FREE BREATHING HIGH-PITCH CTPA

HUNG DO

Pulmonary Embolism

Venous thromboembolism[1]

Specific clinical pathways[1]

D-dimer test[1]

Anticoagulation as treatment[1]

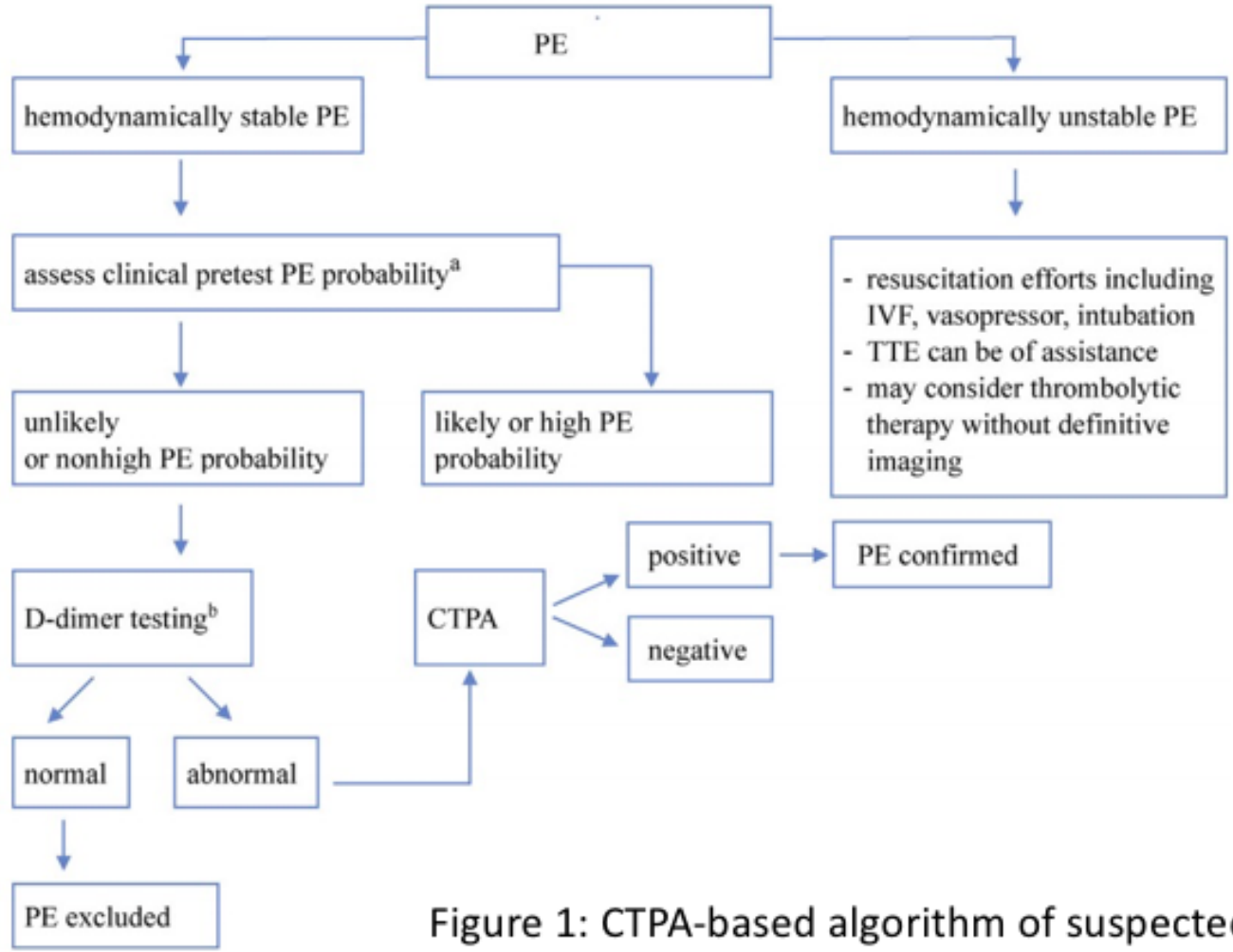


Figure 1: CTPA-based algorithm of suspected PE[1].

Pulmonary Embolism

Filling defect in CT contrast enhanced imaging

V/Q scans

Figure 2: A CTPA demonstrating a saddle embolus
Case courtesy of Dr Jeremy Jones, Radiopaedia.org, rID: 6120

Dual Energy Protocol

Siemens SOMATOM Force

90kVp/Sn150kVp & 40mAs/90mAs (dual energy mode), 0.55 pitch

Monitoring slice at the level of the pulmonary trunk

ROI in the pulmonary trunk & scan start 3s after trunk reaches 100HU

Breathing instructions: ‘stop breathing’

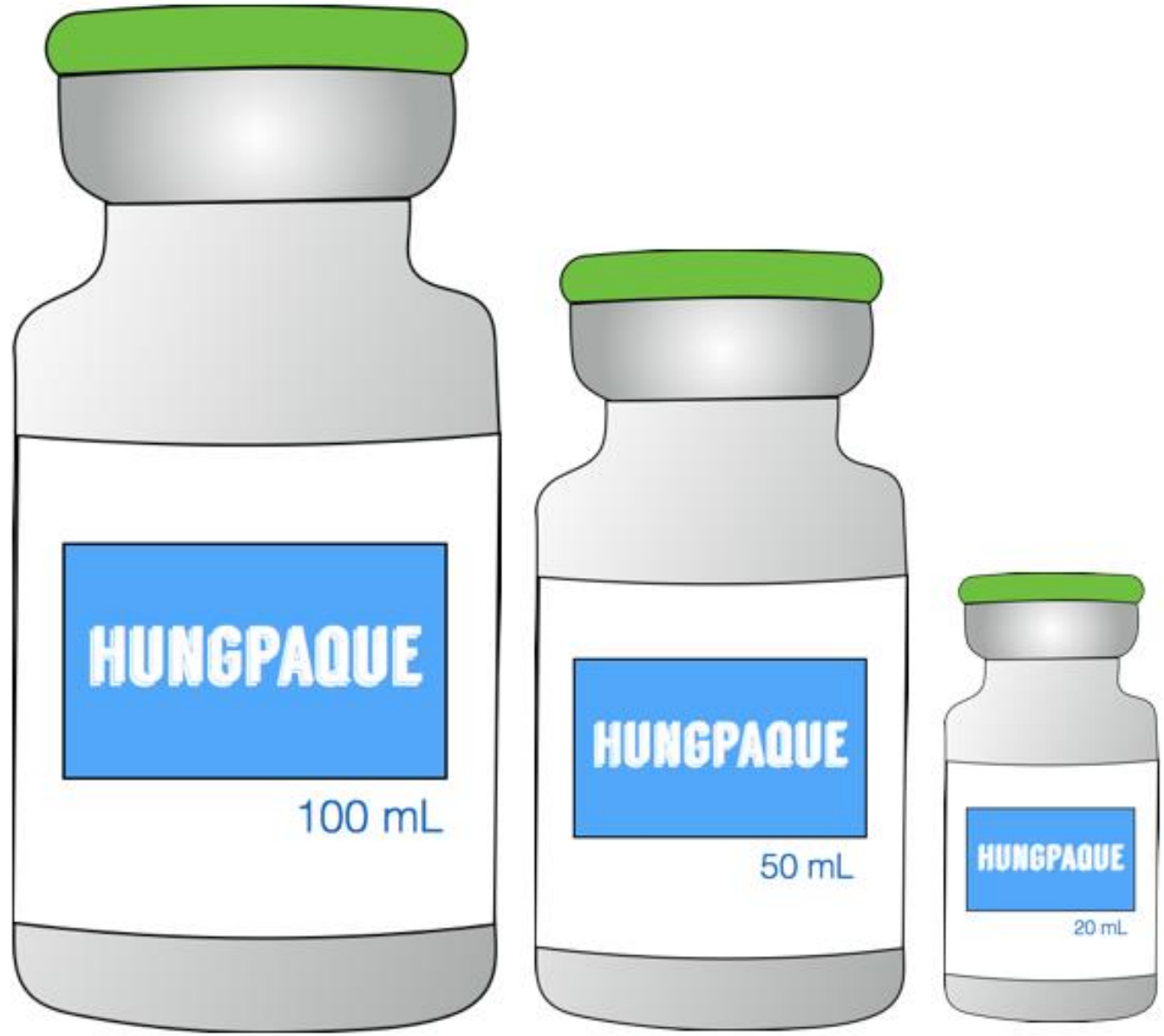
Vendor CareDose4D & Care kV is utilised

ORAL | INTRAVENOUS | RECTAL

SINCE 2016

HUNGPAQUE

ANYWAY YOU WANT



Why did we do it?

Undiagnostic scans

Language barriers

Image Artifacts

Figure 3:
Common contrast and breathing artefacts[2].

Where to start?

What does flash mean?

Scanning really, really, really fast.

pitch < 1.0

- overlap of adjacent acquisitions
- increased sampling of each location and increased radiation dose (not necessarily true)
- Increased SNR and CNRs

Pitch > 1.5

- Interpolation artifacts

What does flash mean?

Scanning really, really, really fast.

Our scanner

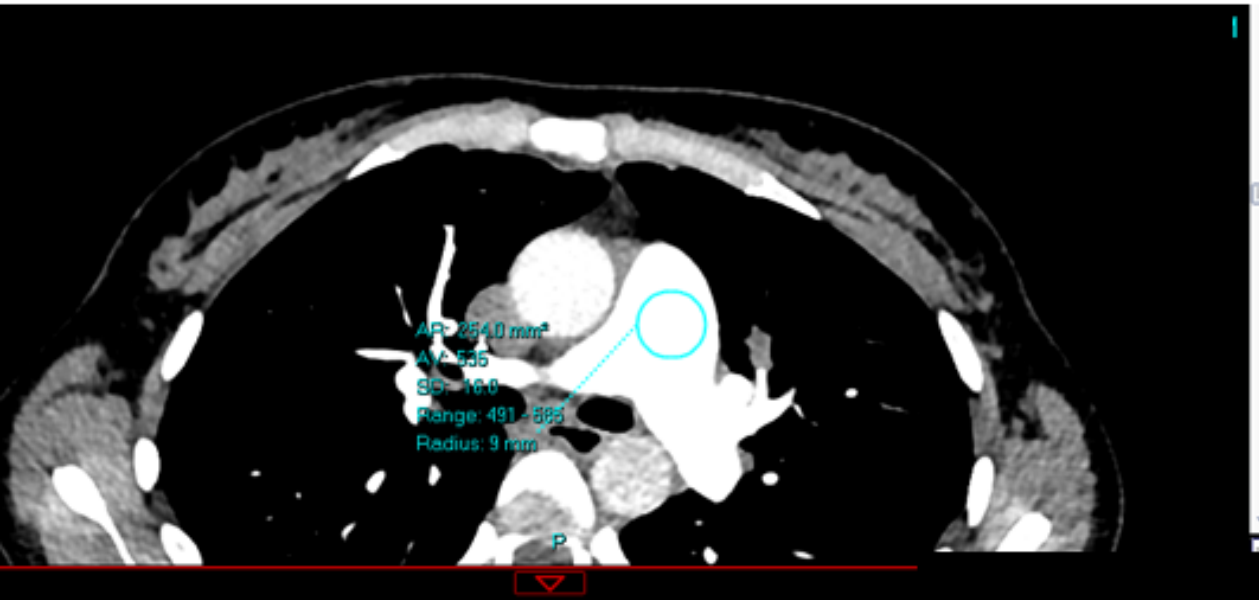
- 0.25s rotation time
- Average pitch of 2.5 - 3.0 for flash acquisition
- 73.7 cm/s on Turbo Flash Mode (average chest acquisition 0.67s)
- Negation of sampling gaps along the z-axis

Pulmonary trunk attenuation

	High-pitch Group	Control Group	*P*
Examination time (s)	0.67 ± 0.09 0.47-0.86	6.19 ± 1.24 4.50-7.66	<0.0001
$CTDI_{vol}$ (mGy)	3.92 ± 0.58 3.14-8.35	8.59 ± 2.76 4.24 ± 19.44	<0.0001
DLP (mGy cm)	142 ± 31 99-301	233 ± 95 100-657	<0.0001
Image noise (HU)	11 ± 2 7-23	13 ± 6 6-37	0.68
Pulmonary trunk (HU)	404 ± 104 228-691	314 ± 107 126-684	<0.0001
S1 artery (HU)	455 ± 119 244-809	377 ± 134 168-793	<0.0001
S10 artery (HU)	447 ± 111 242-704	363 ± 135 154-957	<0.0001
SNR S1	41.5 ± 13.5 18.1-73.3	33.3 ± 14.5 7.3-77.5	0.0005
SNR S10	41.2 ± 14.0 18.0-73.0	32.2 ± 14.6 7.7-78.7	0.0001
Observer 1	1.14 ± 0.35 1-2	2.25 ± 1.11 1-5	<0.0001
Observer 2	1.18 ± 0.39 1-2	2.26 ± 1.11 1-5	<0.0001

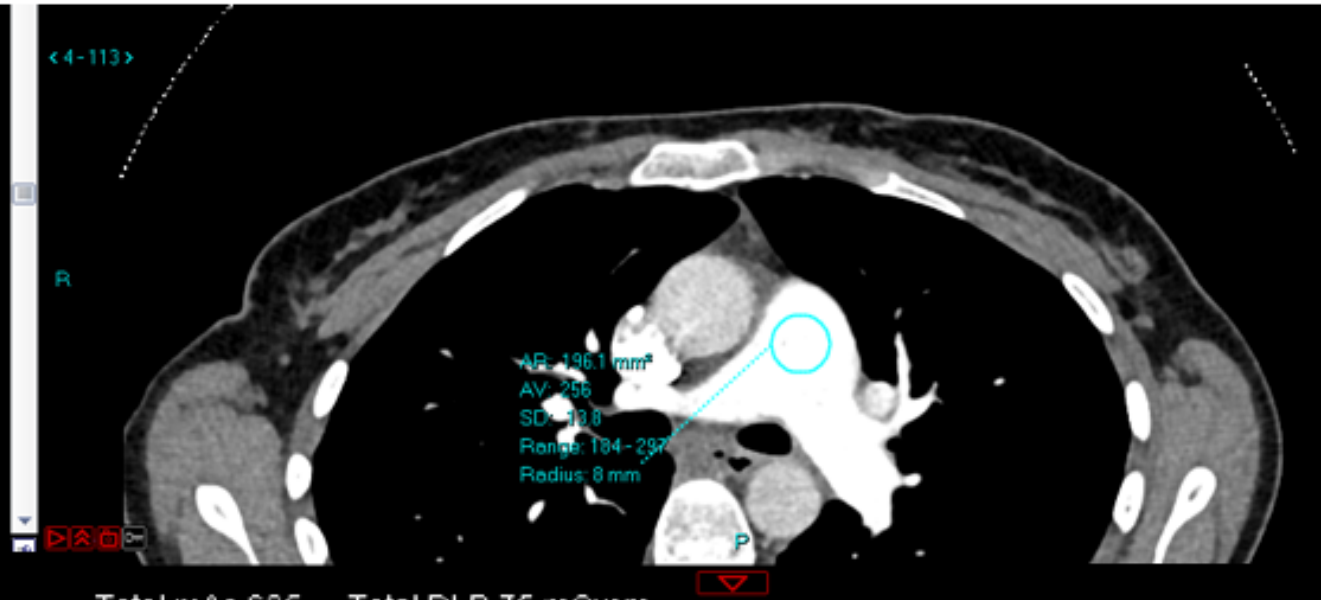
Image 6: Shows the attenuation level in HU of different vessels[2].

Pulmonary trunk attenuation



l mAs 1195 Total DLP 81 mGycm

	Scan	kV	mAs / ref.	CTDIvol* mGy	DLP mGycm	TI s	cSL mm
ent Position F-SP							
ogram	1	100	19 mA	0.04 L	1.6	4.0	0.6
Monitoring	2	100	23	0.65 L	0.6	0.25	10.0
ntrast							
itoring	3	100	23	1.94 L	1.9	0.25	10.0
CTPA	6D	80	171 / 200	2.53 L	77.3	0.25	0.6

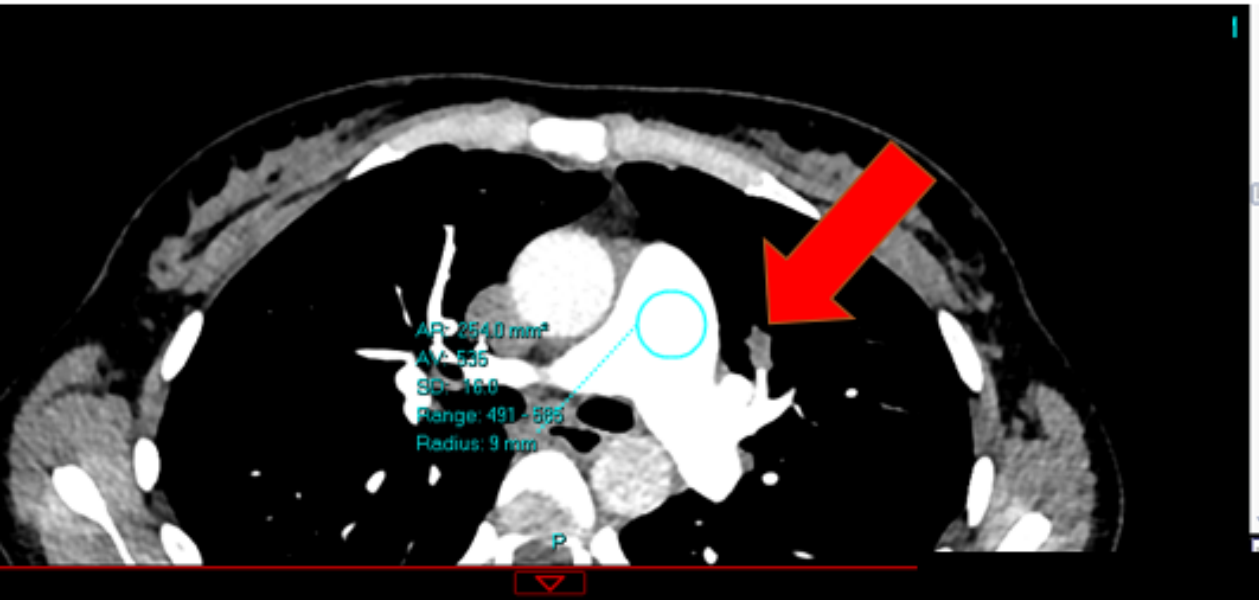


Total mAs 685 Total DLP 75 mGycm

‹ 501 - 1 ›

	Scan	kV	mAs / ref.	CTDIvol* mGy	DLP mGycm	TI s
Patient Position F-SP						
Topogram	1	100	19 mA	0.04 L	1.5	3.6
PreMonitoring	2	100	23	0.82 L	0.8	0.25
Contrast						
Monitoring	3	100	23	4.09 L	4.1	0.25
DE_CTPA	8A	90	51 / 60			
	8B	Sn150	36 / 46	2.56 L	68.6	0.25

Pulmonary trunk attenuation



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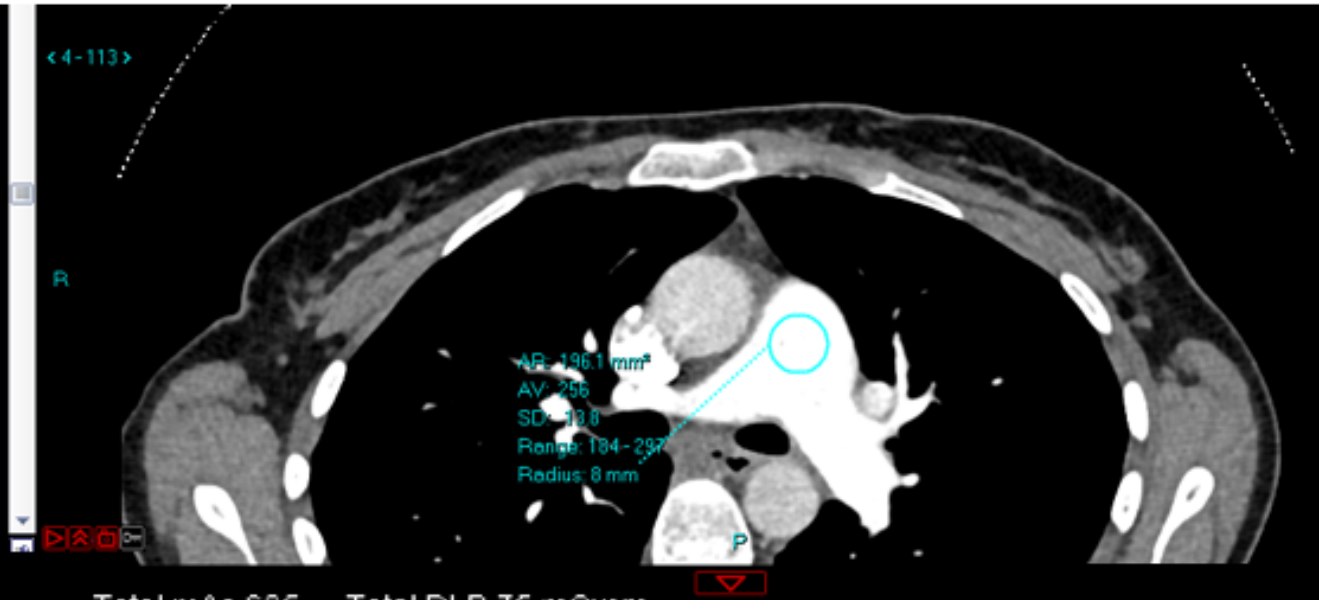

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	8B	Sn150	36 / 46	2.56 L	68.6	0.25

Motion artifacts vs Pitch

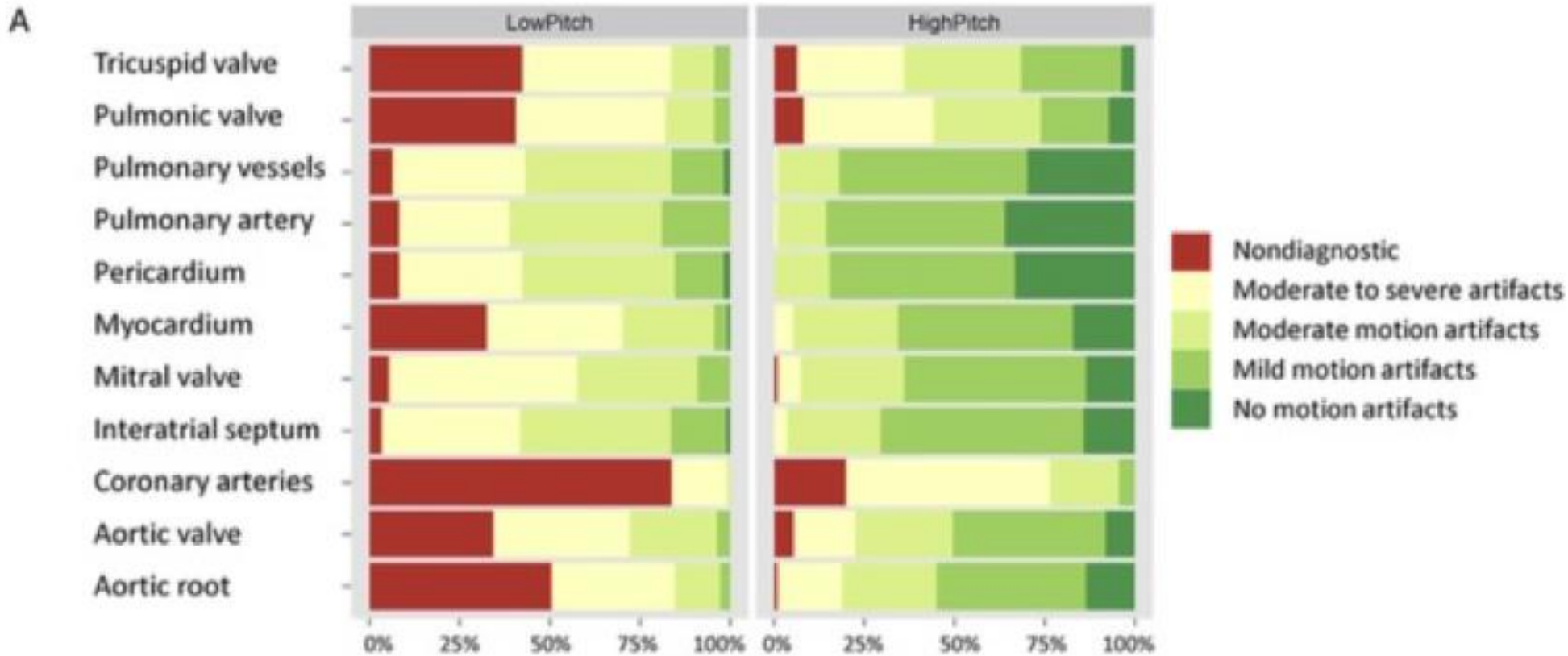

Image 5: Image quality between the low and high pitch CTPAs demonstrating percentage of artifacts[4].

Free-breathing

High-pitch Helical Dual-source Computed Tomographic Pulmonary Angiography

Comparing Image Quality in Inspiratory Breath-hold and During Free Breathing

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Lamia G. Jamjoom, MD, and Jonathon Leipsic, MD‡*

Conclusions: High-pitch helical CTPA acquired during BH or in FB yields comparable image quality for the diagnosis of PE and lung pathology, with low radiation exposure. Only a modest increase in lung parenchymal artifacts is encountered in FB high-pitch helical CTPA.

Free-breathing

BH alters intrathoracic and intravascular gradients and impact on pulmonary artery enhancement i.e. valsalva[2,3]

Interruption of the contrast column[2,3]

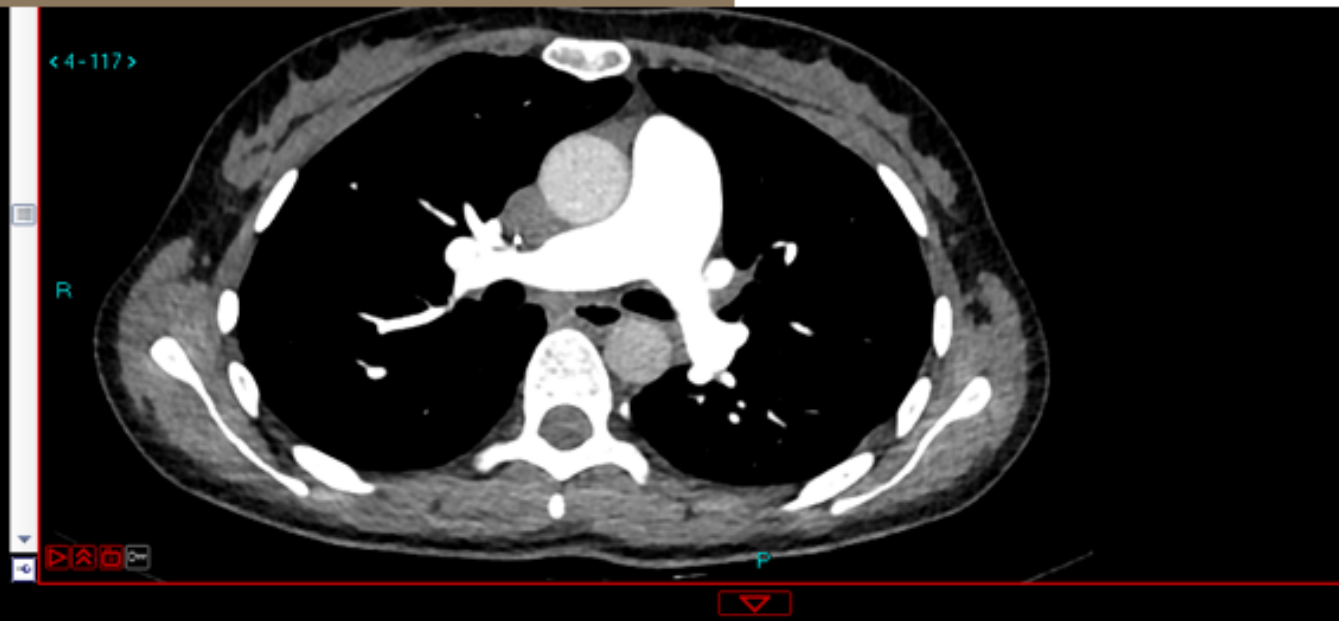
Patient factors[2]

Bauer et. al.[2], FB high pitch CTPAs produce images that are free of motion and cardiac motion.

Free-breathing

Total mAs 1290 Total DLP 98 mGycm

	Scan	kV	mAs / ref.	CTDIvol* mGy	DLP mGycm
Patient Position F-SP					
Topogram	1	80	19 mA	0.02 L	1.3
FI_Chest	2D	90	22 / 34	0.53 L	18.8
FI_Abdomen PV	3D	80	112 / 146	1.66 L	77.9



Total mAs 1195 Total DLP 81 mGycm

501 - 1

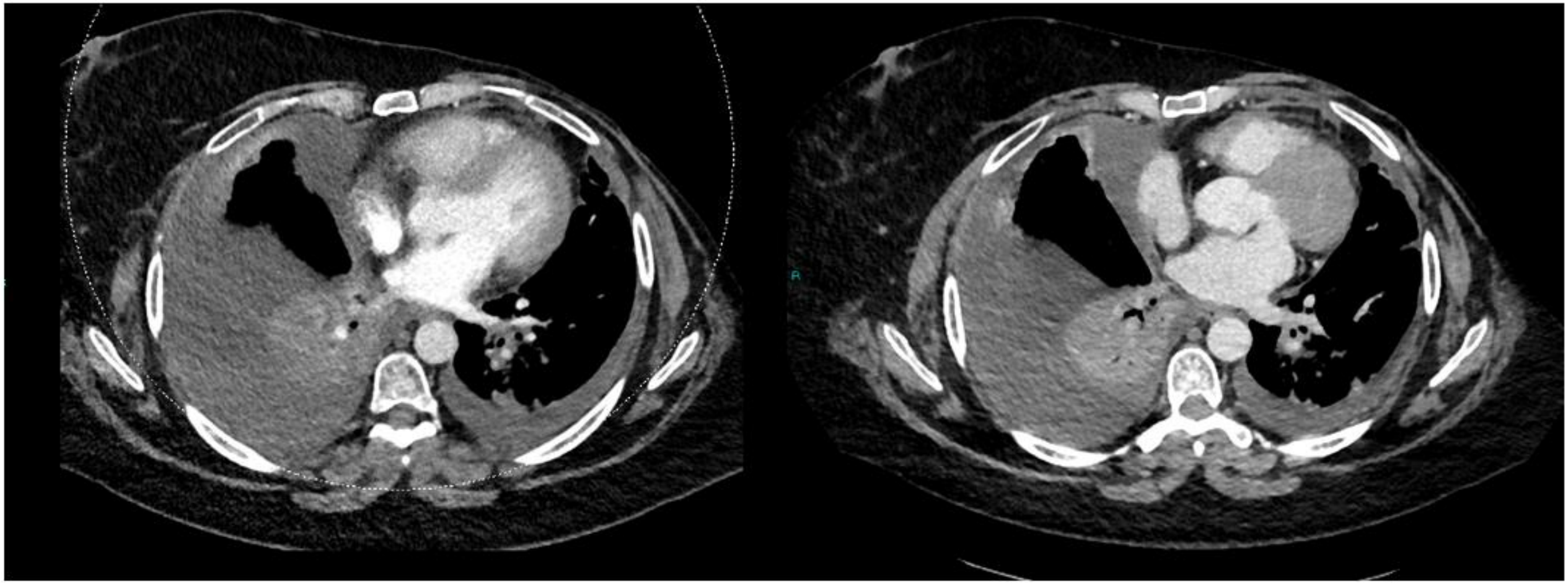
	Scan	kV	mAs / ref.	CTDIvol* mGy	DLP mGycm
Patient Position F-SP					
Topogram	1	100	19 mA	0.04 L	1.6
PreMonitoring	2	100	23	0.65 L	0.6
Contrast Monitoring	3	100	23	1.94 L	1.9
FI_CTPA	6D	80	171 / 200	2.53 L	77.3

Drawbacks

Artifacts are still possible with FB

Scan in expiration

Drawbacks



Conclusion

Free-breathing high-pitch CTPA provide exceptional diagnostic images

Sub-second scans allow for less cardiac and respiratory motion

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References

1. Halligan K, Filippaios A, Myers W. Pulmonary Embolism. Hospital Medicine Clinics [Internet]. 2017 04 [cited 2017 Sep 19]; 6(2); 244-260.
2. Bauer RW, Schell B, Beeres M, Wichmann JL, Bodelle B, Vogl TJ, Kerl JM. High-pitch Dual-source Computed Tomography Pulmonary Angiography in Freely Breathing Patients. J Thorac Imaging [Internet]. 2012 11 [cited 2017 Sep 10]; 27(6); 376-381.
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4. Sandfort V, Ahlman MA, Jones EC, Selwaness M, Chen MY, Folio LR, Bluemke DA, High pitch third generation dual–source CT: coronary and cardiac visualisation on the routine chest. J Cardiovascular CT [Internet].2016 04 [cited 2017 Oct 2017]; 10; 282-288