A Primer in Coronary Angiography

Core Curriculum for the Cardiovascular Clinician

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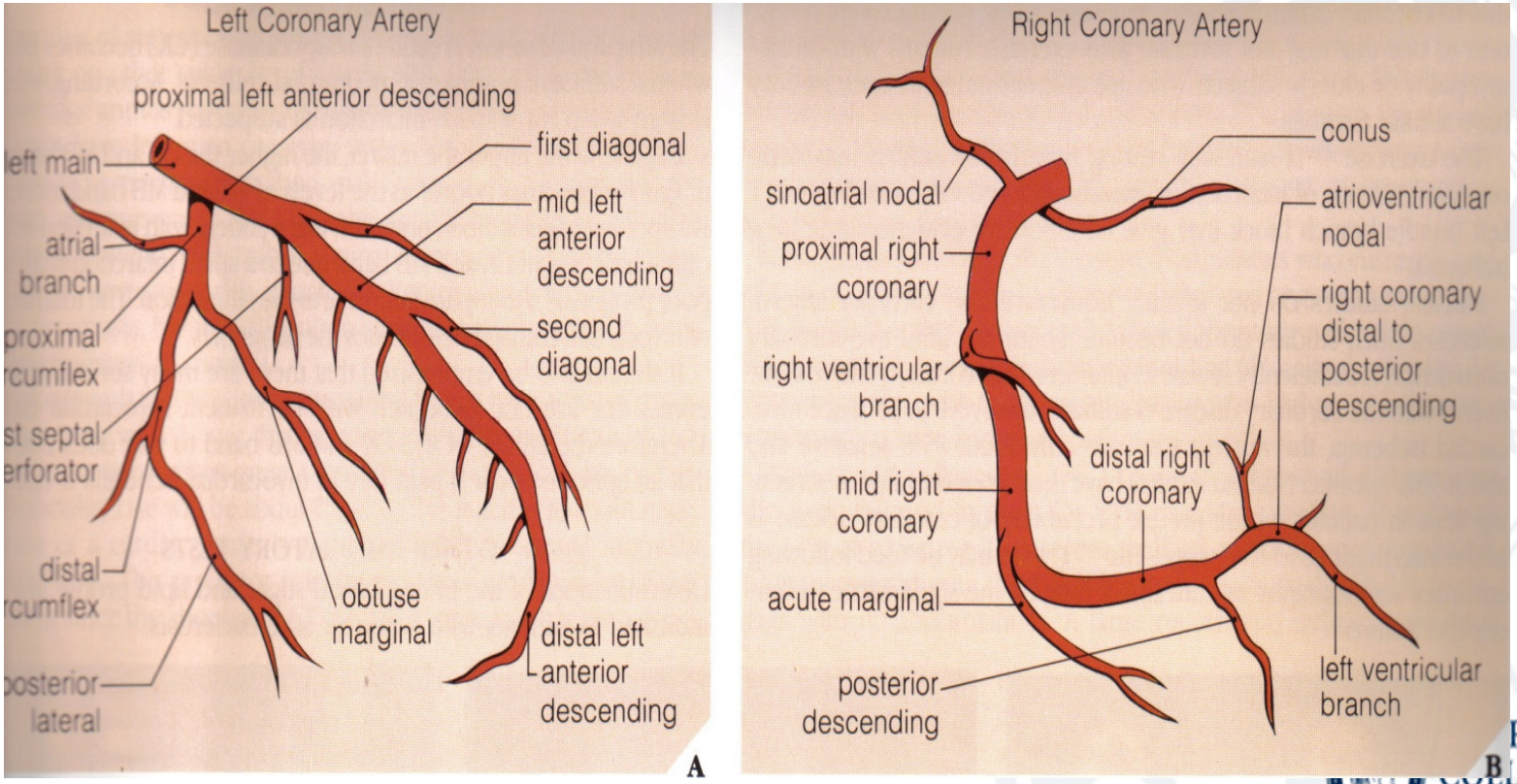
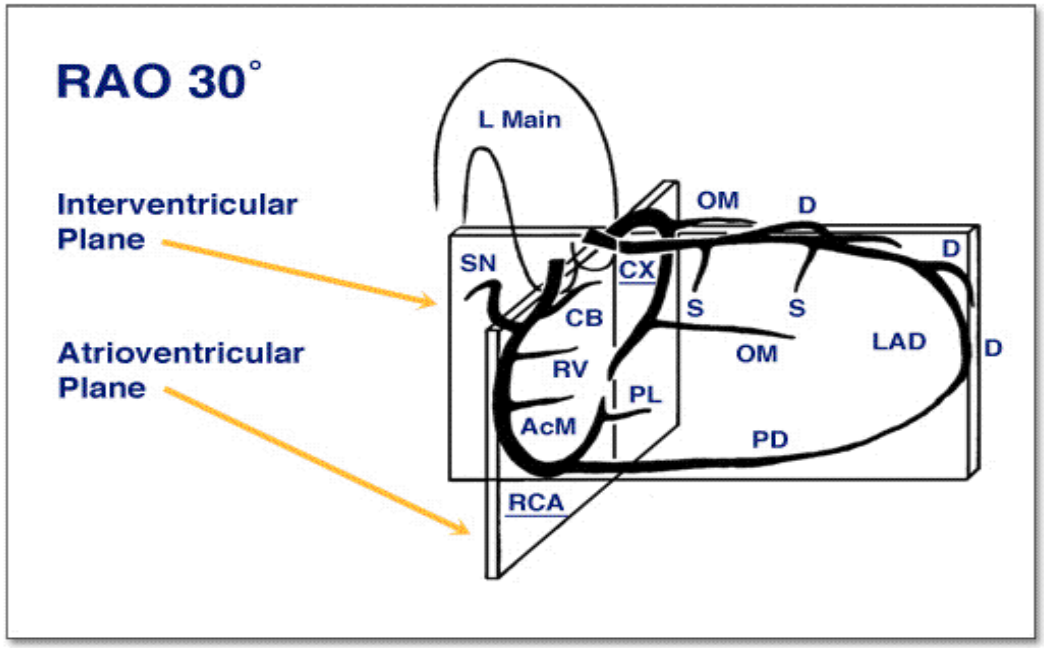
Coronary Anatomy

- Most important to know normal coronary anatomy and normal variants



Coronary Anatomy

- Epicardial tree lies in 2 primary planes
  - Atrio-Ventricular plane
    - CX and RCA
  - Interventricular plane
    - LAD and PDA



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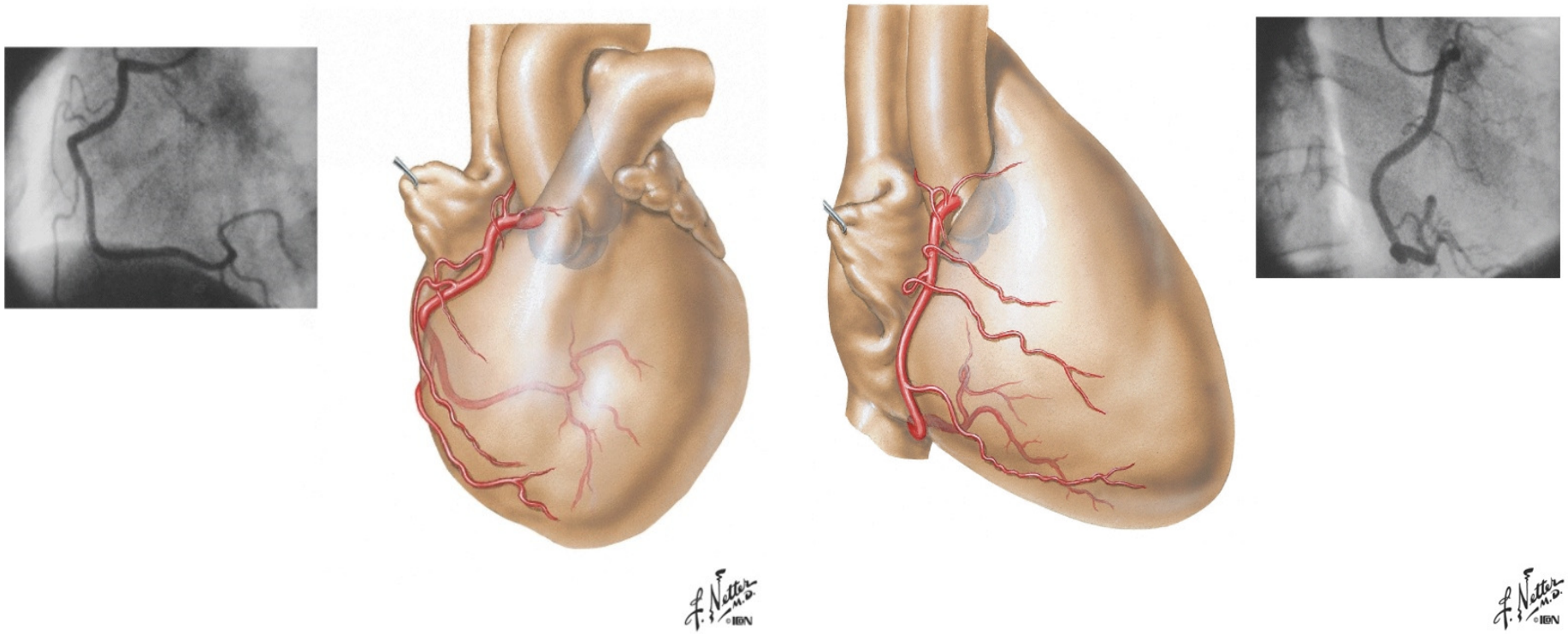
Right Coronary Artery



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Right Coronary Artery

- Origin
  - Right aortic sinus, lower than the LCA
- Course
  - courses inferiorly down AV groove toward crux
  - gives rise to PDA (85% are right dominant) and septals
  - continues in AV groove giving rise to posterolateral branches
  - PDA may originate proximally, bifurcate early, or be small with some of territory supplied by acute marginal branch
- Supplies
  - 25-35% of left ventricle

Right Coronary Artery

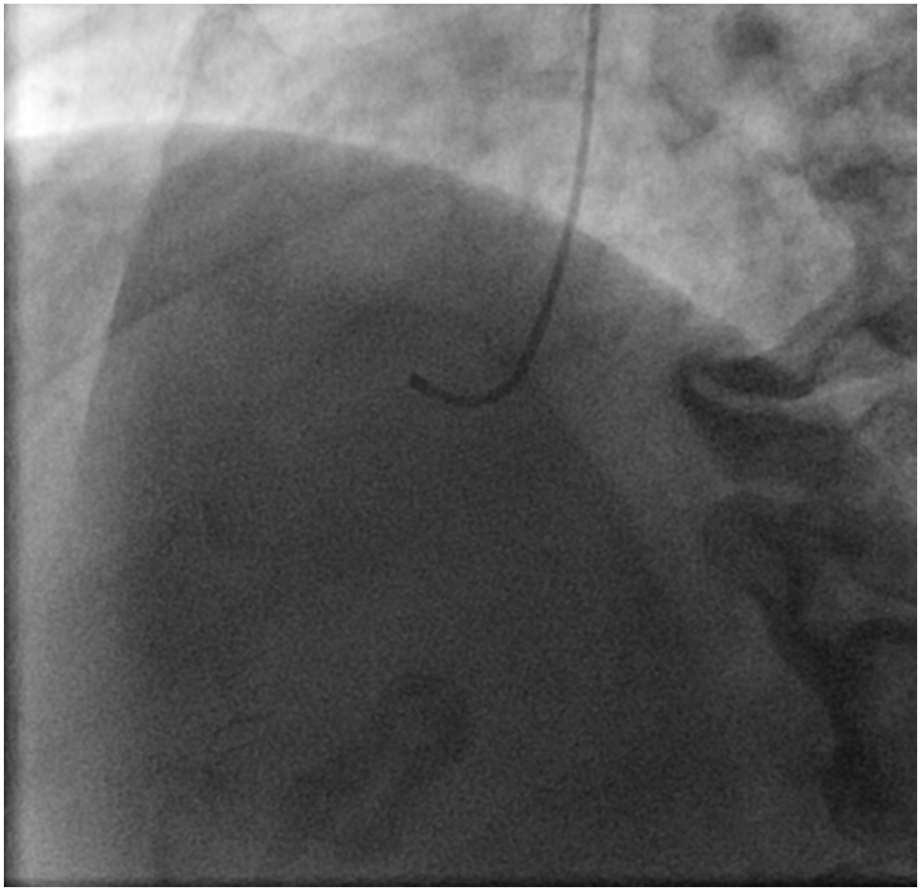
- Other Branches
  - SA Nodal Branch
    - usually the second branch of the RCA
    - courses laterally and superior/posterior
    - supplies the SA node, often the RA, and sometimes the LA
  - Conus artery
    - usually very proximal although 50% have separate ostium
    - anterior/superior course over RV outflow tract towards LAD
    - May be an important source of collaterals

Right Coronary Artery

- Other Branches

- Right ventricular or acute marginal branches
  - arise from the mid-RCA
  - supply the anterior aspect of the right ventricle
  - may be a source of collaterals
- AV Nodal artery
  - arises at or near the crux
  - supplies the AV node
- PDA
  - supplies inferior wall, inferior interventricular septum, and posteromedial papillary muscle

Right coronary, LAO



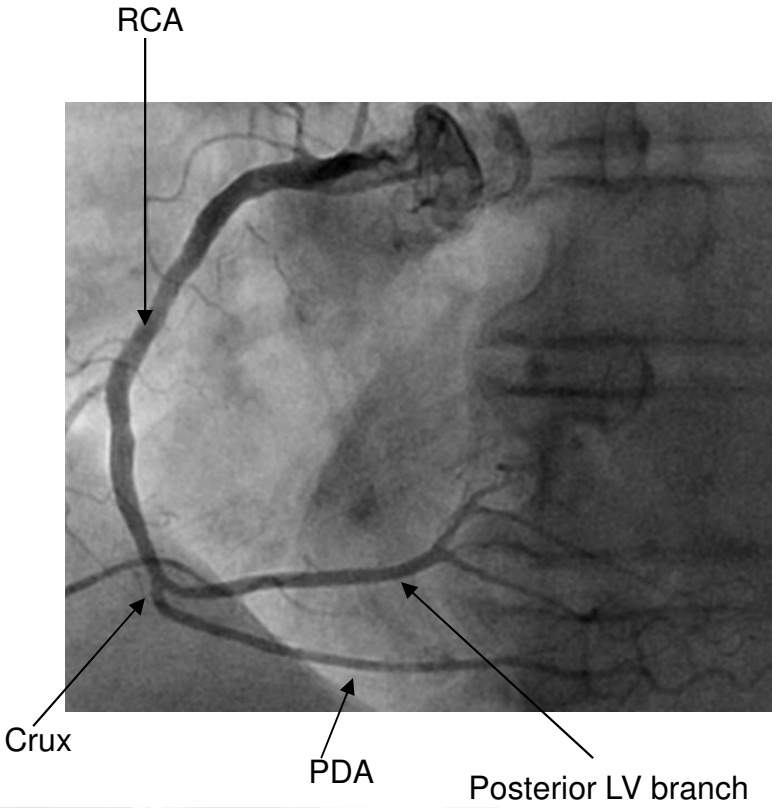
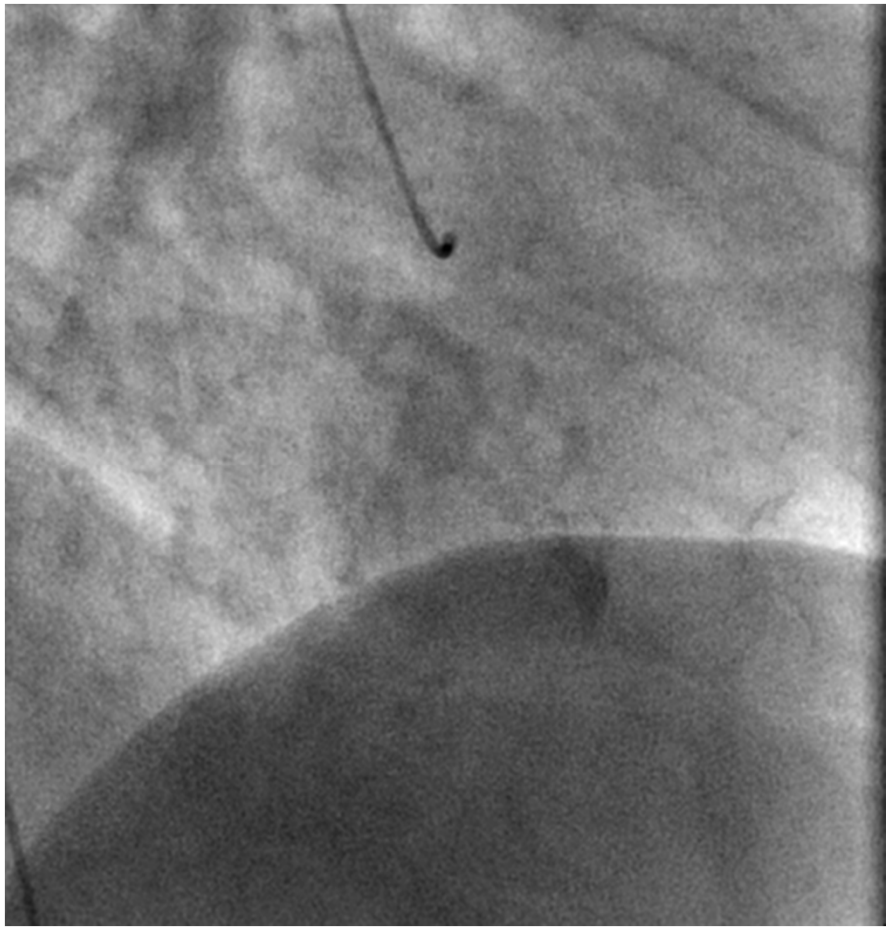


Image intensifier is moved from AP to LAO for catheter positioning and LAO projection image.

Right coronary, RAO



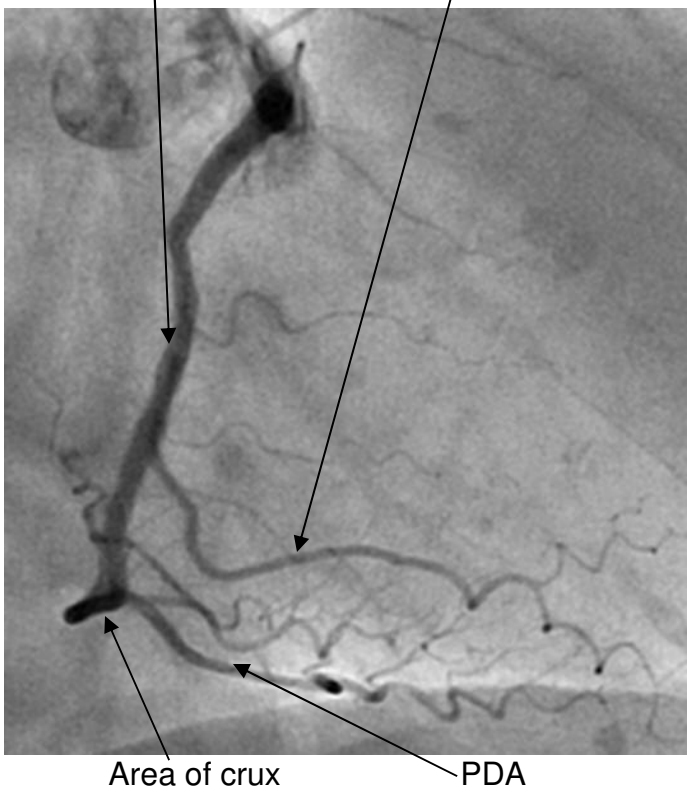
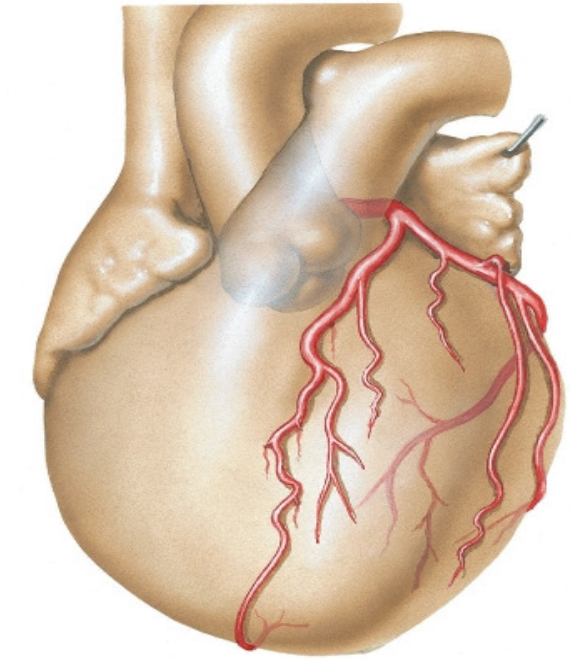
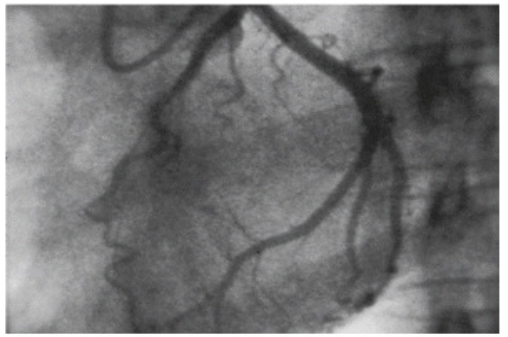


Image intensifier moved from LAO to RAO

Left Coronary Artery

Left Coronary Artery
Arteriographic View





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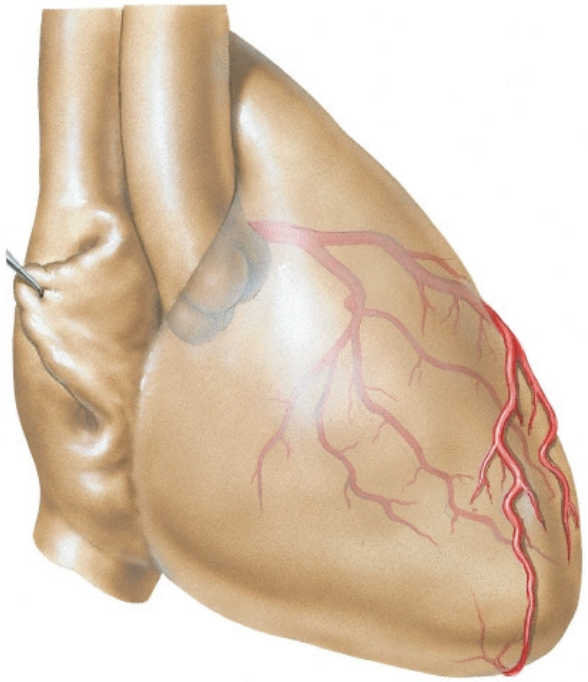
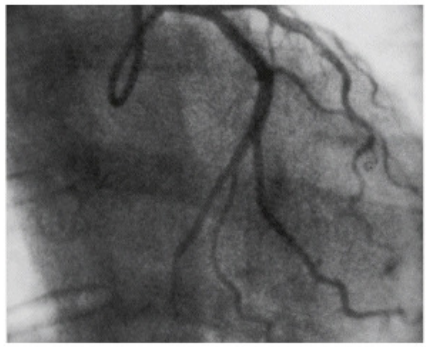
Left Coronary Artery

Left Coronary Artery
Arteriographic View





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Left Main Coronary Artery

- Origin
  - arises from the upper left aortic sinus just below the sino-tubular ridge
  - left main is typically 5-12 mm in length
  - separate LAD and LCx origins a rare variant
- Angiographic Technique
  - Judkins L4 most commonly
  - other Judkins Left sizes available (3.0, 3.5, 4.5, 5.0, 6.0, 7/0)
  - can also use C-curve catheters (XB, CLS, EBU) and Amplatz
  - be aware of hemodynamic dampening
  - for separate ostia use larger catheters for LCx, counter for LAD
- Optimal Views
  - shallow LAO, LAO cranial or caudal, AP cranial or caudal
  - minimize views if left main diseased
  - IVUS or FFR may be of benefit

Left Anterior Descending Artery

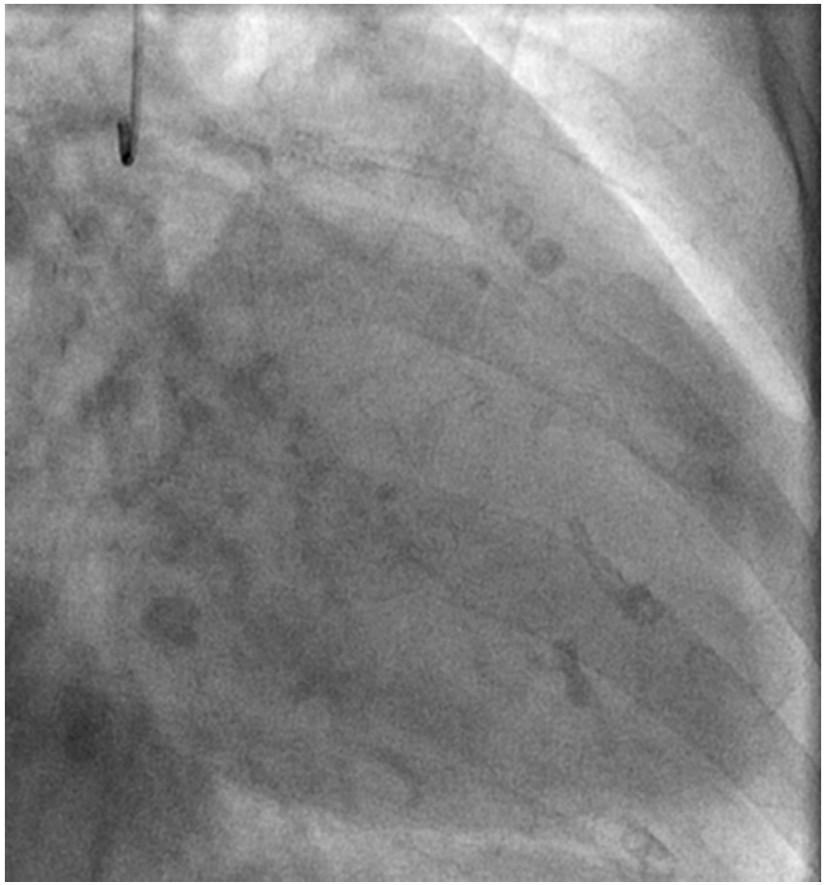
- Origin
  - LAD originates from the let main
  - the LAD courses down the superior interventricular groove
  - does not reach the apex in 20-25%
- Branches
  - septal branches supply the interventricular septum
  - diagonal branches supply the lateral wall and the anterolateral papillary muscle
- Territory
  - Typically supplies the anterolateral, apical, and septal regions, approximately 45-55% of left ventricle

Left Circumflex Coronary Artery

- Origin
  - bifurcates from the left main
  - LCx courses down the posterior atrioventricular groove
  - dominant vessel in 8%
- Branches
  - lateral branches are obtuse marginals
  - 35-40% have a proximal branch at the LAD/LCx bifurcation called the ramus intermedius
  - posterolateral branches if dominant or co-dominant
  - SA nodal artery in 35-40%
- Territory
  - supplies posterolateral region
  - contributes to anterolateral papillary muscle
  - 15-25% of LV if non-dominant and 40-50% if dominant

The following loops and still images are actual cine loops in the standard projections as labeled with labels on fixed images. The lower middle loops show image intensifier positioning.

Left coronary, RAO caudal



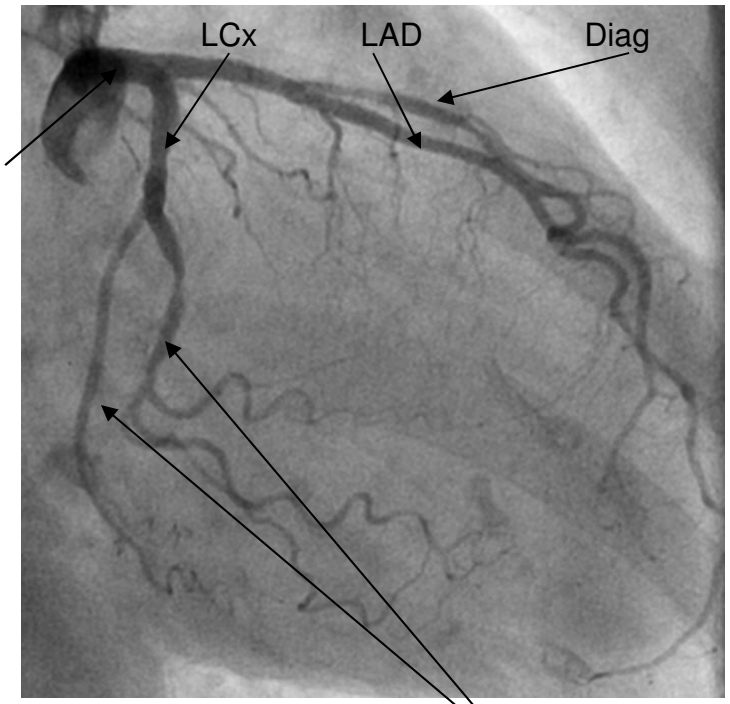
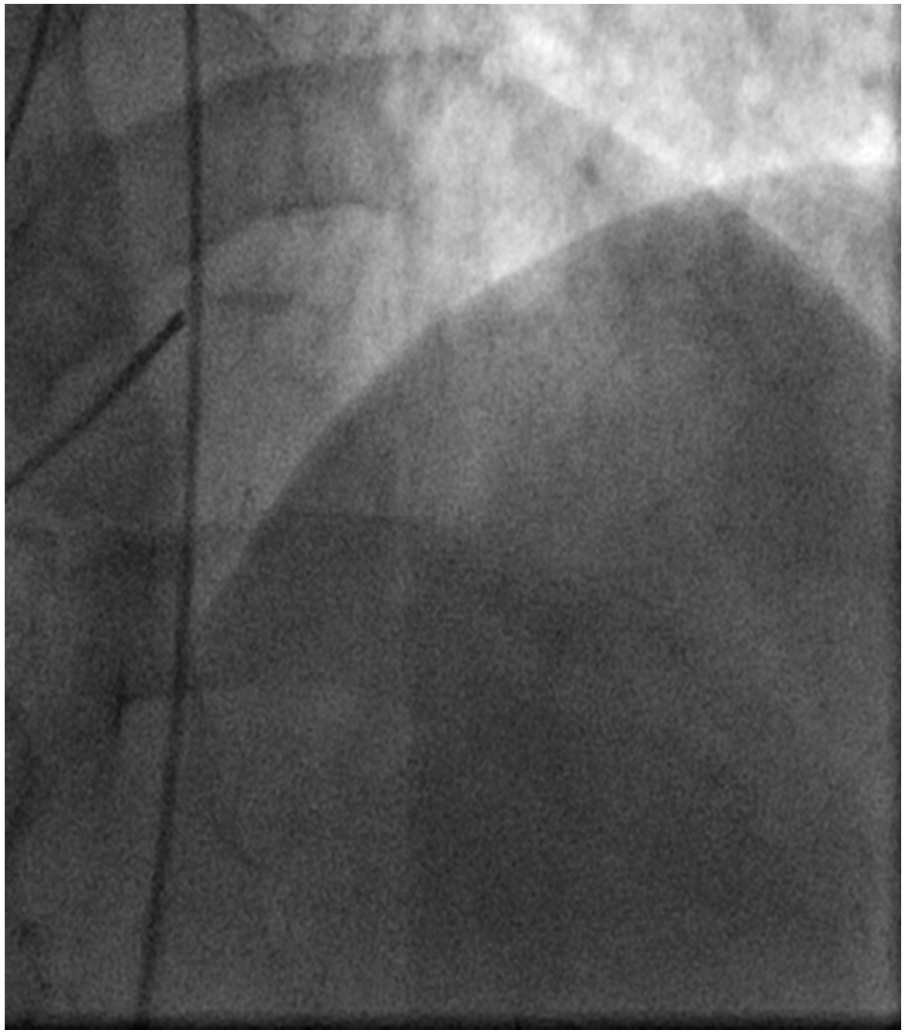


Image intensifier rotated from AP to RAO caudal

Left coronary, RAO cranial



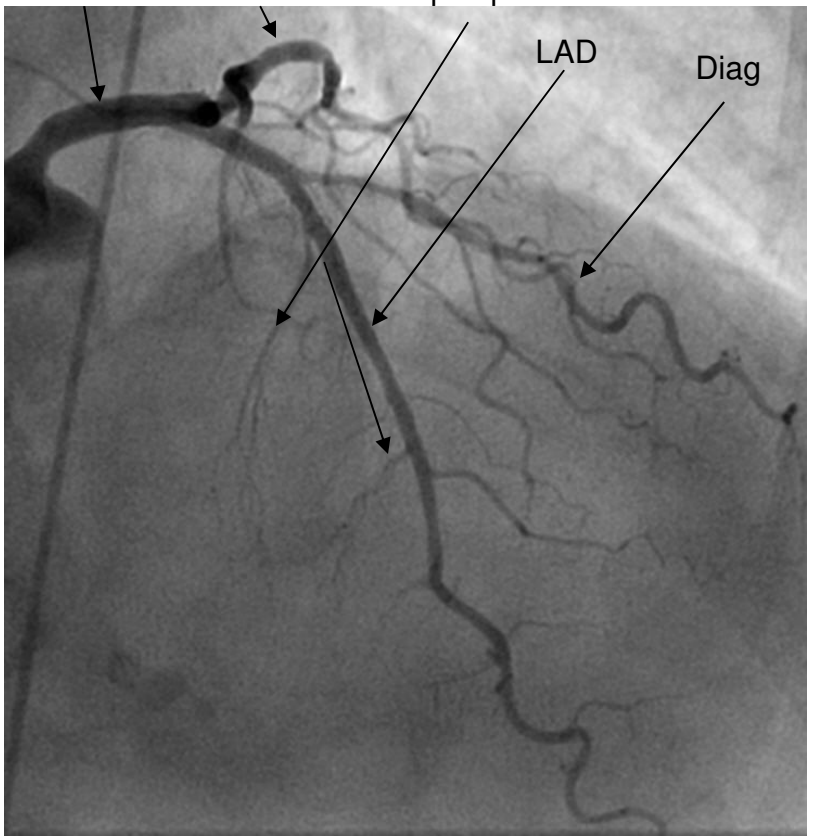
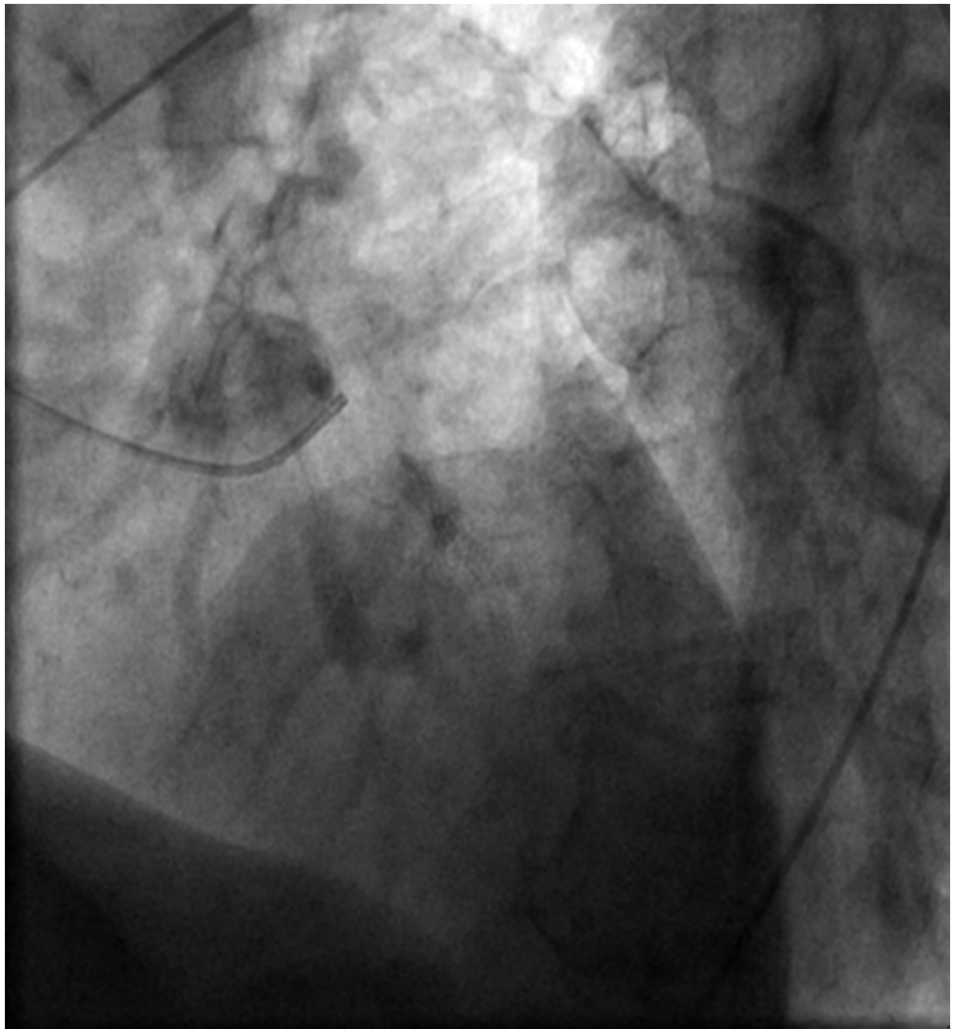


Image intensifier rotated from RAO caudal to RAO cranial

Left coronary, LAO cranial



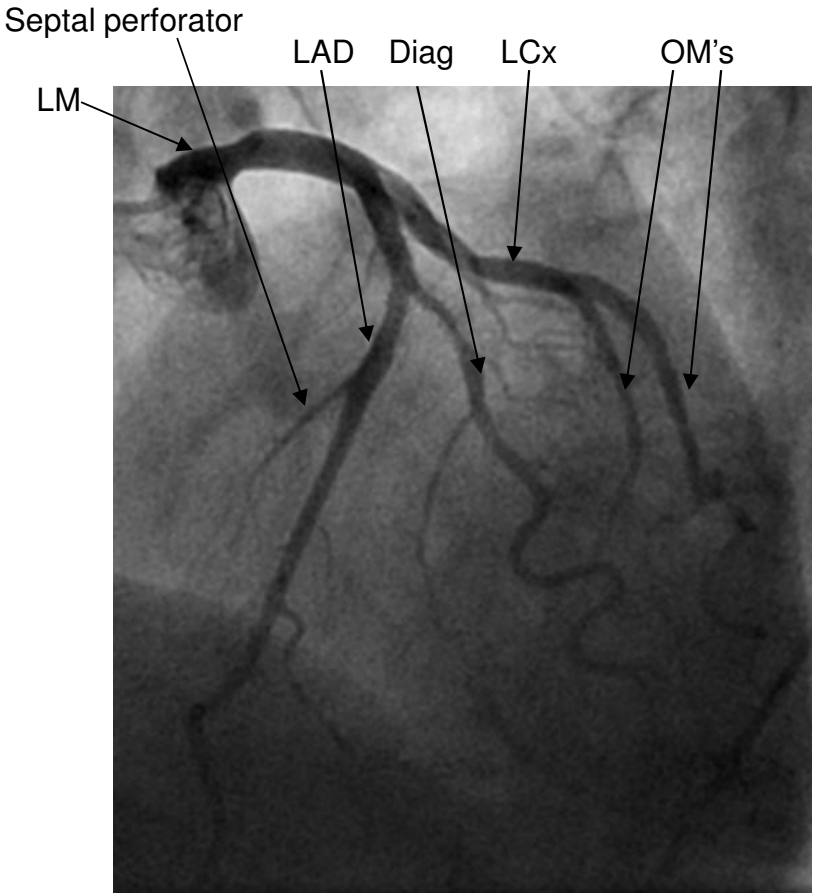
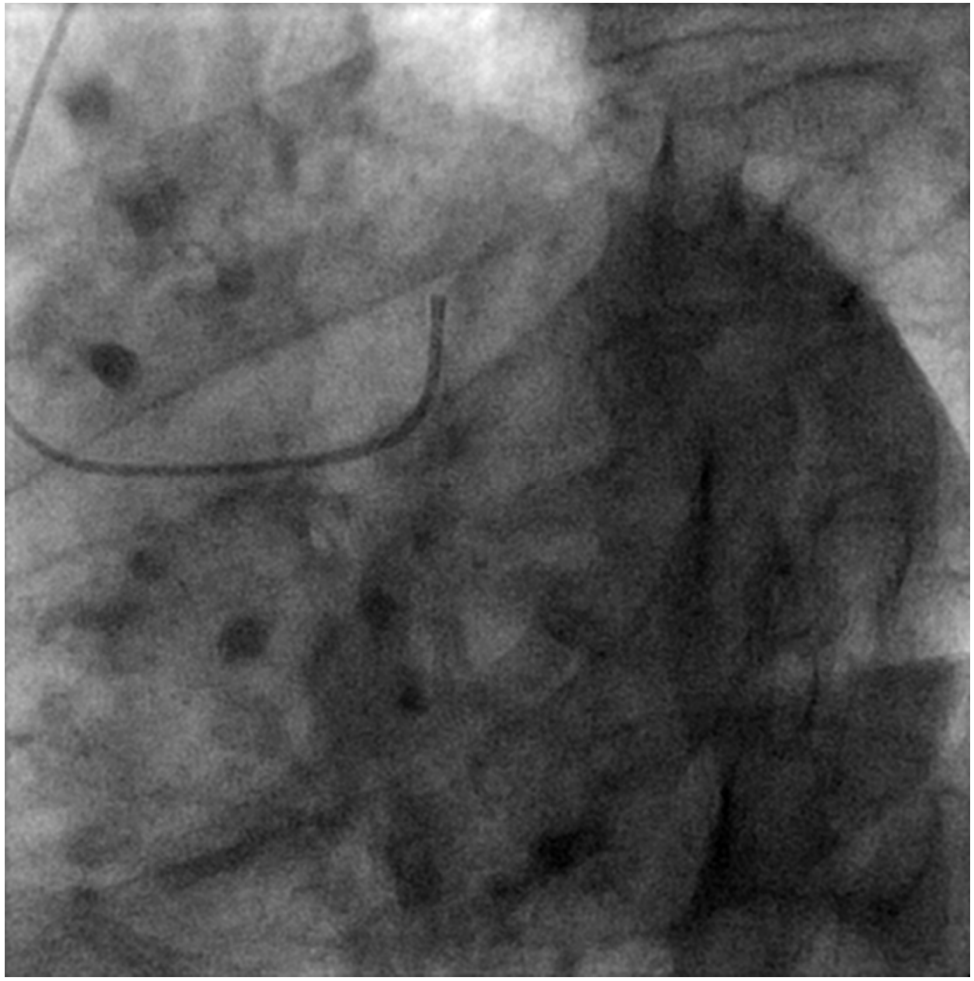


Image intensifier rotated from RAO cranial to LAO cranial

Left coronary, LAO caudal



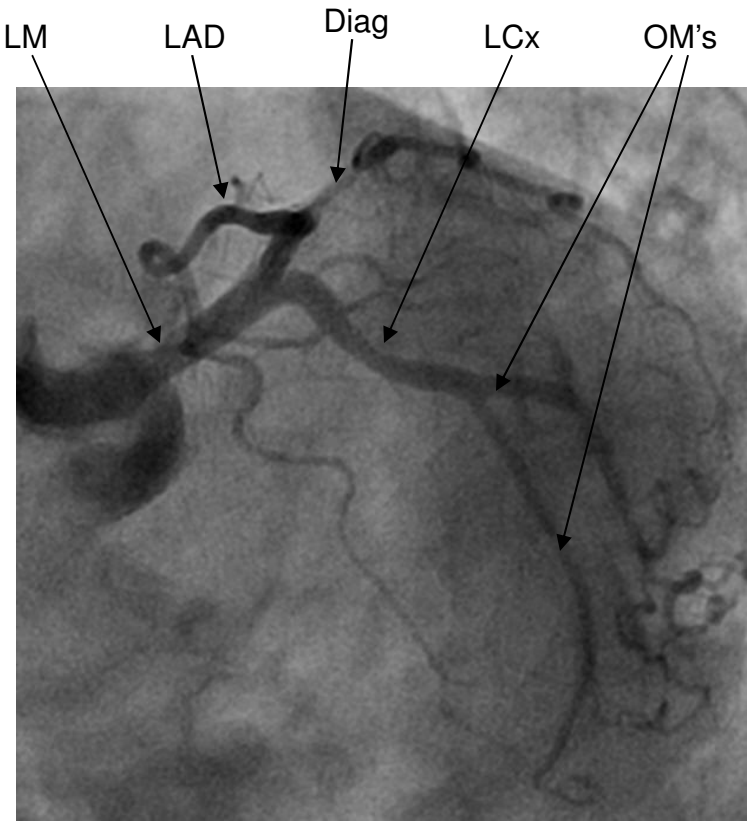


Image intensifier rotated from LAO cranial to LAO caudal

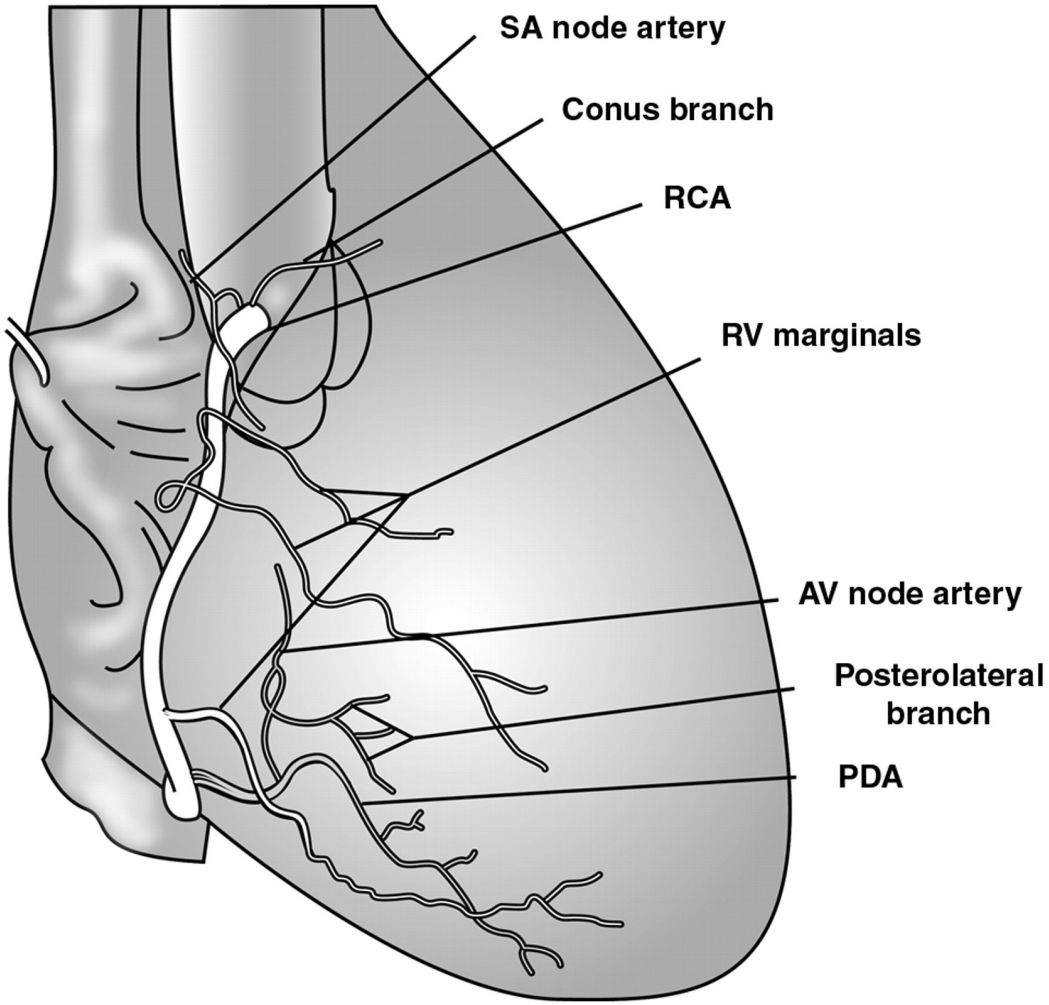
Coronary Dominance

- Two Definitions

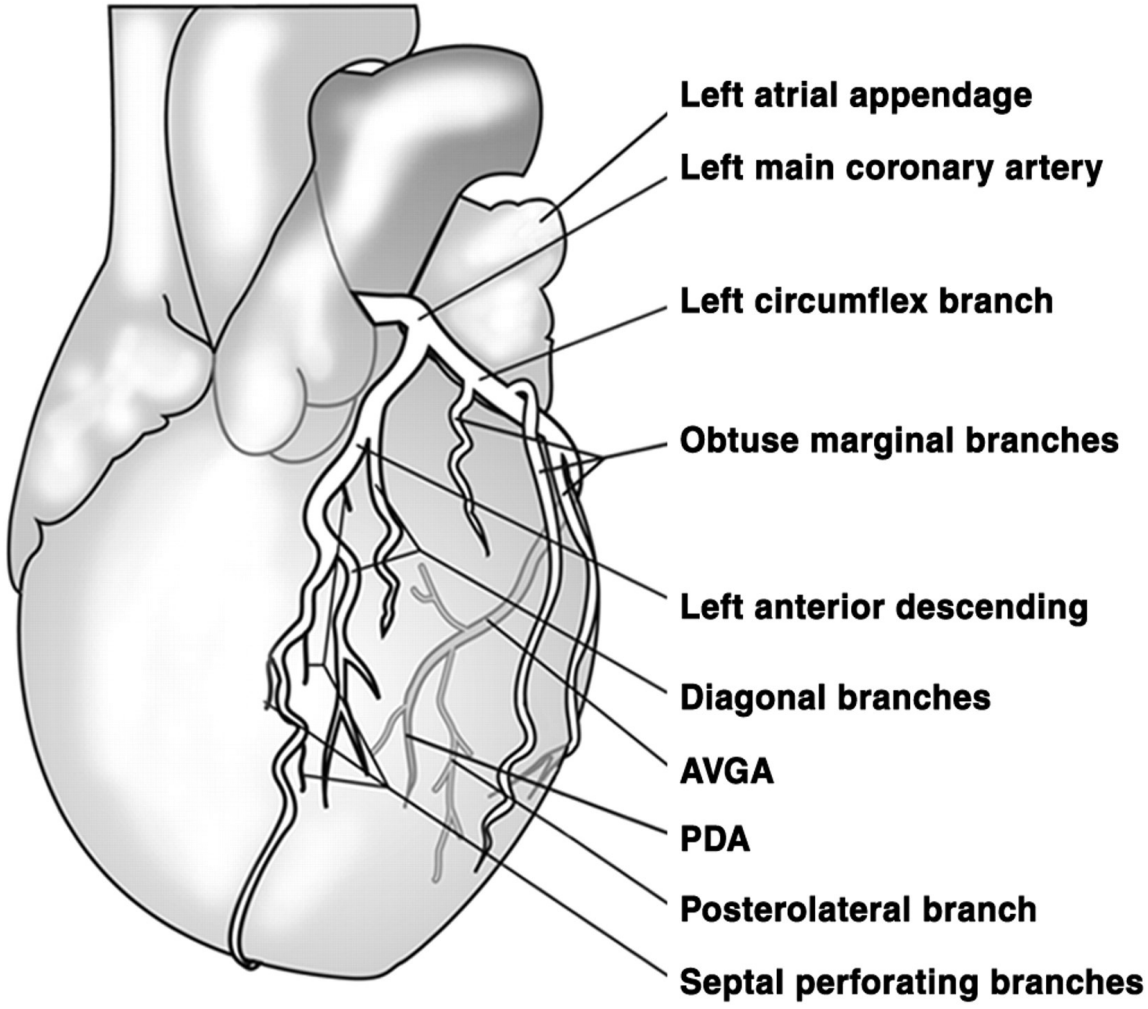
- Definition #1
  - The vessel that reaches the crux of the heart and gives rise to the posterior descending artery (PDA) is dominant

- Definition #2
  - The vessel that gives rise to the PDA and the posterolateral branches is dominant. Definition #2 allows for co-dominance.

Schematic of Dominant RCA



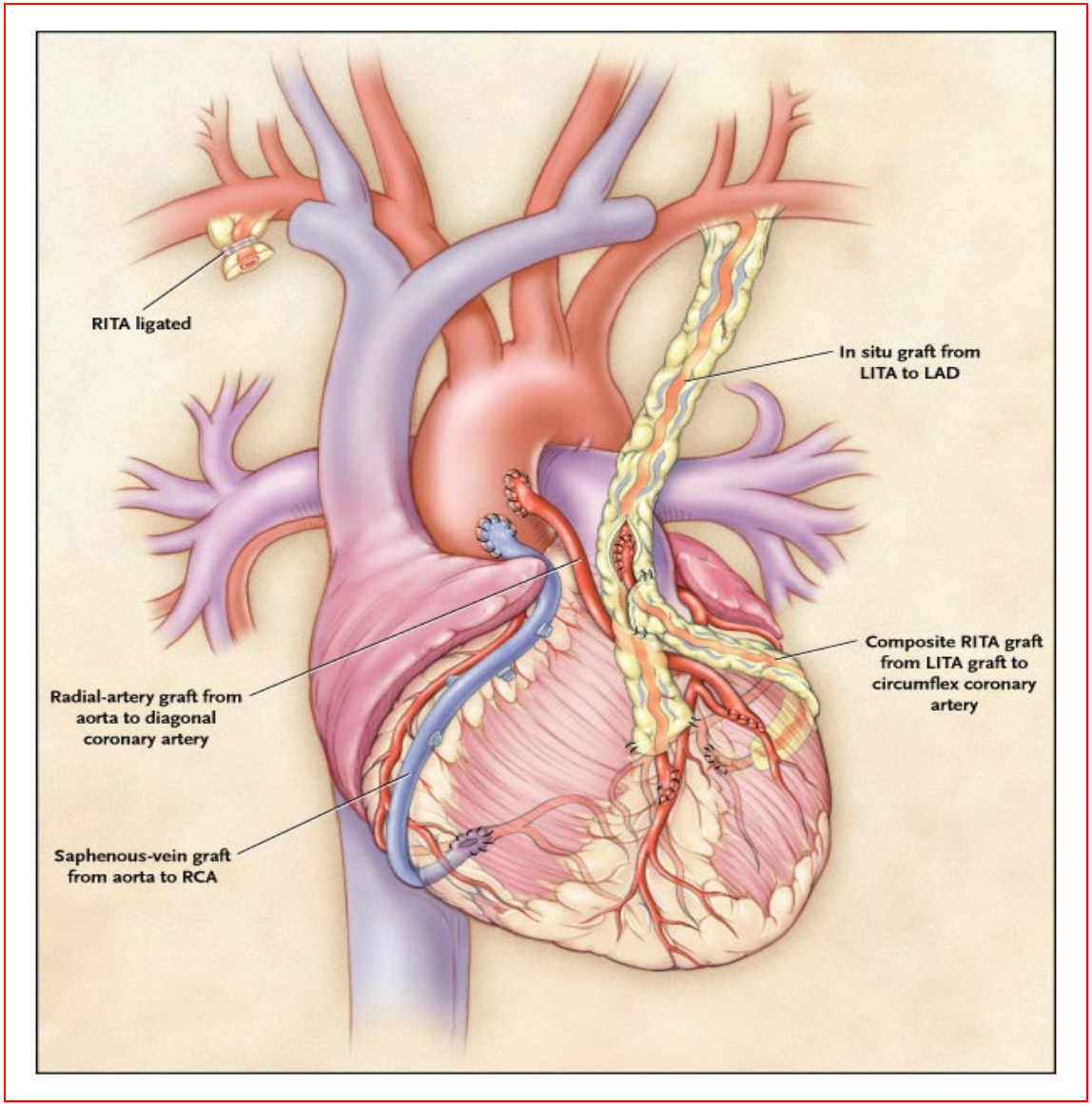
Schematic of Dominant Left Circumflex



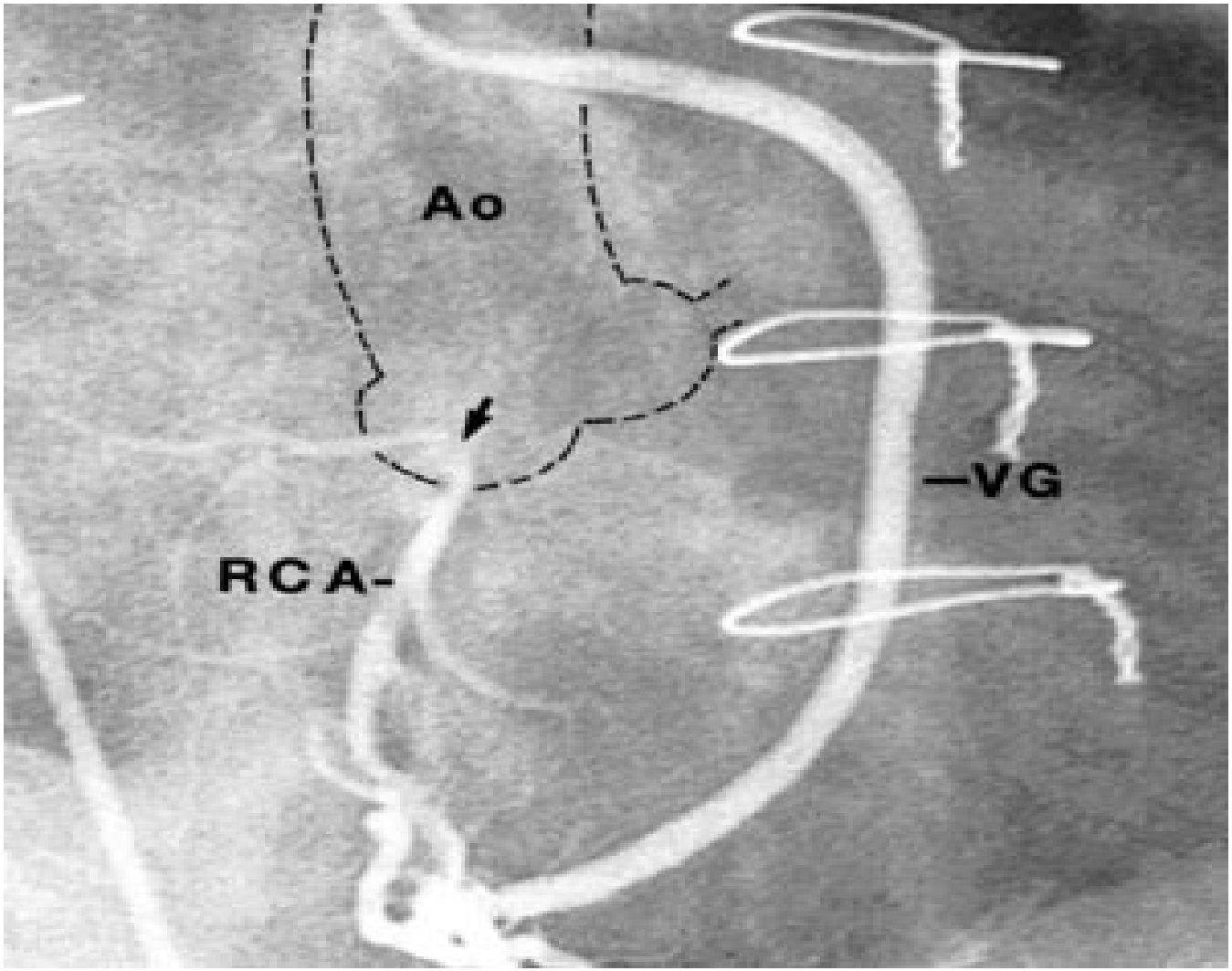
Coronary Complimentarity

- if the posterior descending artery is large, the LAD will likely be small.
- if the circumflex is large, with significant posterolateal branches, the RCA will be small.
- if the circumflex is dominant and large, both the LAD and RCA will be small
- etc!!!

Completed Coronary Bypass Operation

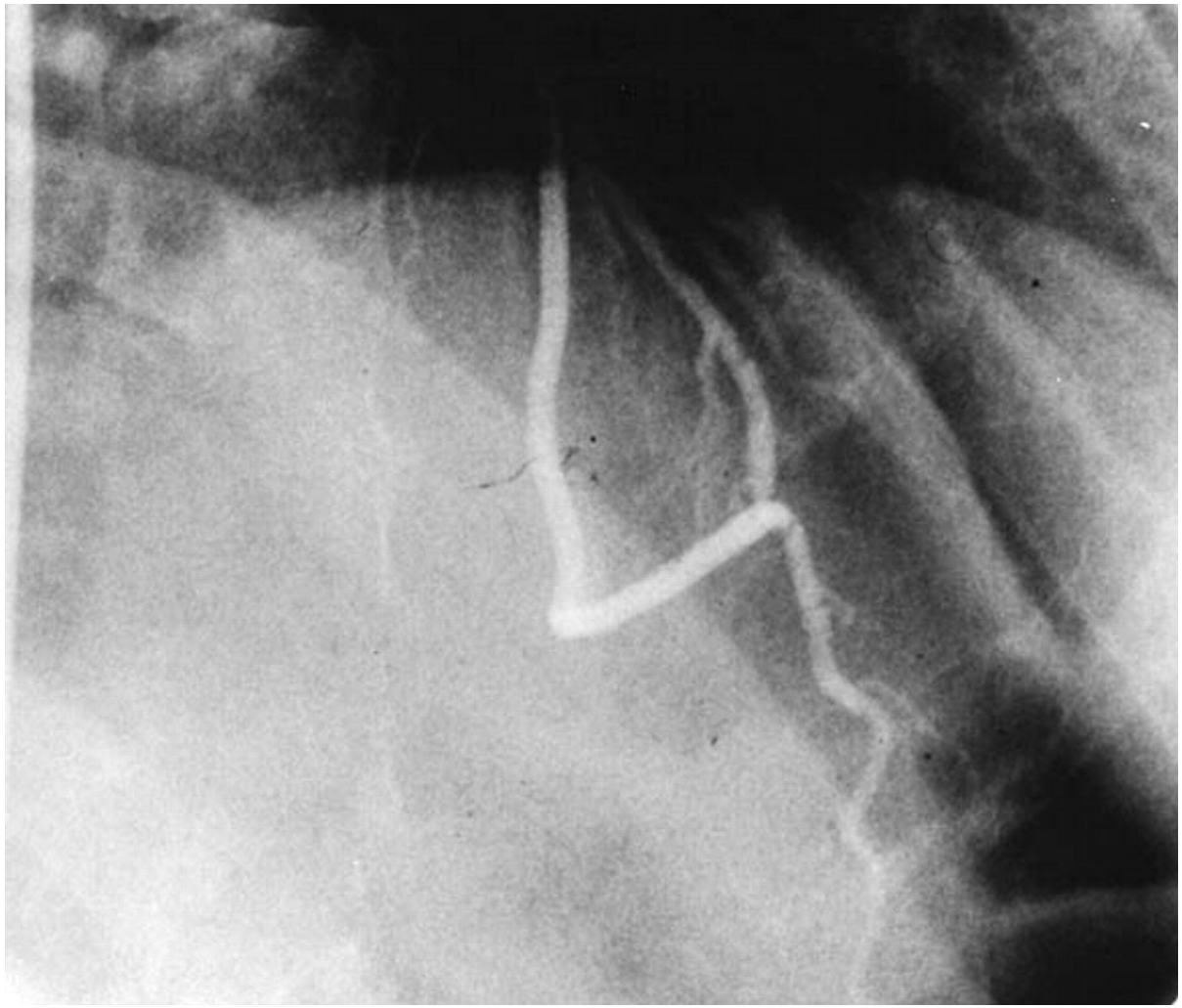


Anatomy of a Bypass Graft

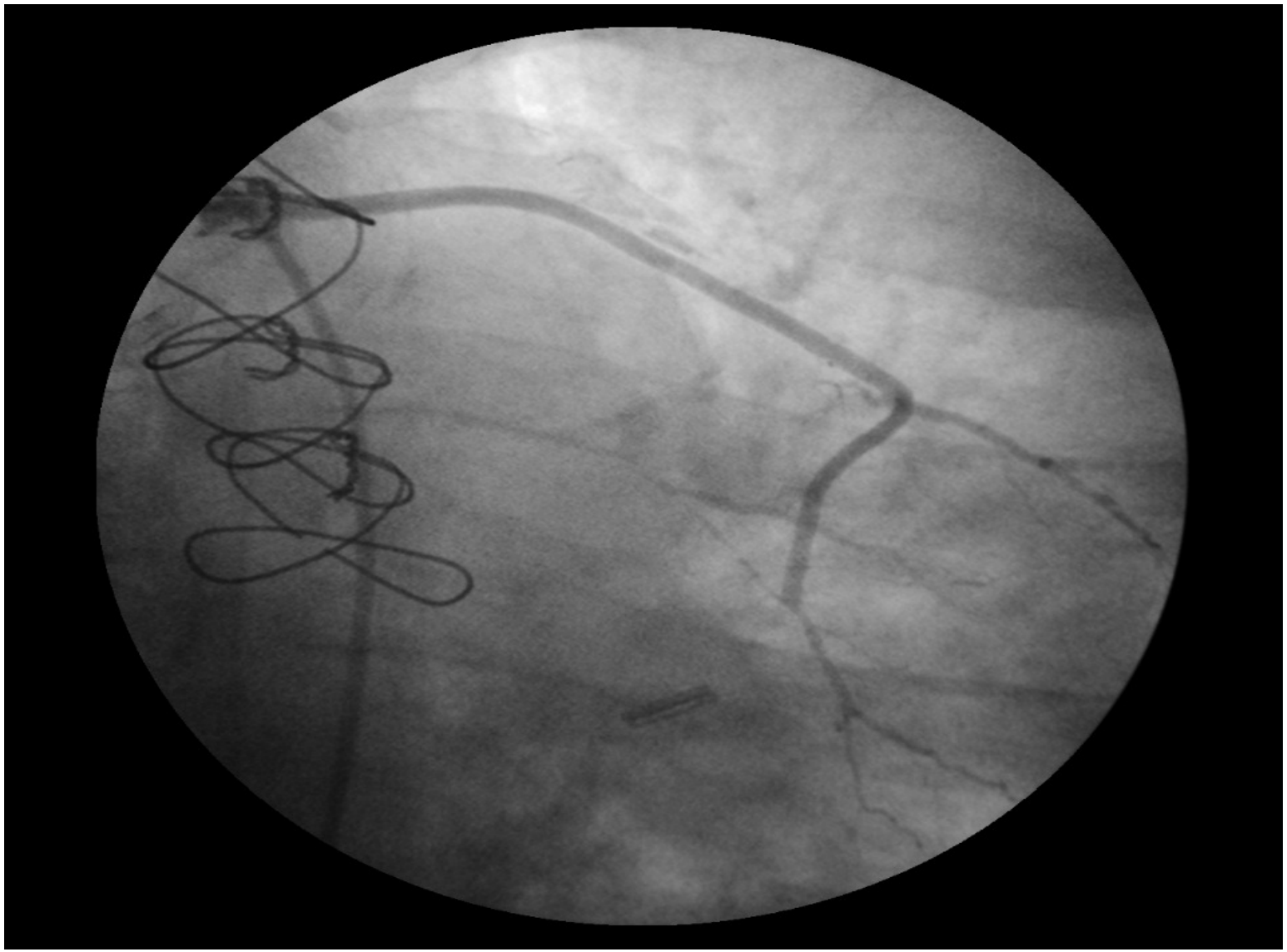


Saphenous Vein Bypass Graft to the Circumflex (SVG-LCx)

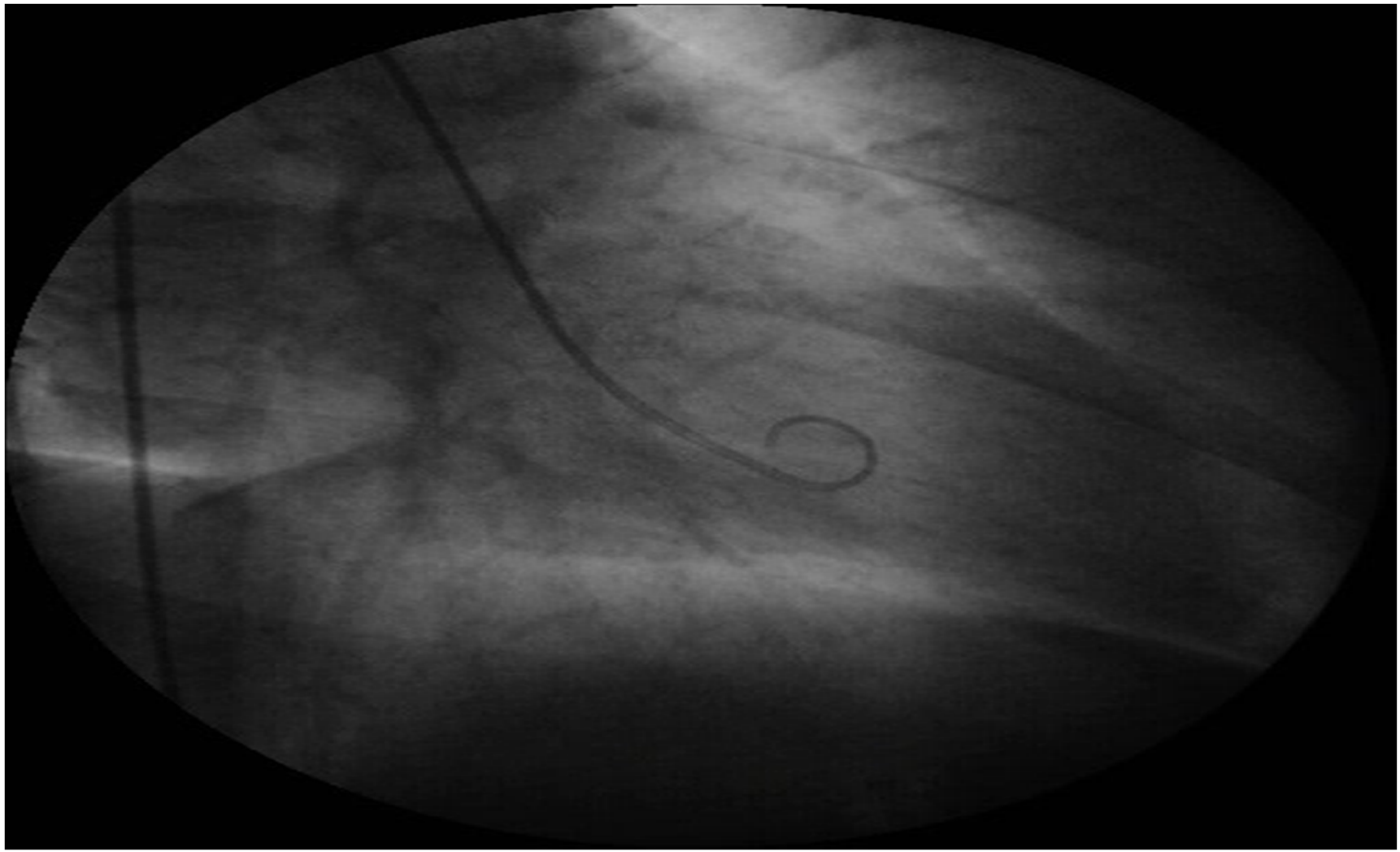
IMA Graft to the LAD (LIMA – LAD)

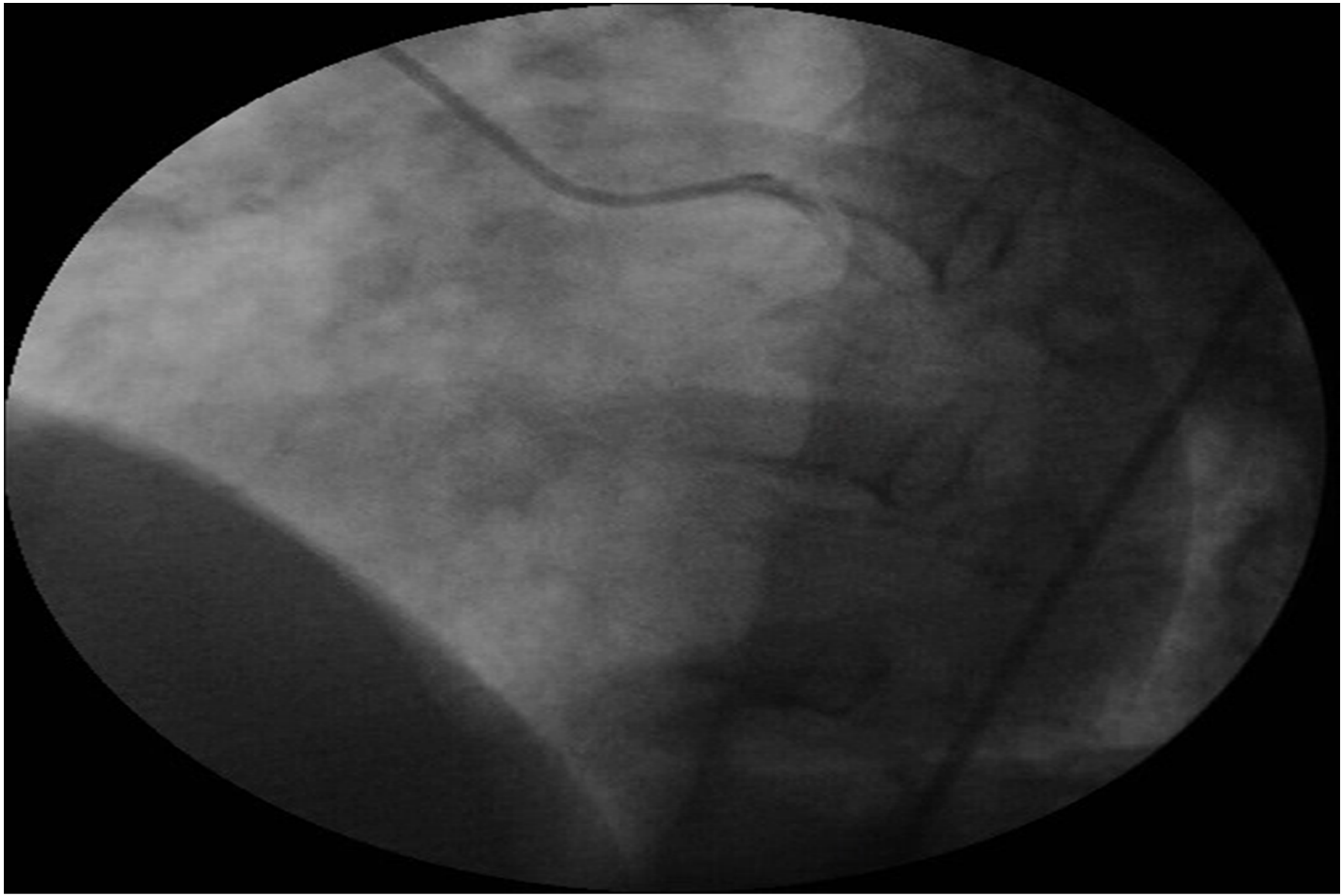


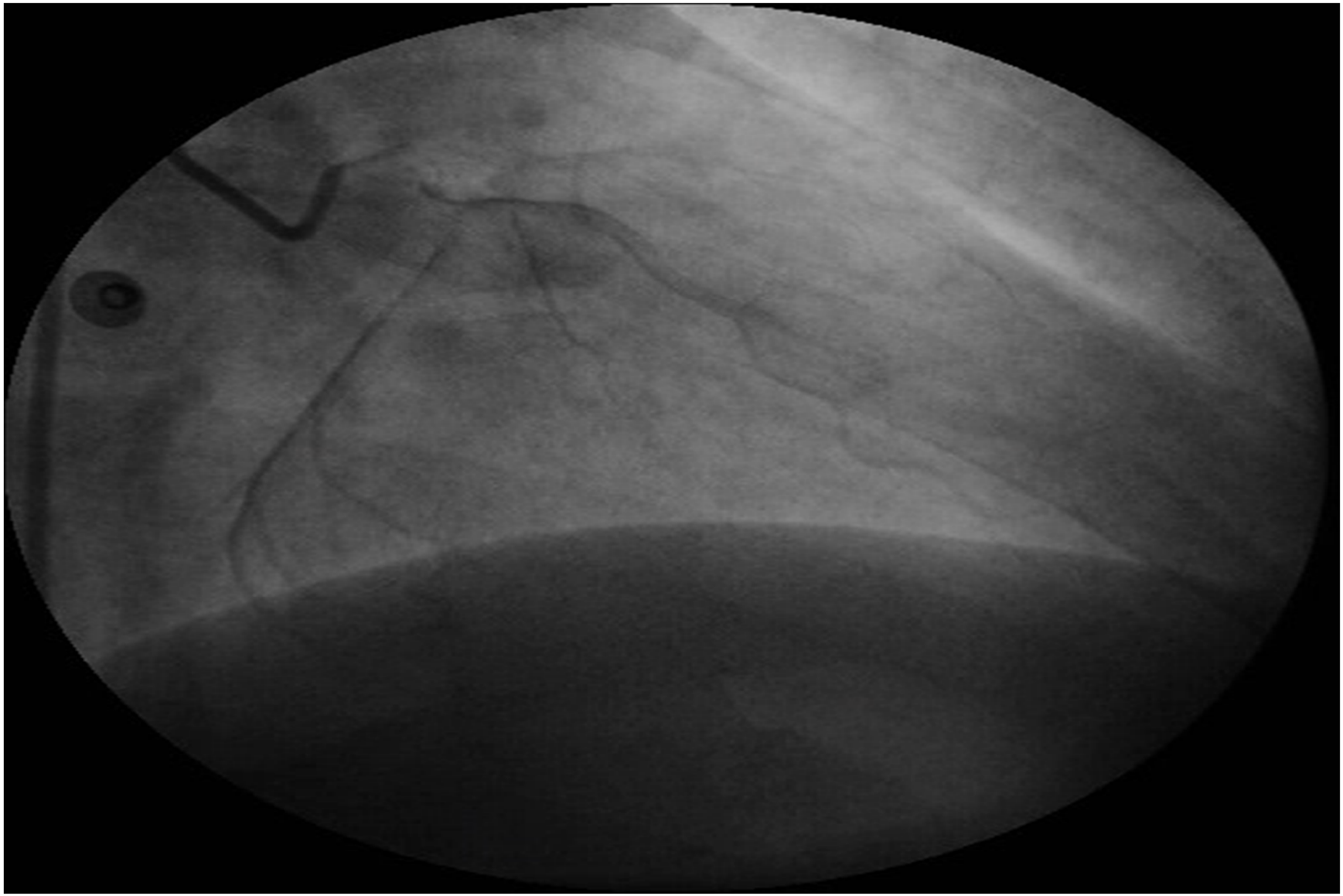
Sequential SVG to Circumflex

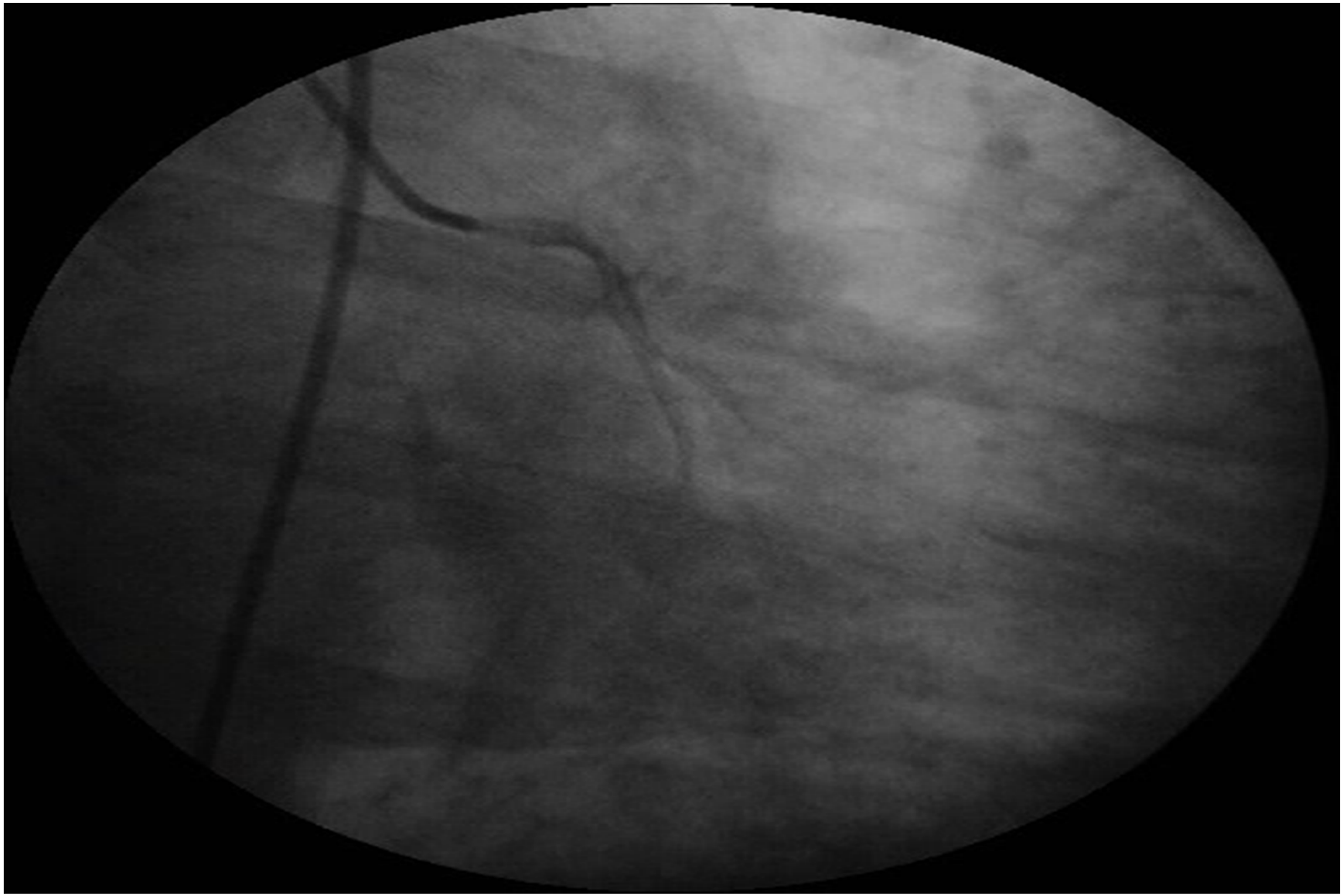


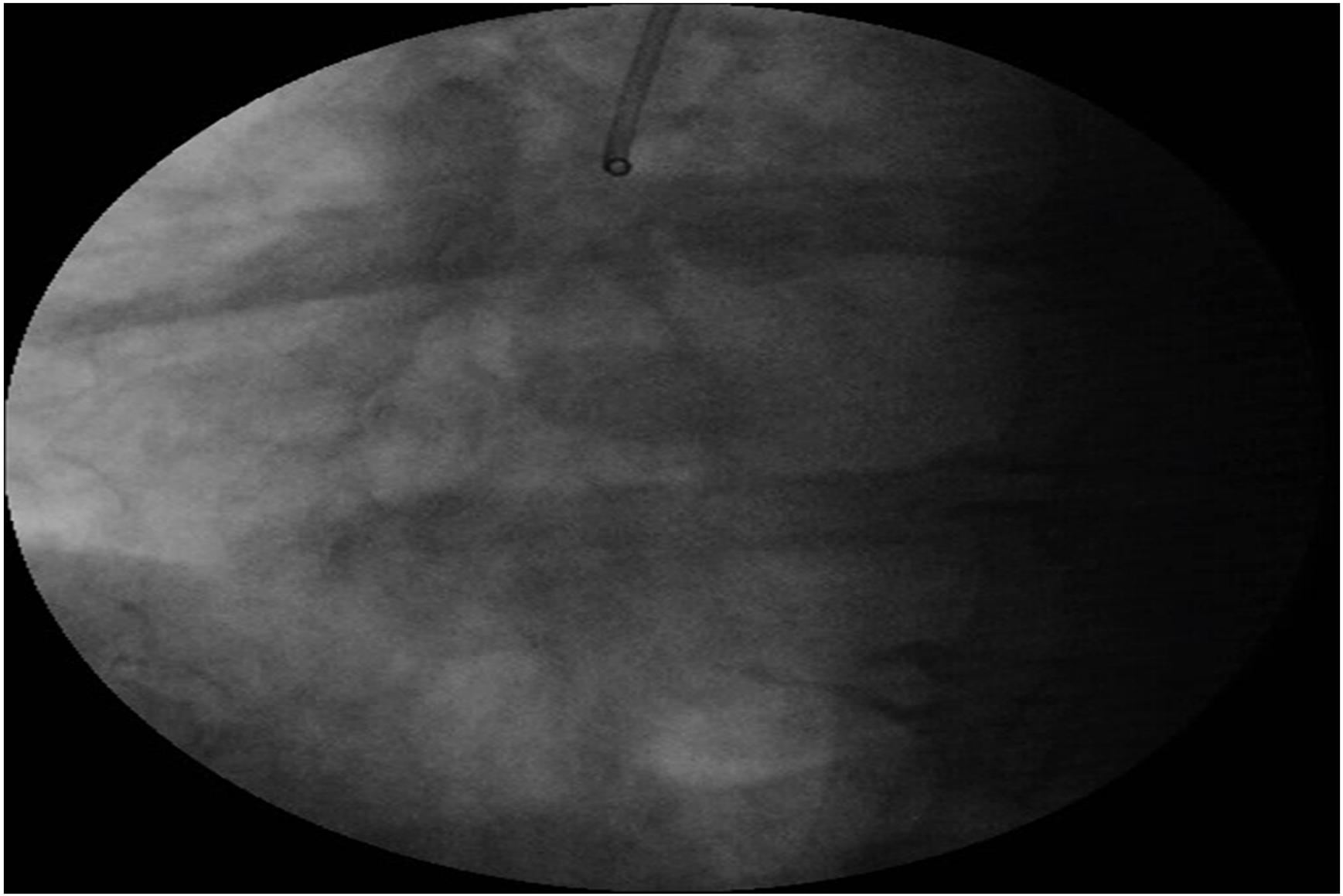
Case #1

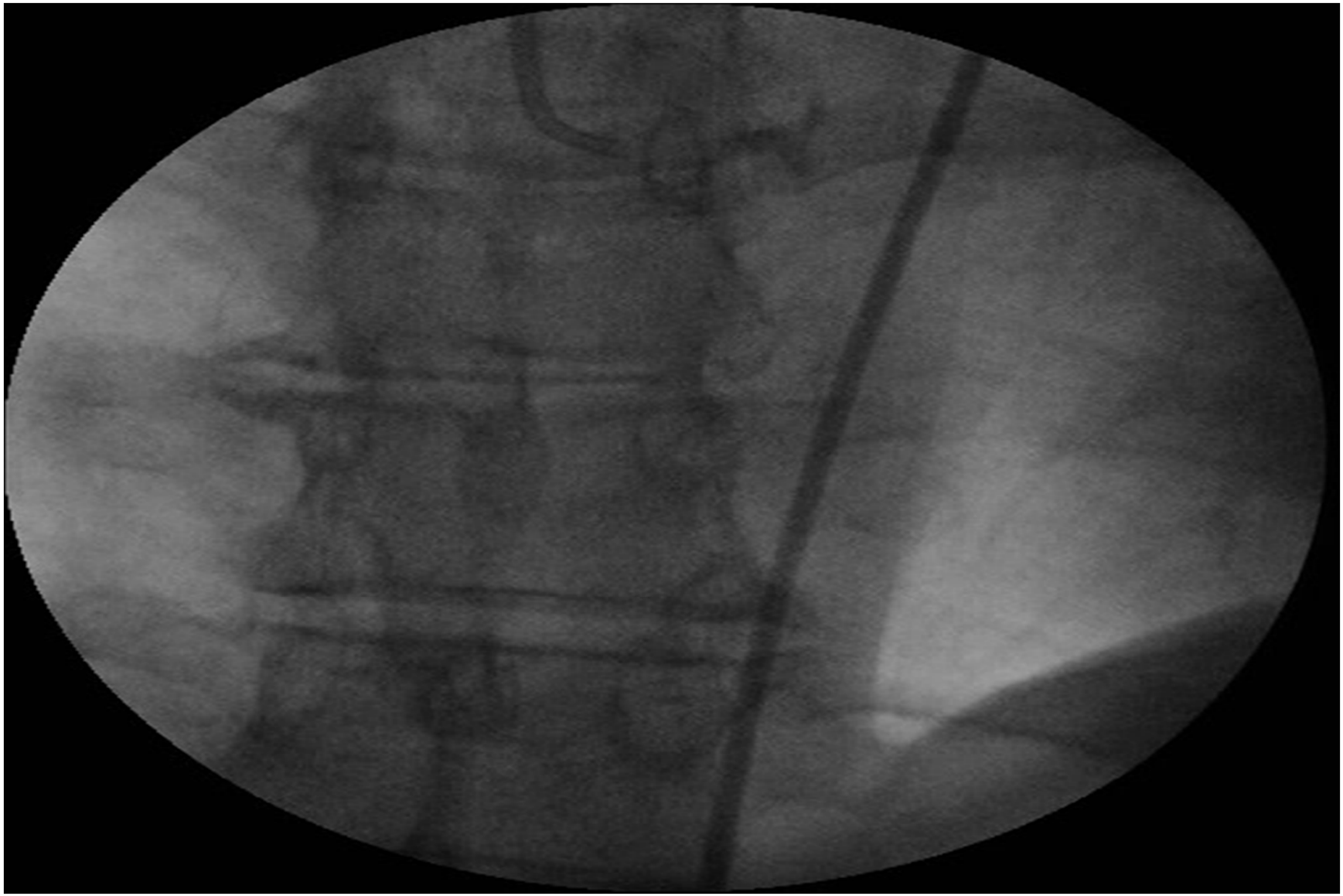




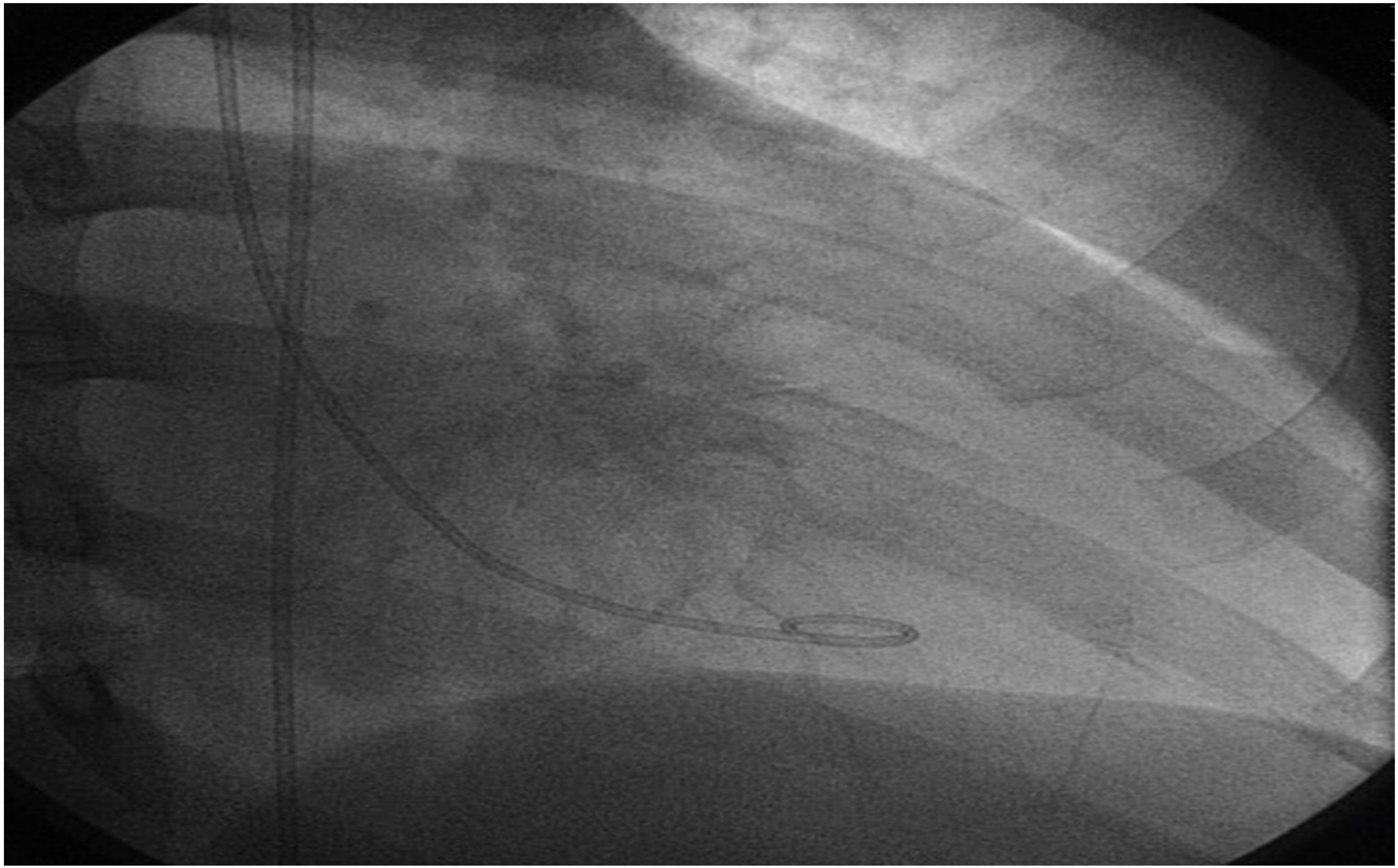


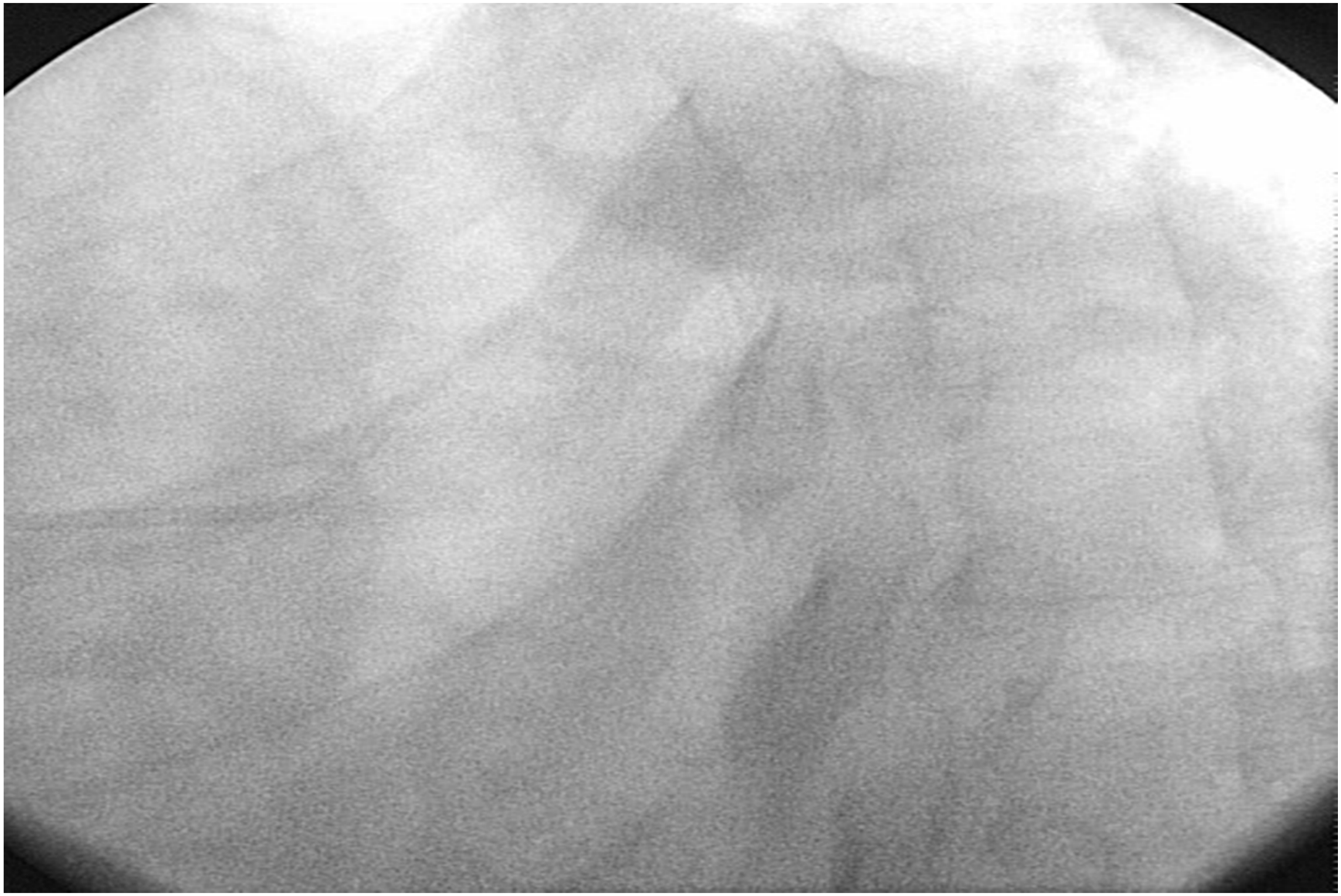


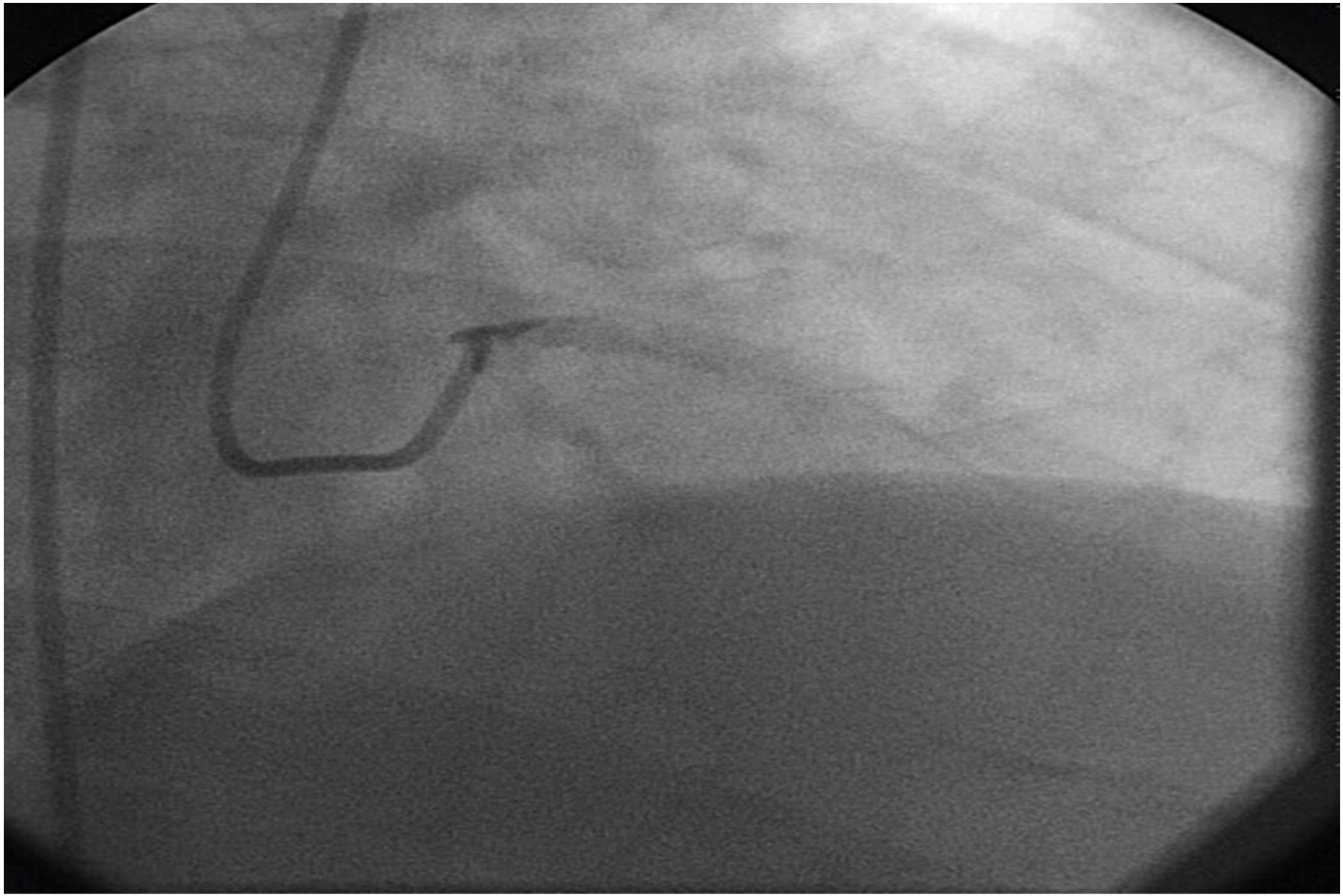


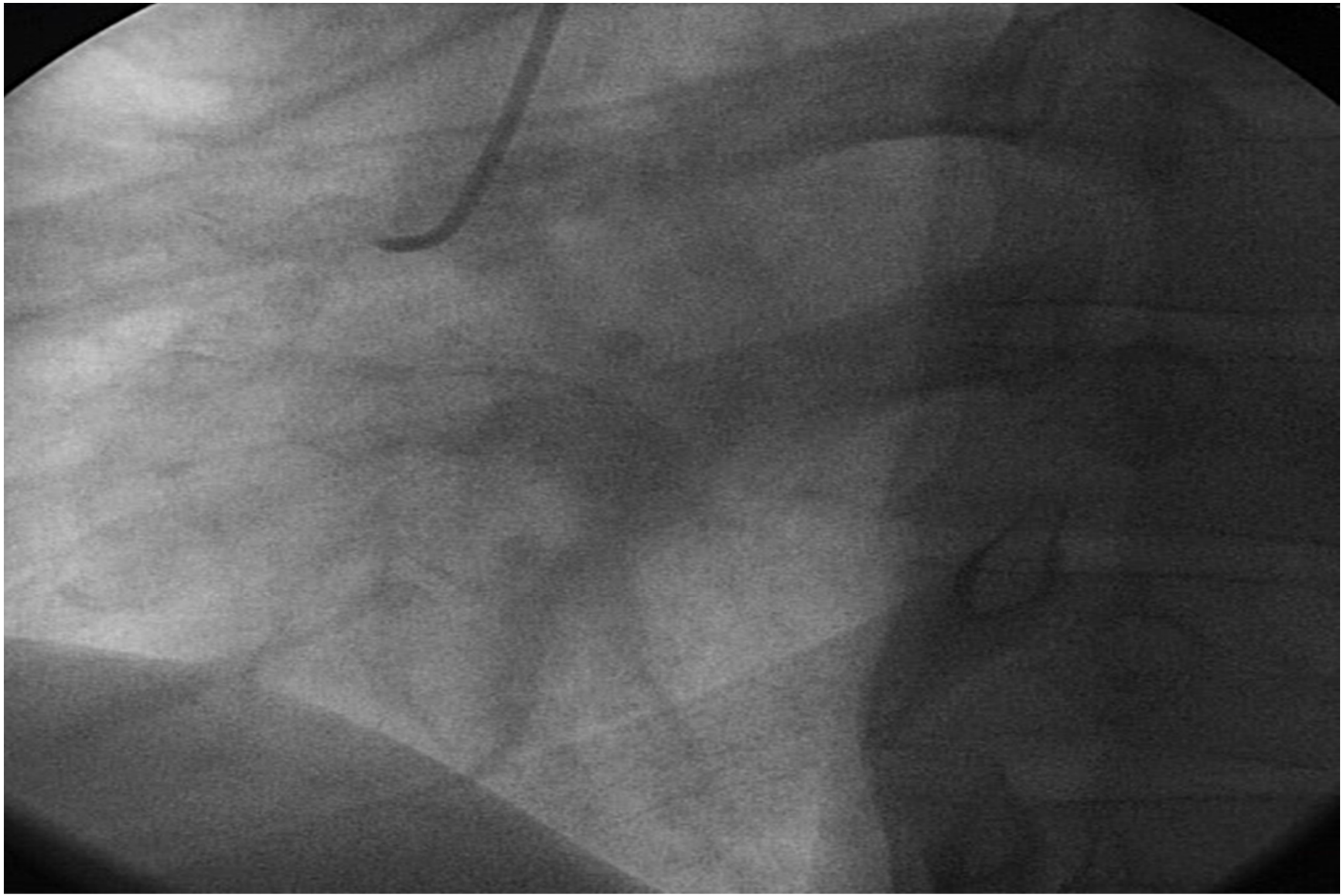


Case #2









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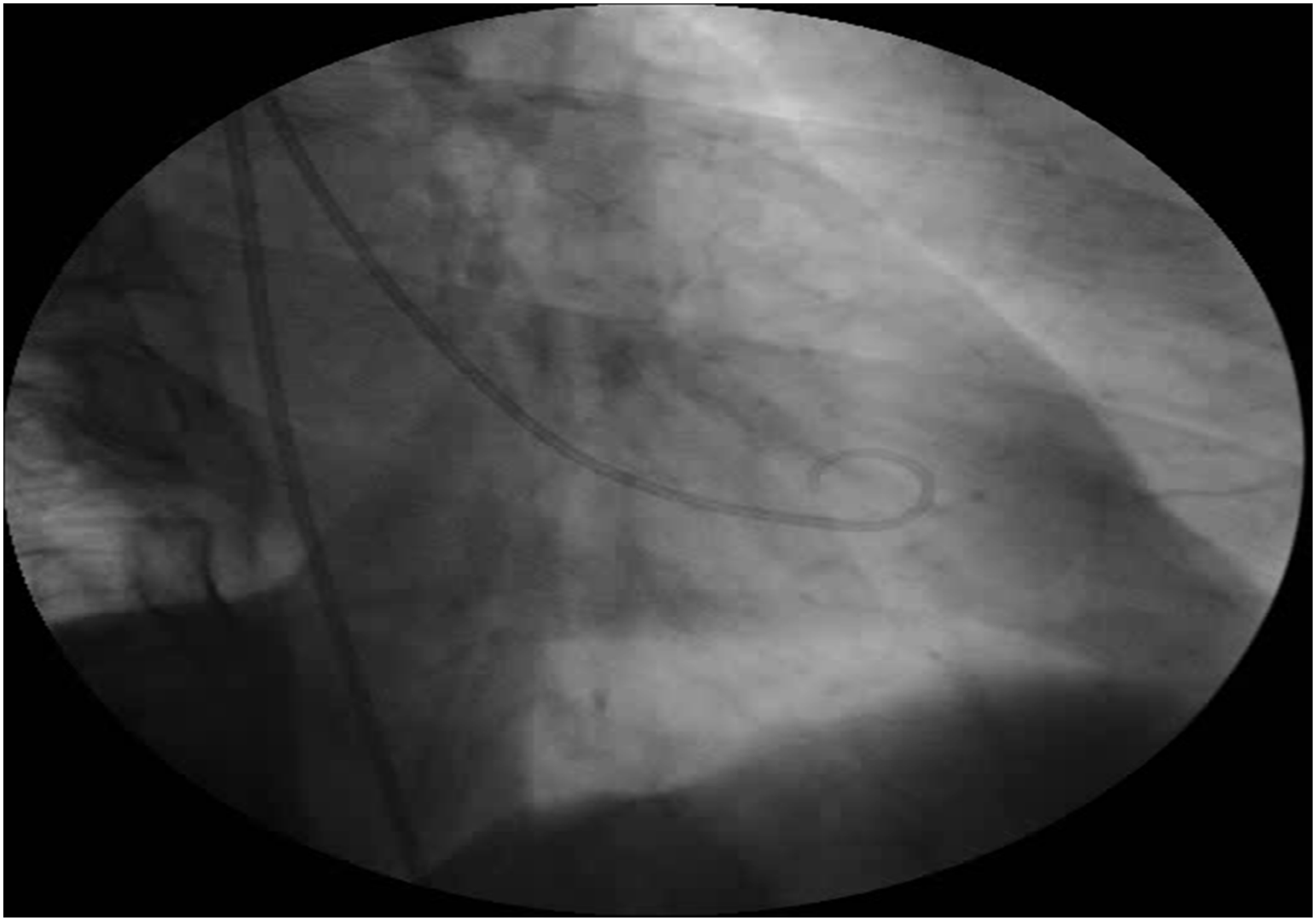

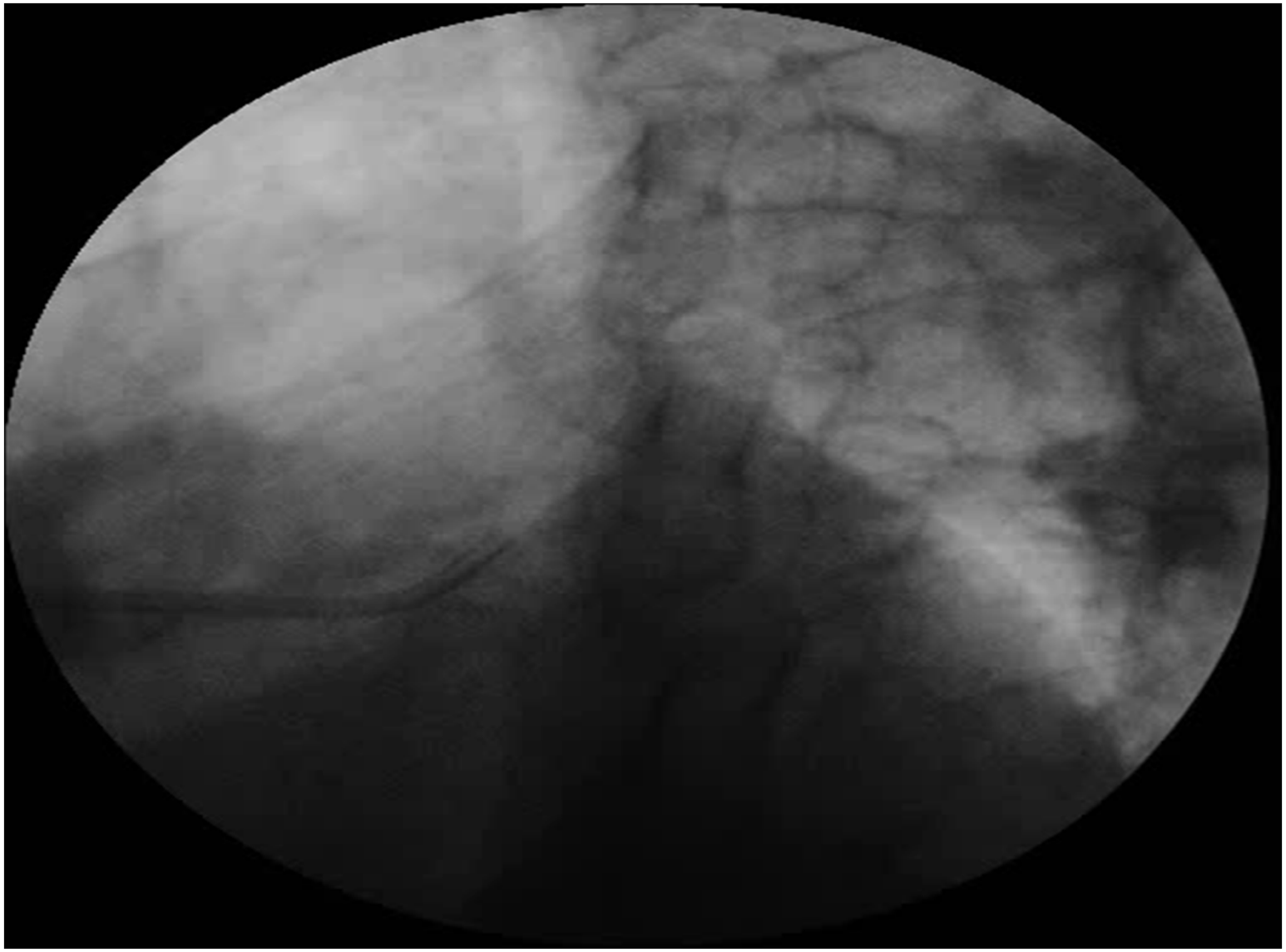

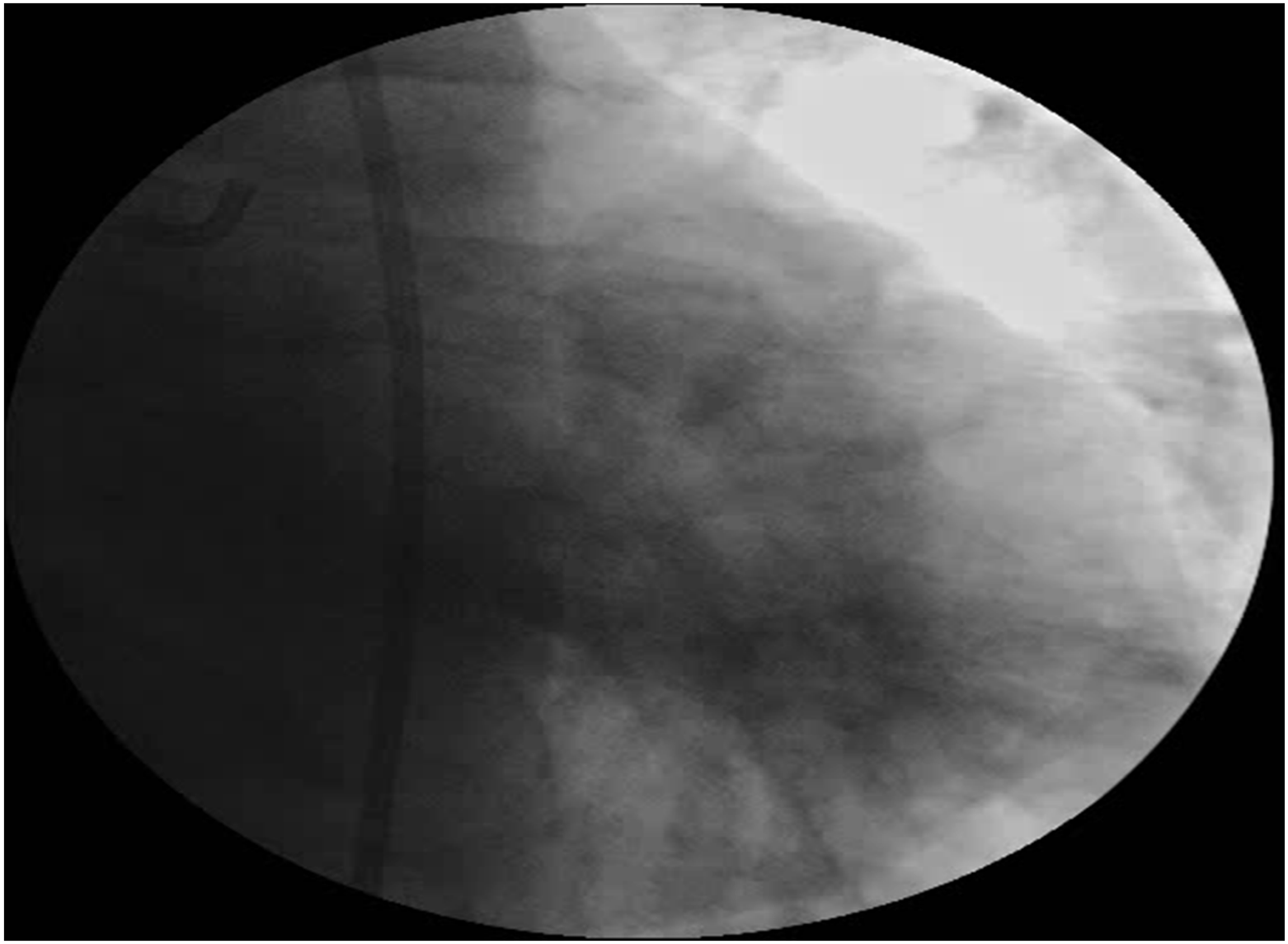

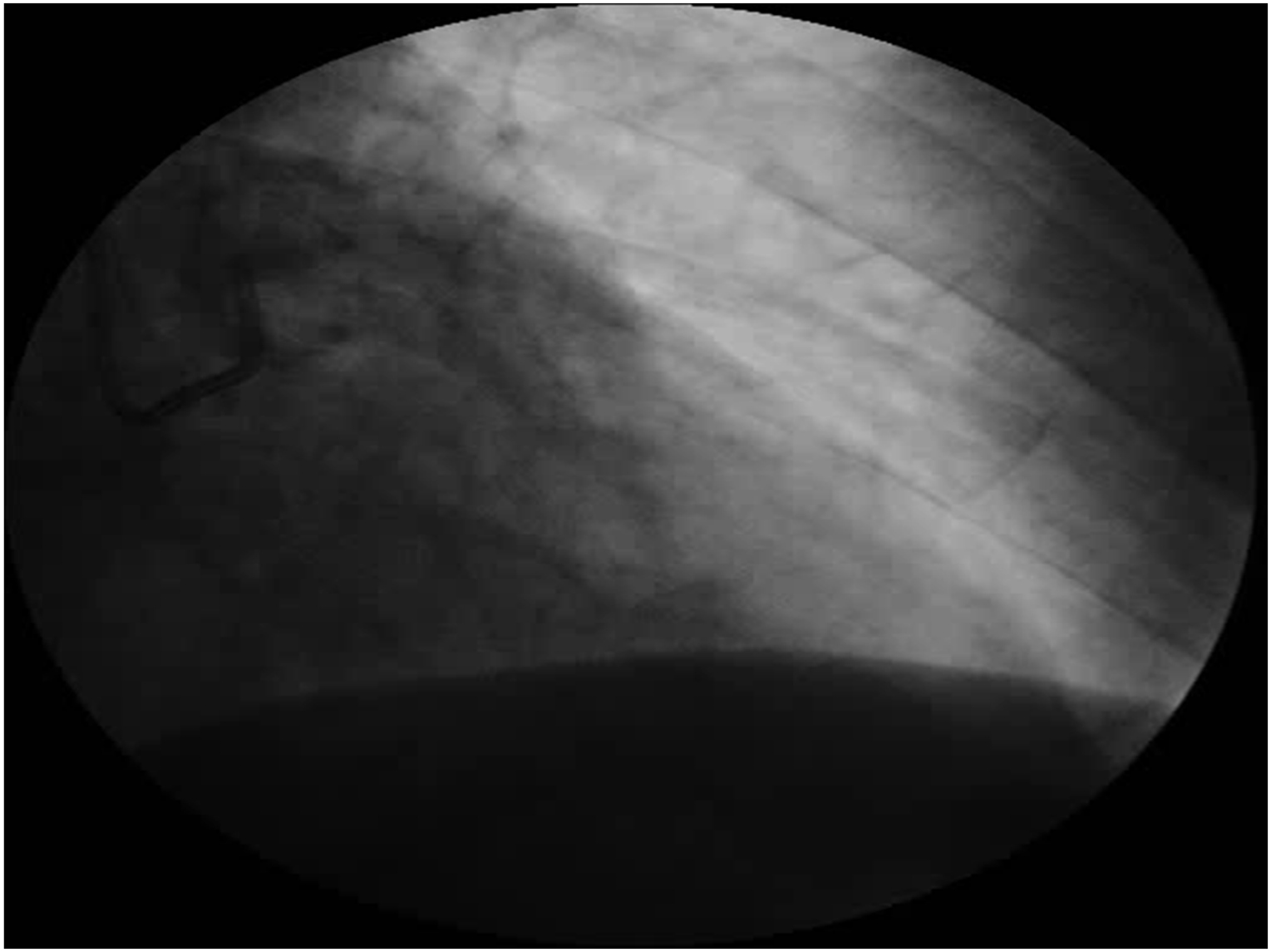

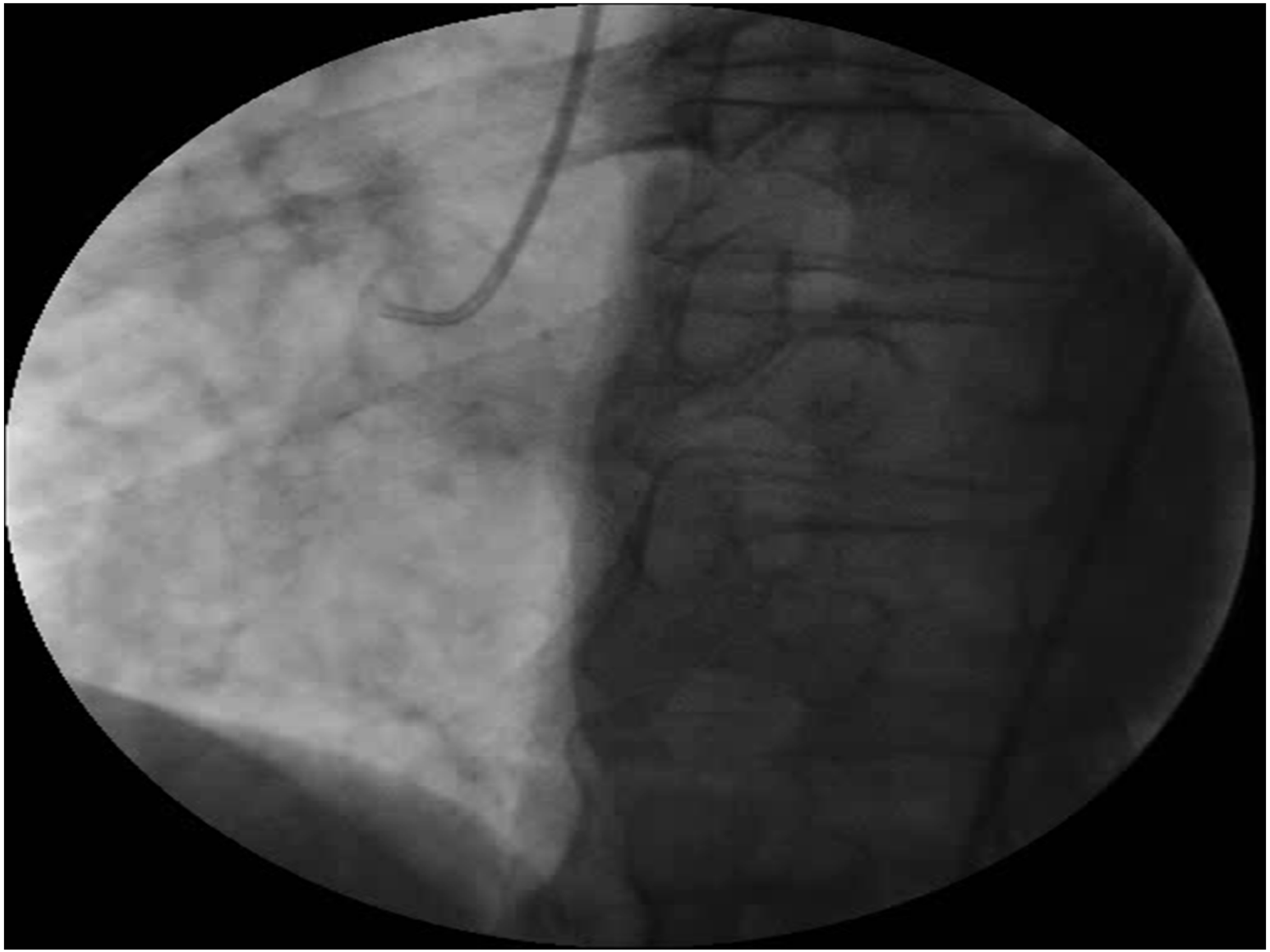

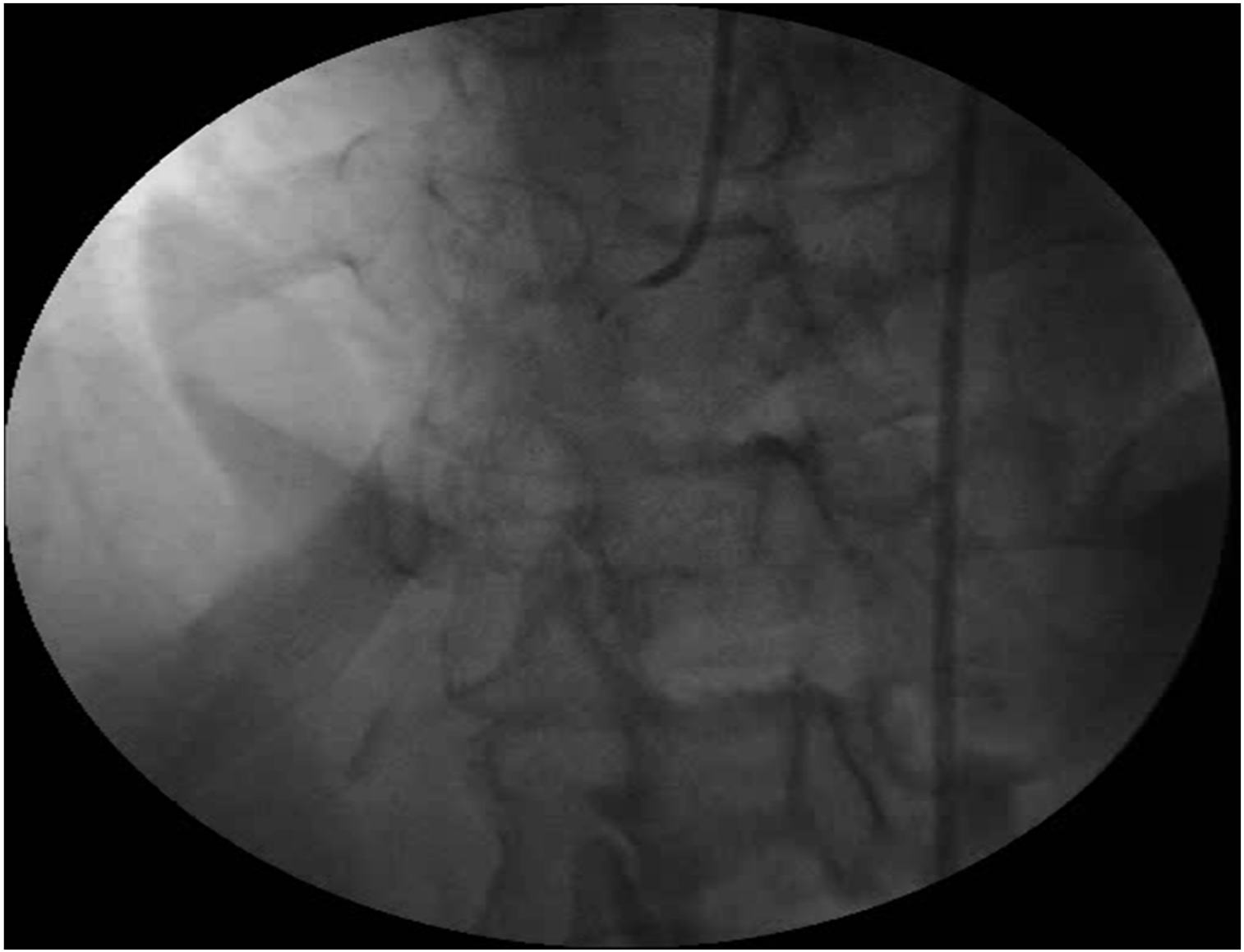

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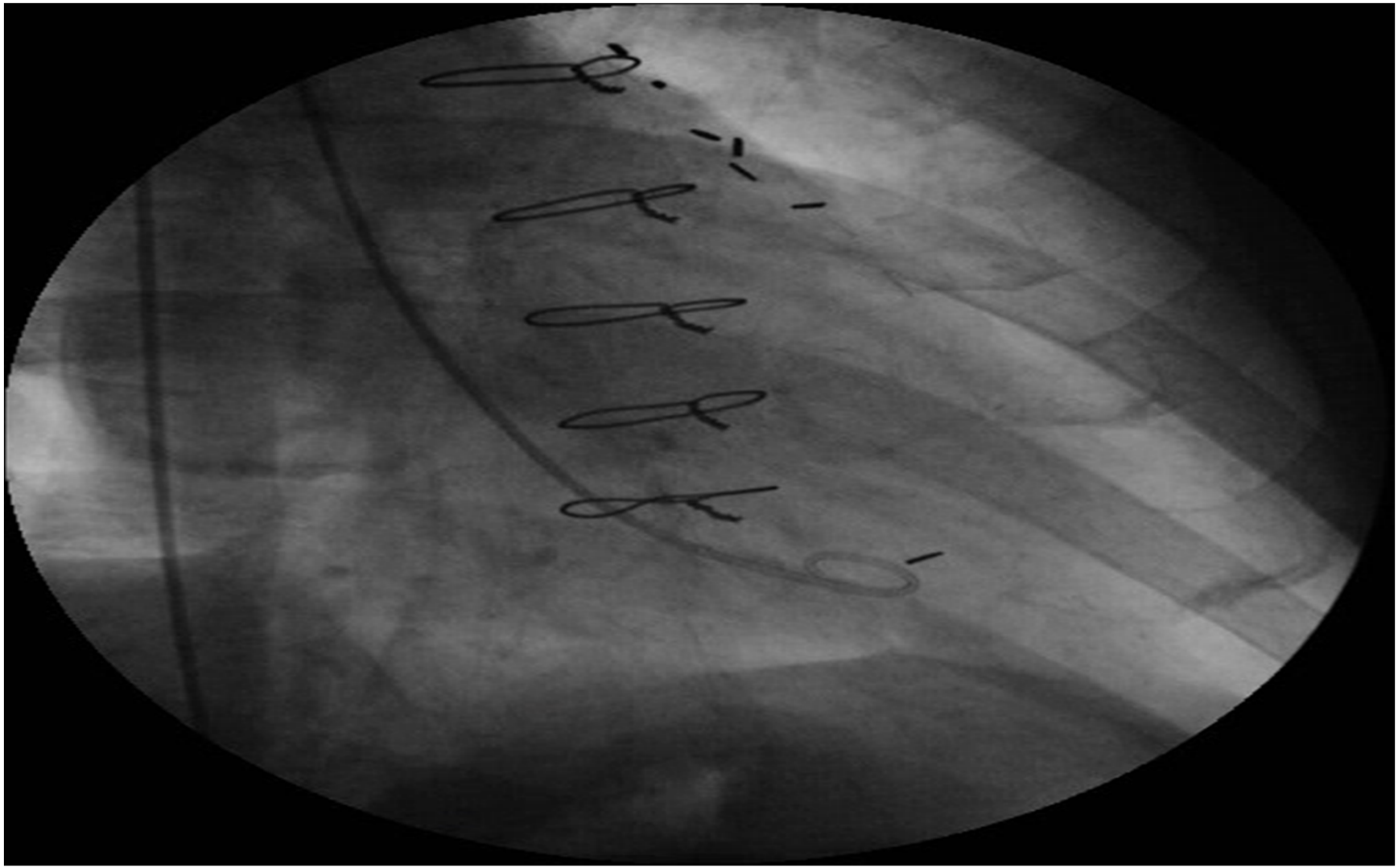

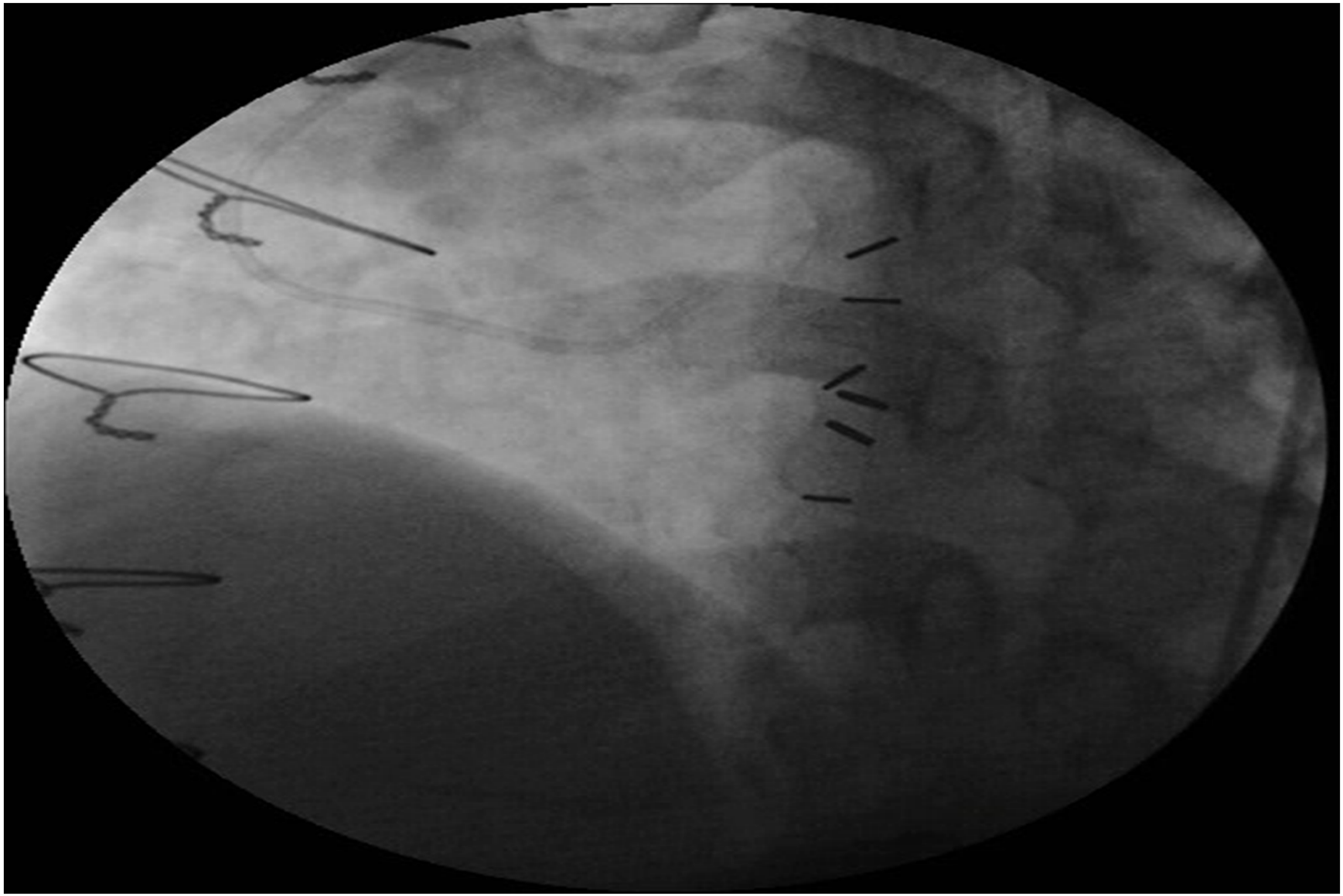

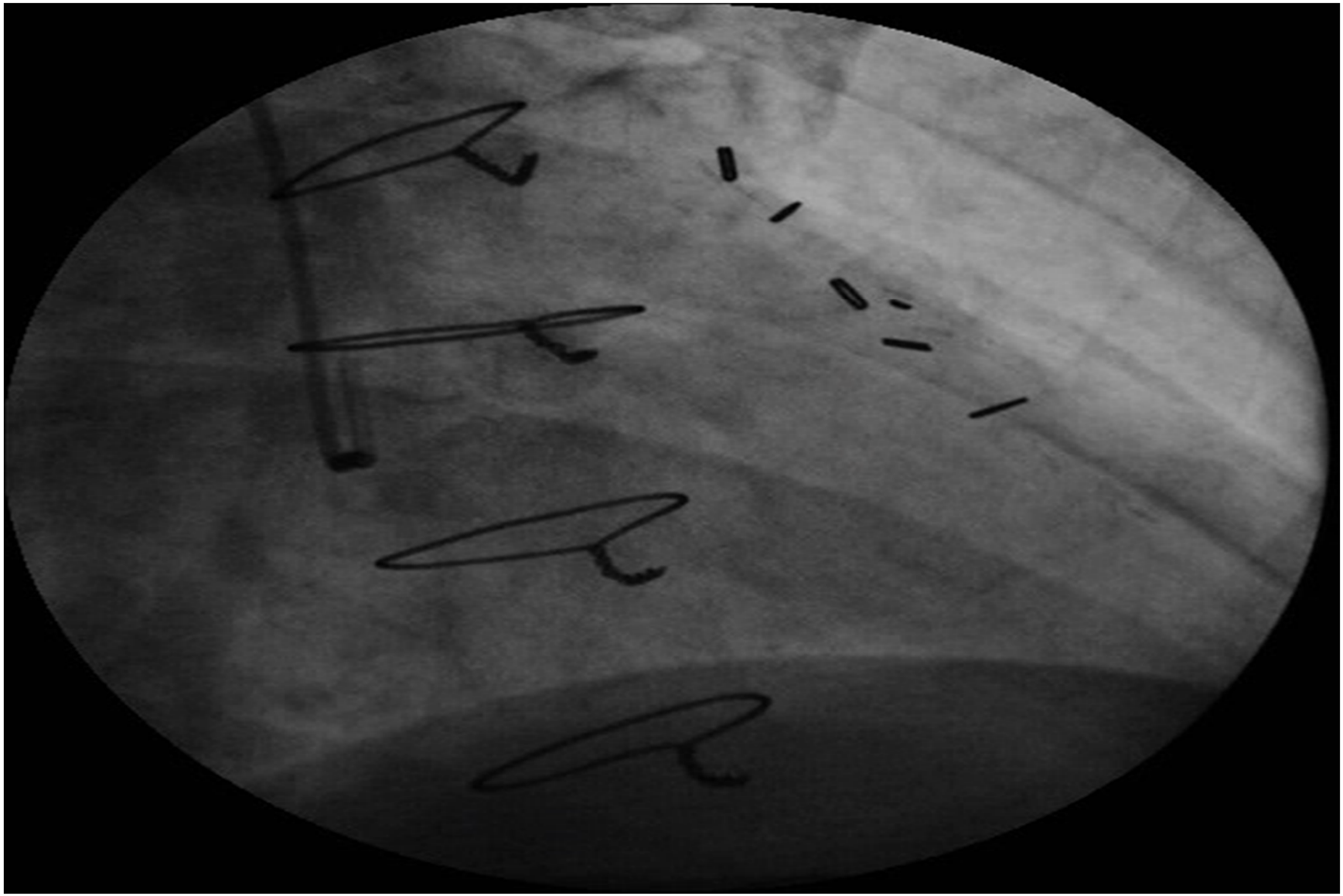

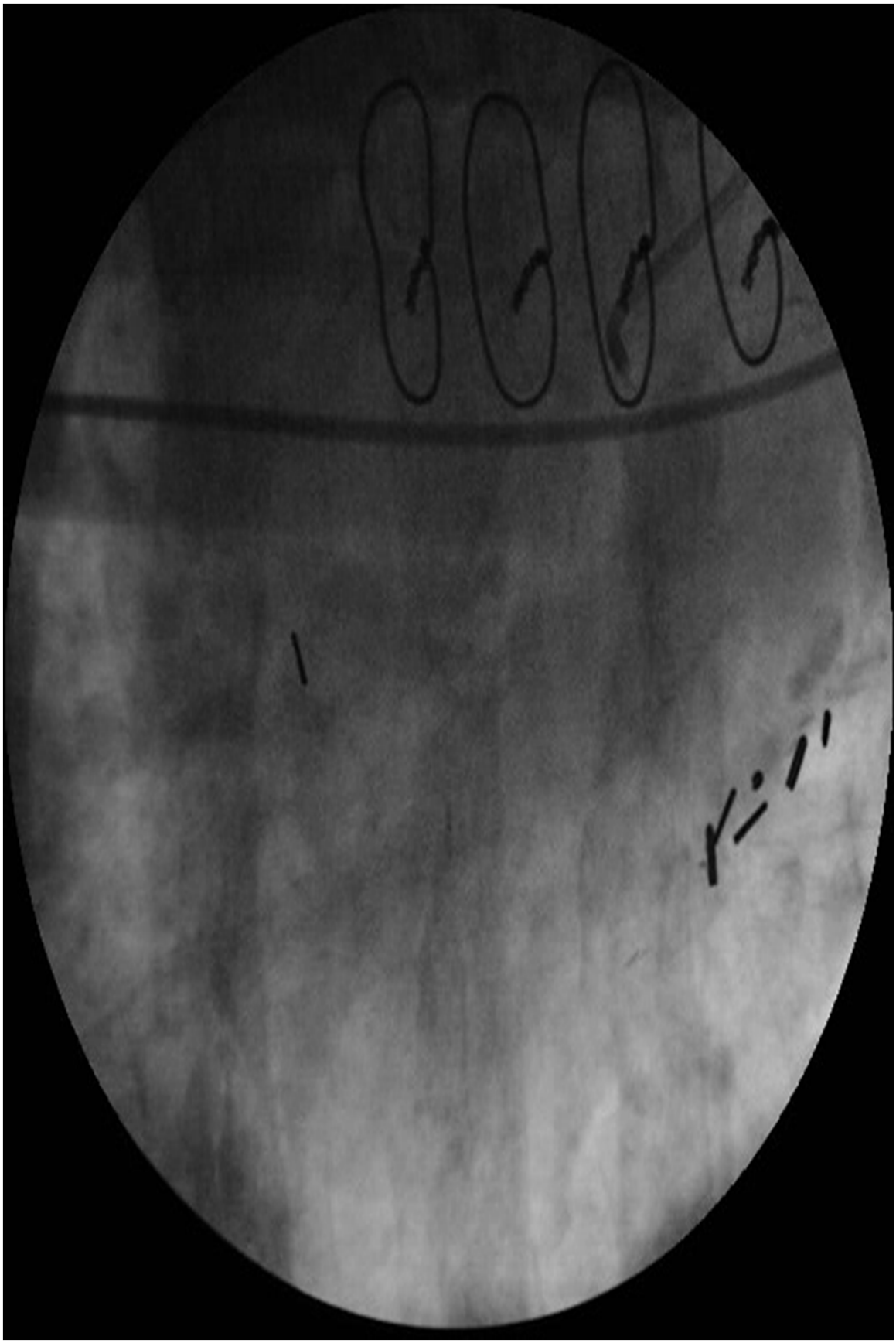

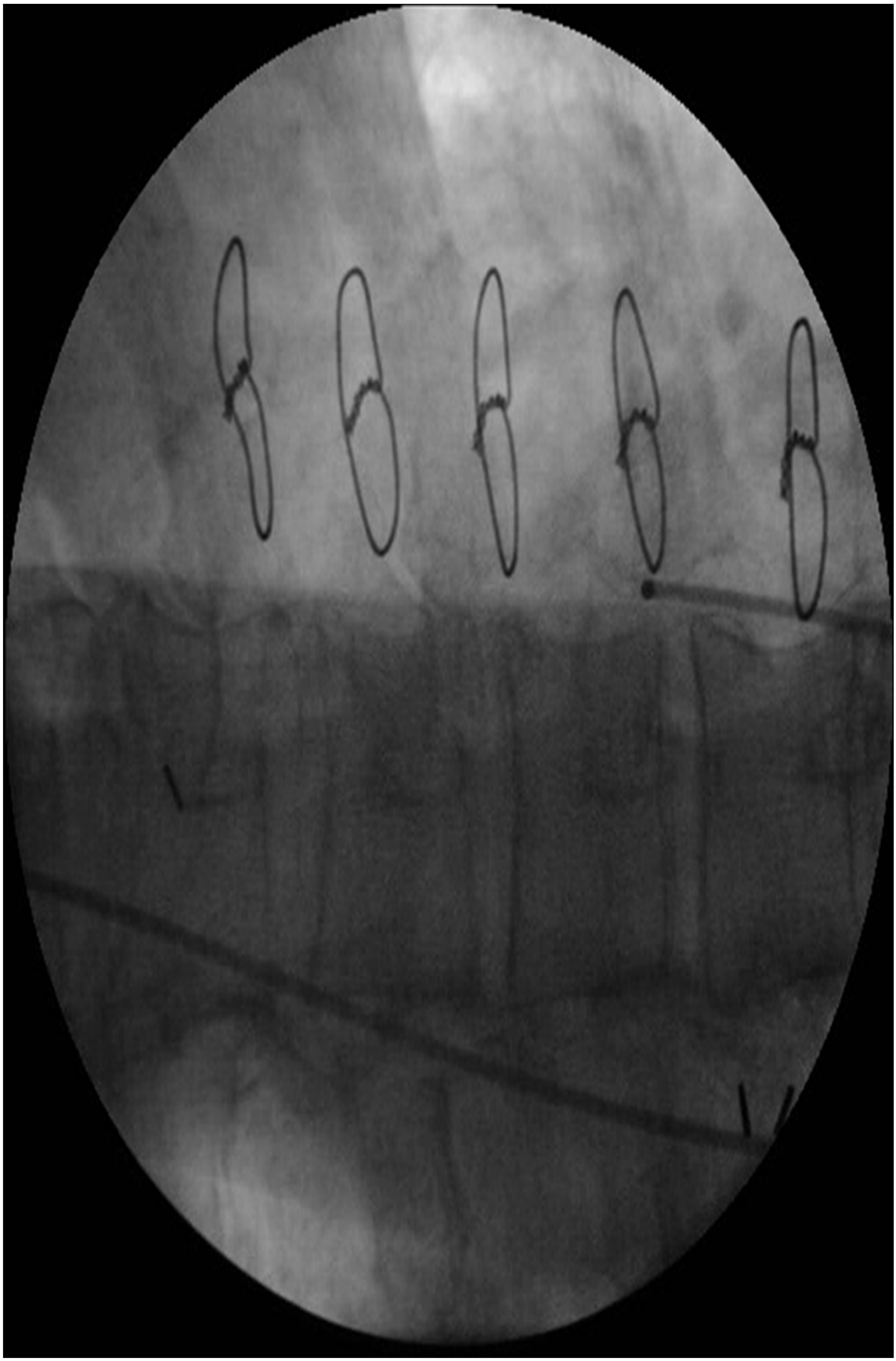

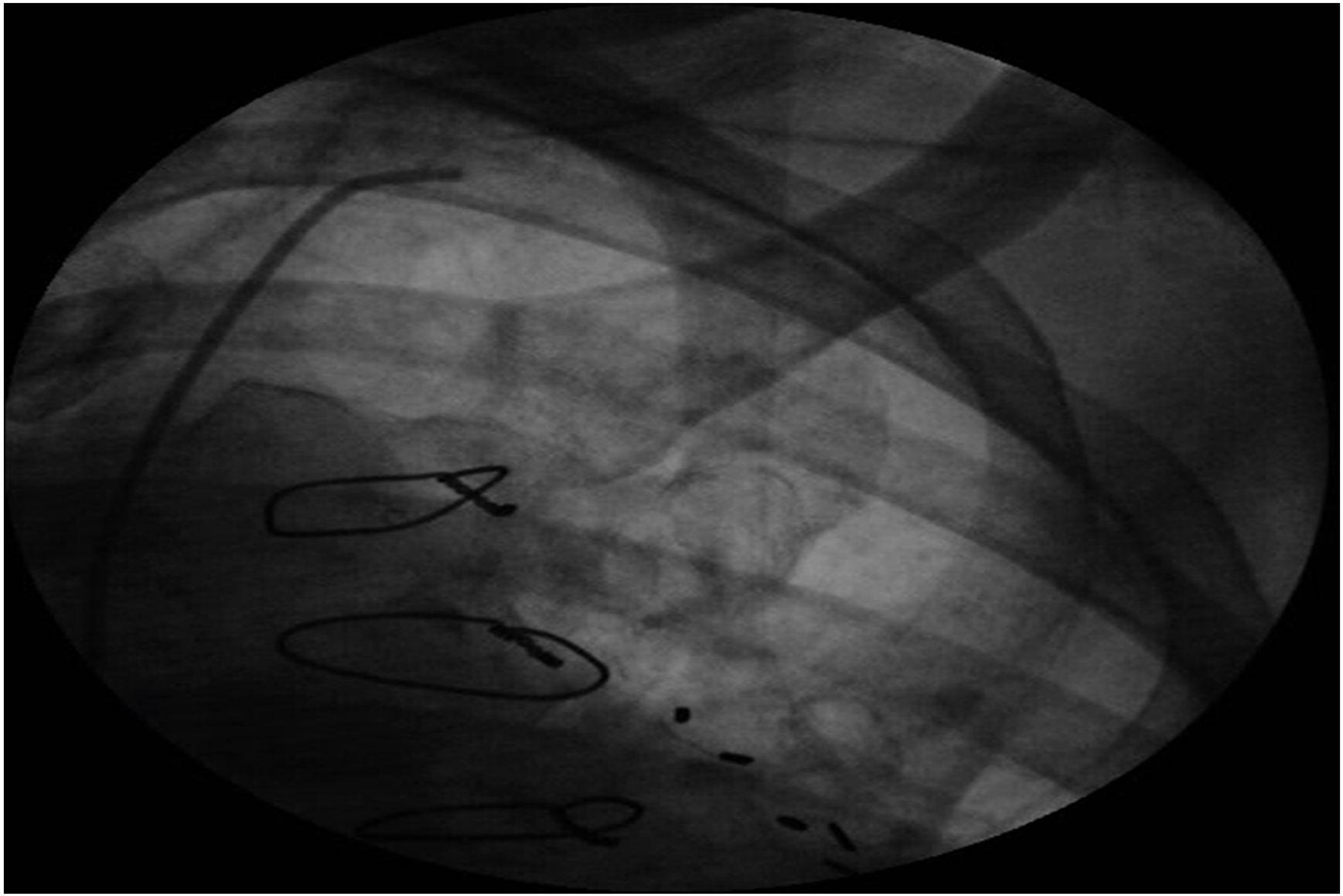

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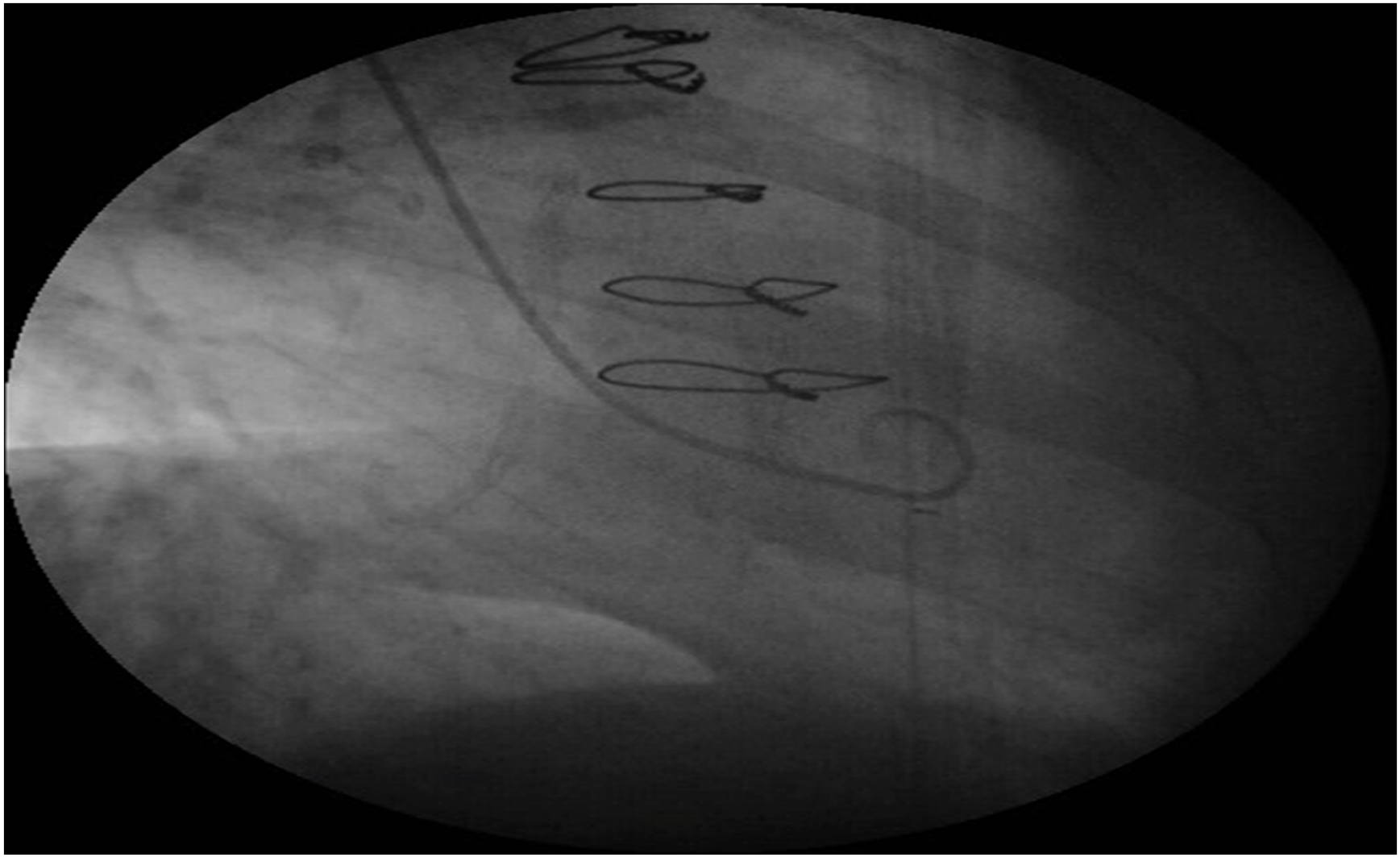

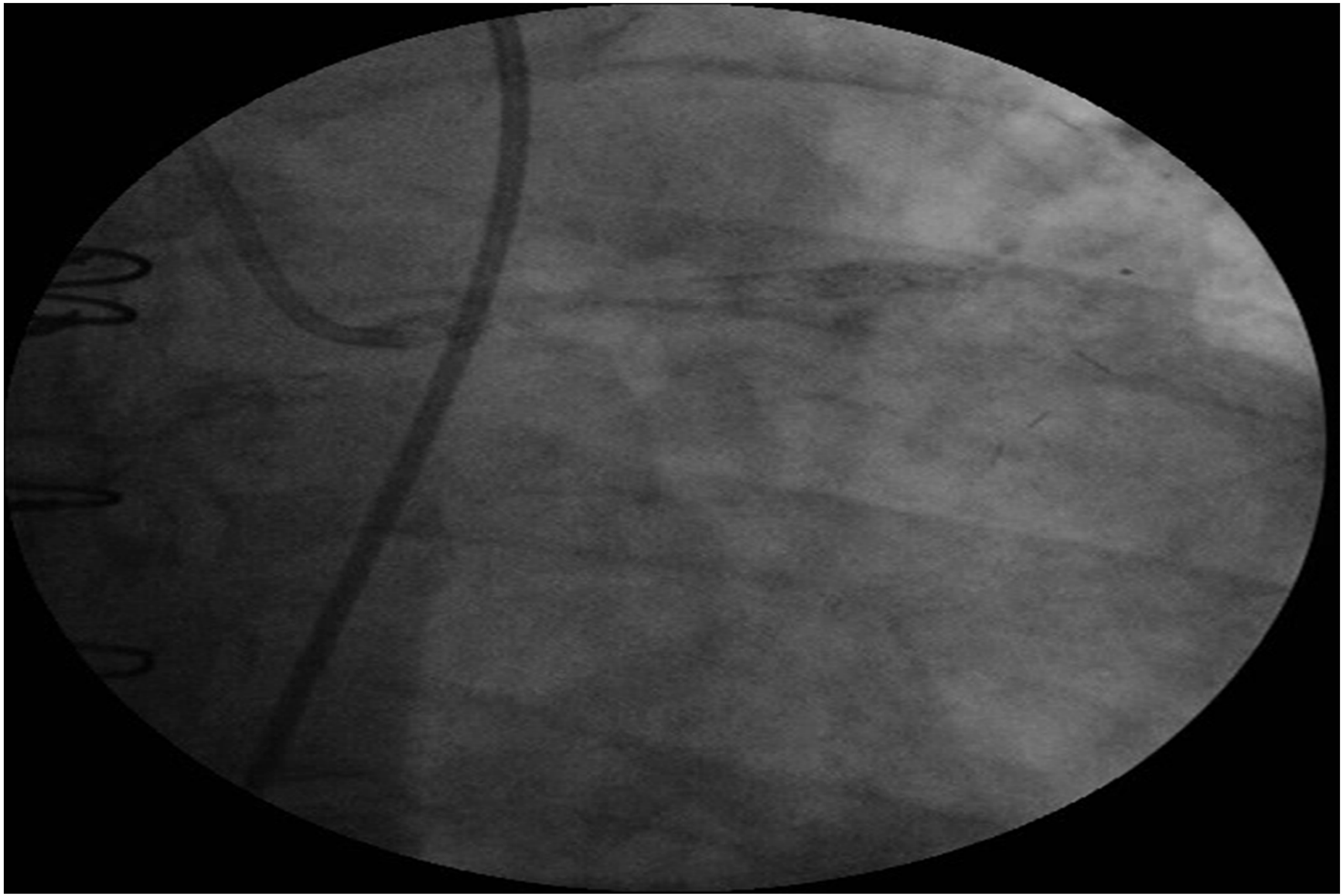

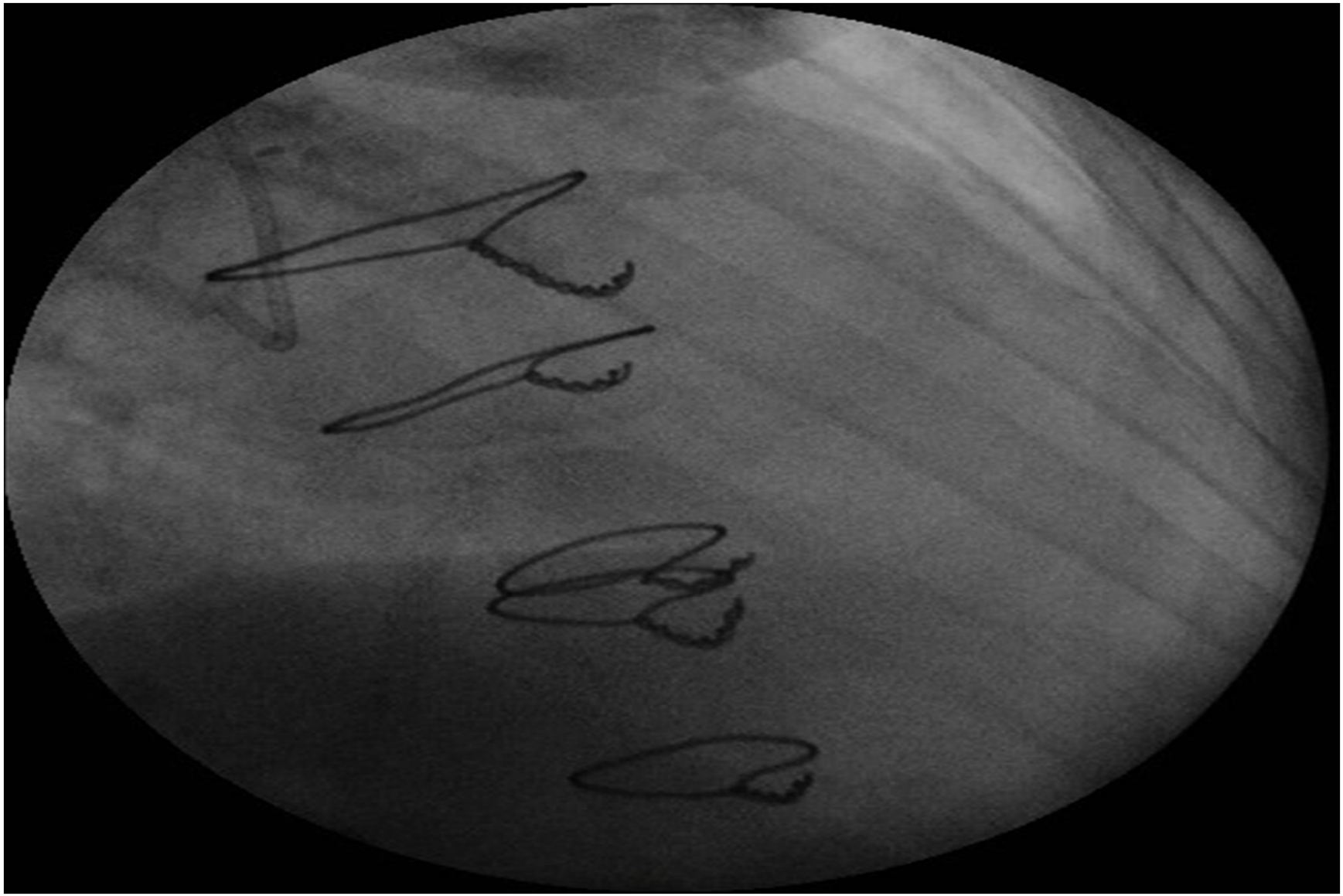

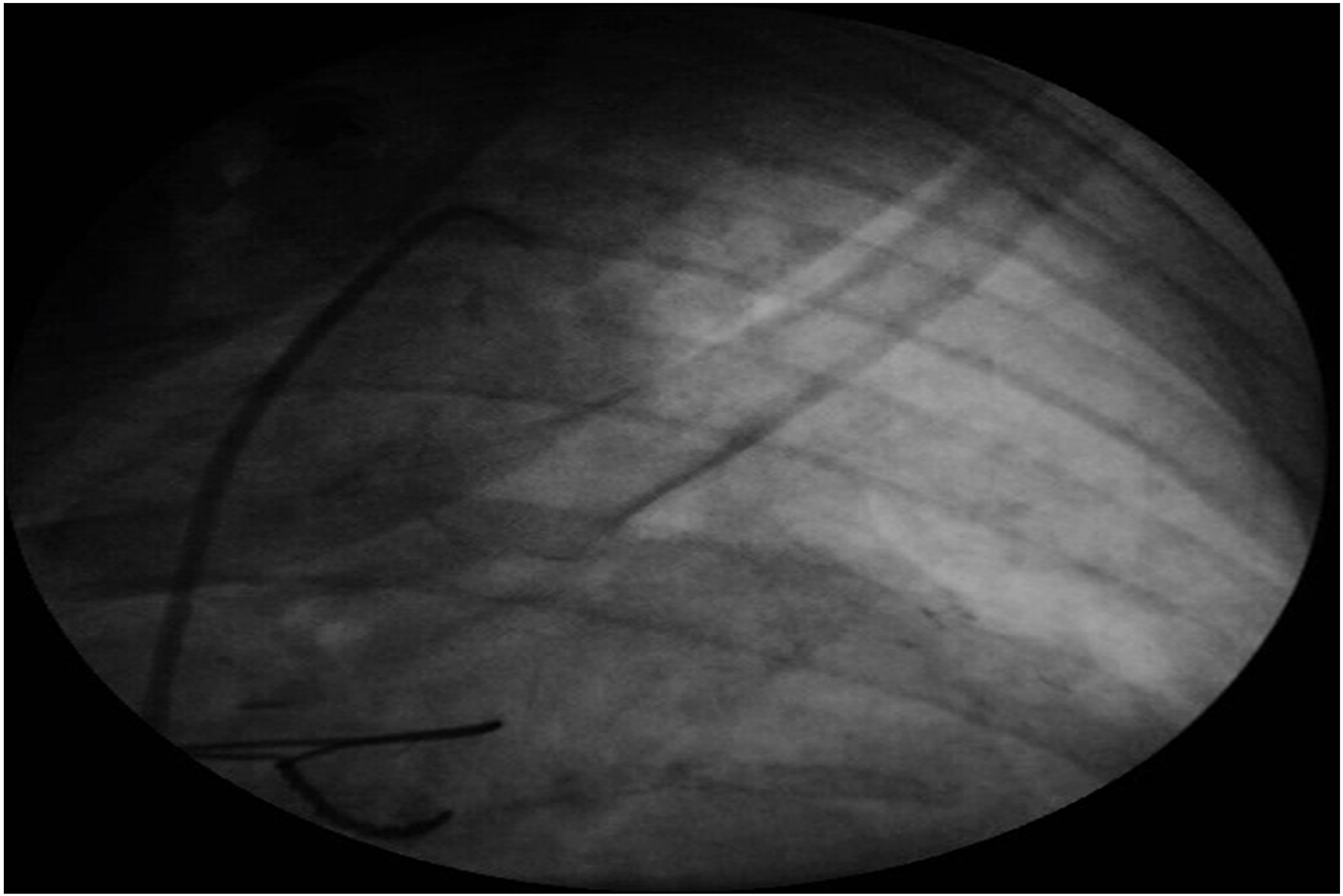

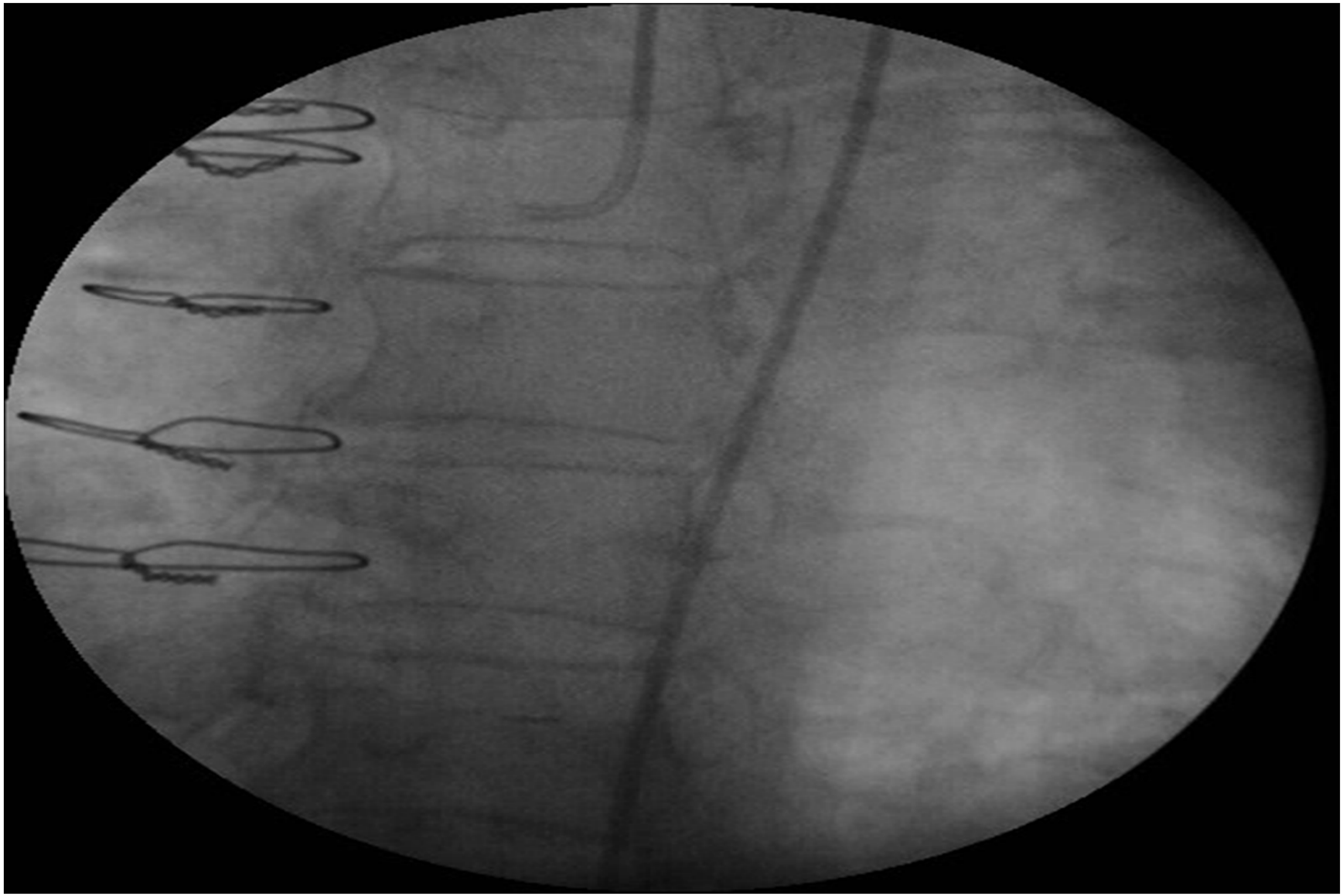

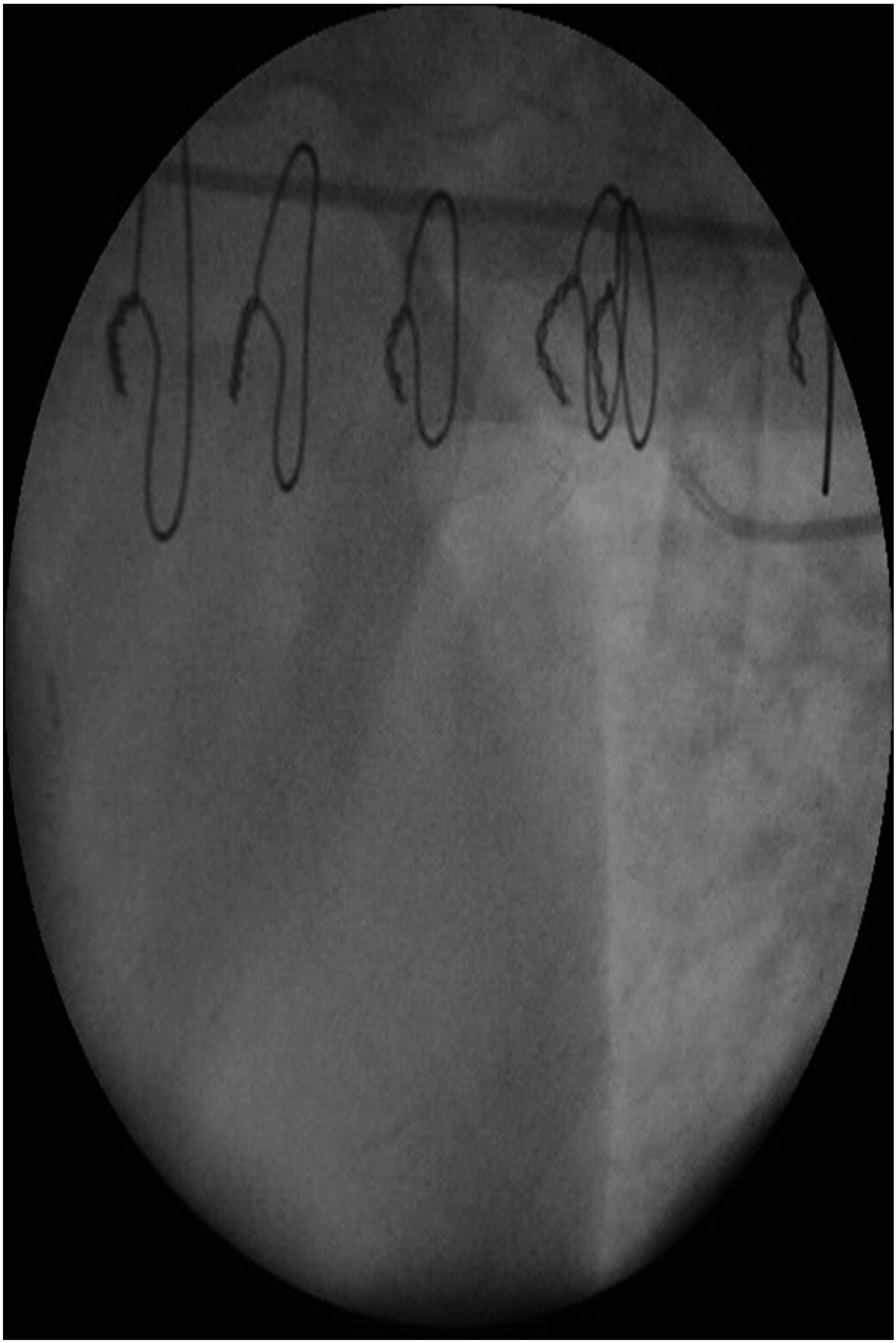

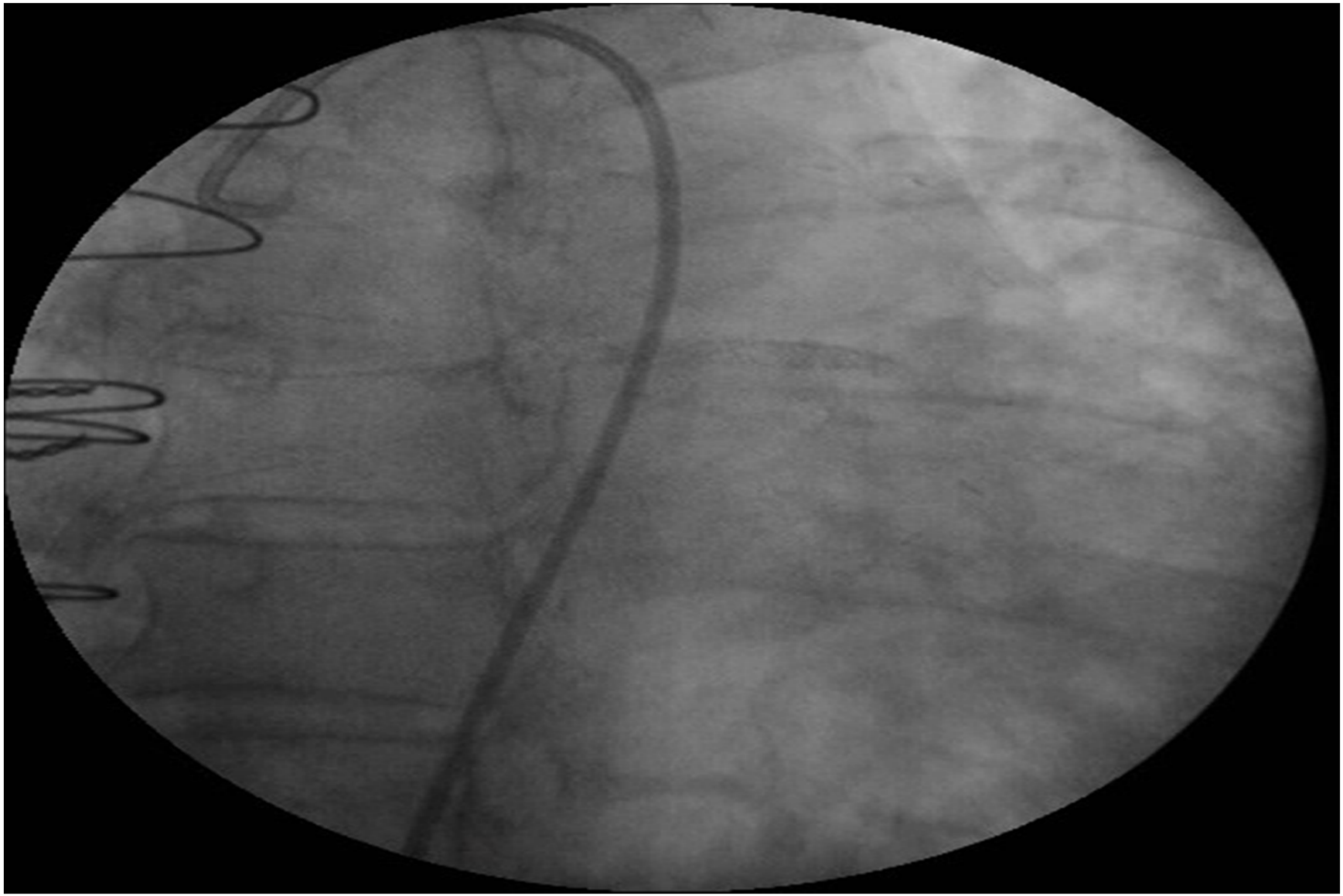

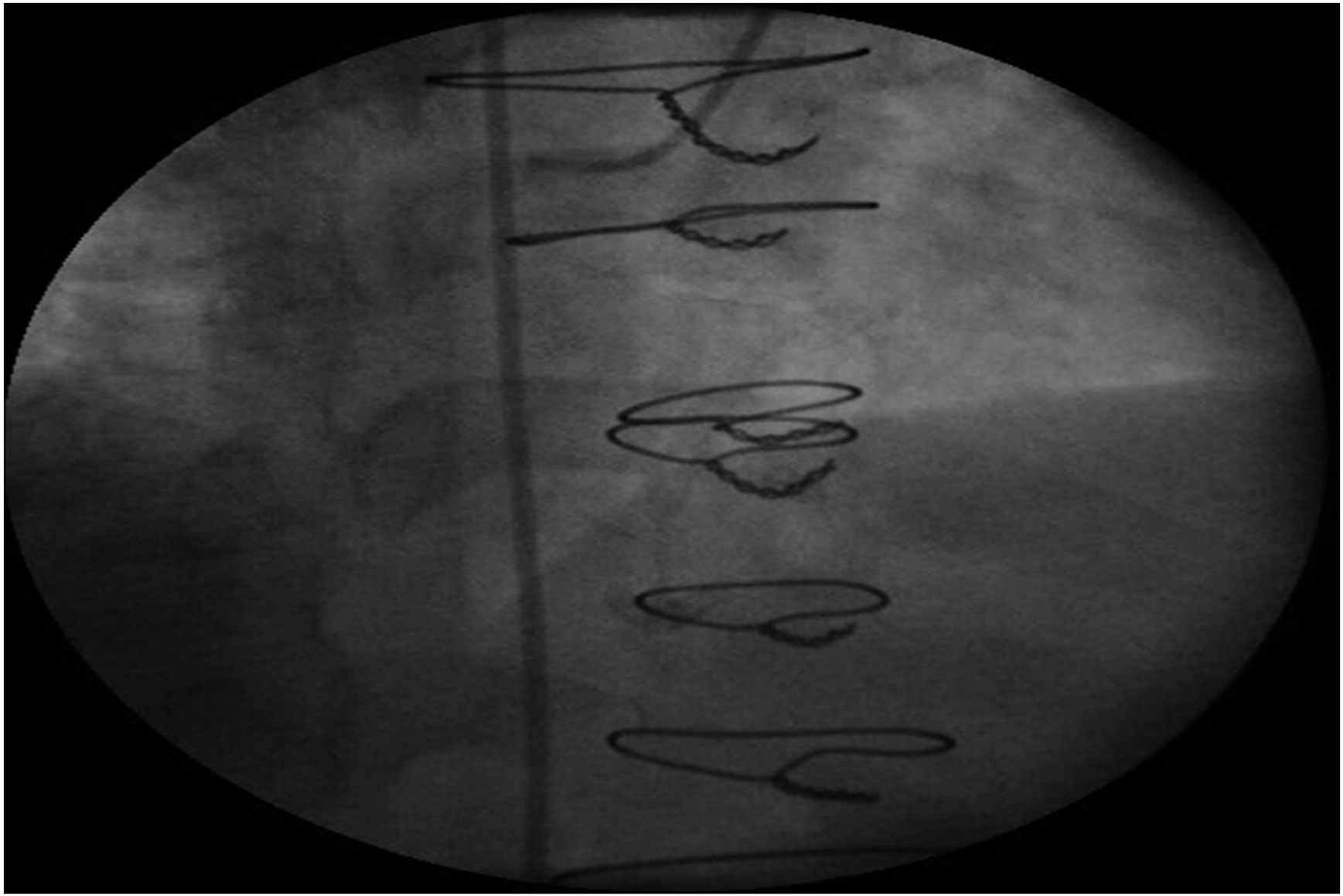

Case #6