Using the D-dimer as a continuous variable for the likelihood of pulmonary embolism

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Background
The D-dimer was developed as a dichotomous variable to determine thrombosis risk following an assessment of pre-test probability (usually calculation of the Wells score). In practice, D-dimer is available before clinical assessment - rendering its clinical utility questionable. A pragmatic solution to this problem is required.

The aim of this study was to evaluate the efficacy of D-dimer as a continuous variable for the prediction of pulmonary embolus (PE).

Methods
Two months’ of CT pulmonary angiogram (CTPA) data were analysed (n=200). At our institution, entry of Wells score by the requesting physician, is required for CTPA authorisation. The Wells score and D-dimer values were extracted from the entry in the electronic patient records (EPR). In a subgroup (n=145), an independent physician (blinded to the CTPA report) reviewed the clinical records to recalculate the Wells score, using only data available to the admitting physician. Wells score calculation: signs/symptoms of DVT =3; PE as or more likely than alternative diagnosis =3; Heart rate >100 =1.5; Immobilization or surgery in previous four weeks = 1.5; Previous DVT/PE =1.5; Haemoptysis =1; Malignancy (on treatment, treated in last 6 months or palliative) =1. We considered Wells score ≤4 to be low probability and >4 to be high probability. D-dimer >500ng/ml is considered positive.

A Receiver-Operating Characteristic (ROC) curve was constructed and positive predictive values (PPV) calculated for different thresholds of D-dimer to predict PE.

Results
All 200 patients who had CTPA had a D-dimer measured prior to imaging, 186 were positive (>500ng/ml). In total, 25 PEs (12.5%) were diagnosed.

The area-under curve for ROC was 0.80 (95% confidence interval (CI) was 0.71-0.89; Fig 1). The D-dimer sensitivity using a threshold of 500ng/ml (to confer a positive result) was 100% and the PPV was 13.5% (95% CI 13.0–14.1). Adjusting the threshold to 2000ng/mL resulted in a PPV of 25.0% (95% CI 20.0–30.7). When the threshold was adjusted to 3000ng/mL, it gave PPV of 34.0 (95% CI 25.1–44.3).

Of n=145 clinical records, four patients had a Wells score of between 2 to 3 (low probability) and subsequent CTPAs were positive for PE. Each of these 4 patients had D-Dimer >2000ng/mL.

Conclusion
As well as ‘ruling-out’ PE (due to high sensitivity), high D-dimer values will confer PPV. In our hands a threshold of 2000ng/mL may be considered to assign higher risk for PE, even if Wells score was low-risk. D-dimer values may therefore have an additional role to ‘rule-in’ PE.