

MULTI-DETECTOR CT CORONARY ANGIOGRAPHY

West Suburban Cardiology

MDCT CORONARY ANGIOGRAPHY



“A non-invasive alternative to direct angiography has been a “Holy Grail” to clinicians and radiologists...”

**Applied Radiology
10/04**

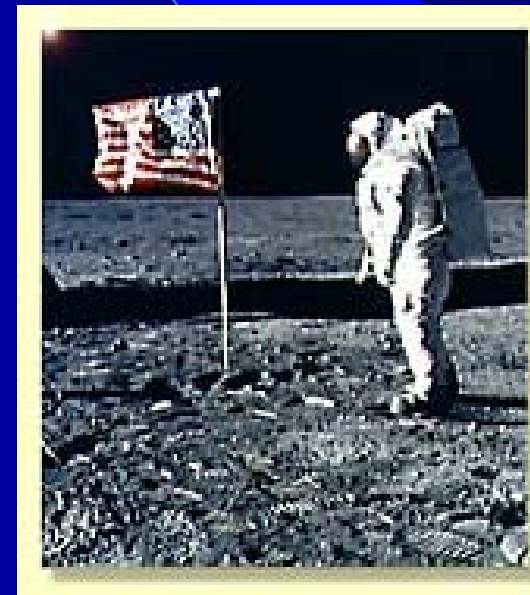
MDCT CORONARY ANGIOGRAPHY

- **What we bought & How it works**
- **How it's done**
- **Indications (good patients)**
- **Contraindications (bad patients)**
- **Benefits of CTA**
- **Limitations / Literature**
- **Radiation**
- **Non-cardiac findings**
- **Pretty pictures**
- **Implications for our practice**

MDCT CORONARY ANGIOGRAPHY

Why are coronaries so difficult?

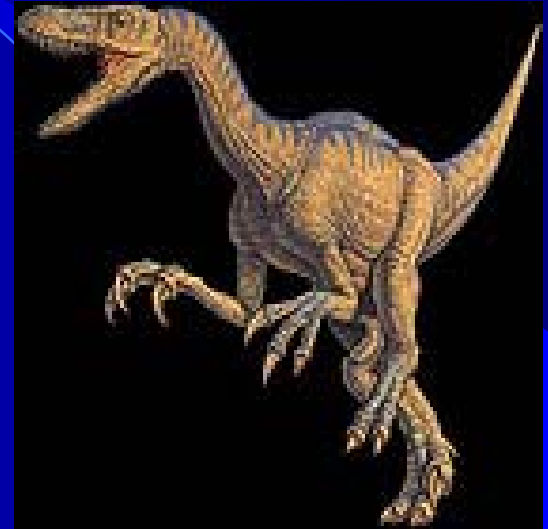
- **Small & Tortuous**
- **Diseased vessels frequently calcified**
- **Respiratory motion**
- **Cardiac motion**
- **Surrounded by other vascular (enhancing) structures**



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GE Lightspeed VCT

- 64-detector CT scanner
- Each detector 0.625 cm width
- Scan the heart in 5 seconds
(5 beats @ 60 BPM)
- Total body scan 10 seconds
(excludes extremities)
- Gantry rotation speed 370mS (>15 Gs!)



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GE Lightspeed VCT

- **X-ray tube generates up to 100kW peak power, up to 800mA**
- **As the gantry rotates, acquiring data set every 180 degrees, the table moves cranially, scan from base to apex of heart**
- **Gated RETROSPECTIVELY (i.e. radiation always on), then reconstructed from a portion of diastole**
 - **Dose Modulation w/MDCT will decrease radiation 30-50%**
 - **EBCT (solid state) gates Prospectively – less radiation**

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GE Lightspeed VCT

- **Image reconstructed from a portion of data acquired during diastole, creating a static picture of contrast-filled coronary arteries**
- **Data reconstruction allows 3-dimensional and even endoluminal review of the vascular tree**
- **Data manipulation by physician at workstation provides optimal diagnostic images**

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How to

- Patient prep: 4hr fast, 12 hr. no caffeine
- Exclude patients w/ irregular rhythms
- Heart rate control is KEY – resting HR <60
 - Metoprolol night before and AM of
 - IV metoprolol
 - Soothing/reassuring environment
- Peripheral IV left arm (18-20 G.)
- Supplemental oxygen

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Heart rate control is KEY

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MDCT CORONARY ANGIOGRAPHY

Heart rate control is KEY

- Better image resolution
- Fewer “non-evaluable” segments
- LESS PHYSICIAN POST-PROCESSING

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MD CT-A: How to

- **Dual barrel injector (saline chaser)**
- **SL NTG.**
- **Timing injection (<20cc)**
 - **time to peak contrast in ascending Aorta**
 - **practice breath hold**
 - **assess HR response**
- ***DO IT* – 4-5cc/sec x 50cc**
 - **breath hold 4-5 seconds before imaging**

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Indications (Good patients)

- Non-diagnostic stress test
- Abnormal/low-risk stress [suspect false (+)]
- Abnormal stress → risk stratification (patients we don't really want to cath)
- Evaluation of cardiomyopathy
- Recurrent CP despite (-) stress test
- Patients who “Don't Want Cath”
- Anomalous coronaries

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Indications (seems reasonable)

- Prior CABG, unknown anatomy (pre-cath)
- Difficult lesions at cath
- Pre-op eval (?)
- F/U CABG (?)
- F/U stent (??)
- No symptoms, “High risk” (?)
- Unexplained syncope (?)

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Cardiac (Non-coronary) Uses

- Cardiac tumors
- LA thrombus / LV thrombus
- LVEF
- Pericardium
- EP usage

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Other Vascular Uses

- Confirm carotid stenosis / occlusion
- TAA
- AAA – follow-up when approaching 5cm
– post stent graft follow-up
- RAS – diagnosis, follow-up
- Ao/iliac, lower extremities (ischemic feet)
- PE

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Contra-Indications (Bad patients)

- Afib/Irregular rhythm
- Severe renal insufficiency (Cr. 1.8 – 2)
- Severe contrast allergy
- No IV access
- Unable to lie still
- ? High calcium score ?

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Benefits (vs. Invasive Angiography)

- **Safer : significant complication of cath $\leq 2\%$**
 - Eliminates vascular complication, MI, stroke
- **Better for Plaque:**
 - will diagnose CAD in patients with “normal” cath → more Secondary prevention
 - Identify calcific and “soft” (vulnerable) plaque
- **3D Anatomy (anomalous cors, congenitals)**
- **“Drive through” procedure**
- **Less expensive for society**

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Limitations (vs. Invasive angiography)

- Cath better for stenosis assessment

Resolution:

x, y planes – 0.5mm (cath = 0.1mm)

z plane – 44msec (cath = 7msec)

- Stenosis vs. Occlusion?
- More contrast: 60 -80cc
- No valvular / hemodynamic data
- Need stable/cooperative patient

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Can this replace cath?

(Not yet)

Most literature on 4-slice, 16-slice or EBCT

- 64-detector CT expected to be better
- frequently excludes non-evaluable segments (5-30%)
- patient selection likely strongly influences data

- ***Negative Predictive Value: >97%**
- **Positive Predictive Value: >80% (?>90%)**
- **Sensitivity: 81-96%**
- **Specificity: 84-98%**

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What about RADIATION ?

- Medical radiation is “hot” topic

CA risk attribute to diagnostic x-rays by age 75

- U.K. 0.6%

(Lancet 2004)

- U.S. 0.9%

- Japan > 3%

- How much radiation do you get? Who knows...

- Cardiac cath: 3-10 mSv (3.5-6)

- MD CTA: 6 – 16 mSv

?? Effects of dose modulation, multi-detector scanners??

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Typical radiation exposures (mSv)

- ❖ **Avg. U.S. background: 3.6**
- ❖ **PA/Lat CXR: 0.06**
- ❖ **Mammo: 1.8**
- ❖ **Head CT: 1-2**
- ❖ **Abd/pelvis CT: 8-11**
- ❖ **Cardiac Cath: 3-10**
- ❖ **Calcium score (EBCT): 0.9**
- ❖ **Coronary CTA: 6-12**

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What about RADIATION ?

Doses higher for women due to absorption by breast tissue



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Are over reads necessary?

Incidental or “ancillary” findings on 10% of scans
(both CT and MR)

Lung CA

Pulmonary Embolism

Esophageal CA

Pancreatic CA

Lymphoma

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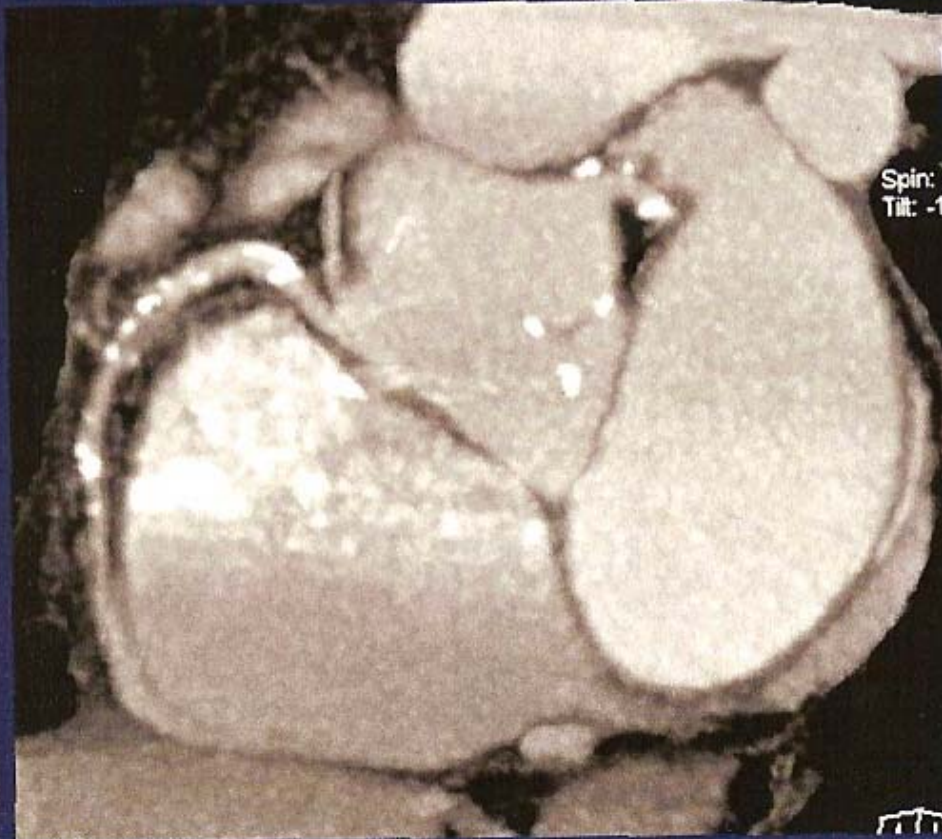
DIFFERENT than Direct Coronary Angiography

- **Tons of data acquired**
- **Static Image of MULTIPLE contrast filled structures**
 - **Coronary arteries**
 - **Coronary veins**
 - **Ventricles**
 - **Atria**
 - **Aorta/SVC**
- **Coronary reconstruction by cardiologist at workstation**

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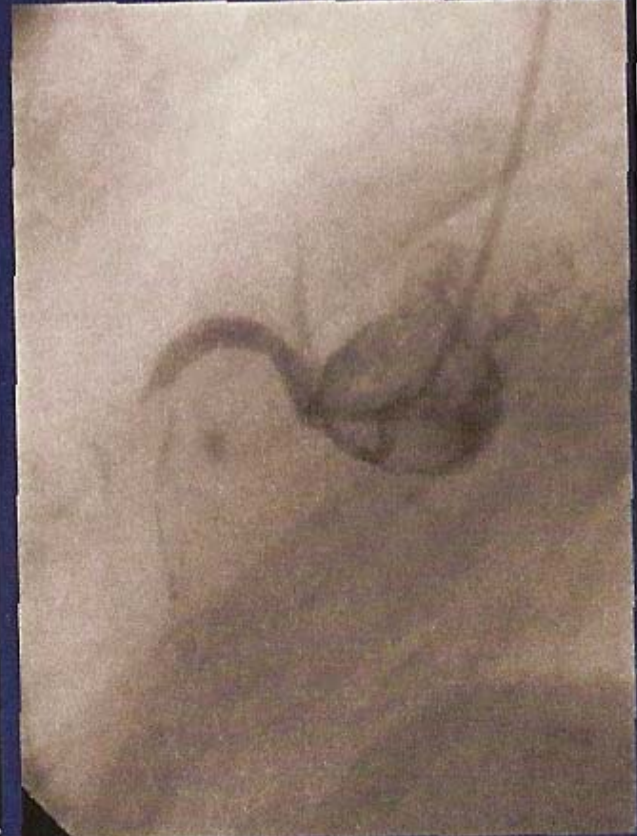
DIFFERENT than Direct Angiography

Intravenous Injection



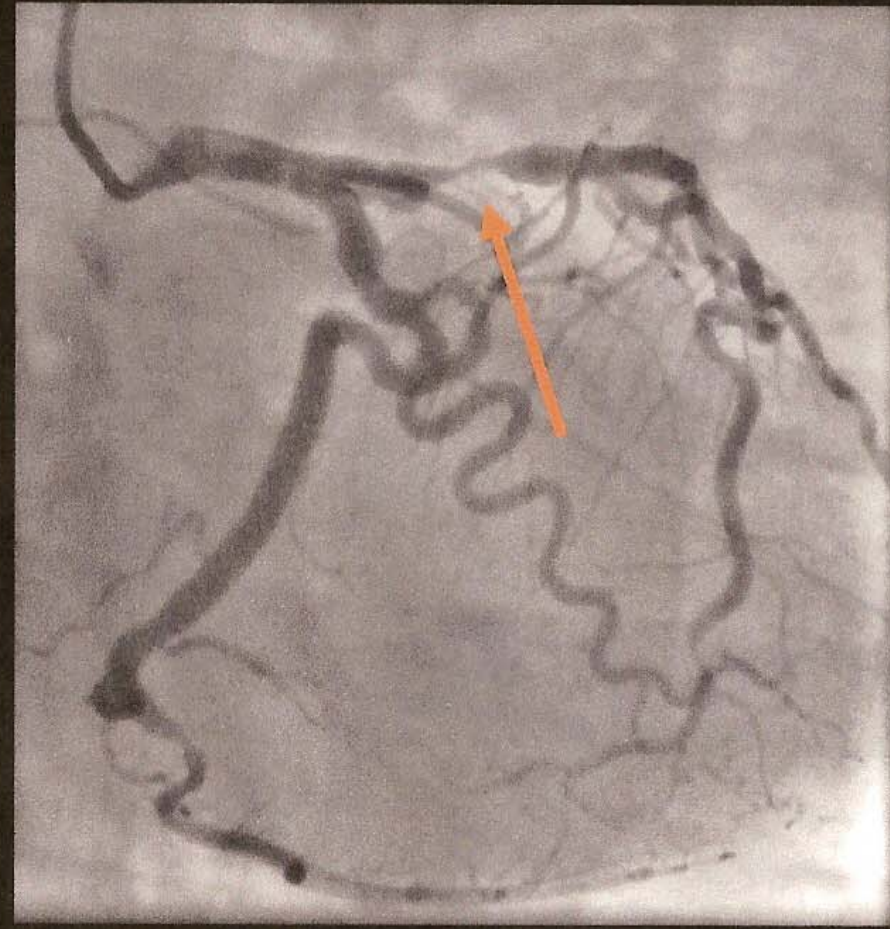
Retrograde filling of the distal vessel

Intra-arterial Injection



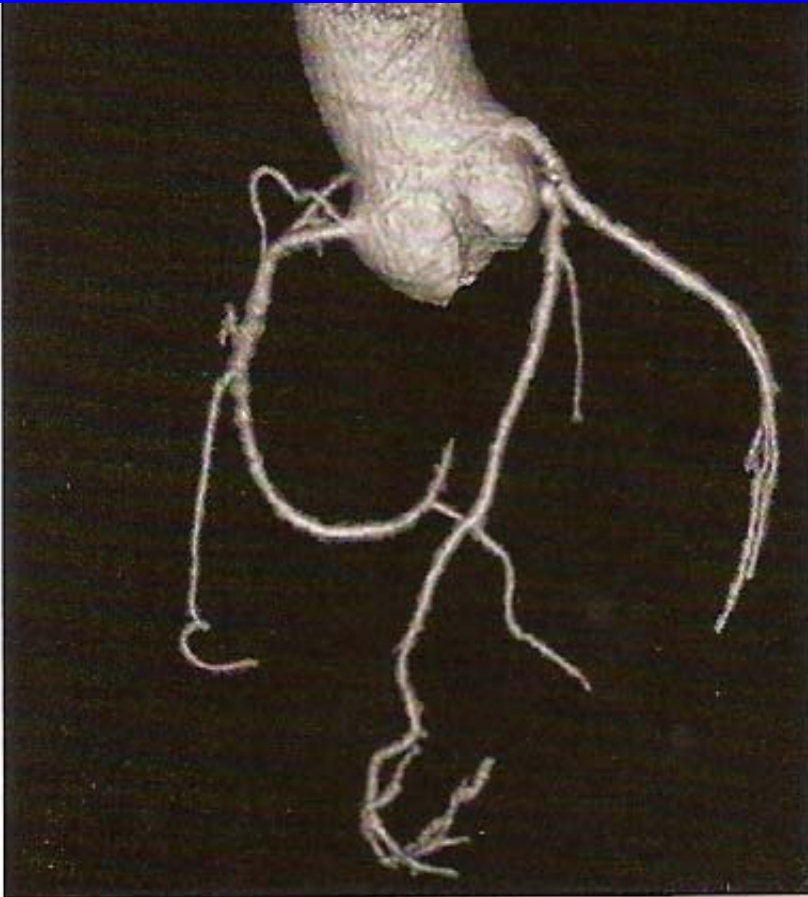
RCA Total Occlusion

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3-D Volume Rendering Technique

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**Volume Rendering
Technique**



**Maximum Intensity
Projection (MIP)**

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**3-D Volume
Rendering
Technique**

**Maximum
Intensity
Projected
(MIP)**

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Implications

- **Paradigm shift:**
 “plaque-ologists” (vs. “lumen-ologists”)
- **Will be doing “secondary prevention” on patients without prior event**
- **Some studies will be non-diagnostic**
- **Expect some false (+), few false (-)**
- **Probably less outpatient caths**
- **Try not to rob Peter to pay Paul**

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Reimbursement

MD CT- \$900

Cath (pro fee) - \$415

Nuclear stress - \$960

Better patient care/Practice enhancement

Priceless (?)...