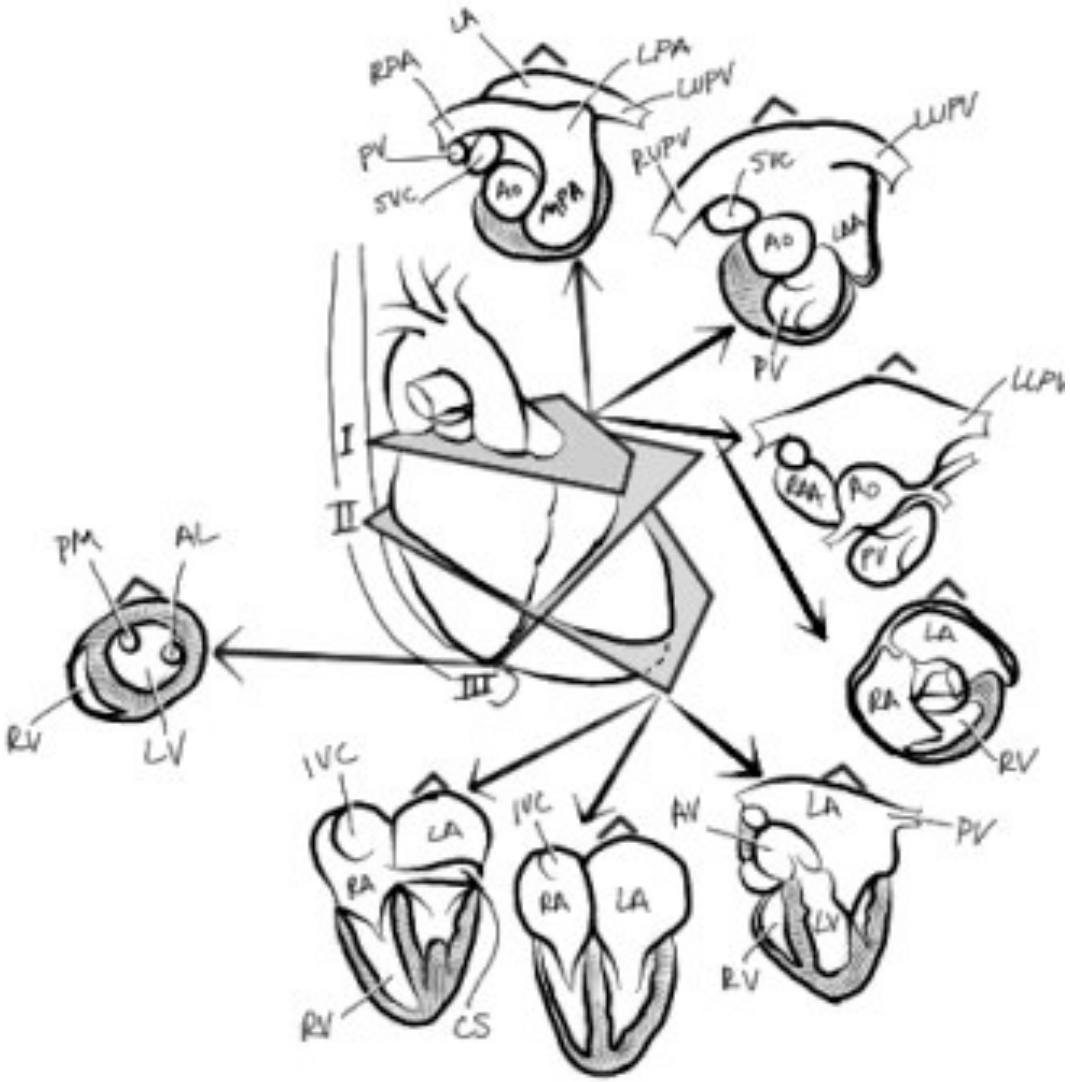
BASIC TEE PROTOCOL



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Before the TEE procedure…

Although generally a very safe procedure when performed in appropriately selected patients with proper technique, TEE can, on rare occasions, result in serious complications.

Table 1 TEE-related injuries

Site	Injury
Oropharyngeal	Lip bruising/laceration, loose/chipped tooth, displaced dentures, pharyngeal laceration, perforation of the hypopharynx, accidental tracheal intubation
Esophageal	Odynophagia, dysphagia, laceration/perforation, Mallory-Weiss tear
Gastric	Laceration/perforation, hemorrhage
Miscellaneous	Splenic laceration, compression of mediastinal structures, airway compromise, thermal injury/ burn, tongue necrosis

Therefore, every comprehensive TEE examination begins with a thorough history of the patient illness, indications for TEE, prior echo/TEE reports, review of the medical records, pertinent labs, and most important a search for **contraindications to the procedure**:

Table 4 Suggested contraindications to TEE

Absolute Contraindications	Relative Contraindications
Perforated viscous	Atlantoaxial joint disease*
Esophageal pathology (stricture, trauma, tumor, scleroderma, Mallory-Weiss tear, diverticulum)†	Severe cervical arthritis*
Active upper GI bleeding	Prior radiation to the chest
Recent upper GI surgery	Symptomatic hiatal hernia
Esophagectomy, esophagogastrectomy	History of GI surgery
	Recent upper GI bleed
	Esophagitis, peptic ulcer disease
	Thoracoabdominal aneurysm
	Barrett's esophagus
	History of dysphagia
	Coagulopathy, thrombocytopenia

Specific questions should be asked regarding history of **anticoagulation** or **bleeding disorders**, **dysphagia**, **odynophagia**, **hematemesis**, **esophageal disease** (history of chronic ETOH or liver cirrhosis shall rise the concern for esophageal varices), and **prior GI surgeries**.
When a history of esophageal disease or symptoms is discovered, the relative risk of performing TEE must be balanced against the potential benefit of the procedure.

The decision to proceed despite such symptoms should be documented in the medical record with an acknowledgement of the increased risk, including informed consent from the patient. GI evaluation with esophagoscopy can be helpful in assessing the risk of performing TEE.

Assessment of **last food and drink intake**, as well as presence of **dentures or loose teeth**

The pre-procedure evaluation continues with an assessment of patient's suitability for moderate sedation:

The **history** should focus on identifying risk factors that may increase the sensitivity to sedatives and analgesics, patients at risk of cardiopulmonary complications or difficulties in managing complications if they were to arise:

- Underlying cardiopulmonary disease may cause accentuated depression with sedatives and analgesics
- Renal and hepatic disease may impair drug metabolism
- Other medications that may cause unwanted drug interactions
- Allergies may cause allergic reactions
- Alcohol or drugs abuse may change the patient's reaction to the sedatives and analgesics
- Tobacco may cause airway irritability, bronchospasm and coughing
- Previous reactions to sedatives may increase the risk in subsequent procedures
- Airway history that increases the sedation risk includes stridor, snoring, sleep apnea, dysmorphic facial features, Down Syndrome, upper respiratory infections, and advanced rheumatoid arthritis

The **physical examination** should emphasize cardiac, respiratory and airway.

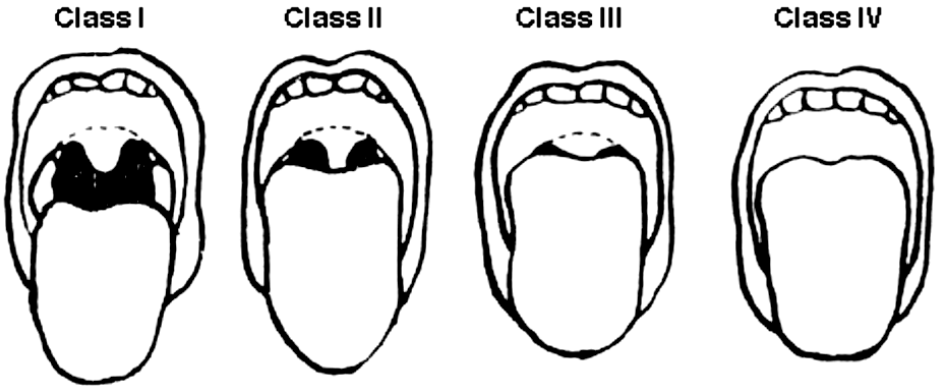
- **Normal Airway Examination**

  Opens mouth normally (for adults – greater than 2 finger widths or 3 cm)

  Able to see at least part of the uvula and tonsillar pillars with mouth open & tongue out

  Normal chin length (for adults – length of chin is greater than 2 finger widths or 3 cm)

  Normal neck flexion and extension without pain/paresthesias



ASA airway classification. The progression of diagrams from left to right suggests increased difficulty in airway management during sedation

Abnormal Airway Exam

Inability to open mouth normally
Inability to visualize at least part of uvula or tonsils with mouth wide open and tongue out
High arched palate
Tonsillar hypertrophy
Small or recessed chin
Neck has limited range of motion
Low set ears
Signficant obesity of the face/neck

Patients with any significant history or an abnormal airway examination (including Class III or IV airway) should be considered at higher risk and should be evaluated by anesthesia.

After patient is medically clear for the TEE procedure:

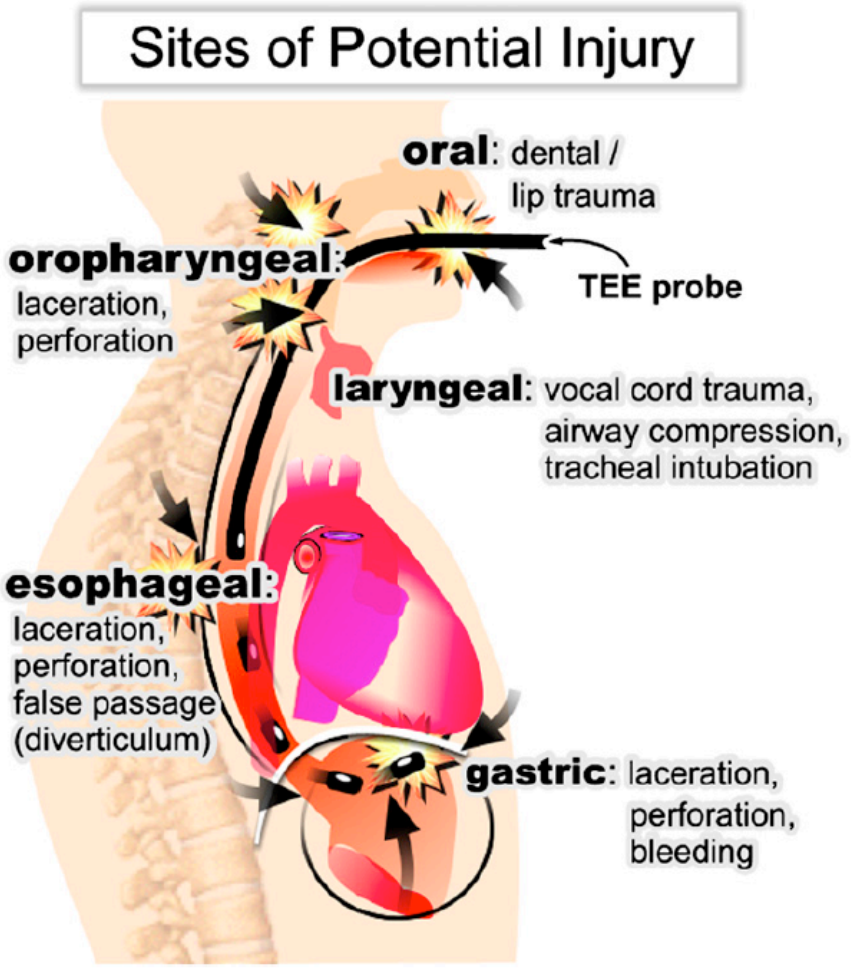
- Explain benefits and risks to the patient and/or family member; and obtain a written consent for TEE and moderate sedation from patient or family member if patient is not able to consent.
- Time Out – proper identification !!!!
- Connect and test ALL TEE probe functions, including flexion versions and the multiplane angle rotation.
- Select correct TEE settings
- Check EKG tracing in the Echo display and VS monitor
- Check there is tape available to record study
- Check for adequate vital signs monitor tracings (EKG, HR, Blood Pressure, RR, Sp02).
- Patient positioning and prepare bite guard

During the TEE procedure…

Before attempting to perform an oropharingeal intubation with the TEE probe:

- **Check immediate pre procedure vital signs!!!!**
- Check for proper function of the suctioning device
- Specify to the nurse sedative and analgesic medications and estimated doses.
- Sedate only with an attending present.
- **Insert probe**
- **During the TEE examination very frequently observe the VS monitor to assess patient hemodynamic status, breathing and oxygenation; or ask the nurse to provide you with several readings during procedure**

Beware of the potential complications and injuries during TEE probe insertion and manipulation in the esophagus and stomach



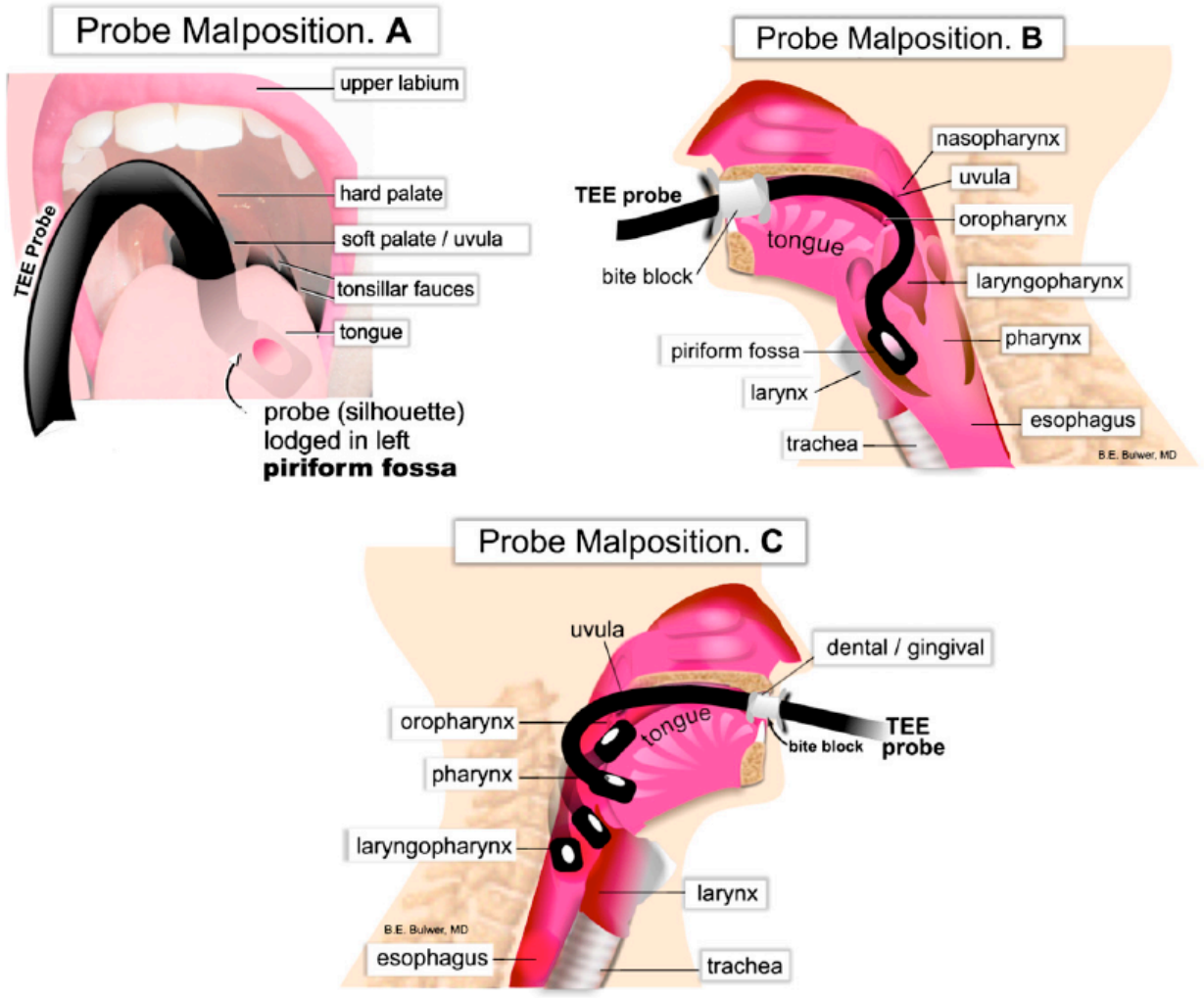


Figure 2 Probe malposition. **(A,B)** Difficulty during probe insertion can be encountered if the TEE probe is lodged into one of the pyriform sinuses. **(C)** In addition to causing mucosal injury to the oropharynx, the TEE probe can occasionally become distorted in extreme flexion. Attempts to withdraw a TEE probe in this configuration before advancing into the stomach and unfolding the kink can lead to severe esophageal injury.

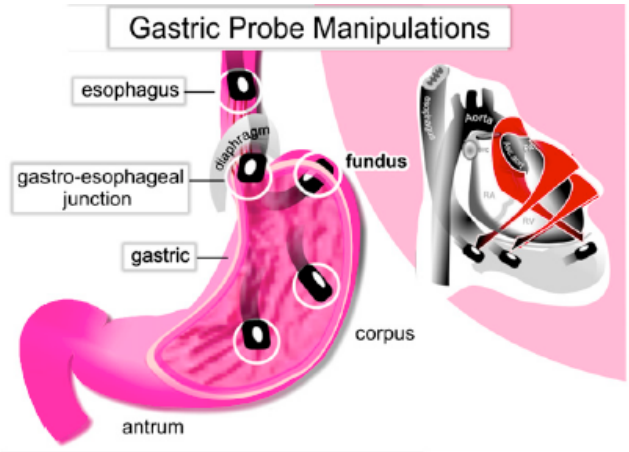


Figure 3 Gastric probe manipulations. Gastric injury typically occurs in the gastric fundus during deep transgastric probe manipulation, especially when requiring extreme anteflexion to bring the probe inline and in contact with the apex of the heart (e.g., deep transgastric aortic outflow view). The gastroesophageal junction is a vulnerable zone because probe manipulation at this level may place the relatively fixed tissues under considerable tension.

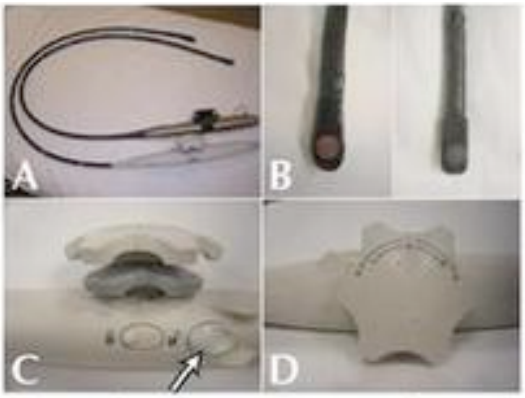
The American Society of Echocardiography (ASE) and the Society of Cardiovascular Anesthesiologists (SCA) jointly published guidelines for performing a comprehensive transesophageal examination.

ASE/SCA Guidelines for Performing a Comprehensive Intraoperative Multiplane Transesophageal Echocardiography Examination: Recommendations of the American Society of Echocardiography Council for Intraoperative Echocardiography and the Society of Cardiovascular Anesthesiologists Task Force for Certification in Perioperative Transesophageal Echocardiography

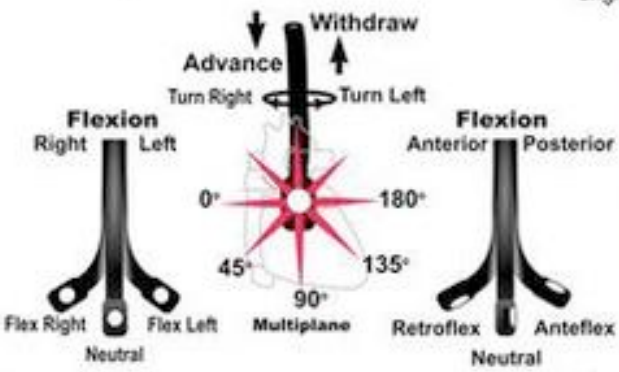
J Am Soc Echocardiogr 1999; 12:884-900

These guidelines describe **20 views** of the heart and great vessels that include all four chambers and valves of the heart as well as the thoracic aorta and the pulmonary artery. The order in which these views are acquired during a TEE examination will vary according operator preferences and/or the particular cardiac problem of the patient.

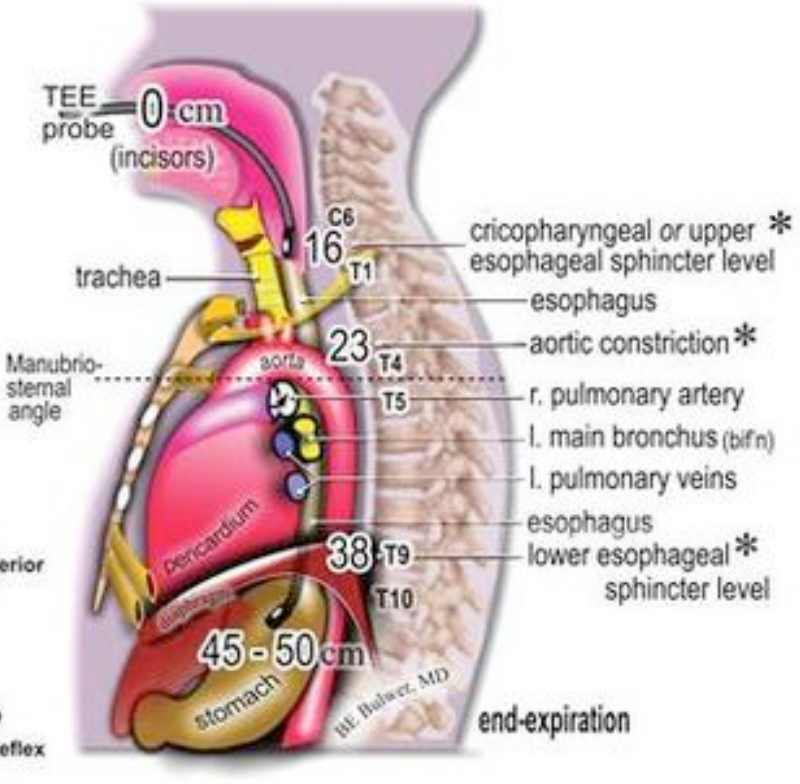
The following is a description of an approach to perform a comprehensive TEE examination. It is merely one example of many equally valid ways to proceed.
It is usually most efficient to complete all of the midesophageal views first, then proceed to the transgastric views, and finally finish with an examination of the thoracic aorta, however a more focus examination is also customary based on the clinical scenario.



TEE Instrumentation



TEE Probe and Transducer: Position Basics



TEE: Anatomical Landmarks

Comprehensive TEE examination


a. ME four chamber


b. ME two chamber


c. ME LAX


d. TG mid SAX


e. TG two chamber


f. TG basal SAX


g. ME mitral commissural


h. ME AV SAX


i. ME AV LAX


j. TG LAX


k. deep TG LAX

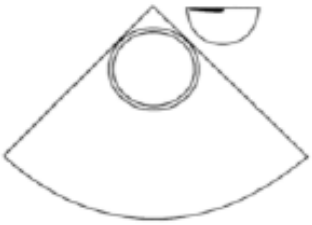

l. ME bicaval


m. ME RV inflow-outflow


n. TG RV inflow


o. ME asc aortic SAX


p. ME asc aortic LAX


q. desc aortic SAX

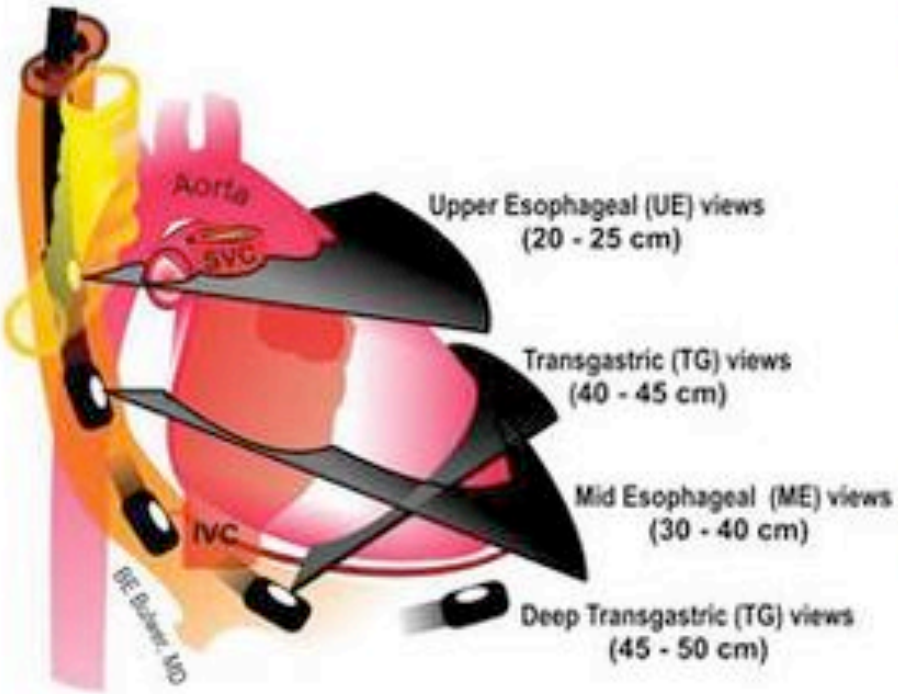

r. desc aortic LAX

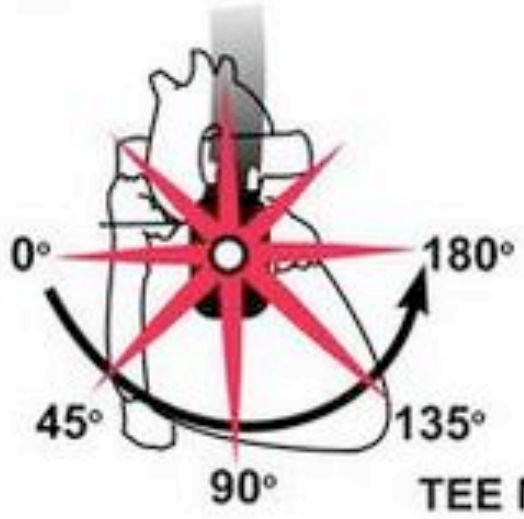

s. UE aortic arch LAX


t. UE aortic arch SAX

Transesophageal Echocardiography

Nomenclature: ASE/SCA





TEE Multiplanes

Order of Examination: Summary

Stage 1. Cardiac Chambers, Valves, and LAA

ME Level: Multiplane from ~0° to ~120°

1. (**A**): ME four-chamber ~ 15°
2. (**G**): ME mitral commissural ~ 80°
3. (**B**): ME two-chamber ~ 90°
4. (**C**): ME long axis ~ 120°

Stage 2. RV and LV Inflows and Outflows

ME level: with angle ~90° to ~130° , sweep R to L

5. (**M**): ME right ventricular inflow-outflow ~ 80°
6. (**L**): ME bicaval ~ 110°. *Figs. 19, 20*
7. (**P**): ME ascending aortic long axis ~ 100°
8. (**I**): Advance: ME aortic valve long axis ~ 130°

Stage 3. Great Vessels: Aorta and PA

Mid and Upper Esophageal Views. Start at 0° to 20°

9. (**O**): ME ascending aortic short axis ~ 20°
10. (**H**): ME aortic valve (AV) short axis ~ 60°
11. (**S**): UE aortic arch long axis ~ 0°
12. (**T**): UE aortic arch short axis ~ 90°
13. (**R**): Descending aortic long axis ~ 90°
14. (**Q**): Descending aortic short axis ~ 0°

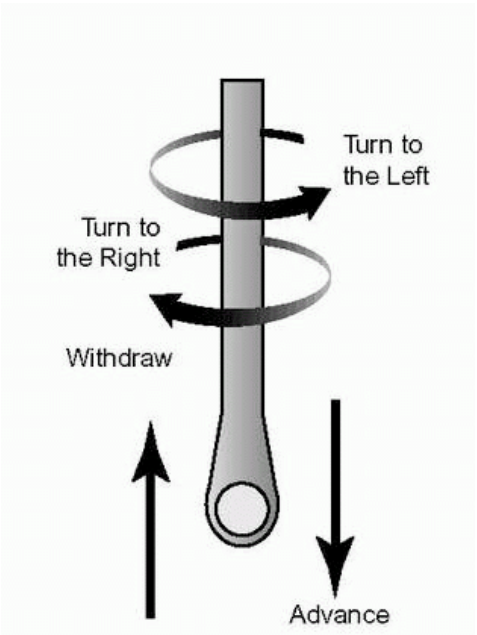
Stage 4. Gastric Views

Advance to stomach, anteflex

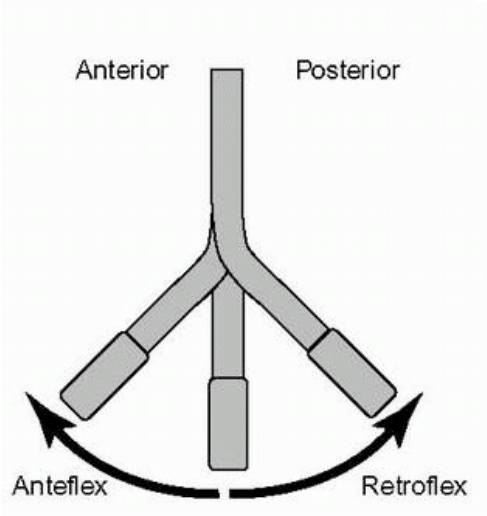
15. (**D**): Transgastric mid-short axis ~ 0°
16. (**F**): Transgastric basal short axis ~ 0°
17. (**E**): Transgastric two-chamber ~ 90°
18. (**J**): Transgastric long axis ~ 120°
19. (**N**): Transgastric right ventricular inflow ~ 120°
20. (**K**): Deep transgastric long axis ~ 0°

LAA, left atrial appendage, PA, pulmonary arteries

After the TEE probe is inserted, it is manipulated to obtain different views of the heart. The following terminology is used in the ASE/SCA guidelines to describe the manipulation of the probe. These terms are made assuming that the imaging plane is anterior to the esophagus through the heart in a patient in standard supine anatomic position.

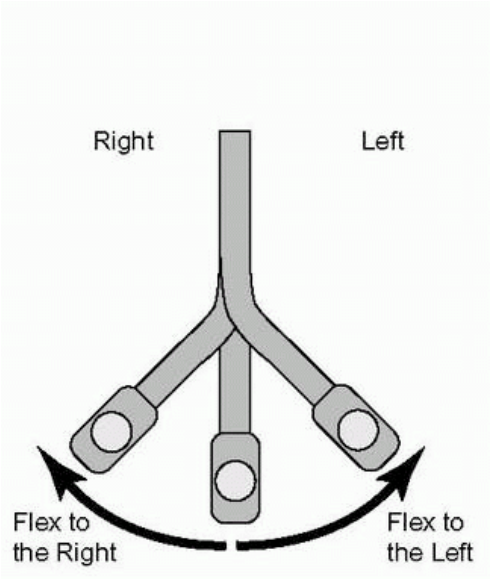


Rotating the anterior aspect of the probe within the esophagus toward the patient's right is called **"turning to the right"** *(clockwise)*, and rotating it toward the left is called **"turning to the left"** *(counterclockwise)*.



Pushing the tip of the probe more distal into the esophagus or the stomach is called **"advancing the transducer"**, and pulling the tip more proximally is called **"withdrawing the probe"**.

Flexing the tip of the probe with the large control wheel anteriorly is called **"anteflexing"**, and flexing it posteriorly **"retroflexing"**. Flexing the tip of the probe with the small control wheel to the patient's right is called **"flexing to the right"**, and flexing it in the opposite direction is called **"flexing to the left"**.



Finally, increasing the transducer multiplane angle from zero degrees towards 180 degrees is called **"rotating or multiplane forward"**, and decreasing in the opposite direction towards zero degrees is called **"rotating or multiplane back"**.

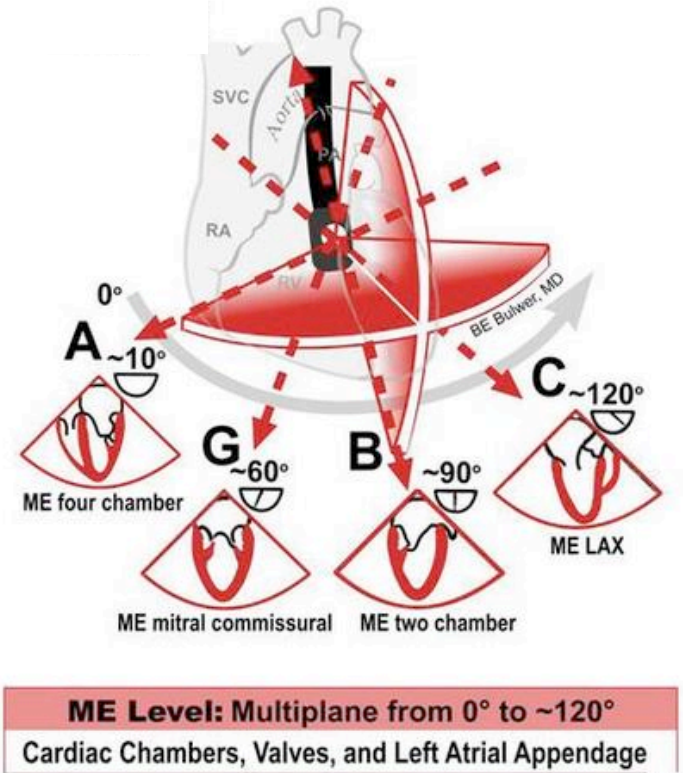
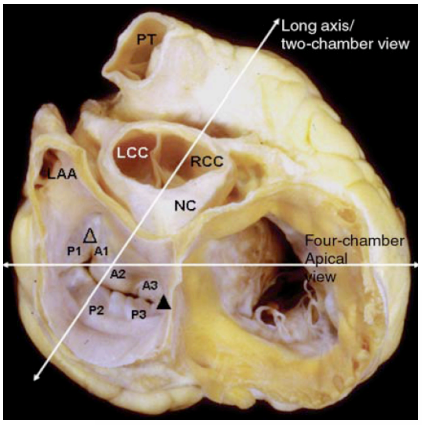
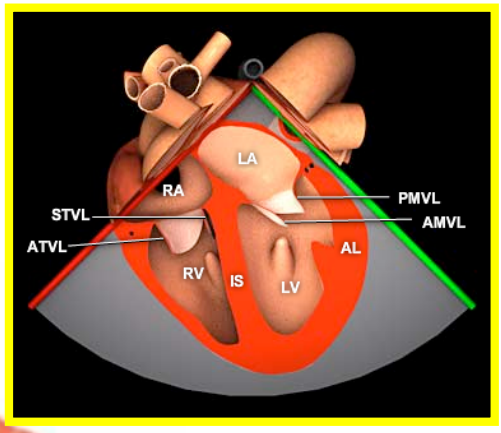


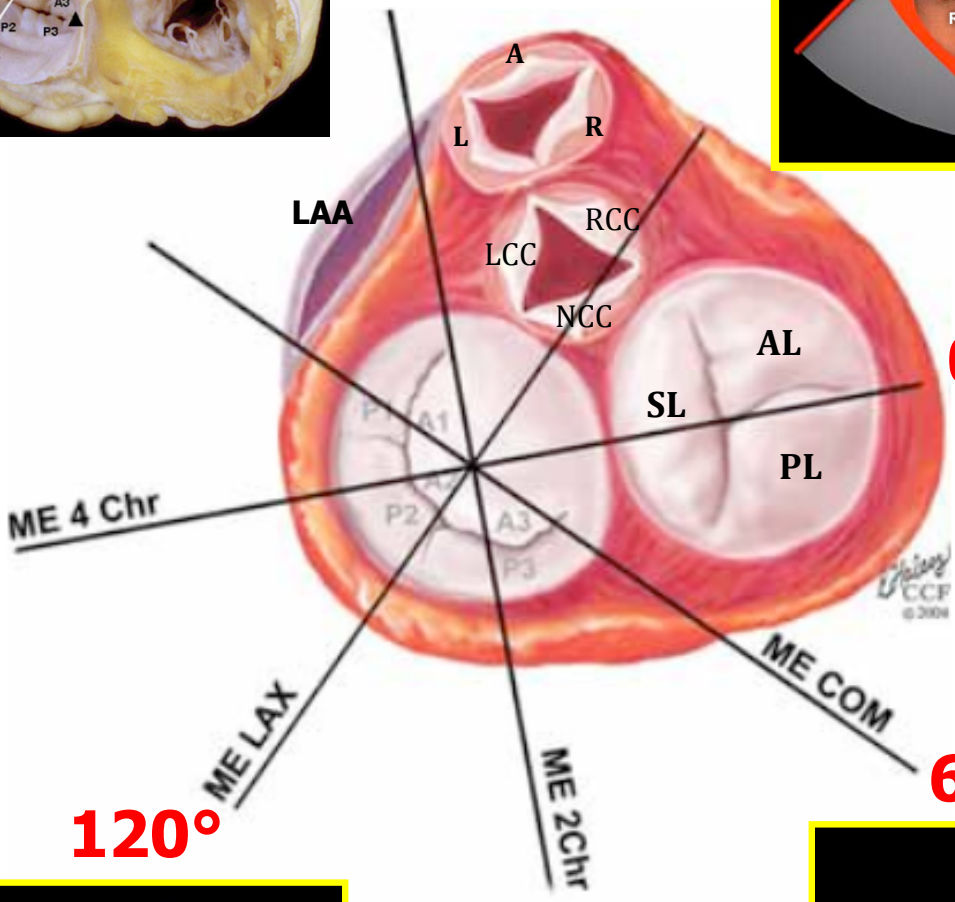
Table 1 Recommended transesophageal echocardiography cross sections

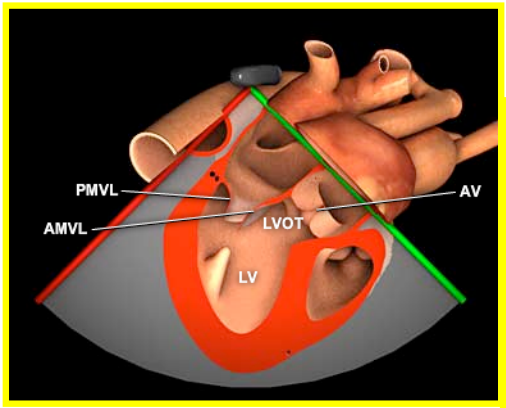
Window (depth from incisors)	Cross section (panel in Figure 3)	Multiplane angle range	Structures imaged
Upper esophageal (20-25 cm)	Aortic arch long axis (s)	0°	Aortic arch, left brachio v
	Aortic arch short axis (t)	90°	Aortic arch, PA, PV, left brachio v
Mid esophageal (30-40 cm)	Four-chamber (a)	0°-20°	LV, LA, RV, RA, MV, TV, IAS
	Mitral commissural (g)	60°-70°	MV, LV, LA
	Two-chamber (b)	80°-100°	LV, LA, LAA, MV, CS
	Long axis (c)	120°-160°	LV, LA, AV, LVOT, MV, asc aorta
	RV inflow-outflow (m)	60°-90°	RV, RA, TV, RVOT, PV, PA
	AV short axis (h)	30°-60°	AV, IAS, coronary ostia, LVOT, PV
	AV long axis (i)	120°-160°	AV, LVOT, prox asc aorta, right PA
	Bicaval (l)	80°-110°	RA, SVC, IVC, IAS, LA
	Asc aortic short axis (o)	0°-60°	Asc aorta, SVC, PA, right PA
	Asc aortic long axis (p)	100°-150°	Asc aorta, right PA
	Desc aorta short axis (q)	0°	Desc thoracic aorta, left pleural space
	Desc aorta long axis (r)	90°-110°	Desc thoracic aorta, left pleural space
Transgastric (40-45 cm)	Basal short axis (f)	0°-20°	LV, MV, RV, TV
	Mid short axis (d)	0°-20°	LV, RV, pap mm
	Two-chamber (e)	80°-100°	LV, MV, chordae, pap mm, CS, LA
	Long axis (j)	90°-120°	LVOT, AV, MV
	RV inflow (n)	100°-120°	RV, TV, RA, TV chordae, pap mm
Deep transgastric (45-50 cm)	Long axis (k)	0°-20° (anteflexion)	LVOT, AV, asc aorta, arch

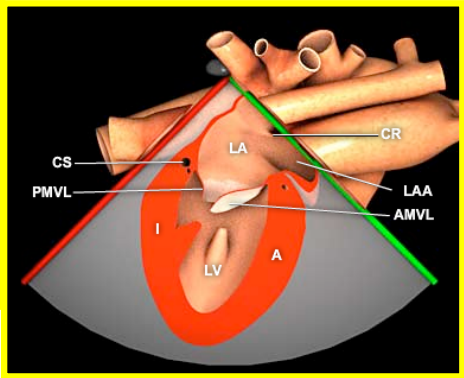
A - MID ESOPHAGEAL VIEWS

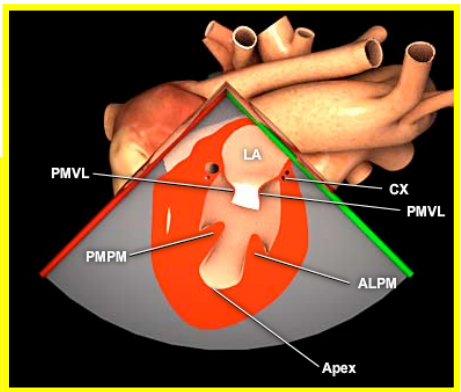




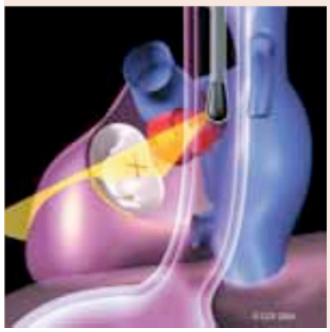


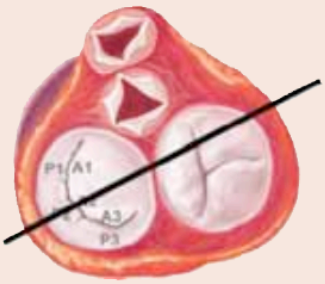


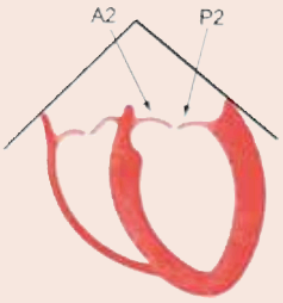




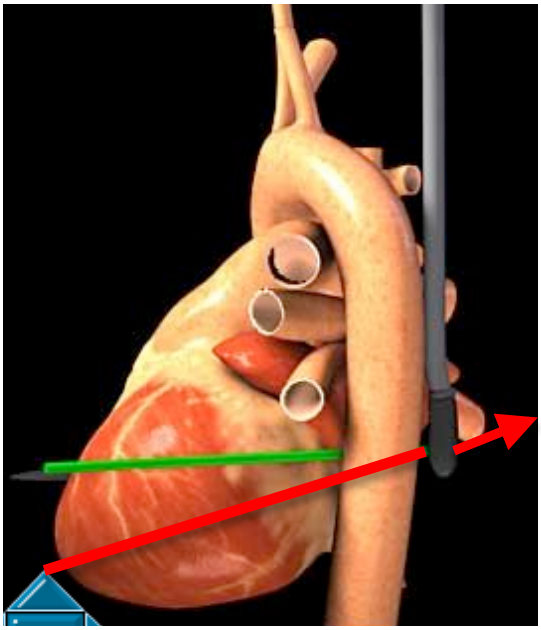
(a) ME 0° FOUR CHAMBERS views

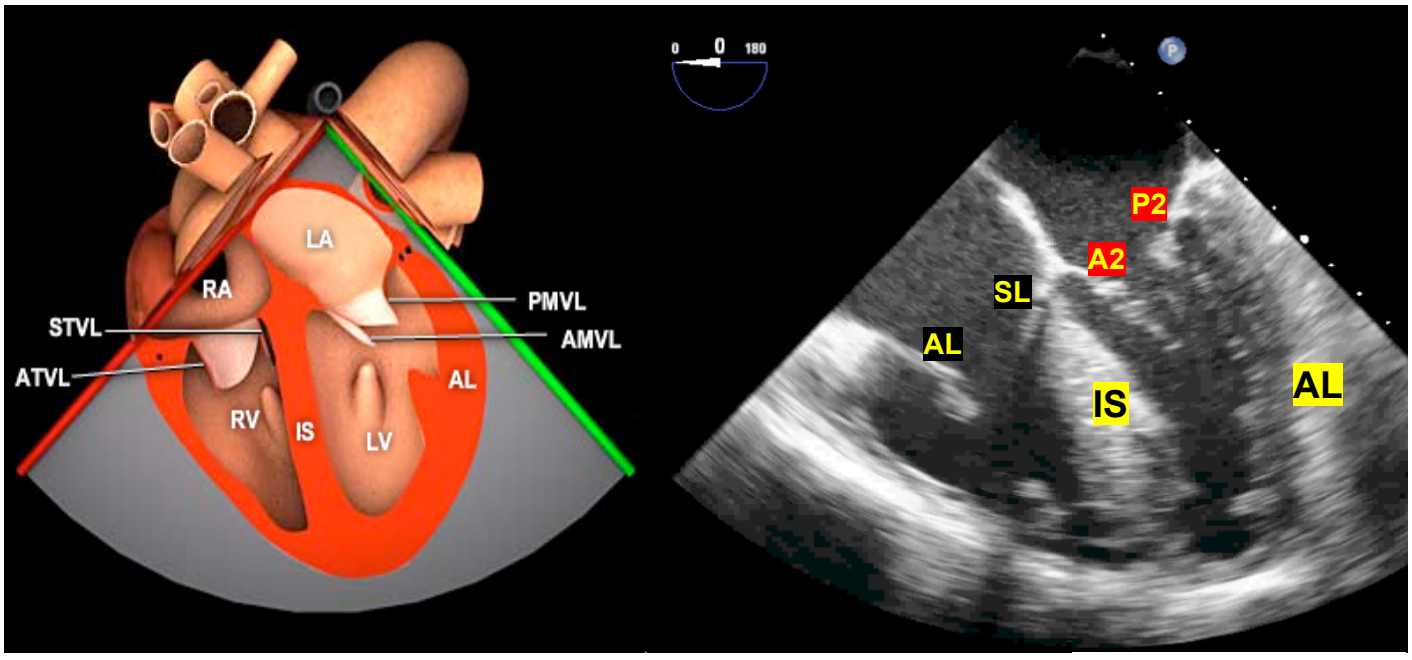






To obtain the **ME at 0° view** of the LV, position the transducer posterior to the LA at the mid level of the MV. The imaging plane is oriented to pass simultaneously through the center of the mitral annulus and the apex of the LV.
The LV is usually oriented within the patient's chest with its apex somewhat more inferior than the base, so the **tip of the probe may require retroflexion to direct the imaging plane through the apex and attempt to obtain a "true apex"**
Multiplane rotation between **0° - 20°** may be necessary to obtain a true four chamber view, until the AV is no longer visualized.



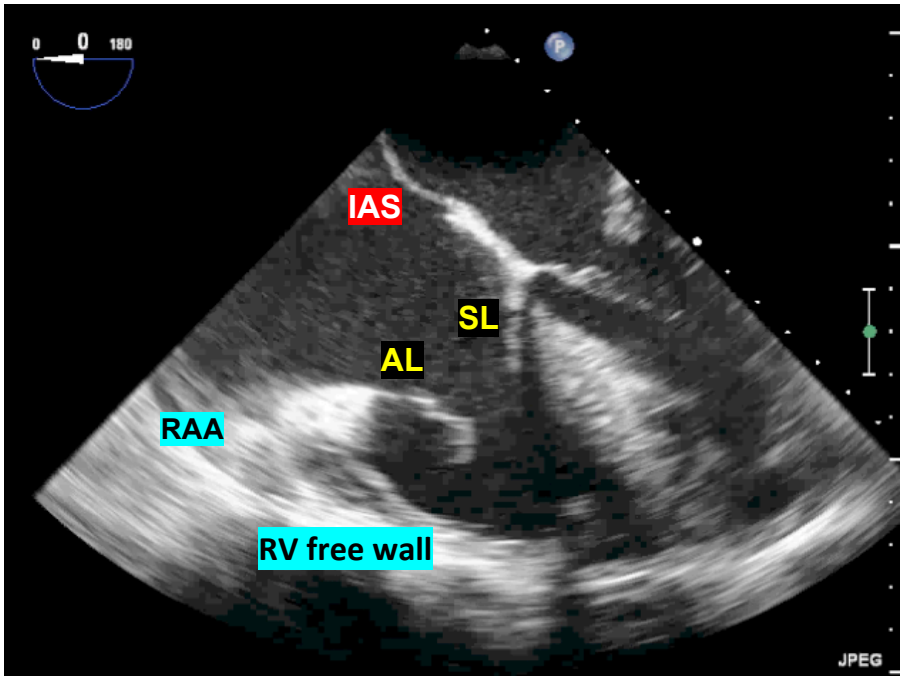


From the **ME at 0°** of the LV view position, the LA is fully examined from top to bottom by rotating the probe from right to left and advancing the probe until the plane passes through the floor of the LA and then withdrawing until the dome of the atrium is reached.

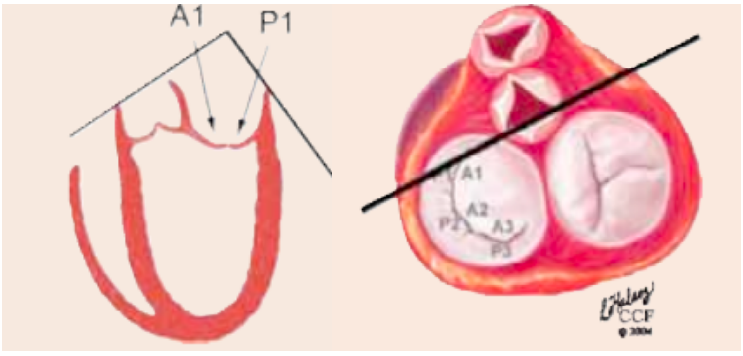
The MID esophageal four chambers show:

- The basal and mid infero-septal, basal and mid antero-lateral segments, as well the apical septum and apical lateral if a true apex is obtained.
- The **A2** and **P2** Mitral valve scallops.
- The **septal leaflet** and the **anterior** (or posterior depending on the orientation) **leaflet** of the Tricuspid valve.

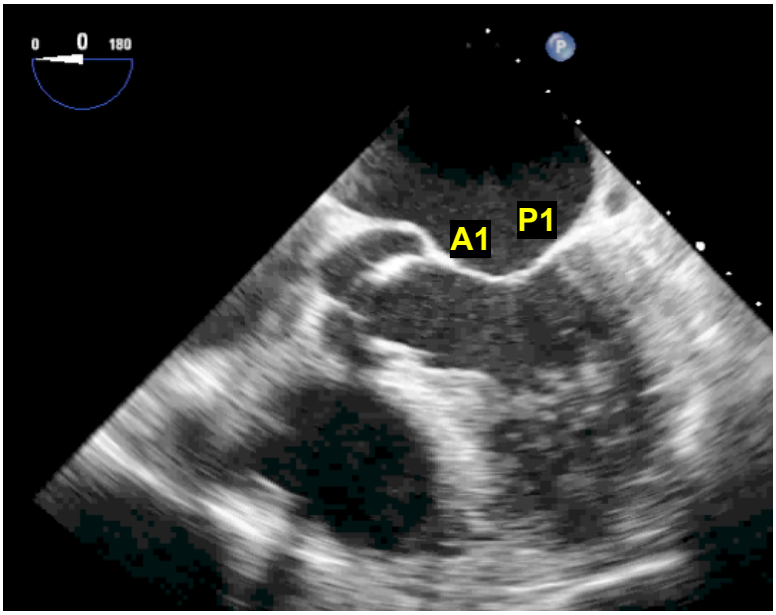
By **turning the probe to the right** until the tricuspid valve is in the center of the display, the right heart is exposed fully, and appropriate assessment of the size and function is obtained.

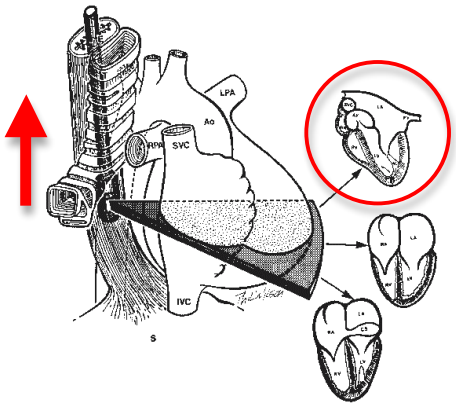


T**urning back to the left**, the four chambers view is again in the center of the field. → Now withdrawing the probe 1 – 1.5 cm, the LVOT and aortic valve are exposed and a **ME 5 chambers view** is obtained

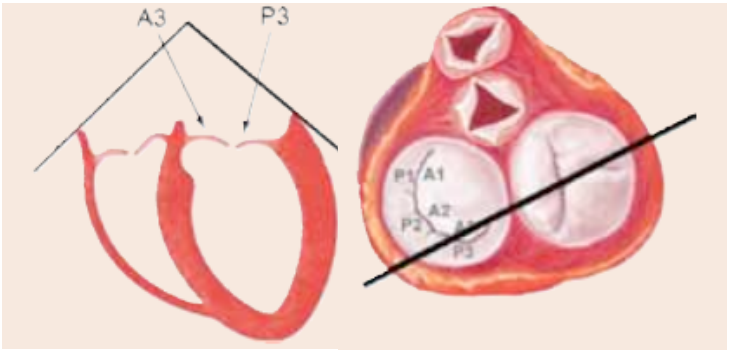


- The **A1** and **P1** Mitral valve scallops are now seen.

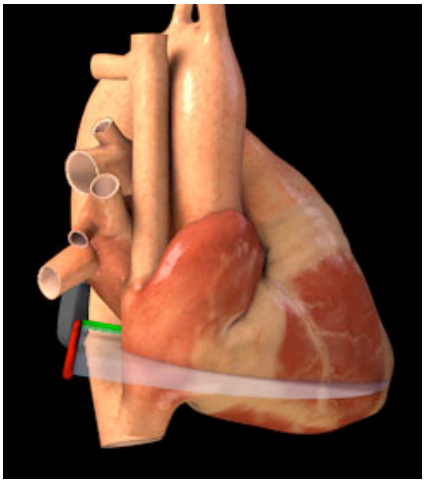


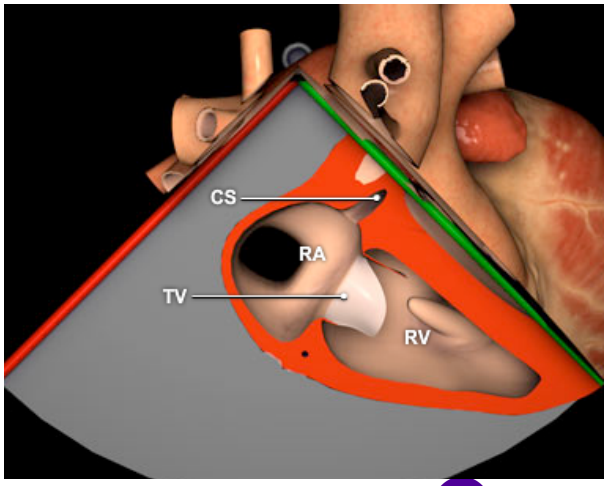


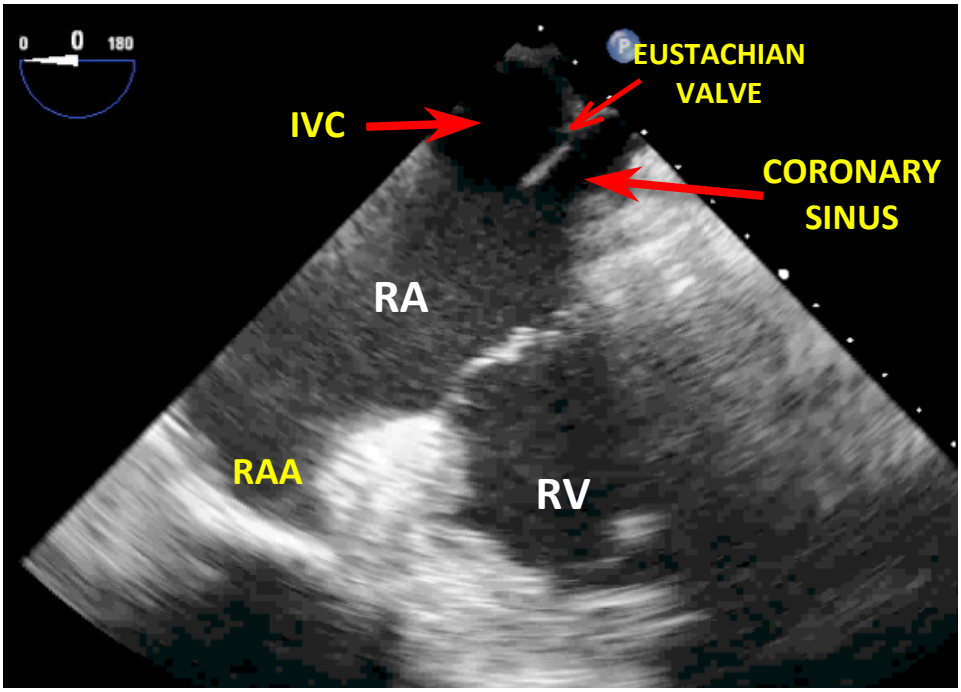
Lower esophageal 4 CH view: Advancing the probe slightly beyond the plane of the four chambers view, **A3** and **P3** scallops may be seen.

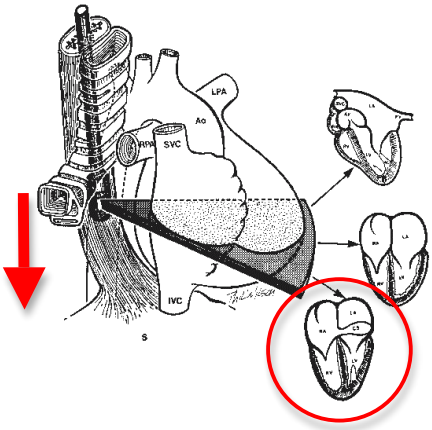


While in the **ME at 0°,** further advancing the probe until the transducer is located in the right posterior atrio-ventricular groove (the LA is no longer visualized), the **coronary sinus** is exposed, and the ostium of the inferior vena cava and Eustachian valve as well may be seen.

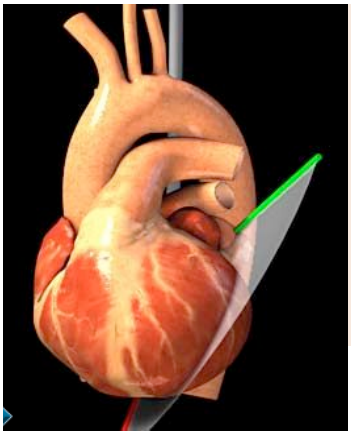


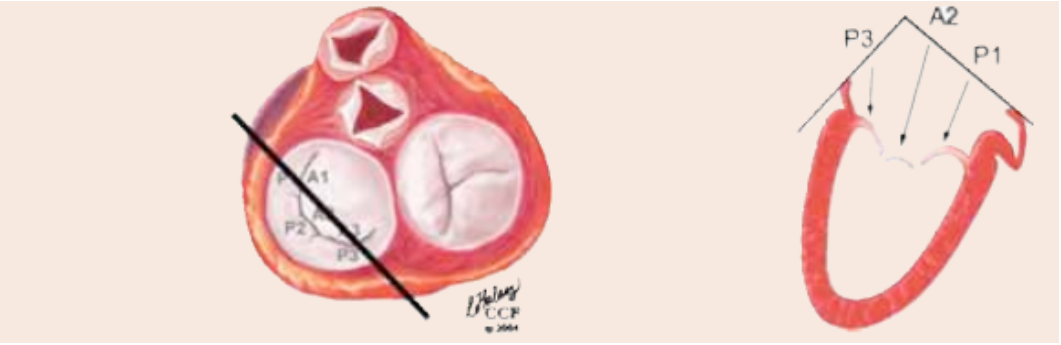


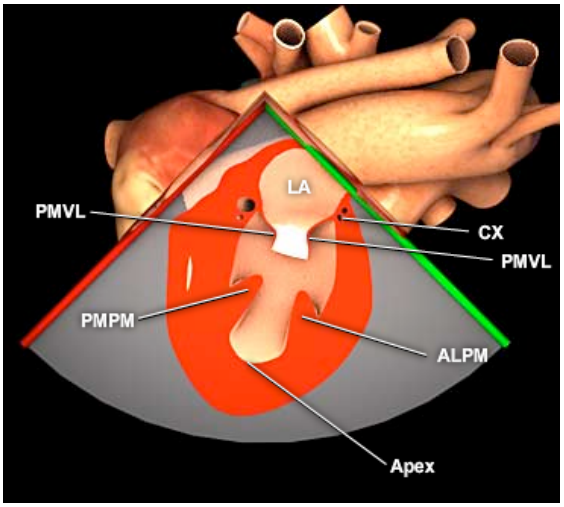




(g) ME 60° COMMISSURAL view

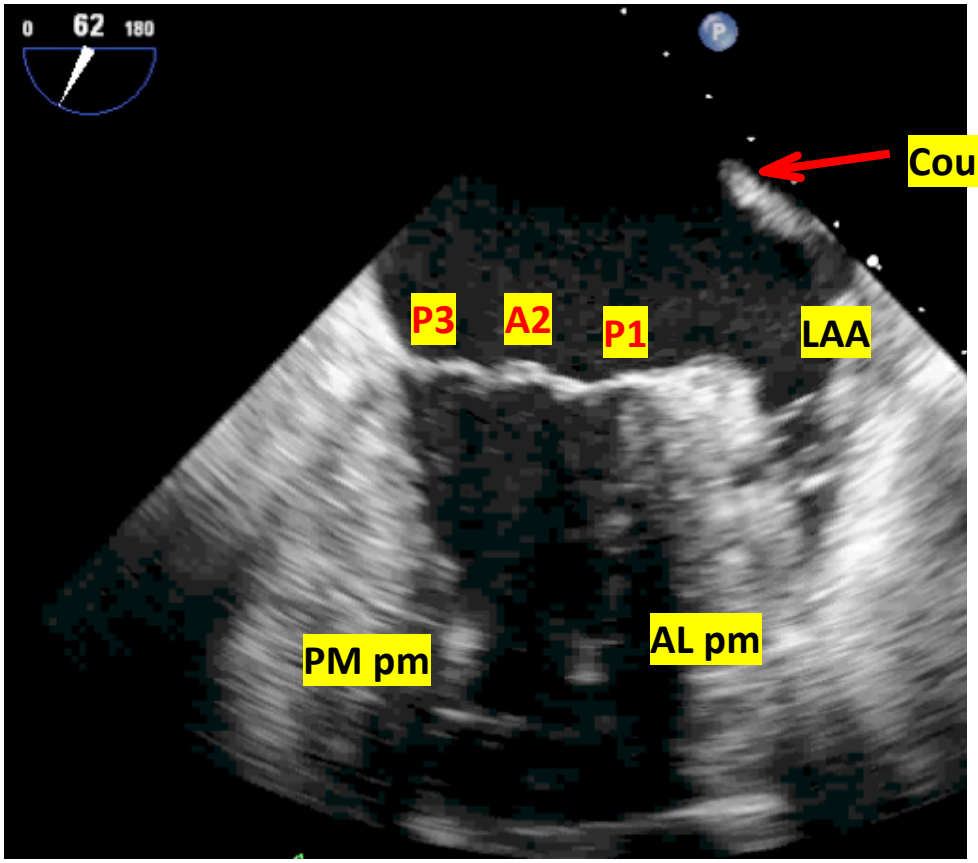


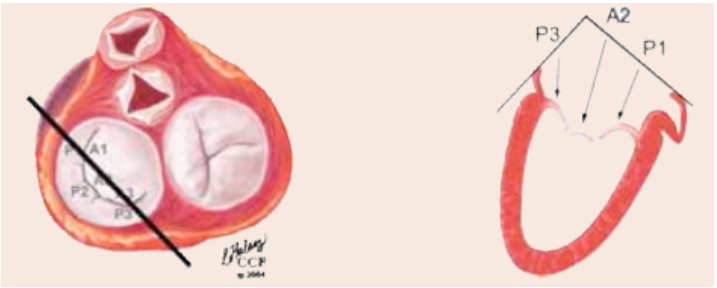


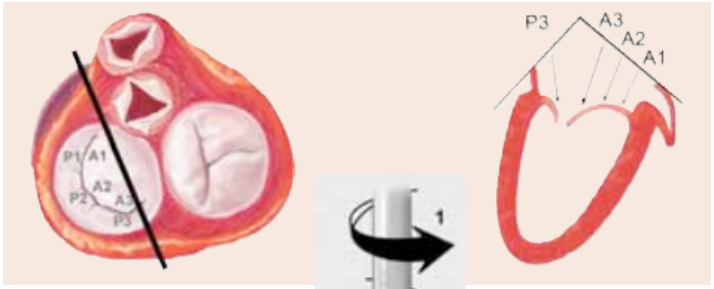


From the ME four chamber view at 0° center the LV in the middle of the display. The ME 60° Commissural view is developed by rotating the multiplane angle to about 60°, and slightly turning the probe to the left to keep the LV open. This view will allow you to see:

- The left atrial appendage
- Mitral valve scallops **P3 – A2 – P1**
- The PM and AL commissures.
- The postero-medial papillary muscle
- The antero-lateral papillary muscle



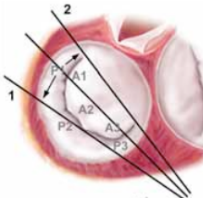




ME 60° Commissural view variations:

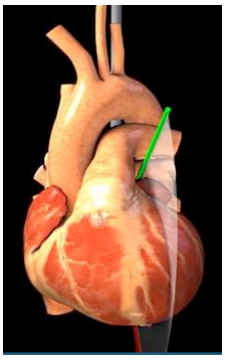
- Depending on the orientation of the MV commissure and transducer rotation angle, the 2-D plane may pass through **P3**, the PMcomm, **A2**, ALcomm, and **P1** scallop.

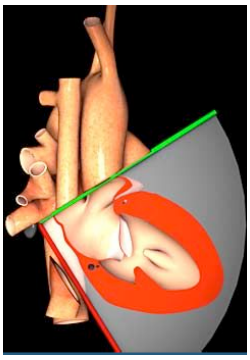
- ❷ Turning the probe to the right (clockwise) the 2-D plane may cut through the P3 scallop, the PMcomm, and the **A3, A2, A1** segments of the ALMV.

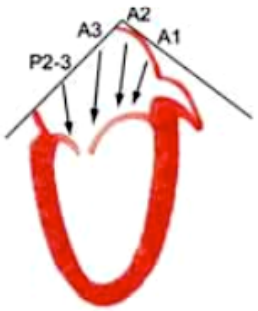


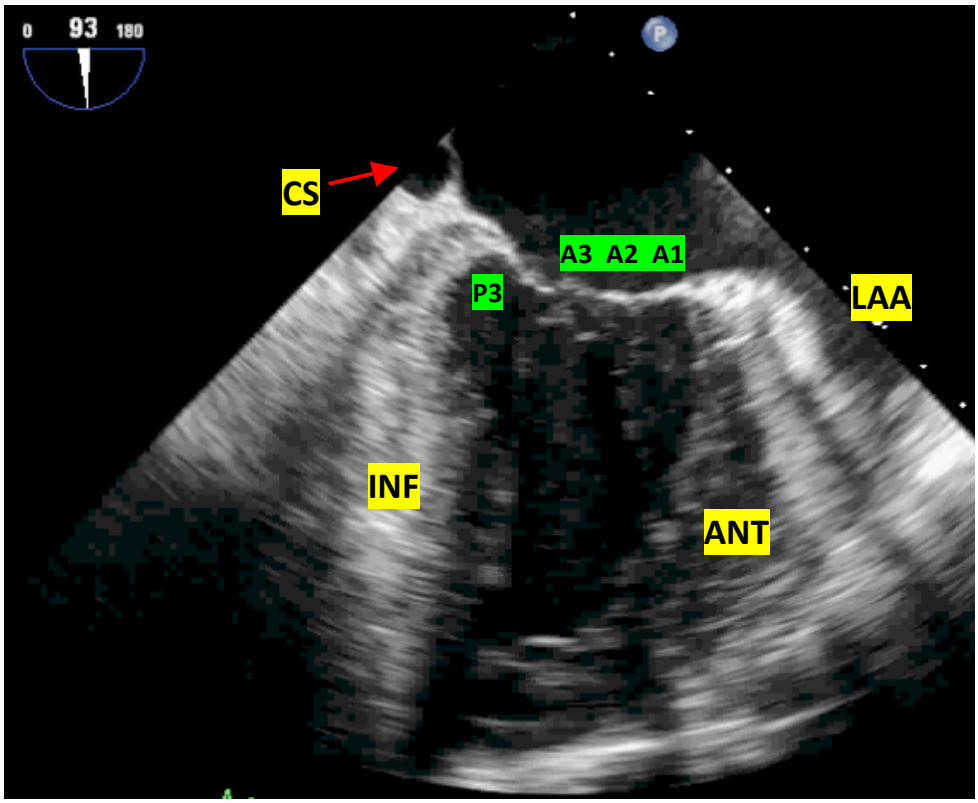
- ❶ Turning the probe to the left (counterclockwise) the 2-D plane may cut through the **P3, P2, P1** scallops. *The commissure may not be visualized except in diastole*.

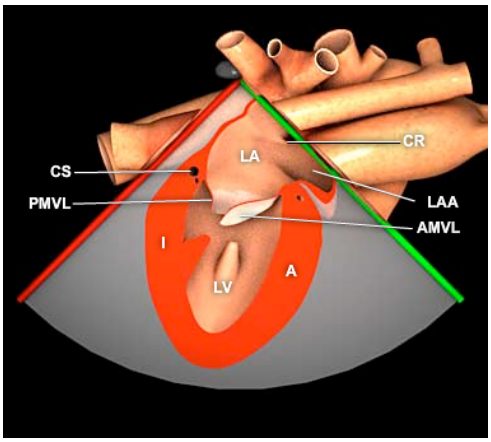
(b) ME 90° TWO CHAMBERS view







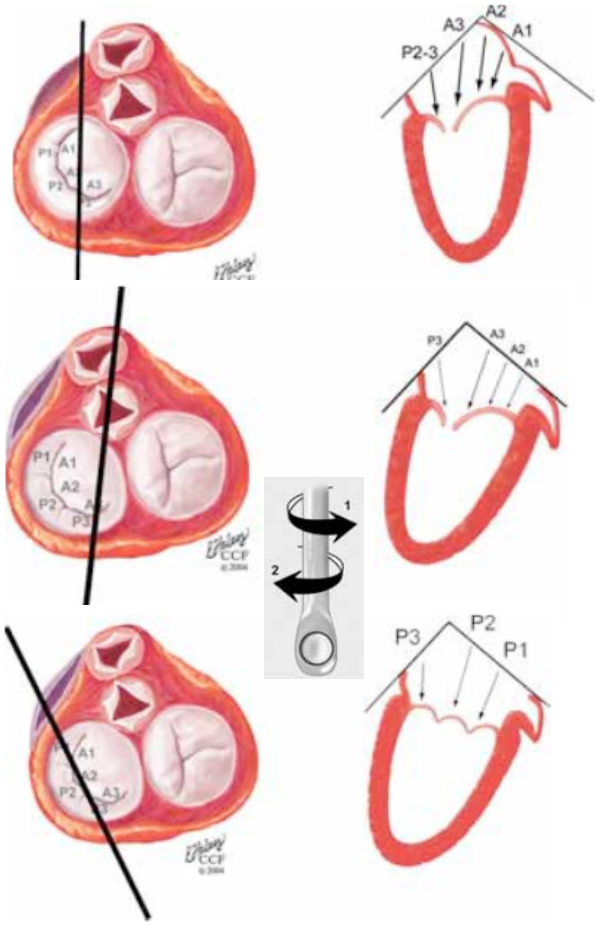




ME 90° 2 Chambers view and variations:

The ME two-chamber view is developed by rotating the multiplane angle forward to between 80° and 100° until the right atrium (RA) and right ventricle (RV) disappear. This cross-section shows:

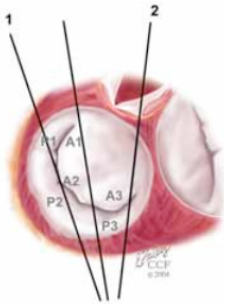
- The basal, mid, and apical segments in each of the anterior and inferior walls.
- Depending on the orientation of the MV commissure and transducer rotation angle, different segments and scallops of the anterior and posterior leaflets.



ME 90° 2 Chambers view variations:

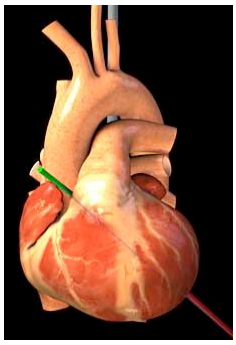
- Depending on the orientation of the MV commissure and transducer rotation angle, the 2-D plane may cut through **P2/3** scallop, the PMcomm, and the **A3**, **A2, A1** segments.

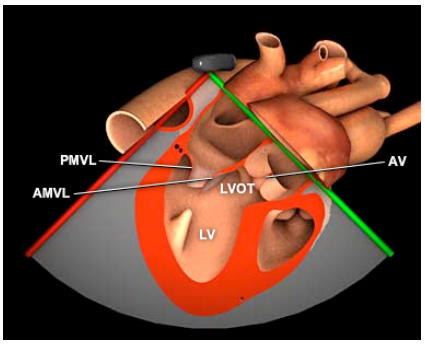
- ❷ Turning the probe to the right (clockwise) the 2-D plane may cut through the **P3** scallop, the PMcomm, and the **A3, A2, A1** segments of the ALMV.

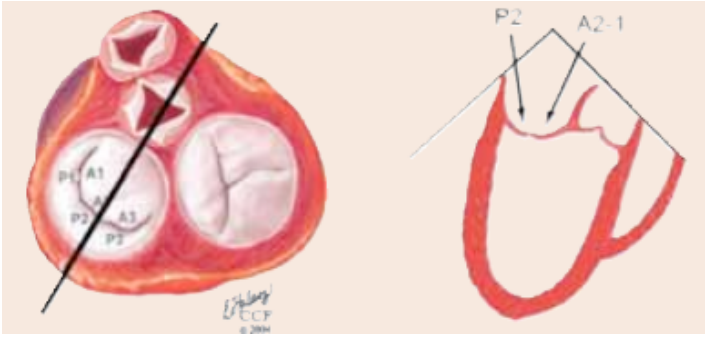


- ❶ Turning the probe to the left (counterclockwise) the 2-D plane may cut through the **P3, P2, P1** scallops. *The commissure may not be visualized except in diastole*.

(c) ME 120° AV LONG AXIS view

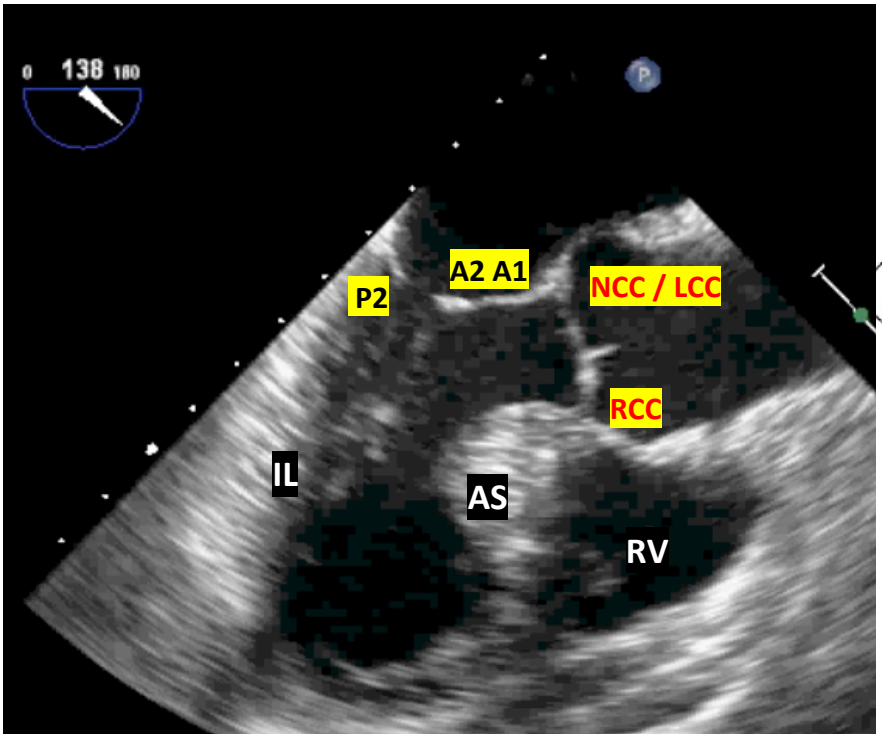


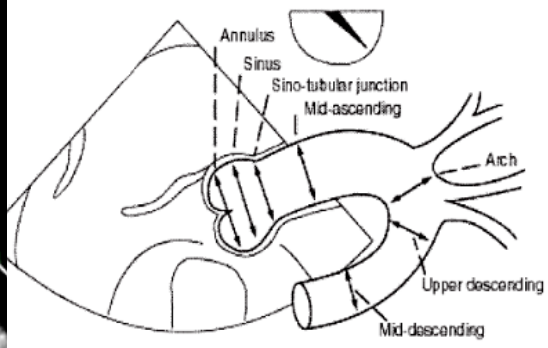




Finally, the mid esophageal long axis view is developed by rotating the multiplane angle forward to between 120 and 140 degrees, and turning the probe slightly to the right (clockwise), until the LV outflow tract (LVOT), AV, and the proximal ascending aorta come into view. This view shows:

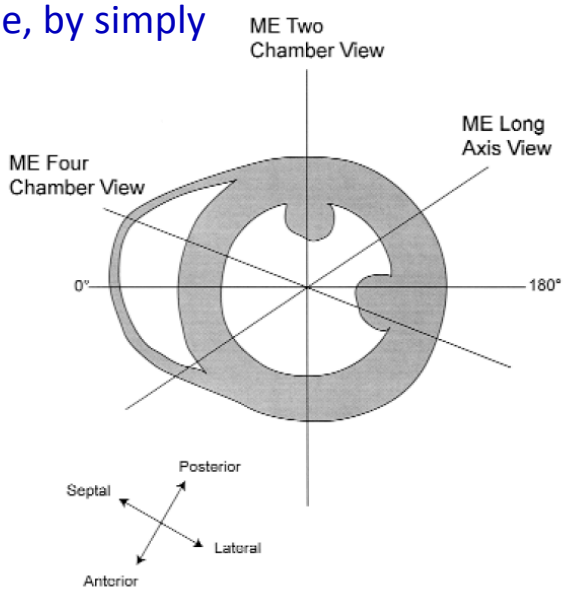
- The basal and mid antero-septal, and the basal and mid infero-lateral segments.
- The **P3/2** scallops and the **A1, A2** segments of the Mitral valve.
- The **RCC** and the **NCC** (or **LCC)** of the aortic valve.
- Part of the right ventricle





To visualize more of the proximal ascending aorta, slightly withdraw the probe, maintaining the longitudinal axis of the vessel by making minor changes in the multiplane angle rotation.

With the imaging plane properly oriented through the center of the mitral annulus and the LV apex, the entire LV can be examined, without moving the probe, by simply rotating forward from 0 to 180 degrees

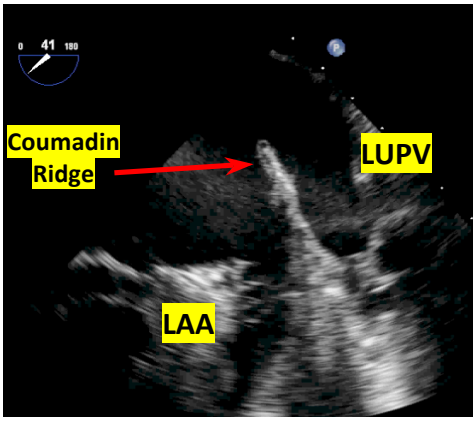


The Left Atrial Appendage views

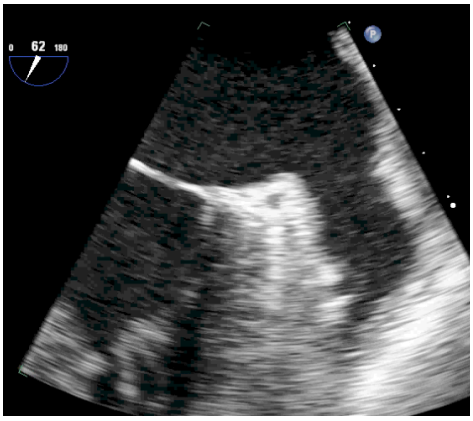
Examination of the LAA is initiated with the ME four chamber view rotating the multiplane angle to 20° – 40°, and slightly withdrawing and turning the probe to the left to expose the superior and lateral aspect of the LA where the LAA is seen.

The left upper pulmonary vein (LUPV), which enters the LA just lateral to the LAA is seen as well separated from the LAA by the “Coumadin ridge”.

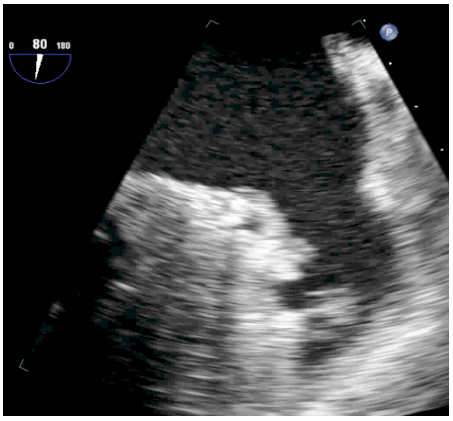
Adjust the image depth to approximately 10 cm or less to maximize the LAA size in the display. The LAA is then carefully examined for thrombus by increasing and decreasing the multiplane angle (from 20° – 150°) while holding the LAA on the centerline of the image. Slight counterclockwise rotation of the probe might be necessary to keep the LAA open while increasing the angle rotation forward.



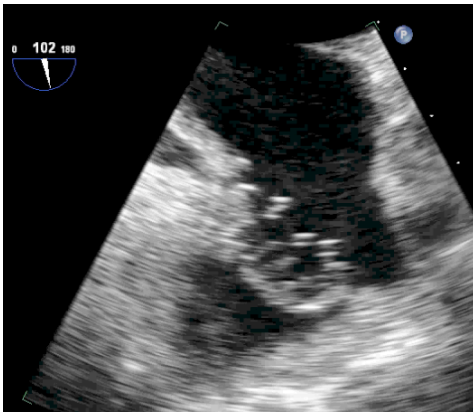
40°



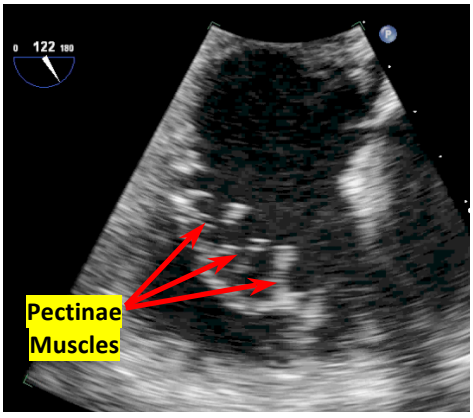
60°



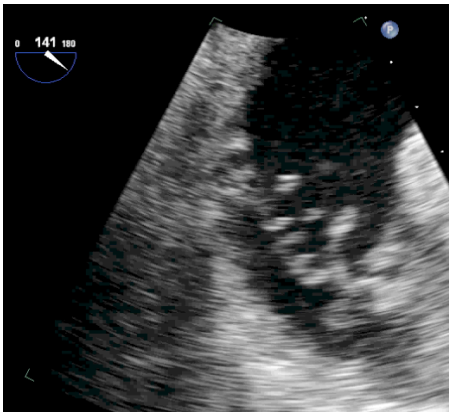
80°



100°



120°

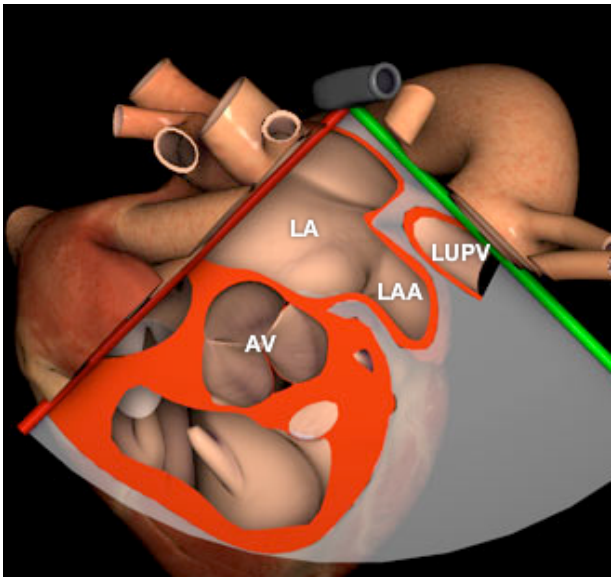


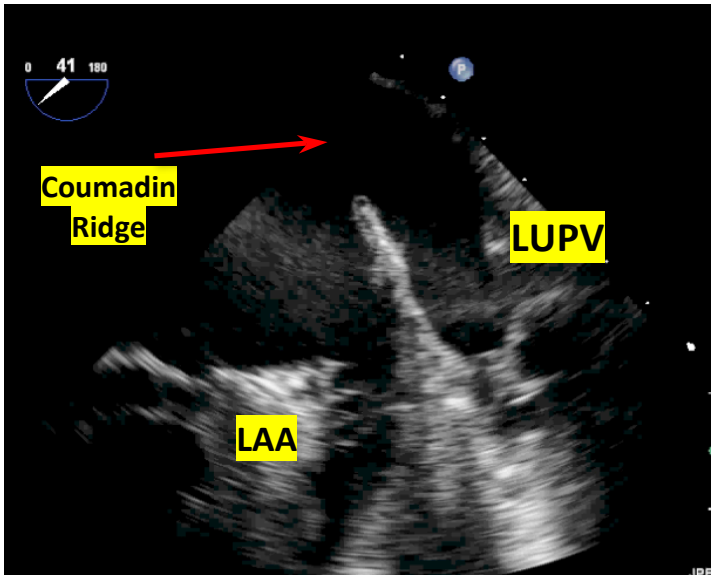
140°

The Pulmonary Veins

Left Pulmonary Veins:

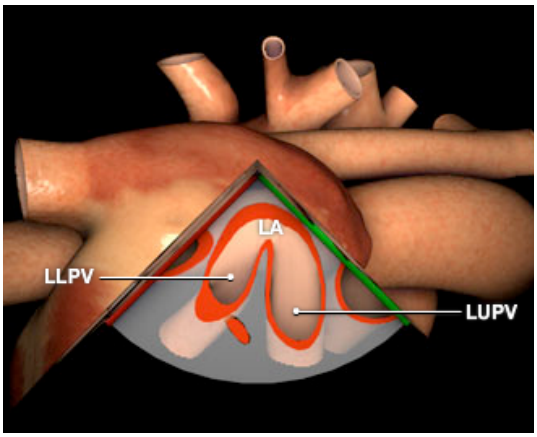
The **left upper pulmonary vein (LUPV)**, which enters the LA just lateral to the LAA from an anterior to posterior trajectory, can be examined **in the ME at 40° - 60°** by slightly withdrawing and turning the probe to the left to expose the superior and lateral aspect of the LA (where the LAA is seen). The LUPV is superior (in the display) to the LAA and separated by the Coumadin ridge.

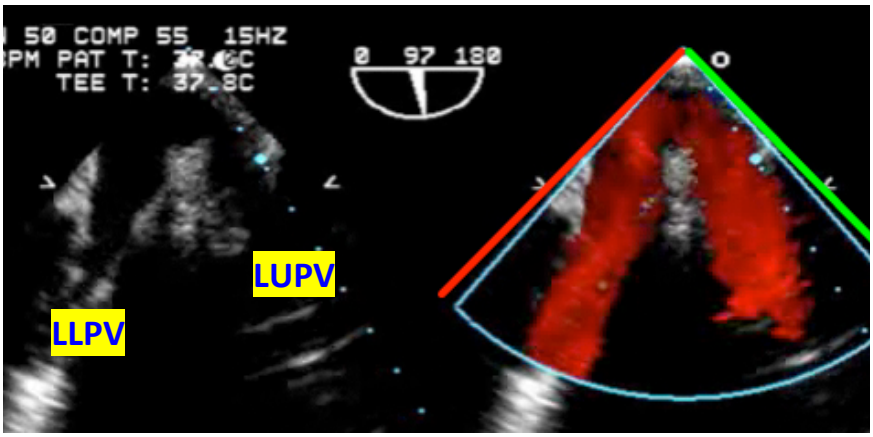




The **Left lower pulmonary vein (LLPV)** is then identified by turning slightly farther to the left and advancing 1 to 2 cm. The LLPV enters the LA just below the LUPV and courses in a more lateral to medial direction.

The **LLPV** can also be imaged from ME view at 90°: at 40°-60° the **LUPV** lies above and posterior to the LAA → To find the **LLPV** center the LUPV on the display with color Doppler → increase the omniplane angle to 90-100°, → then identify the bifurcation of the LUPV and LLPV as an inverted **"V"** using color Doppler.

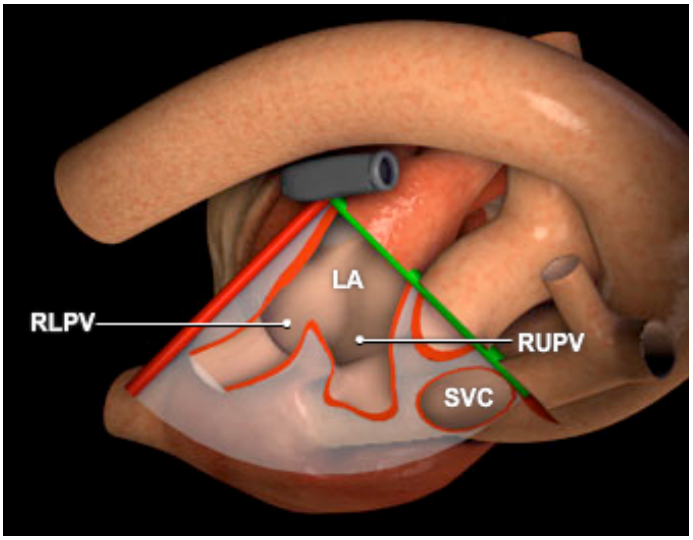


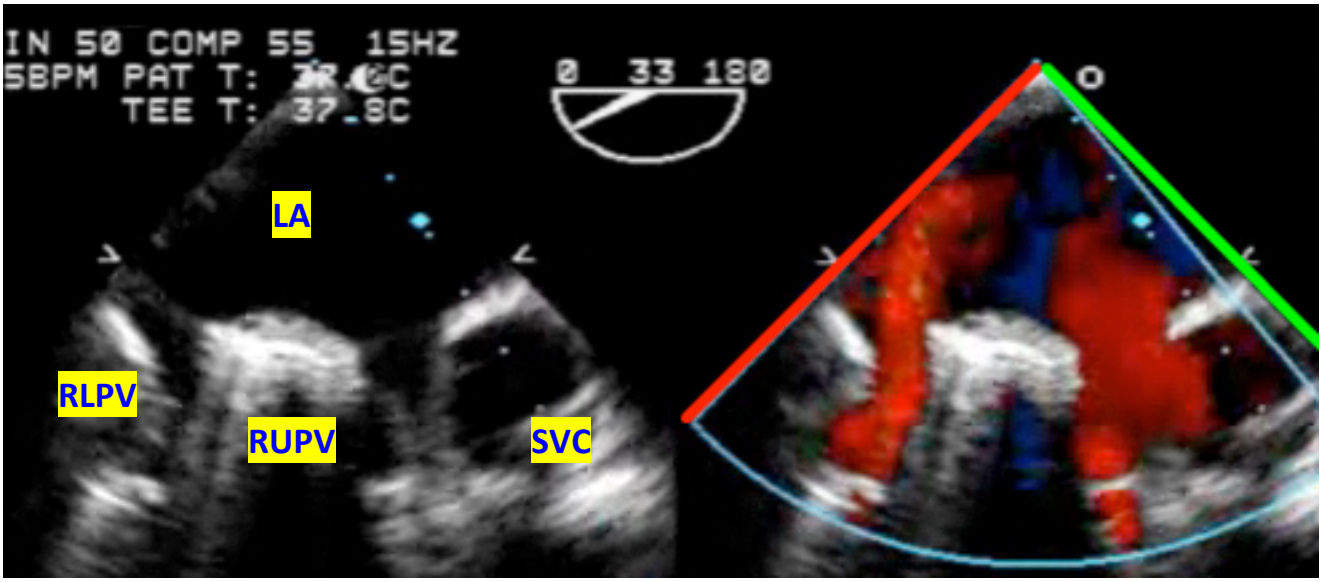


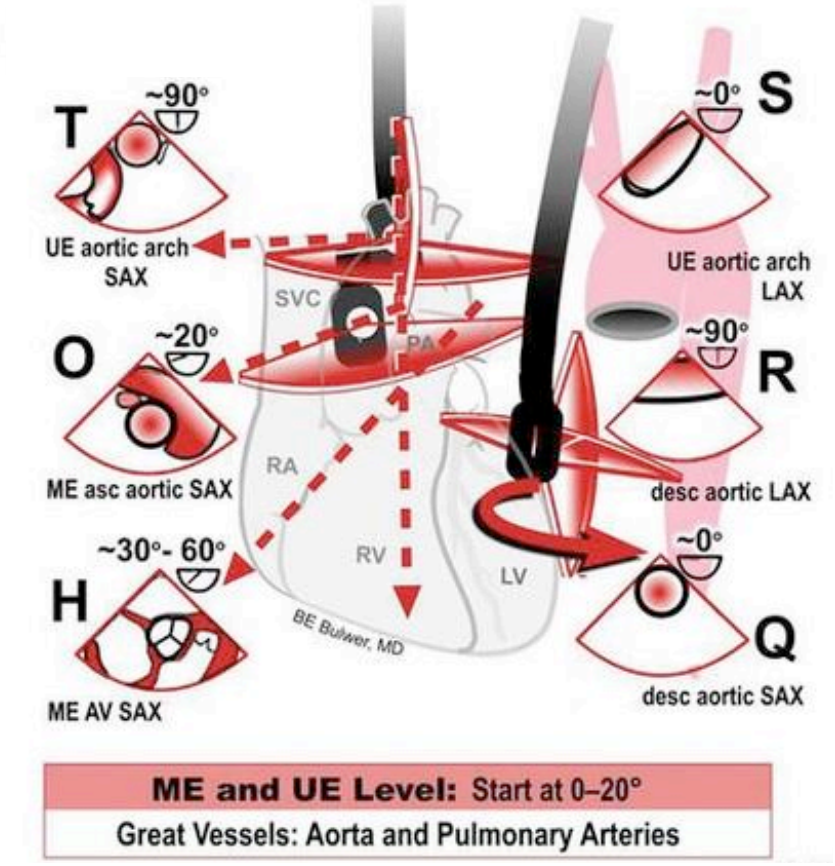
Right Pulmonary Veins:

The **right upper pulmonary vein (RUPV)** is imaged by turning the probe to the right at the level of the LAA. Like the LUPV, the RUPV can be seen entering the LA in an anterior to posterior direction. **The right lower pulmonary vein (RLPV),** which enters the LA nearly at a right angle to the Doppler beam, is then located by advancing the probe 1 to 2 cm and turning slightly to the right. The inter-atrial septum (IAS) is examined next at the mid esophageal level by turning the probe slightly to the right of midline and advancing and withdrawing the probe through its entire superior-inferior extent.

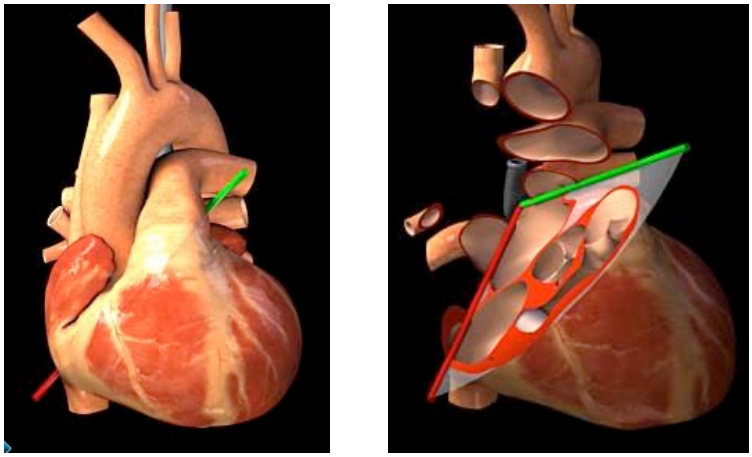
The right pulmonary veins can be imaged from ME views.
Both right pulmonary veins can be imaged in the same display → Find the LAA view **(30-60°)** with the LUPV → then turn the probe right to find both right pulmonary veins, then with Color Doppler identify both veins as an inverse **"V".**







(h) ME 45° AV SHORT AXIS view



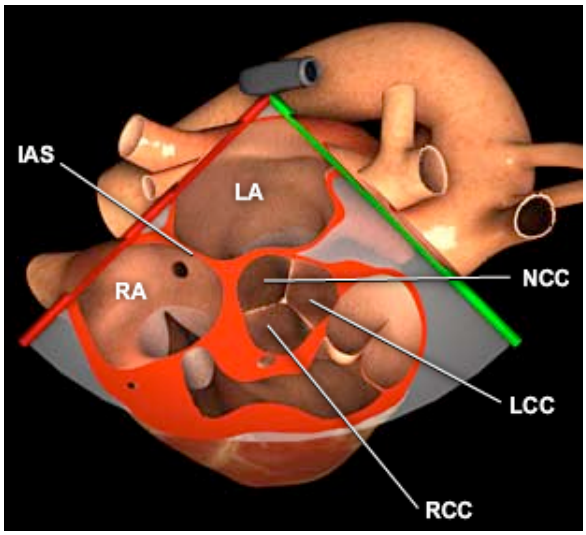
The **ME 45°AV SAX** view is developed from the ME window by advancing or withdrawing the probe until the **AV** comes into view and then turning the probe to the right until the **AV** is centered in the display. The image depth should be adjusted between 10 to 12 cm until the **AV** is at the mid level of the display.

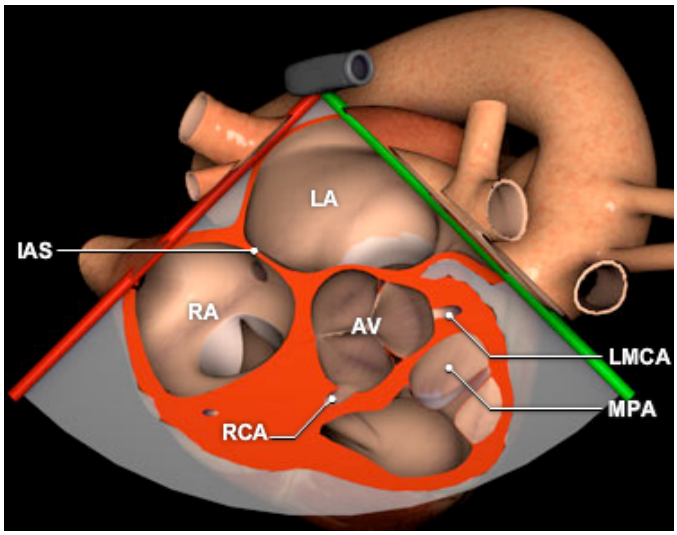
Rotate multiplane angle forward until a symmetrical image of all three cusps of the **AV** is seen, approximately **30 to 60°** (*it usually correspond to **minus 90°** of the multiplane angle of the ME LONG Axis*).

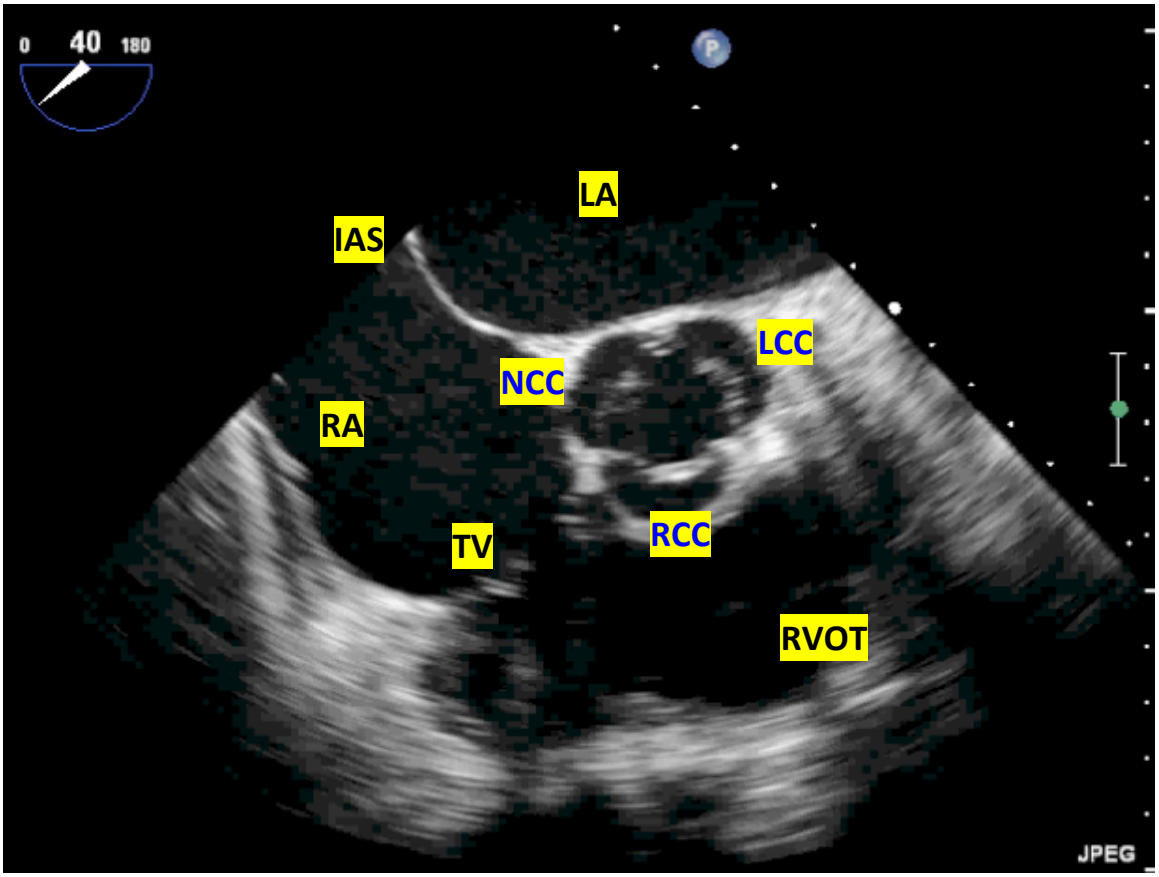
The cusp adjacent to the atrial septum is the **NCC**, the cusp adjacent to the RVOT is the **RCC**, and the remaining cusp adjacent to the LAA is the LCC.

The imaging plane is moved superiorly through the **sinuses of Valsalva** by withdrawing and anteflexing the probe slightly to bring the right and left coronary ostia and then the **sinotubular junction** into view.

The probe is then advanced by moving the imaging plane through and then under the AV annulus showing a short-axis view of the LVOT.

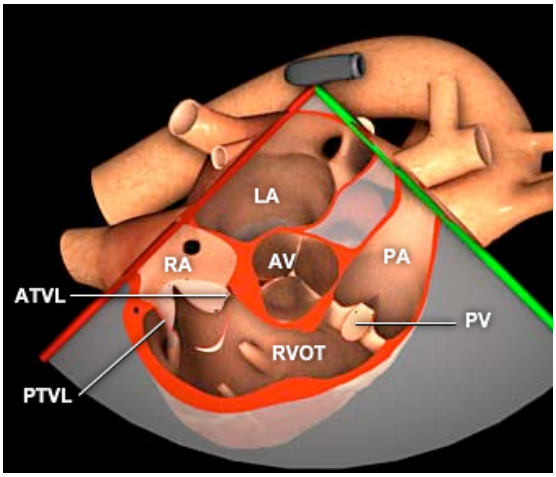


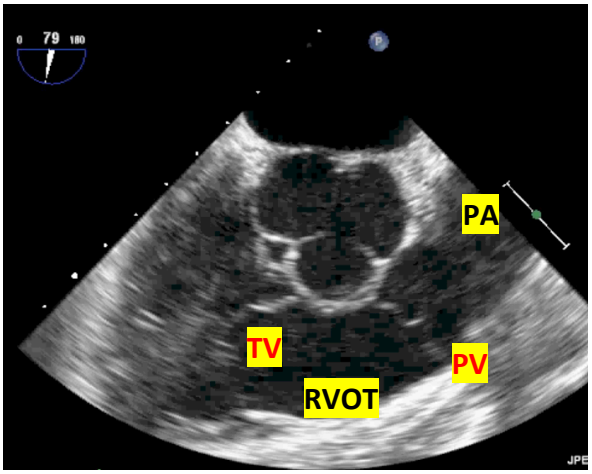


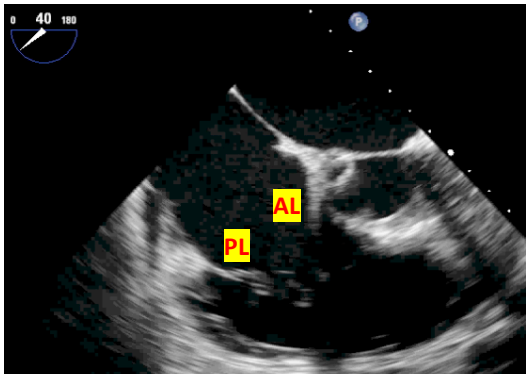


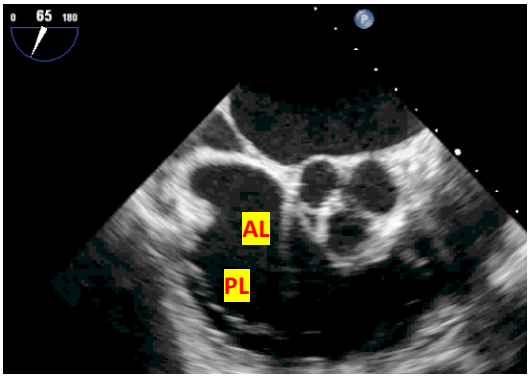
(m) ME RV inflow – outflow view:

Multiplane angle forward to **60 - 90°** keeping the TV visible, until the **RVOT**, **Pulmonic Valve** and the main **Pulmonary Artery** come into view.



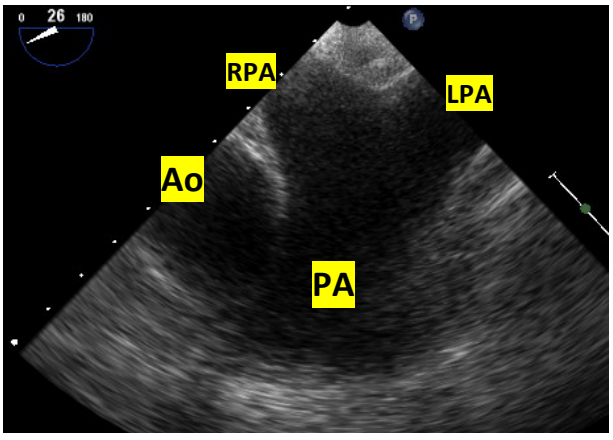


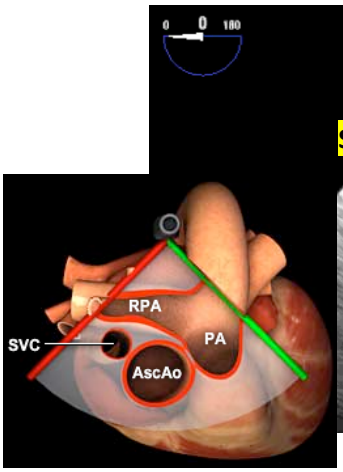


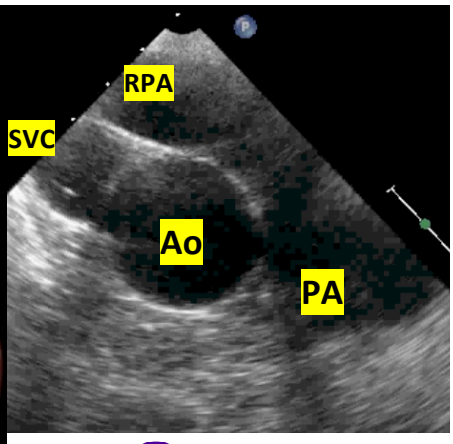


(o) ME Ascending AORTA SAX view:

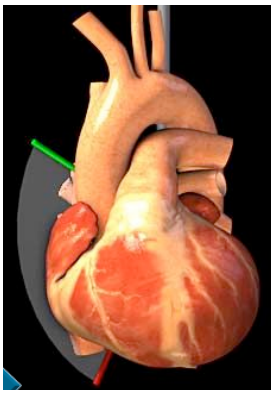
The ME AV SAX view provides a view of the **PV** and **main PA** to the right side of the display. Rotate multiplane angle toward **0° - 20°** and slightly withdraw the probe to display the bifurcation of the **main PA** with the **right PA** at the top of the display coursing off to the patient's right. (*The **left PA** arches over the left bronchus after bifurcating and is often difficult to visualize with TEE as the airway comes between it and the esophagus*).

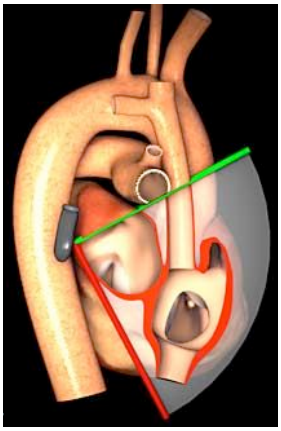






(i) ME BICAVAL view:





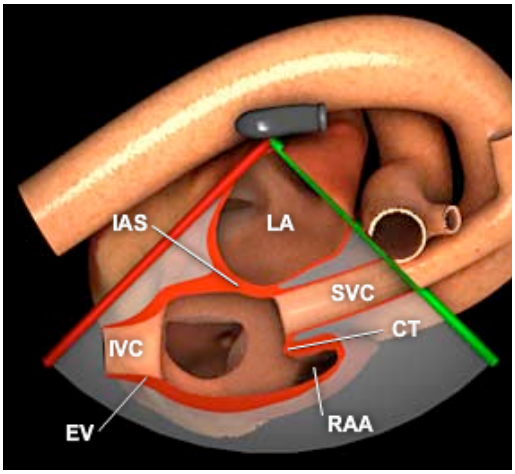
The **ME BiCAVAL view** is developed by increasing the multiplane transducer angle forward to **90° – 120°** and turning the probe to the right (clockwise), until the **IVC** in the left side of the display and the **SVC** appears in the right side.

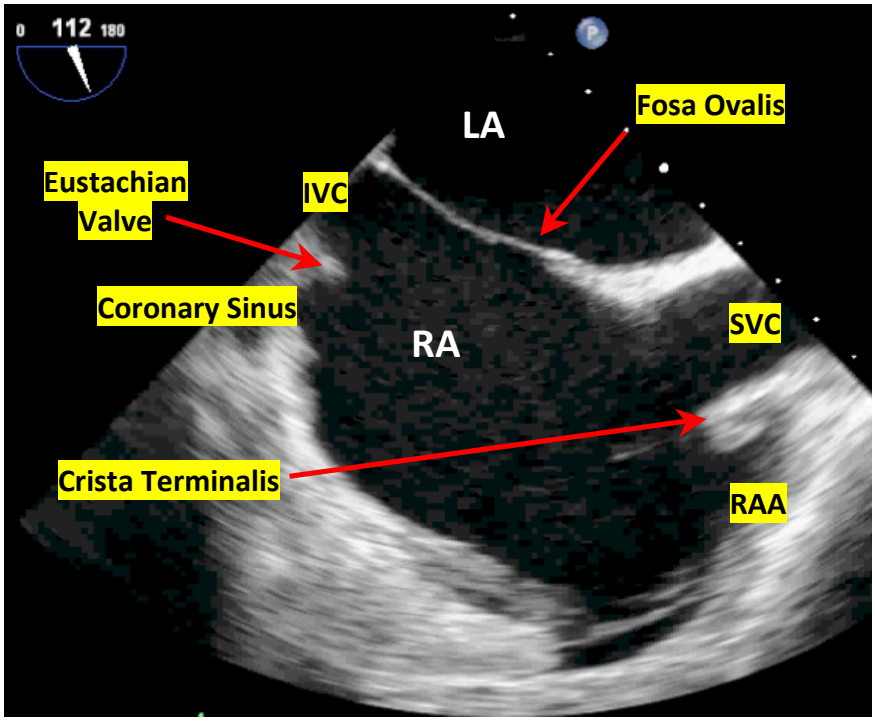
The **right atrial appendage**, extending superiorly from the anterior aspect of the RA is seen in this view, below the **"Crista Terminalis".**

The **Coronary Sinus** is seen at the posterior and inferior aspect of the right atrium, separated from the IVC by the **Eustachian valve**.

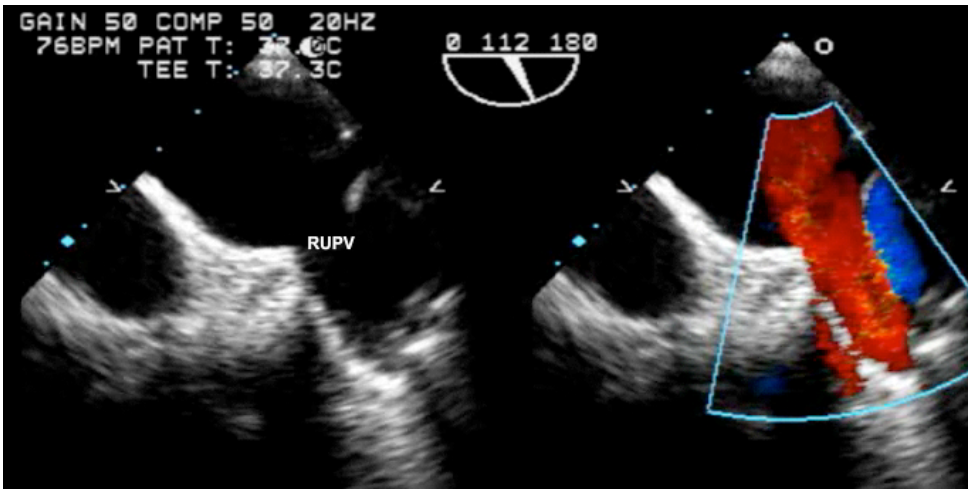
The imaging of the RA is completed by turning the probe to the left and the right through the lateral to the medial extent of the atrium.

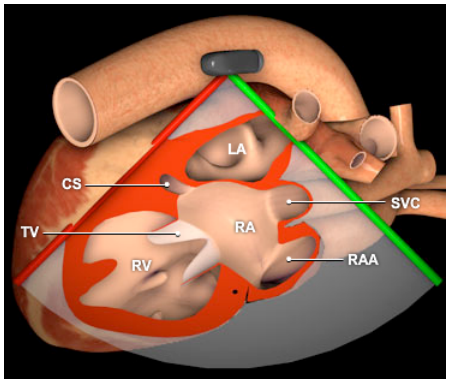
The **inter-atrial septum (IAS)** is shown through its entire medial-lateral extent with the midesophageal bicaval view by turning the probe to the right and left. The IAS has a thin region centrally called the **"fossa ovalis"** and thicker regions called the **"limbus,"** anteriorly and posteriorly.



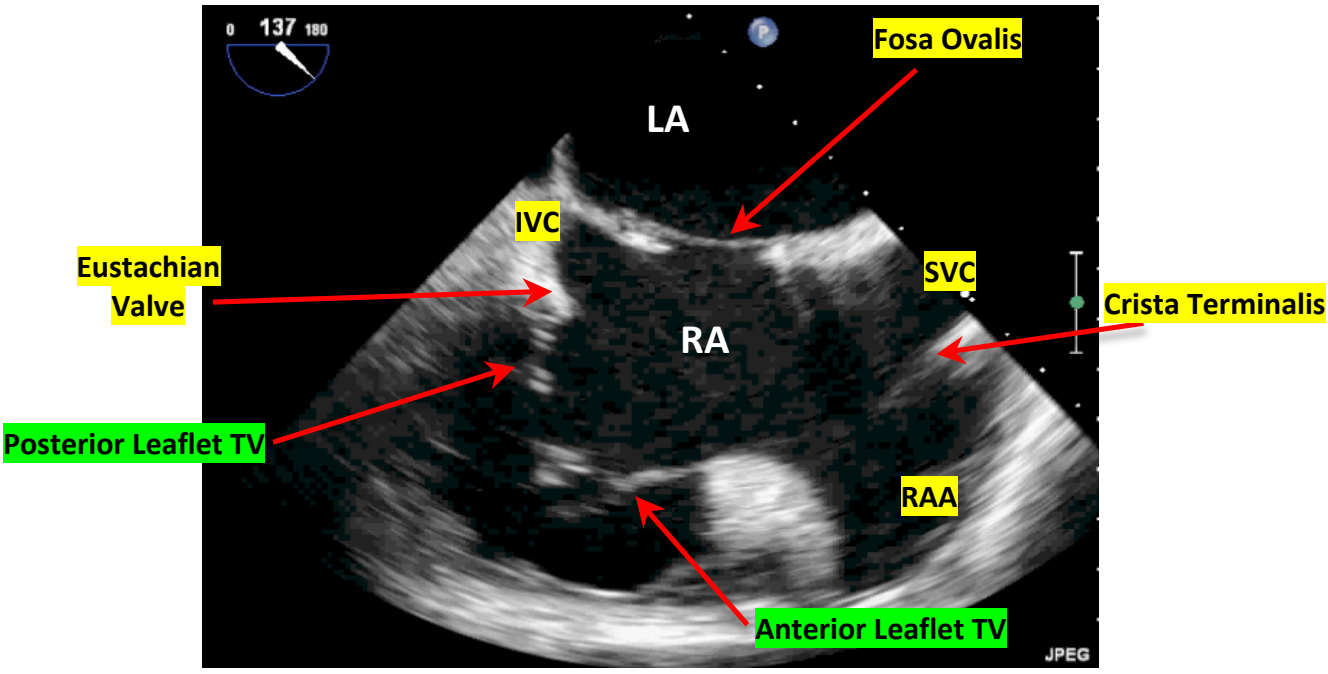


From the **ME BiCaval view at 110°,** continue turning the probe to the right (clockwise), until the **Right Upper Pulmonary vein** is displayed in the right side of the field.

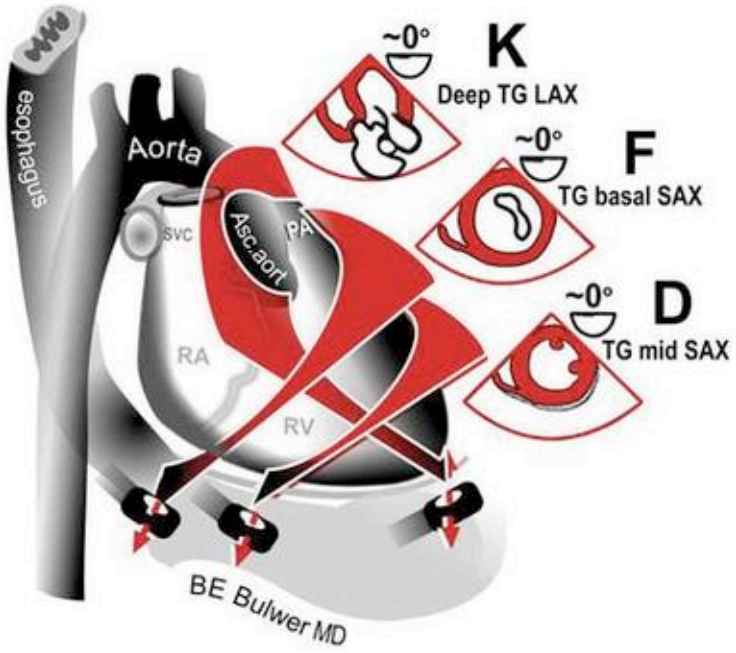




The **Tricuspid Valve** is seen in from the **ME BiCaval view at 110°,** rotating the multiplane angle towards **140° - 150°.**



B - TRANSGASTRIC VIEWS



Advance to Stomach, Anteflex: 0°

Transgastric short axes and Deep Transgastric long axis

After all the Mid-Esophageal views were examined, multiplane the transducer angle back to the ME 0° four chambers view and position the left ventricle in the center of the display. Then gently advancing the probe into the stomach and anteflexing the tip until the heart comes into view develops **the transgastric views of the LV**.

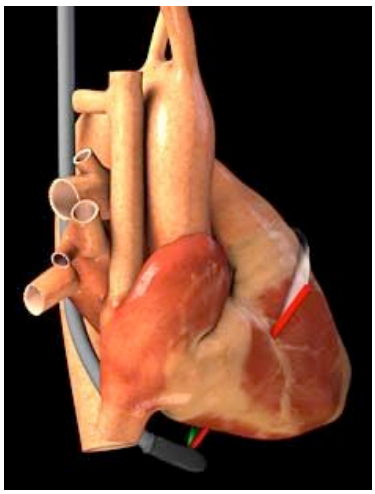
At a **multiplane angle of 0°** the **short-axis view of the LV** will be seen, and the probe is then slightly turned as needed to the left (counterclockwise) or right (clockwise) to center the LV in the display.

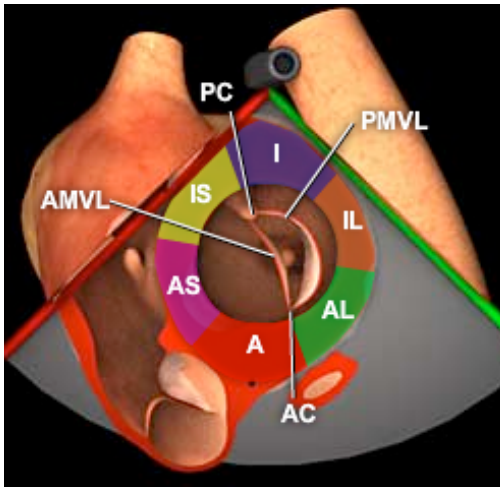
Consider decrease to a lower transducer frequency to improve penetration and set the depth of the image to include the entire LV, usually 12 cm.

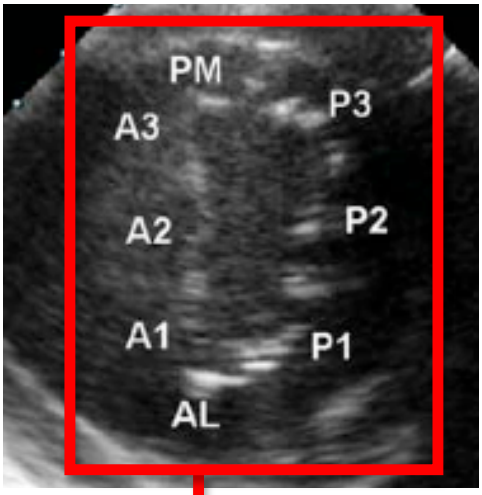
There are several transgastric views to explore at different angles:

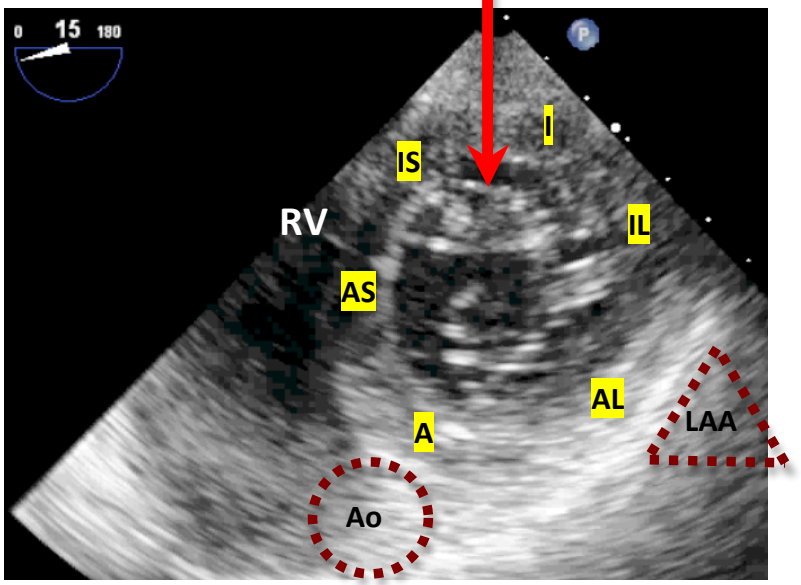
- **At 0°: TG LV Basal SAX view**
  TG LV MID SAX view
  TG DEEP LAX view or Five Chamber view
- **At 90°: TG TWO CHAMBERS view**
- **At 120° TG LAX view**
  TG RV INFLOW view
- **At 30° TG RV OUTFLOW view (or Tricuspid SAX view)**

(f) TG 0° LV BASAL SAX view: "the mitral valve view"









The **SAX view of the mitral valve** is obtained by advancing and positioning the probe in the upper stomach, until the basal level of the LV and MV are displayed.

Anteflexing the tip and sometimes adding 10°- 20° of rotation may be necessary to align the imaging plane of the MV as parallel as possible to the mitral annulus plane.

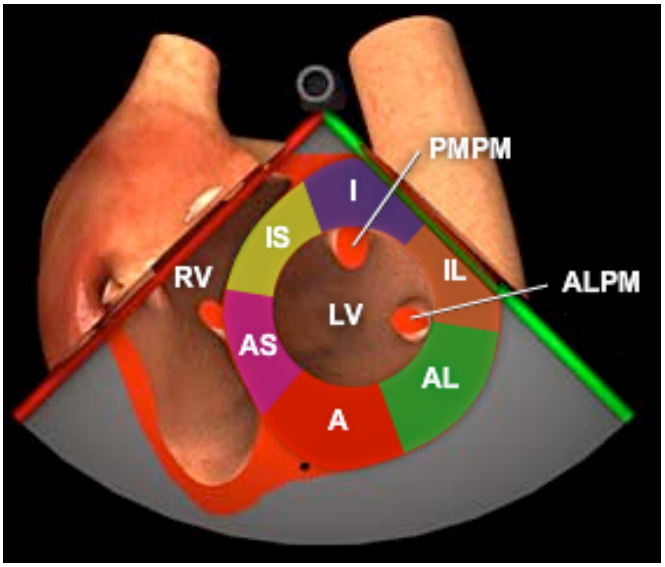
This view will allow you to see:

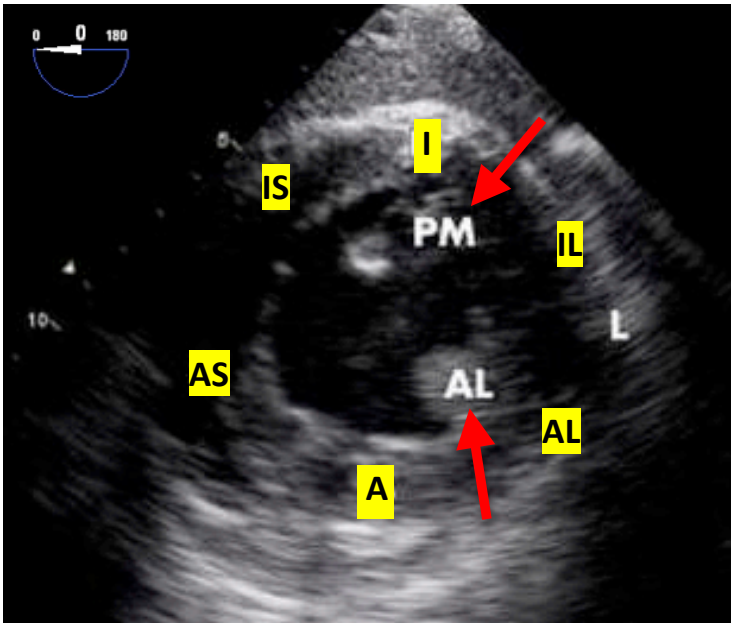
- All six basal segments of the LV,
- The 3 MV anterior leaflet segments and 3 posterior scallops *(Although this view is often not easy to obtain, it is very helpful in assessing the origin of mitral regurgitant jets).*
- RV function

(d) TG 0° LV MID SAX view:

Further advancing the probe *(always leave the large control wheel in neutral position when advancing or withdrawing the probe to avoid erosions of the gastric mucosa)* will display the SAX of the left ventricle at the mid-papillary level (at 0°):

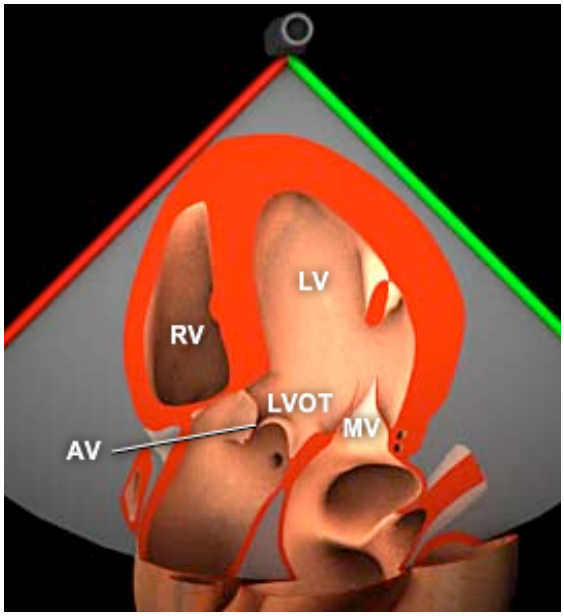
- the **anterolateral papillary** muscle is seen at ~4 and 5 o'clock
- the **posteromedial papillary muscle** approximately between ~11 and 2 o'clock
- The free wall of the right ventricle is seen on the left sector side

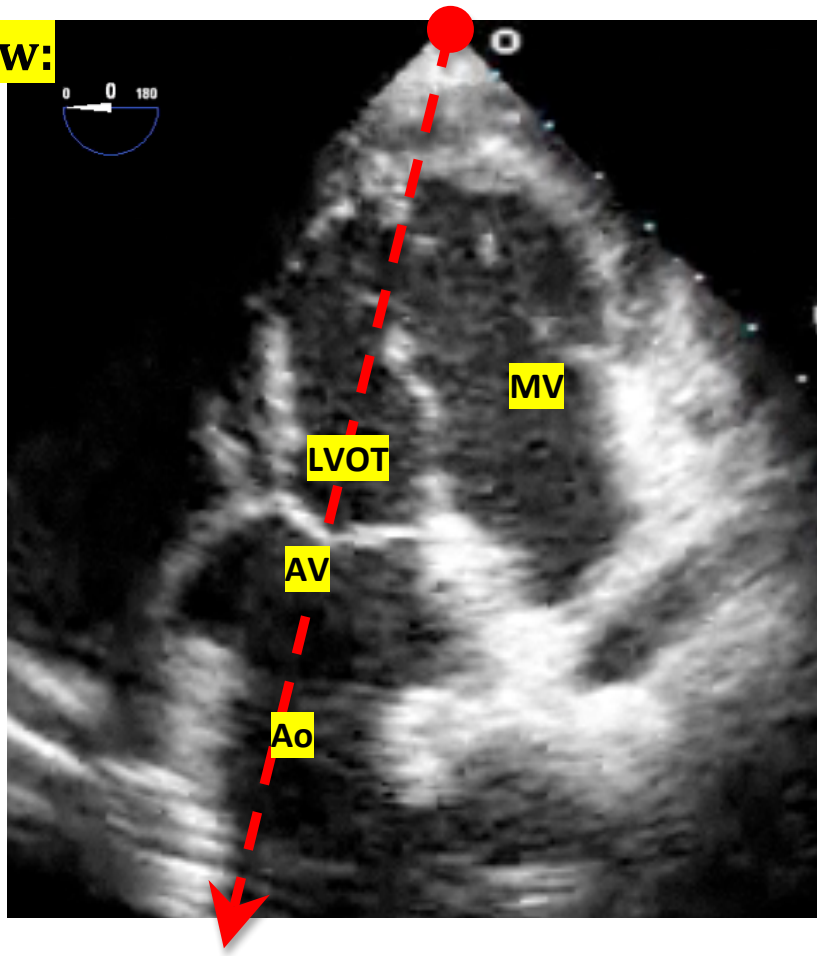


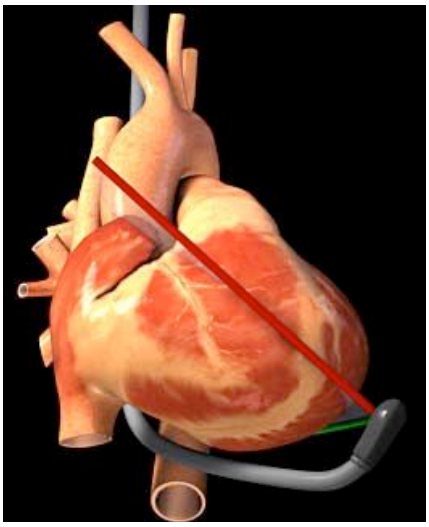


If the image is not clearly displayed, slightly anteflex the probe to make good contact.
This cross-section shows the **six mid level segments of the LV** and is the most common view for monitoring LV function.
The TG mid short axis view is used for assessing LV chamber size and wall thickness.

(k) TG 0° DEEP LAX view:







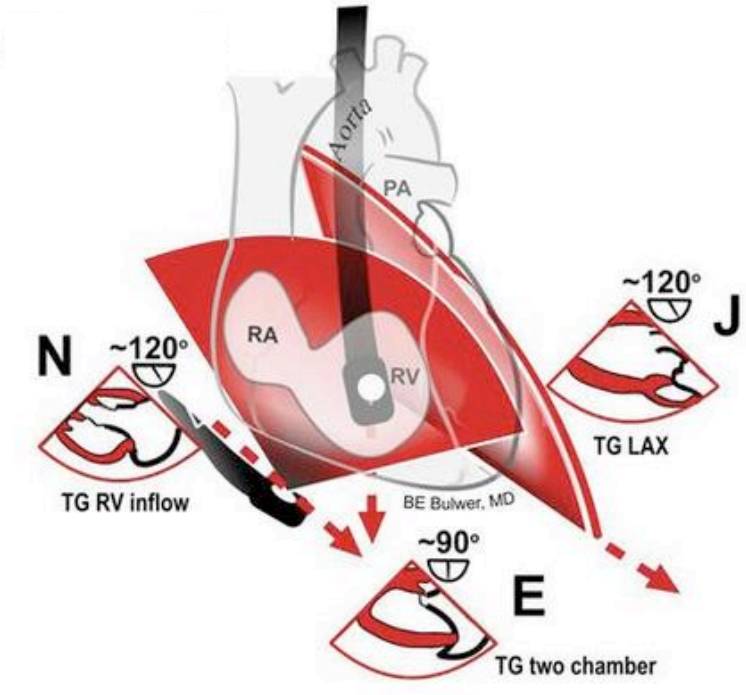
To develop the deep transgastric view of the AV, the probe is advanced deep into the stomach from the transgastric mid-short-axis view and positioned adjacent to the LV apex. The probe is then anteflexed until the imaging plane is oriented towards the base of the heart producing the **Deep transgastric long-axis view.**

Deep in the stomach the exact position of the transducer is somewhat difficult to determine, some trial and error withdrawing or advancing the may be needed, and slightly turning the probe to the right (clockwise) to develop this view in most patients.

The AV is located at the bottom of the display in the far field in the deep transgastric long-axis view, with the LV outflow directed away from the transducer.

Doppler quantification of flow velocities through the LVOT and the AV is possible and usually optimal because the ultrasound beam is parallel to the direction of the flow, maximizing the Doppler shift accuracy (see red arrow in the prior image).

(e) TG 90° TWO CHAMBERS view:

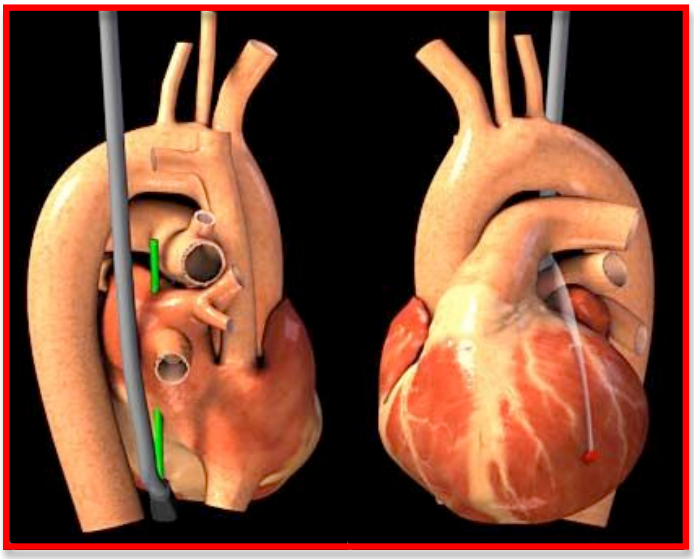


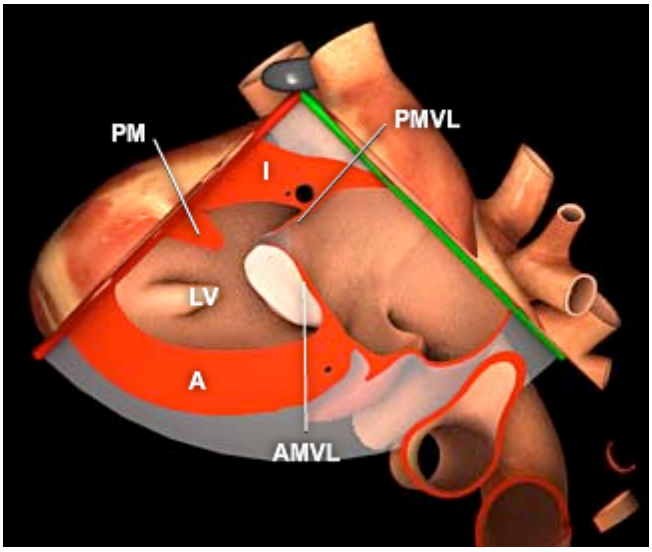
Advance to Stomach, Anteflex: 90°- 120°
Transgastric 2-chamber, long axis; RV Inflow (turn right)

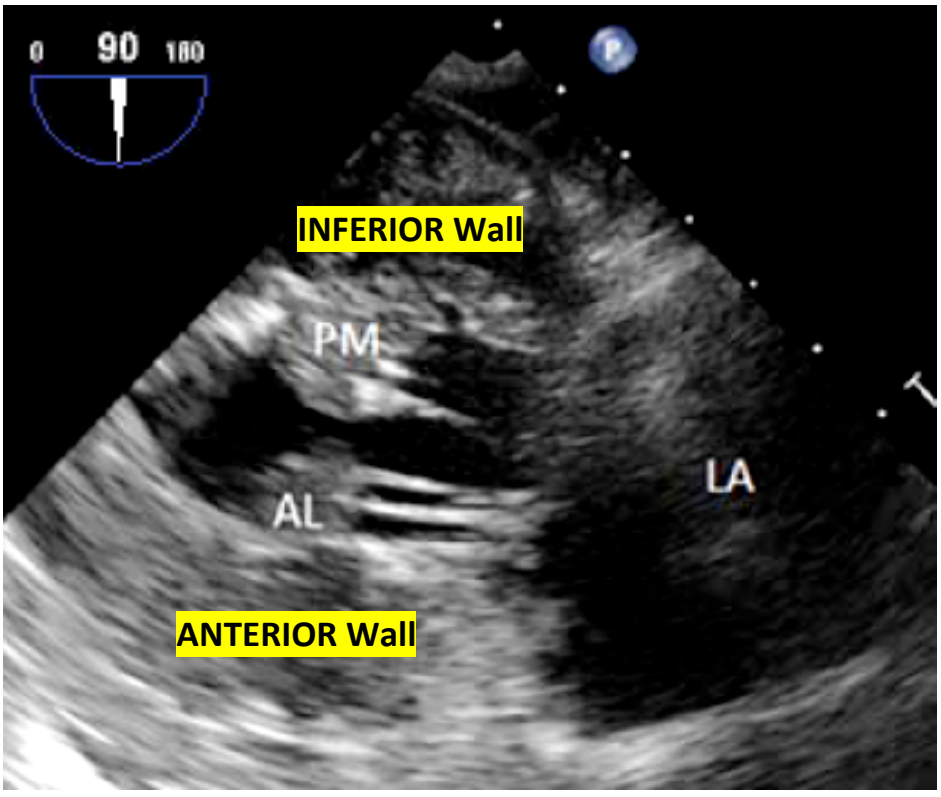
From the TG 0° LV basal view (MV view), **multiplane angle rotation forward to 90°** to show the **LV in long axis** with the apex to the left and the mitral annulus to the right of the display.

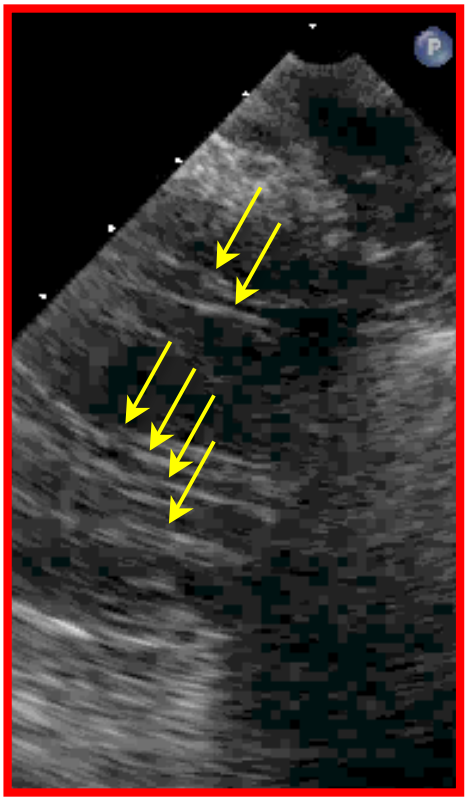
The anteflexion of the probe is adjusted until the long axis of the LV is horizontal in the display. This view is especially useful for examining the MV sub-valvular apparatus, regarding the chordae tendinae → is perpendicular to the ultrasound beam in this plane.

The inferior wall and the postero-medial papillary muscle are at the top of the display; and the anterior wall, antero-lateral papillary muscle, and left atrial appendage at the bottom.

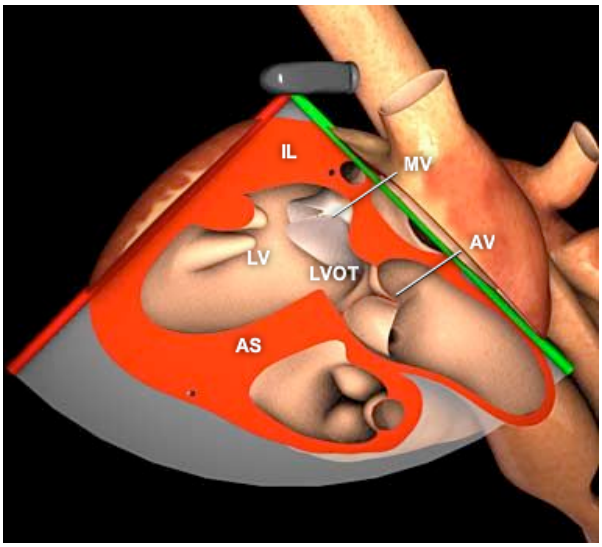


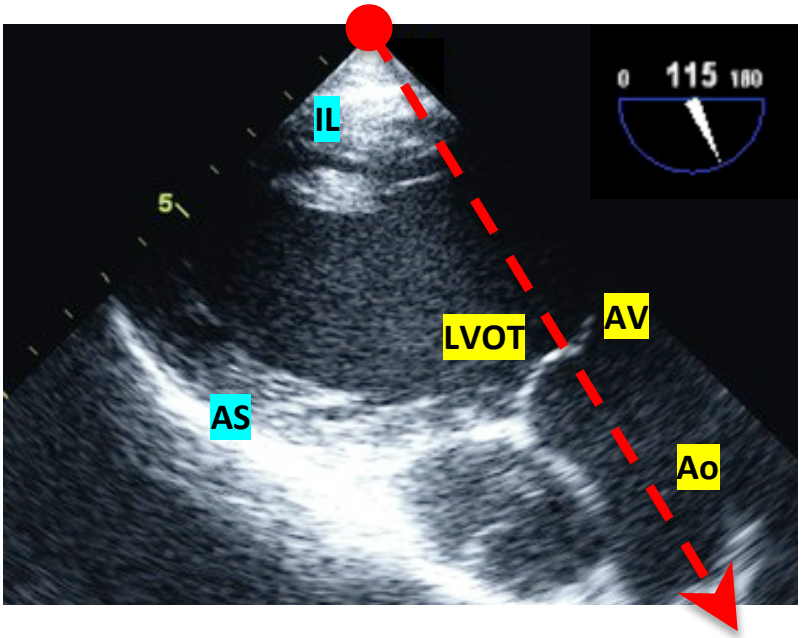






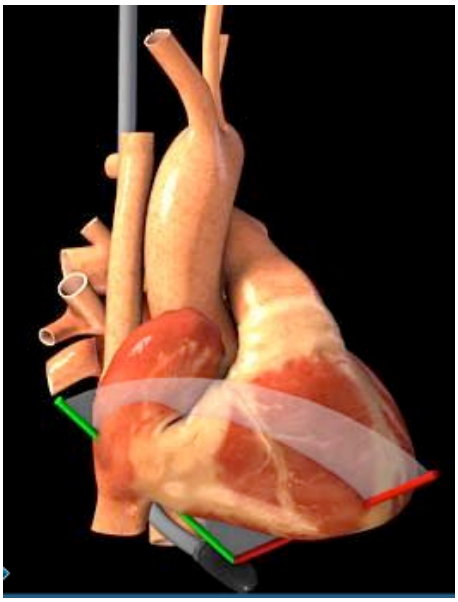
(j) TG 120° LAX view:

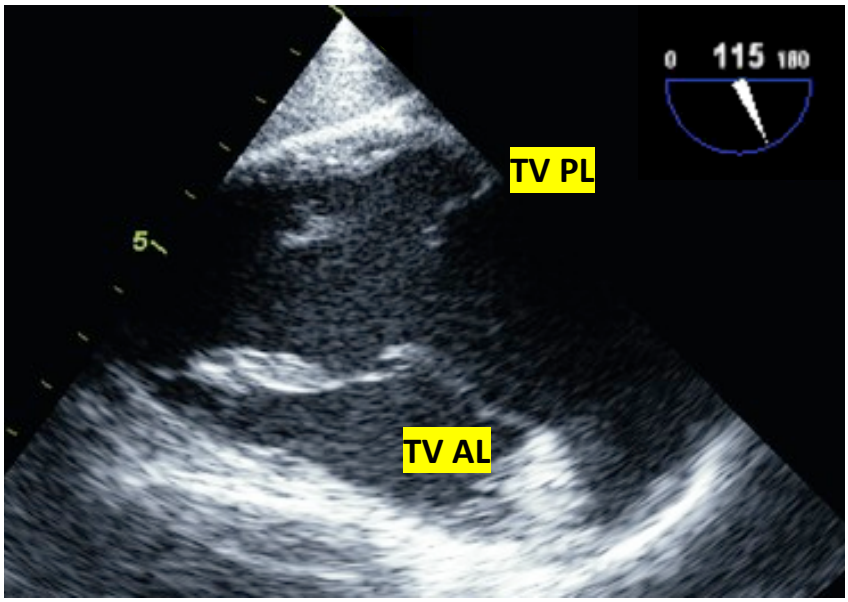




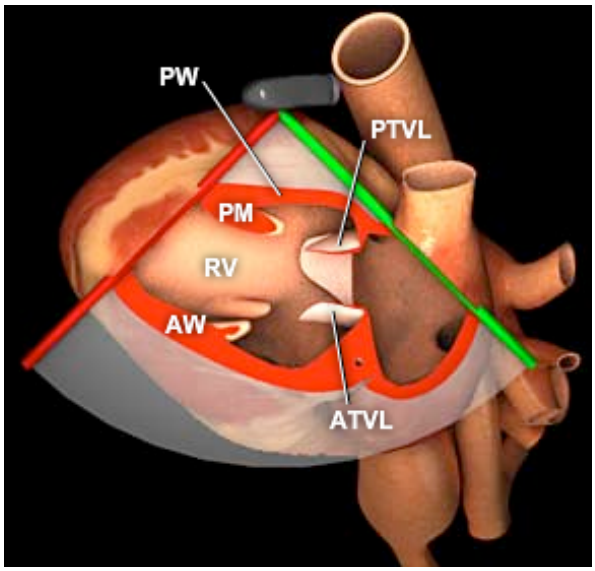
From TG 90° two chamber, omniplane angle rotation to 110-120°. May need to turn probe to right (clockwise). The AV seen on the right side of display, adjust depth to 14-16 cm. In the TG LAX view (110-120°) the imaging plane is directed longitudinally through the LV to image the aortic root in LAX. The LVOT and AV appear on the display right, depending on the depth settings. This is view is similar to the ME AV LAX view and permits better spectral Doppler alignment. (Ultrasound beam is parallel to the direction of the flow, maximizing the Doppler shift accuracy (see red arrow in the image)

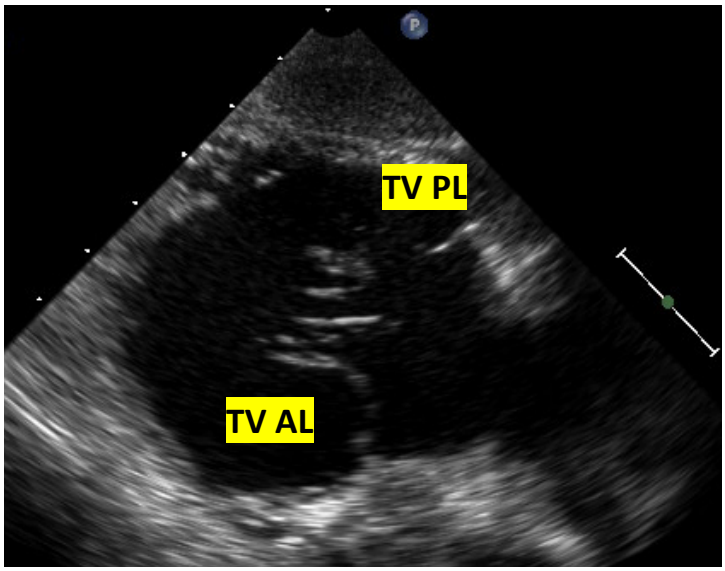
(n) TG 120° RV INFLOW view:



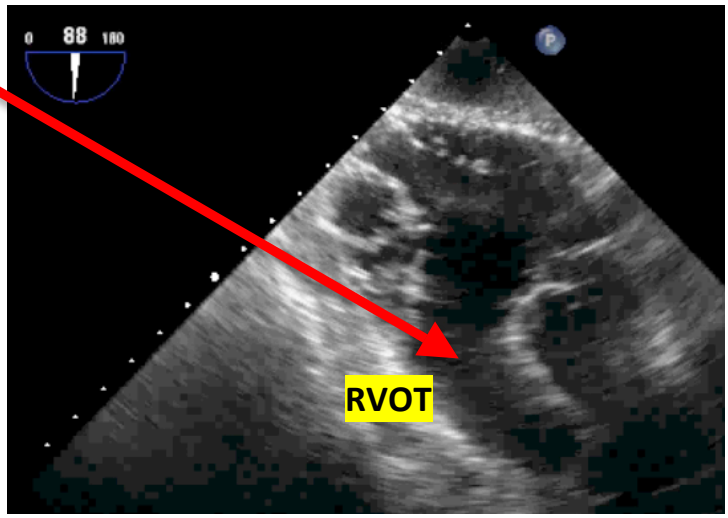


The **transgastric RV inflow view** is developed from the TG two chambers or the LAX view, by turning the probe to the right until the RV cavity is located in the center of the display and rotating the multiplane angle forward to between 100 and 120 degrees until the apex of the RV appears in the left side of the display.
This cross-section provides good views of the inferior (diaphragmatic) portion of the RV free wall, located in the near field.

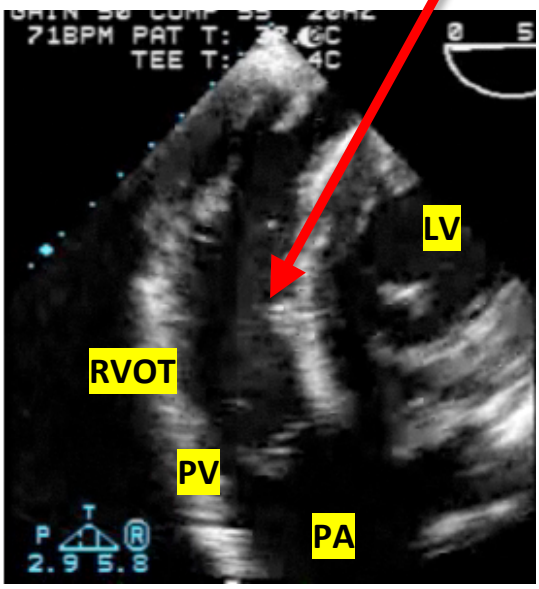


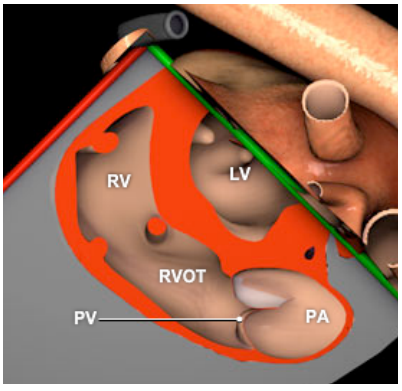


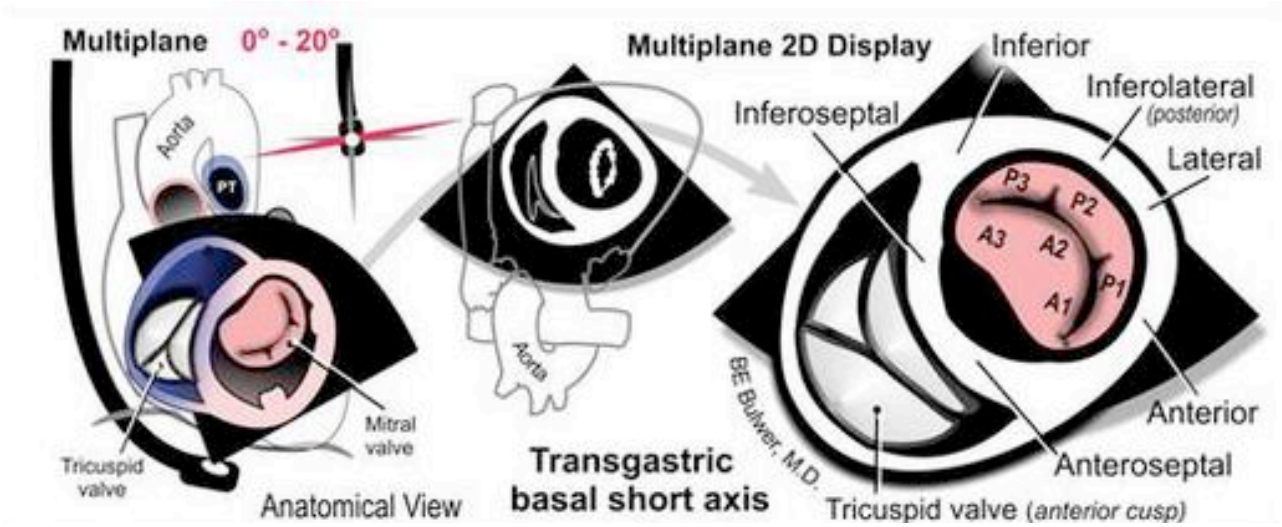
Further rotation and turning the probe to the right, discloses the **right ventricular outflow tract**, with the **PV** located at the bottom of the sector.



The **RVOT and PV** can also be obtained from the TG basal or mid SAX view by turning the probe to the right and rotating the multiplane angle to **0°- 40°**



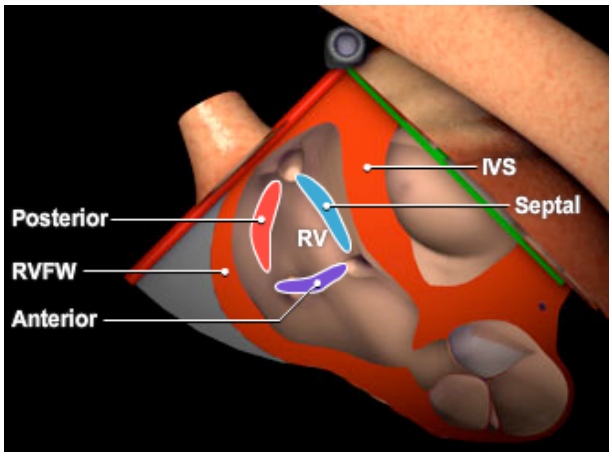


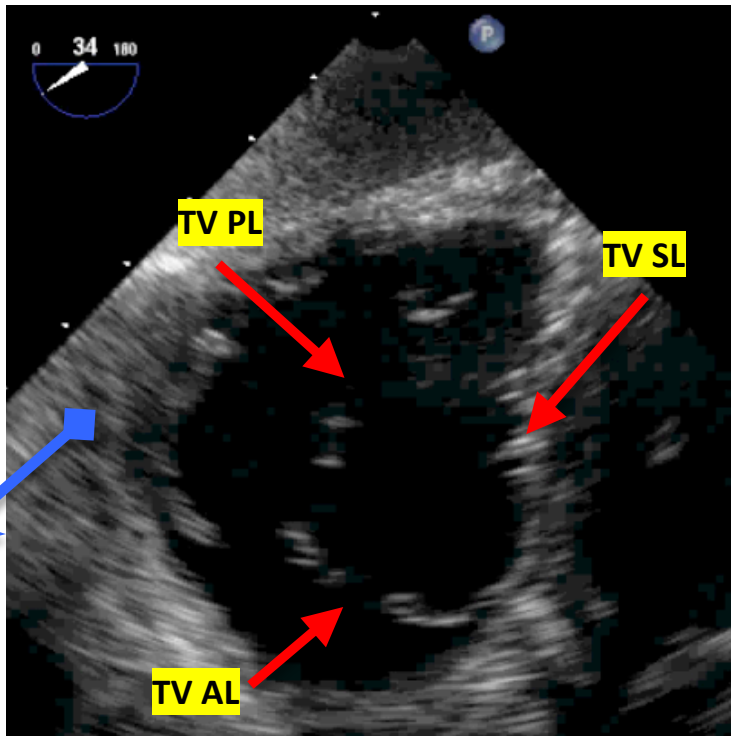


An additional view of the right heart (not routinely obtained, but important whenever tricuspid valve pathology has to be evaluated), is the **TG SAX view of the TV**:

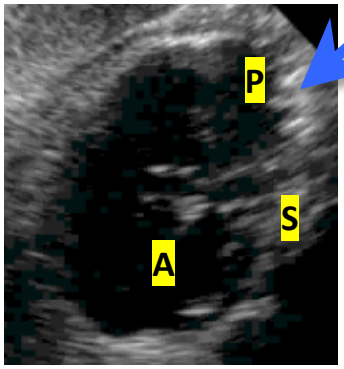
The SAX view of the TV is developed from the TG RV inflow (100° - 120°) view by placing the TV annulus plane in the center of the display, and multiplane the angle rotation back to **30° - 40°.** Slight advancing/withdrawing the probe may be necessary to see all three leaflets of the tricuspid valve.

This cross section produce a **short-axis view of the tricuspid valve**, with the **posterior leaflet** to the upper left, the **septal leaflet** to the upper right, and the large **anterior leaflet** in the lower half of valve cross-section.

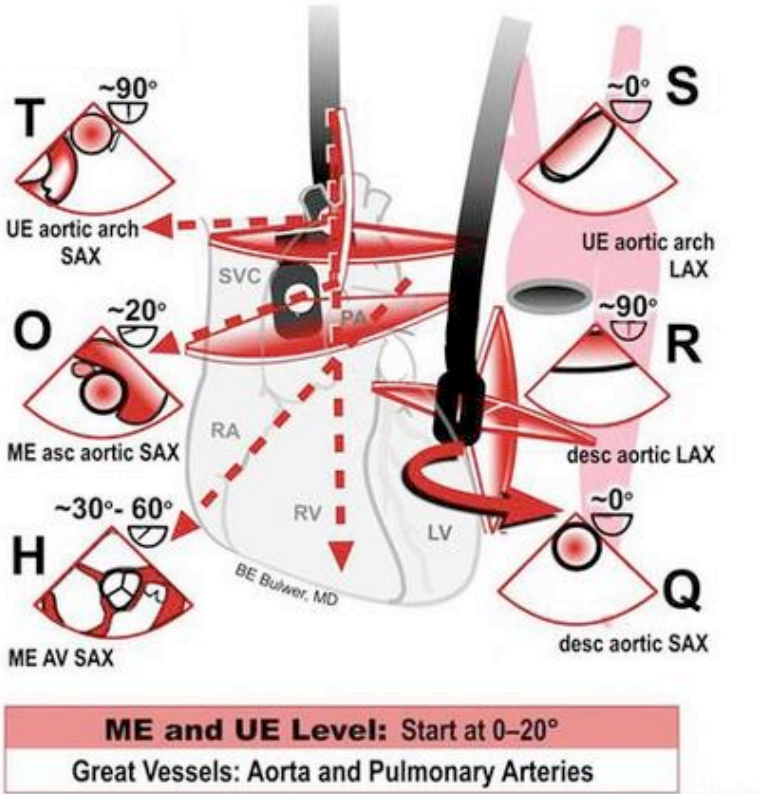




Same image: TV SAX view, but during Sytole (valve closed)



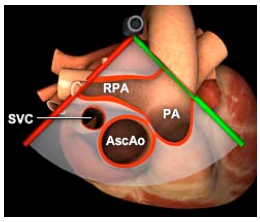
C – UPPER ESOPHAGEAL VIEWS



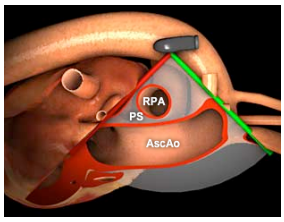
(o) ME Asc. AORTA SAX and (p) ME Asc. AORTA LAX views:

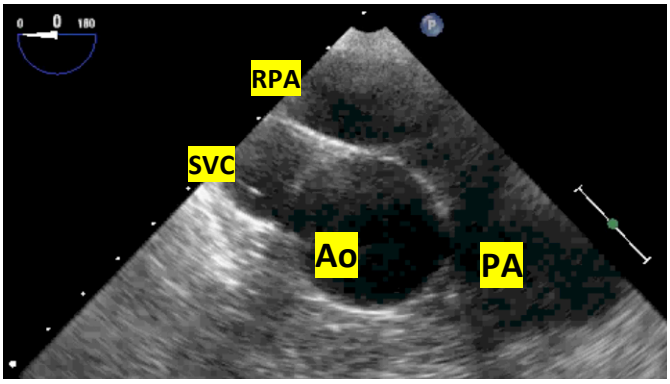
The **ME Ascending Aorta SAX view at 0°**provides a view of the **proximal ascending aorta**, **main PA** and **RPA**. To obtain this cross section: from ME AV SAX (30°- 50°), withdraw probe (ascending aorta SAX), then omniplane angle rotation back to 0°. Adjust depth to a 10-12cm. By rotating the multiplane angle to **90°-100°** the **ME Ascending Aorta LAX view** is obtained.

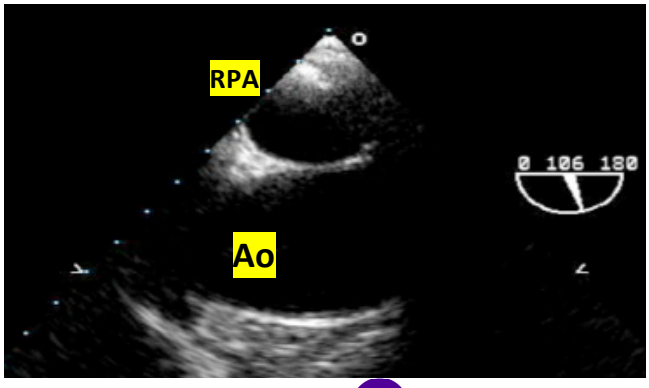
ME Ascending Aorta SAX view at 0°



ME Ascending Aorta LAX view at 90°





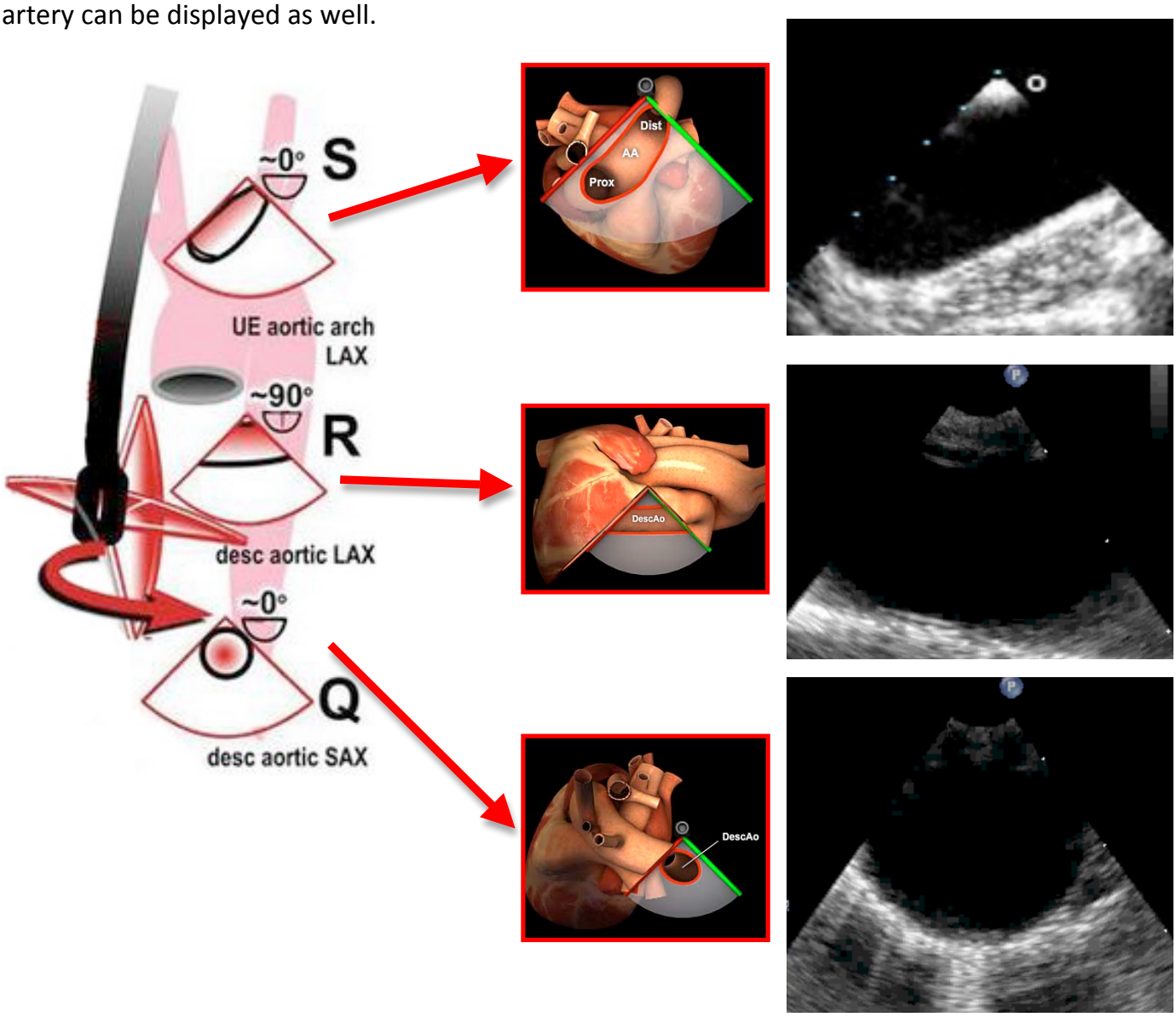


(q, r, s) DESCENDING AORTA and AORTIC ARCH views:

TEE examination of the **descending thoracic aorta** is accomplished by turning the probe to the left (counterclockwise) from the ME 0° five-chamber view until the circular image of the aorta is located in the center of the near field of the display producing the **DESCENDING AORTA SAX** view.

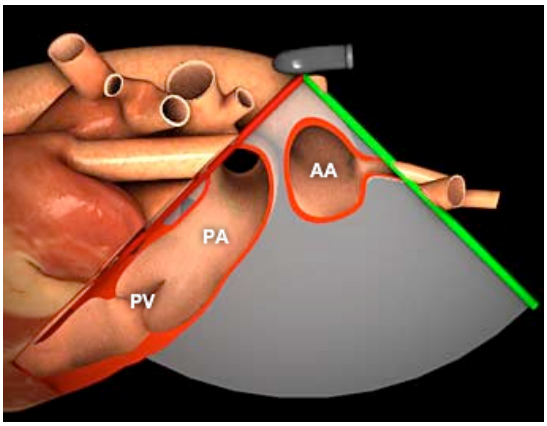
The image depth is decreased to 6 to 8 cm to increase the size of the aorta in the display and the focusing depth moved to the near field to optimize image quality. The multiplane angle is rotated forward from 0° to between 90° and 110° to yield circular, oblique, and eventually the descending aortic long axis view.

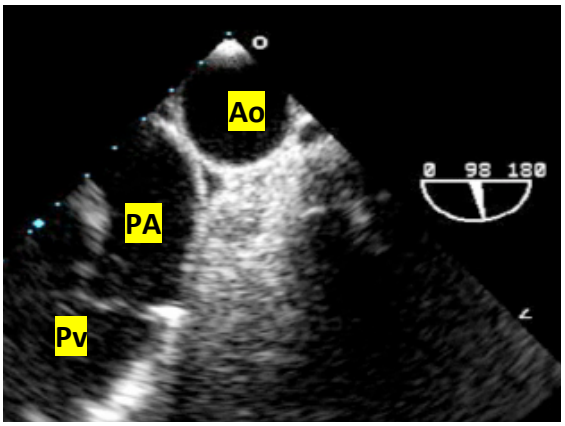
With the view of the **AORTA in SAX**, slow and gently withdraw the probe to follow the descending thoracic aorta until the view of the **UE AORTIC ARCH LAX** is reached at about 20-25 cm from the incisors (the aorta changes into an oval shape). → Then withdraw and turn probe slightly to the right to see the aortic arch. Rotating the multiplane angle to 90°, the **UE AORTIC ARCH LAX** view will be at the center of display. By slightly withdraw the probe the origin of the left subclavian artery can be displayed as well.



(t) UE AORTIC ARCH SAX view:

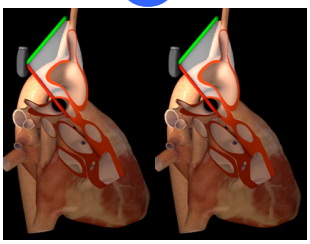
From the UE Aortic Arch LAX (0°) view rotate the omniplane angle to **60-90°**, then bring the **PV** and **PA** in view by slight turn the probe to the right.
The display shows the proximal origin of the **aorta** and **left subclavian artery** in the upper right.
The **PV** and **main PA** in LAX is seen in the lower left of the display.

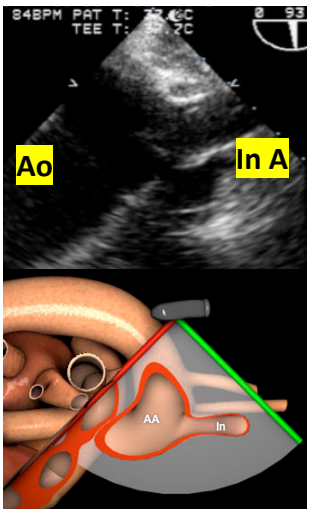




The AORTIC ARCH vessels:

3





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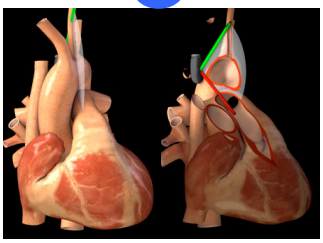

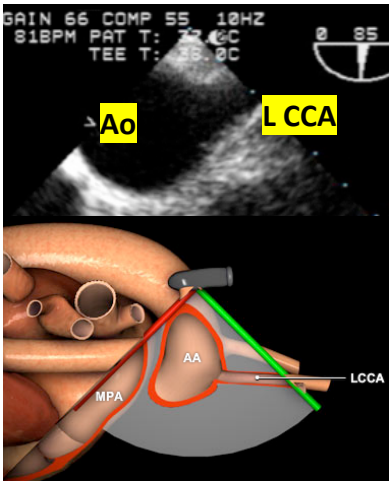

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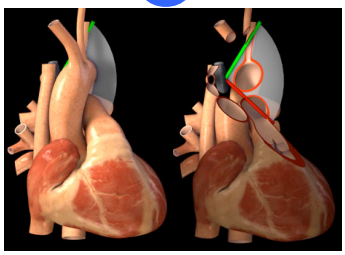

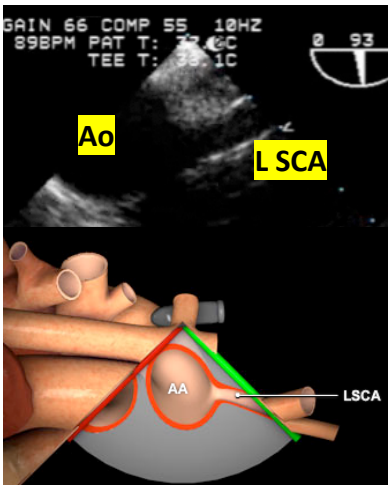

Farther turn probe to the right → Identify the origin of **the left common carotid artery**

Rotate the probe far right → Proximal segment of the **innominate artery** in LAX is seen at 2 o'clock

From the **UE aortic arch SAX view (90°)** slightly withdraw and turn probe to the right → Identify the origin of the **left subclavian artery** at 2 o'clock

After the TEE procedure…

After the comprehensive TEE examination is done (make sure you did obtain all the required information) proceed to remove the probe from the oropharinx:

- **MAKE SURE THE PROBE IS IN NEUTRAL POSITION before attempt to remove it.**
- **Check immediately post procedure vital signs!!!!**
- **Suction to clear mouth and airway from secretions**
- **Check for bleeding from the mouth and for blood in the TEE probe**
- **Check patient mental status and degree of conscious sedation**
- **Check for neck pain, sore throat, difficulty swallowing**
- **Pull the rails of the bed up again before leaving bedside**
- Check with nurse total dose of sedative and analgesic medications given.
- Store movie clips and end study in the machine.
- Discuss with attending pertinent findings and communicate them to the referring provider or medical team. Brief procedure note in chart (if necessary) documenting pertinent positives and negatives.
- Evaluate patient prior discharge.
- Discuss with the patient and/or family members results (if appropriate).
- Advise regarding common side effects of the sedatives, and possible minor discomfort due to procedure (mild sore throat, hoarseness, etc). Advise to call MD if more serious discomfort develops.
- Sign the discharge papers.
- Create a preliminary report

Sources and References

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