

LEFT VENTRICULAR ANGIOGRAM

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TARGETS

- ▶ INTRODUCTION
- ▶ INDICATIONS
- ▶ EQUIPMENT
- ▶ PROCEDURE
- ▶ COMPLICATIONS
- ▶ NORMAL LV ANGIOGRAM
- ▶ CALCULATION OF LV FUNCTION
- ▶ MITRAL REGURGITATION
- ▶ VSD
- ▶ SPOTTERS



INTRODUCTION

- ▶ In 1929 Werner Forssman, inserted a urologic catheter into his right atrium from a left antecubital vein cut down he had performed on himself using a mirror.
- ▶ Retrograde left heart catheterization was first done by Zimmerman, Limon Lason & Bouchard in 1950's (Nobel prize in 1956).
- ▶ Used to be the only method available for assessing LV segmental dysfunction.



INDICATIONS

- ▶ Define the anatomy and function of left ventricle.
- ▶ Global and segmental LV function-qualitative and quantitative
- ▶ Mitral valvular regurgitation
- ▶ Congenital heart disease –VSD
- ▶ Cardiomyopathy
- ▶ LV non compaction.



EQUIPMENT

▶ 1. INJECTION CATHETERS

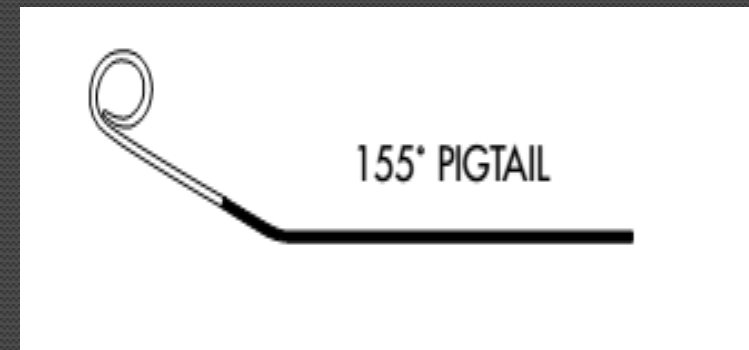
- large amount of contrast in short period of time.

- 6F/7F/8F catheter with multiple side holes.



- angled(145-155) **pigtail catheters**

- straight tip ventriculographic catheters- Sones catheter, NIH, eppendorf catheters, Lehmann catheter.



- Balloon tip ventriculographic catheters- Berman

Equipment..

2. Power injectors – flow injectors (Medrad)

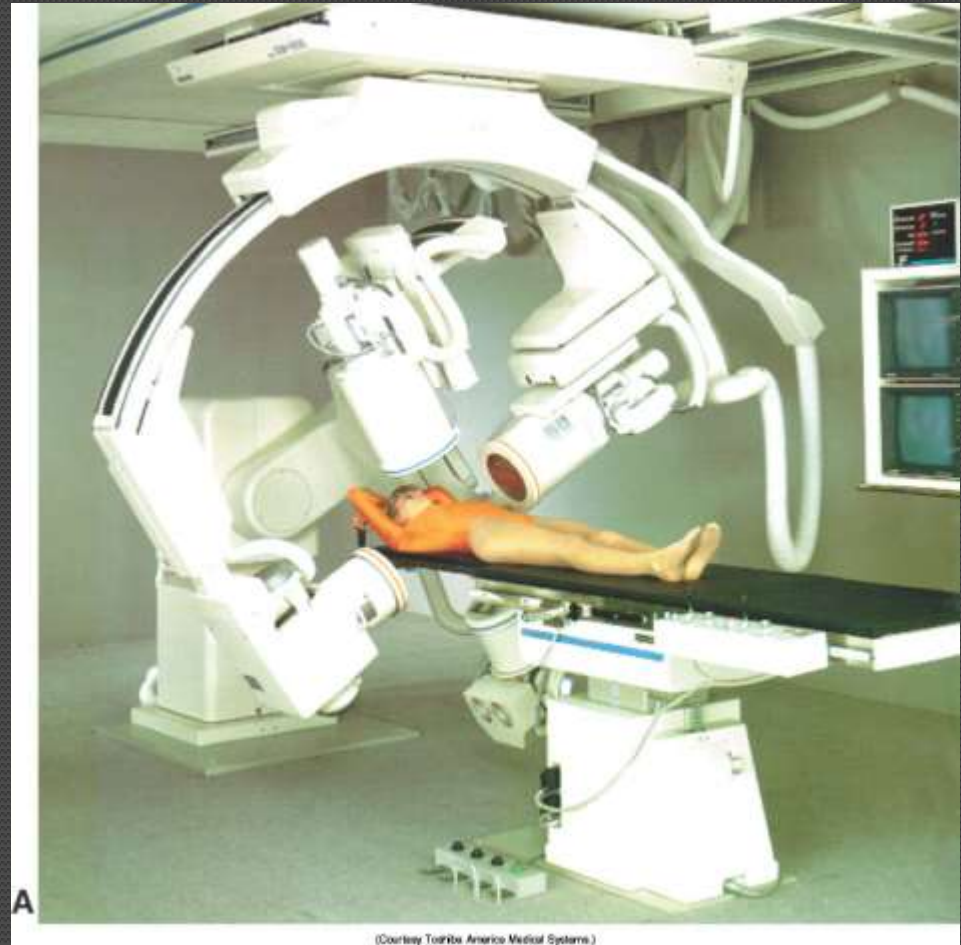
- volume and rate of delivery can be selected
- maximal pressure limit of 1000psi
- can be synchronised with R wave
- hand injection should be avoided.



(Courtesy Liskel-Flanheim, a product of Mallinckrodt, Inc., Cincinnati, Ohio.)

EQUIPMENT...

- ▶ **3.Biplane ventriculography** better than single plane ventriculography.
 - more information at no additional risk.
 - single injection of contrast.
- ▶ Disadvantages-
 - higher cost
 - additional time
 - Reduced quality of cineangiographic images



PROCEDURE

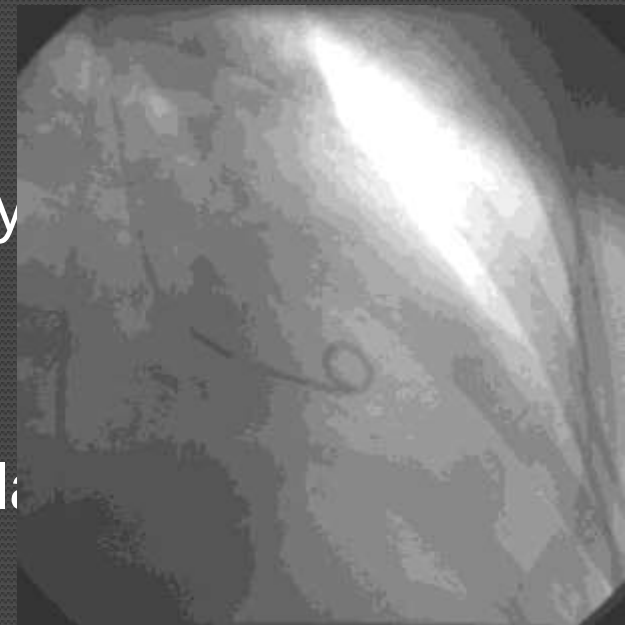
- ▶ **Approach to LV—**

- Retro aortic ,injection directly into the ventricles

- Anterograde/trans septal approach

- Apical left ventricular puncture

- ▶ **Optimal catheter position** —midcavitary
adequate delivery to body and apex
will not interfere with MV function
less endocardial staining and ventricular
ectopy



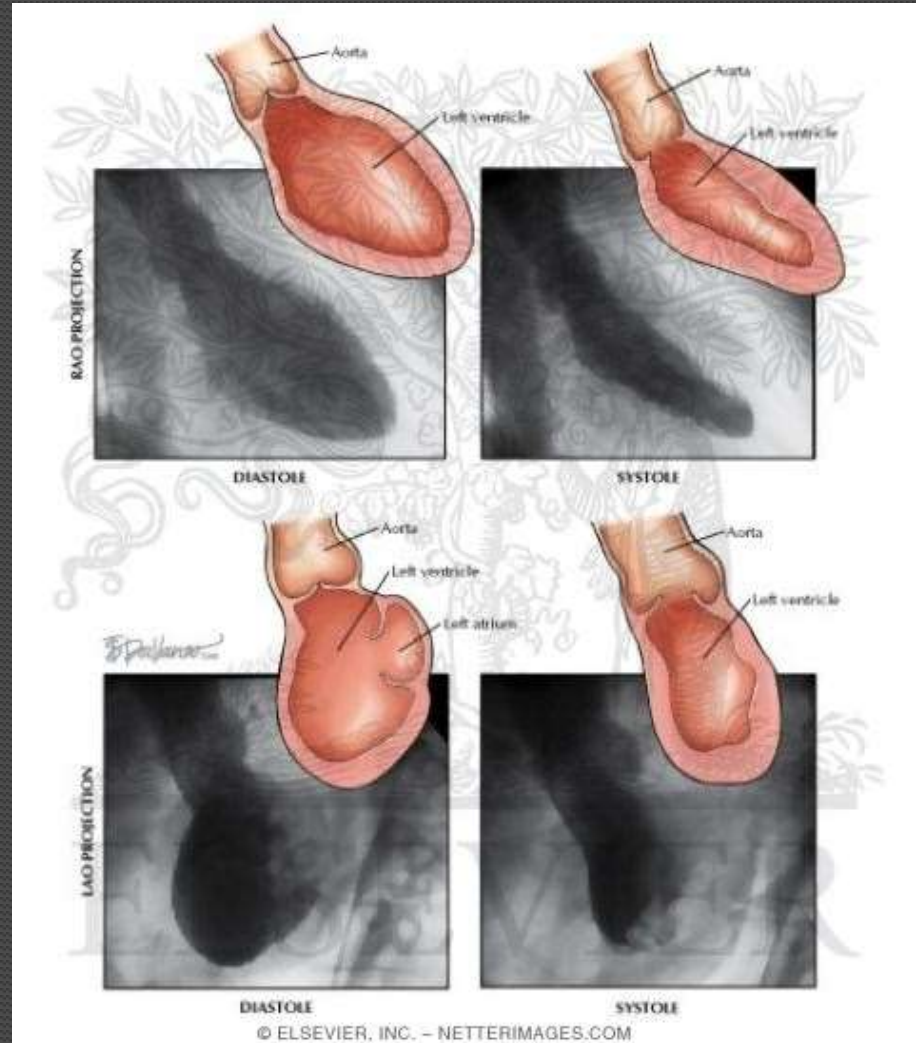
PROCEDURE..

- ▶ **Cine left ventriculography** with
contrast vol – 30-36ml
rate – 10-12ml/sec(pig tail)
 - 7-10 ml/sec(sones)
- ▶ Older imaging systems required image acquisition at deep inspiration.
- ▶ Newer imaging systems permits imaging during normal quite breathing.



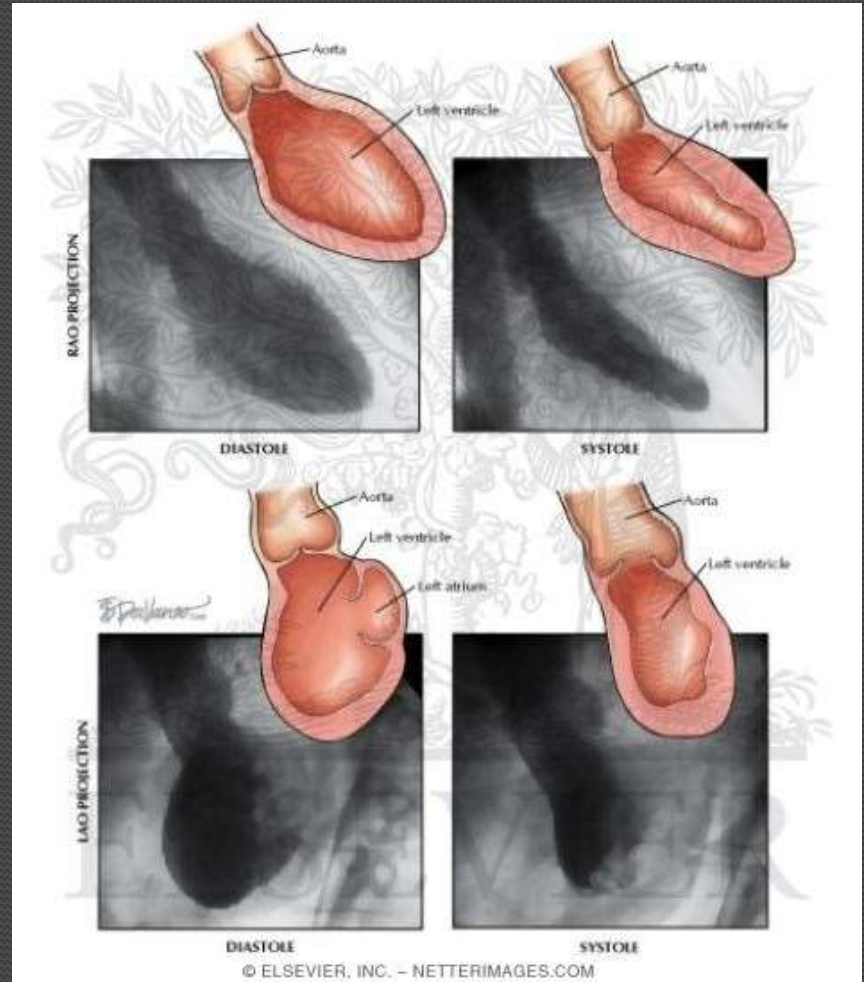
FILMING PROJECTION AND TECHNIQUE

- ▶ **Cine left ventriculography**
 - 15-30 frames/sec
- ▶ Typically 30 deg RAO and 60 deg LAO views are obtained
- ▶ **30 deg RAO**
 - eliminates overlap of LV and the vertebral column
 - anterior apical inferior
 - segmental wall motion
 - mitral valve profile ideal for assessment of MR



FILMING PROJECTION..

- ▶ 60 deg LAO
 - assess ventricular septal integrity and motion
 - lateral and posterior segmental function
 - aortic valvular anatomy
 - 15-30 deg cranial angulation for profiling entire IVS

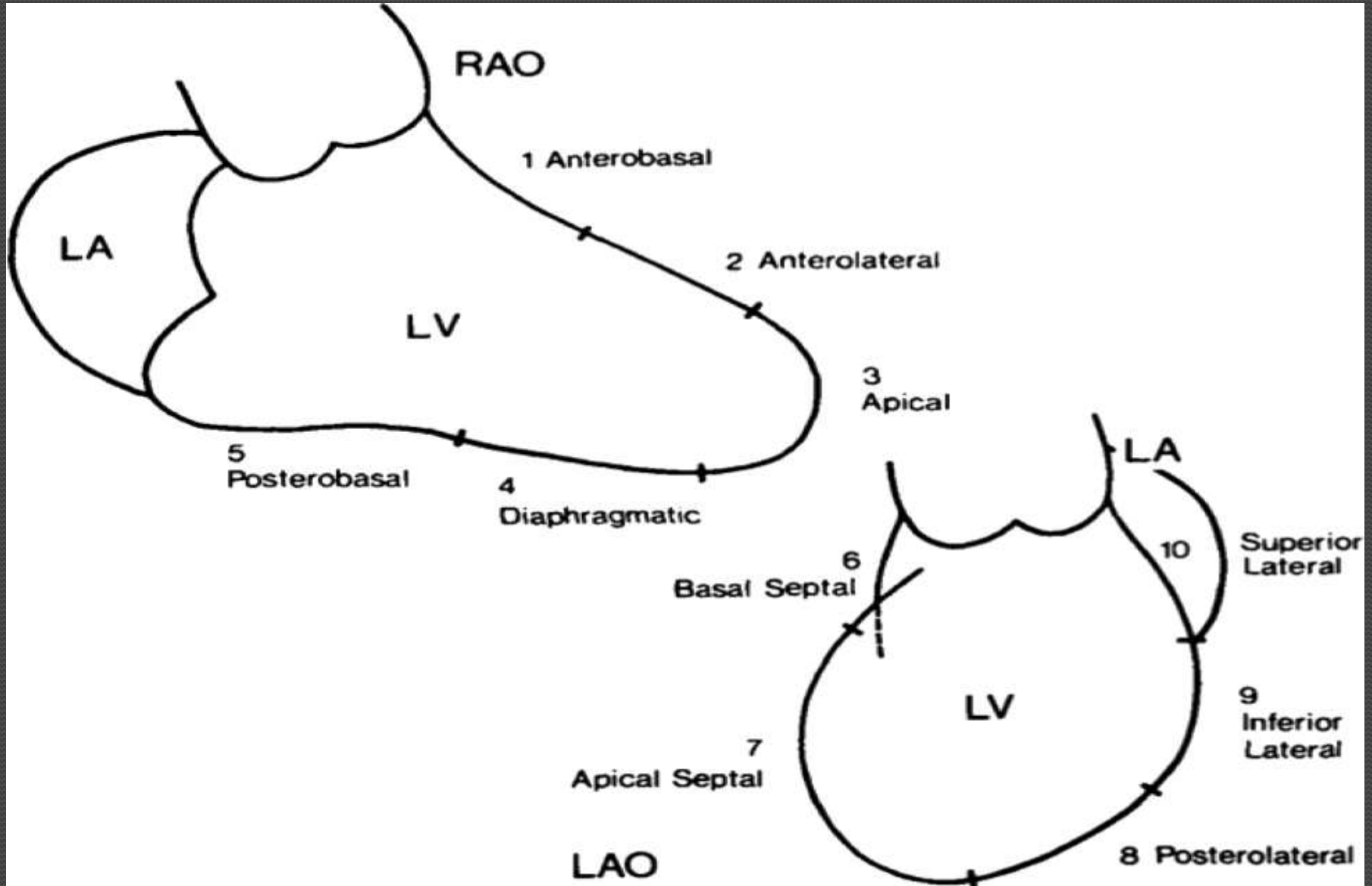


VIEWS FOR SPECIFIC CONDITIONS

CONDITION	VIEW
LV FUNCTION	30 RAO/60 LAO
MEMBRANOUS VSD	70 LAO 30 CRANIAL / RAO
MUSCULAR VSD	4-C PROJECTION(45LAO-45CRANIAL) 70 LAO 30 CRANIAL / RAO
AVSD	4-C PROJECTION(45LAO-45CRANIAL) 45RAO-45CRANIAL
LVOTO	70 LAO 30 CRANIAL / RAO
DORV	70 LAO 30 CRANIAL / RAO
D-TGA	70 LAO 30 CRANIAL / RAO
L-TGA	RAO CRANIAL/LAO CRANIAL

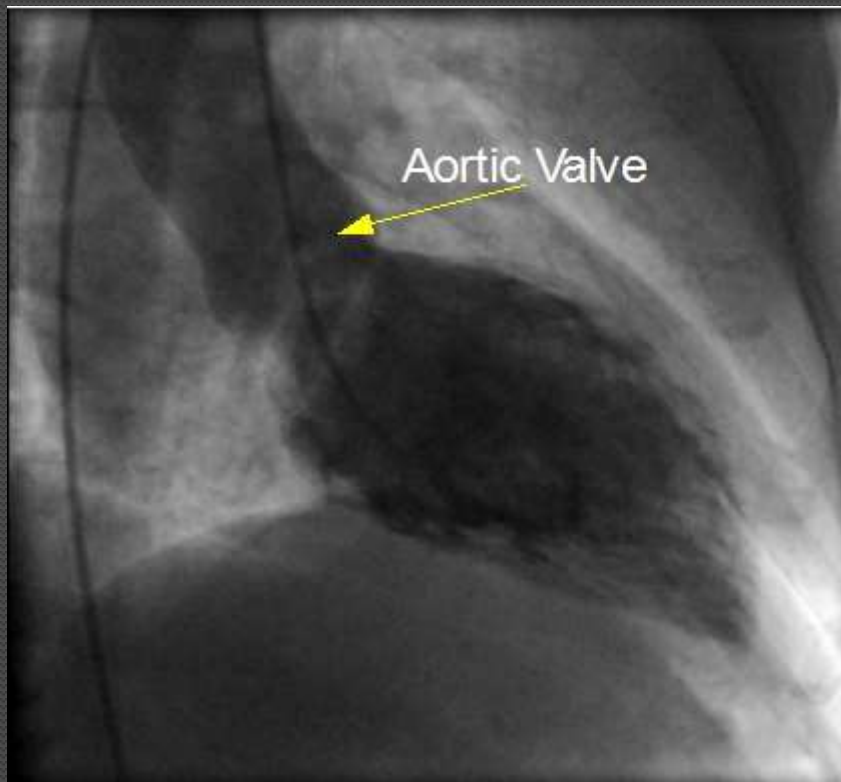


NORMAL LV ANGIOGRAM -SCHEMATIC

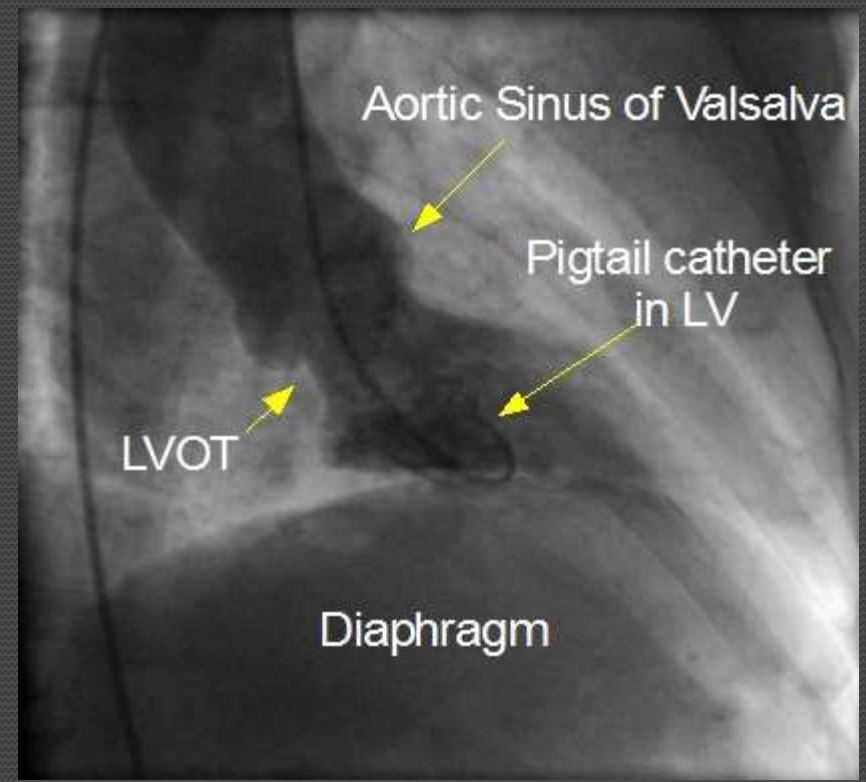


NORMAL LV ANGIOGRAM

RAO DIASTOLIC FRAME



RAO SYSTOLIC FRAME

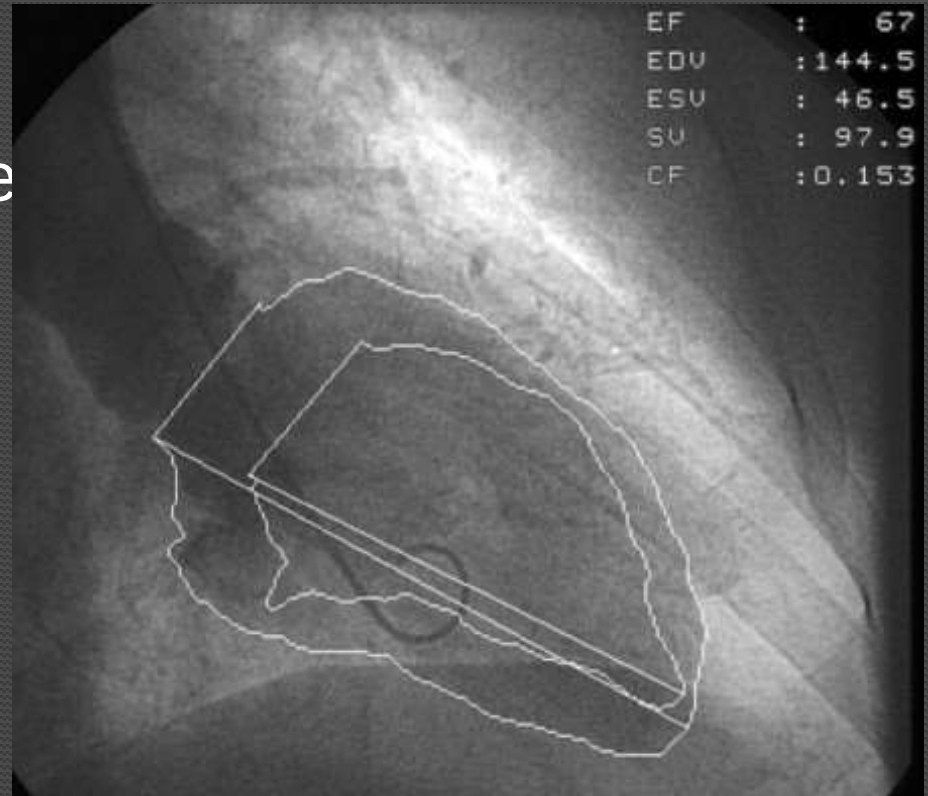


NORMAL LEFT VENTRICULOGRAM



LV FUNCTION ASSESSMENT

- ▶ Cineventriculography was the first method introduced in the routine practice to determine the LVEF.
- ▶ The area-length technique is the most widely used method to quantify the left ventricular diastolic and systolic volumes.



LV FUNCTION ASSESSMENT

▶ MEASURE

Ventricular dimension

Area

Wall thickness

▶ DERIVE

Chamber volume

Ejection Fraction

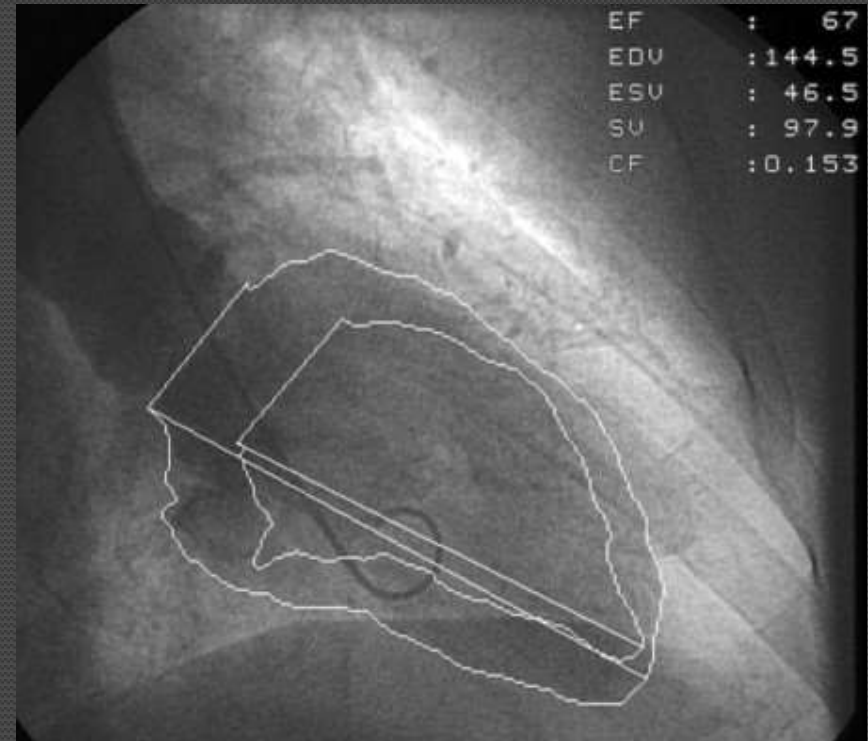
LV mass

LV wall stress



STEPS IN LV VOLUME CALCULATION

- ▶ 1. Tracing LV outline or silhouette
- ▶ 2. Marking aortic valve border
- ▶ 3. Calculation of LV volume by computer based algorithms
- ▶ 4. Magnification correction
- ▶ 5. Applying Regression Equation



CALCULATION OF LV EF

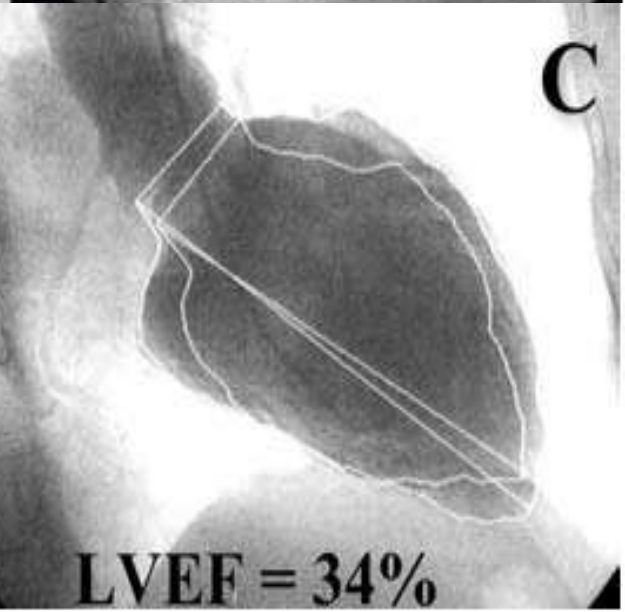
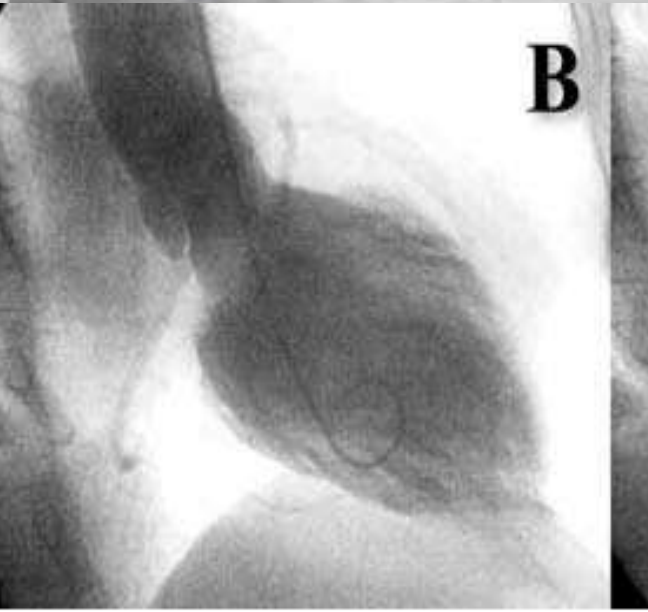
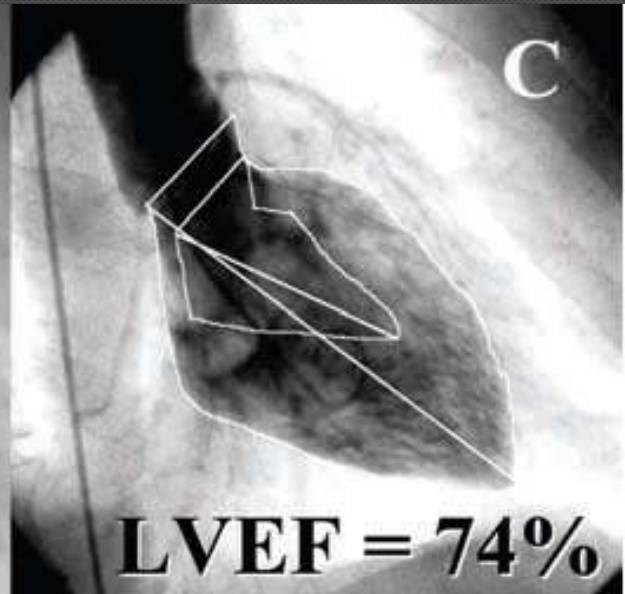
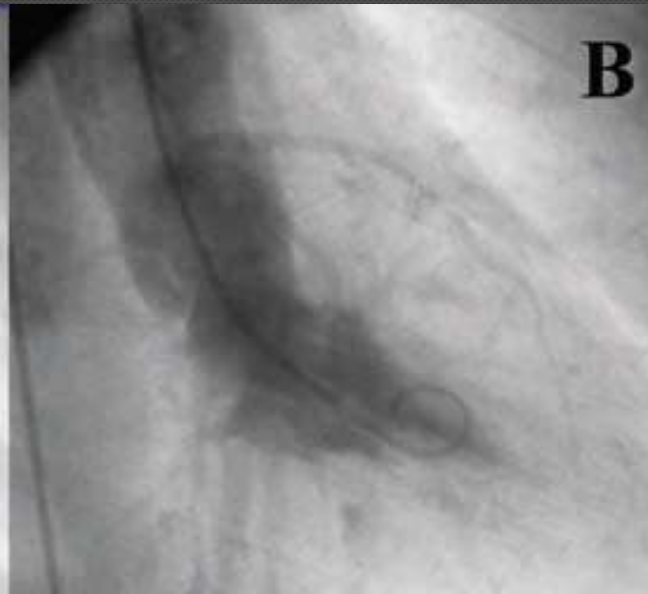
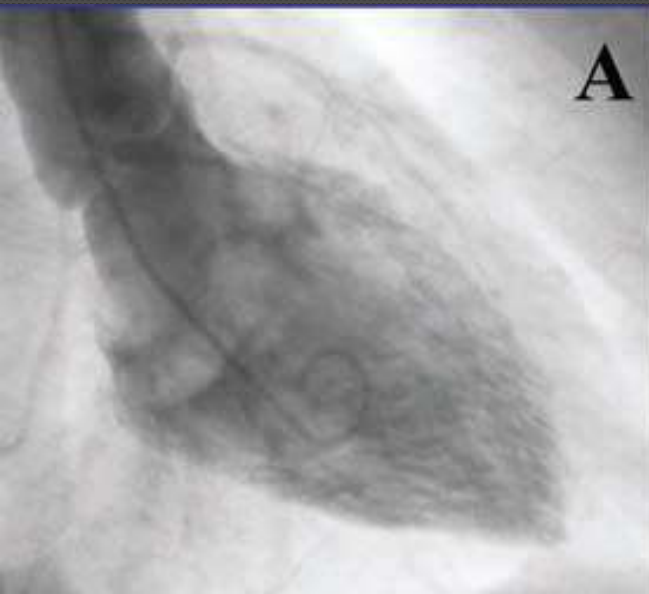
- ▶ Angiographic stroke volume, $SV = EDV - ESV$
- ▶ Ejection fraction, $EF = (EDV - ESV) / EDV$

CALCULATION OF LV MASS

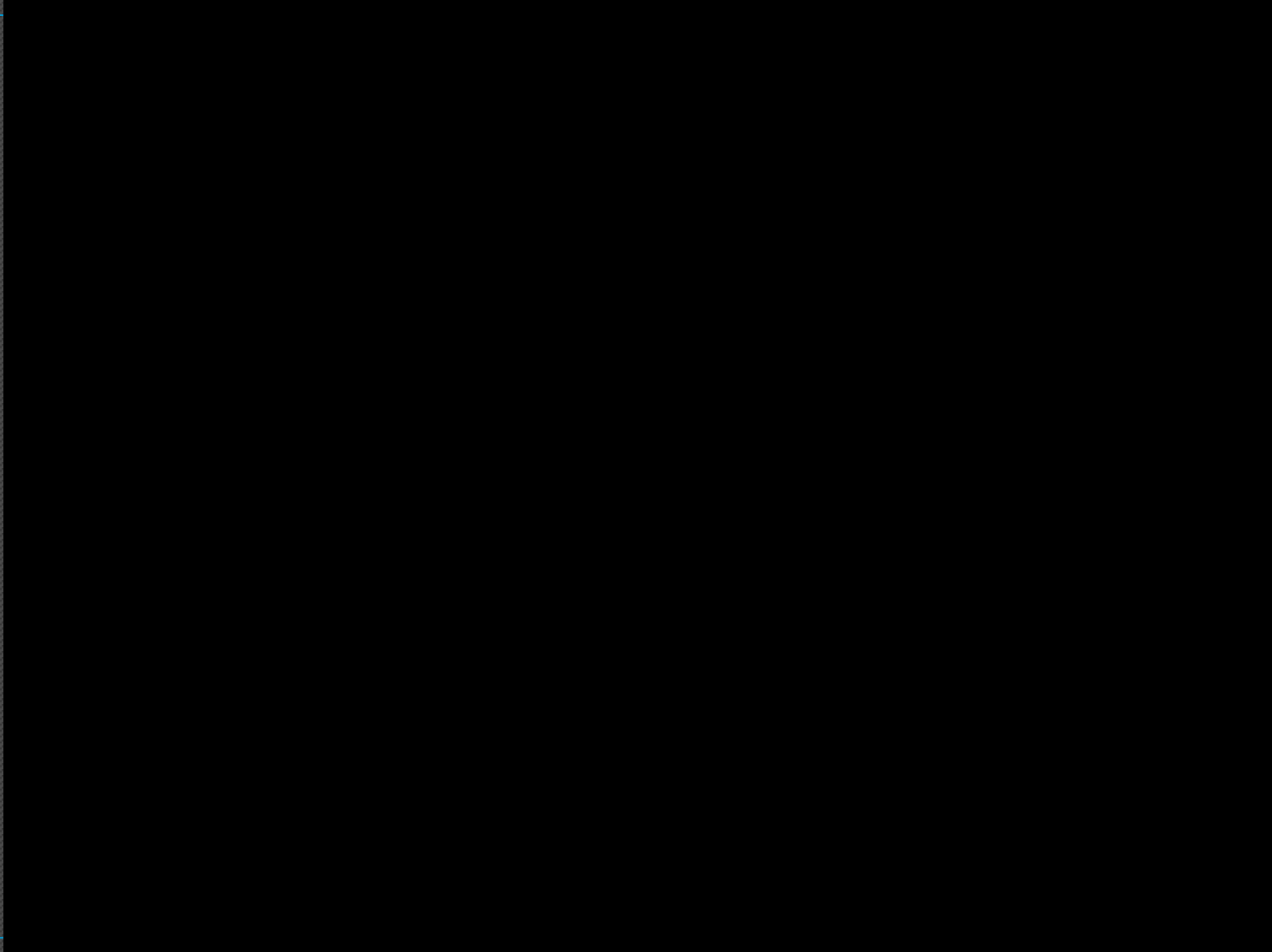
- ▶ LV wall thickness, h is measured at end diastole at LV free wall 2/3 distance from aortic valve to apex in RAO
- ▶ LV Mass = $V_{c+w} - V_c$



LV FUNCTION ASSESSMENT..



GLOBAL LV DYSFUNCTION



REGIONAL LV DYSFUNCTION

- ▶ Regional wall motion can be graded qualitatively as normal, hypokinetic, akinetic, dyskinetic, or hyperkinetic.
- ▶ The analyses of the RAO and LAO projections as

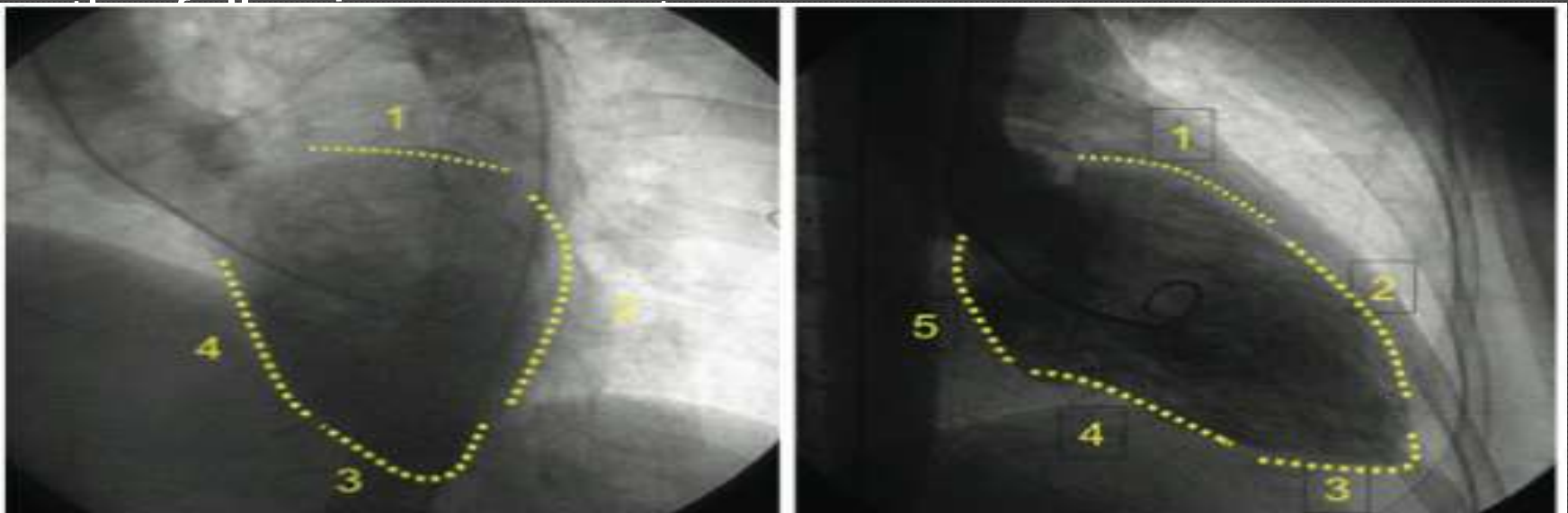


Figure 4. Left ventriculograms in LAO with cranial angulation (left) and RAO (right). The LAO segments are 1) basal, 2) lateral, 3) apical, 4) septal. In this projection, the apex of the heart is tipped downward. The RAO segments are 1) anterior basal, 2) anterior, 3) apical, 4) inferior, 5) inferior basal.

REGIONAL LV DYSFUNCTION...

CORONARY ARTERY	SEGMENTS
LAD	Anterolateral Apical Septal
Diagonal branches	Anterolateral
Ramus intermedius	Anterolateral Superolateral
Left circumflex (dominant RCA)	Posterolateral Superolateral
Dominant right coronary artery	Posterobasal Diaphragmatic Inferolateral

MITRAL REGURGITATION

► Diagnosis and assessment of severity of MR

DEGREE	VENTRICULOGRAPHIC CRITERIA
1+	Faint opacification of the left atrium with clearing of contrast during each beat
2+	Opacification of the atrium that does not clear but is not as dense as the left ventricle
3+	Opacification of the atrium with the same density as the ventricle
4+	Immediate, dense opacification of the atrium with filling of the pulmonary veins

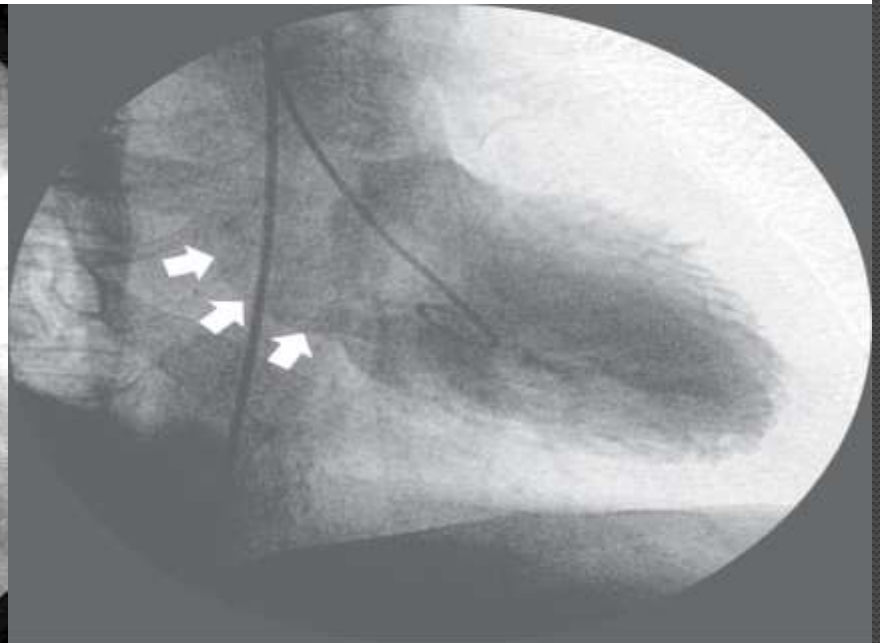


MR - REGURGITANT FRACTION

- ▶ Angiographic quantification of MR
- ▶ Total Stroke Volume (TSV = EDV – ESV) calculated from LVgram.
- ▶ Forward Stroke Volume(FSV) calculated by Fick method or indicator dilution technique.
- ▶ Regurgitant Stroke Volume (RSV) = TSV – FSV
- ▶ Regurgitant Fraction (RF) = RSV/TSV

ANGIO GRADE	DOPPLER RF(%)	ANGIO RF(%)
1	28 +/- 9	<20
2	38 +/- 9	21 - 40
3	44 +/- 10	41 - 60
4	59 +/- 12	>60

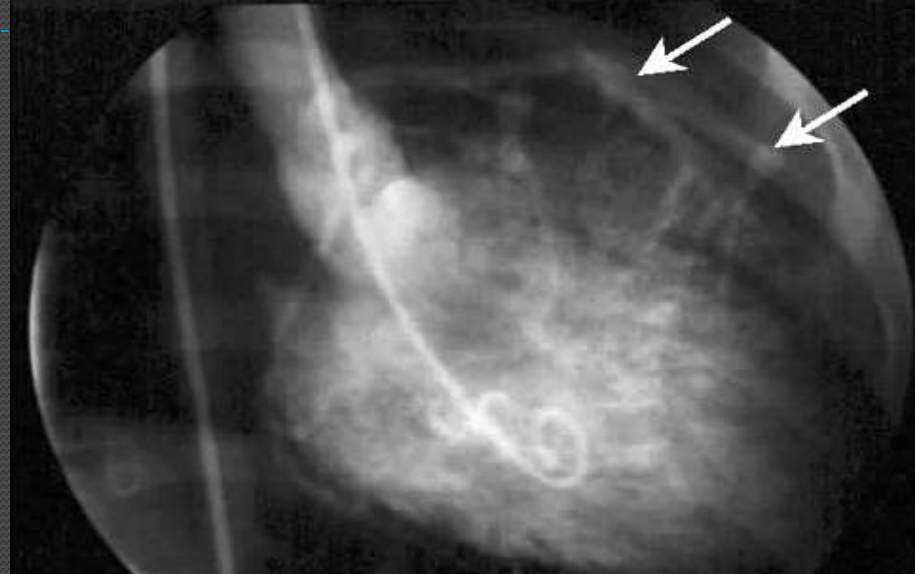
MITRAL REGURGITATION



HYPERTROPHIC CARDIOMYOPATHIES

- ▶ In HCM, cavity obliteration is commonly seen together with small ventricular end-systolic volumes .
- ▶ Systolic anterior motion of the mitral valve may result in severe degrees of mitral regurgitation.
- ▶ The ventriculogram in the apical variant typically appears with a “spade”-shaped contour.

End-Diastolic LV Angio in HCM

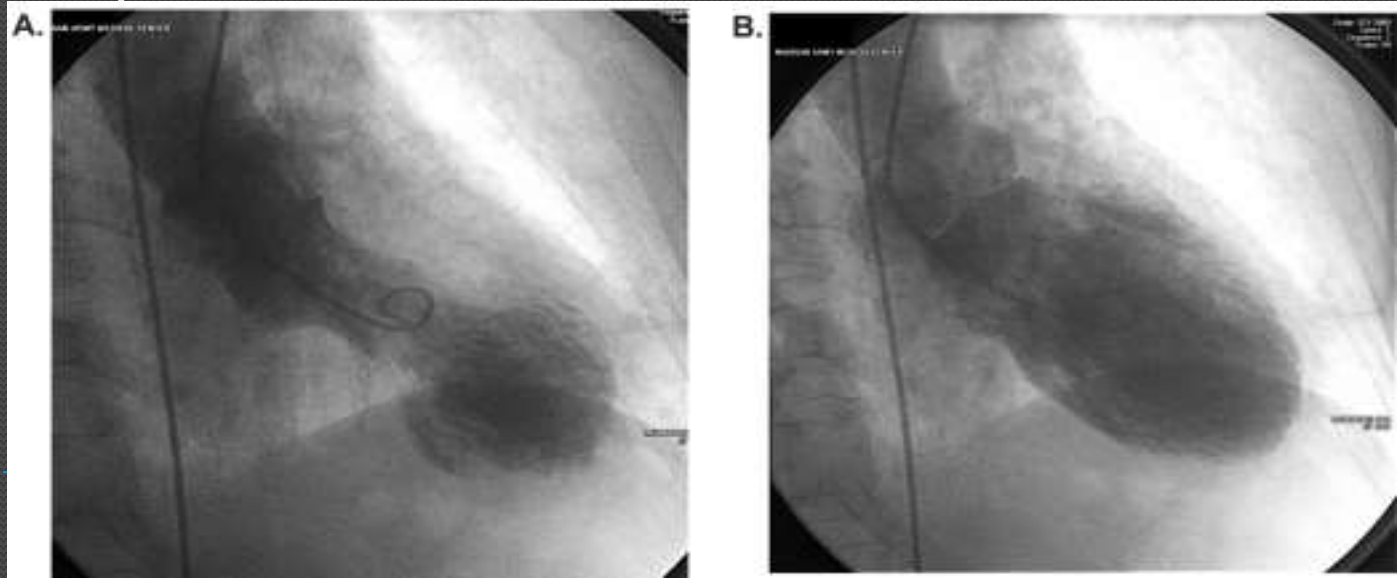
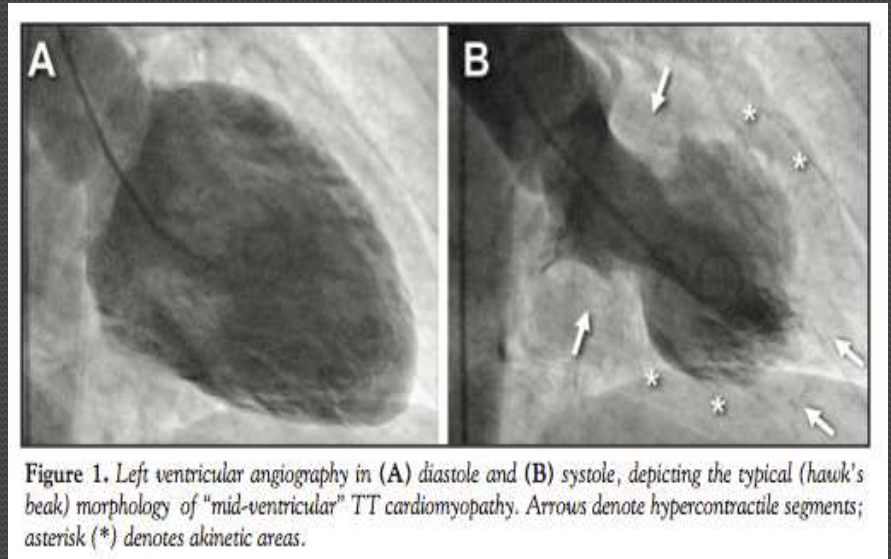


End-Systolic LV Angio in HCM



TAKO TSUBO CARDIOMYOPATHY

- ▶ Diffuse akinesis of LV apex with preserved basal contractility.
- ▶ Characteristically resemble the shape of a japanese octopus trap(tako-tsubo)



VENTRICULAR SEPTAL DEFECT

- ▶ A standard view in the evaluation of patients with ASDs or muscular VSDs is the **hepatoclavicular view** at 30° to 45° LAO and



Fig. 1. Aneurysmal VSD: Left ventricular angiogram reveals large aneurysmal VSD (arrow).



Figure 2. Left ventriculography in the left anterior oblique (LAO) projection confirming VSD (arrow) with significant angiographic shunting.

COMPLICATIONS...

- ▶ Ventricular extrasystole – mechanical stimulation
- ▶ Ventricular tachycardia – mostly NSVT
- ▶ Intramyocardial injection/endocardial staining
- ▶ Myocardial perforation
- ▶ Left anterior fascicular block
- ▶ Transient complete heart block
- ▶ Embolism- air/thrombus
- ▶ Complications of contrast media

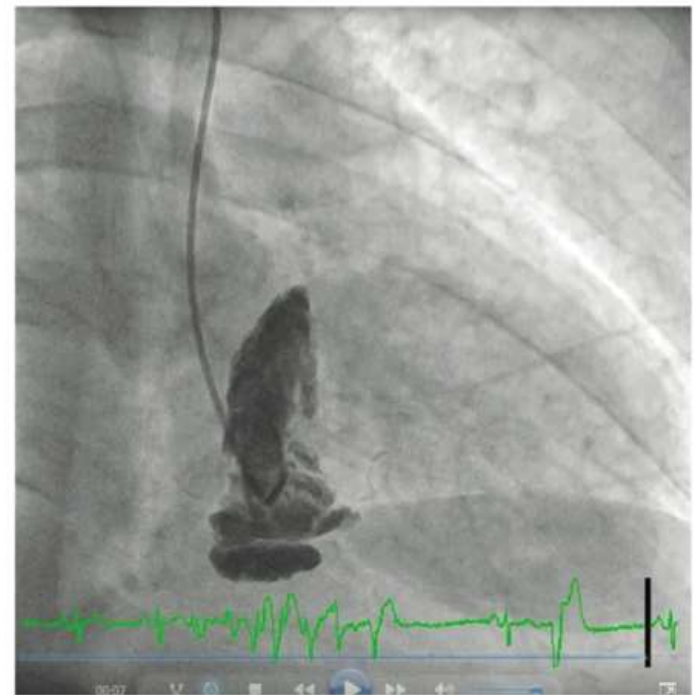


Figure 1G. Persistent contrast stain after the ventriculogram.

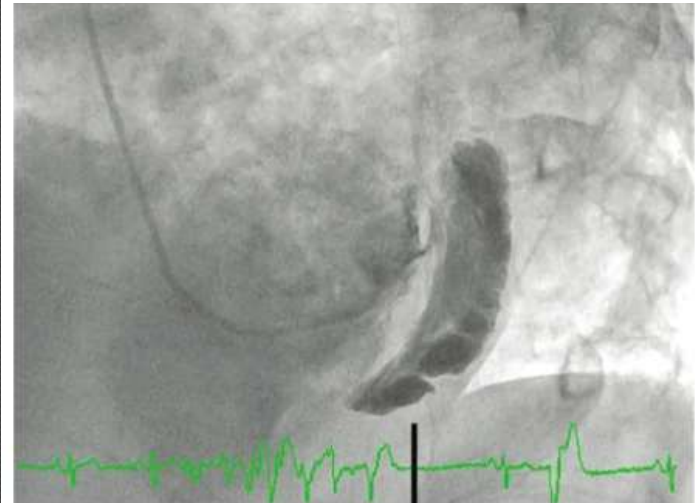
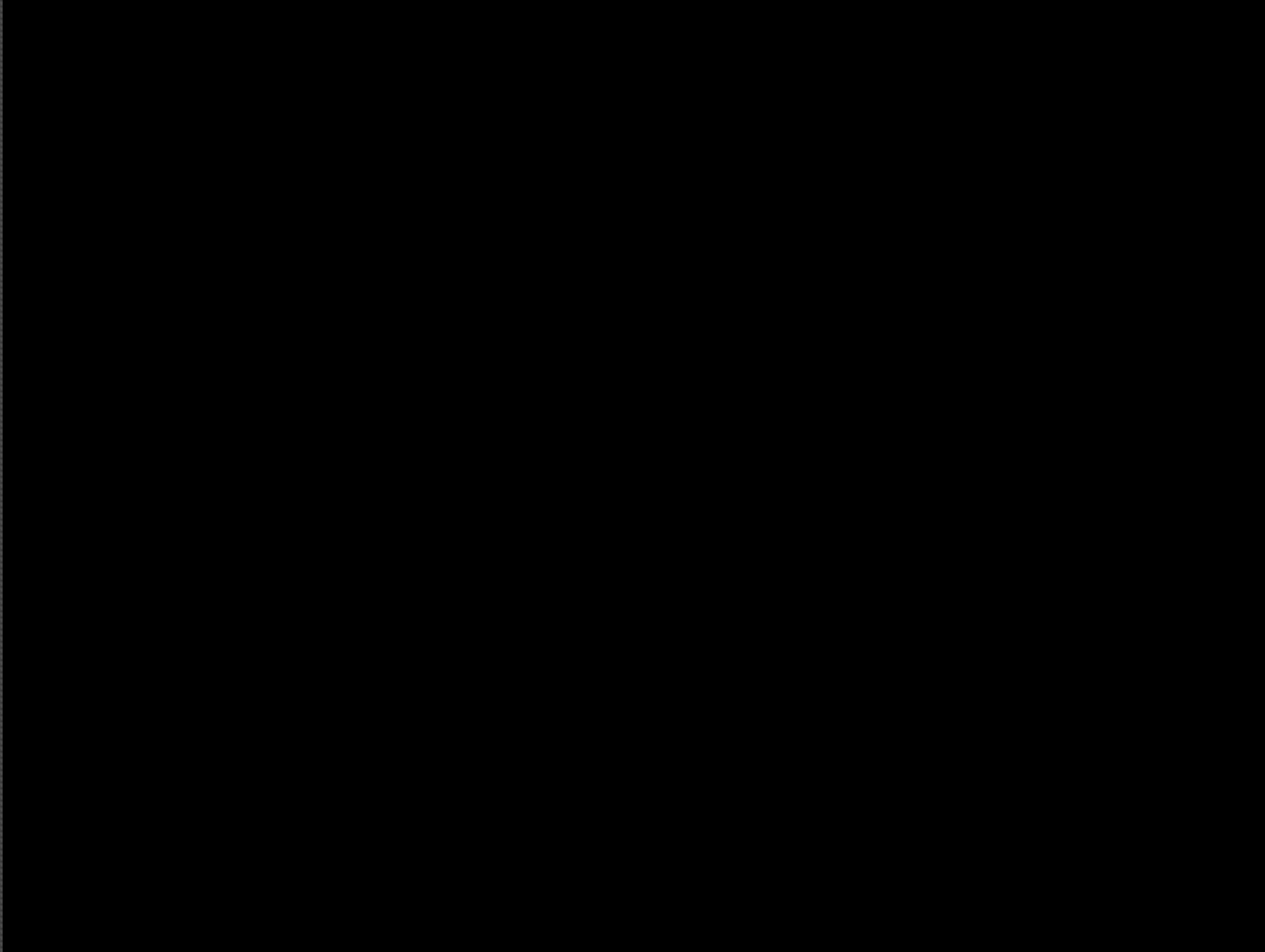
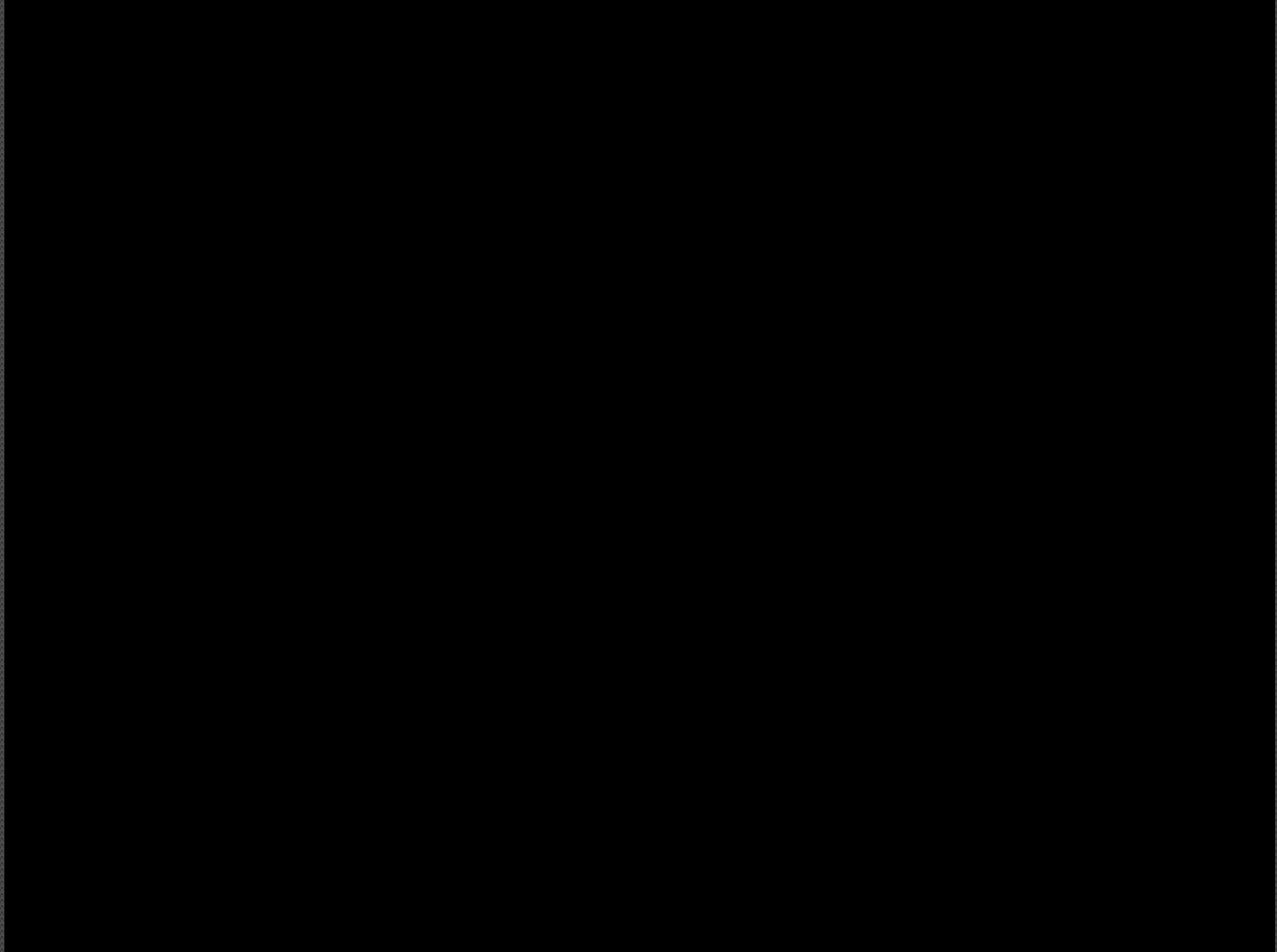


Figure 2E. Last frame of LV gram shows dense, fixed staining of myocardium. Fortunately, there were no clinical sequelae associated with this procedure. An echocardiogram was performed urgently before the patient left the laboratory. There was no pericardial effusion or wall motion abnormality.

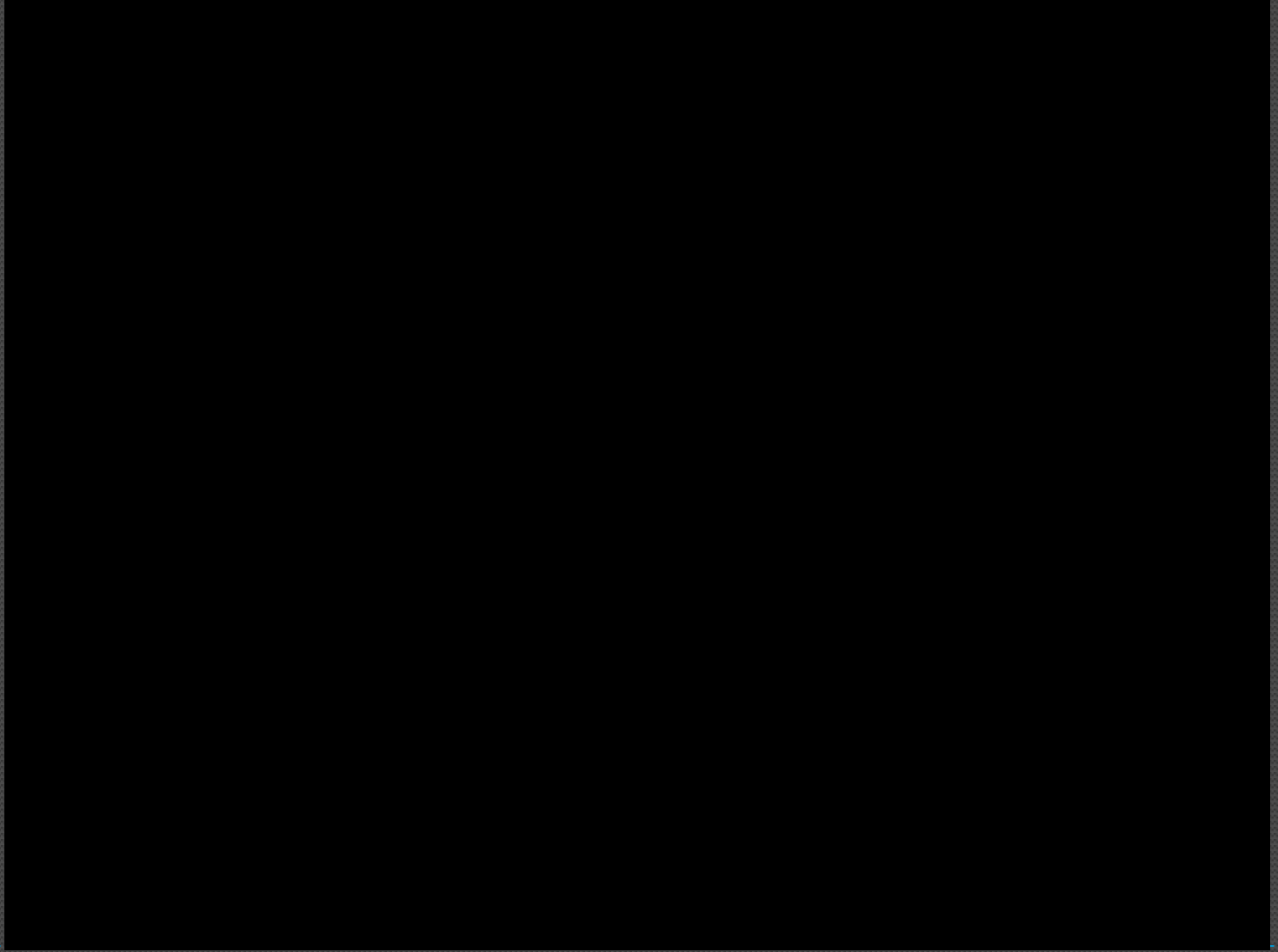
SPOTTER 1



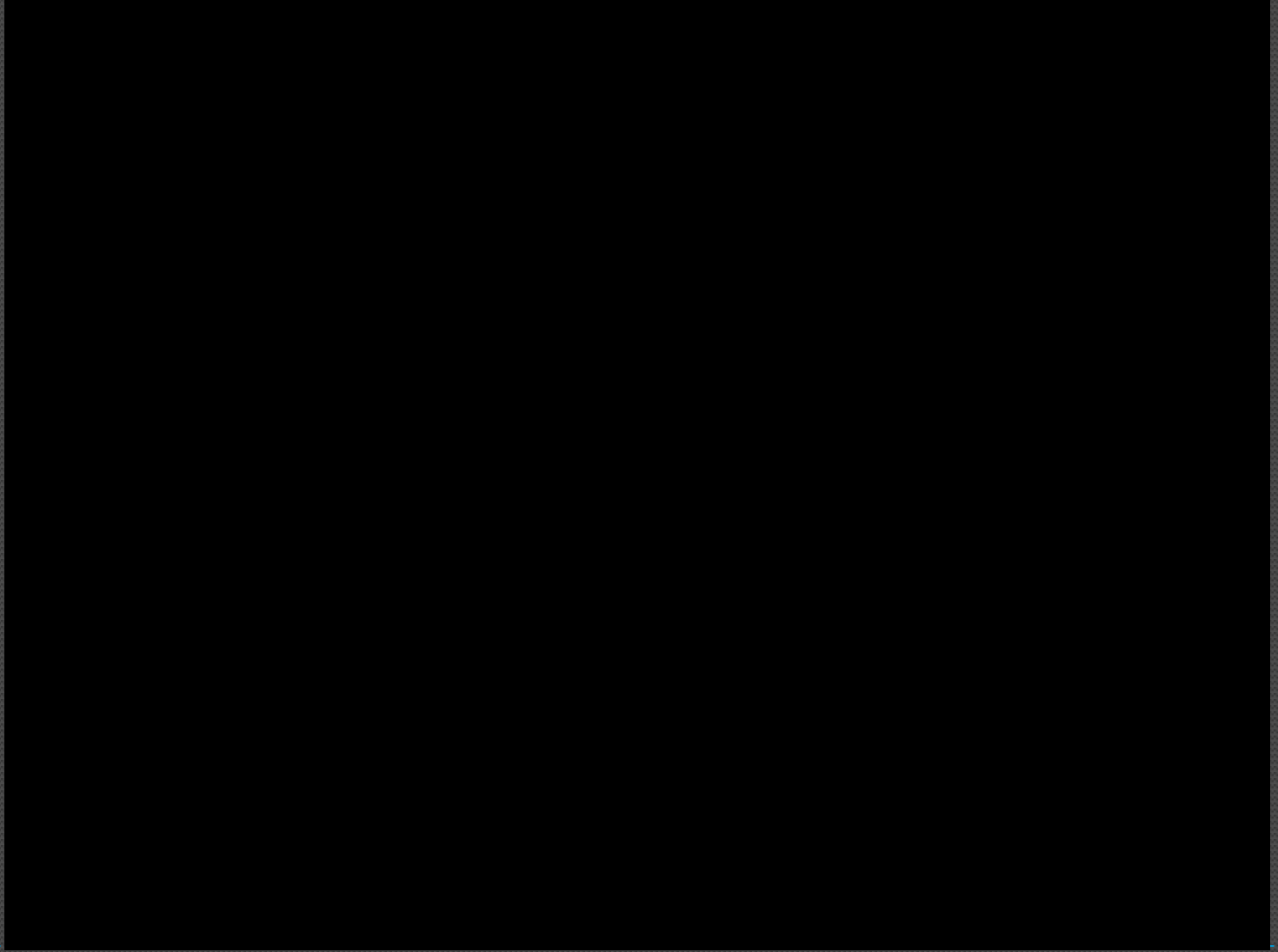
SPOTTER 2



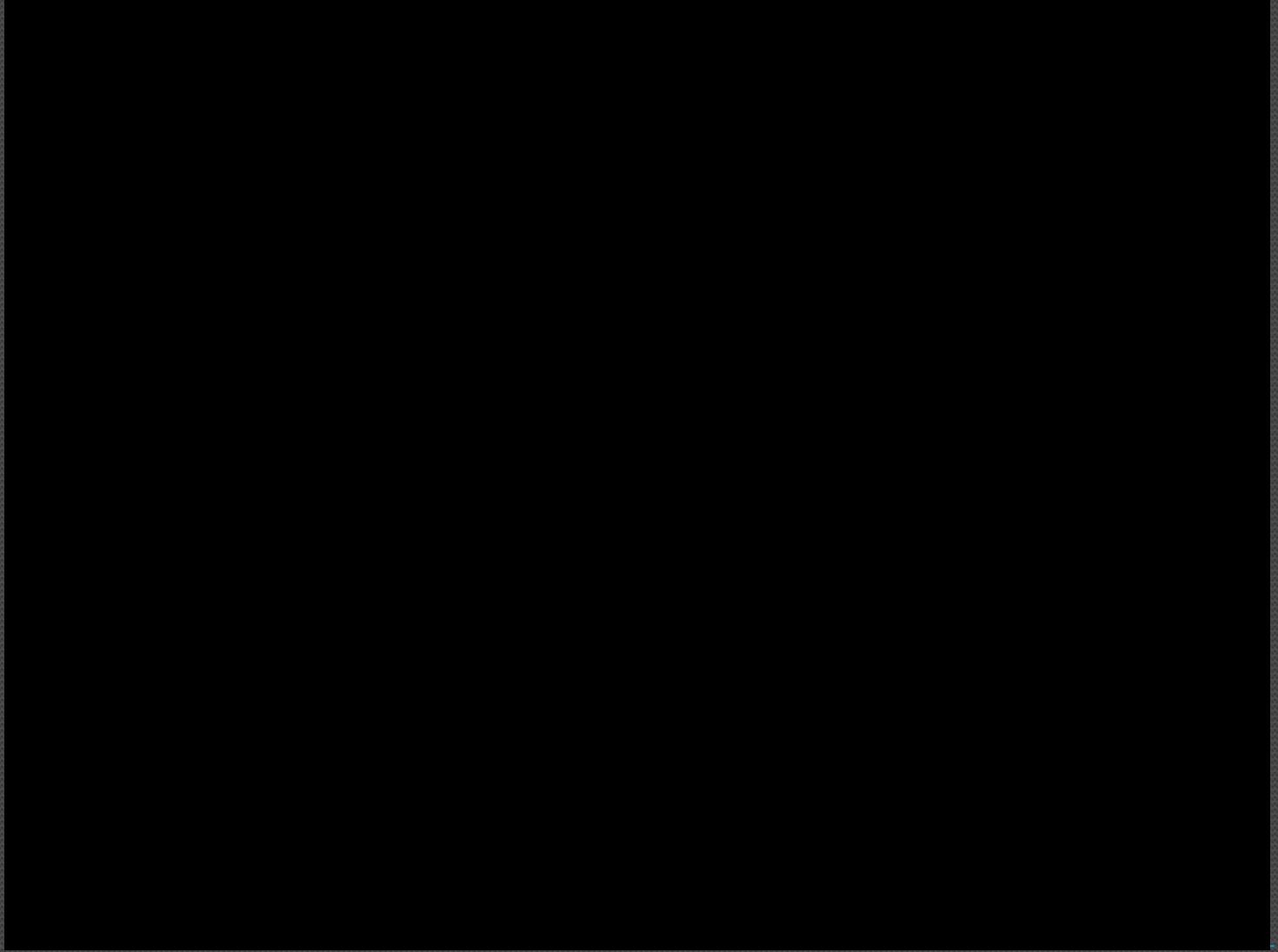
SPOTTER 3



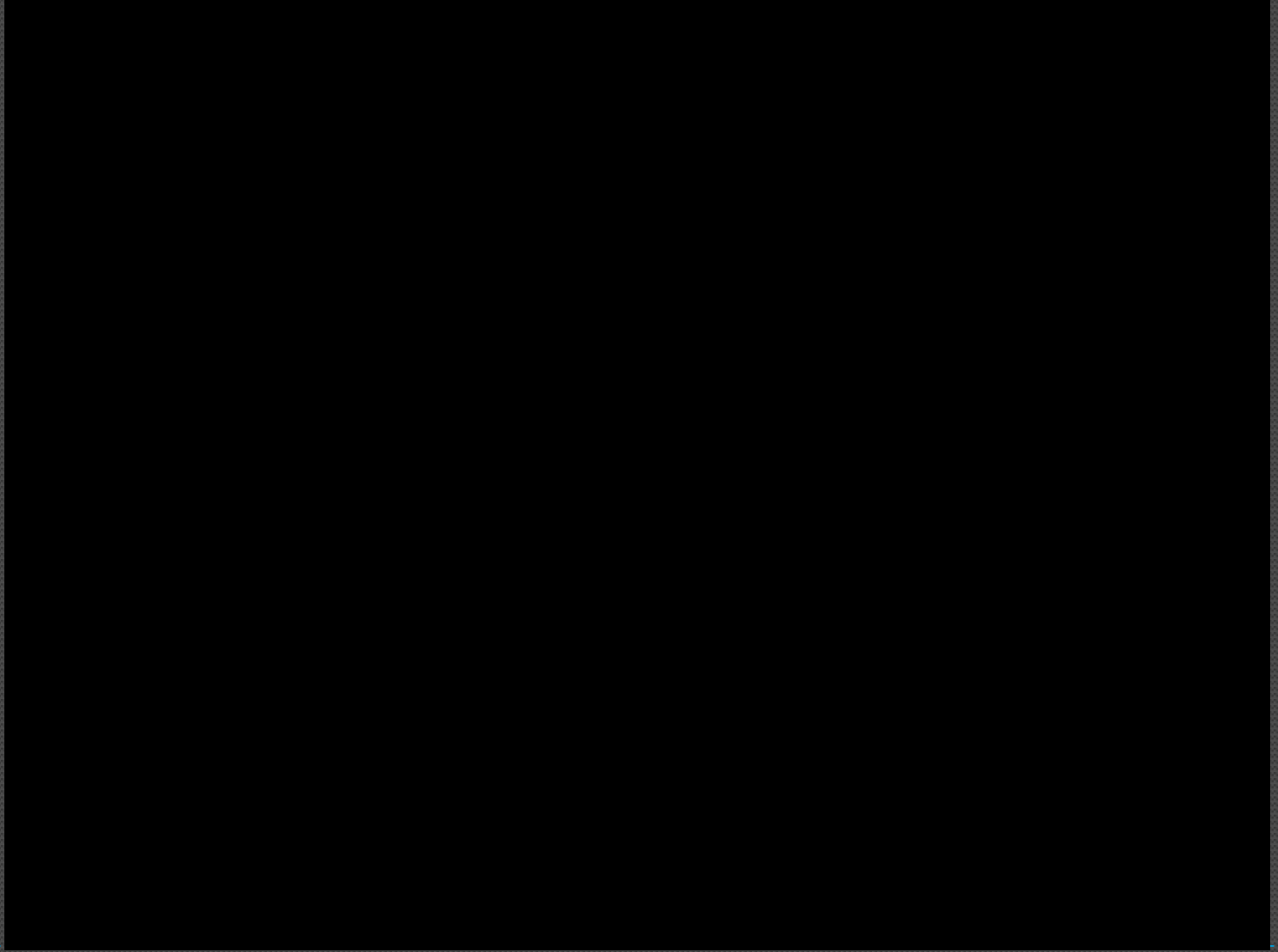
SPOTTER 4



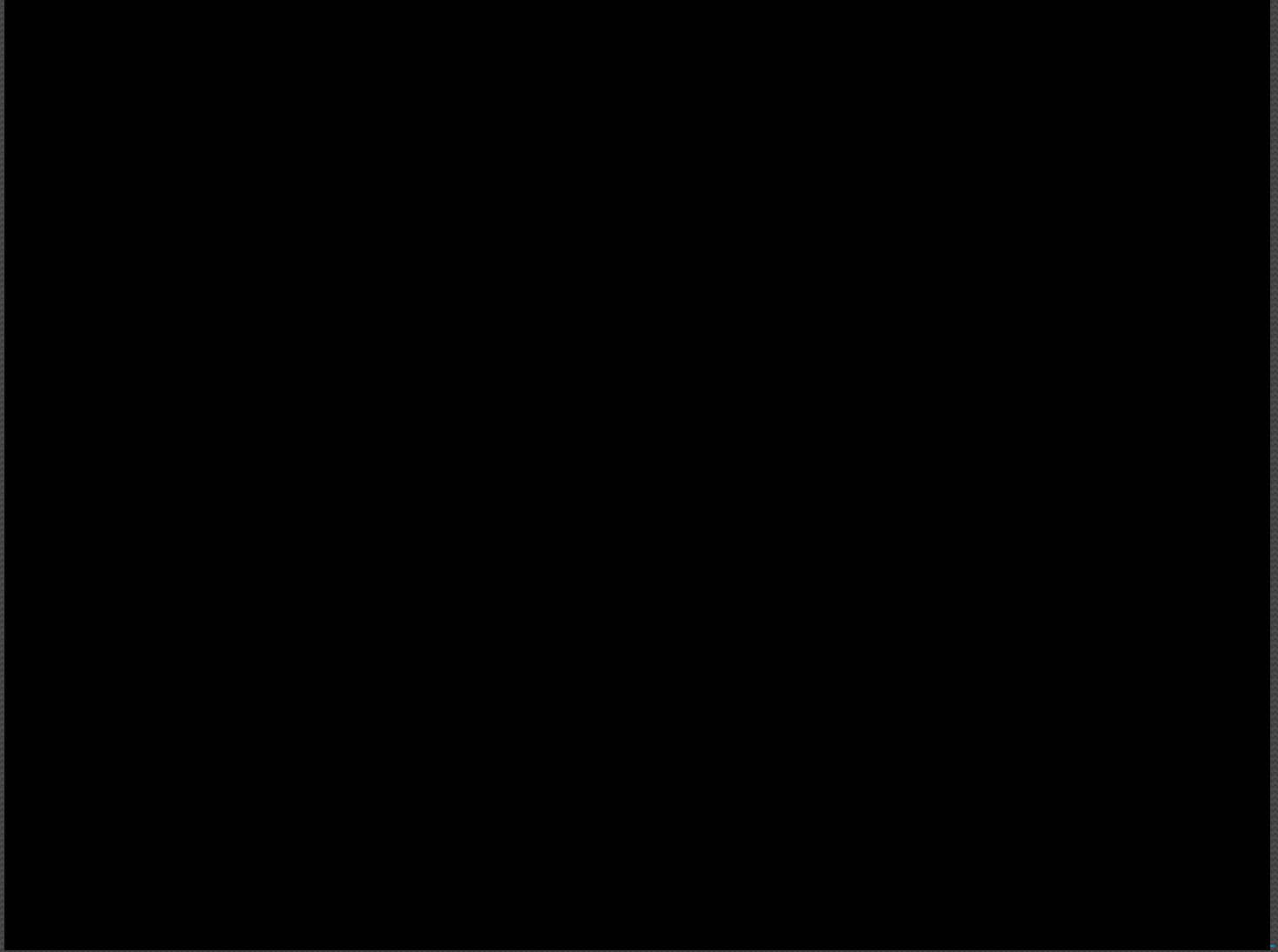
SPOTTER 5



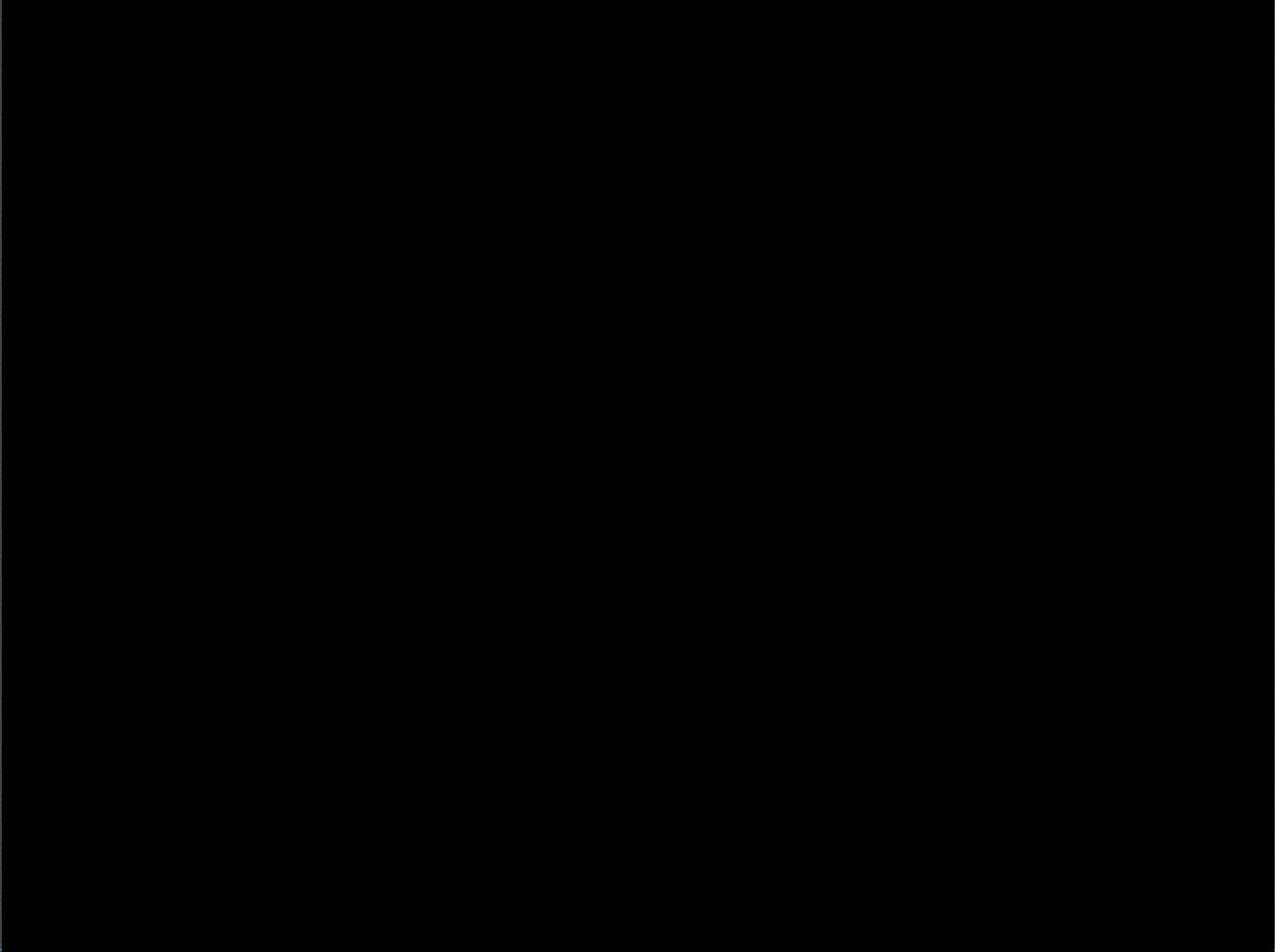
SPOTTER 6



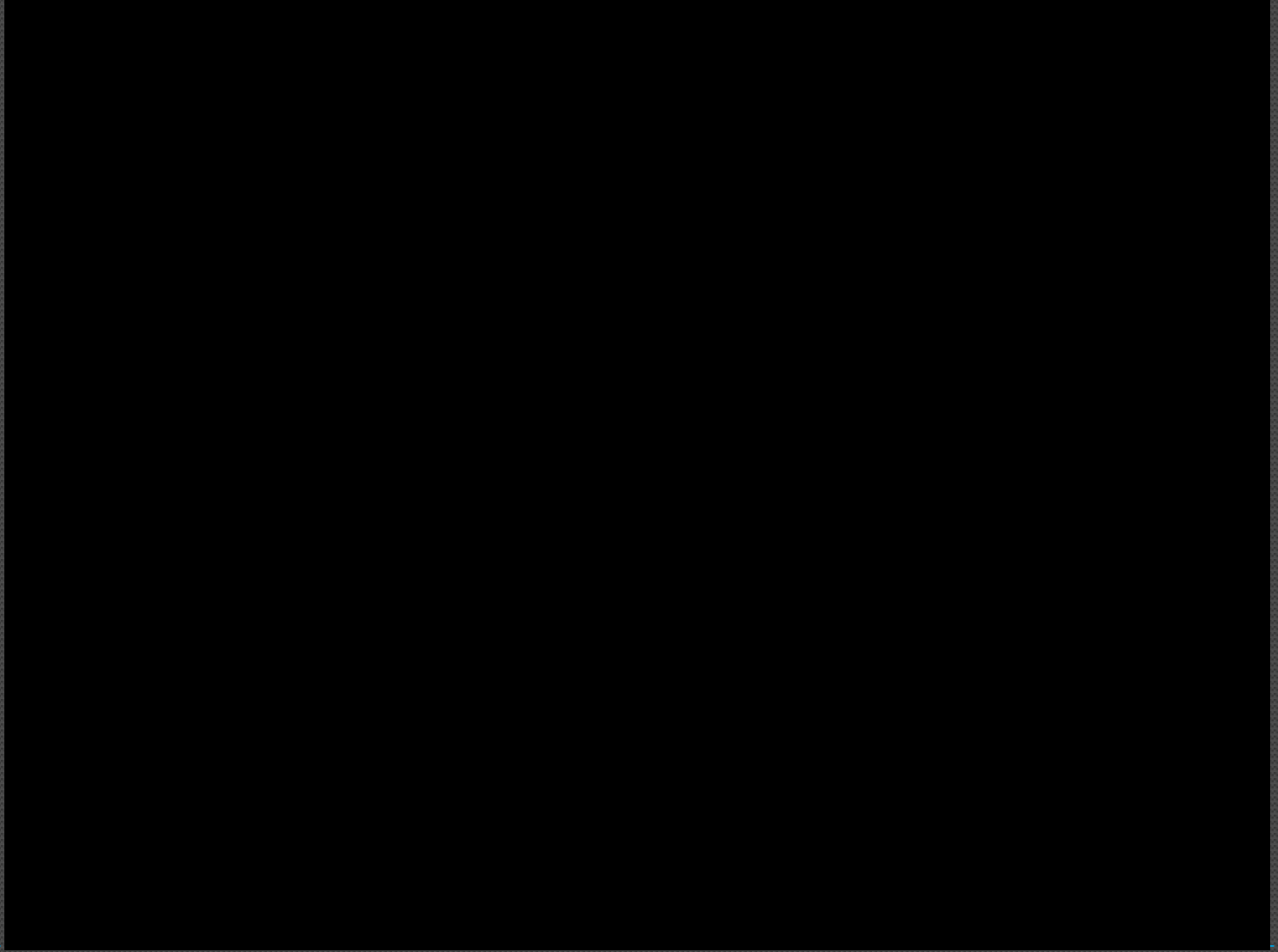
SPOTTER 7



SPOTTER 8



SPOTTER 9

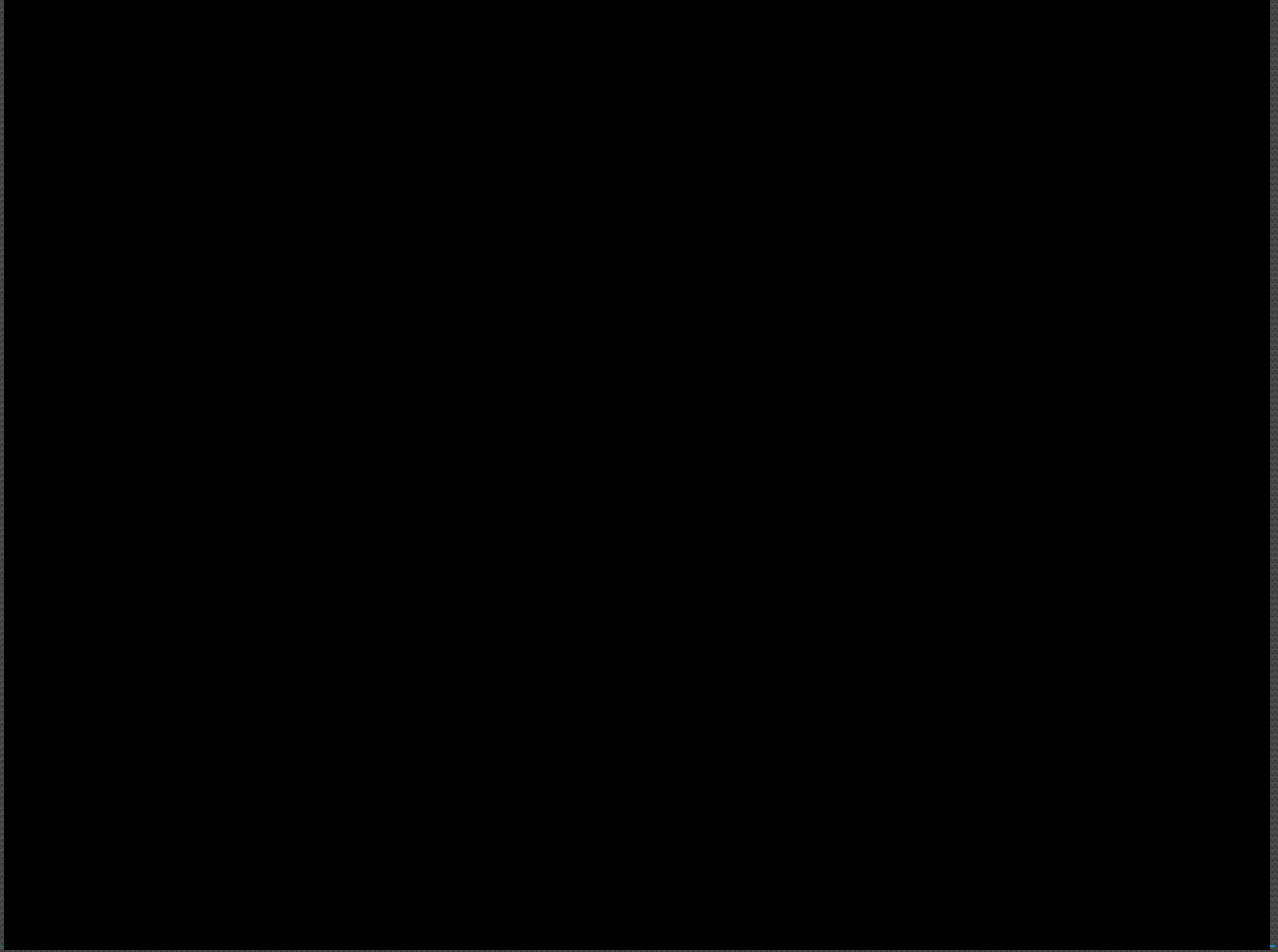


SPOTTER 10

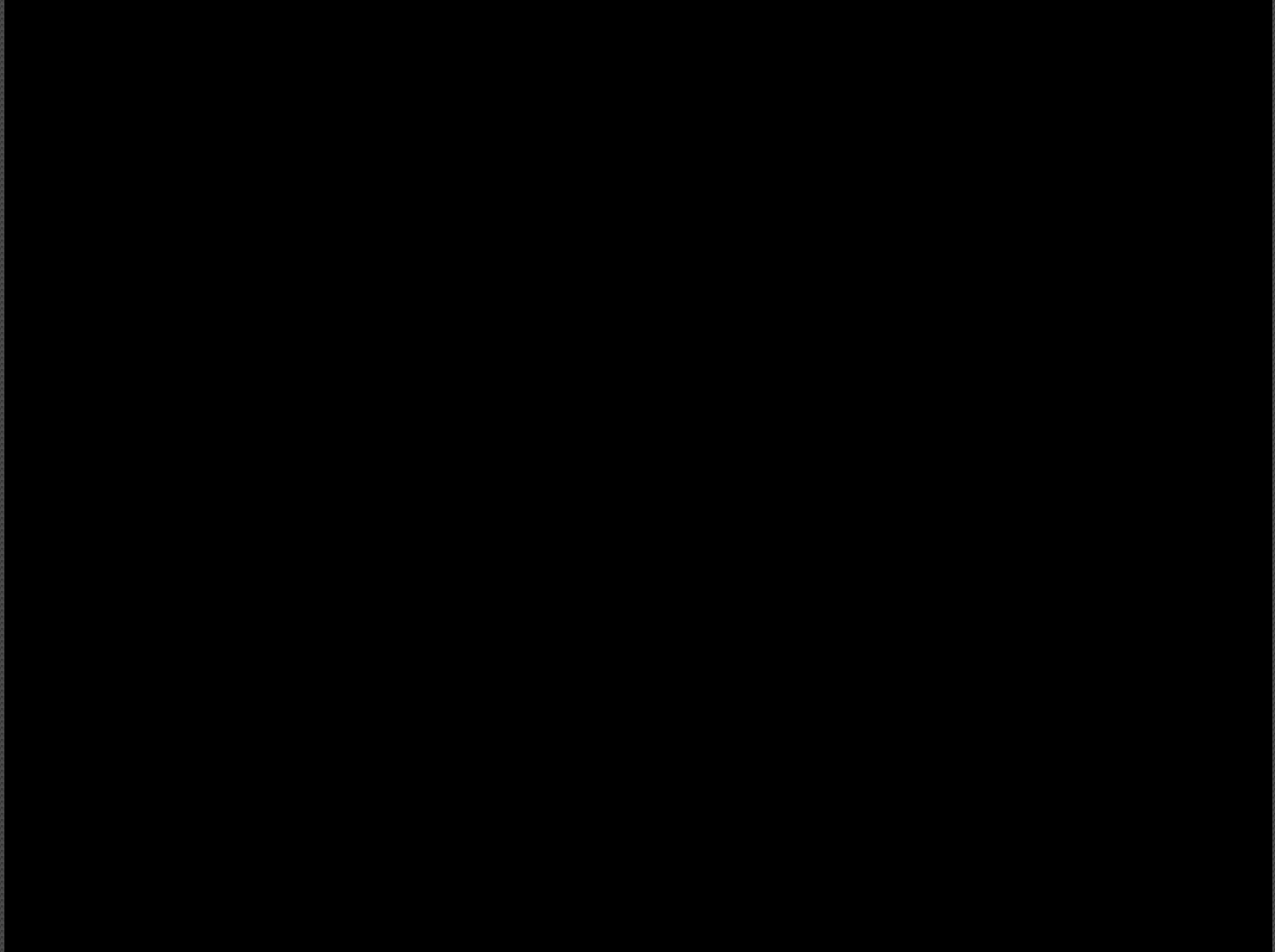
“STACK OF COINS” APPEARANCE



SPOTTER 11



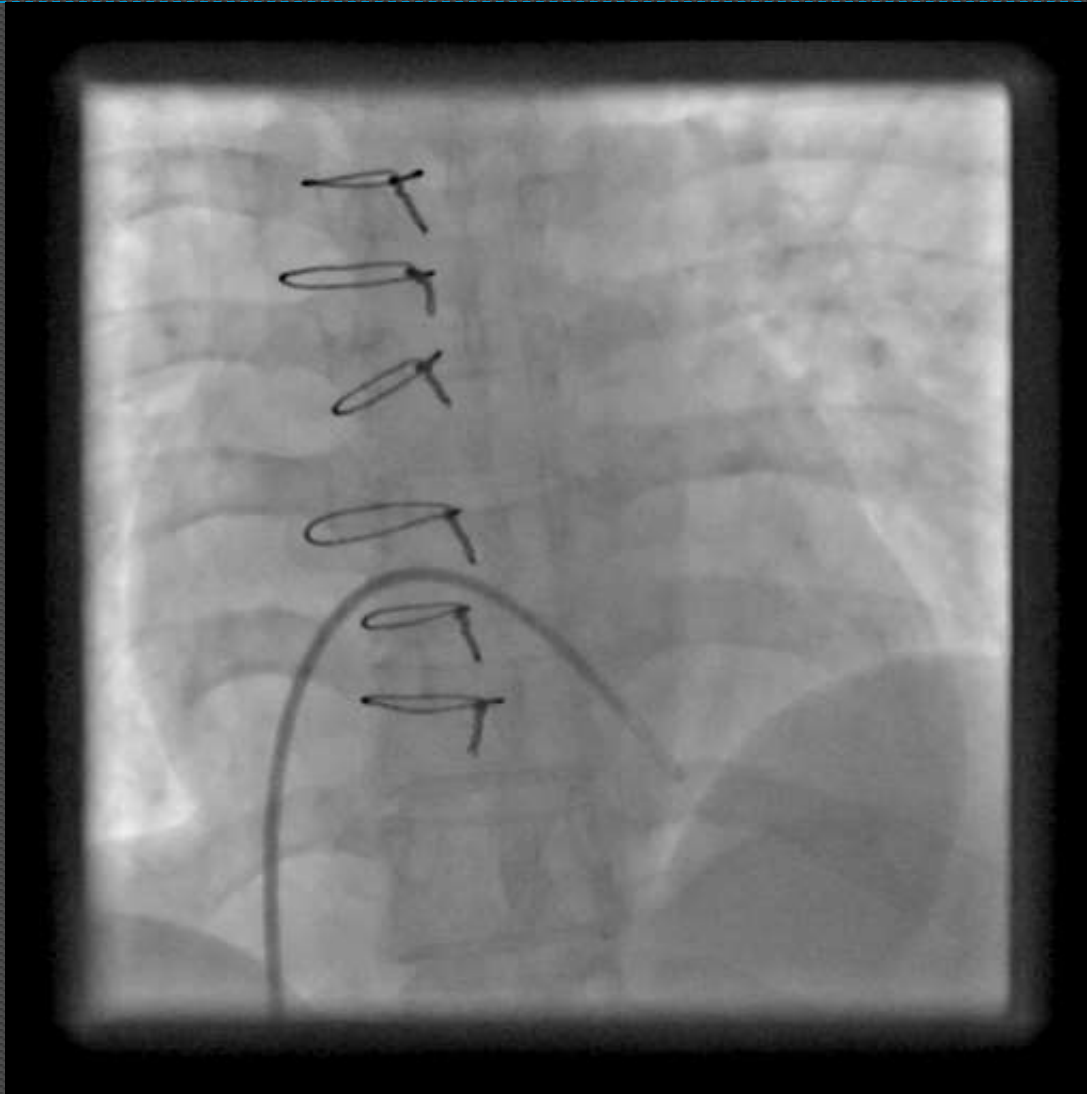
SPOTTER 12



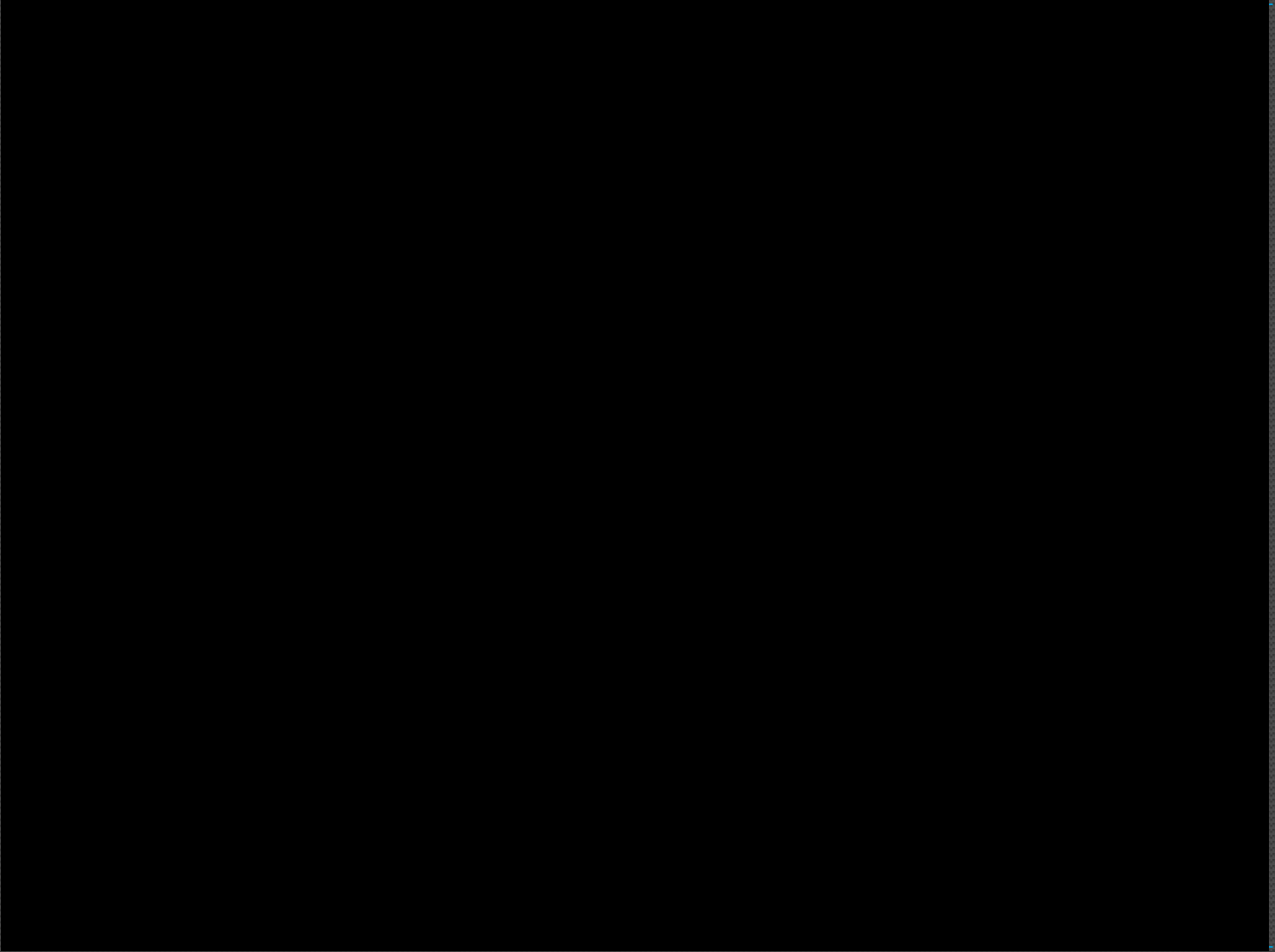
SPOTTER 13



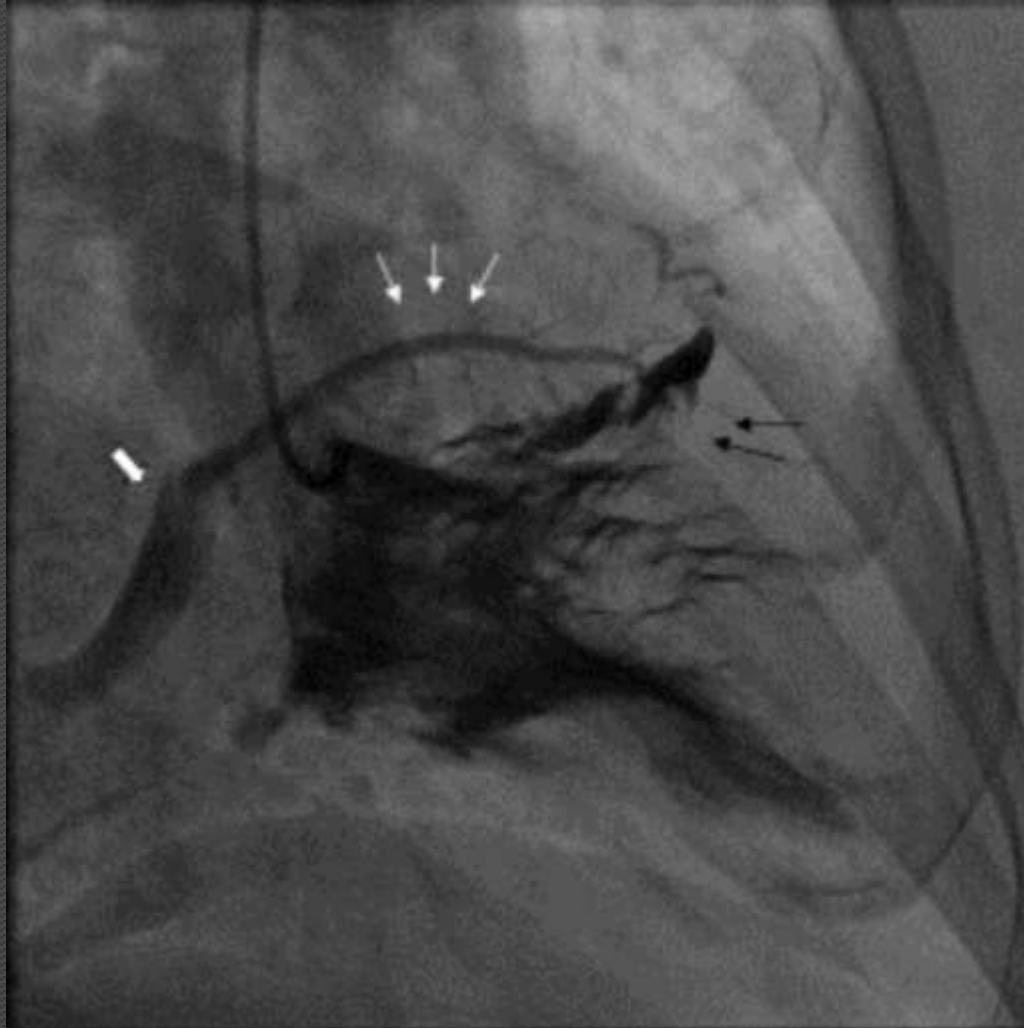
SPOTTER14



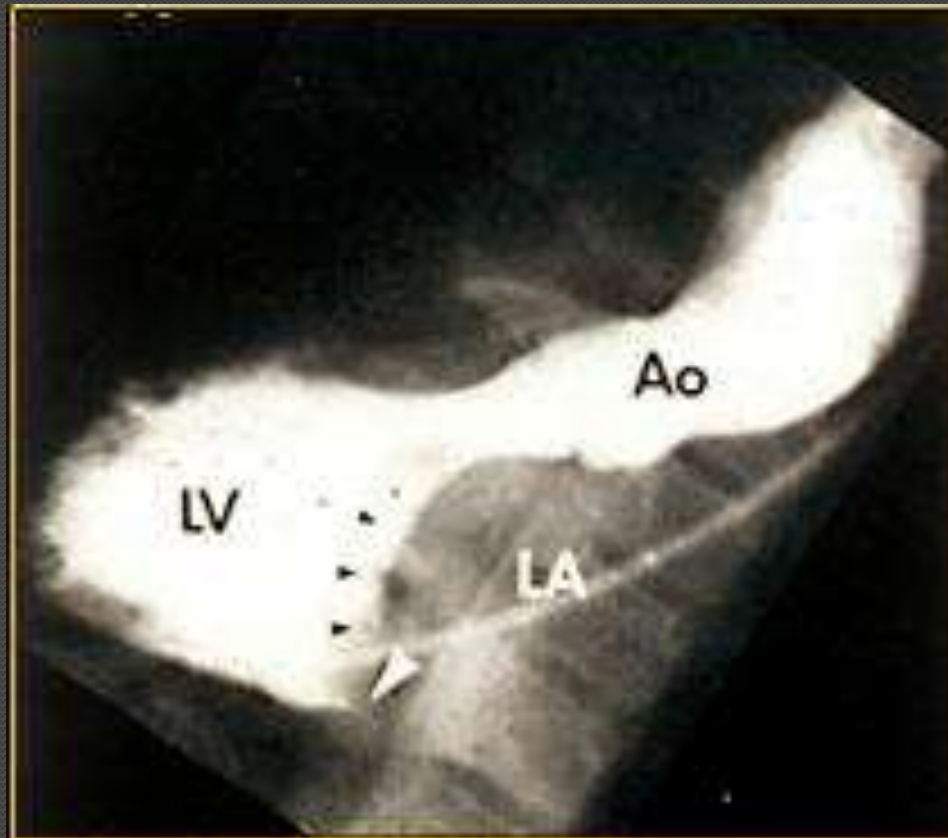
SPOTTER 15



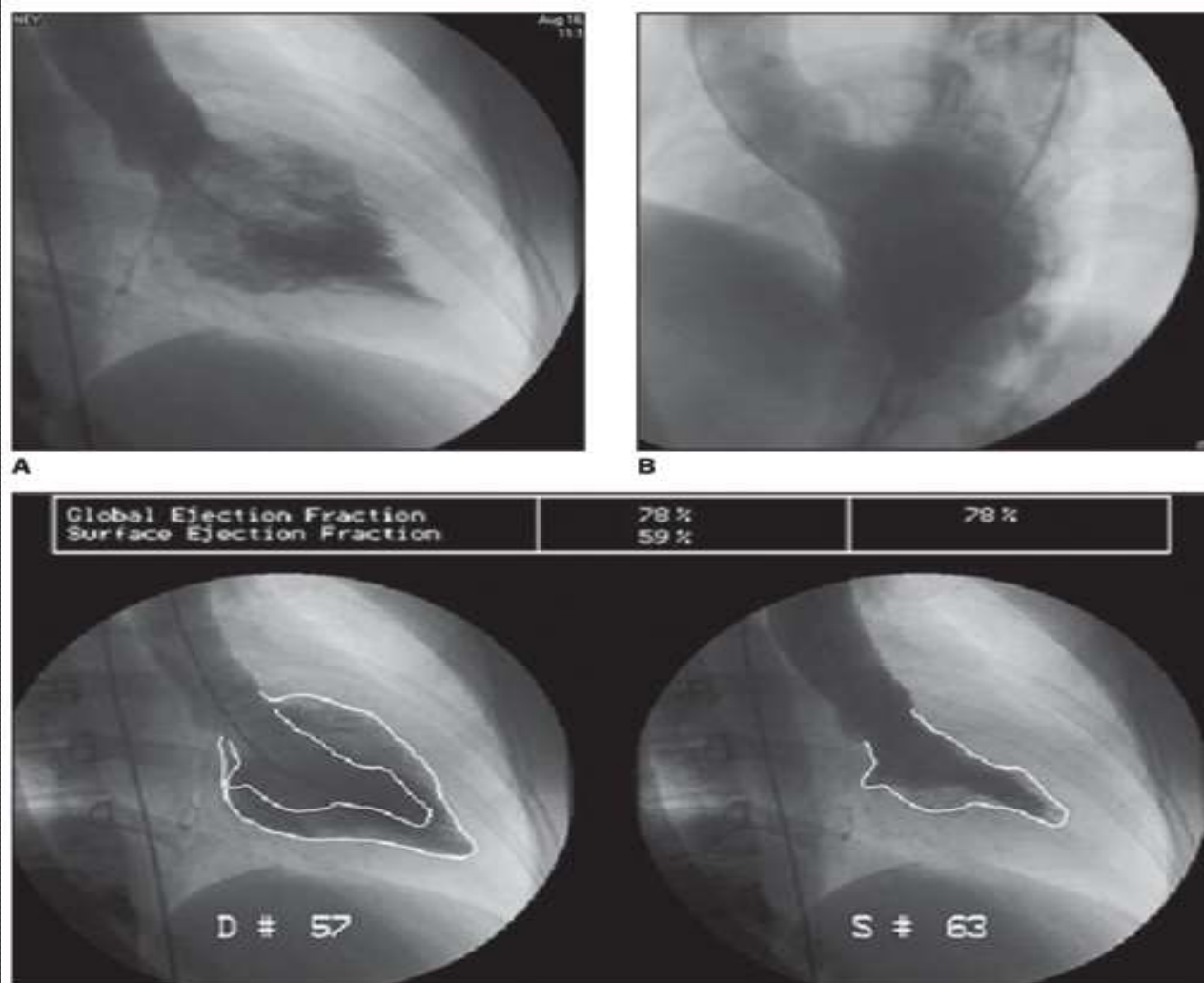
SPOTTER 16



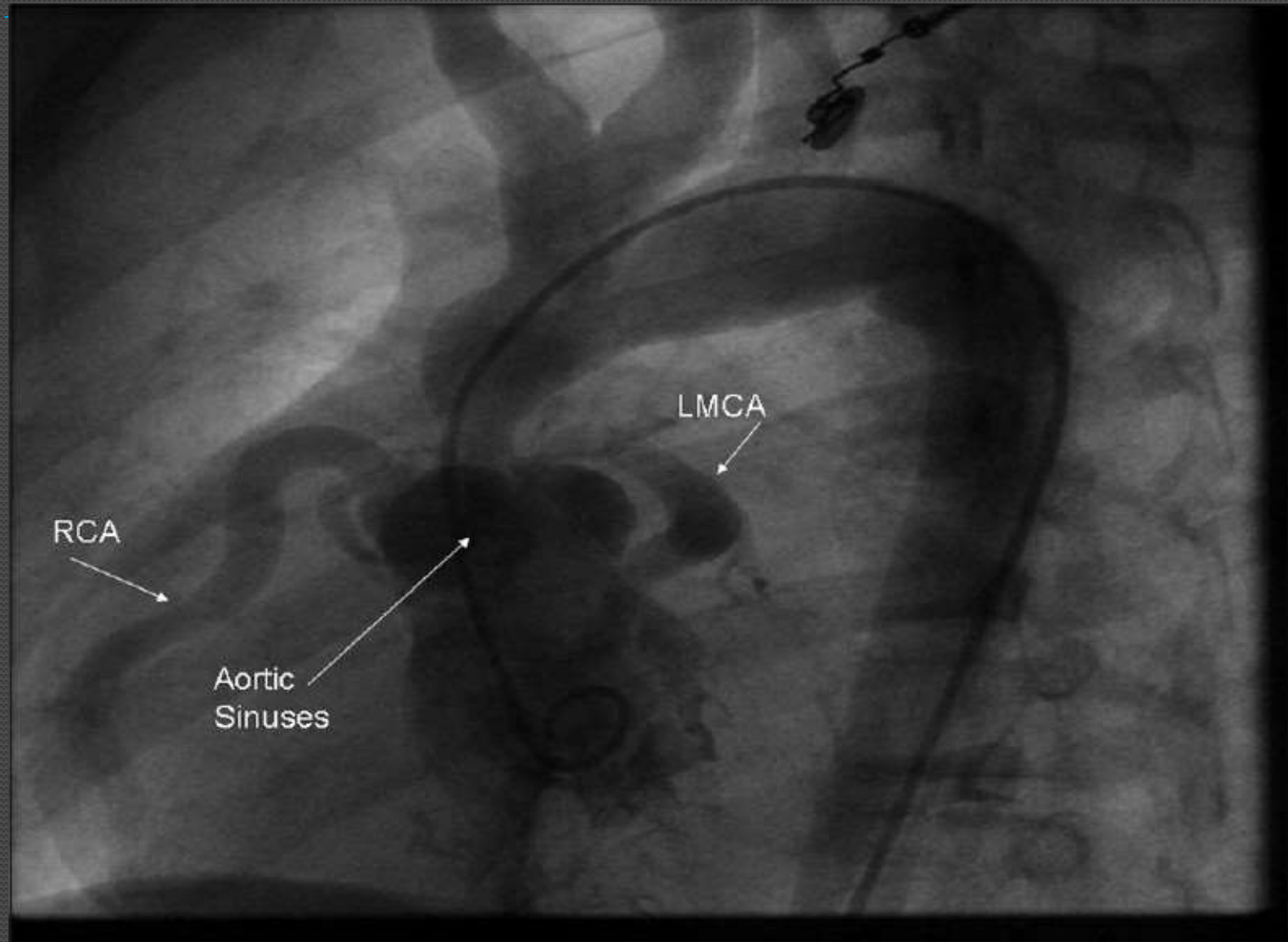
SPOTTER 17



SPOTTER18



SPOTTER 19





RHF



THANK YOU..



UTV