Trauma/Critical Care

Rate of lower-extremity ultrasonography in trauma patients is associated with rate of deep venous thrombosis but not pulmonary embolism

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Background. *Disparate lower-extremity ultrasonography (LUS) screening practices among trauma institutions reflecta lack of consensus regarding screening indications and whether screening improves outcomes. We hypothesized that LUS screening for deep-vein thrombosis (DVT) is not associated with a reduced incidence of pulmonary embolism (PE).*
Methods. *The 2012 ACS National Trauma Data Bank Research Data Set was queried to identify 442,108 patients treated at institutions reporting at least one LUS and at least one DVT. Institutions performing LUS on more than 2% of admitted patients were designated high-screening facilities and remaining institutions were designated low-screening facilities. Patient characteristics and risk factors were used to develop a logistic regression model to assess the independent associations between LUS and DVT and between LUS and PE.*
Results. *Overall, DVT and PE were reported in 0.94% and 0.37% of the study population, respectively. DVT and PE were reported more commonly in designated high-screening than low-screening facilities (DVT: 1.12% vs 0.72%, P < .0001; PE: 0.40% vs 0.33%, P = .0004). Multivariable logistic regression demonstrated that LUS was associated independently with DVT (odds ratio 1.43, confidence interval 1.34–1.53) but not PE (odds ratio 1.01, confidence interval 0.92–1.12) (c-statistic 0.86 and 0.85, respectively). Sensitivity analyses performed at various rates for designating HS facilities did not alter the significance of these relationships.*
Conclusion. *LUS in trauma patients is not associated with a change in the incidence of PE. Aggressive LUS DVT screening protocols appear to detect many clinically insignificant DVTs for which subsequent therapeutic intervention may be unnecessary, and the use of these protocols should be questioned. (Surgery 2015;158:379-85.)*

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VENOUS THROMBOEMBOLISM (VTE) occurs commonly in patients hospitalized for traumatic injuries, and pulmonary embolism (PE) related to VTE has been cited as the third-leading cause of death for trauma patients who survive beyond the first day.[1] Accordingly, there is tremendous interest in measures that may prevent PE. Many centers perform routine screening of high-risk trauma patients for

lower-extremity deep-venous thrombosis (DVT) with the use of duplex ultrasonography, because detection of asymptomatic DVT may allow early initiation of therapy to prevent PE.[2] Contradictory evidence about the utility of routine DVT screening to decrease the incidence of PE, however, is reflected by differences and ambiguity in practice guidelines and variability in practice patterns.[1-3] Previous literature demonstrates that surveillance bias accounts for much of the variability in reported rates of DVT; however, it remains unclear whether aggressive screening practices affect the incidence of the key clinical outcome of interest, ie, PE. We sought to characterize the relationship between lower-extremity ultrasonography (LUS) screening and PE and hypothesized that aggressive DVT screening is not associated with a decrease in the incidence of PE in trauma patients.

METHODS

Data source. The Research Data Set (RDS) of the National Trauma Data Bank (NTDB) for admission year 2012 was used for this study with approval by the American College of Surgeons. The University of Virginia Institutional Review Board exempted this study from formal review, because the NTDB contains de-identified data, of which the use is not considered human subject research. The NTDB is a multi-institutional, clinical outcomes database that combines data from the trauma registries of more than 900 trauma centers in the United States. The RDS contains all records submitted to the NTDB for a particular admission year and is an appropriate data set for studying specific procedures and conditions among trauma patients. Detailed descriptions of the collection and handling of the NTDB data, as well as limitations of the data set, have been described extensively in the literature and in a publically available user manual distributed by the American College of Surgeons.[4]

Patients and outcomes. The 2012 NTDB RDS contained records for 833,311 trauma admissions to participating institutions. Data for 442,108 patient admissions from institutions that reported performing at least one LUS and at least one episode of DVT to the NTDB were included for study. The remaining records were excluded from study, because the admitting institution did not report performing at least one LUS or at least one DVT. The primary outcome of interest was the risk-adjusted association between institutional rate of LUS and PE, whereas a secondary outcome was the risk-adjusted association between institutional rate of LUS and DVT.

Patient characteristics and risk factors. Independent, a priori variables shown previously to predispose trauma patients to VTE as described in earlier literature were included for analysis.[5-7] These risk factors included age $\geq$40 years, Injury Severity Score $\geq$9, head injury with an Abbreviated Injury Scale score $\geq$3, lower-extremity fracture with Abbreviated Injury Scale score $\geq$3, pelvic fracture, spinal cord injury with neurologic deficit, vertebral column fracture, solid organ injury, venous injury, ventilator days $\geq$3 days, and major surgery.

Statistical analysis. Hospital rate of LUS was calculated by dividing patients who underwent at least one LUS at an institution by the total number of admissions.[5,8] Hospitals that performed LUS on at least 2% of admitted patients were designated as "high screening" facilities, replicating methodology described previously by Haut et al.[5,8]

Data analyses were designed to test the null hypothesis that hospital rate of LUS is not associated with PE or DVT. Statistical significance was determined using the standard alpha value of <0.05. All data analyses were performed with the use of SAS software, version 9.3 (SAS Institute, Cary, NC).

A descriptive, univariate analysis was performed to characterize baseline injury characteristics and outcome frequencies and was stratified by hospital screening designation. Bivariate analysis was used to describe outcome frequencies at high-screening (HS) versus low-screening (LS) facilities by risk factor. Categorical values are reported as a percentage of the total population of each group, and were compared with the χ^2 test. Finally, multivariate logistic regression was performed to determine the independent, risk-adjusted associations between hospital screening status, risk factors, and outcome measures. Modeled factor likelihood ratios (Wald 2 statistic) were used to estimate the predictive strength and relative contribution of each covariate with the odds of DVT and PE. Results are reported as adjusted odds ratios with 95% confidence intervals. Model performance was assessed by use of the calculated area under the receiver operating characteristic curve. All calculated test statistics were used to derive reported 2-tailed *P* values.

Sensitivity analysis. Sensitivity analysis was performed to determine the association of primary and secondary outcomes with various LUS rate thresholds used to designate facilities as HS versus LS facilities. Multivariate logistic regressions were repeated using screening thresholds of 1%, 5%, 10%, 20%, and 30%.

RESULTS

Characteristics of patients and injuries as well as unadjusted outcomes are listed in Table I and stratified by hospital screening status. Using the 2%