estimates of patients with DVT and with PE and the total number of diagnostic tests performed in the United States were derived from the number of patients with DVT, the number with PE, and the number of diagnostic tests performed in sampled patients. This was done using a multistage estimation procedure that produces unbiased national estimates and has 3 basic components: inflation by reciprocals of the probabilities of sample selection, adjustment for nonresponding hospitals and for missing discharges within hospitals, and population-weighting ratio adjustments.12 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

All available diagnostic code fields were screened for specific codes to identify patients with DVT or PE. Since 1979, the ICD-9-CM diagnostic codes11 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 and pulmonary infarction and for phlebitis and thrombophlebitis of deep vessels of the lower extremities have changed little. The specific codes that we used for identification of patients with PE are 415.1, 634.6, 635.6, 636.6, 637.6, 638.6, and 673.2.

The codes that we used for the identification of DVT are 451.1, 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 radioisotopic scan), and 88.77 (DVT ultrasonic scanning).

#### POPULATION ESTIMATES

The population estimates are derived form the US Bureau of the Census estimates of national, state, and county resident populations. The estimates for 1979 and 1981 through 1989 are intercensal estimates of the July 1 resident population. The 1980 and 1990 estimates are modified April 1 census counts. The estimates for 1991 through 1999 are postcensal estimates of the July 1 resident population. The US Bureau of the Census prepares a complete series of postcensal estimates each year consisting of estimates for the current year and revised estimates for previous years. The postcensal estimates for previous years are revised to reflect the use of final data files rather than preliminary data files in the estimation process.

#### STATISTICAL ANALYSIS

Age-adjusted rates of diagnosis of PE and DVT according to race were obtained as follows: The population of a given race was stratified according to decade of age. The number of cases recorded for each decade of age by race was divided by the population of that race in that decade of age. This gave the crude (unadjusted) case rate per decade according to race. This was adjusted to a standard population of the year 2000 as follows: The crude case rate for each decade of age was multiplied by...
Figure 1. Rates of diagnosis during 21 years of pulmonary embolism (PE) and deep venous thrombosis (DVT) per 100 000 population according to race. A, Unadjusted (crude) rates of diagnosis of PE. The rates of diagnosis were comparable among blacks and whites. B, Age-adjusted rates of diagnosis of PE. There was no change in the rate of diagnosis among blacks during the period. Whites, however, showed a decreasing rate of PE during the survey. C, Unadjusted rate of diagnosis of DVT. The rate of diagnosis was comparable among blacks and whites. D, Age-adjusted rate of diagnosis of DVT. The rate was higher in blacks than in whites ($P = .001$).

RATES OF DIAGNOSIS OF PE AND DVT

The rate of diagnosis of PE per 100 000 population, not adjusted for age, was comparable between blacks and whites (Figure 1A). The rate ratio (ratio of the rate for blacks divided by the rate for whites) ranged from 0.61 to 1.45. Despite some year-to-year fluctuation, the rate of diagnosis of PE among blacks did not change appreciably during the 21 years studied. Whites, however, showed a decreased rate of PE during the period (slope, $−1.51$ PE diagnoses per 100 000 population per year; $P=−0.85$; $P < .001$).

Adjustment for age caused the rate of diagnosis of PE among blacks to diverge from that of whites after the mid 1980s (Figure 1B). The age-adjusted rate of diagnosis of PE per 100 000 population was higher in blacks than in whites ($P = .001$) (Figure 1B). The rate ratio of blacks to whites for the years 1979 and 1984 ranged from 0.8 to 1.2. From 1985 to 1999, the rate ratio ranged from 1.2 to 1.9. From 1979 to 1992, there was a decline in the rate of diagnosis among blacks (slope, $−1.50$ PE diagnoses per 100 000 population per year; $r=−0.85$; $P < .001$). Between 1992 and 1999, the rate of diagnosis was constant in blacks, but the rate of diagnosis increased somewhat in whites.

The rate of diagnosis of DVT per 100 000 population, not adjusted for age, was comparable between blacks and whites (Figure 1C). The rate of diagnosis increased during the 21 years in blacks (slope, 2.23 DVT diagnoses per 100 000 population per year; $r = 0.64$; $P = .002$). Among whites, the rate of diagnosis remained unchanged during the period. The ratio of rates of diagnosis, blacks to whites, ranged from 0.61 to 1.36.

The age-adjusted rate of diagnosis of DVT per 100 000 population was higher in blacks than in whites ($P = .001$) (Figure 1D). Between 1979 and 1987, the rate ratio of blacks to whites ranged from 0.8 to 1.2. Between 1989 and 1999, the rate ratio in general ranged...
from 1.2 to 1.9, although there was a transient dip to a rate ratio of 0.9. From 1979 to 1992, the age-adjusted rate of diagnosis was constant in blacks, whereas whites showed a gradual decrease in the rate. From 1992 to 1999, the rate of diagnosis increased sharply in blacks; the rate increased more gradually in whites.

**USE OF DIAGNOSTIC TESTS FOR PE AND DVT**

The use of pulmonary angiography per 100000 population was low among blacks and whites. The frequency of use of angiography among blacks was too low to calculate rates. However, inspection of the data showed no suggestion of a disparity of use between blacks and whites.

Rates of use per 100000 population of radioisotopic lung scans among blacks and whites from 1979 through 1999 were comparable (Figure 2). There was overlap of the data between 1979 and 1990, and a transient fluctuation showed an increased use of lung scans among blacks between 1991 and 1994. From 1995 through 1999, the ratio of use of lung scans, comparing blacks with whites, ranged between 1.2 and 1.6. The use of radioisotopic lung scans in whites and blacks increased sharply between 1979 and 1986. The use then declined in blacks (slope, −2.59 lung scans per 100000 population per year; \( r = -0.84; P < .001 \)) and in whites (slope, −3.53; \( r = -0.98; P < .001 \)).

The rates of use per 100000 population of contrast venography among blacks and whites from 1979 through 1999 were comparable (Figure 3A). The rate of use of venography in blacks and in whites increased to a peak in the late 1980s. Use in blacks increased at a rate of 3.62 venographic studies per 100000 population per year (\( r = 0.85; P = .004 \)), and use in whites increased at a rate of 3.52 per 100000 population per year (\( r = 0.99; P < .001 \)). After reaching a peak, the rate of use decreased until 1994 in blacks (slope, −5.05 venographic studies per 100000 population per year; \( r = -0.88; P = .004 \)) and in whites (slope, −4.32; \( r = 1.00; P < .001 \)). From 1994 to 1999, the rates of use remained unchanged in whites and in blacks.

The rates of use per 100000 population of venous ultrasonography of the lower extremities among blacks and whites from 1979 through 1999 were comparable (Figure 3B). Between 1979 and 1987, the data were essentially superimposed. Between 1988 and 1999, the ratio of use of ultrasonography in blacks to whites ranged from 1.2 to 1.8. The rate of use of venous ultrasonography increased in whites and blacks until 1991. Between 1991 and 1999, blacks showed no change in the rate of use of ultrasonography. Whites showed a slight reduction in the rate of use of ultrasonography (slope, −1.2 ultrasonographic examinations per 100000 population per year; \( r = -0.78; P = .02 \)).

**USE OF MEDICAL FACILITIES FOR TREATMENT OF PE AND DVT**

The duration of hospitalization for blacks and whites with a primary discharge diagnosis of PE was comparable (Figure 4A). The duration of hospitalization decreased over time in blacks (slope, −0.32 days per year; \( r = -0.84; P < .001 \)) and whites (slope, −0.30; \( r = -0.94; P < .001 \)).

The duration of hospitalization for blacks and whites with a primary discharge diagnosis of DVT was comparable (Figure 4B). The duration of hospitalization decreased over time in blacks (slope, −0.27 days per year; \( r = -0.86; P < .001 \)) and whites (slope, −0.25; \( r = -0.96; P < .001 \)).
or DVT among blacks. There was no evidence of an adverse disparity causing a failure of diagnosis of thromboembolic disease in blacks.

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 blacks and whites. Given that PE and DVT are conditions that increase in incidence with age, the adjusted rates indicate the hospitalization rates for blacks and whites assuming identical age distributions for the black and white populations. Therefore, age was removed as a potential confounder of the association between race and rates of PE and DVT.

Regarding the use of diagnostic tests, the findings indicate no evidence of less diagnostic testing among the black population. This was shown with contrast venography, venous ultrasonography, and radioisotopic lung scans. Although pulmonary angiography was not done with sufficient frequency to make comparative rate calculations of use, available data showed no apparent disparity of use. The duration of hospitalization for PE and the duration of hospitalization for DVT were the same in blacks and whites, indicating one aspect of comparable care once the system has been accessed. During the survey, the duration of hospitalization decreased for DVT and PE in blacks and in whites. This reflects the use of protocols for a rapid attainment of therapeutic levels of heparin sodium, a shorter duration of therapy with heparin, and use of low-molecular-weight heparin. Our data were obtained entirely from hospitalized patients. We do not have information related to care after hospitalization. Some authors have reported use of a shorter duration of anticoagulant therapy in blacks.

In black and white populations, the use of venography increased 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 tended toward more frequent use in blacks than whites. The use of radioisotopic lung scans increased from 1979 to a peak in the mid 1980s, when it became clear 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. The potential for variation of sensitivity of coding over time represents a possible threat to the validity of our findings. In particular, 2 phenomena may have introduced variability into the sensitivity of coding: diagnosis related group creep and changes over time to 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 fact that the use of some procedures declined in the mid to late 1980s suggests that diagnosis related group creep is unlikely to be a major confounder of the evidence. As changes over time to the ICD-9-CM coding system, there were no confounding changes of the coding scheme for PE or for DVT.

Disparities in health care may be due to lack of appropriate communication between patients and their physicians, limited access to care and services, lack of trust of health care providers, and racial bias among medical care providers. Caution has been recommended, however, in the use of race as a variable. We must account for distinctions between race and socioeconomic status. An emphasis on ethnic groups rather than on race implies an appreciation of cultural and behavioral attitudes, beliefs, lifestyle patterns, diet, environmental living conditions, and other factors.

In conclusion, there is nothing to suggest that diagnostic tests are being withheld, and there is no evidence of a failure to reach a diagnosis in blacks with thromboembolic disease. A comparable effort was shown in the United States for the diagnosis of PE and DVT, irrespective of race.

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