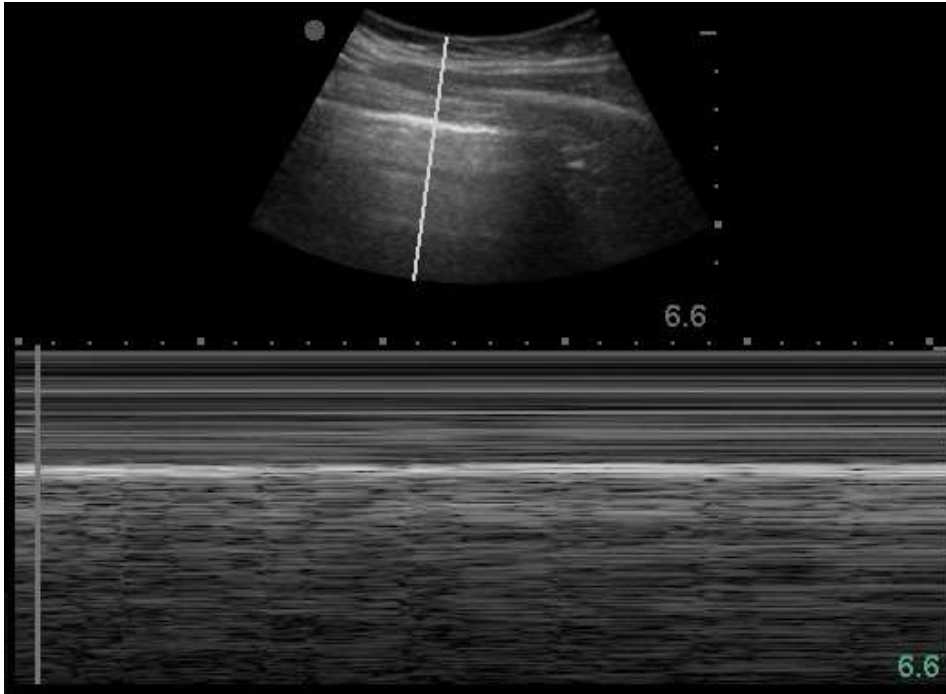# Pre-test: Written Exam for Lung Ultrasound Study

ID #: _____   Date: _____

Instructions: circle the single best answer

I am taking the: Pre-test   /   Post-test   /   Retention-test

1. The following image is consistent with:

    a. Apnea
    b. Pneumothorax
    c. Both a and b

2. The finding of lung pulsations rules out a pneumothorax at that location.
    a. True
    b. False

3. The video clip on the screen for this question (see separate video clip) is consistent with pneumothorax
    a. True
    b. False

4. In a hemodynamically unstable patient with possible complete lung collapse, a lung point is a likely finding.
    a. True
    b. False

5. The presence of A-lines makes a pneumothorax very unlikely at that location.
    a. True
    b. False

6. A healthy patient with right mainstem intubation will likely show B-lines and lung pulse, but lack of lung sliding over the left lung.
    a. True
    b. False

7. Your trauma patient has rib fractures and is hemodynamically unstable. In this setting, this ultrasound is strongly suggestive of a pneumothorax.
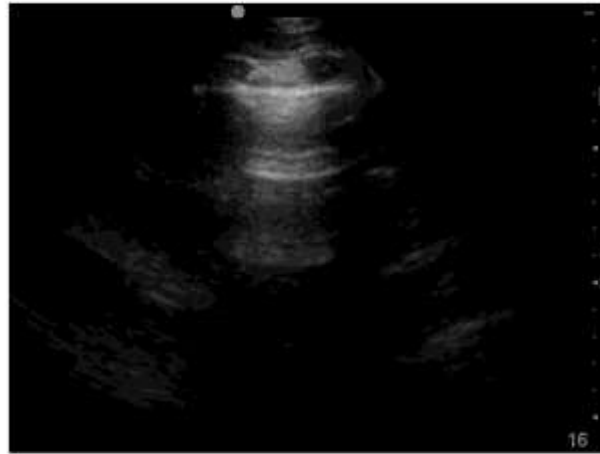

    a. True
    b. False

8. The following finding is NOT consistent with pneumothorax?

A

B
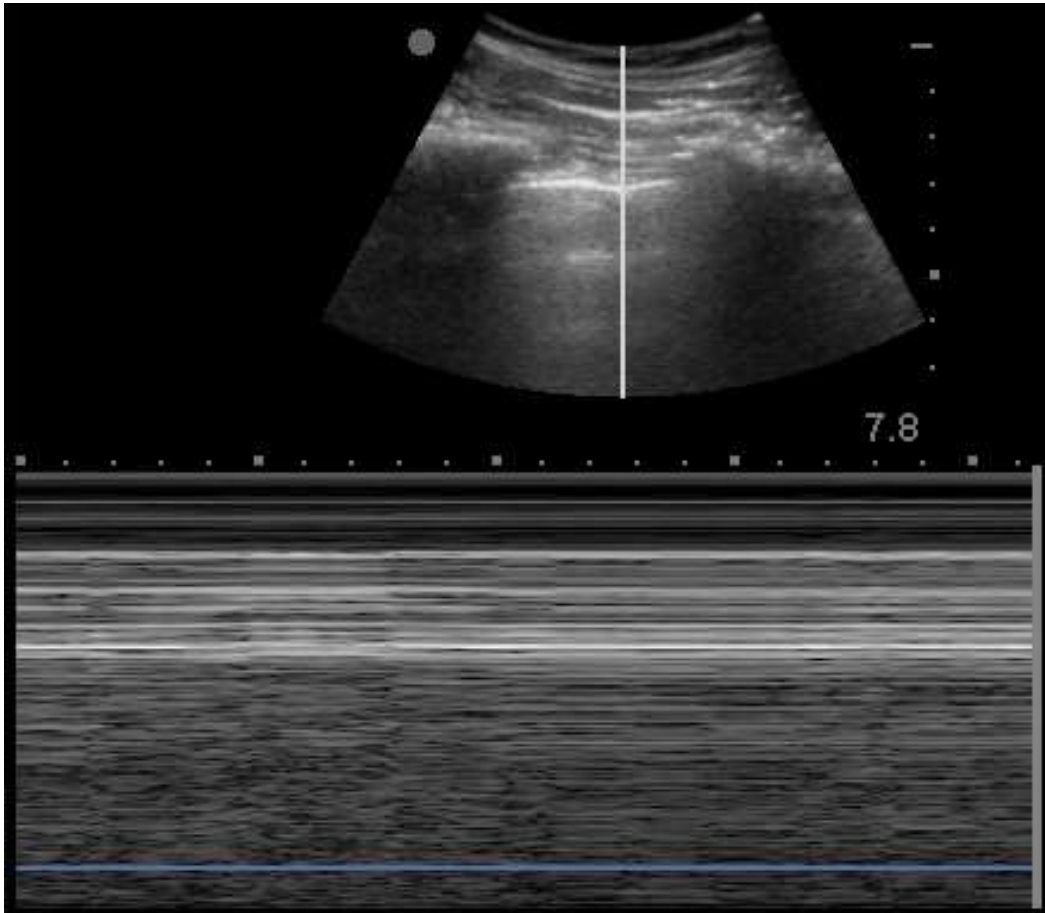
    a. A
    b. B
    c. A and B
    d. Neither

9. A patient has a consolidated right lower lobe on chest X-ray. The following lung ultrasound findings would NOT be expected anywhere over the right lung (choose best single answer):
    a. A-lines
    b. B-lines
    c. Lack of lung sliding
    d. Lung point
    e. a and d
    f. c and d

10. You have high peak ventilation pressures after intubating a patient with pulmonary fibrosis. You find bilateral anterior B-lines but cannot find lung sliding over the right anterior thorax. A pneumothorax is an unlikely cause of the high ventilation pressures.
    a. True
    b. False

_____

11. Are you a:
    a. Resident
    b. Fellow
    c. Staff

12. What is your age? _____

13. What is your gender? _____

14. What is your PGY level of training? _____

15. How many lung ultrasound examinations have you performed before today? _____

Post-test: Written Exam for Lung Ultrasound Study

Instructions: circle the single best answer

I am taking the: Pre-test   /   Post-test   /   Retention-test

1. The finding of lung pulsations rules out a pneumothorax at that location.
   a. True
   b. False

2. Your trauma patient has rib fractures and is hemodynamically unstable. In this setting, this ultrasound is strongly
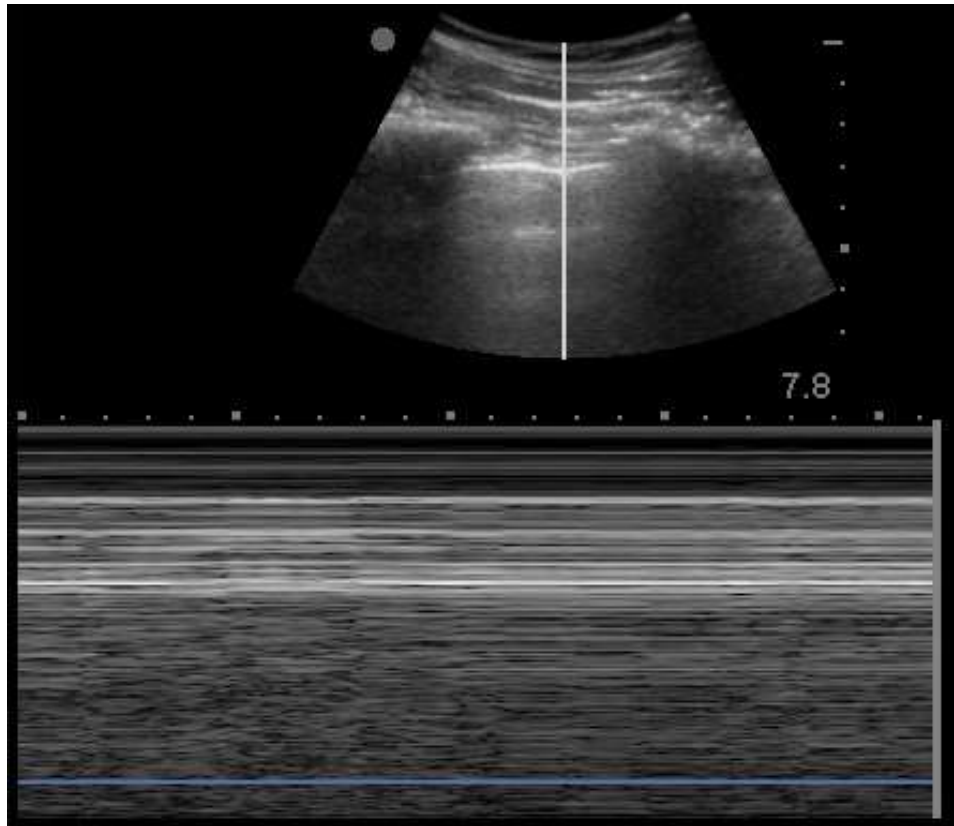
   suggestive of a pneumothorax.
   a. True
   b. False

3. In a hemodynamically unstable patient with possible complete lung collapse, a lung point is a likely finding.
   a. True
   b. False

4. You have high peak ventilation pressures after intubating a patient with pulmonary fibrosis. You find bilateral anterior B-lines but cannot find lung sliding over the right anterior thorax. A pneumothorax is an unlikely cause of the high ventilation pressures.
    a. True
    b. False

5. A healthy patient with right mainstem intubation will likely show B-lines and lung pulse, but lack of lung sliding over the left lung.
    a. True
    b. False

6. The following image is consistent with:
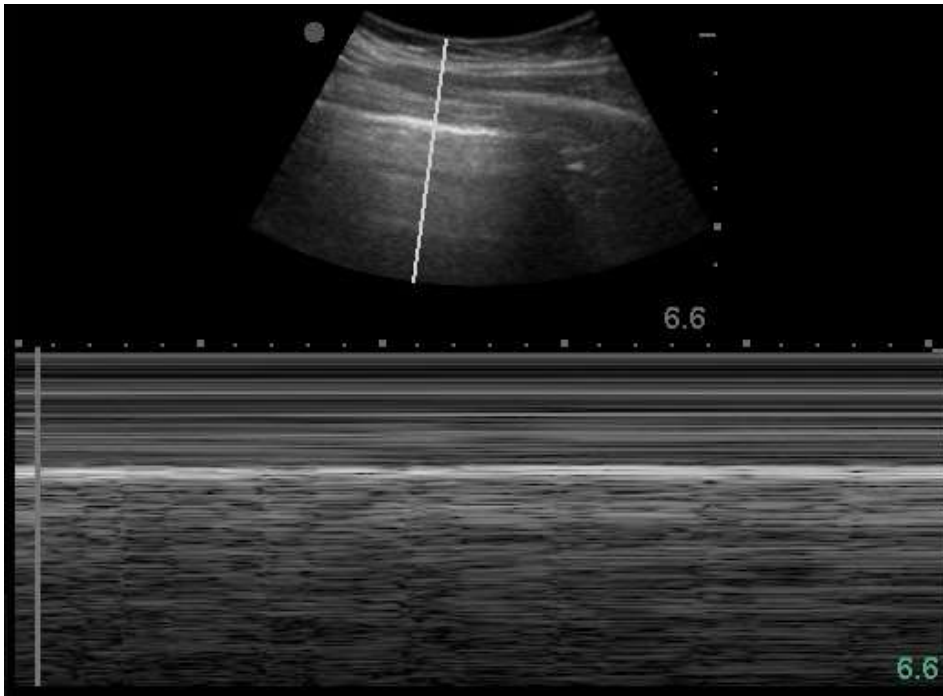

    a. Apnea
    b. Pneumothorax
    c. Both a and b

7. The video in the clip for this question (see separate video clip) is consistent with pneumothorax
    a. True
    b. False

8. A patient has a consolidated right lower lobe on chest X-ray. The following lung ultrasound findings would NOT be expected anywhere over the right lung (choose best single answer):
   a. A-lines
   b. B-lines
   c. Lack of lung sliding
   d. Lung point
   e. a and d
   f. c and d

9. The presence of A-lines makes a pneumothorax very unlikely at that location.
   a. True
   b. False

10. The following finding is NOT consistent with pneumothorax?

A

B
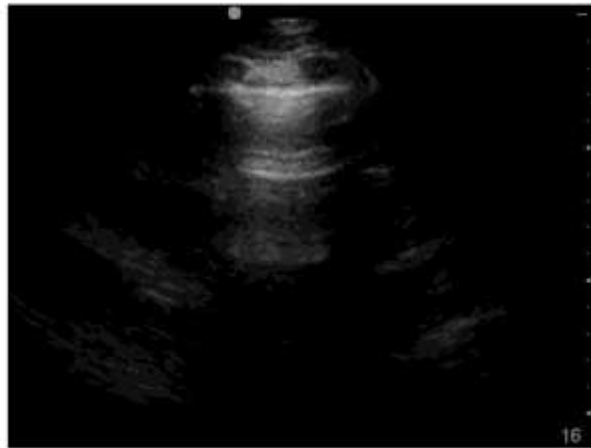
   a. A
   b. B
   c. A and B
   d. Neither

_____

11. If you were in group Web: How many days ago did you watch the video lecture? _____

12. If you were in group Web: How much time did you spend with the instructional video and the portfolio exercise? _____

13. For all groups: How many lung ultrasound exams have you performed since the pre-test? _____

ID #: _____   Date: _____

Instructions: circle the single best answer

I am taking the: Pre-test   /   Post-test   /   Retention-test

1. You have high peak ventilation pressures after intubating a patient with pulmonary fibrosis. You find bilateral anterior B-lines but cannot find lung sliding over the right anterior thorax. A pneumothorax is an unlikely cause of the high ventilation pressures.
   a. True
   b. False

2. Your trauma patient has rib fractures and is hemodynamically unstable. In this setting, this ultrasound is strongly
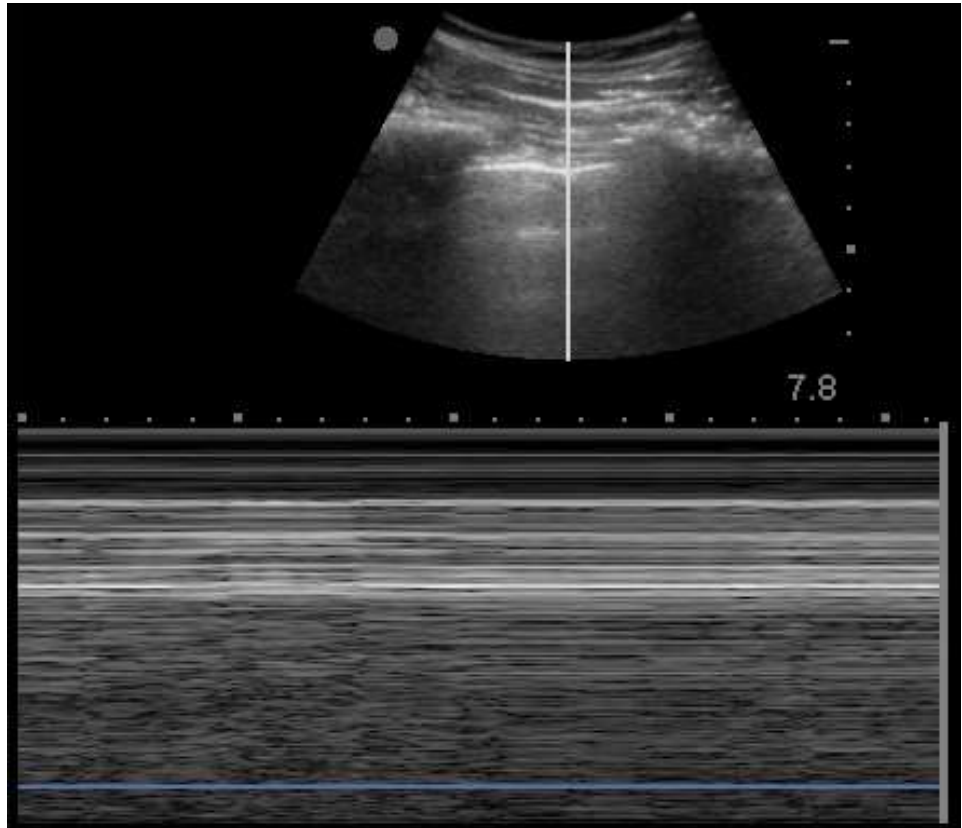
suggestive of a pneumothorax.
   a. True
   b. False

3. A healthy patient with right mainstem intubation will likely show B-lines and lung pulse, but lack of lung sliding over the left lung.
   a. True
   b. False

4. The finding of lung pulsations rules out a pneumothorax at that location.
   a. True
   b. False

5. The video in the clip for this question (see separate video clip) is consistent with pneumothorax
   a. True
   b. False

6. A patient has a consolidated right lower lobe on chest X-ray. The following lung ultrasound findings would NOT be expected anywhere over the right lung (choose best single answer):
   a. A-lines
   b. B-lines
   c. Lack of lung sliding
   d. Lung point
   e. a and d
   f. c and d

7. In a hemodynamically unstable patient with possible complete lung collapse, a lung point is a likely finding.
   a. True
   b. False

8. The following finding is NOT consistent with pneumothorax?

A

B
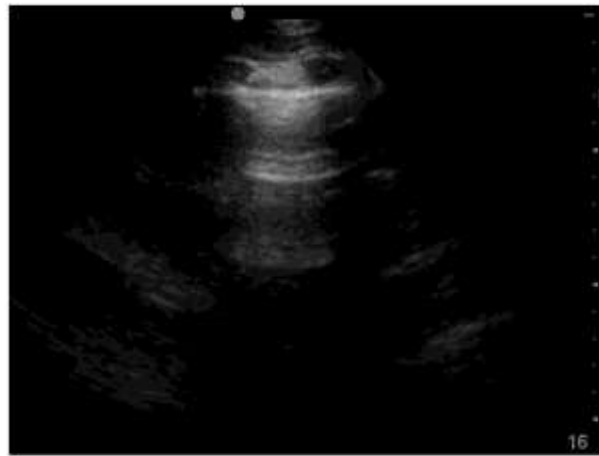
   a. A
   b. B
   c. A and B
   d. Neither

9. The presence of A-lines makes a pneumothorax very unlikely at that location.
    a. True
    b. False

10. The following image is consistent with:

    a. Apnea
    b. Pneumothorax
    c. Both a and b

_____

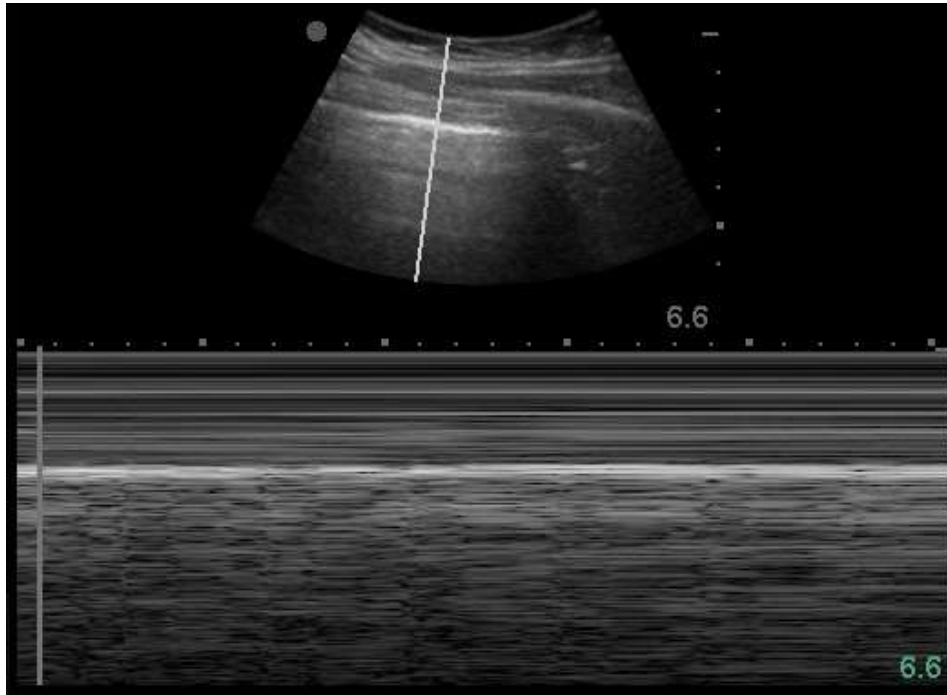11. How many lung ultrasound exams have you performed since the post test?: _____

Data Sheet for Practical Test

Subject information:

ID #: _____   Circle correct test: Pre-test / Post-test / Retention-test

<u>For pre-test only:</u>

- Age:_____
- Gender (circle): M / F
- Level of training (circle):   resident / fellow / staff
- Post graduate year of training (PGY): _____
- Overall number of lung ultrasounds that you have ever performed: _____

<u>For post- or retention-tests only:</u>

- How many days ago did you watch the video lecture? _____
- How many times did you watch the video lecture? _____
- How much time did you spend with the instructional video and the portfolio exercise? _____
- Approximate number of times you performed lung ultrasound on your own since the last testing for this study. Include any exams performed on yourself or on patients: _____

Testing protocol for practical hands-on test		
Examiner: *"Your patient is hypotensive after placement of a subclavian central line. You are concerned about a possible tension pneumothorax. You will perform an ultrasound examination to assess for pneumothorax. I will be the model for this exam."*		
Task	**Evaluation of trainees actions**	**check**
A. <u>Examiner prompt:</u> *"please enter your ID as the patient's last name"*	1. Enters patient data into machine (prompted to enter study subject ID number only as the last name)*	☐
B. <u>Examiner prompt:</u> *"Please tell me what ultrasound modalities you would use to assess for pneumothorax. For instance, would you use pulse-wave Doppler?"*	2. Places transducer with the index mark pointed in the cephalad direction on the upper anterior chest.	☐
Examiner waits for answer. If the trainee mentions 2D imaging then the examiner prompts: *"please perform 2D imaging on my chest. First record a video clip."*	3. Is able to find the "clip" button*	☐
"Now freeze an image, and point to and name the most important anatomic structures"	4. Is able to find the "freeze" button*	☐
The examiner marks the exact location that the trainee points to and labels each one exactly as it is named by the trainee. Only three or less locations are marked.	5. Points to the pleura on the 2-D image$^\$$	☐
If the trainee mentions M-mode then the examiner prompts:	6. Points to a rib above and/or below the interspace$^\$$	☐
"please perform M-mode imaging on my chest. Please freeze an image, and point to and name the most important anatomic structures"	7. Places M-mode line through pleura and performs M-mode$^\$$	☐
The examiner marks the exact location that the trainee points to and labels each one exactly as it is named by the trainee. Only three or less locations are marked.	8. Mentions and points out the "sandy beach sign" or the "sea shore sign" $^\$$	☐
Only elements that are spontaneously pointed out and named by the trainee are marked on the screen by the examiner. No hints and no suggestions by the reviewer! Do not mention 2-D or M-mode unless the trainee mentions them. Move on to the next question without delay if the trainee has no further ideas about how to assess for pneumothorax.	9. Points to pleura on the M-mode image$^\$$	☐
C. <u>Examiner prompt:</u> *"Extra-credit question: please adjust the ultrasound machine and the transducer to see A-lines. Please show me the A-lines"*	10. Sets depth sufficiently to observe A-lines$^+$	☐
	11. Demonstrates and points out A-lines$^\$$	☐
total time:_____		

* Examiner helps the trainee accomplish task if she is not able after a short delay, but does not check the box for that task. When the task is "pressing Clip or Freeze buttons" please wait for no more than 5 seconds before helping them by pressing the button for them.

+Do not help the trainee set the depth. If they do not increase the depth and there are no visible A-lines, then leave the box unchecked.

$ Examiner labels exact location that the trainee pointed to with a pointer, adds text, and records the image by pressing "Save". Then press "delete" to erase the text afterwards.

Specific rules:

- Do not provide any hints or suggestions; we do not want to teach anything during the testing phase. Do not comment on the answers and selections of the trainee. Simply say "I am not allowed to help you during the test." If asked for help.
- Ask the trainee to point exactly to the anatomic structures with their finger tip or pen tip.
  - If they are off the pleural line by more than a 2 mm, then do not give credit. Place the arrow exactly where the trainee indicates with a text label.
  - If they do not place the pencil tip inside the anatomic boundary of the rib, then do not give credit.
  - If they point to the shadow of the rib but not the rib itself, do not give credit.
  - If they point inside the zone of the sandy beach and name it as "sandy beach" or "sea shore" then give credit. If they point to it but cannot name it then do not give credit.
- For each frozen image, allow the trainee to point out at most 3 anatomic landmarks, then move on to the next question. If they do not select the landmarks requested by this test within those first 3 attempts then do not give credit.
- Note, that the scores will be multiplied by a weighting factor vector to account for the differing clinical relevance of each task. This vector is [0.5 1 0.1 0.1 2 1 1 1 2 0.5 0.5]. Thus, the maximum score is 9.7 points.

Numeric Results

Figure 2

Group	N	average	IQR 25%	IQR 50%	IQR 75%	mean rank	lower 95% confidence limit	upper 95% confidence limit
1: Web pre-test	59	39.1	27.4	36.6	50.6	91.1	59.4	122.8
2: Class pre-test	59	38.2	26.8	36.6	46.3	85.9	54.2	117.6
3: Web post-test	57	81.6	75.0	85.4	92.7	316.5	284.2	348.7
4: Class post-test	58	76.9	68.3	82.9	90.2	289.7	257.8	321.7
5: Web ret-test	54	74.2	65.9	75.6	85.4	270.3	237.1	303.5
6: Class ret-test	56	68.9	59.8	73.2	80.5	241.5	209.0	274.1
7: Control pre-test	20	46.5	31.7	41.5	59.8	123.1	66.1	180.0
8: Control post-test	20	47.7	35.4	47.6	57.3	131.3	74.4	188.2
9: EM baseline	38	75.0	63.4	78.0	85.4	272.0	232.0	312.0

Pairwise comparisons		
Groups Compared		P value
1	2	1.0000
1	3	0.0000
1	4	0.0000
1	5	0.0000
1	6	0.0000
1	7	1.0000
1	8	1.0000
1	9	0.0000
2	3	0.0000
2	4	0.0000
2	5	0.0000
2	6	0.0000
2	7	1.0000
2	8	1.0000
2	9	0.0000
3	4	1.0000
3	5	1.0000
3	6	0.0379

3	7	0.0000
3	8	0.0000
3	9	1.0000
4	5	1.0000
4	6	1.0000
4	7	0.0000
4	8	0.0000
4	9	1.0000
5	6	1.0000
5	7	0.0001
5	8	0.0005
5	9	1.0000
6	7	0.0066
6	8	0.0181
6	9	1.0000
7	8	1.0000
7	9	0.0003
8	9	0.0010

Figure 3

Panel A: Improvement in written test scores					
Group	N	mean	stdev	lower 95% confidence limits	upper 95% confidence limits
1: Web pre->post	57	29.3	21.2	23.7	34.9
2: Class pre->post	58	23.4	22.8	17.4	29.5
3: Web pre->ret	54	15.2	23.9	8.7	21.7
4: Class pre->ret	56	12.3	25.1	5.6	19.0
5: Control pre->post	20	-3.0	13.4	-9.3	3.3

Panel A: Pairwise comparisons of the groups	
Groups compared	P value

1	2	1.0000
1	3	0.0118
1	4	0.0009
1	5	0.0000
2	3	0.5481
2	4	0.0927
2	5	0.0001
3	4	1.0000
3	5	0.0240
4	5	0.0997

Panel B: Improvement in practical test scores.							
Group	N	mean	IQR25%	IQR50%	IQR75%	lower 95% confidence limits	upper 95% confidence limits
1: Web pre->post	57	55.9	35.7	61.9	76.2	120.1	157.6
2: Class pre->post	58	54.2	28.6	59.5	76.2	115.8	153.1
3: Web pre->ret	54	53.5	38.1	57.1	71.4	110.8	149.4
4: Class pre->ret	56	48.3	28.6	52.4	69.0	101.7	139.6
5: Control pre->post	20	5.2	-9.5	2.4	21.4	-1.0	65.2

Panel B: Pairwise comparisons of the groups		
Groups compared		P value
1	2	1.0000
1	3	1.0000
1	4	1.0000
1	5	0.0000
2	3	1.0000
2	4	1.0000
2	5	0.0000
3	4	1.0000
3	5	0.0000
4	5	0.0000

Panel C: Improvement in combined overall test scores.					
Group	N	mean	stdev	lower 95% confidence limits	upper 95% confidence limits
1: Web pre->post	57	42.9	18.1	38.1	47.7
2: Class pre->post	58	39.2	19.2	34.2	44.2
3: Web pre->ret	54	34.8	17.8	30.0	39.7
4: Class pre->ret	56	30.7	20.1	25.4	36.1
5: Control pre->post	20	1.2	13.9	-5.3	7.7

Panel C: Pairwise comparisons of the groups		
Groups compared		P value
1	2	1.0000
1	3	0.2183
1	4	0.0055
1	5	0.0000
2	3	1.0000
2	4	0.1538
2	5	0.0000
3	4	1.0000
3	5	0.0000
4	5	0.0000

Figure 4

Non-inferiority graphic.		
Mean difference	lower 95% conf. limit	upper 95% conf. limit
-3.7	-10.6	3.2