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## Maximizing Echo Image Utility for PH Diagnosis

### Announcer:

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### Dr. Haddad:

Hi, my name is Francois Haddad. I'm a Cardiologist at Stanford University. And I'll be presenting today on maximizing echo image utility. It's not just about pressure.

The format of the presentation will take the form of five pearls that will help optimize the assessment of pulmonary hypertension, pulmonary vascular disease, and right ventricular dysfunction in clinical practice.

One of the most important pearl in the assessments of tricuspid regurgitation maximal velocity is to assess the maximum velocity at the modal frequency. Visually, one can, with a cartoon and an image, summarize that the estimate should be done at the chin and not at the beard of the signal. This was an image by Dr. Kane from Mayo Clinic.

In the landmark study by Dr. Farber, when they compared the estimates of pulmonary pressure by echocardiography, versus the gold standard of right heart cath, they found that there's only 44% of the estimates that are within 10 millimeters of mercury when done within 1 month of the right heart cath, on the same date was about 40% that were within 10 millimeters of mercury.

While this number seems too low, to gain insight on the question, Dr. Amsallem from Stanford University tried to better assess what the importance of the quality of the signal. And this is the second very important pearl, we cannot neglect the quality of the signal. When we classify the quality signal into good, moderate, and poor, this was a major feature that differentiate how the clinical report reported much more signals of suboptimal quality versus the expert level 3 reader. The reason of the overestimations was mainly estimations at the beard, and not that the chin, and estimations that we're not at the modal frequency.

So in summary, for the first pearl, having good insulation angle for the tricuspid regurgitation velocity, estimating at the modal frequency are essential parts for accurate assessments.

The second pearl is one can never neglect the importance of pulmonary flow signal analysis. The presence of pulmonary flow acceleration, or notching, is related to an increased reflected wave of the pulmonary circulation. These were shown by beautiful hemodynamic studies, and beautiful M-Mode based studies of the pulmonary valve in at least 40 years ago.

In this beautiful comprehensive study that I invite everybody to read from Dr. Takayama in JACC Imaging in 2018, that was work with Dr. Kane from Mayo Clinic, they analyzed in depth the pulmonary flow signals. And this presentation from data from Dr. Kane in his presentation, he really shows that by the pulmonary flow signal can have different changes as the pulmonary vascular disease severity progresses to go from normal flow signal to an increase in acceleration time to the presence of notching, and to a change in to the proximal velocity of the pre-notch signal and post-notch signal velocity. And this could give an idea of the severity of the pulmonary vascular disease.

This brings us to pearl number three. Sometimes the tricuspid regurgitation signal is not well assessed. And another very useful metric that we can see is analyze the septal curvature. A flattening of the septum in systole is really more indicative of either pressure overload of the right ventricle, or volume overload sometimes when its presence is more present in diastole. And it also can indicate the synchrony. One of the most useful metric that we see, whether we can measure is the eccentricity index, which represents the measure of the diameter parallel to the septum, divided by the diameter perpendicular to the septum. In normal circumstances, the eccentricity index is close to 1.

Here, we should also have no changes in septal motion that we can also observe in patients with pulmonary arterial hypertension.

The fourth pearl that is very important, is really that we have to pay attention to regional function of the right ventricle to diagnose accurately pulmonary vascular disease. It was well shown by Dr. McConnell that the presence of the apical wink, or hyper contraction of the apex of the right ventricle, can be seen more frequently in pulmonary embolism, when compared to chronic pulmonary arterial hypertension. This can also be observed in patients with acute pulmonary vascular disease or acute lung injury, and also in patients with right ventricular myocardial infarction.

Another very important pearl in assessing right ventricular function is that the longitudinal function of the right ventricle can be altered post cardiac surgery. And this alteration has important implications on which metrics to use to assess right ventricular dysfunction. For example, post cardiac surgery, tricuspid annular plane systolic excursion, or right ventricle longitudinal strain may not be accurate to assess right ventricular function post-operative.

Finally, the last pearl, we are entering the era of venous excess imaging. This is a beautiful study Beaubien-Soulimy, where he shows that in patients with elevated or estimated elevated right atrial pressure, the end-organ 05:55 can be estimated by assessing the hepatic venous Doppler flow, the portal venous flow, or the intrarenal venous Doppler flow. This is a beautiful study and some - and review. And I invite readers to read the full article.

So in summary, in these five pearls, we summarized that the quality of the echo image is essential to diagnose and monitor pulmonary hypertension, especially as this relates to RVSP estimates. In integrating the echo imaging, the practitioner must focus on the heart structure, and not just the estimated pressure. We talked about the septal curvature, but also the right ventricular size is important. And finally, we need to focus on both sides of the heart, not just the RV, but also the LV as it could indicate the causes of pulmonary hypertension. There's numerous echo signs that can aid in the diagnosis of pulmonary hypertension, and putting all these together is essential for an accurate diagnosis. And the more complete the data, the better served is the patient and the PH care team.

So I want to thank you for listening, and I hope this presentation was useful. Thank you, and wishing you a wonderful day.

**Announcer:**

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