Twitter Thread by IM POCUS Focus

IM POCUS Focus
@IMPOCUSFocus

A tweetorial on optimal machine settings for B line image acquisition, with a focus on: focal position at pleura, harmonics off, and increased far gain.

Inspired/based on the recent article - https://t.co/vv2xBSZm6N @cameron_baston @IsaacMatthiasM1

#POCUS #IMPOCUS

1/18

Let's start with some polls
We will stick to low frequency probes here (i.e. curvilinear and phased array - linear has its own purpose for detailed pleural assessment)

Which preset do you prefer for B line assessment?

2/

What depth do you typically set?

3/

After selecting preset and selecting depth, do you ever adjust any other machine settings to optimize B line assessment?

4/

Importantly, there is no right answer to the above questions!

We won't discuss much about preset or probe type. But we will discuss machine settings to optimize B line quality, based on
1) Theory based on physical basis of B lines
2) In vitro study

3) Study in patients

5/

To start with the theoretical basis:

B lines are
1) reverberation artifacts
2) formed from the pleural interface when the interstitium is thickened
3) span the full depth of the field

See explanation in tweetorial on ABCs of lung ultrasound here
https://t.co/6GPdnK9gUP

6/

When the interstitium thickens, B lines form. The mechanism is not entirely understood. Either
1) Tetrahedral structure created at the pleural surface continuously reflects
2) Some waves are able to pass through the lung

11/ pic.twitter.com/rrWEI2ICfX

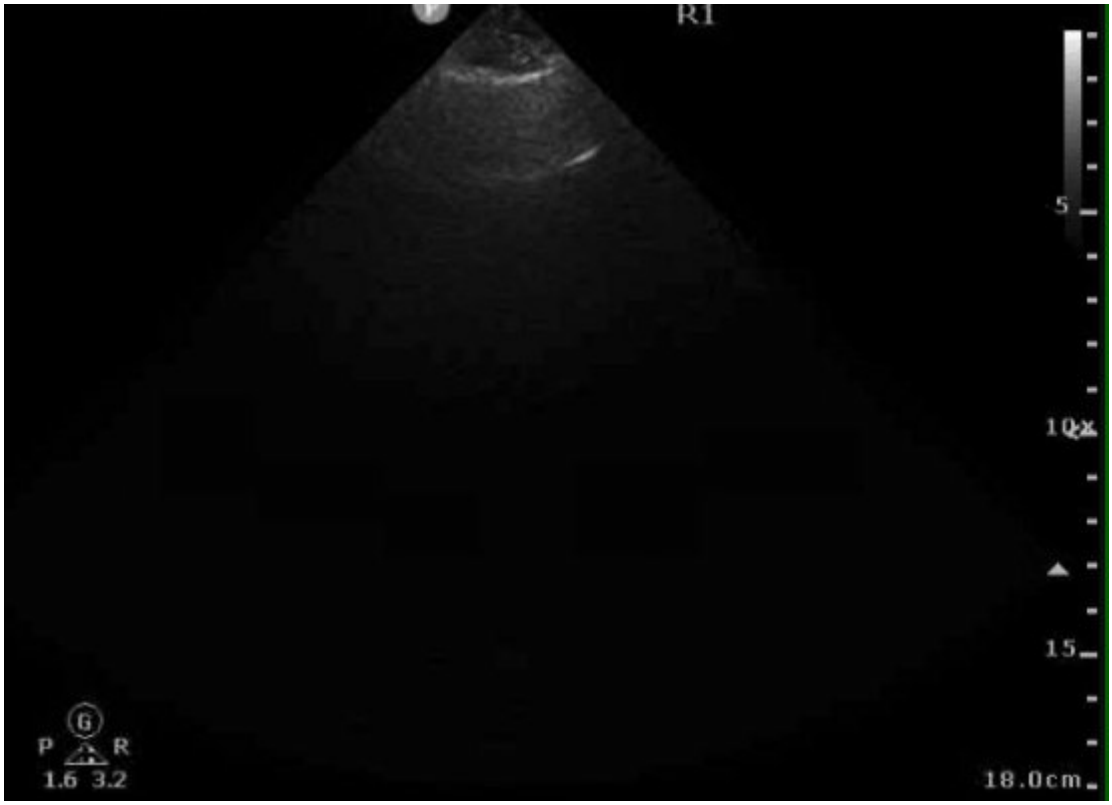
— IM POCUS Focus (@IMPOCUSFocus) September 27, 2019

1) Artifact
Tissue harmonic imaging is a technology designed to minimize artifact. In theory, harmonics being "on" may reduce B line quantity. The same idea applies for cardiac presets, which tend to minimize artifact.
(Notably, there is conflicting literature here)

7/

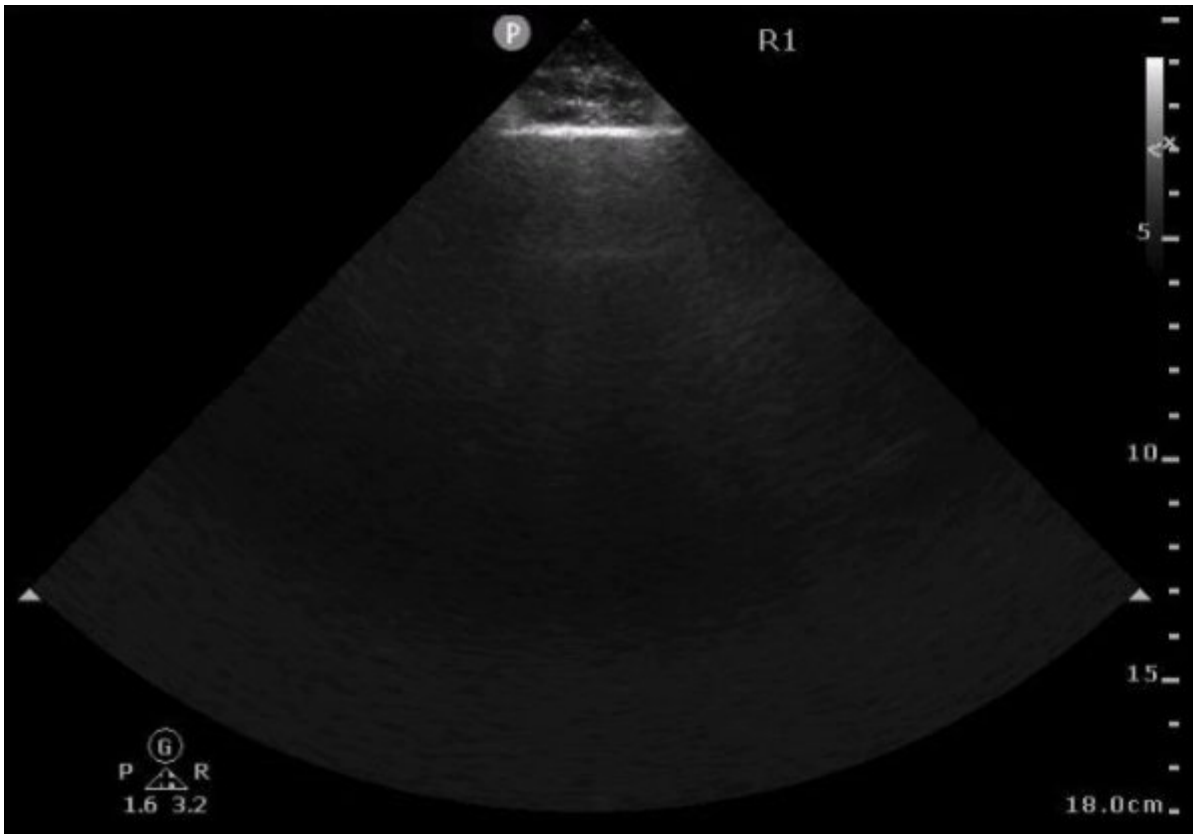
2) Formed at the pleural interface
Thus it would make sense to put the focus at the pleural line. The focal position is the depth at which lateral resolution is highest, so interstitial thickening is more likely to be detected w pleural at focal position.

Here, focus at 10 cm
8/



Same site, but focus moved to pleura. Improved lateral resolution at the pleural line brings out more B lines.

9/



3) B lines Span the full depth of the field

Often the brightness of B lines fades deeper into the image due to loss of energy with subsequent reverberations. Increasing the far gain can theoretically improve ease of visualizing B lines in the far field (as shown here).

10/



Study using in-vitro B line model (tetrahedral air bubbles) found better quality w
-focus at pleura
-more far-gain
-lung preset (vs abd)

Did not acheive significance for "harmonics off"
Limitations: one machine (Sparq), needs further study in pts.
https://t.co/jzJmSr0ZRZ

11/

Journal of Clinical Monitoring and Computing (2020) 34:277–284
https://doi.org/10.1007/s10877-019-00321-z

ORIGINAL RESEARCH

Optimizing B-lines on lung ultrasound: an in-vitro to in-vivo pilot study with clinical implications

Christopher N. Schmickl[1,2] · Aravind Ajakumar Menon[2,3] · Rajanigandha Dhokarh[1] · Bhavna Seth[2,4] · Frank Schembri[2]

Received: 17 December 2018 / Accepted: 8 May 2019 / Published online: 14 May 2019
© Springer Nature B.V. 2019

Back to the article that inspired the thread. https://t.co/vv2xBSZm6N

This study sought to test if adjusted settings (developed based on in-vitro experiments) were associated change in perceived quality (and quantity) of B lines.

12/

Effect of Machine Settings on Ultrasound Assessment of B-lines

Isaac Matthias, MD, Nova L. Panebianco, MD MPH, Mitchell G. Maltenfort, PhD, Anthony J. Dean, MD, Cameron Baston, MD MSCE

Objectives—B-lines are a lung ultrasound (LUS) artifact that often indicate pathology. Little is known about the optimal ultrasound machine settings to assess B-lines. We compared settings typically used to evaluate B-lines at our institution with adjusted settings based on recent studies.

Methods—In order to determine typical settings for B-line assessment, we retrospectively reviewed LUS images obtained at our institution. We then prospectively performed LUS with both typical and adjusted settings, using curvilinear and phased array probes, in 20 patients presenting to the emergency department with shortness of breath. The prospectively obtained clips were rated for quality and quantity of B-lines by 14 clinicians with experience in LUS, with 1 assigned for typical settings "much greater," 2 for typical settings "slightly greater," 3 for both settings "similar," 4 for adjusted settings "slightly greater," and 5 for adjusted settings "much greater."

Results—Mean ratings and 95% confidence intervals significantly exceeded the null value of 3 for both B line quality (curvilinear probe: 4.68, 4.50–4.85; phased array probe: 4.02, 3.70–4.35) and B line quantity (curvilinear probe: 4.16, 3.84–4.49; phased array probe: 3.68, 3.41–3.96).

Conclusions—B-line quality and quantity were rated higher using adjusted settings based on recently published evidence than when using settings that are typically employed in our institution. Our findings suggest that B-line assessment should be performed with focal zone at the level of the pleura, harmonics off, and gain increased in the far field.

Key Words—B-lines; focal zone; gain; harmonics; lung ultrasound; settings

Received July 17, 2020, from the The Department of Internal Medicine, Section of Hospital Medicine (I.M.); The Department of Emergency Medicine (N.L.P., A.J.D.); The Department of Internal Medicine, Division of Pulmonary, Allergy, and Critical Care, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania (C.B.); and The Department of Biomedical and Health Informatics at the Children's Hospital of Pennsylvania, Philadelphia, Pennsylvania (M.G.M.). Manuscript accepted for publication October 22, 2020.

Adjusted settings were defined as focus at pleural line, harmonics off, and time gain compensation increased linearly in the far field.

In a retrospective study, most exams resembled the typical settings (and cardiac was most common preset).

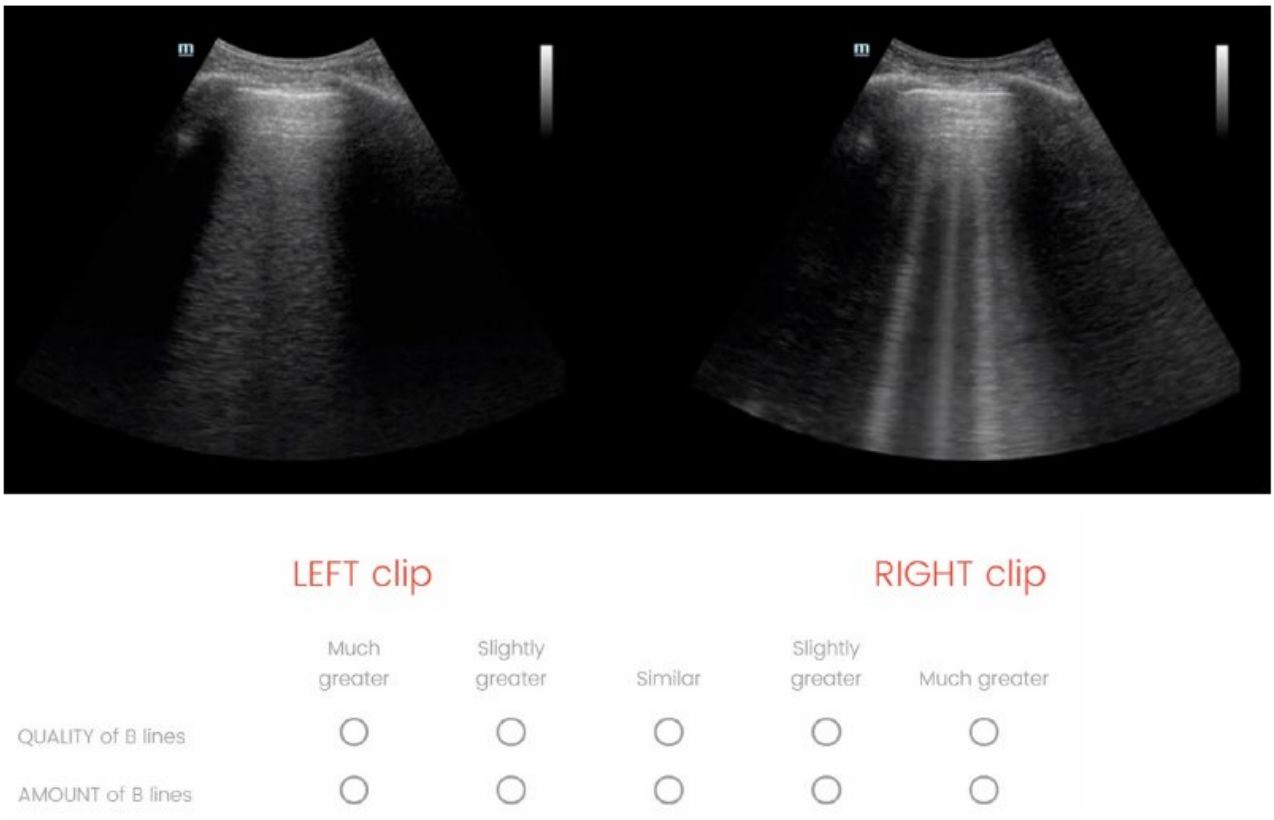
Table 1. Retrospective review of cardiopulmonary ultrasound exams containing lung clips evaluating B-lines

Total cardiopulmonary ultrasound exams with lung clips evaluating B-lines from January 2019 to June 2019	**174**
Probe	
- curvilinear	52 (29.9%)
- phased array	122 (70.1%)
Preset	
- lung	63 (36.2%)
- cardiac	87 (50.0%)
- abdomen	20 (11.5%)
- focused assessment with sonography for trauma (FAST)	3 (1.7%)
Mean focal zone depth from pleura, centimeters, +/– standard deviation	6.1 +/– 3.1
Harmonics on	151 (86.8%)

In the prospective study, reviewers (>100 prior lung ultrasound exams) were shown side by side clips of typical v adjusted settings (side randomized) and were asked to grade the quality and quantity of each.

Adj settings were reported to have better quality in ~97% of cases

Figure 2. This is an image of the screen of one of the 40 clip-pairs that were evaluated in the survey. Respondents were asked to rate the clips, left versus right, for quality and amount of B-lines. These images were from a curvilinear probe, with the typical settings on the left and adjusted settings on the right. Video examples of the clips as seen by the respondents are available in the online supplement.



Conclusions

Though more data is needed, it seems reasonable that for B line assessment:

1) focus set at pleural line

2) harmonics off

3) increased fair gain

Limitations: these were studied as a bundle (not individual). Study not designed to compare probes or presets.

15/

Why does this matter?

1) Consistency is important, in both clinical practice and in research.

2) The utility of B lines lies in their high sensitivity for interstitial edema. If settings are suboptimum and limit sensitivity, that reduces the power of the B line assessment.

16/

Other points on B line acquisition

-remember to find the most perpendicular angle to the pleural line. Otherwise you may end up with a non-A non-B pattern, which is non-diagnostic.

-if ribs are obscuring view, can turn probe to remove ribs from view.

17/

After considering the above data and discussion, will you adjust machine settings for B line assessment?

18/

Thanks for reading, interested to hear all thoughts on experiences w B line assessment!

Tagging a few #POCUS friends @kyliebaker888 @iceman_ex @msenussiMD @cameron_baston @Manoj_Wickram @DRsonosRD @NephroP @ArgaizR @ria_dancel @hraza222 @ThinkingCC @Wilkinsonjonny @katiewiskar