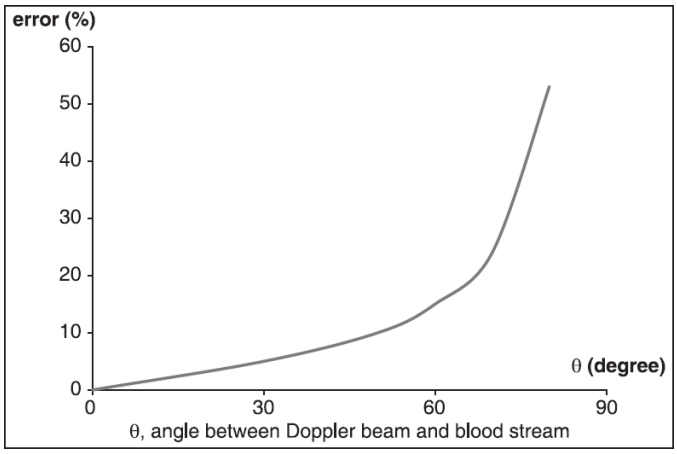
MCQ Measurements (ANSWERS) (LVOTd, LVOT VTI, LVEDD, TAPSE, TR Vmax)

1. Regarding the measurement of cardiac output using the VTI (Velocity Time Integral) method, the following statement is TRUE

The cross sectional area of aortic root is commonly used.
A Doppler angle of 25 degrees is preferable.
The cross sectional area of the assumed cylinder is measured in mid systole.
Pulsed wave is applied in the PLAX view.

Explanation:
The aortic root can be used to calculate cardiac output but this is not common at the aortic root changes significantly in size during systole and diastole. The LVOT is used for this reason as well as the flat laminar blood flow profile that occurs. Doppler interrogation should occur as parallel to blood flow as possible due to errors based on the Doppler equation. It is not possible to apply PW in the conventional PLAX view for this reason.



2. Regarding the measurement of LVOT diameter, the following statement is FALSE

The measurement is taken just before the insertion point of the aortic leaflets
The Bernoulli Principle is applied to obtain a cardiac output measurement.
Errors in diameter measurements result in over or under estimation of stroke volume.
Calcification of aortic leaflets can make this measurement difficult.

Explanation:
Bernoulli principle is used to obtain a pressure from velocity measurement (eg RVSP). The Continuity Principle is used to obtain stroke volume measurement from VTI.

3. Errors in cardiac output measurement using the VTI method can occur under these circumstances EXCEPT:

Foreshortening in the PLAX view resulting in inadequate visualisation of the both aortic leaflet opening in systole.
Application of pulsed wave Doppler gate 5 mm proximal to the aortic valve in A5C view.
Doppler cursor placement that is not parallel to aortic blood flow.
Poor tracing of VTI Doppler tracing.

Explanation:
Inability to clearly visualised the aortic valve opening will result in LVOTd measurement errors. Doppler interrogation to obtain VTI should be parallel to blood flow. Poor tracing of VTI and Doppler interrogation will result in underestimation of cardiac output.

4. The following statement is TRUE regarding LVOT VTI
Continuous wave Doppler is used.
The aortic valve closing click should be seen on Doppler trace.
A value of 10cm indicates a normal stroke volume.
This measurement assumes the blood velocity profile is turbulent under normal circumstances

Explanation:
Continuous wave is applied across the aortic valve, not at the level of the LVOT. As we are interested in flow just in a specific area, pulsed wave is used. The flow profile across the LVOT is laminar and flat. VTI between 16-20 cm usually indicates a normal stroke volume.

5. Regarding the measurement of left ventricular internal diastolic diameter (LVIDD), the following statement is FALSE

It is measured at the end of diastole
Care should be taken to ensure the mitral valve apparatus is not included in the measurement
The measurement should be taken from the left ventricular posterior wall, through the tips of the mitral valve leaflets, to the septal wall.
Measurement can be performed if the left ventricle is foreshortened ie not in true long axis.

Explanation:
Foreshortening of the LV in PLAX may result in over or underestimation of diameter.

6. Regarding TR Vmax (Tricuspid regurgitation maximum velocity), the following is FALSE

In 10% of the population, this measurement cannot be performed.
The peak velocity of the Doppler trace is measured.
Pulsed wave Doppler is applied in this measurement.
The simplified Bernoulli equation results in a pressure value from velocity measurement.

Explanation:
TR is absent in about 10-15% of the population. Therefore, RVSP cannot be obtained via this method of measurement. The peak TR jet velocity is measured, rather than tracing. The Bernoulli equation RVSP = $4V^2$ + RAP is used here.

7. The measured TR Vmax in an apical 4 chamber view is 3m/s. The RVSP (Right ventricular systolic pressure) is:

36mmHg
12mmHg
36mmHg + RAP
3mmHg + RAP

Explanation: See above

8. Regarding TR Vmax, select the TRUE statements.

It can be measured in the parasternal and apical views.
Colour Doppler can be utilised to guide Doppler cursor placement.
In the event of an incomplete Doppler profile trace, a best guess estimate of the peak velocity can be used.
An average of the maximum velocities in all views will result in the true measurement.

Explanation:
TR can be seen in the RV inflow (parasternal), wrap around short axis view (parasternal) and apical 4 chamber view. Colour Doppler is useful to guide Doppler cursor placement to maximize the jet profile. If inadequate trace is obtained and the peak velocity cannot be clearly seen, the peak velocity should not be estimated. In view of the Doppler principle, the highest TR velocity should be used as this is as a result of best Doppler alignment to blood flow. (NB Cosine 0 equals 1)

9. Regarding Tricuspid annular plane systolic excursion (TAPSE) (select all that apply)

A reliable way of assessing the right ventricular systolic function.
Accuracy can be improved by zooming in on the tricuspid annulus.
The medial annulus is used in the measurement.
A value of 1.6cm or greater is normal

Explanation:
The anterior free wall ie anterior annulus or lateral in the A4C view is used to measure TAPSE.

10. Regarding the cardiac cycle, select the TRUE statements

Systole begins following the closure of atrio-ventricular valves.

The LV cavity size is smallest in diastole.
Diastole corresponds to the end of T wave on ECG
Regurgitation of the mitral or tricuspid valves occur during the QRS complex on ECG.