



Age-adjusted D-dimer in the Prediction of Pulmonary Embolism: Does a Normal Age-adjusted D-dimer Rule out PE?



Christopher Little¹, Jacob Ortiz MD¹, Rabia Saeed MD¹, Blyth Durbin-Johnson PhD³, Saul Schaefer MD^{1,2}

¹Department of Internal Medicine, Division of Cardiovascular Medicine, University of California Davis, ²

Cardiology Section, Department of Veteran Affairs, Northern California Health Care System, ³Department of Public Health Sciences

INTRODUCTION

- Physicians evaluating patients for a possible pulmonary embolism (PE) use Clinical Decision Rules (CDRs) to decide whether to proceed to CT pulmonary angiography (CTPA).
- Two CDRs, the Well's rule and Geneva score have been validated in populations, and have good negative predictive value (NPV) but poor positive predictive value (PPV).
- D-dimer (a measure of fibrinolysis) can be used as adjunct to refine the predictive value of a CDR
- Clinicians often use a negative D-dimer to "rule-out" PE

Well's Rule		Revised Geneva Score	
Variable	Points	Variable	Points
Previous DVT or PE	1.5	Age >65	1
Recent Surgery or immobilization	1.5	Previous DVT or PE	3
Cancer	1	Surgery of Fracture within 1 Month	2
Hemoptysis	1	Active malignancy	2
Heart rate >100 beats/min	1.5	Unilateral lower limb pain	3
Clinical Signs of DVT	3	Hemoptysis	2
Alternative diagnosis less likely than PE	3	Heart Rate 75-94 beats/min	3
		Heart Rate ≥ 95 beats/min	5
		Pain on lower limb deep vein at palpation and unilateral edema	4
Clinical probability (3 Levels)	Total	Clinical probability (3 levels)	Total
Low	0-1	Low	0-3
Intermediate	2-6	Intermediate	4-10
High	≥7	High	≥11

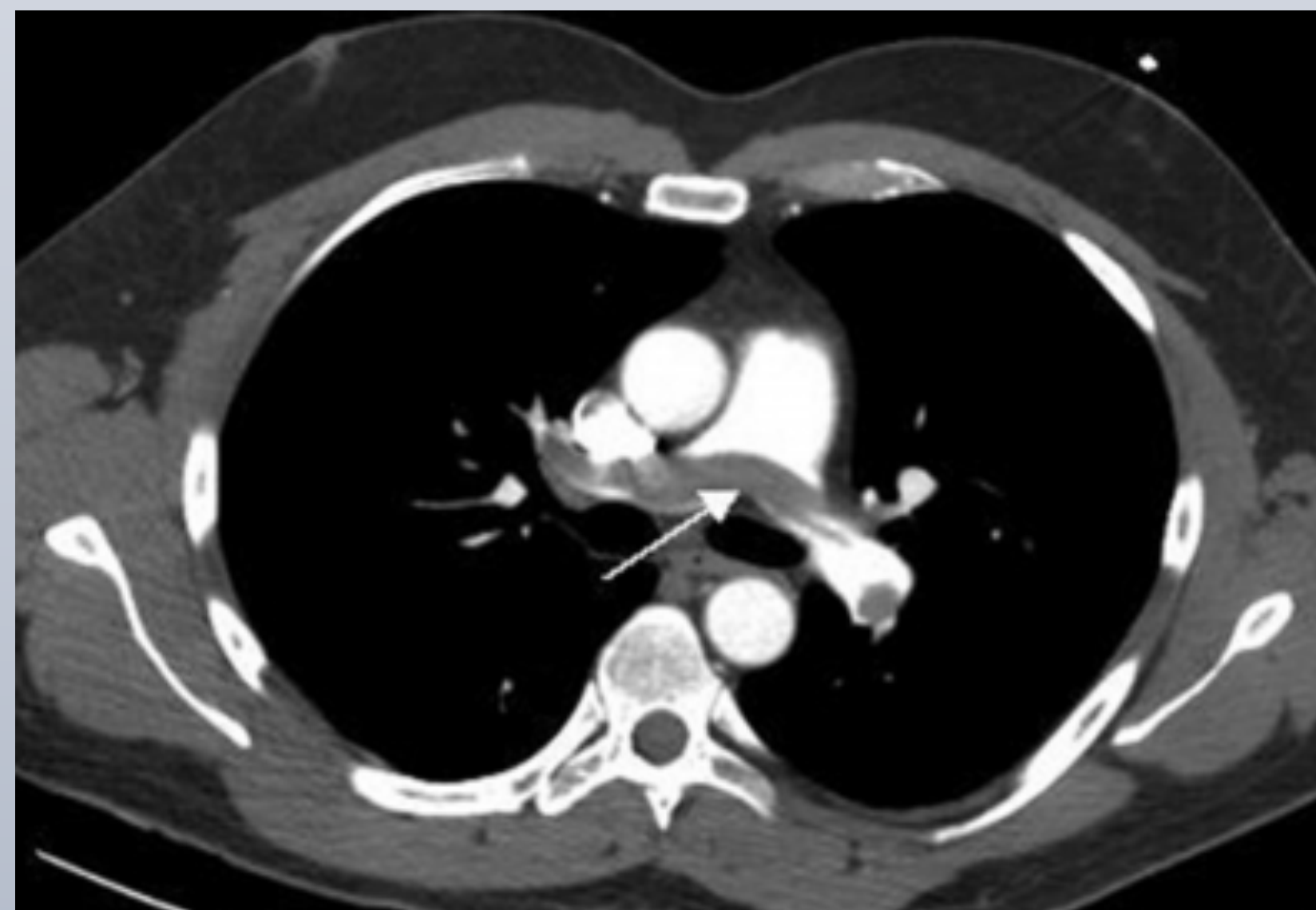
OBJECTIVES

- To determine the predictive values of the CDRs in our patient population at UCDMC
- To determine if any element of the CDRs was independently predictive of PE
- To determine if the addition of a negative D-dimer test to a low or intermediate CDR improved the negative predictive values
- To determine the relationship of CDRs and D-dimer to the extent of PE as determined by CTPA.

Methods

- CDRs: Imaging reports for all patients referred for CTPA to evaluate for PE between 2012 and 2015 were screened, yielding 894 charts. Elements of the CDRs were recorded, as were results of D-dimer testing.
- Groups were analyzed by CDR score (low-intermediate-high) and age-adjusted D-dimer (age x 10 over age 50)
- Clot burden: CTPA images were analyzed for clot burden using a published scoring system (1 = sub-segmental clot, 32 = saddle embolus)
- Logistic regression was used to model the probability of PE by each score, score element, and other clinical characteristics.
- Sensitivity, specificity, negative predictive value, and positive predictive value were calculated from 2X2 tables of predicted and actual outcomes.
- Data are presented as mean +/- standard deviation. Negative predictive value and positive predictive value were defined conventionally.
- Significance was defined as a P value < 0.05.

Saddle Pulmonary Embolism with Clot Score of 32



Results

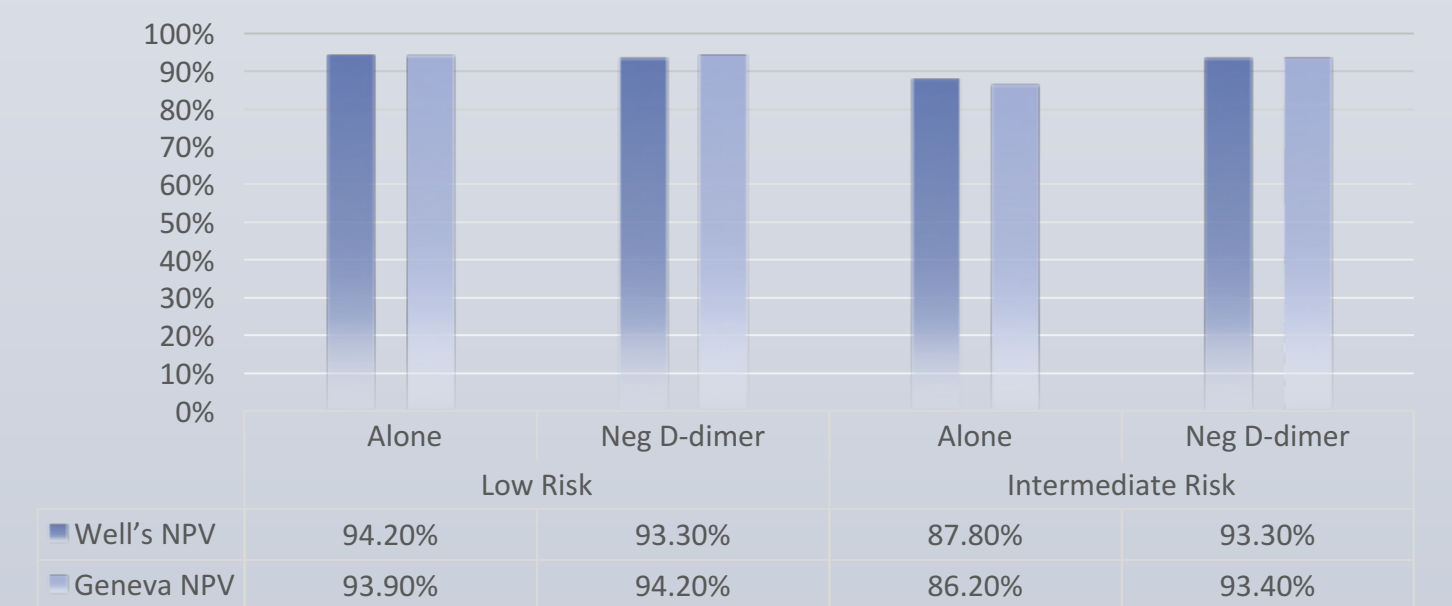
Characteristics of the Study Population that differed significantly (P<0.05)

	No PE (N=761)	PE (N=126)
(-) Signs of DVT	681 (89.5%)	83 (65.9%)
(+) Signs of DVT	80 (10.5%)	43 (34.1%)
(-) Unilateral Limb Pain	719 (94.5%)	97 (77%)
(+) Unilateral Limb Pain	42 (5.5%)	29 (23%)

Well's rule and Geneva score

- The overall incidence of PE was 15.3%, [5.3% in low CDR, 12.2% in intermediate CDR, and 41.5% in high CDR]
- A negative D-dimer did not "rule out" PE
- Addition of negative D-dimer in patients with intermediate risk Well's Rule and Geneva Score increased the NPV by 5.5% and 7.2% respectively, but did not improve the NPV in patients with low risk.

ADDITION OF NEGATIVE D-DIMER TO CDR



Clot Burden

- Neither CDR predicted the extent of clot burden on CTPA
- A negative D-dimer was always associated with a low clot burden (<4), irrespective of CDR.

Conclusions

- Signs of DVT and Unilateral limb pain stand out as predictive of pulmonary embolism – no other elements were predictive
- Using D-dimer in patients with intermediate risk CDRs increases the NPV of those CDRs
- Clot burden cannot be reliably predicted using a CDR
- A negative D-dimer does not "rule out" a PE, but is associated with a low clot burden