<u>The Year in Review Series</u>: Case 3. Abnormal CXR Case-based NBME review



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Spirometry (BTPS)		Predicted	Pre Bronchodilator		
ophomouy	(511-5)	Mean	Actual	% Pred	
FVC	L	2.57	2.02	79	
FEV1	L	2.06	1.17	57	
FEV1 / FVC	%	79	58	73	
Lung Volumes (Box)		Predicted	Pre Bron	chodilator	
Lang Ford		Mean	Actual	% Pred	
TLC	L	4.53	5.80	128	
VC	L	2.57	2.17	84	
RV	L	1.96	3.63	185	
IC	L	1.93	1.41	73	
FRC	L	2.60	4.39	169	
ERV	L	0.64	0.76	119	
RV/TLC	96	42	63	150	
Diffusion		Predicted Range	Pre Brond	hodilator	
		Mean	Actual	% Pred	
DLCO	mL/min/mmHg	19.91	9.62	48	
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	

- 1. Diffusion defect
- 2. Hypoventilation
- 3. Perfusion defect
- 4. Physiologic shunt
- 5. Decreased alveolar surface area



Spirometry (BTPS)		Predicted	Pre Bronchodilator		
Sphomed	y (D1F3)	Mean	Actual	% Pred	
FVC	L	2.57	2.02	79	
FEV ₁	L	2.06	1.17	57	
FEV1 / FVC	%	79	58	73	
Lung Volumes (Box)		Predicted	Pre Bron	chodilator	
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TLC	L	4.53	5.80	128	
VC	L	2.57	2.17	84	
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DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	

Patient presents with chronic dyspnea. Studies obtained. Which cell type most contributed to the constellation of findings observed in these studies?

- 1. Fibroblast
- 2. Type II Pneumocyte
- 3. Polymorphonuclear leukocyte
- 4. Mast cell
- 5. B-lymphocyte
- 6. T-lymphocyte
- 7. Eosinophil



Spirometry (BTPS)		Predicted	Pre Bronchodilator		
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TLC	L	4.53	5.80	128	
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RV	L	1.96	3.63	185	
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Diffusion		Predicted Range	Pre Brond	hodilator	
		Mean	Actual	% Pred	
DLCO	mL/min/mmHg	19.91	9.62	48	
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	

- 1. Interalveolar wall destruction
- 2. Bronchial smooth muscle hyperresponsiveness
- 3. Idiopathic pulmonary fibrosis
- 4. Pulmonary artery smooth muscle proliferation
- 5. Deficiency of protease inhibitor
- 6. Loosely formed granulomas



Which of the following most likely accounts for the cardiac findings?

- 1. Hypoxia-induced vasoconstriction
- 2. Pulmonary artery obstruction
- 3. Obliterative arteriopathy
- 4. Ventricular septal defect
- 5. Pulmonary venous congestion



		Mean	Actual	% Pred
DLCO	mL/min/mmHg	19.91	9.62	48
FEV1	L	2.06	1.17	57
FEV1 / FVC	%	79	58	73
RV/TLC	%	42	63	150



The same patient is referred for CT scan. Coronal image shown. Which of the following is most likely associated with this imaging abnormality?

- A. Anti-protease deficiency
- B. Toxin exposure
- C. Granulomatous destruction
- D. Chronic infectious illness

Spirometry (BTPS)		Predicted	Pre Bron	chodilator
Sphomedy	(011-3)	Mean	Actual	% Pred
FVC	L	2.57	2.02	79
FEV ₁	L	2.06	1.17	57
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Diffusion		Predicted Range	Pre Brond	hodilator
		Mean	Actual	% Pred
DLCO	mL/min/mmHg	19.91	9.62	48
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48

Patient presents with chronic dyspnea. Studies obtained.
Which of the following most likely explains the
pathophysiologic basis for a reduced diffusing capacity?

- 1. Diffusion defect
- 2. Hypoventilation
- 3. Perfusion defect
- 4. Physiologic shunt
- 5. Decreased alveolar surface area

Ventilatory defect	
$\sqrt{\mathbf{FEV}_1}, \sqrt{\mathbf{FVC}}$ and	
\downarrow FEV ₁ /FVC ratio	

Spirometry (BTPS)		Predicted	Pre Bron	chodilator
		Mean	Actual	% Pred
FVC	L	2.57	2.02	79
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Lung Volumes (Box)		Predicted	Pre Bron	chodilator
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		Mean	Actual	% Pred
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Ventilatory defect \downarrow FEV₁, \downarrow FVC and \downarrow FEV₁/FVC ratio



Obstruction

Spirometry	(BTPS)	Predicted	Pre Bron	chodilator	
ophometry	(511-5)	Mean	Actual	% Pred	
FVC	L	2.57	2.02	79	Montilatorr defect
FEV ₁	L	2.06	1.17	57	
FEV1 / FVC	%	79	58	73	\downarrow FEV ₁ , \downarrow FVC and
Lung Volu	mes (Box)	Predicted	Pre Bronchodilator		\downarrow FEV ₁ /FVC ratio
Lung Ford		Mean	Actual	% Pred	
TLC	L	4.53	5.80	128	
VC	L	2.57	2.17	84	Air Tranning
RV	L	1.96	3.63	185	
IC	L	1.93	1.41	73	个 TLC
FRC	L	2.60	4.39	169	\uparrow RV
ERV	L	0.64	0.76	119	个 B.V/TLC
RV/TLC	%	42	63	150	1
Diffusion		Predicted Range	Pre Bron	chodilator	
		Mean	Actual	% Pred	
DLCO	mL/min/mmHg	19.91	9.62	48	
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	

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Spirometry	(BTPS)	Predicted	Pre Bron	chodilator	
opnomeny	(511-5)	Mean	Actual	% Pred	
FVC	L	2.57	2.02	79	Ventileterr defect
FEV ₁	L	2.06	1.17	57	venuatory defect
FEV1 / FVC	%	79	58	73	\downarrow FEV ₁ , \downarrow FVC and
Lung Volur	nes (Box)	Predicted	Pre Bron	chodilator	\downarrow FEV ₁ /FVC ratio
Lung Ford		Mean	Actual	% Pred	
TLC	L	4.53	5.80	128	
VC	L	2.57	2.17	84	Ain Tranning
RV	L	1.96	3.63	185	AIRTRAPPING
IC	L	1.93	1.41	73	个 TLC
FRC	L	2.60	4.39	169	\uparrow RV
ERV	L	0.64	0.76	119	↑ BV/TLC 🗸
RV/TLC	%	42	63	150	
Diffusion		Predicted Range	Pre Bron	chodilator	
Dillusion		Mean	Actual	% Pred	
DLCO	mL/min/mmHg	19.91	9.62	48	
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Sphomedy	(BIF 3)	Mean	Actual	% Pred			
FVC	L	2.57	2.02	79	Montilatory defect]	
FEV ₁	L	2.06	1.17	57			
FEV1 / FVC	%	79	58	73	\downarrow F'E'V ₁ , \downarrow F'VC and		
Lung Volur	nes (Box)	Predicted	Pre Bron	chodilator	\downarrow FEV ₁ /FVC ratio		
Lung Volu	nes (Box)	Mean	Actual	% Pred		1	
TLC	L	4.53	5.80	128			
VC	L	2.57	2.17	84	Air Tranning]	
RV	L	1.96	3.63	185		_	
IC	L	1.93	1.41	73	1 TLC		Obstructio
FRC	L	2.60	4.39	169	\uparrow RV	<u> </u>	
ERV	L	0.64	0.76	119	↑ RV/TLC		
RV/TLC	%	42	63	150	1	J	
Diffusion		Predicted Rance	Pre Bron	chodilator			
Diffusion		Mean	Actual	% Pred			
DLCO	mL/min/mmHg	19.91	9.62	48			
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Spirometry (BTPS)		Predicted	Pre Bronchodilator		
opnomouj	(2110)	Mean	Actual	% Pred	
FVC	L	2.57	2.02	79	
FEV ₁	L	2.06	1.17	57	
FEV1 / FVC	%	79	58	73	
Lung Volum	es (Box)	Predicted	Pre Bron	chodilator	
Lung Volum		Mean	Actual	% Pred	
TLC	L	4.53	5.80	128	
VC	L	2.57	2.17	84	
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		Mean	Actual	% Pred	
DLCO	mL/min/mmHg	19.91	9.62	48	
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- 1. Diffusion defect
- 2. Hypoventilation
- 3. Perfusion defect
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Diffusing Capacity (DLCO) Alveolar-Interstitial-Capillary Interface

Spirometry	(BTPS)	Predicted	Pre Bronchodilator	
opnomony	(211-0)	Mean	Actual	% Pred
FVC	L	2.57	2.02	79
FEV1	L	2.06	1.17	57
FEV1 / FVC	%	79	58	73
Lung Volum	es (Box)	Predicted	Pre Bron	chodilator
Lung Volum	(D0X)	Mean	Actual	% Pred
TLC	L	4.53	5.80	128
VC	L	2.57	2.17	84
RV	L	1.96	3.63	185
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Diffusion		Predicted Range	Pre Bron	chodilator
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DLCO	mL/min/mmHg	19.91	9.62	48
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Diffusing Capacity (DLCO) Alveolar-Interstitial-Capillary Interface

Loss of alveolar surface area (e.g. COPD) Disease of interstitium (e.g. IPF) Pulmonary vascular disease

Spirometry (BTPS)		Predicted	Pre Bron	chodilator
		Mean	Actual	% Pred
FVC	L	2.57	2.02	79
FEV1	L	2.06	1.17	57
FEV1 / FVC	%	79	58	73
Lung Volumes	(Box)	Predicted	Pre Bron	chodilator
Lung Volumes (Box)		Mean	Actual	% Pred
TLC	L	4.53	5.80	128
VC	L	2.57	2.17	84
RV	L	1.96	3.63	185
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Diffusion		Predicted Range	Pre Bronchodilator	
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- 5. Decreased alveolar surface area

 $\frac{\text{Ventilatory defect}}{\downarrow \text{ FEV}_1, \downarrow \text{ FVC and}} \\ \downarrow \text{ FEV}_1/\text{FVC ratio} \\ \frac{\text{Air Trapping}}{\uparrow \text{ TLC}}$





Marked Reduction (DLCO) Diagnosis depends on clinical correlation

Spirometry	(BTPS)	Predicted	Pre Bronchodilator	
ophomouj	(211-0)	Mean	Actual	% Pred
FVC	L	2.57	2.02	79
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Lung Volun	nes (Box)	Predicted	Pre Bron	chodilator
Lung Forum		Mean	Actual	% Pred
TLC	L	4.53	5.80	128
VC	L	2.57	2.17	84
RV	L	1.96	3.63	185
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ERV	L	0.64	0.76	119
RV/TLC	%	42	63	150
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		Mean	Actual	% Pred
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- 1. Diffusion defect
- 2. Hypoventilation
- 3. Perfusion defect
- 4. Physiologic shunt
- 5. Decreased alveolar surface area: Emphysema

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\downarrow FEV $_1, \downarrow$ FVC and
\downarrow FEV ₁ /FVC ratio
Δ in Tranning
All Happing
\uparrow TLC
\uparrow RV
\uparrow RV/TLC

Ventilatory defect



<u>Marked Reduction (DLCO)</u> Diagnosis depends on clinical correlation

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opromedy (D		Mean	Actual	% Pred	
FVC	L	2.57	2.02	79	Montilatory defect
FEV1	L	2.06	1.17	57	
FEV1 / FVC	%	79	58	73	\downarrow FEV ₁ , \downarrow FVC and
Lung Volumes	s (Box)	Predicted	Pre Bron	chodilator	\downarrow FEV ₁ /FVC ratio
	(2000)	Mean	Actual	% Pred	
TLC	L	4.53	5.80	128	
VC	L	2.57	2.17	84	<u>Air Trapping</u>
RV	L	1.96	3.63	185	↑ TLC
IC	L	1.93	1.41	73	个 B.V
FRC	L	2.60	4.39	169	
ERV	L	0.64	0.76	119	TRV/TLC
RV/TLC	%	42	63	150	(VC, FRC)
Diffusion		Predicted Range	Pre Bron	chodilator	
Difficient		Mean	Actual	% Pred	
DLCO r	mL/min/mmHg	19.91	9.62	48	Marke
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	Diagnosis dep

- Diffusion defect ILD; Findings: normal FEV₁/FVC ratio, decreased lung volumes and dry crackles 1
- 2. Hypoventilation
- Perfusion defect 3.
- Physiologic shunt 4.

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Marked Reduction (DLCO) Diagnosis depends on clinical correlation

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ophomou	(811-5)	Mean	Actual	% Pred	
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FEV1 / FVC	%	79	58	73	\downarrow FEV ₁ , \downarrow FVC and
Luna Volu	mes (Box)	Predicted	Pre Bron	chodilator	\downarrow FEV ₁ /FVC ratio
	(,	Mean	Actual	% Pred	
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RV	L	1.96	3.63	185	个 TLC
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ERV	L	0.64	0.76	119	
RV/TLC	%	42	63	150	(VC, FRC)
Diffusion		Predicted Range	Pre Bron	chodilator	
		Mean	Actual	% Pred	Manlaa
DLCO	mL/min/mmHg	19.91	9.62	48	<u>mar,kee</u>
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	Diagnosis depe

- Diffusion defect ILD; Findings: normal FEV₁/FVC ratio, decreased lung volumes and dry crackles
- 2. Hypoventilation – implies normal A-a gradient (e.g. OSA, opioids).
- Perfusion defect 3

1

Physiologic shunt 4.



Marked Reduction (DLCO) Diagnosis depends on clinical correlation

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 $\frac{\text{Ventilatory defect}}{\downarrow \text{FEV}_1, \downarrow \text{FVC and}} \\ \downarrow \text{FEV}_1/\text{FVC ratio}$

<u>Air Trapping</u> ↑ TLC ↑ RV ↑ RV/TLC (VC, FRC)



<u>Marked Reduction (DLCO)</u> Diagnosis depends on clinical correlation

3. Perfusion defect

abnormal diffusion but normal ventilation, volumes

4. Physiologic shunt

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1. Diffusion defect - ILD; <u>Findings</u>: normal FEV₁/FVC ratio, decreased lung volumesand dry crackles

- 2. Hypoventilation implies normal A-a gradient (e.g. OSA, opioids)
- 3. Perfusion defect

4

- Physiologic shunt abnormal diffusion but normal ventilation, volumes
- 5. Decreased alveolar surface area: Emphysema

<u>Apical involvement</u>: Centrilobular emphysema



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Apical involvement: Centrilobular emphysema



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- Physiologic shunt abnormal diffusion but normal ventilation, volumes
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Diffusion		Predicted Range	Pre Brond	hodilator
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DLCO	mL/min/mmHg	19.91	9.62	48
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Patient presents with chronic dyspnea. Studies obtained. Which cell type most contributed to the constellation of findings observed in these studies?

- 1. Fibroblast
- 2. Type II Pneumocyte
- 3. Polymorphonuclear leukocyte (or $M\Phi$)
- 4. Mast cell
- 5. B-lymphocyte
- 6. T-lymphocyte
- 7. Eosinophil



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- 6. T-lymphocyte
- 7. Eosinophil



- 1. <u>Fibroblast</u>: pulmonary fibrosis \rightarrow IPF, Diffuse Systemic Sclerosis
- 2. Type II Pneumocyte
- 4. Mast cell
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- 6. T-lymphocyte
- 7. Eosinophil



- 1. <u>Fibroblast</u>: pulmonary fibrosis \rightarrow IPF, Diffuse Systemic Sclerosis
- 2. Type II Pneumocyte \rightarrow Surfactant, Regenerative Cell
- 4. Mast cell
- 5. B-lymphocyte
- 6. T-lymphocyte
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- 1. <u>Fibroblast</u>: pulmonary fibrosis \rightarrow IPF, Diffuse Systemic Sclerosis
- 2. Type II Pneumocyte \rightarrow Surfactant, Regenerative Cell
- 4. Mast cell \rightarrow Degranulation in Asthma, Anaphylaxis (tryptase)
- 5. B-lymphocyte
- 6. T-lymphocyte
- 7. Eosinophil \rightarrow Asthma, Parasites, IL-5, Major Basic Protein (Charcot-Leydon crystals)

Spirometry (BTPS)		Predicted	Pre Bror	nchodilator
Spiromeu	y (D1F3)	Mean	Actual	% Pred
FVC	L	2.57	2.02	79
FEV ₁	L	2.06	1.17	57
FEV1 / FVC	%	79	58	73
Lung Volumes (Box)		Predicted	Pre Bron	chodilator
Lung Ford	100 (D0X)	Mean	Actual	% Pred
TLC	L	4.53	5.80	128
VC	L	2.57	2.17	84
RV	L	1.96	3.63	185
IC	L	1.93	1.41	73
FRC	L	2.60	4.39	169
ERV	L	0.64	0.76	119
RV/TLC	%	42	63	150
Diffusion		Predicted Range	Pre Brond	hodilator
		Mean	Actual	% Pred
DLCO	mL/min/mmHg	19.91	9.62	48
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48

Patient presents with chronic dyspnea. Studies obtained. Which cell type most contributed to the constellation of findings observed in these studies?

- 1. Fibroblast
- 2. Type II Pneumocyte
- 3. Polymorphonuclear leukocyte (or $M\Phi$)
- 4. Mast cell
- 5. B-lymphocyte
- 6. T-lymphocyte
- 7. Eosinophil



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- 1. Interalveolar wall destruction
- 2. Bronchial smooth muscle hyperresponsiveness
- 3. Idiopathic pulmonary fibrosis
- 4. Pulmonary artery smooth muscle proliferation
- 5. Deficiency of protease inhibitor
- 6. Loosely formed granulomas



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1. Interalveolar wall destruction

This is the pathologic description of emphysema



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		Mean	Actual	% Pred	
DLCO	mL/min/mmHg	19.91	9.62	48	
DLCO [Hb]	mL/min/mmHg	19.91	9.62	48	



- 2. Bronchial smooth muscle hyperresponsiveness: asthma
- 3. Idiopathic pulmonary fibrosis
- 4. Pulmonary artery smooth muscle proliferation: PPH, Diffuse Systemic Sclerosis
- 6. Loosely formed granulomas: hypersensitivity pneumonitis (well formed in sarcoid)



5. Deficiency of protease inhibitor: A1AT, basilar involvmement, panacinar

Which of the following most likely accounts for the cardiac findings?

<u>COPD</u>: \downarrow Breath Sounds and Hyperresonance



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<u>COPD</u>: \downarrow Breath Sounds and Hyperresonance <u>Pulm HTN</u>: loud S2 at upper LSB, \uparrow JVP



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TR is frequently reported in the setting of pulmonary HTN.

Etiology: 2° to dilated RV annulus Purpose (USMLE): deceipt



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Which of the following most likely accounts for the cardiac findings?

 $\frac{\text{Cardiac Finding: pulm HTN}}{\text{PFT} \rightarrow \text{COPD}}$

- 1. Hypoxia-induced vasoconstriction
- 2. Pulmonary artery obstruction
- 3. Obliterative arteriopathy
- 4. Ventricular septal defect
- 5. Pulmonary venous congestion



		Mean	Actual	% Pred
DLCO	mL/min/mmHg	19.91	9.62	48
FEV1	L	2.06	1.17	57
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Which of the following most likely accounts for the cardiac findings?

 $\frac{\text{Cardiac Finding: pulm HTN}}{\text{PFT} \rightarrow \text{COPD}}$

- 2. Pulmonary artery obstruction: PE
- 3. Obliterative arteriopathy: PPH
- 5. Pulmonary venous congestion: CHF



		Mean	Actual	% Pred
DLCO	mL/min/mmHg	19.91	9.62	48
FEV1	L	2.06	1.17	57
FEV1 / FVC	%	79	58	73
RV/TLC	%	42	63	150

Which of the following most likely accounts for the cardiac findings?

4. Ventricular septal defect: mid-LSB, holosystolic

 $L \rightarrow R$ shunt can cause pulm HTN with TR and $\uparrow JVP$





The same patient is referred for CT scan. Images shown. Which of the following is most likely associated with this imaging abnormality?

- A. Anti-protease deficiency
- B. Toxin exposure
- C. Granulomatous destruction
- D. Chronic infectious illness





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<u>The Year in Review Series</u>: Case 3. Abnormal CXR Case-based NBME review



Take Less Notes, Not More



Develop good Q-bank habits Make sure you understand the language of the stem before moving on.

Practice Making Quick Associations

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