CT PULMONARY

Hamilton General Hospital   Juravinski Henderson Hospital   Saint Joseph's Hospital

ANGIOGRAPHY AUDIT

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Disclosure

None

BACKGROUND

STANDARD

- Published theoretical minimum attenuation of blood required to identify nearly **all acute and chronic** PE are of 93HU and 211HU respectively (Wittram, 2007); hence a **minimum of 211HU**

  - Takes into account the attenuation of acute and chronic thrombus to be 33HU and 87HU

  - To detect 99.75% of all thrombi, attenuation of thrombi can be equal to the mean +3 standard deviations

  - Need attenuation of the PA to be at least one more than highest possible attenuation of a thrombus either acute or chronic

- Prior research suggest up to 10.8% of all CT PAs maybe suboptimal/indeterminate due to multiple causes, with motion artifact and **bolus enhancement** being the most frequent cited causes for indeterminism (Jones *et al*, 2005)

- **TARGET**: No more than 10.8% CT PAs have less than 211 HU enhancement of main pulmonary outflow tract (MPOT)
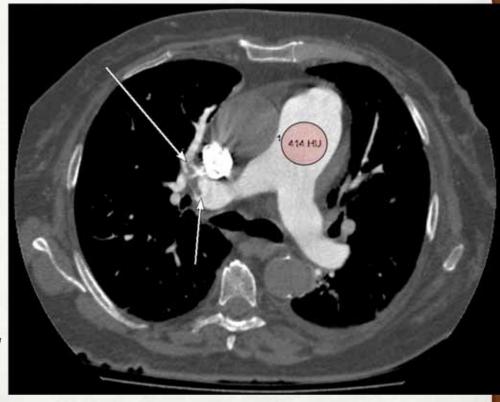
METHODS

TIME AND SEARCH

- Institutional Research Ethics Board Approval was obtained at McMaster University, HIPAA compliant

- All CT pulmonary angiographic studies were identified on PACS over a 20 day period from December 1, 2015 to December 20, 2015

- The following study title searches were completed for each of the hospitals

  - "CT ANGIO PULMONARY" for Hamilton General cases

  - "CT CHEST PULM EMBOLUS" for Henderson Hospital cases

  - "CT-PULMONARY EMBOLUS" for St. Joes cases

METHODS

VARIABLES COLLECTED

- Patient Demographics (id, age, gender)

- Main pulmonary outflow tract (MPOT) enhancement. The details of scan and the average HU for each patient were recorded in a excel database. A circular region of interest was measured in the largest axial image of the main pulmonary artery with a diameter of approximately 50% of the vessel.

- Result of the study: + or - for PE.

- Variables affecting the studies that did not meet 211HU of MPOT such as motion artifact, body habitus, opacification of distal vessels, timing of contrast

PATIENT DEMOGRAPHICS

HOSPITAL COMPARISON

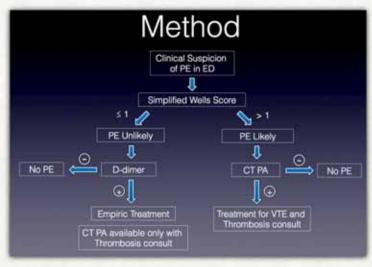|	HGH	JHCC	SJH
Average Patient Age (Years) p=0.87411	63	62	61
# Male Patients	26 M	33 M	18 M
% Female Patients	38/64= 59.4%	31/65= 47.7%	24/42= 57.1%
Total number of patients scanned over 20 day period	64	65	42

OF STUDIES

REQUISITION DIFFERENCE?

- SJH had almost 1/3rd less studies compared to HGH and JHCC (20 day period)

- Why? - population difference? No statistical difference in age. JHCC more cancer patients, however HGH does not. Incidental due to data sampling or patient presentation to the ER during that timeframe.

- SJH has standardized order for PE studies, a specific stamp on the req with the Wells Score (for ER studies only, inpatient studies had standard requisition with open box to fill in information)

  - Impact of implementation of the Simplified Wells Criteria on referrals for pulmonary embolism; **Michelle Ong, Vincent Leung, Julian Dobranowski, Ehsan Haider**, St Joseph's Healthcare, Hamilton, Ontario (http://www.car.ca/uploads/education%20lifelong%20learning/audit%20templates/2014_ap001_audit_presentation.pdf)

AUDIT RESULTS FROM 2014 PROJECT

- 21.7% reduction in the number of studies with enforced use of an algorithm based on the simplified Wells Score

- Higher percentage of positive PE studies after implementation of the algorithm (21.7% vs 13.2%) – but not statistically significant (p = 0.12)

- Change #1: Consider implementation of standardized use of simplified Wells score on the requisitions and need for d-dimer on a score <1 at HGH and JHCC ER requisitions

POSITIVE STUDIES

% STUDIES DIAGNOSTIC

	HGH	JHCC	SJH
Positive for PE	17	21	5
Negative for PE	47	43	37
% Total	36%	49%	14%

MAIN PULMONARY OUTFLOW TRACT

HOUNSFIELD UNITS DISTRIBUTION

	HGH	JHCC	SJH
Range (delta)	143 - 638	157 - 606	102 - 833
Average HU	400	309.5	374.5
How many studies below 211 HU	1	8	4
% studies (target <10.8%)	1.5%	12.3%	9.5%

- 8 patients at JHCC below criteria (50% of the studies were positive for PE)

  - 30 y M - 157HU, breathing, 22g iv rac, suboptimal opacification due to body habitus, however Saddle embolus

  - 57 y M - 170HU, breathing, suboptimal opacification with venous opacification and body habitus

  - 66 y M - 193HU, motion in distal vessels, power picc, positive for subsegmental PE

  - 56 y M - 208 HU, 18g forearm, breathing

  - 70 y M - 178HU, breathing, suboptimal opacification distally

  - 41 y M - 190 HU, suboptimal opacification distally

  - 58 y M - 182 HU, suboptimal opacification distally, body habitus

  - 67 y M - 195 HU, suboptimal distal opacification

- Omnipaque 300 was used (30ml -> 10ml(small-ave patient)/20ml(ave-large patient) 30c:70s blend ->25ml flush)

- Change #2:

  - Better instructions for breath hold, encourage minimal inspiration (decreased draw of unopacified blood from ivc)

  - Can not change body habitus, consider increase in kVP/mAs (to 135/140) for large patients similar to protocols at HGH/SJH

  - Lower concentration of contrast used at JHCC (Omni 300 vs 350 at other sites), improve distal opacification by increasing the initial bolus from 30ml to 40ml, followed by the blend

- 4 patients at <u>SHJ</u> below criteria (Ominpaque 350, 30-40ml ->30ml 30c/70s ->20ml flush)

  - 35 y F - 149 HU, 18g iv distal forearm, delayed scan, contrast already in aorta

  - 41 y M - 206 HU, distal vessels not well opacified

  - 50 y M - 102 HU, delayed scan, contrast mainly in pulmonary veins and LV

  - 38 y M - 123 HU, contrast in right circulation, 20g iv in forearm, repeated twice, however large body habitus

- 1 patient at <u>HGH</u> below criteria (Omnipaque 350 - 90ml)

  - 62 y F - 149 HU, delayed scan, contrast already in aorta and large body habitus

- <u>No change needed, target met</u>

SUMMARY OF CHANGES

- Change #1:

  - Consider implementation of standardized use of simplified Wells score on the requisitions and need for d-dimer on a score <1 at HGH and JHCC

  - Goal: decrease ordering low risk studies and cost to the healthcare system

- Change #2 to meet target at JHCC:

  - Better instructions for breath hold, encourage minimal inspiration (decreased draw of unopacified blood from ivc)

  - Can not change body habitus, consider increase in kVP/mAs (to 135/140) for large patients similar to protocols at HGH/SJH

  - Lower concentration of contrast used at JHCC, improve distal opacification by increasing the initial bolus from 30ml to 40ml, followed by the blend

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- Jones SE, Wittram C. The indeterminate CT pulmonary angiogram: imaging characteristics and patient clinical outcome. Radiology 2005; 237: 329-337.

- Wittram C, Maher MM, Halpern E, Shepard JO. Hounsfield unit values of acute and chronic pulmonary emboli. Radiology 2005: 235; 1050-1054.