

Intraoperative Imaging: Angiography

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Topics

CT 

CT Angiography

- Contrast phases
- Dynamic Multiplanar Reconstructions
- 3D Surface/Volume Rendered CT

Ultrasound 

Intravascular Ultrasound (IVUS)

X-rays 

Digital Subtraction Angiography (DSA)

- CT angiogram image registration
- 3D Rotational Angiography (3DRA)
- Carbon Dioxide Angiography

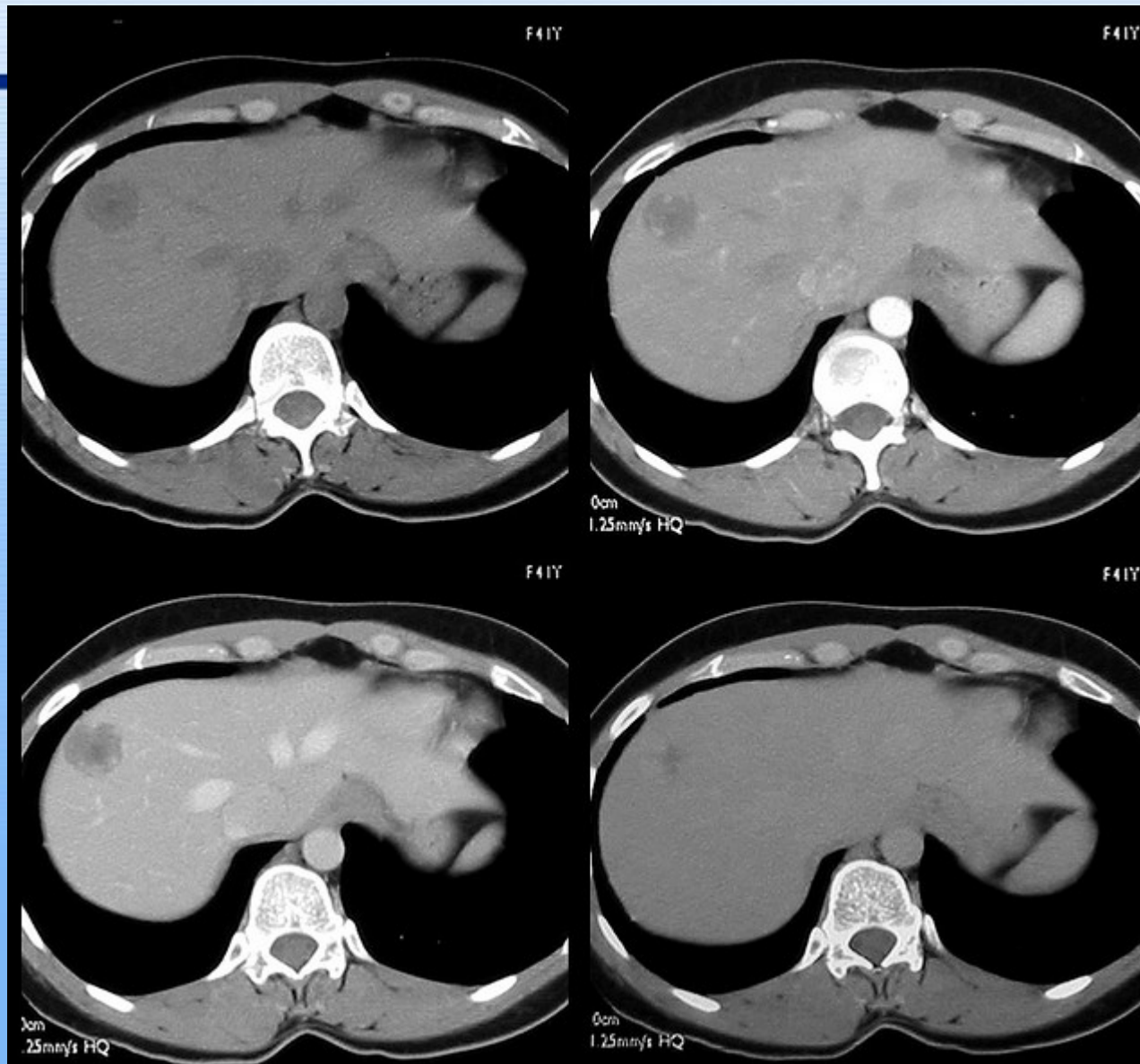
MRI 

MR Angiography and Intervention

CT Contrast Phases

1. Pre-contrast phase
2. Arterial phase 10 sec
3. Portal Venous Phase 60 sec
4. Delayed Phase 5 min

CT Contrast Phases

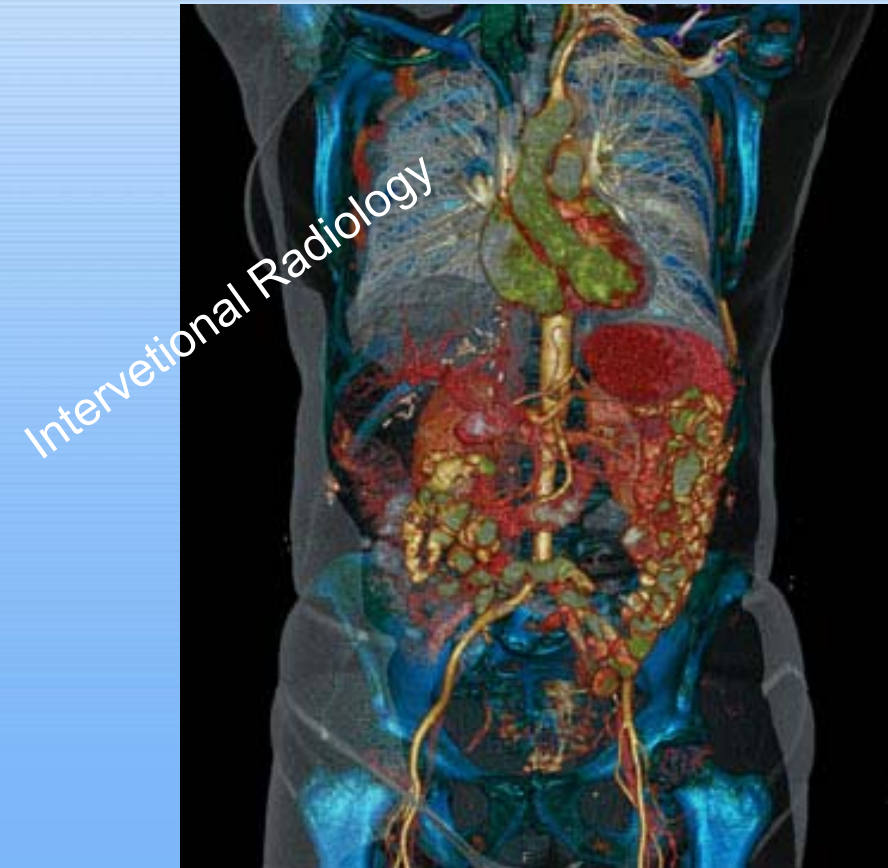


CT Angiography



CT Angiography

- Advantages:
 - Fast
 - Isotropic data
 - Wide coverage



CT Angiography

- Disadvantages:
 - Contrast nephropathy
 - Radiation



Comprehensive Cardiac

Heart Review

Hints

Batch & Cine

Slab Tools

Layout

Orientation

- General Axes
- Cardiac Axes

Rendering

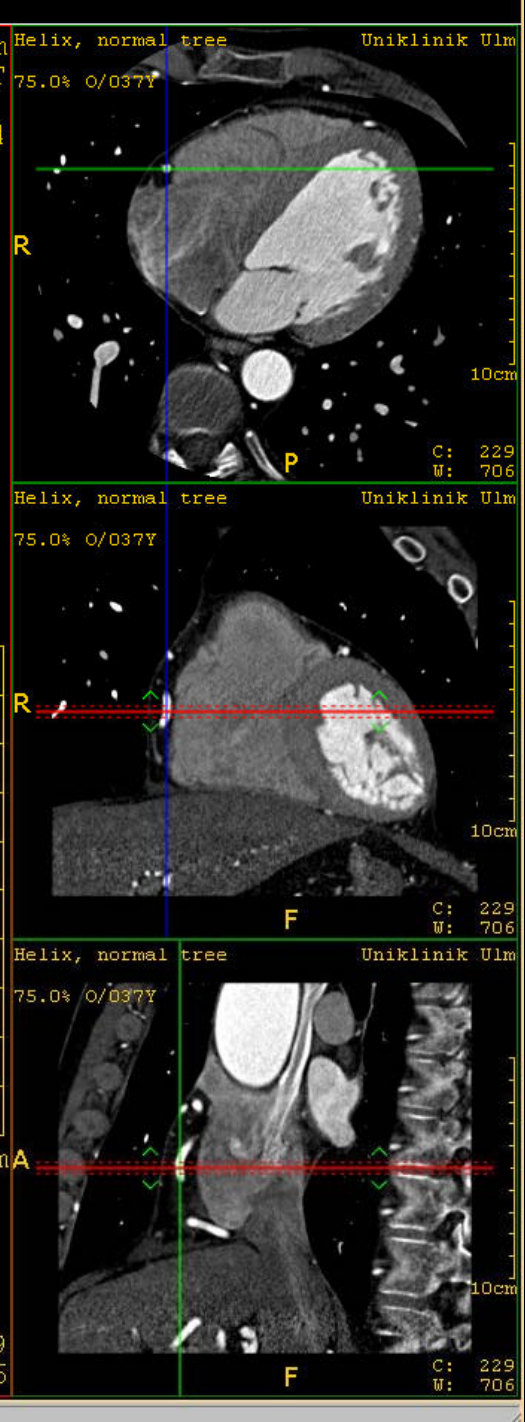
MIP

Thickness (mm): 5.0

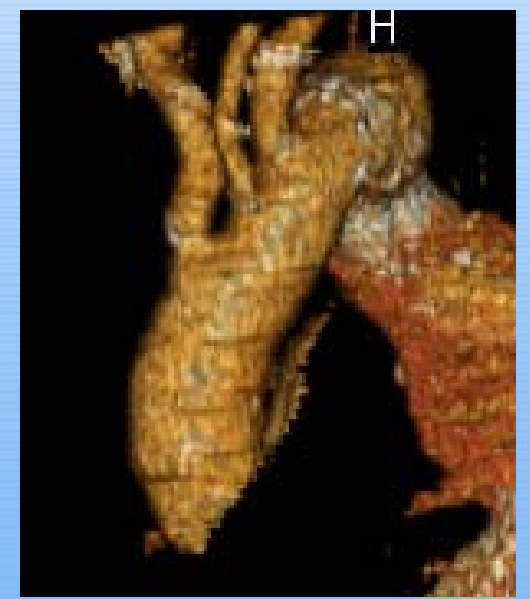
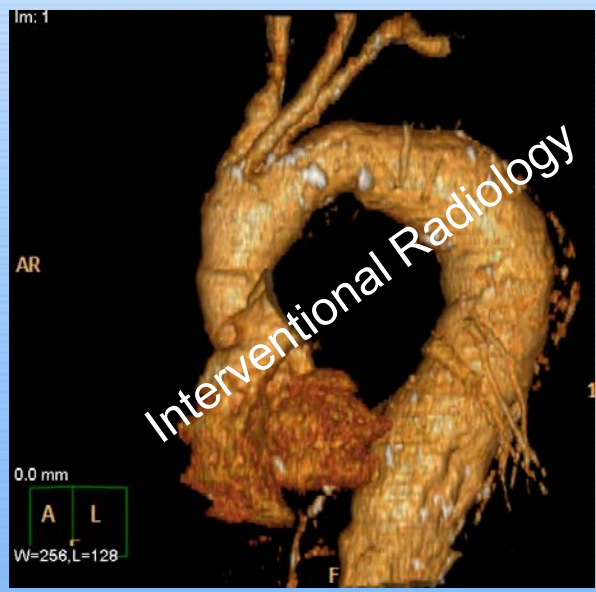
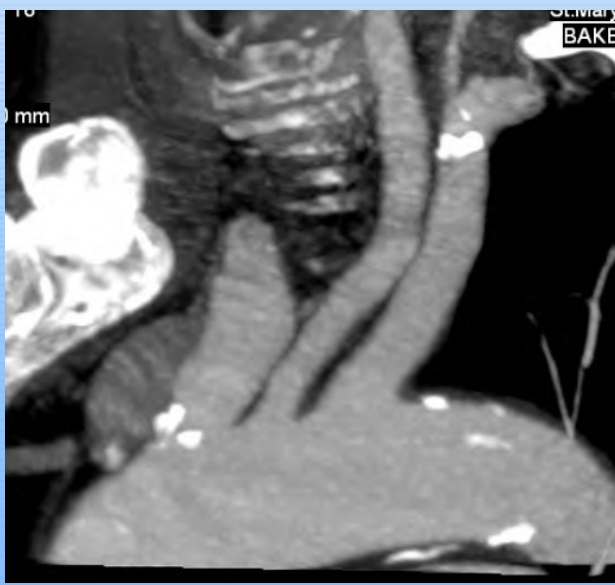
Windowing: Modified

Titles Off

Exit Reset All



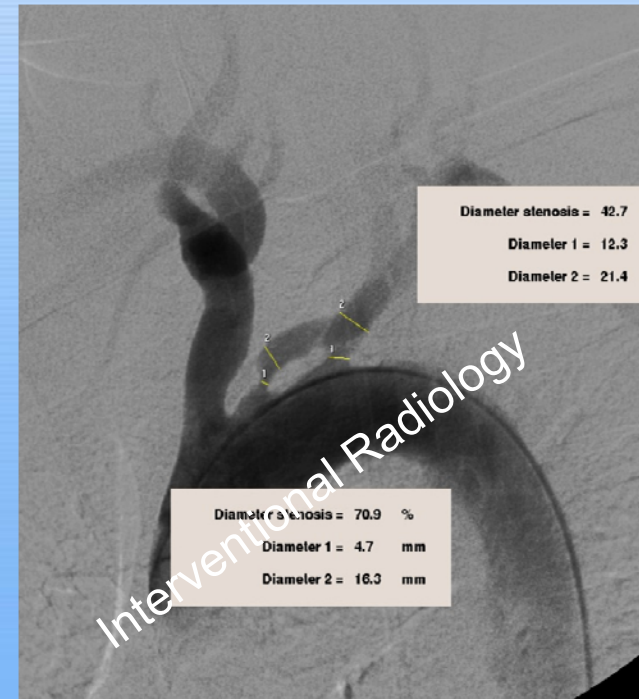
Arch assessment



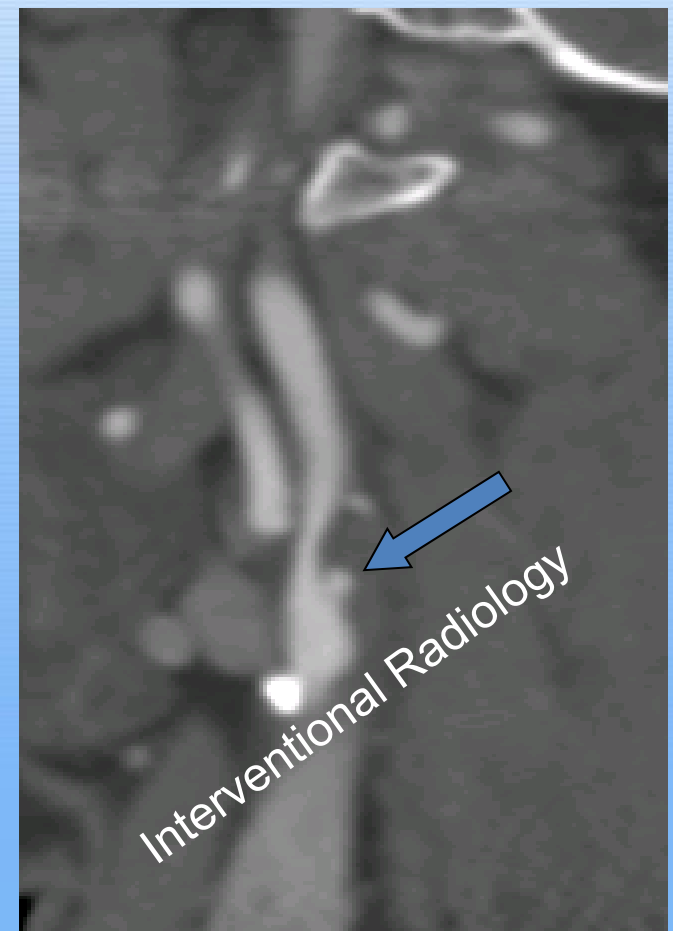
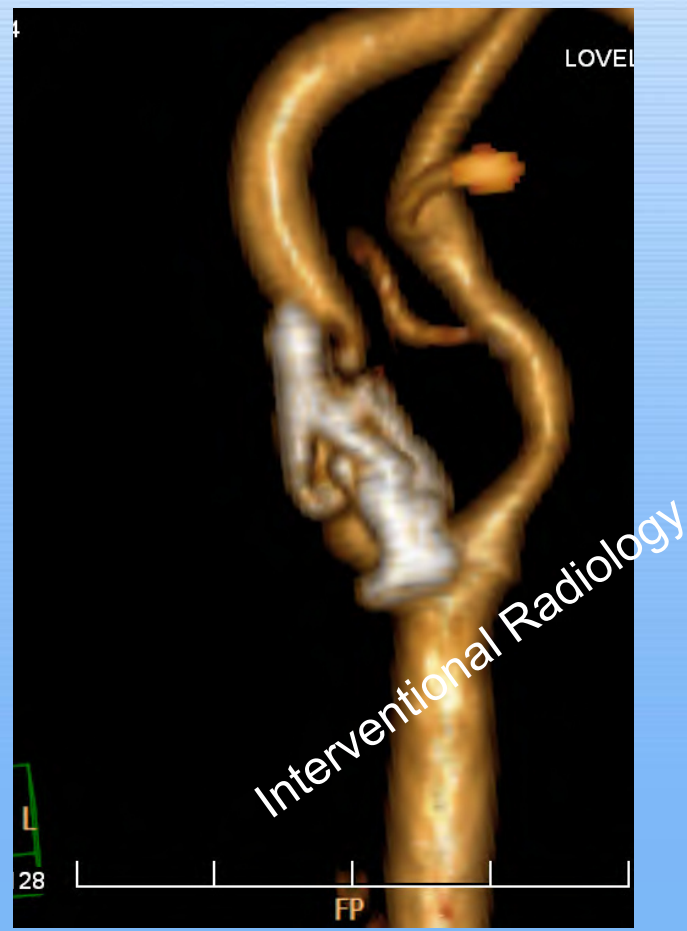
Arch assessment



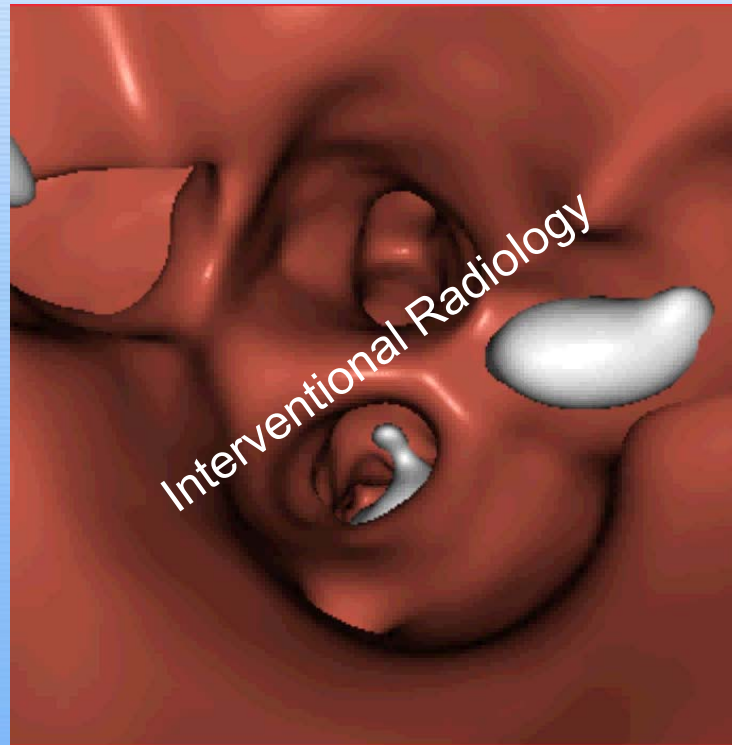
Tandem lesions



Plaque morphology

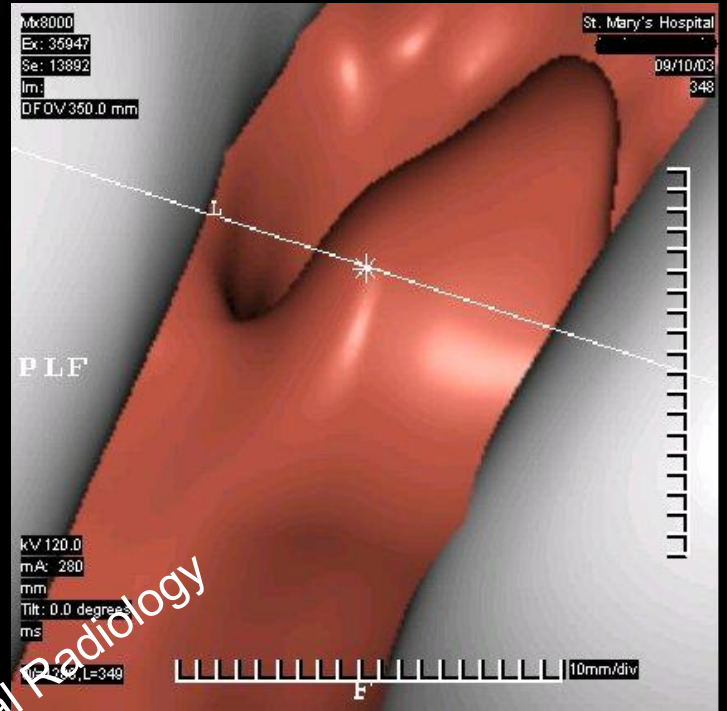
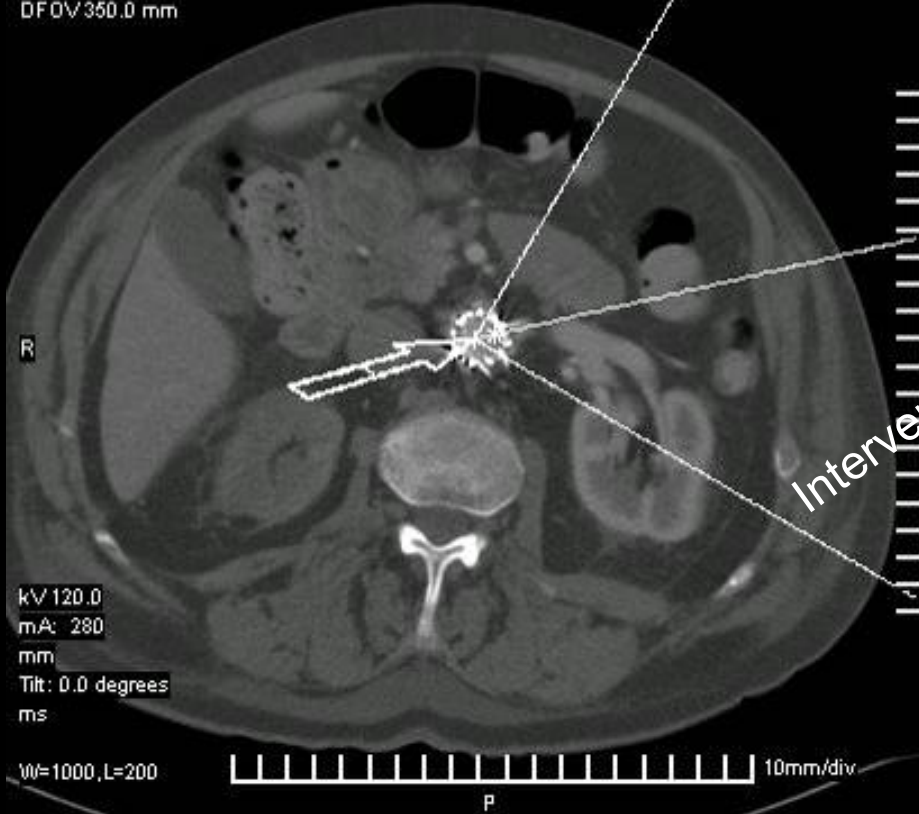


Virtual Arterial Endoscopy

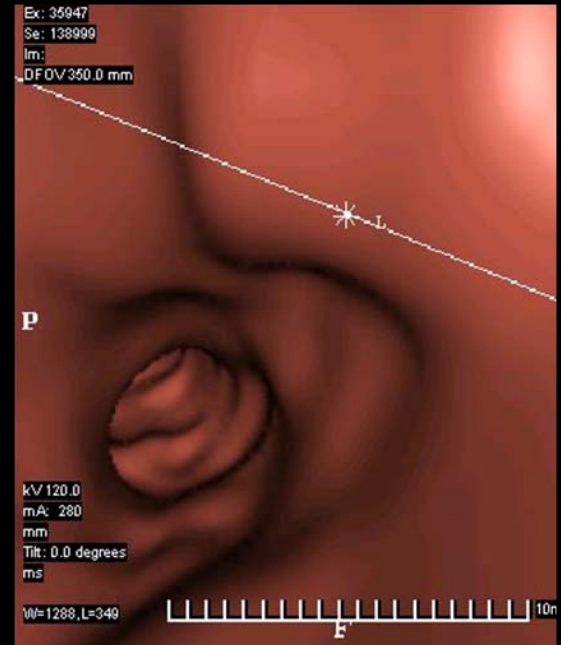


Ex: 35947
Se: 13893
Im:
DFOV 350.0 mm

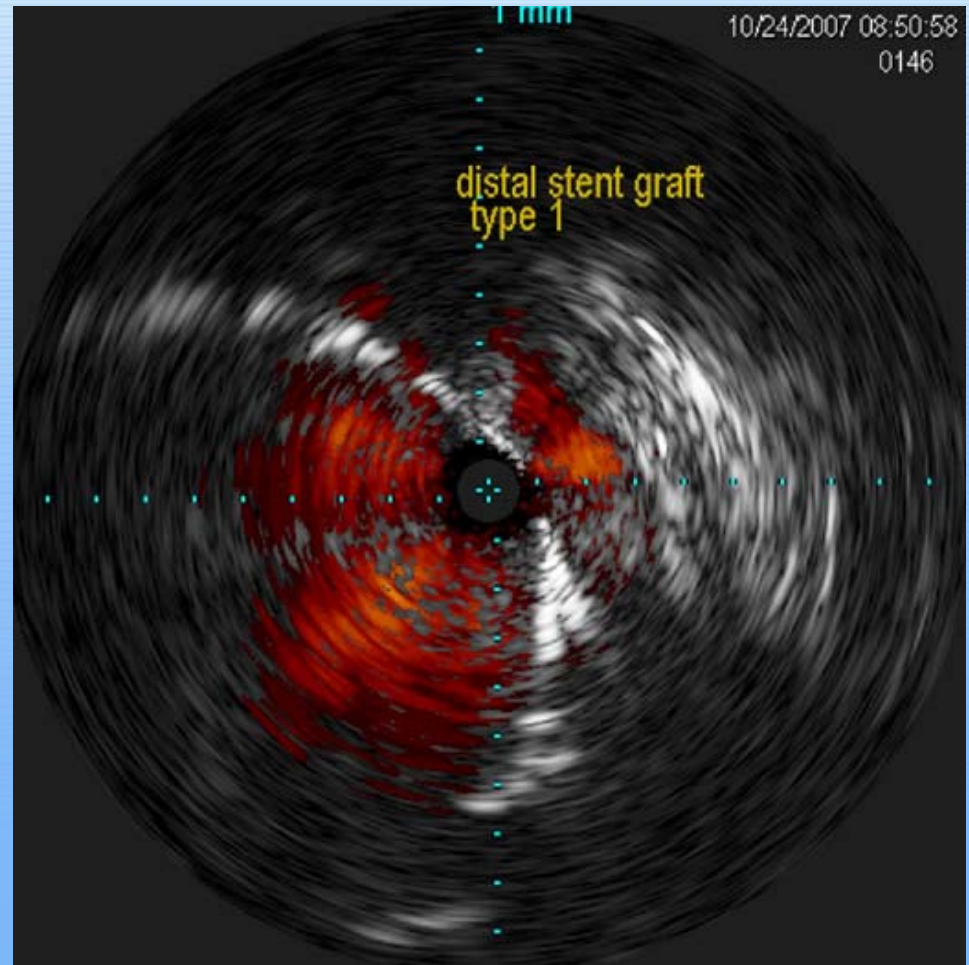
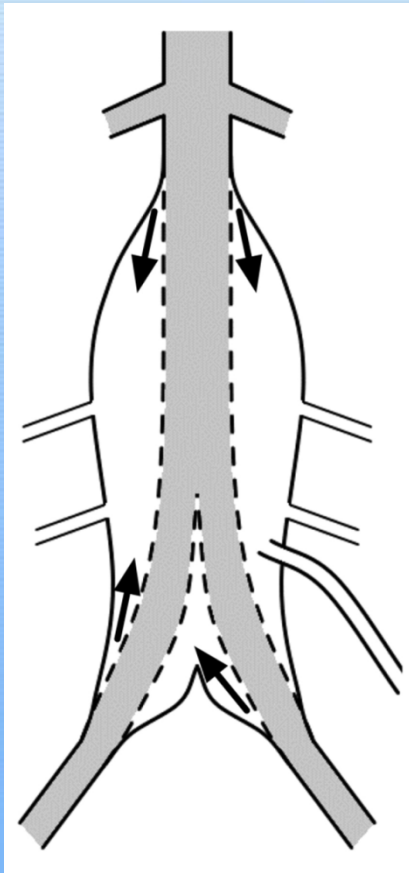
FARNES JAMES
09/10/03
696



Interventional Radiology

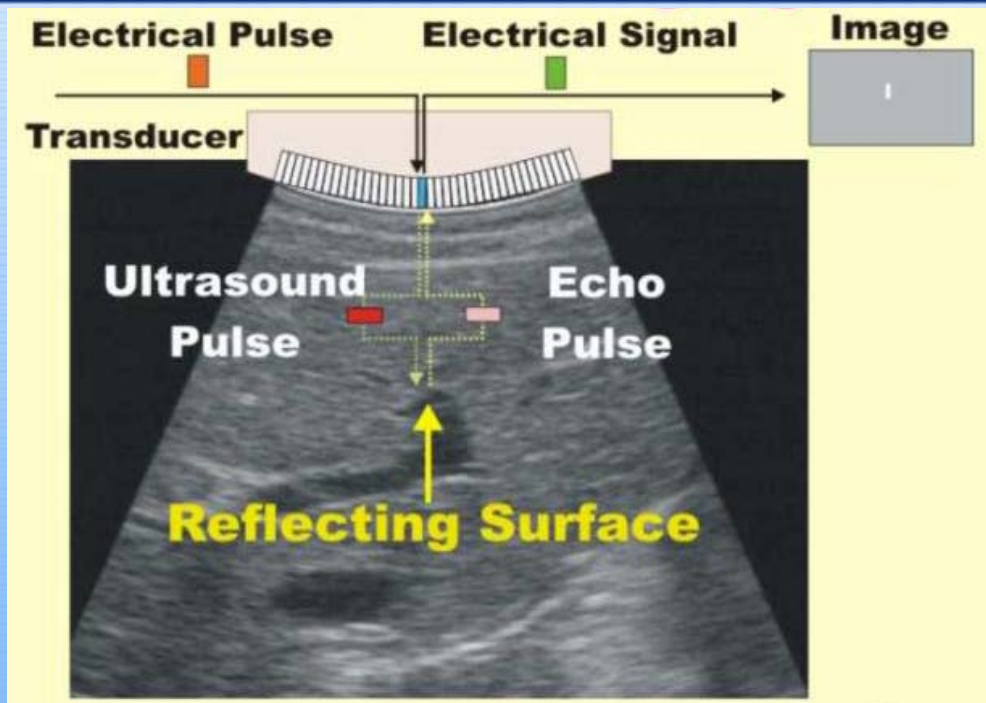


Intravascular Ultrasound (IVUS)

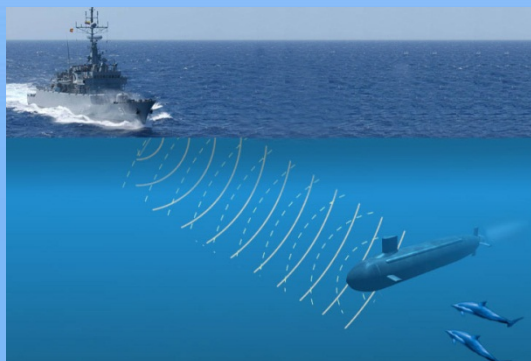
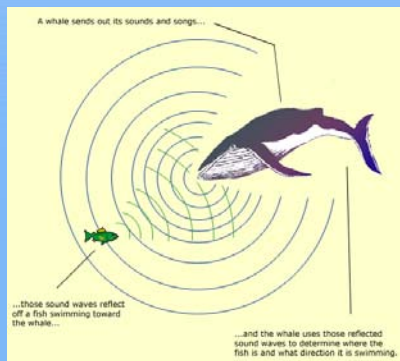


Fernandez et al JEVT 2009

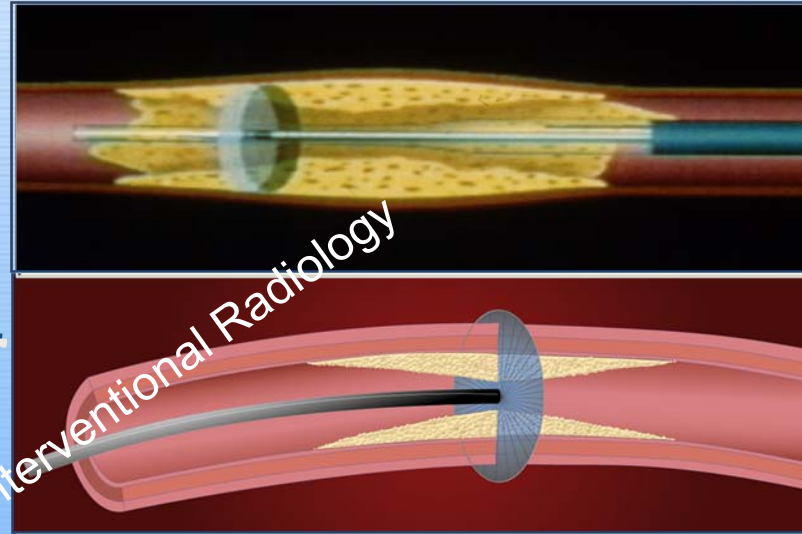
How Does IVUS Work?



- Transducer emits high-frequency sound waves
- Sound waves reflected back to transducer from tissue structures of different densities
- Processor displays cross-sectional image based on intensity of returned waves

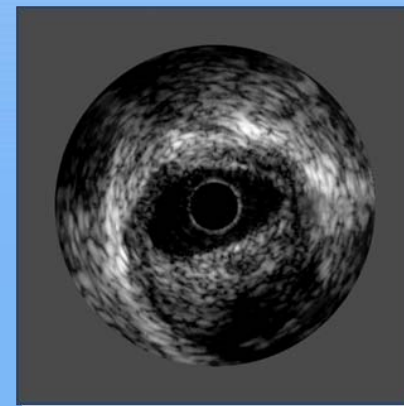


Ultrasound Image Processing



High frequency sound waves
echo off vessel walls and are
sent back to system

System electronics
process the signal



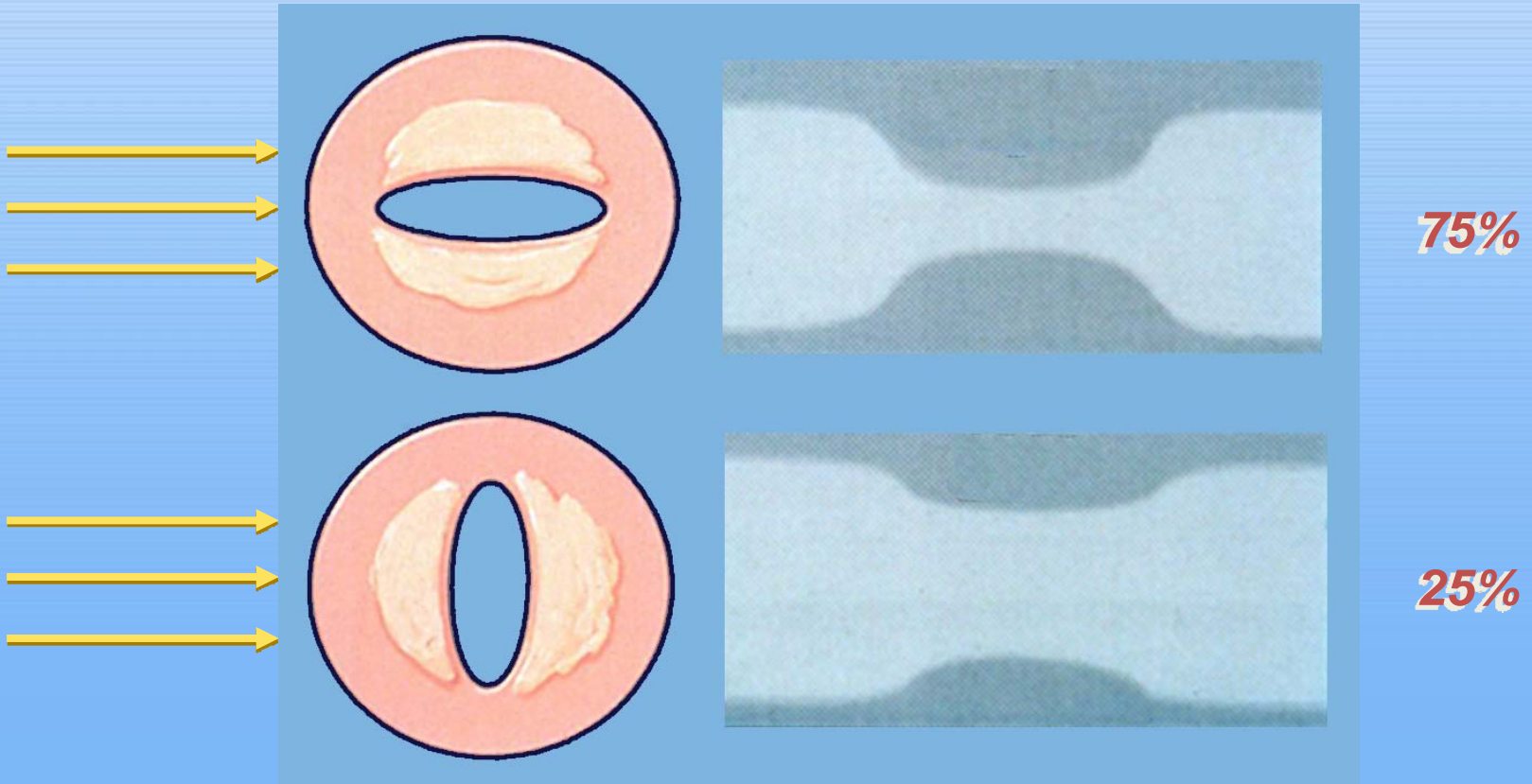
Angiography vs IVUS

- Multiple studies support the use of IVUS
 - Angiography alone is inefficient
 - 2D image of a three-dimensional vessel
 - Cannot see the vessel itself

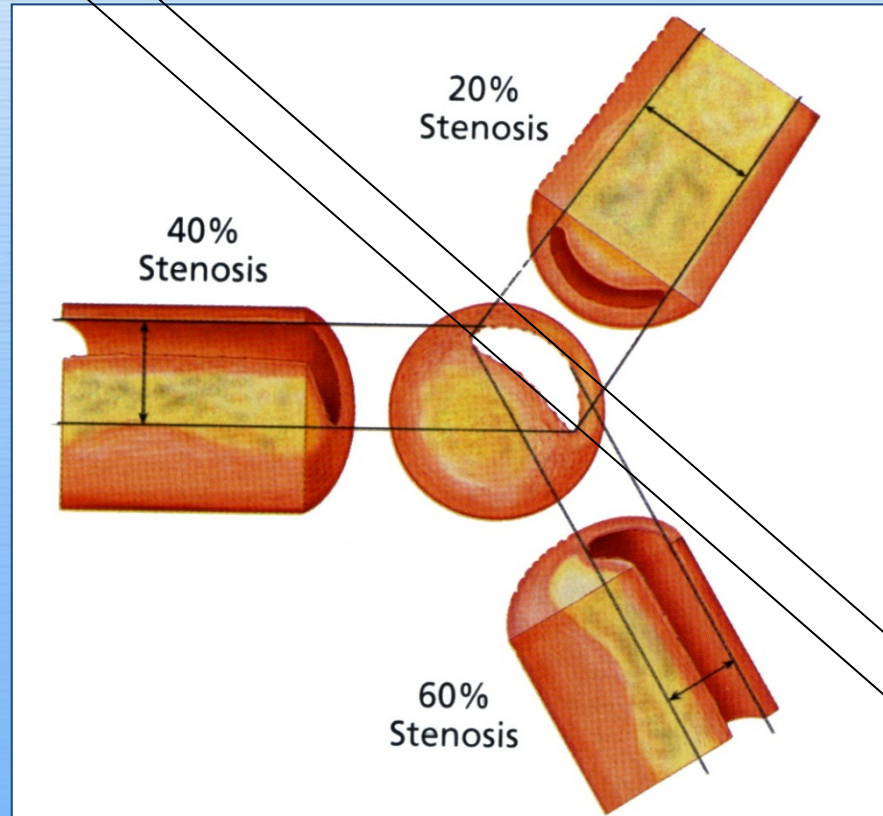
Limitations of Angiography

Cross-section

Angiogram Silhouette

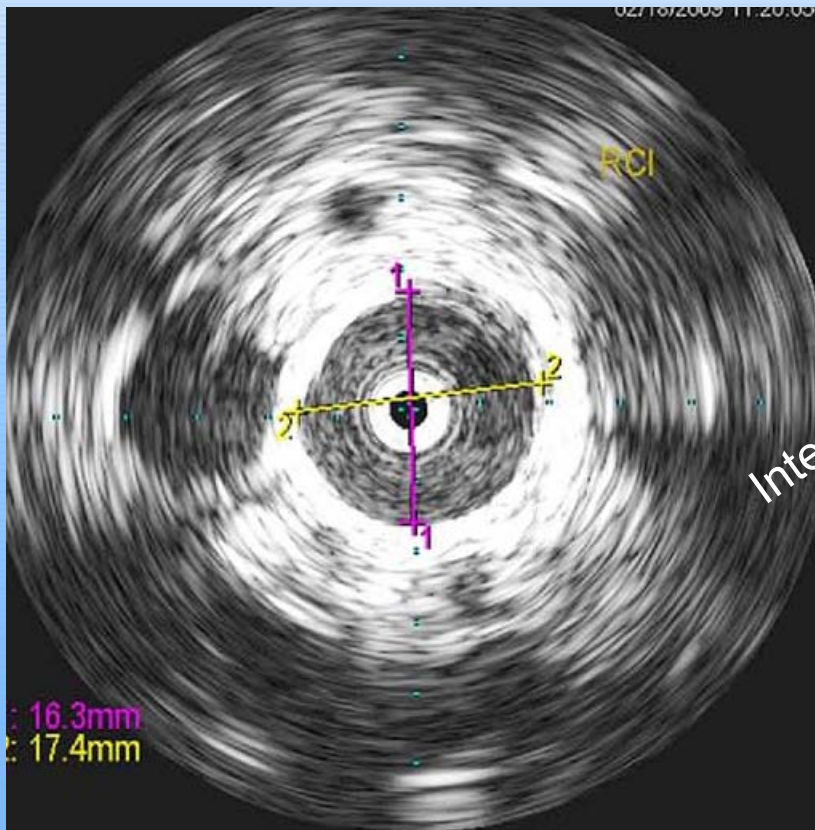


Limitations of Angiography

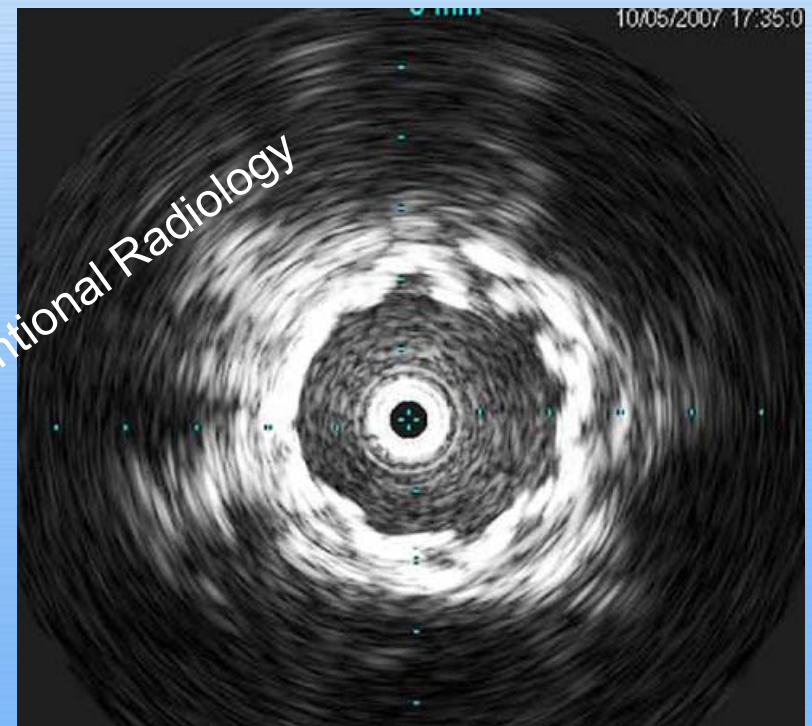


- Angiography alone can underestimate the degree of stenosis!

IVUS for EVAR

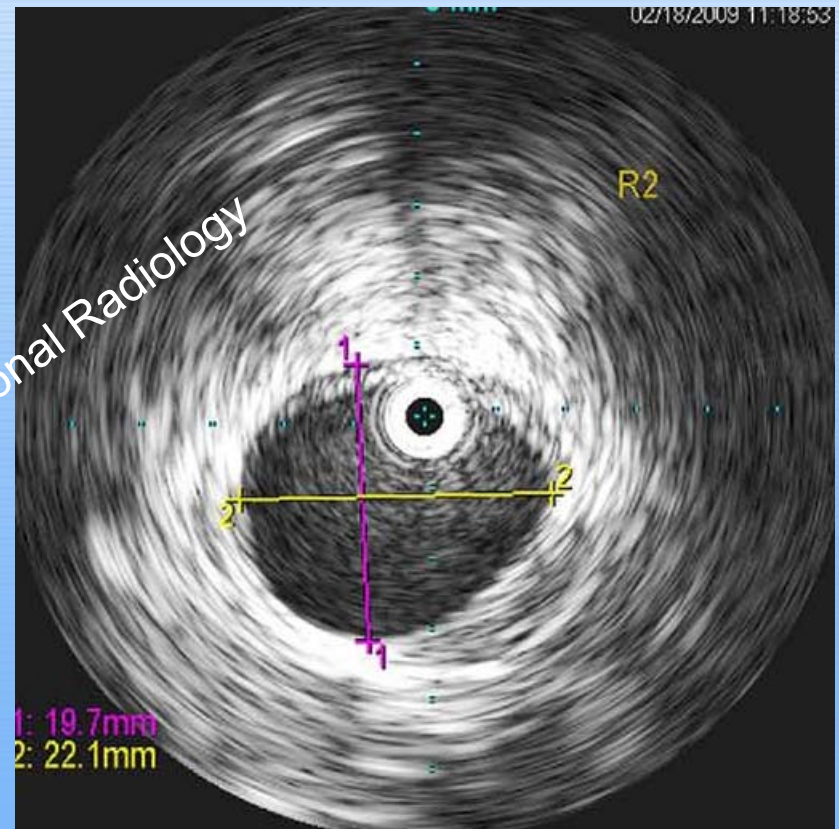
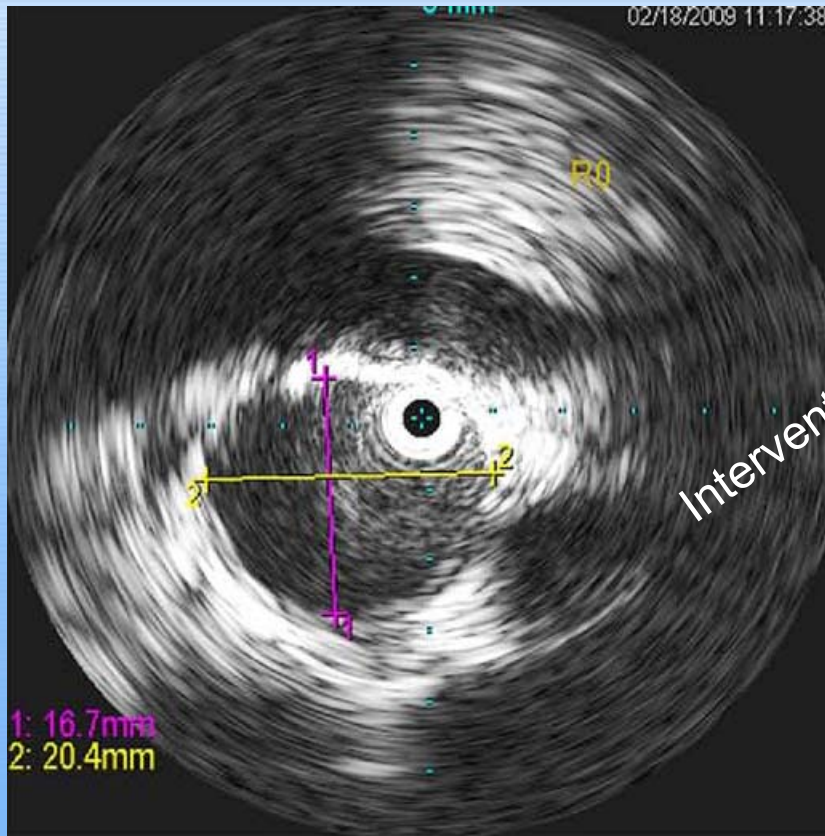


Measuring aortic diameter



Stent graft in situ

IVUS for EVAR



Interventional Radiology

Angiography

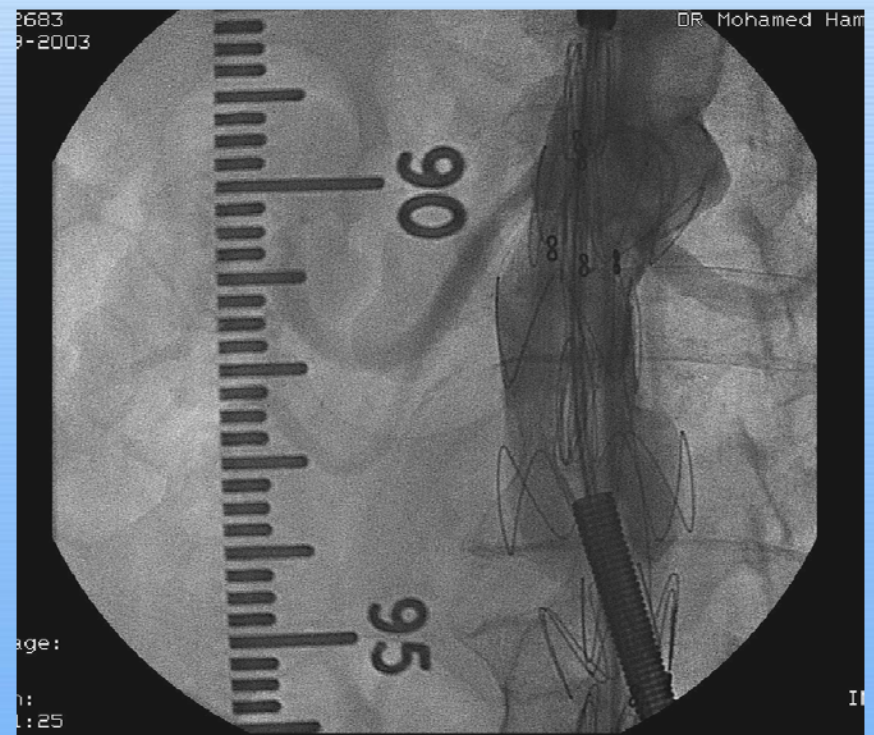


Image registration

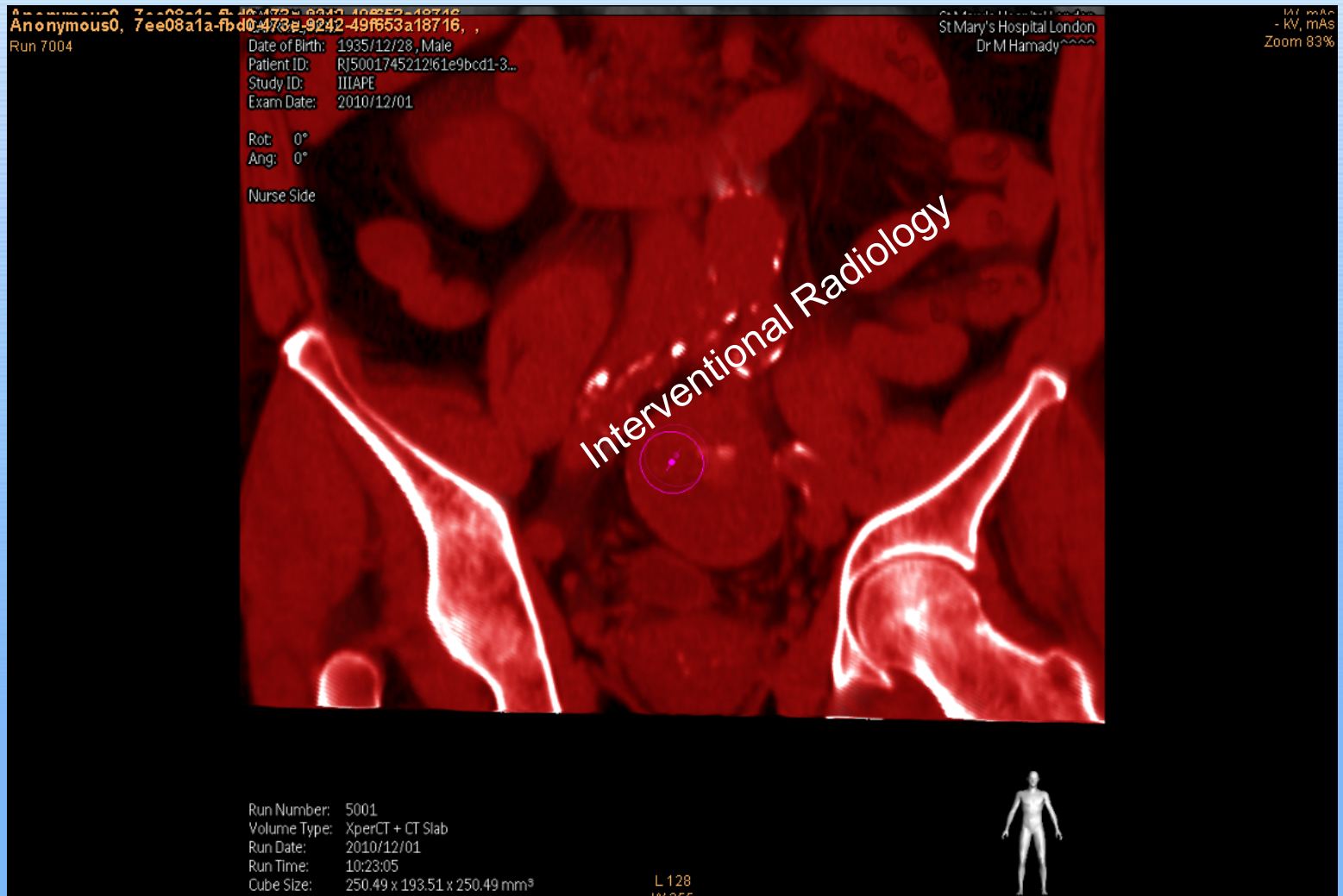
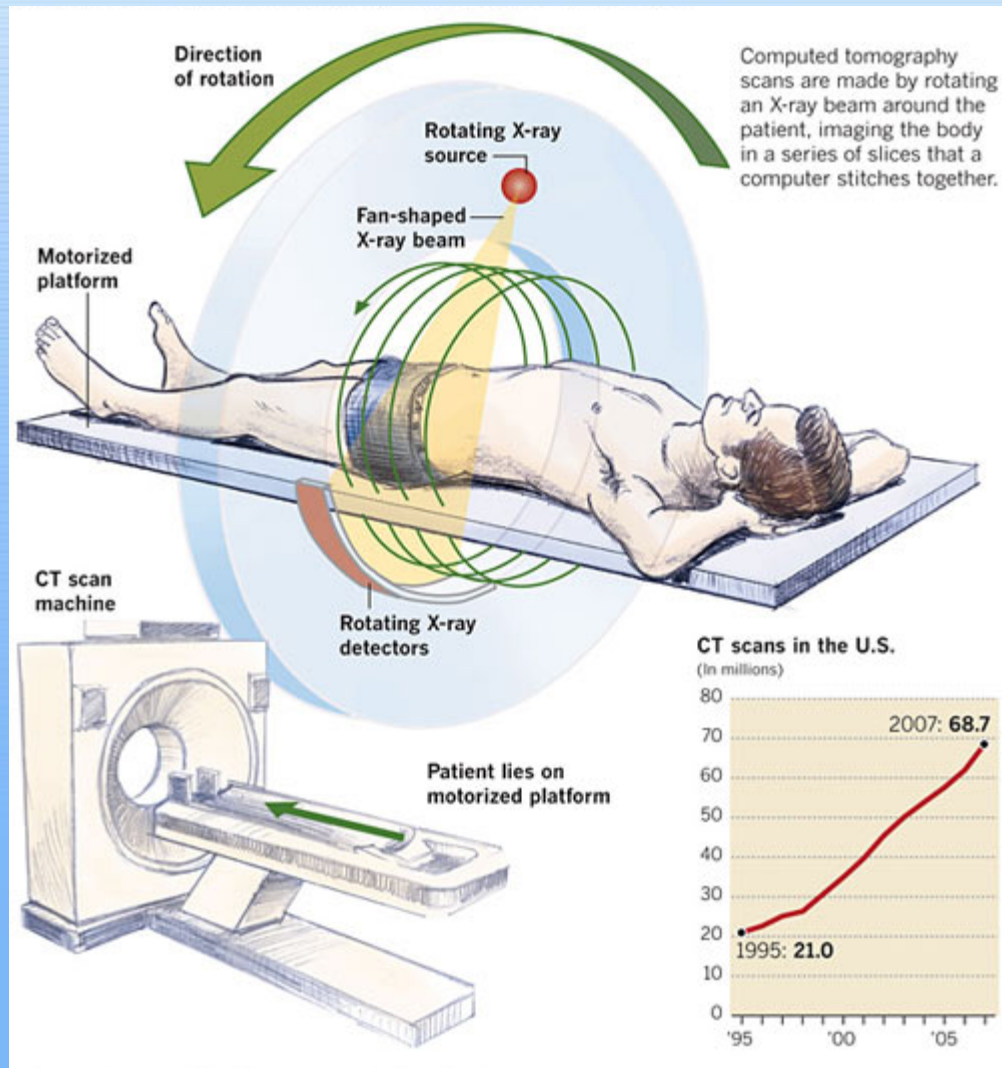


Image registration



3D Rotational Angiography (3DRA)

- CT scanner
 - Continuous x-ray beam rotates



3D Rotational Angiography (3DRA)



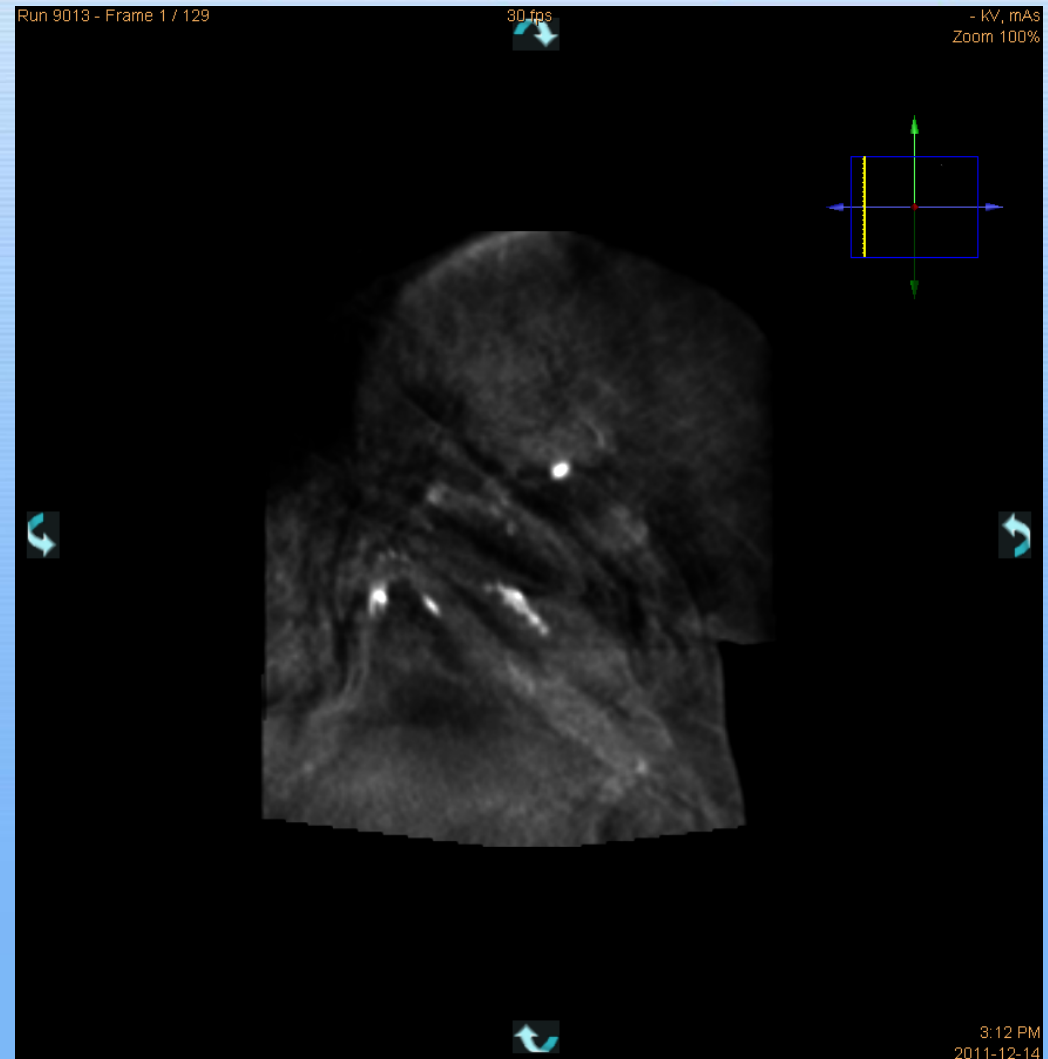
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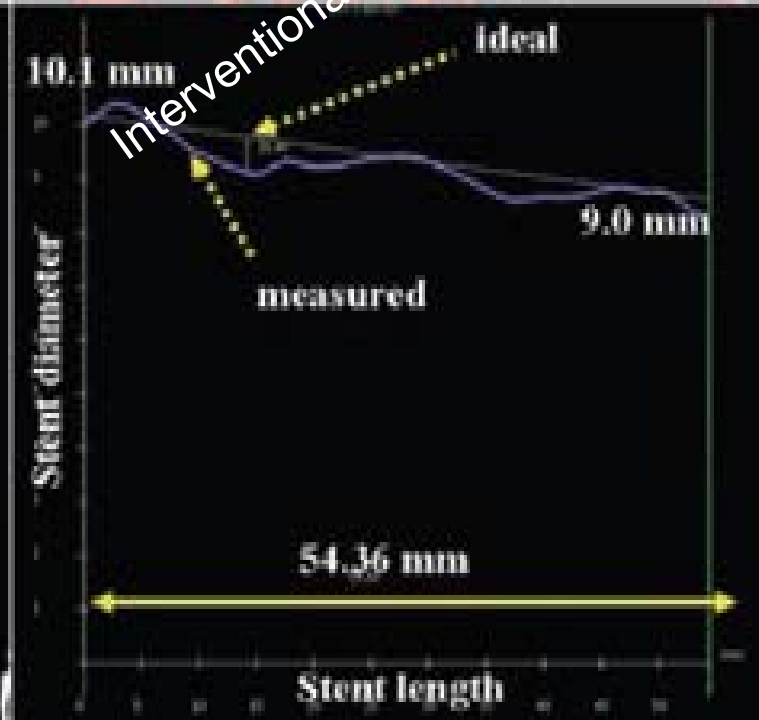
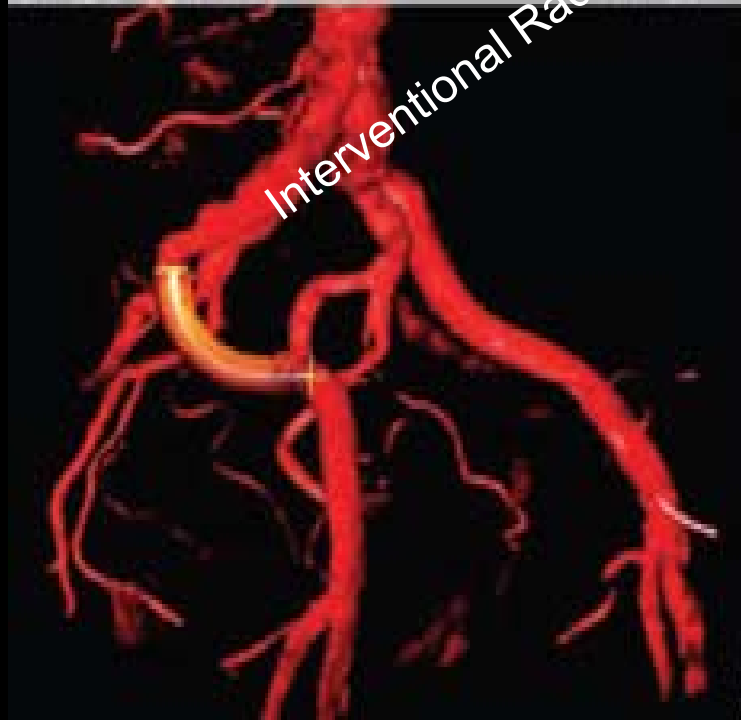
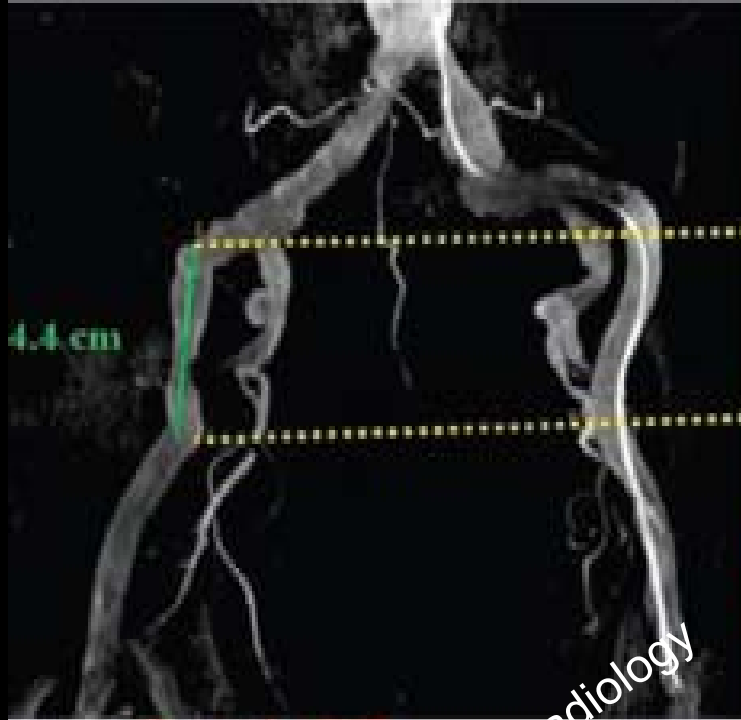


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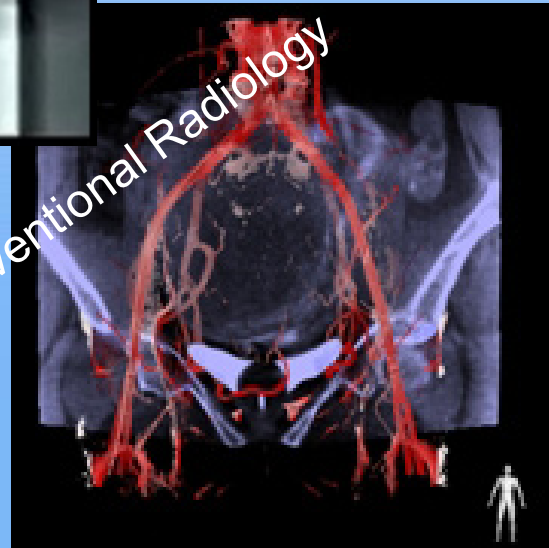
3D Rotational Angiography (3DRA)

- Bronchial Stent Placement

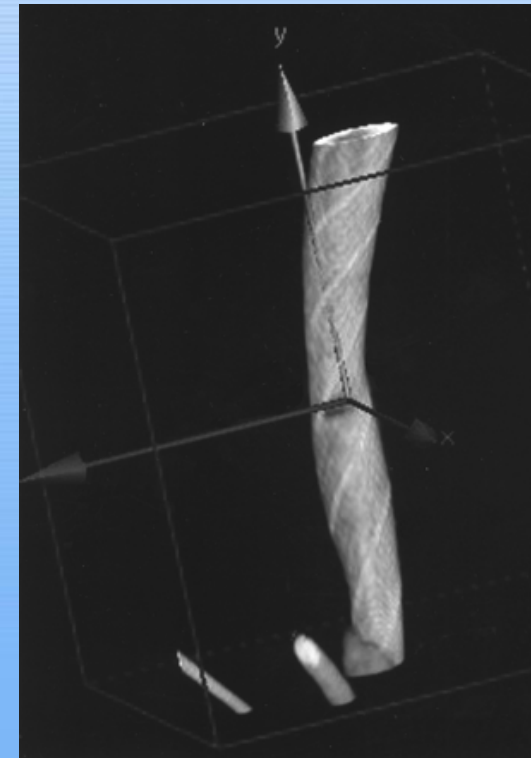
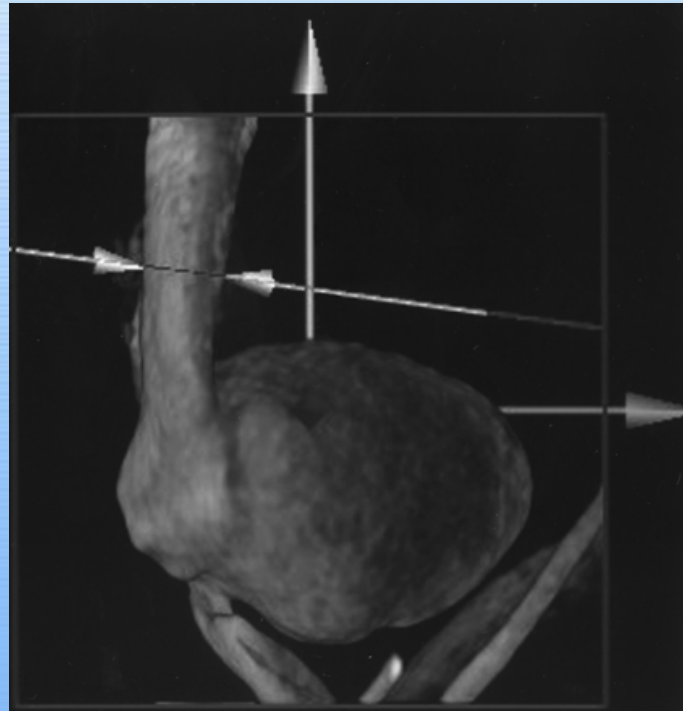




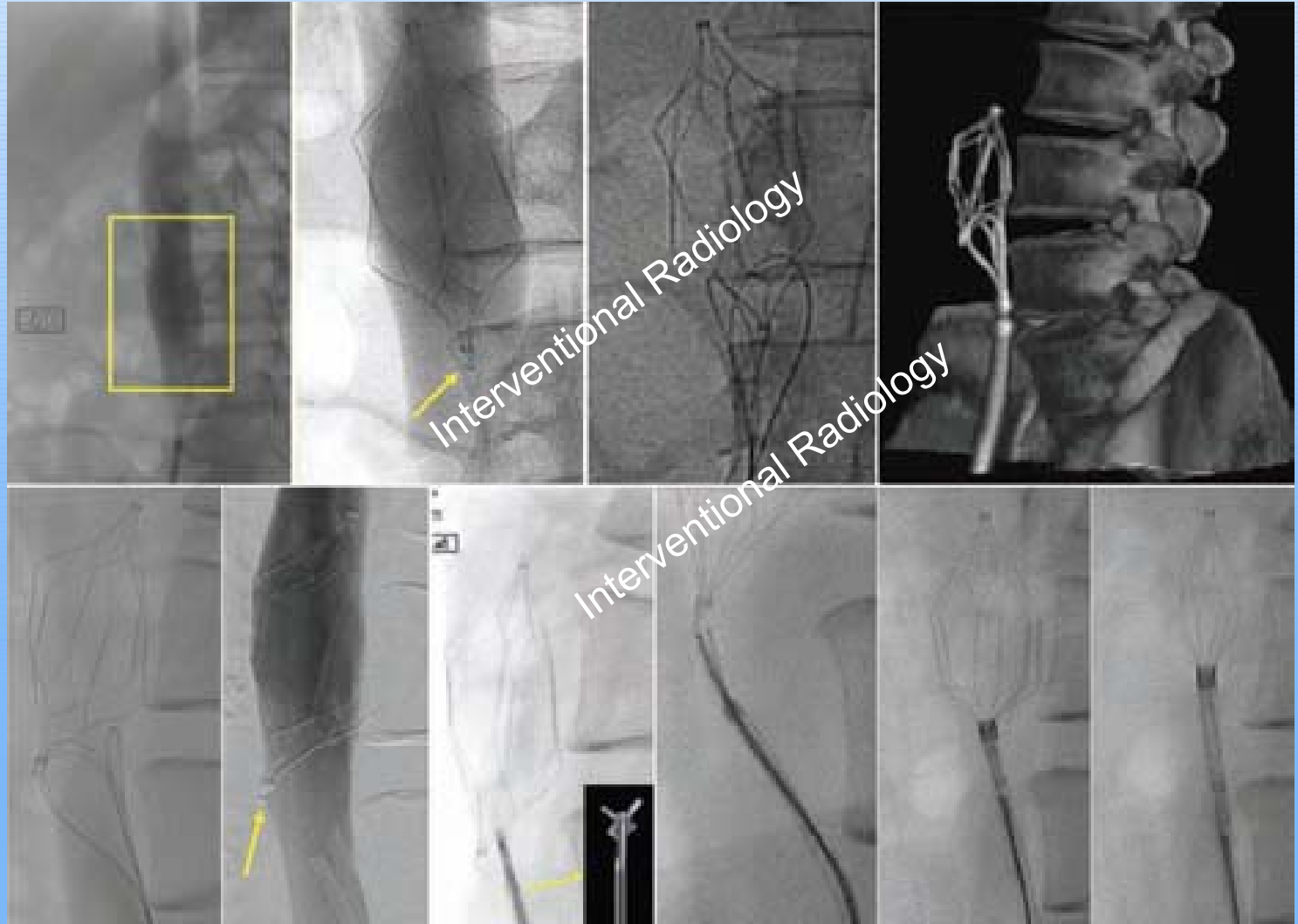
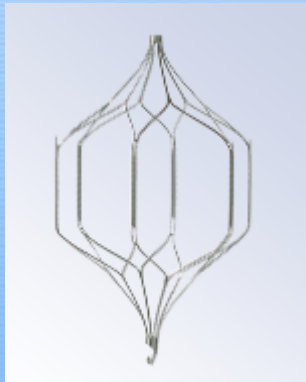
Dynamic 3D Roadmap



3D Rotational Angiography (3DRA)

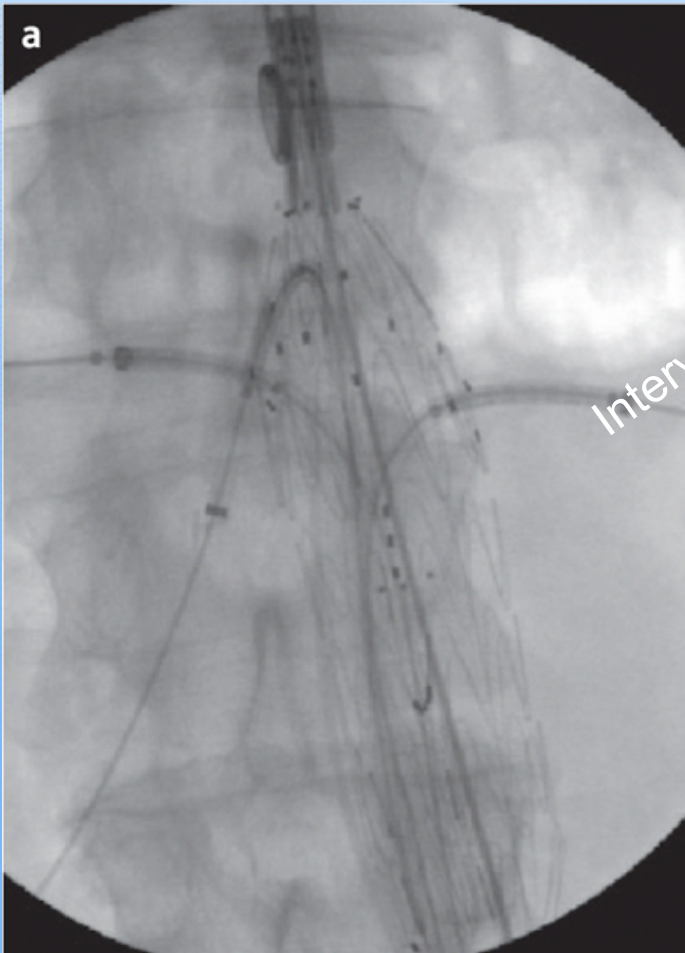


3D Rotational Angiography (3DRA)



3DRA

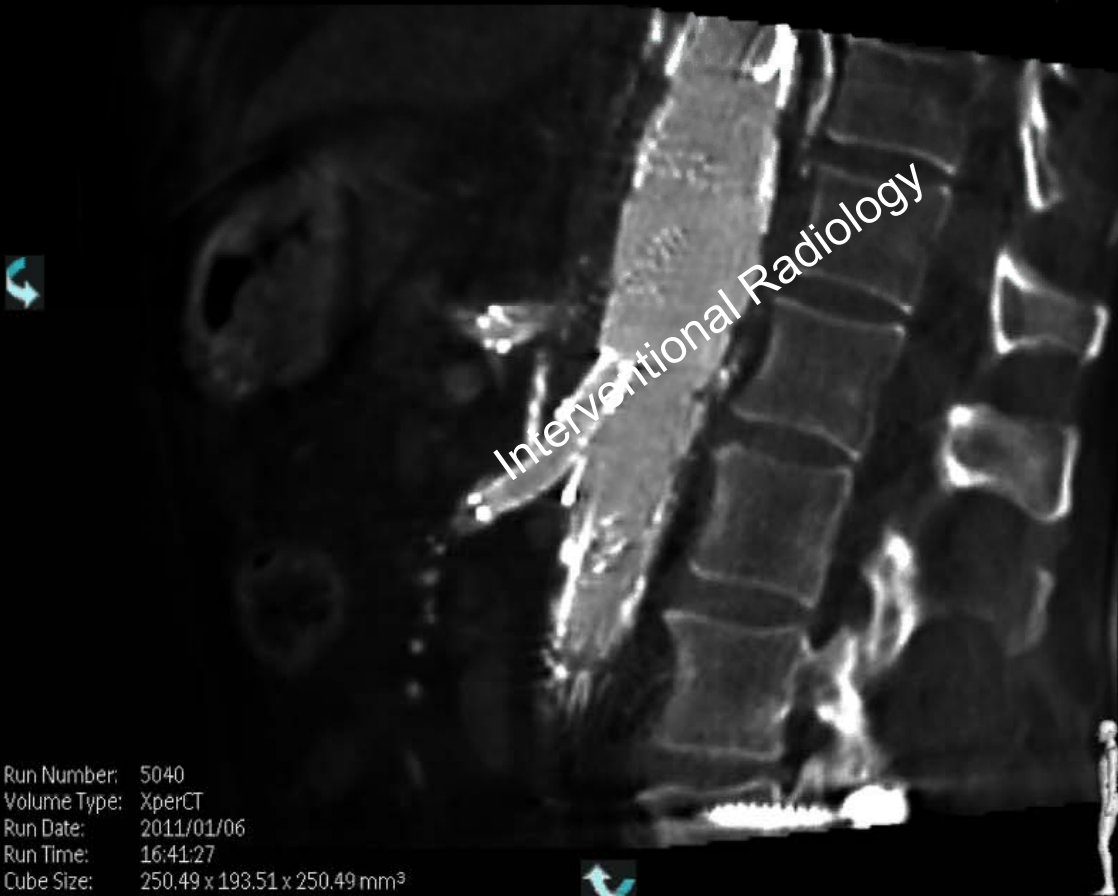
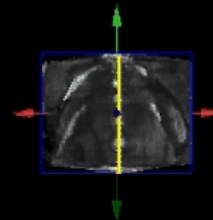
- Fenestrated Endovascular Aortic Repair (FEVAR)



Date of Exam: 2011/01/06
Patient ID: 4525159820
Study ID: IAAFGS
Exam Date: 2011/01/06

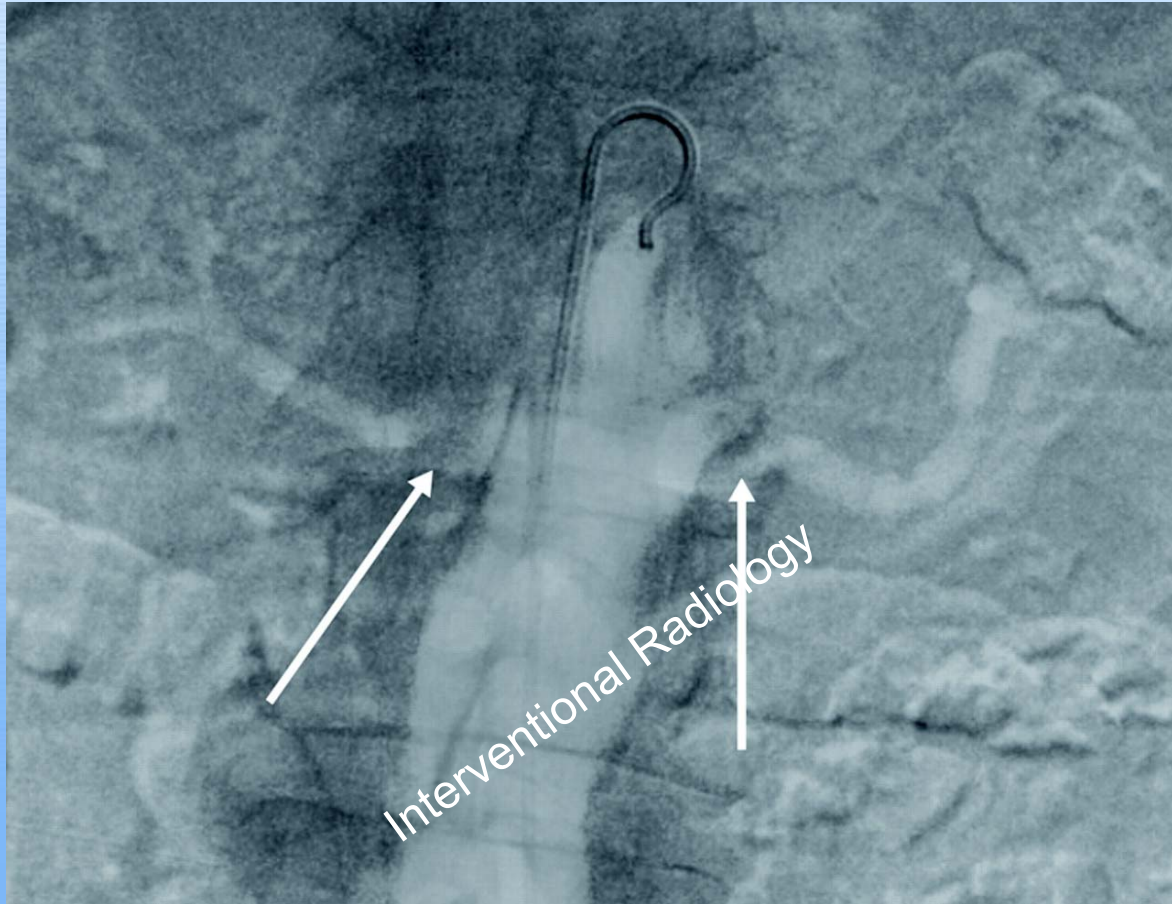
Rot: +90°
Ang: 0°

Nurse Side



Run Number: 5040
Volume Type: XperCT
Run Date: 2011/01/06
Run Time: 16:41:27
Cube Size: 250.49 x 193.51 x 250.49 mm³

CO₂ Angiography

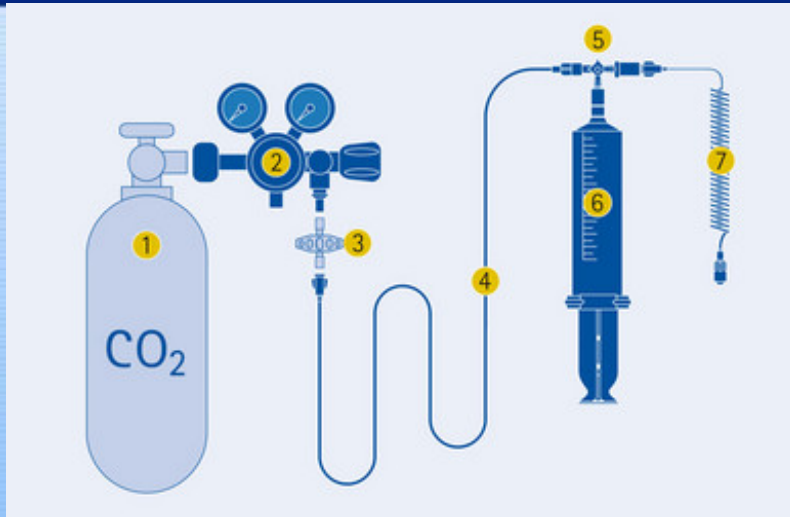


CO₂ Angiography

Why use CO₂?

- Iodinated contrast allergy
- Renal insufficiency
- High volume contrast procedure
- Hyperthyroidism

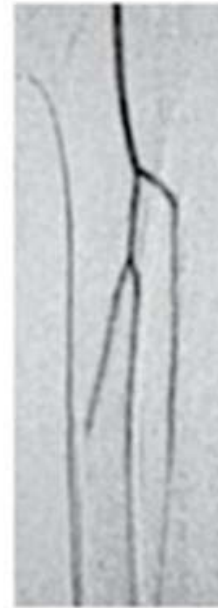
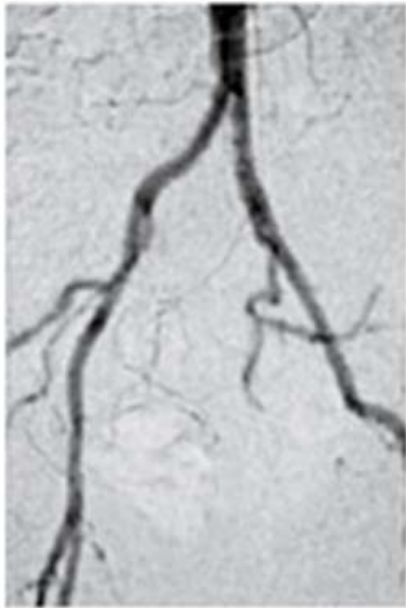
CO₂ Angiography



- Special delivery system connects to CO₂ cylinder



CO₂ Angiography



- Special DSA software for image production

CO₂ Angiography

Contraindications:

1. Supra-diaphragmatic arterial injection
 - Gas embolism
 - L to R shunts
2. Use with nitrous oxide anaesthesia
 - Diffuse from soft tissues

CO₂ Angiography

- Advantages:
 - Non allergenic
 - Non-nephrotoxic
 - Unlimited total volume
 - Inexpensive

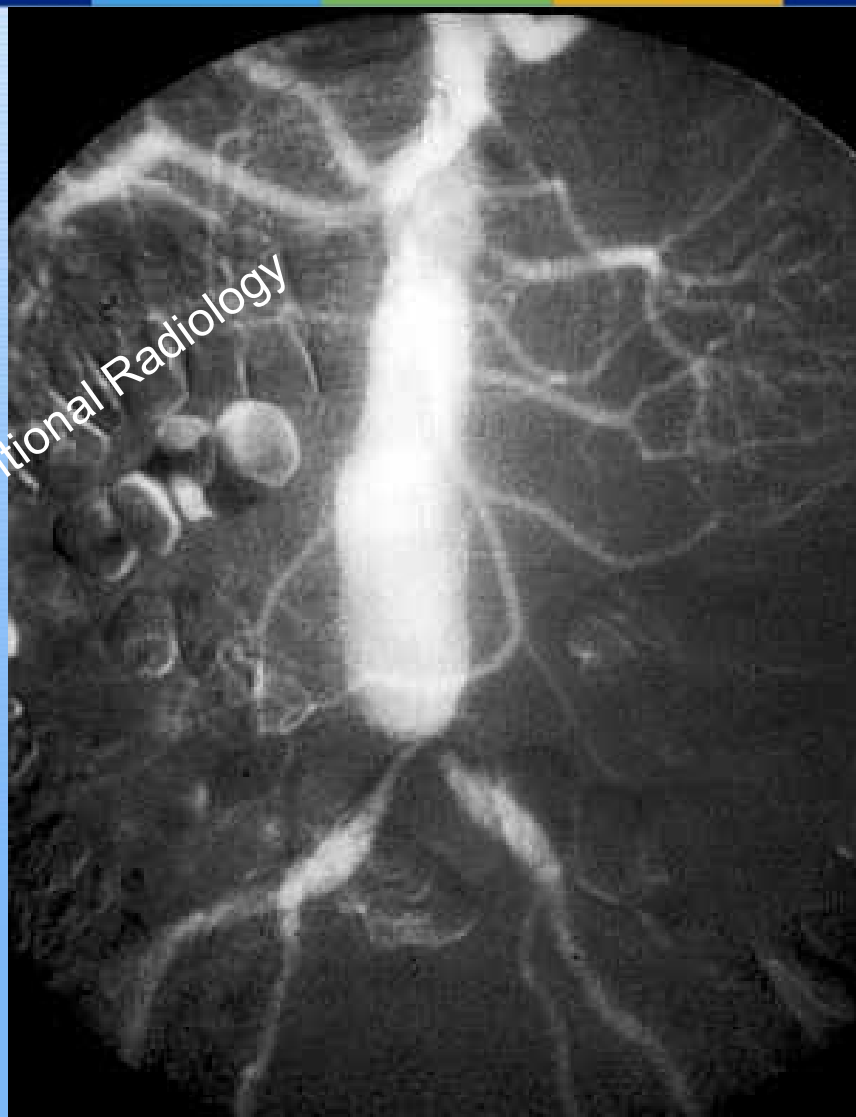
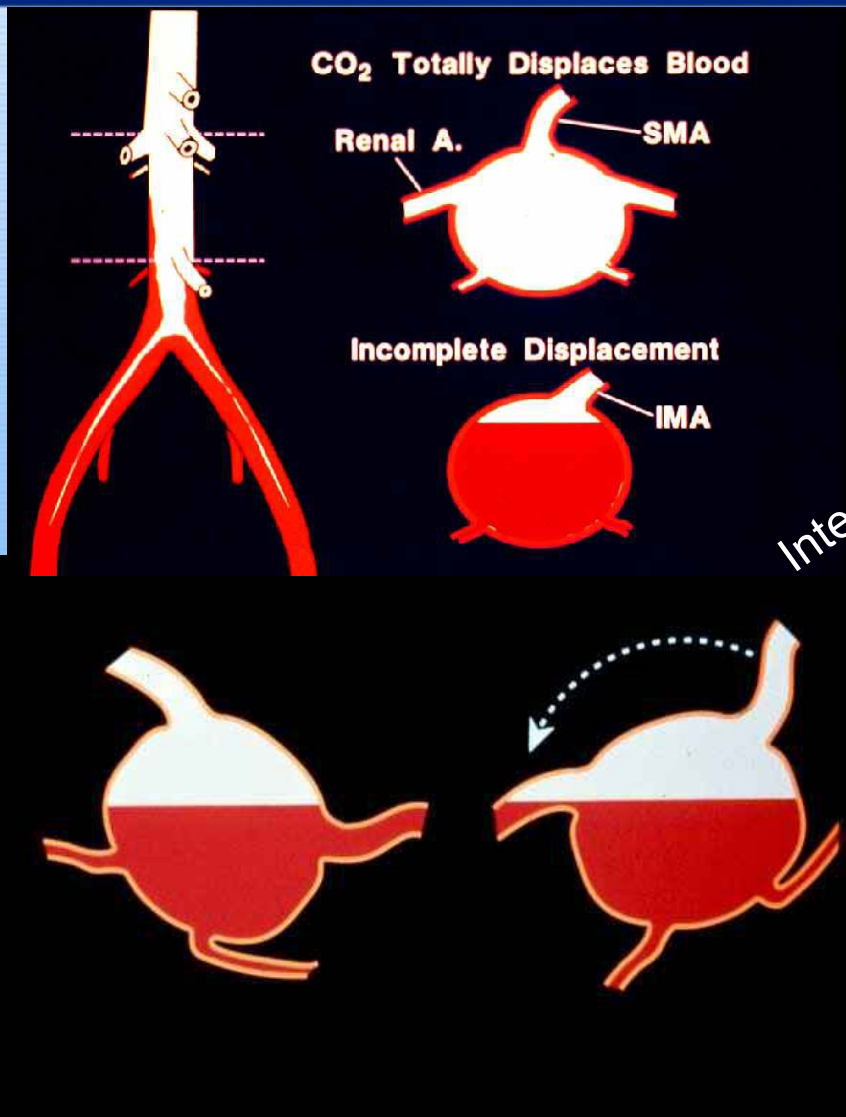
CO₂ Angiography

- Disadvantages:
 - Unique delivery system
 - Risk of explosive injection
 - Potential contamination
 - Room air
 - CO₂ cylinder

CO₂ Angiography

- Properties of CO₂
 - Displaces blood
 - Buoyant

CO₂ Angiography



CO₂ Angiography

- Patient left side up



Interventional MRI



Interventional MRI

- Advantages:
 - No radiation
 - No contrast nephropathy
 - High soft tissue contrast
 - Multiplanar images
 - Evaluation of structure and function



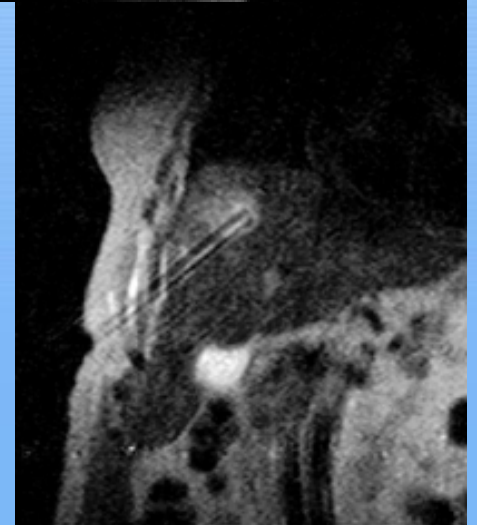
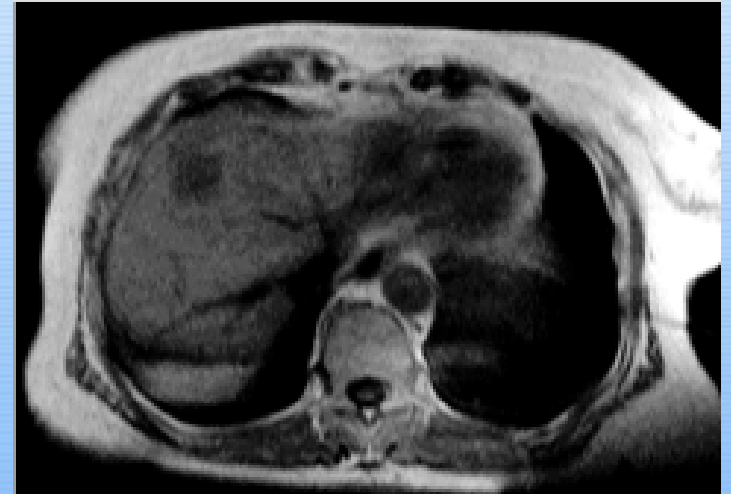
Interventional MRI

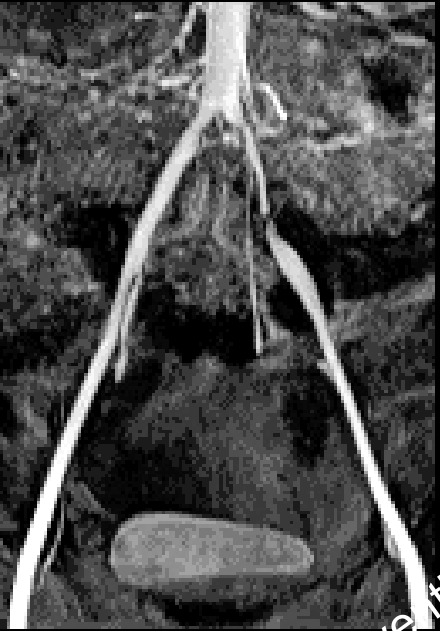
- Limitations:
 - Instrument compatibility
 - High cost
 - Availability



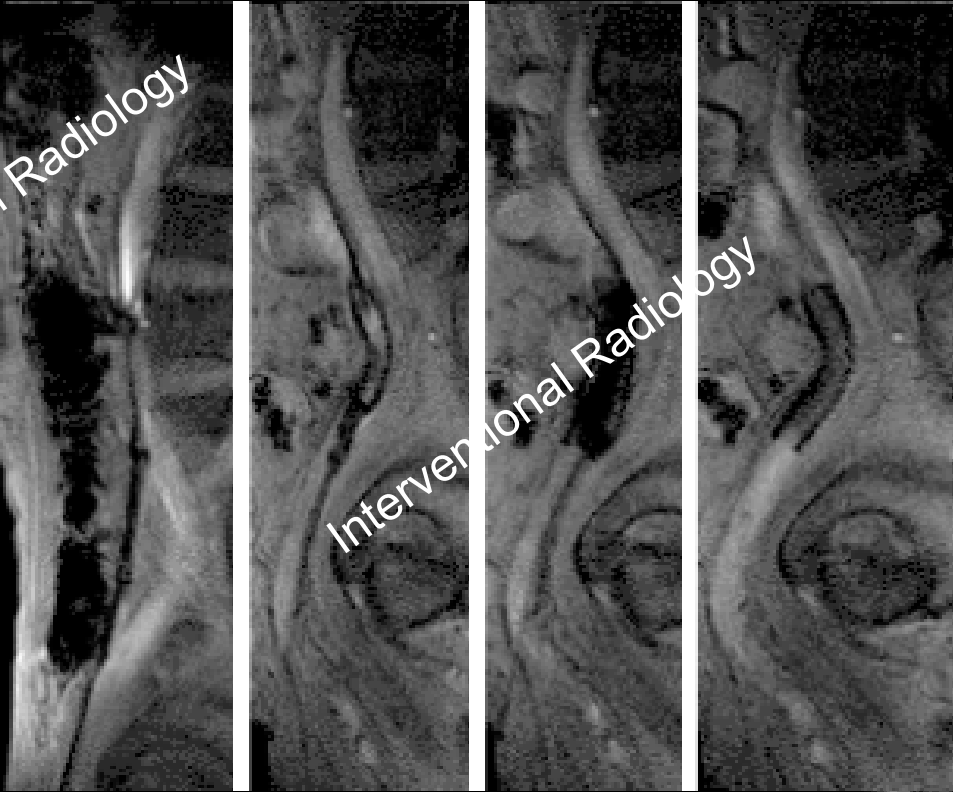
Interventional MRI

- Biopsies
- RF ablation

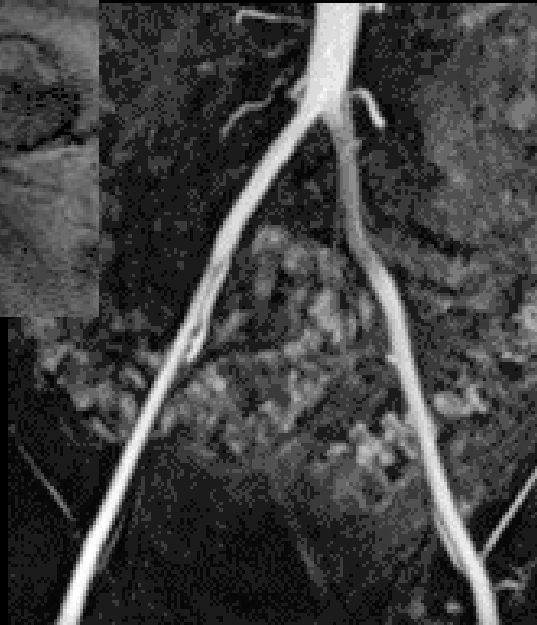




Interventional Radiology

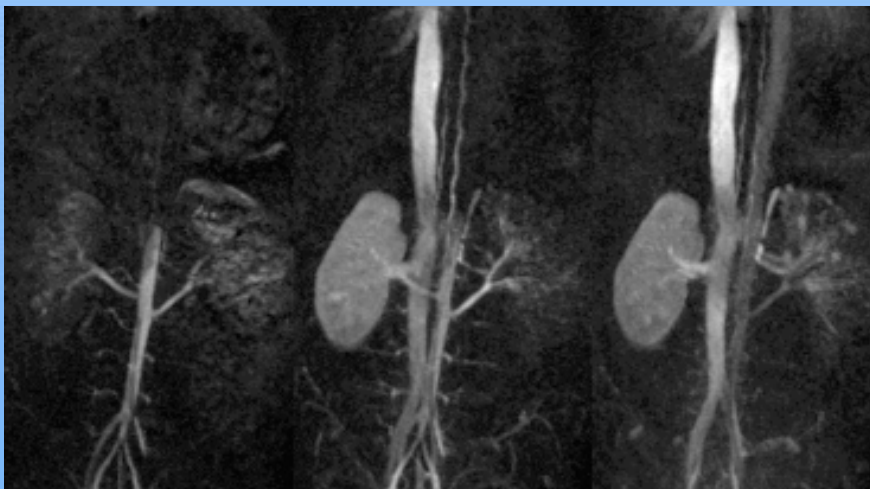


Interventional Radiology



Interventional MRI

- Catheter tracking and embolisation

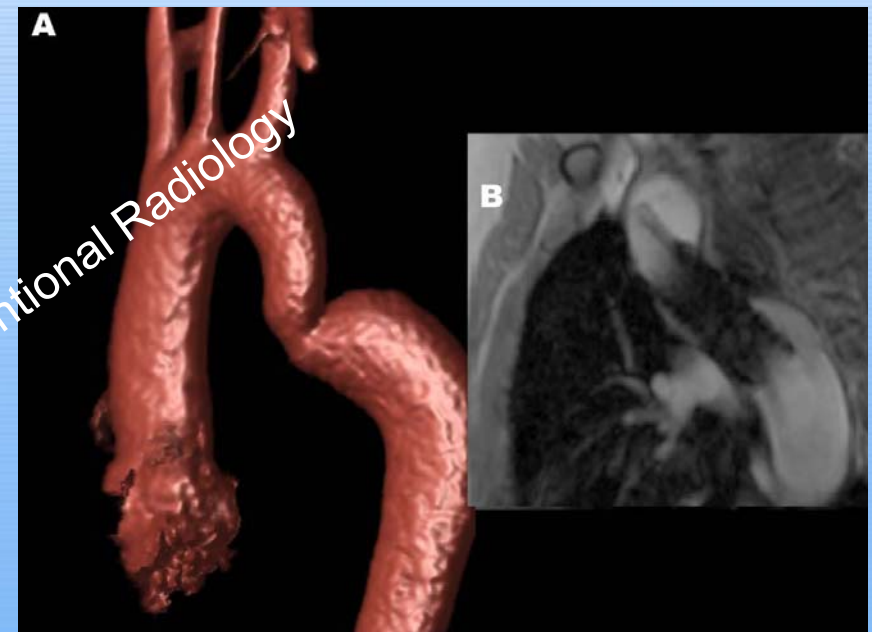
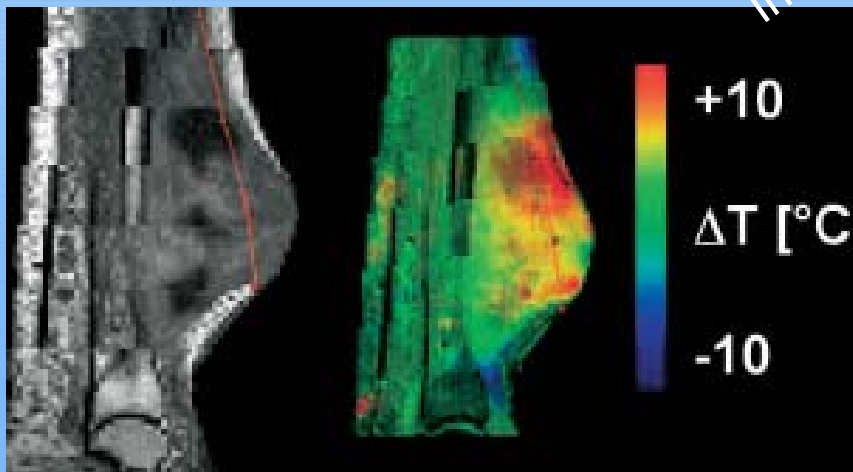


Interventional Radiology



Interventional MRI

- Production of volume and functional images



Interventional MRI





Thank You