

Color Doppler Differentiation of Physiological from Pathological Mitral Regurgitation(MR): Avoiding The Fabrication of MR

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Background:

Mitral regurgitation (MR) is common. Because it is easy and quick, the regurgitant-jet area determined by color Doppler(CD) is still the most widely used approach for diagnosing the presence and severity of MR.

Physiologic Mitral Regurgitation is seen in up to 80 % of normal population, and is commonly seen as a small amount of closing flow (1-2 mm behind the valve). Severity of Physiologic MR is variable, and could be overestimated in patients with a short PR interval and hypertension(physiologic interpreted as mild, mild as moderate, and moderate as severe).

Although CD is very sensitive and specific for MR, the method has limitations. The timing of MR, facilitated by the electrocardiogram and the color M-mode, is crucial, and using the CD criteria during the wrong part of the cardiac cycle, i.e, seeing this MR jet during the pre-ejection period (PEP), when the aortic valve is still closed, and not during the actual ejection time (ET), when the aortic valve is open, can create the impression of pathological mitral regurgitation when it does not exist.

This physiological MR occurring only during the PEP is a normal phenomenon, not an abnormal one.

Failure to make this distinction can result in misdiagnosis of the patient as having pathological MR and lead to serious mismanagement.

Goal:

Goal of this poster is to defferentiate between a physiological mitral regurgitation and a pathological one. This will be clear in the following case:

Case:

A 53-year-old female was admitted to our institution with uncontrolled hypertension secondary to medical non-compliance. Examination the following day revealed a blood pressure of 122/80 mmHg, and an S4 gallop without a systolic murmur by auscultation. Echocardiography was then performed. Color Doppler initially suggested significant mitral regurgitation (MR), but timing of the regurgitant jet revealed MR to occur only within the pre-ejection period (PEP)(Figure 1).

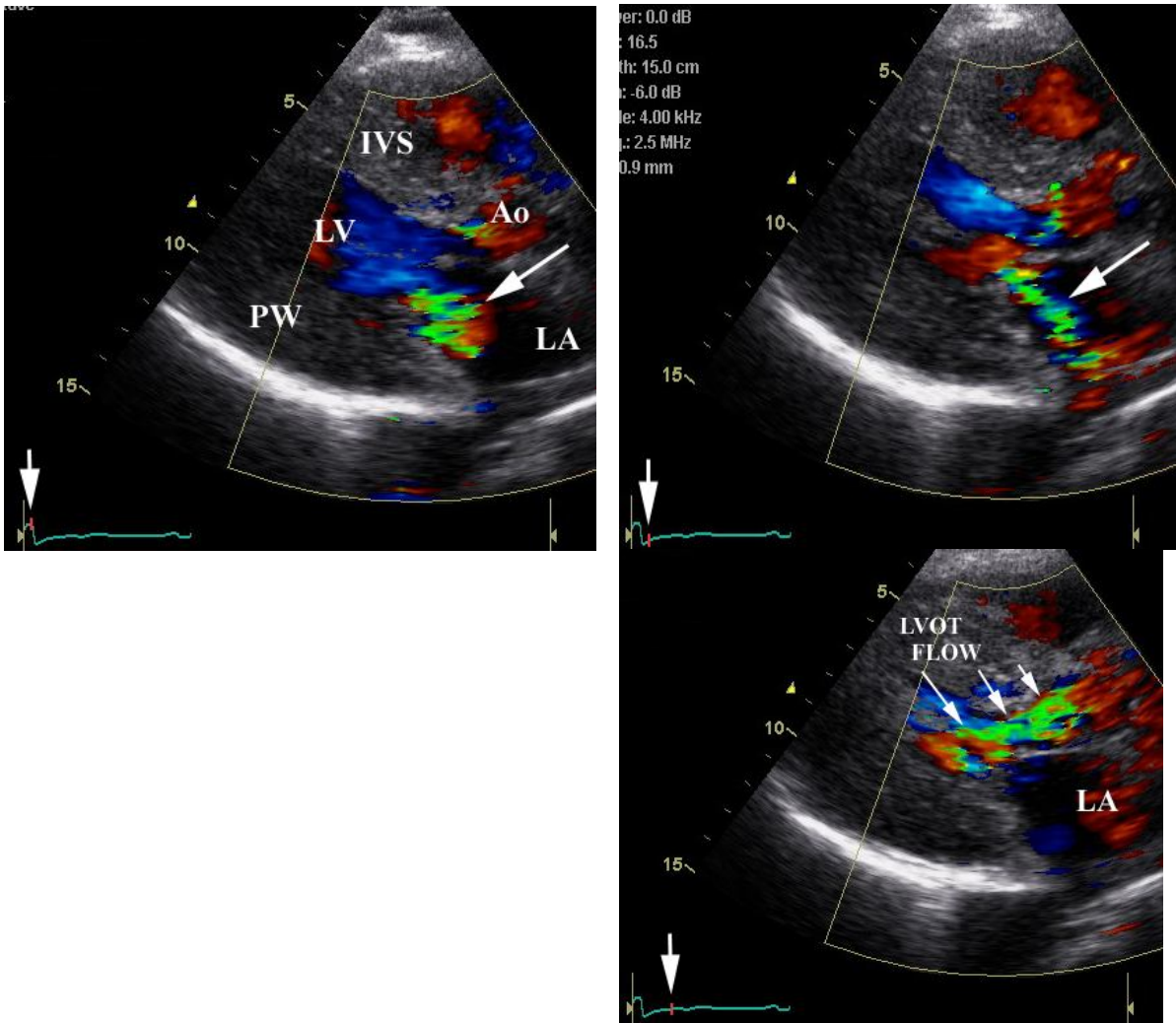


Figure (1a, 1b, 1c) showing the presence of the mitral regurgitation jet during the Pre Ejection Period only, and not during the Eject Time (ET) when the aortic valve opens. The arrow indicates the timing of the jet during the cardiac cycle, EKG.

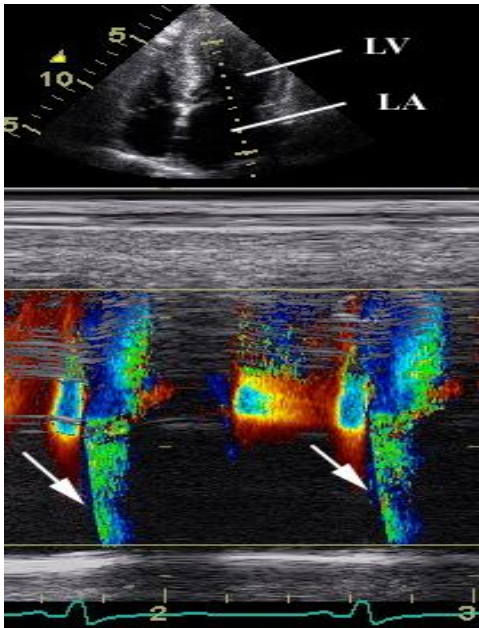


Fig 2, Color M. Mode of the same patient showing the jet of the mitral regurgitation (arrow) is present again during the PEP only and not during the actual ET.

Discussion:

CD is highly sensitive and specific for the detection of MR and grading its severity. By this method MR is considered present if blue, green, or mosaic signals were seen originating from the mitral valve and spreading into the left atrium during systole. Because it's easy and quick, the regurgitation jet area by color Doppler is the most widely used method to the severity of MR. By this method MR is considered significant (more than mild) if regurgitant jet area occupies at least 20% of the left atrial area. Despite the significance of CD in MR, the method has limitations. The timing of MR, facilitated by the electrocardiogram and the color M-mode, is crucial, and using the CD criteria during the wrong part of the cardiac cycle, i.e., seeing this MR jet during the pre-ejection period (PEP), when the aortic valve is still closed, and

not during the actual ejection time (ET), when the aortic valve is open, can create the impression of pathological mitral regurgitation when it does not exist.

Pre ejection Period (PEP) is the period from the beginning of the electrocardiographic QRS complex to the onset of the carotid upstroke (corrected for pulse delay), and is a composite of the isovolemic contraction period (which is from the R of QRS, to the opening of the aortic valve), plus the electromechanical interval (time elapsing from the QRS onset to the beginning of the ventricular contraction). Heart rate has a slight effect on the PEP, and the normal PEP corrected for the HR is 131 ± 13 ms in adults.

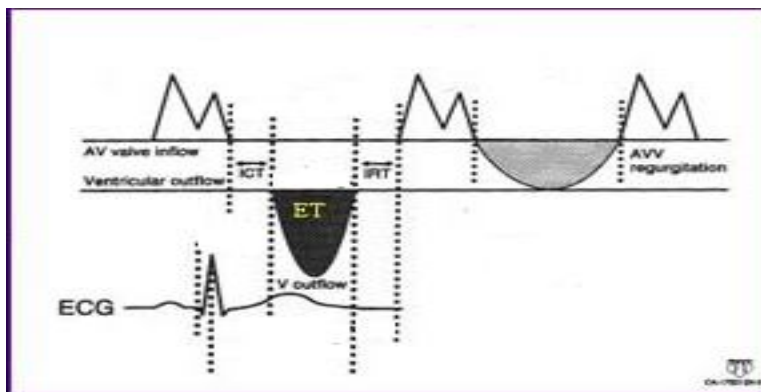


Fig 3, showing the relationship between the ICT, ET, and the surface EKG.

(ICT: iso volemic contraction time, ET, ejection time, IRT iso volemic relaxation time)

The MR, therefore, that is seen by CD during the PEP only, when the aortic valve is still closed and does not extend to the actual ejection time, ET, should be considered as a physiological MR and not a pathological one. The presence of this physiological MR detected by CD can be explained by the backflow of the blood when the leaflets of the

mitral valve are coapting and closing, and also by the displacement of the blood caused by the bulge of the mitral valve during iso volumic contraction time when the volume of the left ventricle is constant but the pressure rises rapidly.

The physiological MR, when compared with the pathological MR, has special characteristics as seen in the following table:

	Physiological MR	Pathological MR
Timing (e.g by EKG, Color M.Mode)	occurs only during the brief PEP of 131+/- 13 ms(does not extend to the ET)	During ET
Severity	Often trace or mild but could appear significant	Mild, moderate or severe
Jet Velocities by Doppler	Low	High
Morphology of the Jet by CD	Halo around the mitral valve	Vena contracta
Other criteria for significant MR (e.g. La enlargement, PISA, blunting of the forward systolic flow on the pulmonary vein Doppler	Abscent	Present(depending on the severity of MR)

Conclusion:

The CD criteria when applied for the detection of MR and grading its severity should be used in conjunction with the EKG, and the MR occurring only during the PEP is a normal phenomenon, not an abnormal one.

Failure to make this distinction can result in misdiagnosis of the patient as having pathological MR and lead to serious mismanagement especially if the jet of the MR detected by CD is significant.