CT Agiography
CTA

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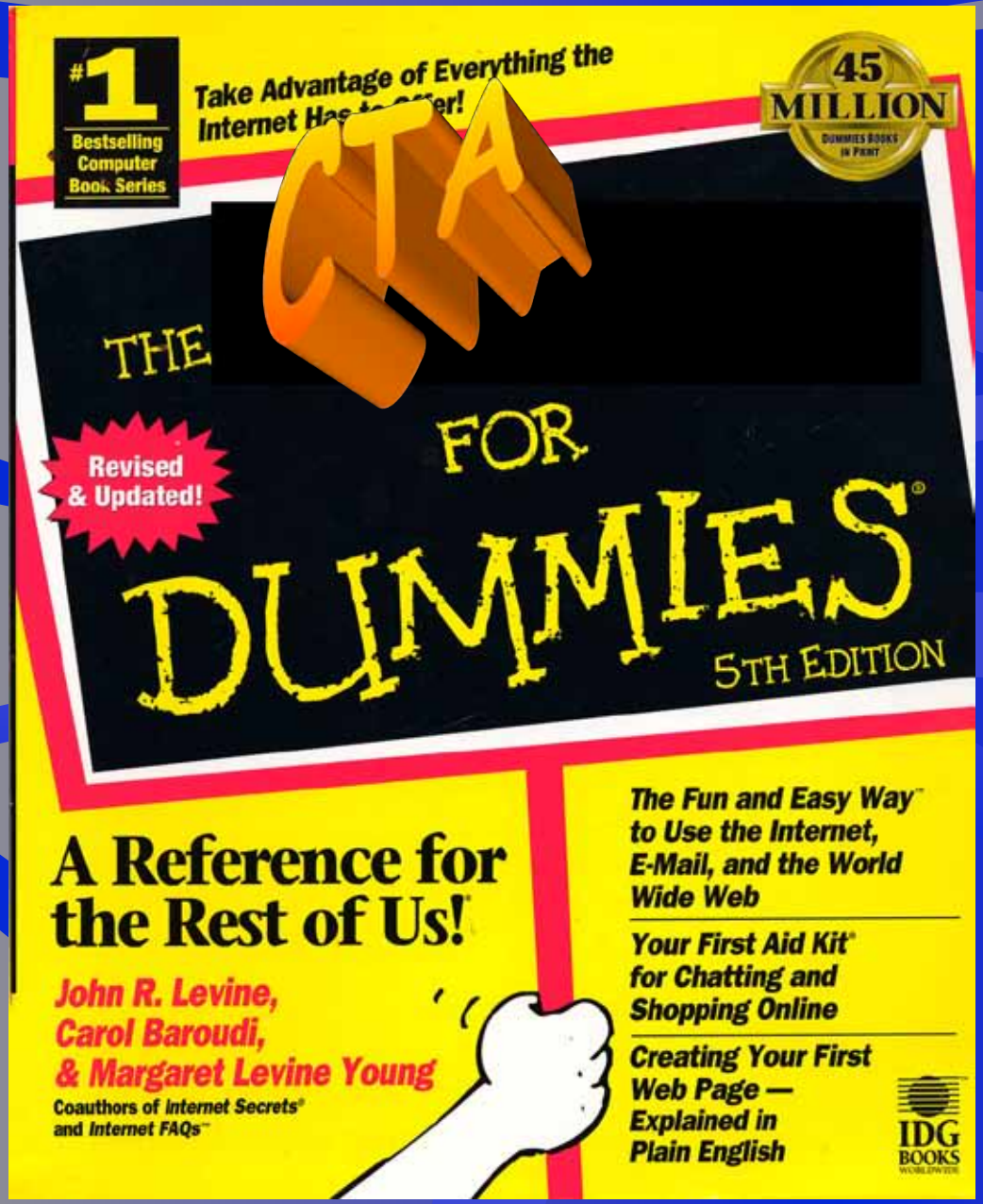
Neuroradiology



- The Fun and Easy Way to use CTA and CTP
- Your First Aid Kit for Reconstructions on Workstation
- Creating Your First Shaded Surface Rendered Image in Plain English
- How to get reimbursement
- How to finance 16 slice CT scanners

Clinical Use of CTA & CTP

- Fast diagnosis of major vessel occlusion in a stroke patient
- Fast diagnosis of the presence of an aneurysm
- Screening of carotid stenosis

CT & CTA

- CT: Most accessible neurological imaging modality
- Fast, efficient and minimally invasive way to look at brain and neck vessels
- Suitable for high volume institutions

CT Angiography

1. Fast, thin section volumetric spiral CT examination

2. Performed with a time-optimized bolus of contrast

3. Reformatting of cross sectional images (raw data →source images)

4. Postprocessing and 3D imaging

CTA

- Can be performed in minutes
- Downside: uses radiation and intravenous contrast

NEW CT TECHNOLOGY

Light Speed

- 16 slice / multislice
- 4,000 programmable protocols
- 3D image processing and display
- Perfusion, advanced vessel anal.
- Dynamic scan: 960 scans/minute
- Image reconstruction time: 6 fps

- Year product introduced: 2002

Light Speed

- 4 slice / multislice
- 4,000 programmable protocols
- 3D Image processing and display
- Perfusion, advanced vessel anal.
- Dynamic scan 240 scans/minute
- Image reconstruction time; 6 fps

- Available since 1998

CT Study for Stroke

16 slice scanner can do it all

- NCCT
- CT PERFUSION
- CT ANGIOGRAPHY

Clinical Aspects
CTA - MRA

CTA
- Fast, needs less sedation
- Less invasive than DSA
- All ERs have CT
- Life support etc
- Less expensive than MRA

MRA
- No radiation
- Information regarding flow direction
- (DWI)

Downsides:
- Radiation
- Uses contrast
- No flow directions

Downsides:
- Difficult if monitors or life support,
- Sedation
- Long examination time

CTA study

- The value of CTA and MRA depends significantly on secondary reconstruction possibilities

CTA Postprocessing

- **Image reformatting**, performed by techs at the scanner console is the recomputation of raw CTA image data into source images with varying slice thickness, interslice spacing and display FOV

- **Reconstructions** refers to the creation of 2D and 3D models from CTA data sets for purposes of diagnosis and communication to referring clinicians

CTA Postprocessing

2D

- MIP: maximum intensity projection
- Curved reformat
- MPR: Multiplanar reformats

3D

- SSD: Shaded surface display
- VR: Volume rendering

CTA Postprocessing

MIP (maximum intensity projection)

- Most commonly used
- Useful for rapid detection of vascular discontinuities
- Part of standard software
- Loss of information; only single layer of the brightest voxels are displayed
- "depth" information is lost

VR (volume rend.) - "the best"

- Groups of voxels within defined attenuation thresholds selected
- Transparent images; opacity assigned

SSD (shaded surface display)

- First layer of voxels within a defined thresholds used for display
- "depth" information preserved but "attenuation" information lost

Advantage of Multisection CT
for vascular imaging of stroke patient

Less than 20 seconds

- Intracranial vessels
- Carotid bifurcations
- Origins from aortic arch

Perfusion CT

- 4 detectors: 2cm slab
- 16 detectors: 3 cm slab

  – Whole brain CTP is not yet possible

Imaging Protocol

for Lightspeed multislice scanner

- 1st group:C-1/2 to vertex
- 2nd group:Arch to C-1/2
- Contrast: IV: 120 cc nonionic contrast, 3 cc/sec, 25 sec delay
- Computer merges both groups
- MIP reformatted images constructed within minutes

CTA -- MRA

MRA

- Flow direction
- Does not visualize collateral flow

CTA

- Shows collateral flow
- Does not show flow direction

CTA and MRA are complementary tests

Neck Vessels
MRA vs CTA

- **PC** (2D/3D)
  - Velocity dependent. Needs specification for VENC (arterial vs venous flow) and flow direction (left-to-right, right-to-left, s/i, a/p)
- **2D TOF**
  - **Antegrade** flow. Saturation pulse to minimize the retrograde flow (including jugular vein)
- **CE MRA**
  - T1 WI, does not take in account the flow direction or velocity. Uses rapid bolus of Gd
    - 3D TOF

      -for circle of Willis
- CTA-one technique

New need: 3D Lab Service

- Since late 1990s
- MGH (June 2003)
  - **Processed 67 exams/day**
    - **47 were neuro CTA/MRA studies** and 20 nonvascular 3D CT and MRI exams

3D post-processing

by experiences tech

- It takes 45-60 minutes for head/neck CTA post-processing (source images and MIPs are available “immediately”)
- Full training of a tech took two months

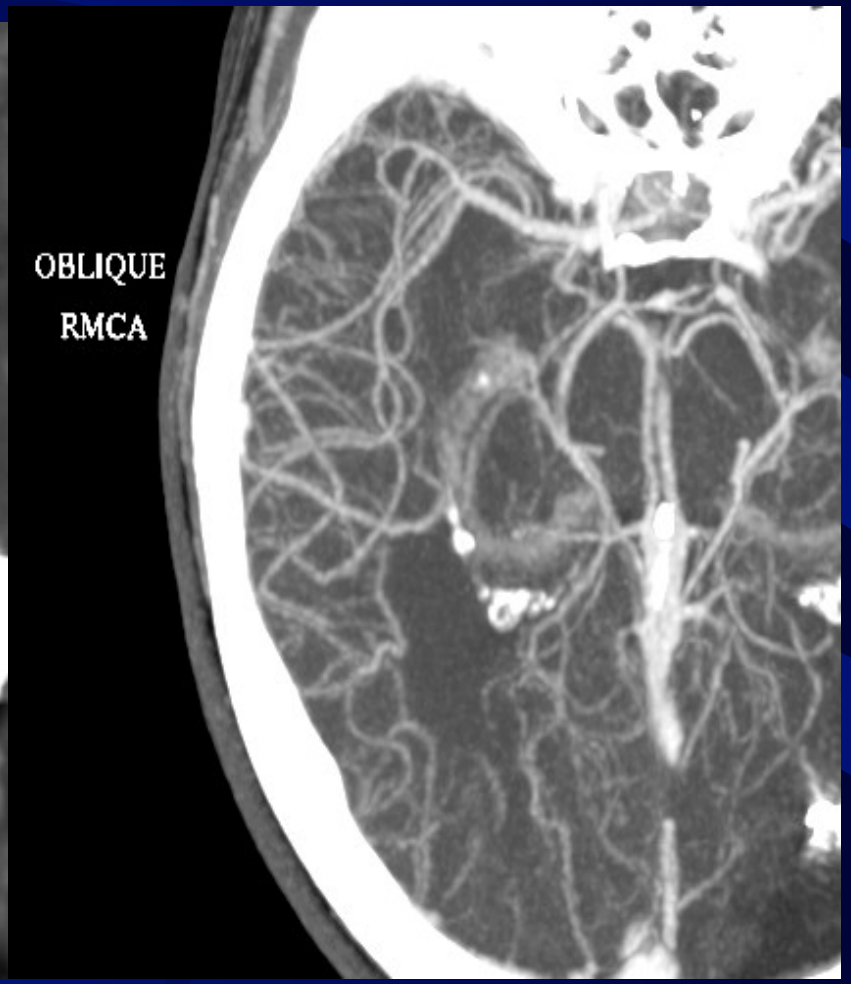
Normal Anatomy

Various ways to look at the Anatomy in CTA

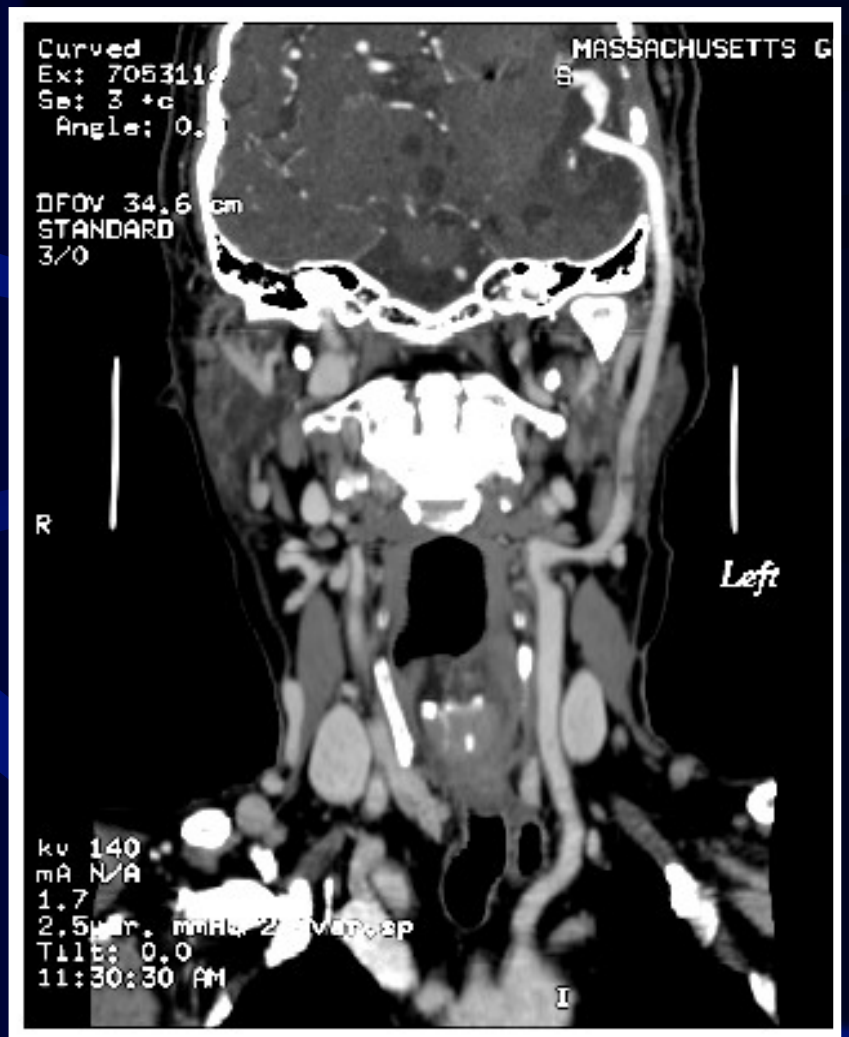
- 2D

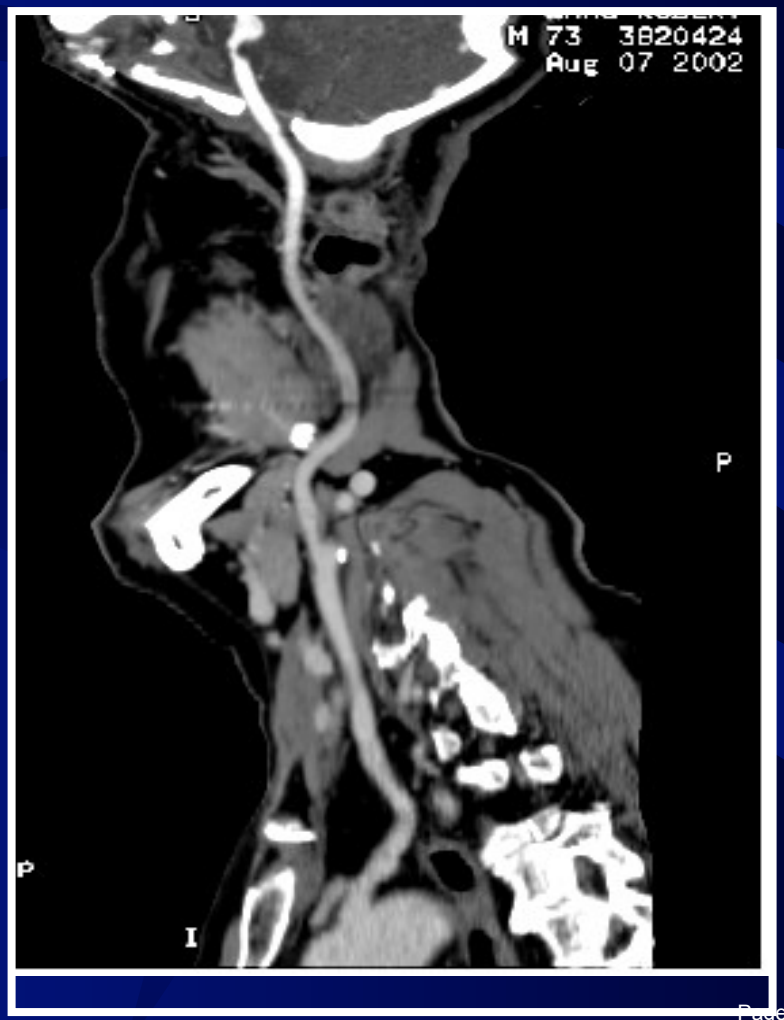
- 3D

Normal Anatomy

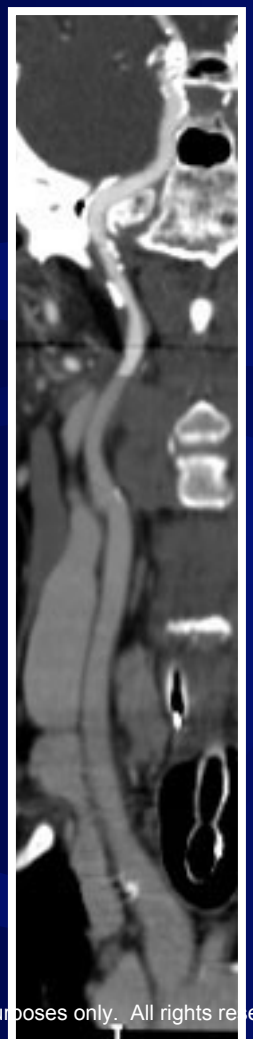


IC-EC Graft, curved reformatted image





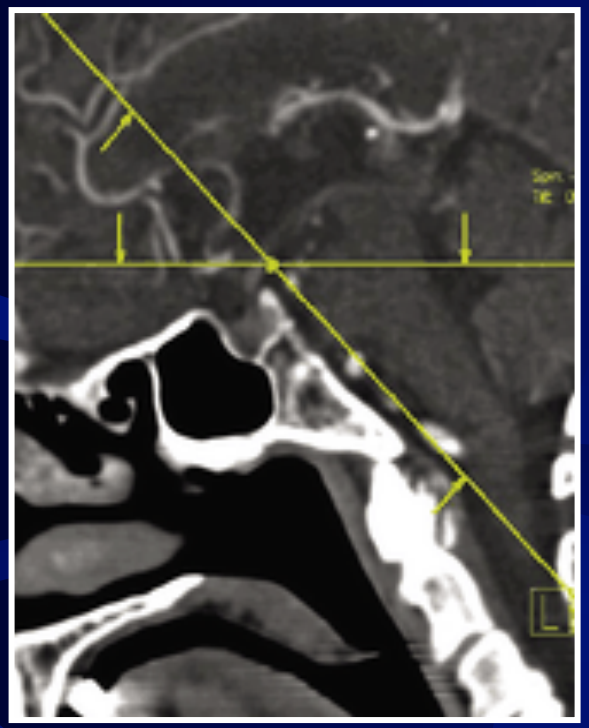
Curved reformatted image



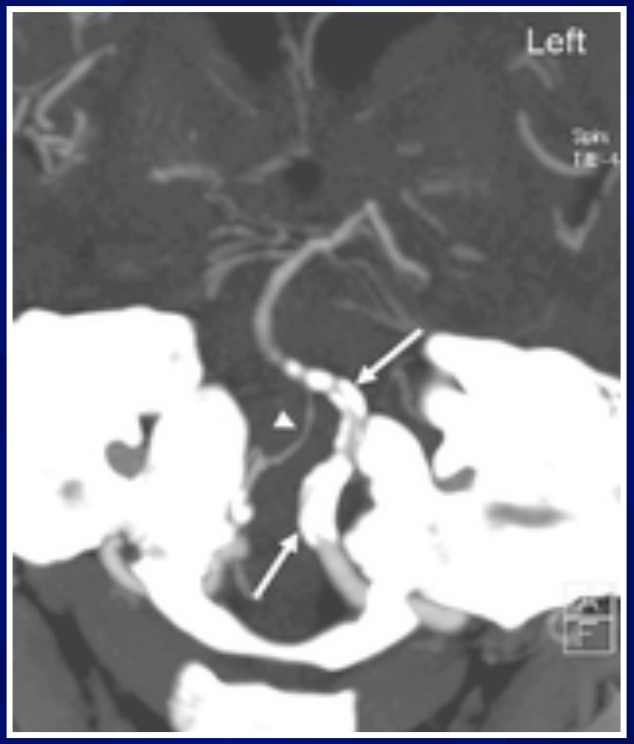
Curvature Reformatted Image

Tracing The Vessel

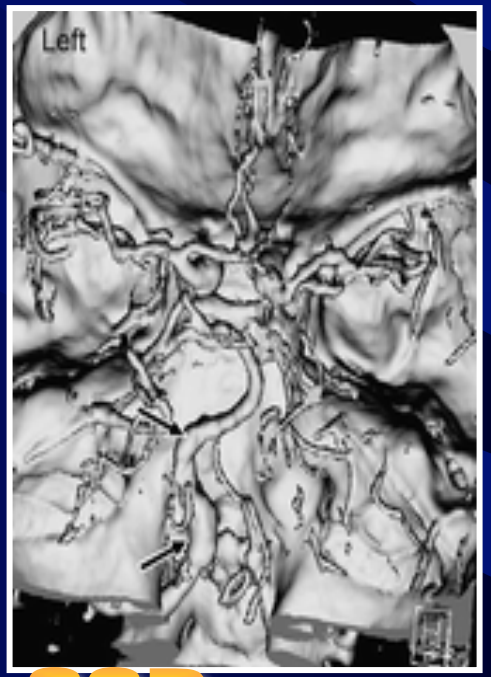
Vertebrobasilar Analysis



MPR



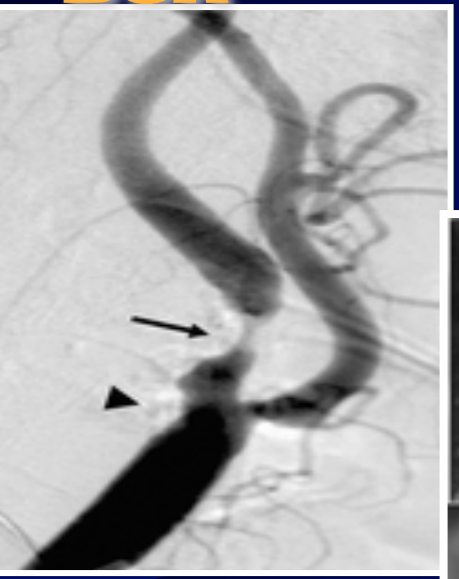
MIP



SSD

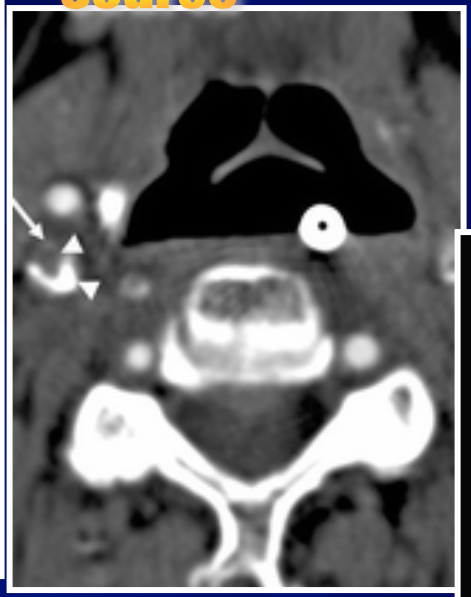
Analysis of Carotid bifurcation

DSA

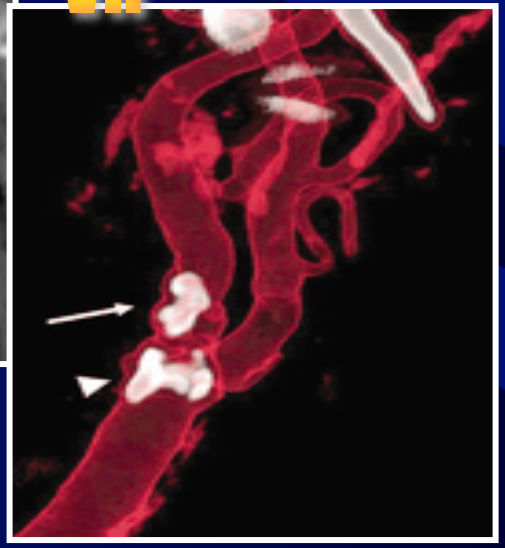


curvat. reformat.

Source

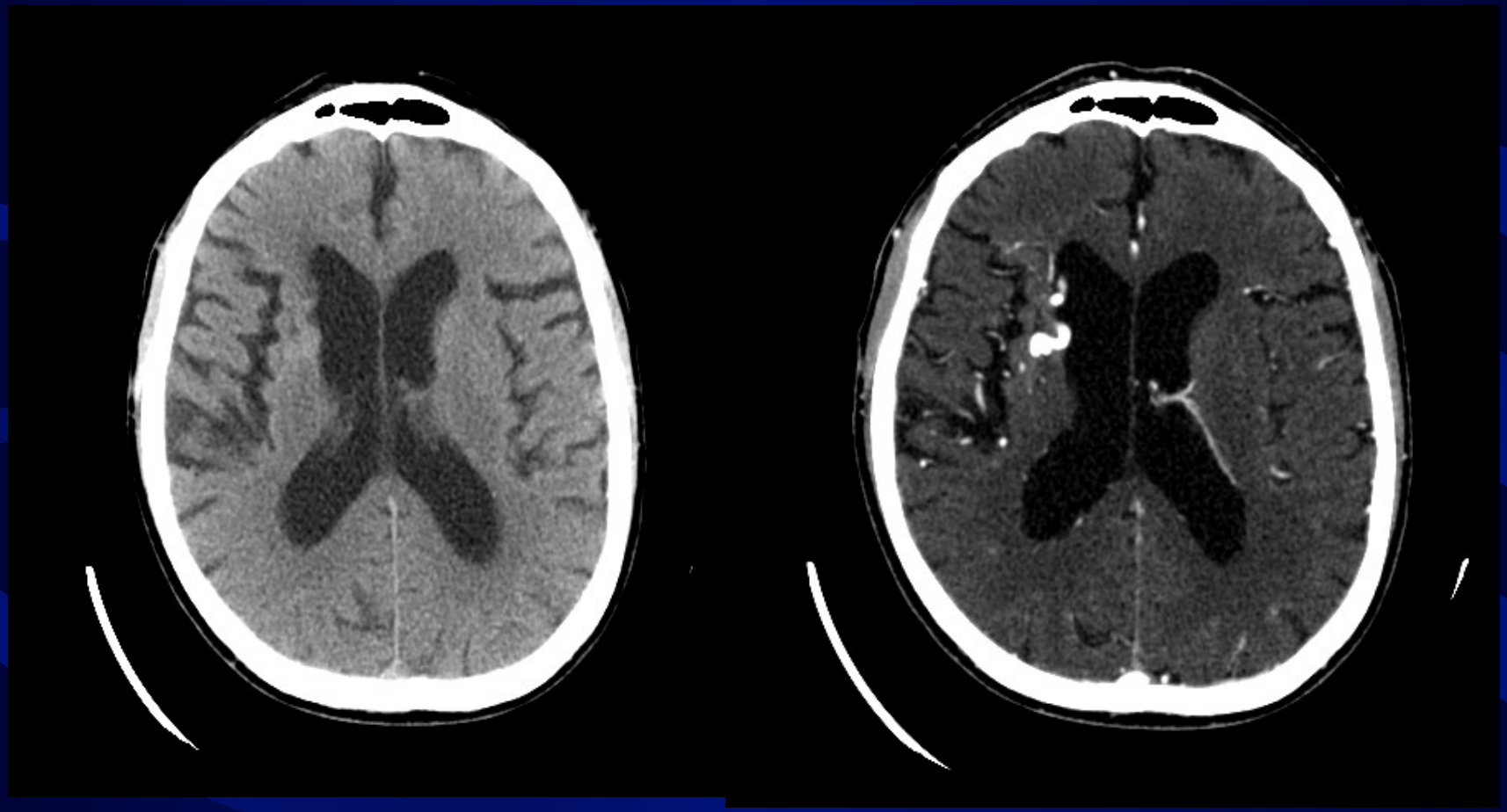


VR

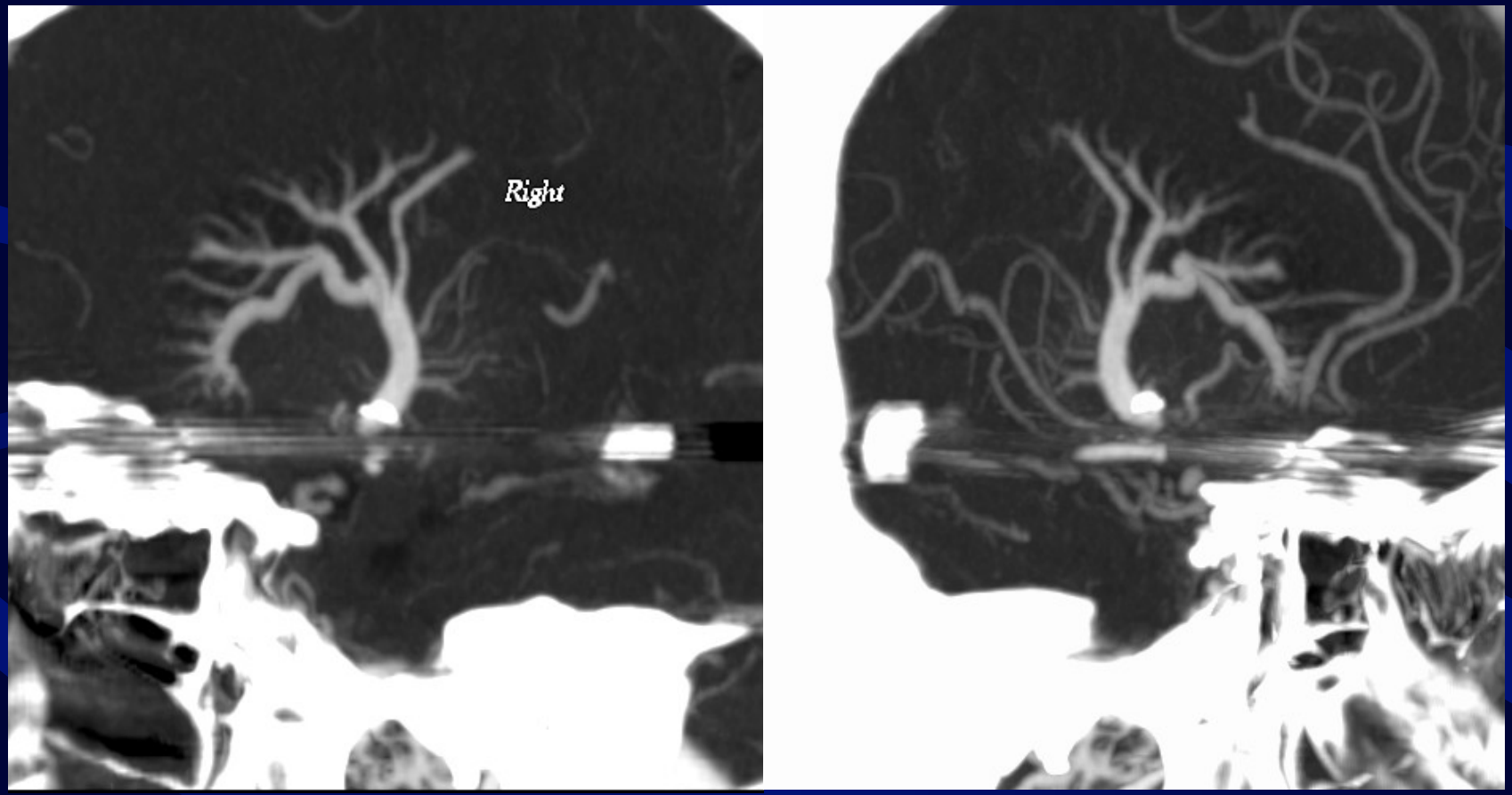


SSD

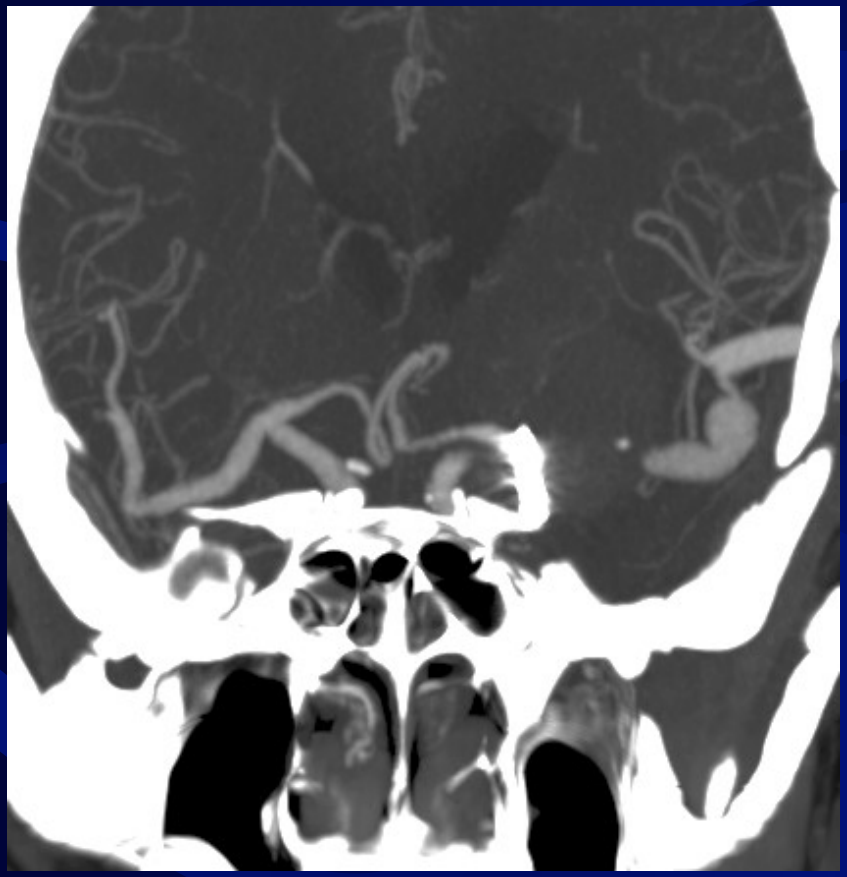
34 year old with headaches



Venous angioma



Saphenous IC-EC Graft



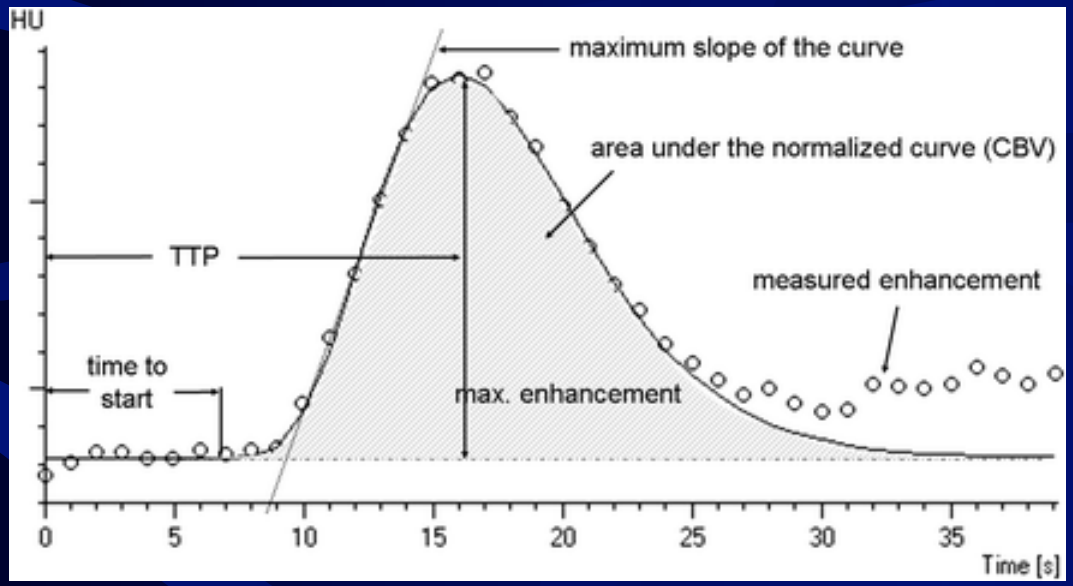
Clinical Use of CTA & CTP

- Fast diagnosis of major vessel occlusion in a stroke patient
- Fast diagnosis of the presence of an aneurysm
- Screening of carotid stenosis

CT Perfusion
CTP

- IV bolus of contrast
- Changes of brain tissue attenuation monitored during the 5 second transit time with high-temporal resolution dynamic CT

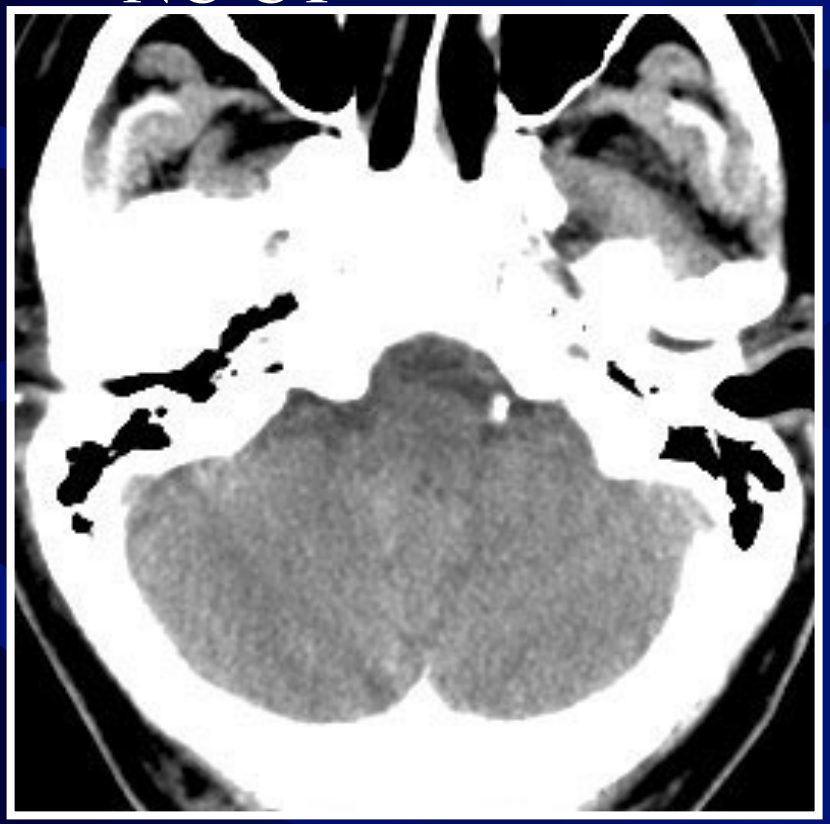
CT Perfusion



- 40 cc bolus of contrast IV
- Semiautomated postprocessing
- TTP, CBF, CBV in less than a minute

TIA vs Stroke

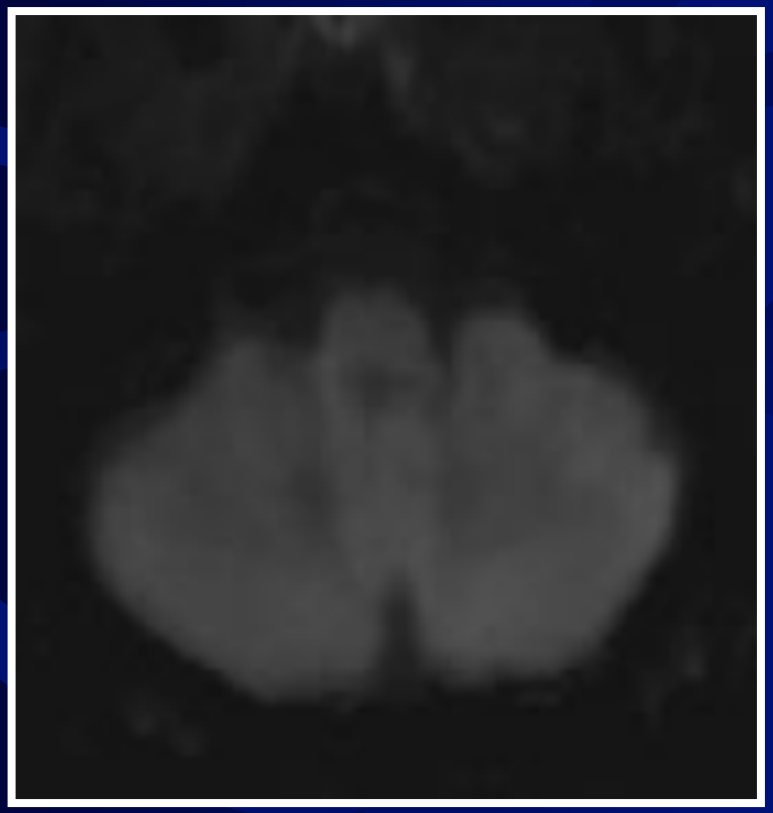
- NC CT



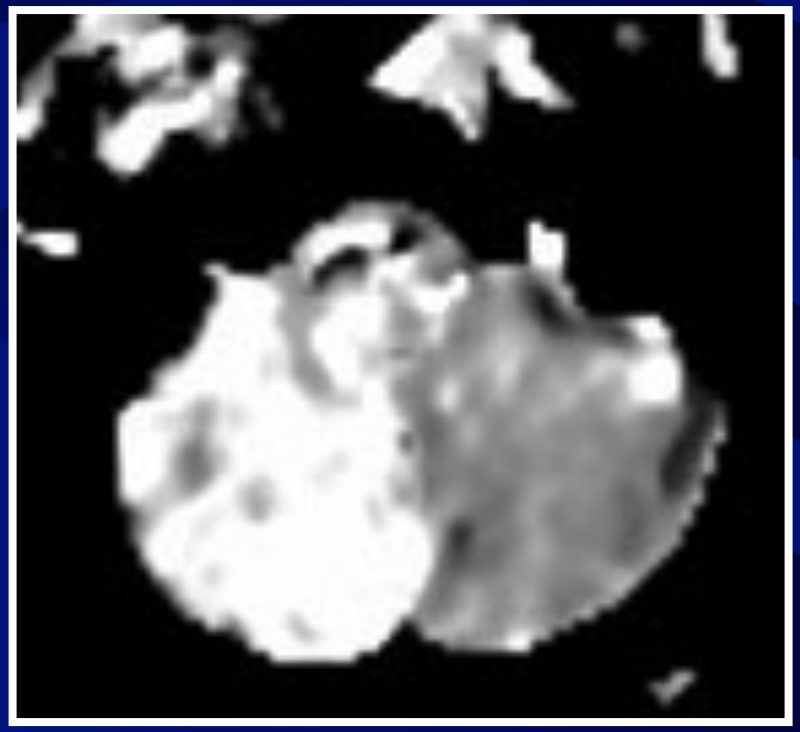
- CTA with contrast: **Perfusion window ("CBV")**

TIA vs Stroke

- DWI

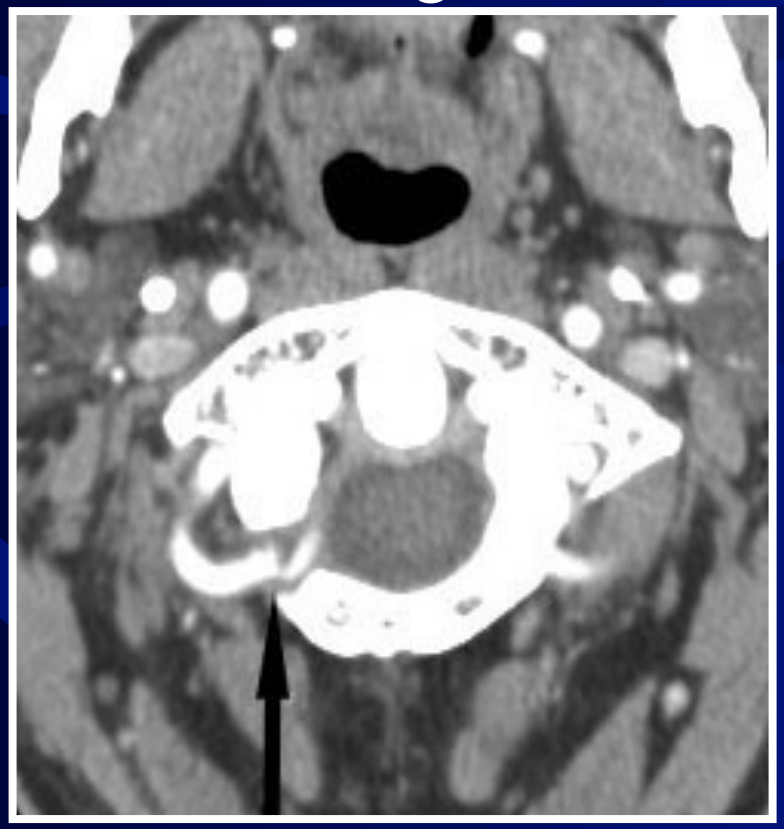


- Perfusion MRP: MTT



CTA

- Source image

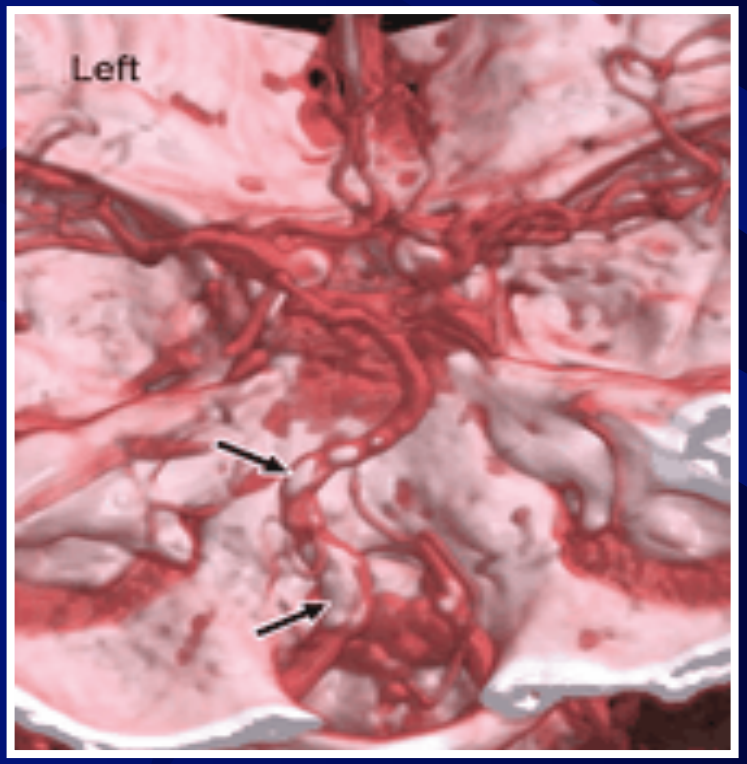


- MIP

CTA

MIP vs 3D

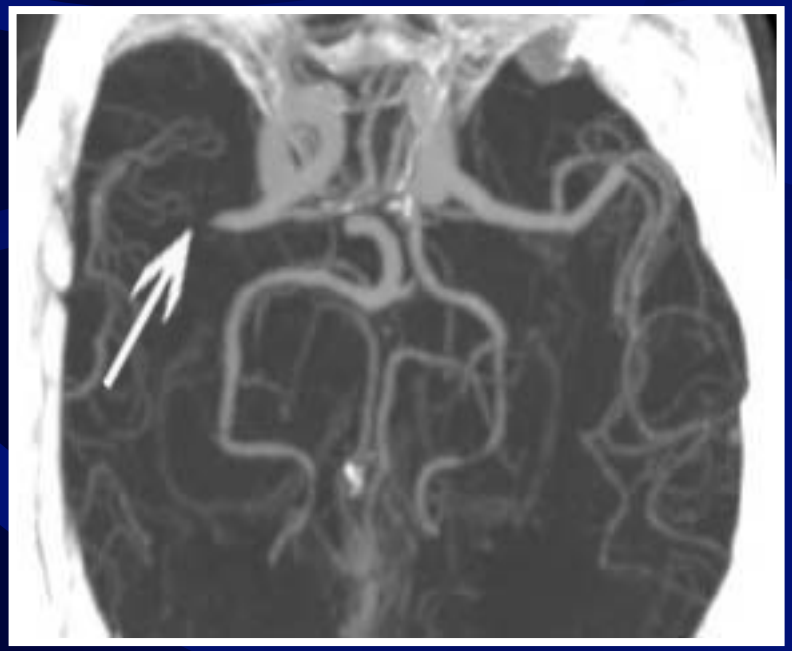
- **MIP** – Ca++ marked with arrows. Residual lumen not visualized.
- **3D VR** -demonstrates Ca ++ and lumen



91 y/o with stroke

- **Perfusion window**
  (poor man's perfusion study, CBV)

CTA, MIP

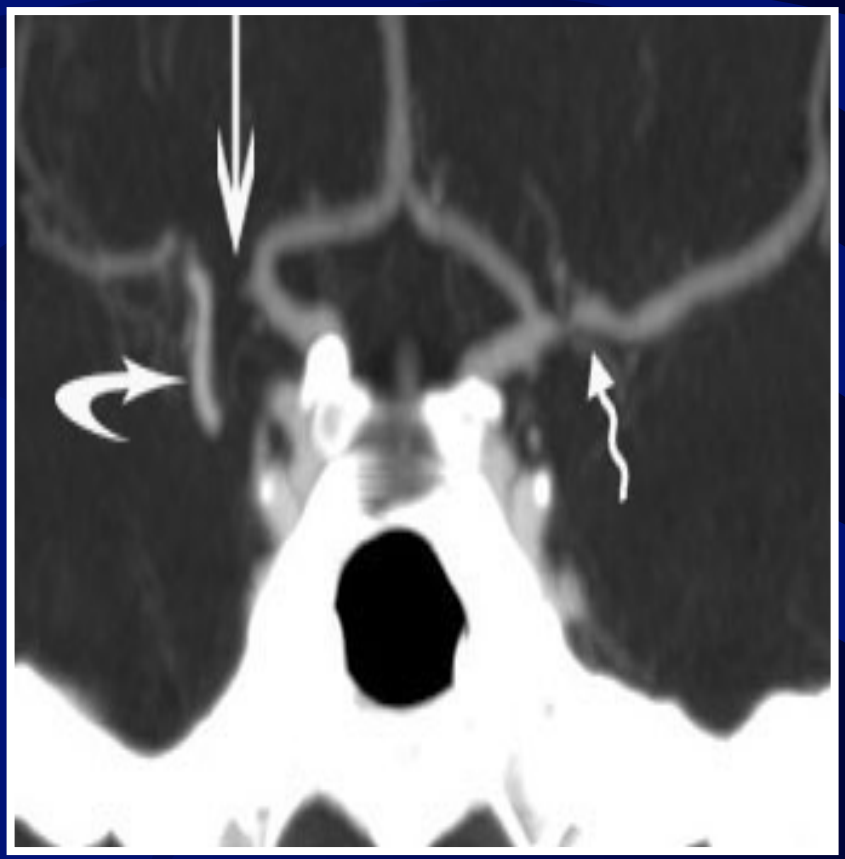


- Patient underwent IA thrombolysis with good initial result

Acute Stroke

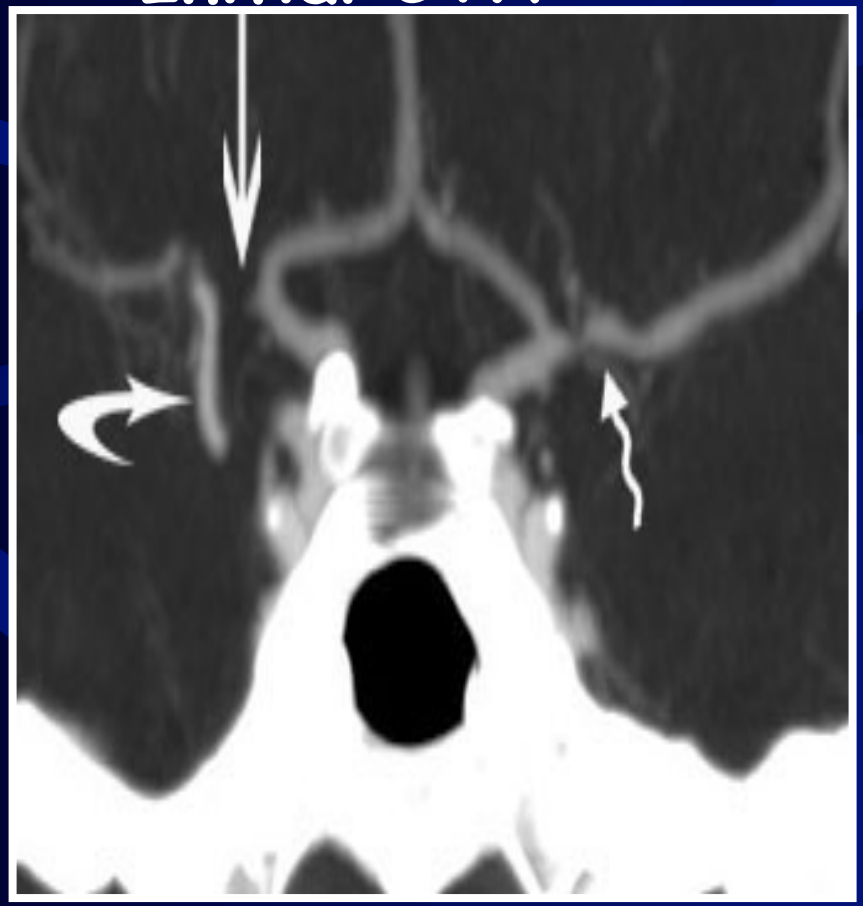
- NCCT

- MIP



CTA, Stroke
1 year follow-up

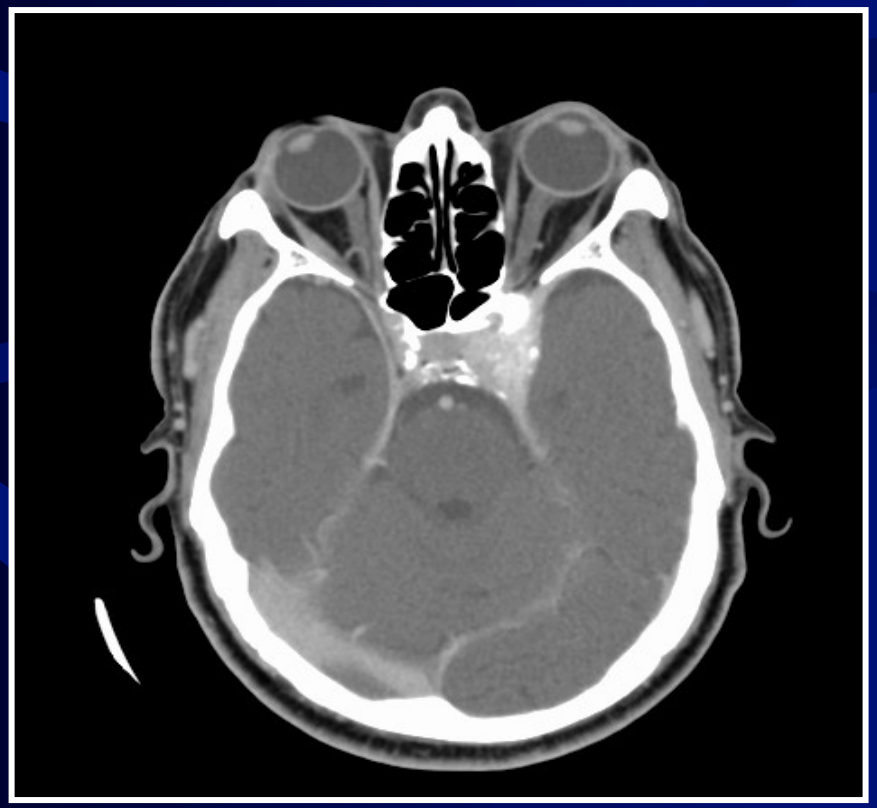
- Initial CTA



- Recanalized vessel

Acute Stroke

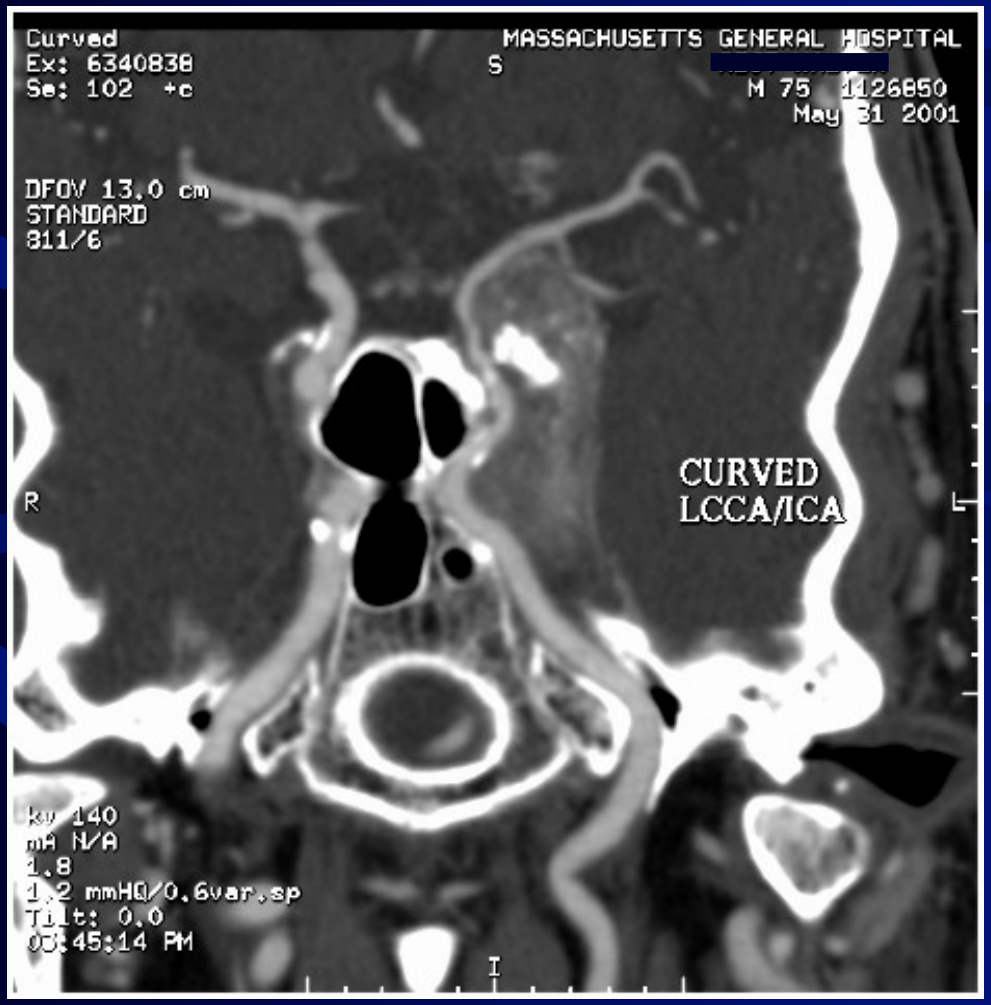
- CECT



- Source image

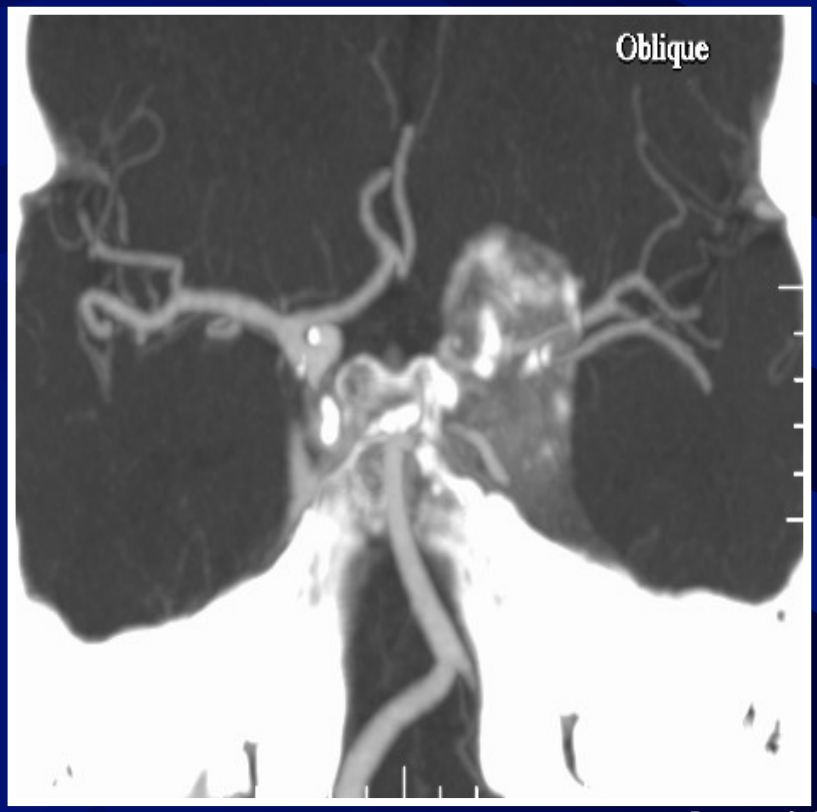
CTA

Curved reformat images



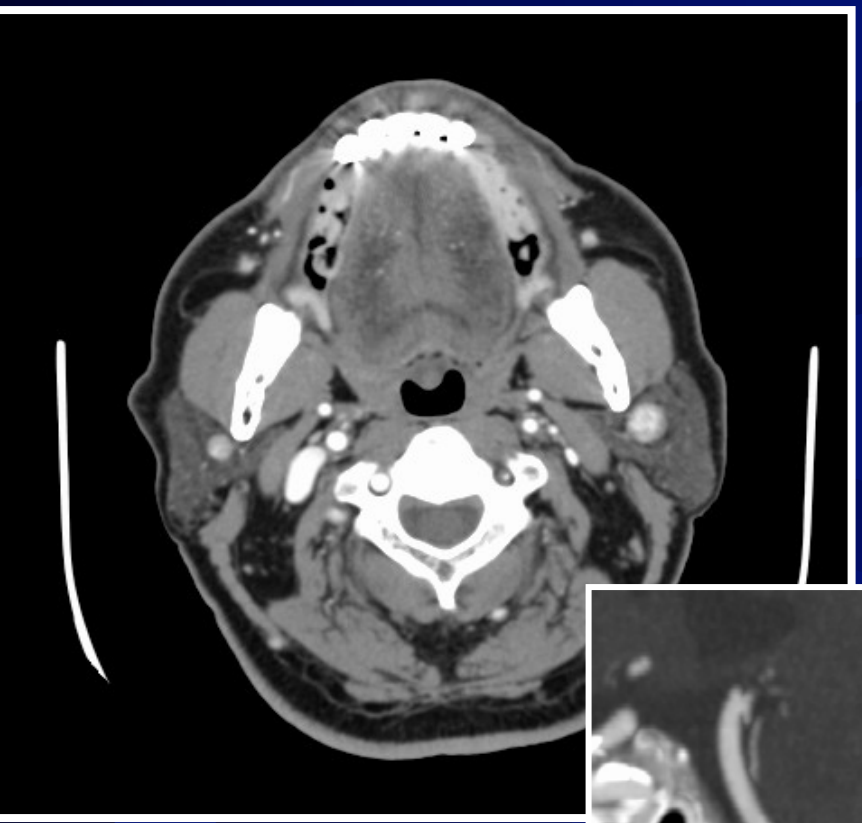
Acute Stroke

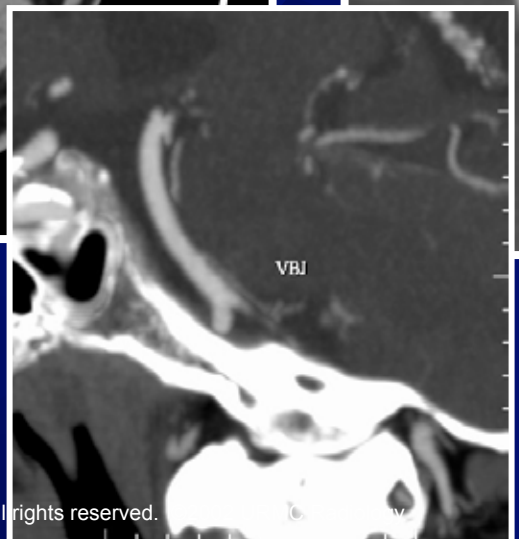
- Basilar artery



CTA

75 y/o with stroke





Acute stroke

- NCCT

- CT perfusion window

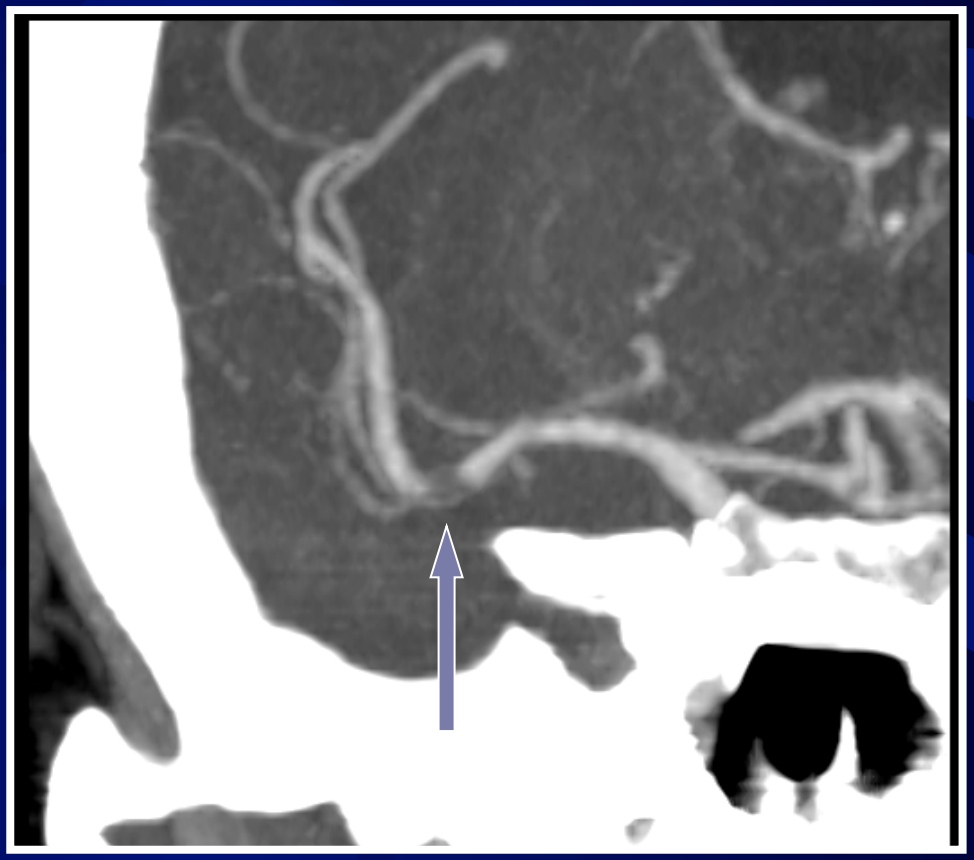
Acute stroke

- 3/3/03 NCCT
- Follow-up

- 3/2/03 perfusion window
- Initial CTA

CTA Embolus

MIP

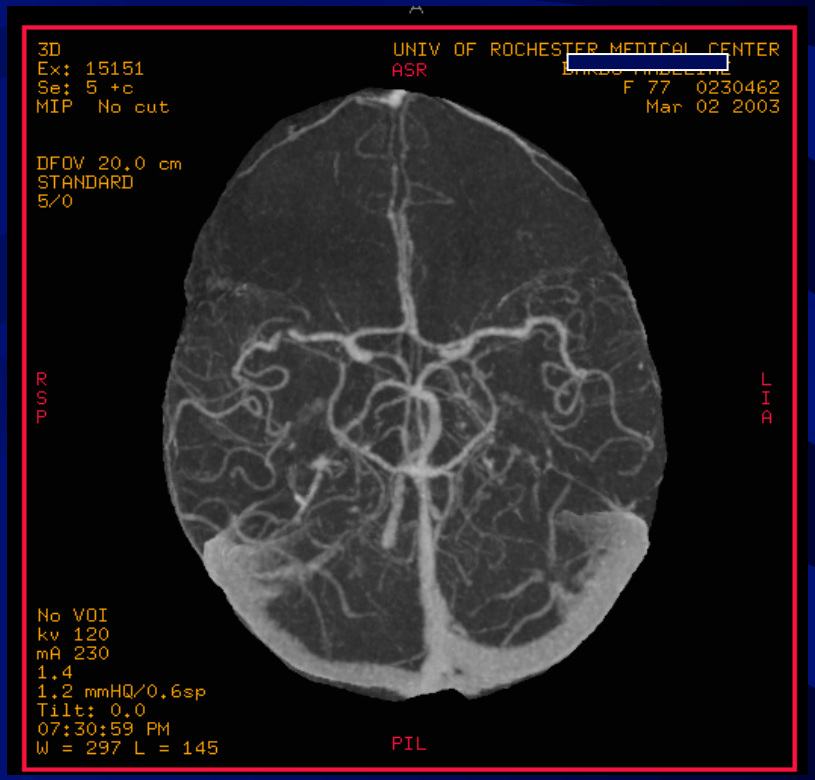


CTA

Stroke; 77 y/o Female

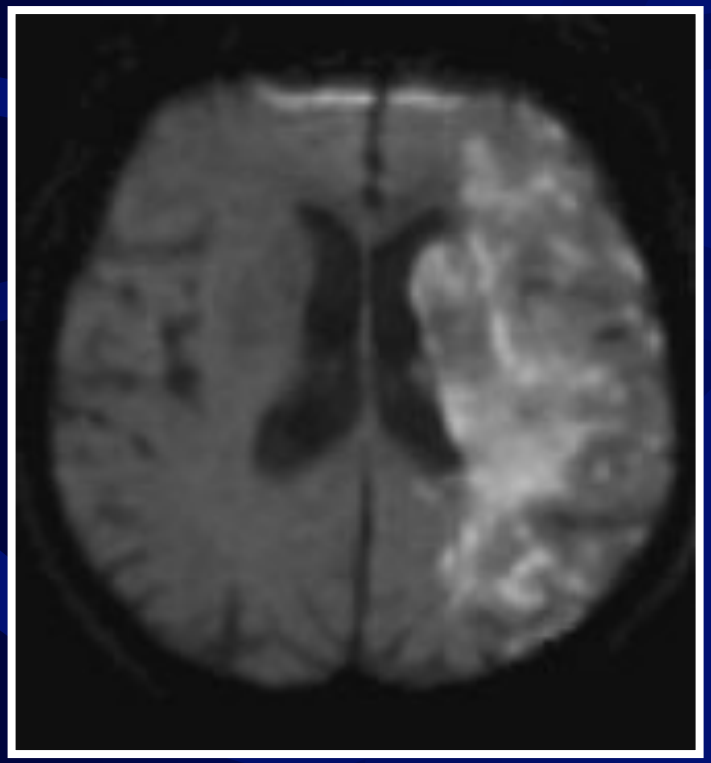
- Source

- MIP

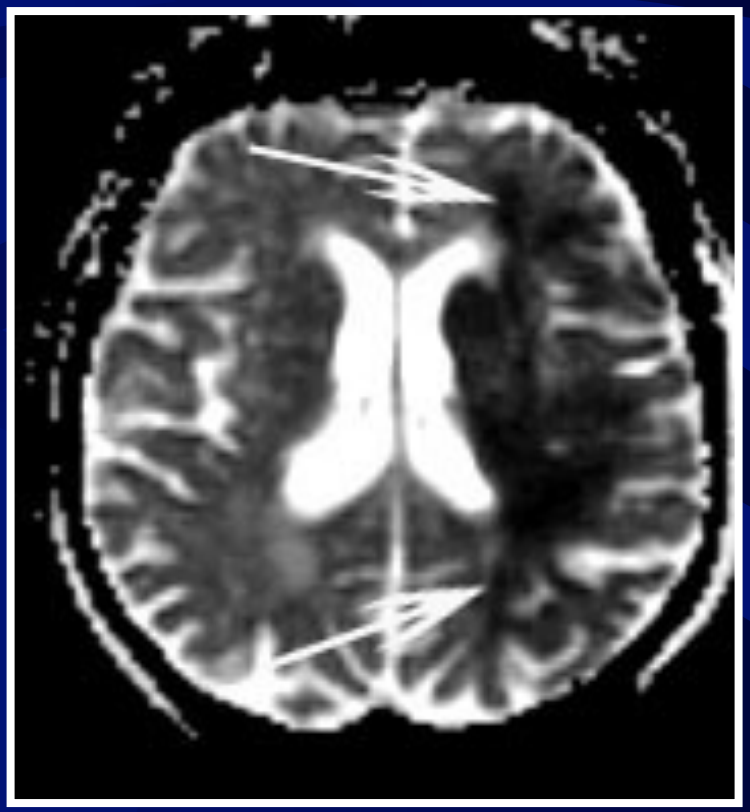


Acute Stroke

- DWI

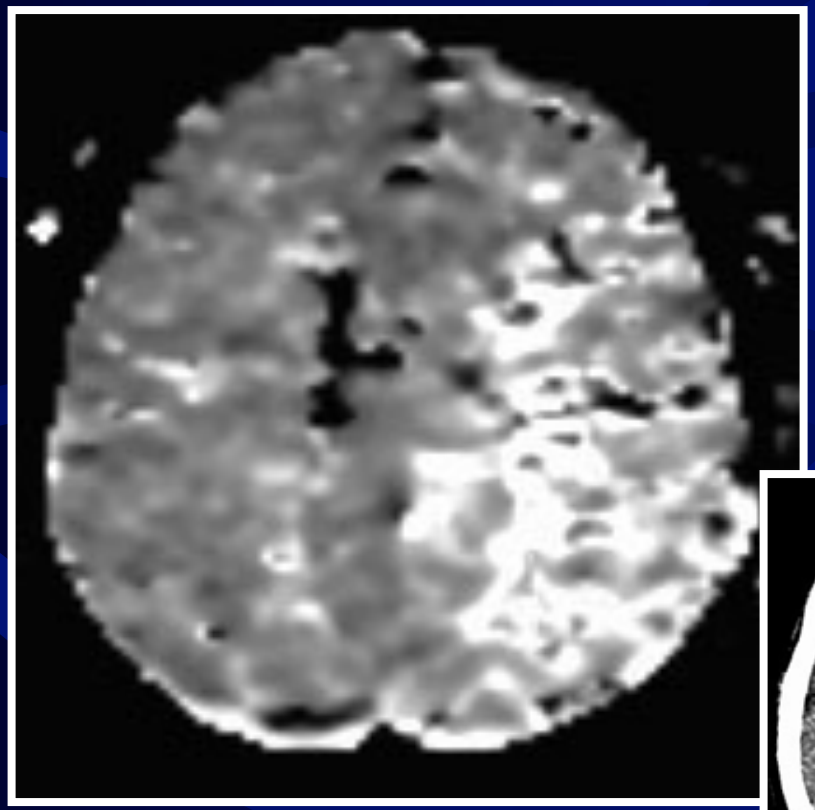


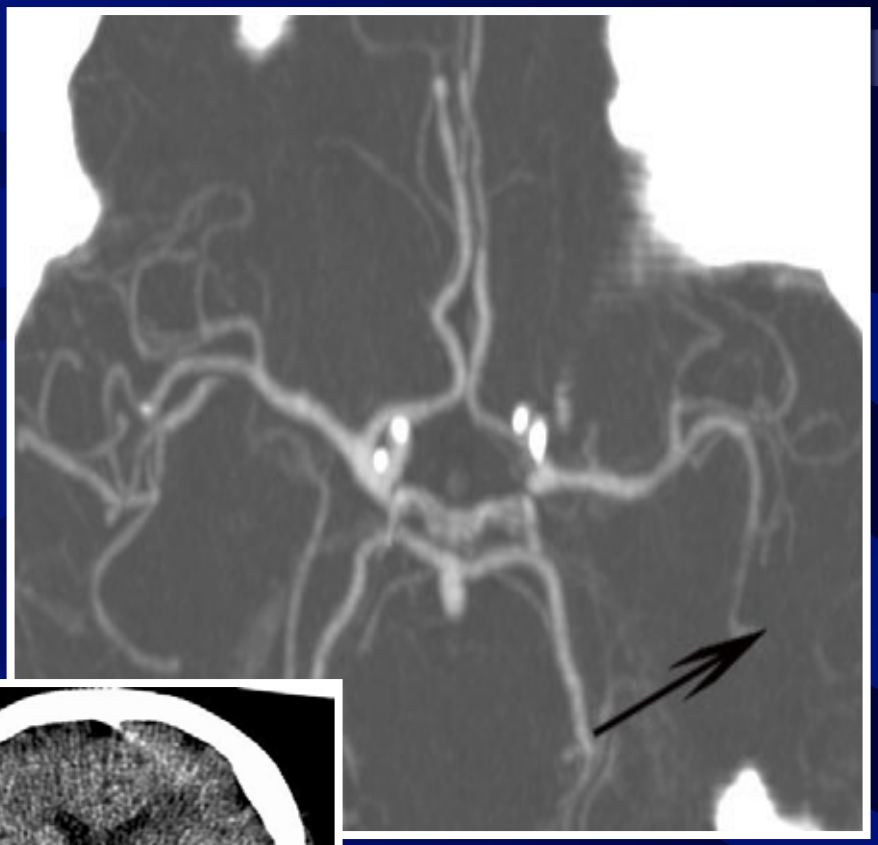
- ADC

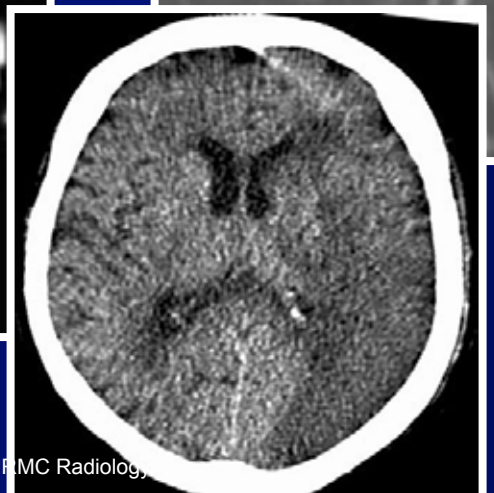


Acute Stroke

- MTT





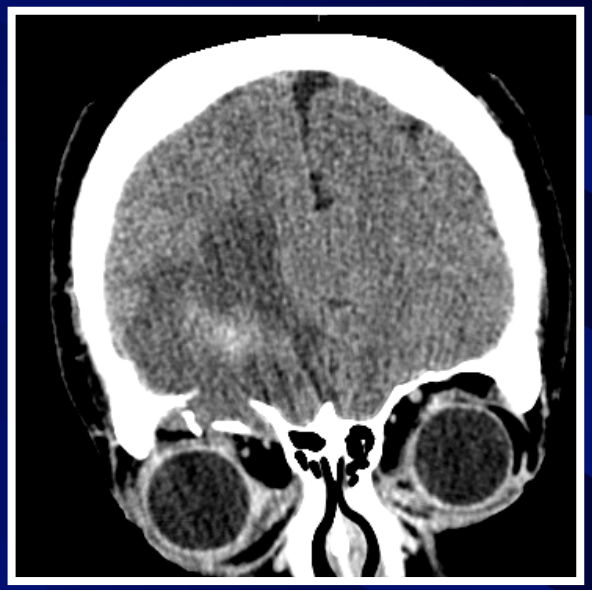


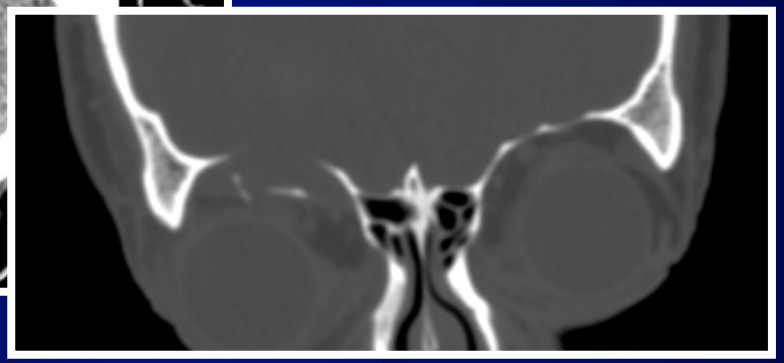
Clinical Use of CTA & CTP

- Fast diagnosis of major vessel occlusion in a stroke patient
- Fast diagnosis of the presence of an aneurysm or other vascular lesion
- Screening of carotid stenosis

Orbital Trauma a Week Ago Proptosis

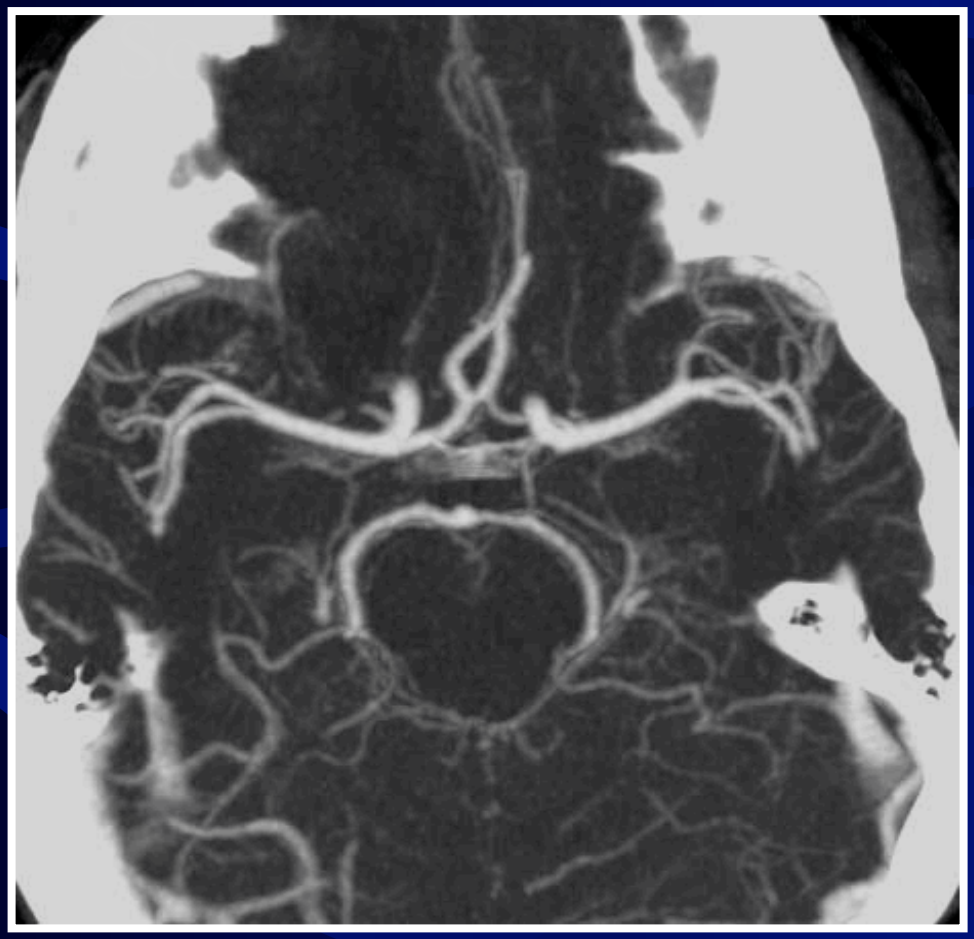
- CECT





CTA

R/O AV fistula



CTA

video reversal

ICH

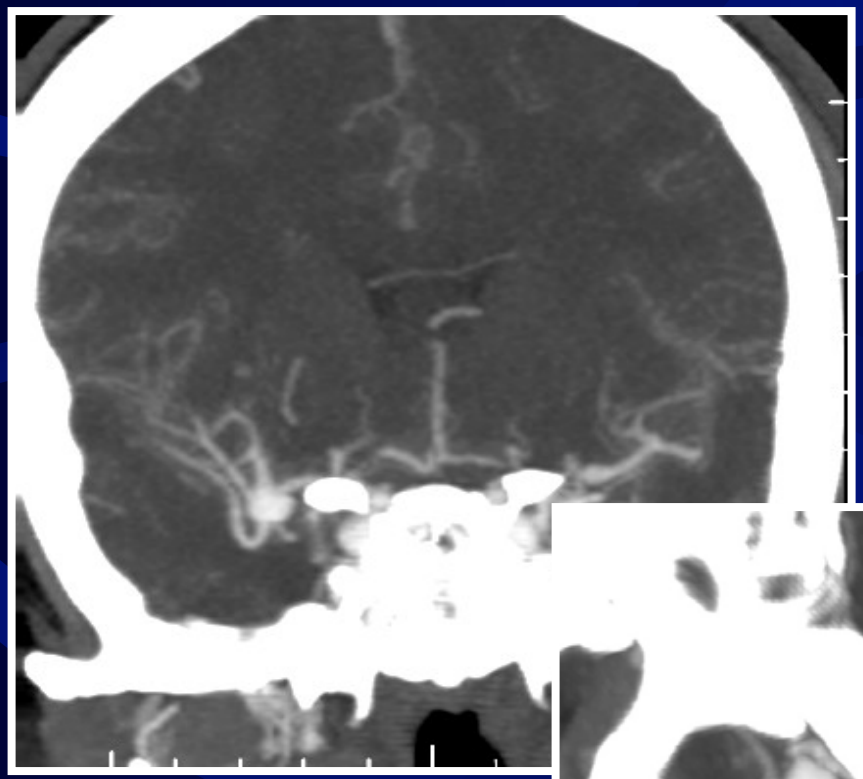
CTA
Aneurysm

- **Noncontrast CT**

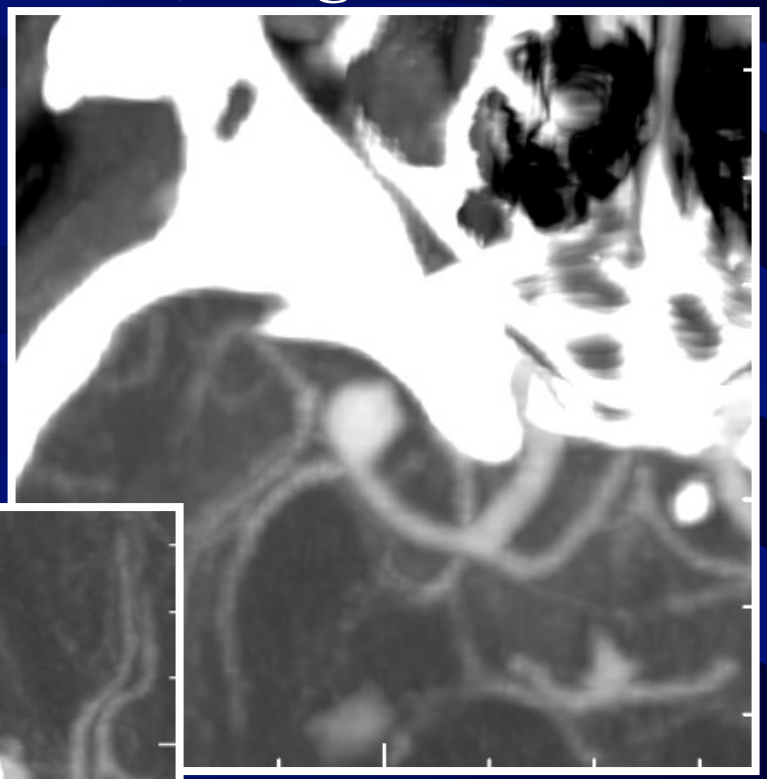
- **Source image**

CTA
Aneurysm

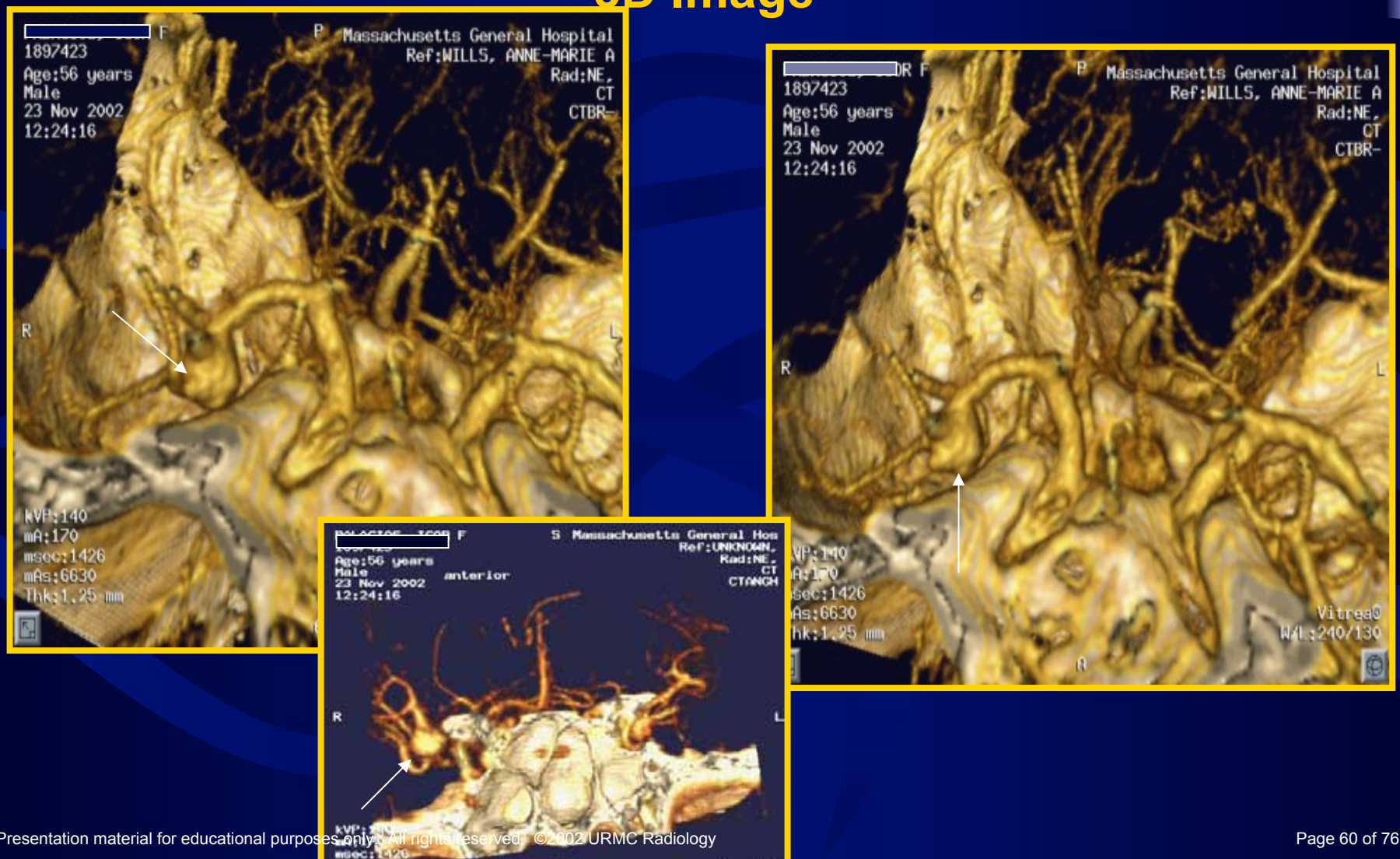
- Coronal MIP



- MIP; magnified



CTA
Surface Rendered Image
3D Image

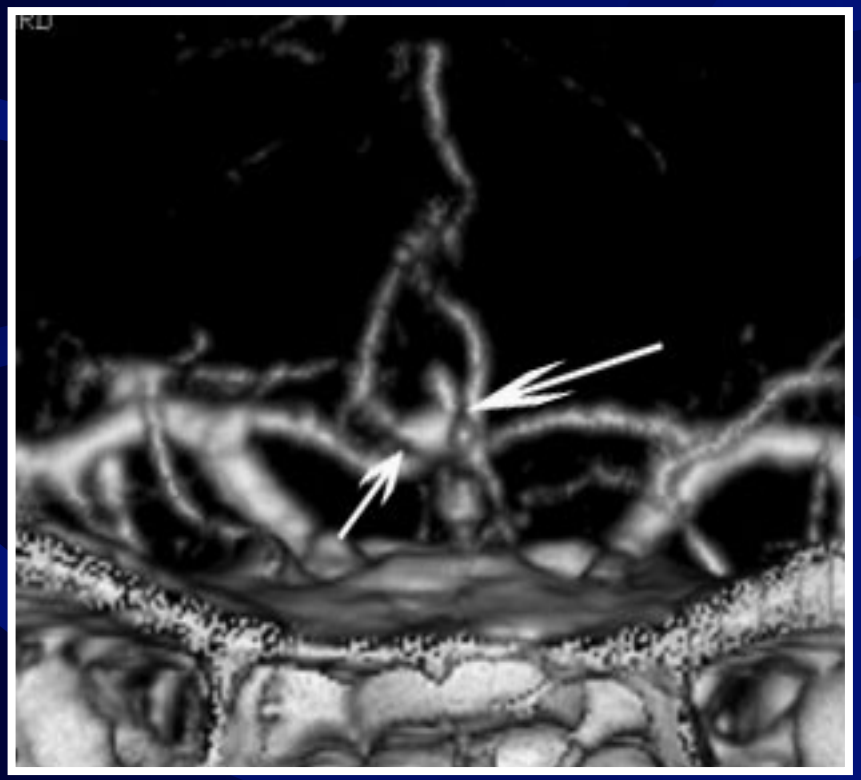


SAH

CTA

ruptured aneurysm

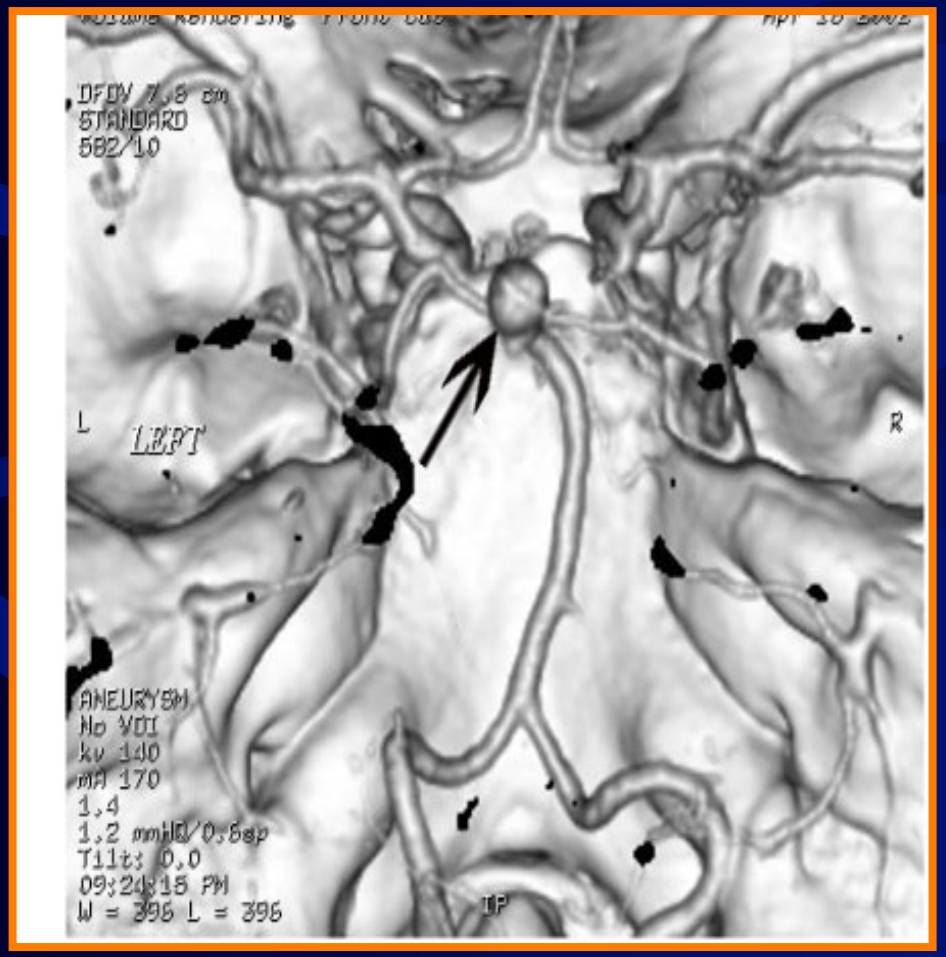
- Surface rendered



- MIP

CTA

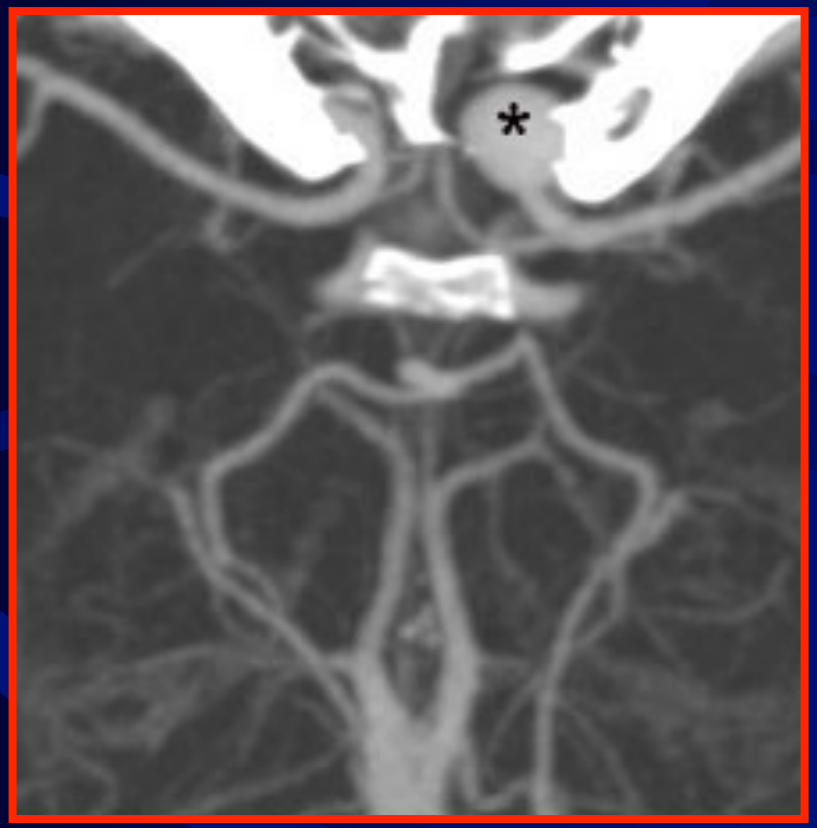
basilar tip aneurysm

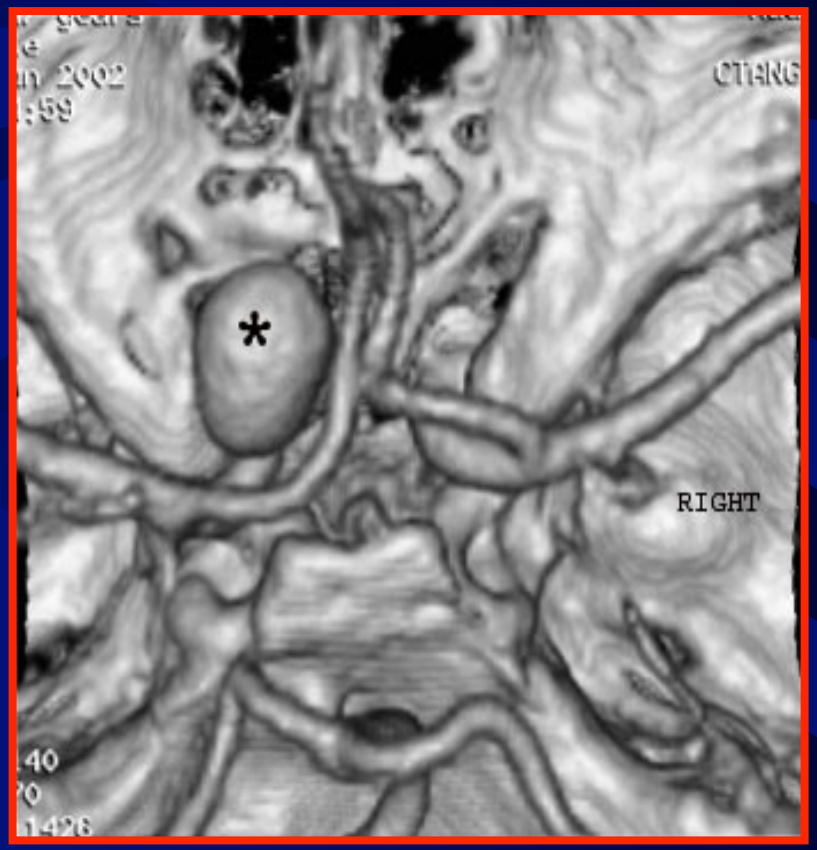


CTA
?Aneurysm

- 3D SSD

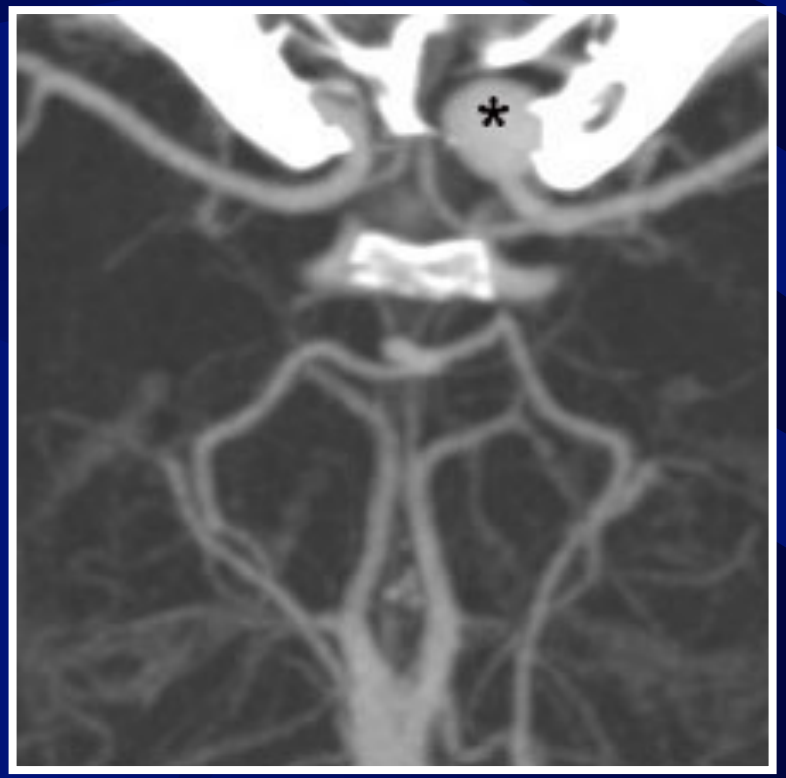
CTA
Aneurysm





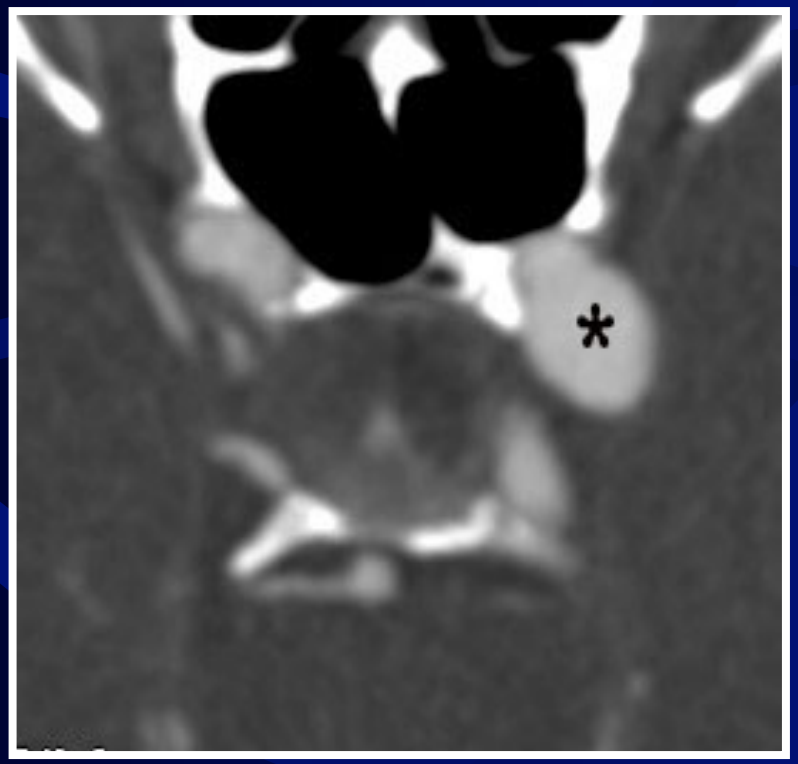
CTA
Aneurysm

- MIP, mag

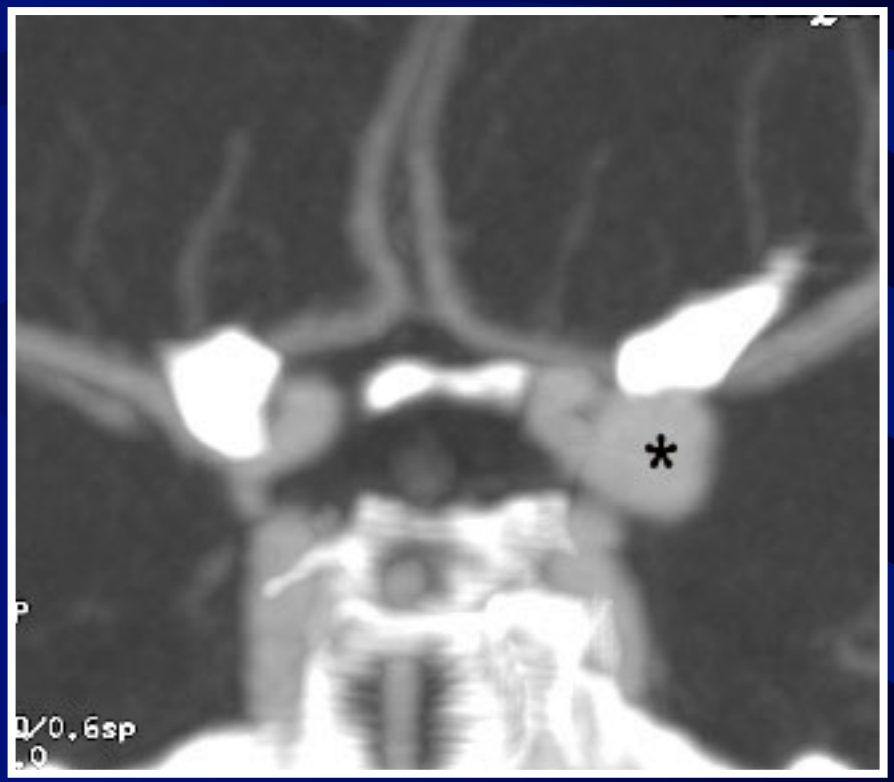


CTA
Aneurysm

- Source image



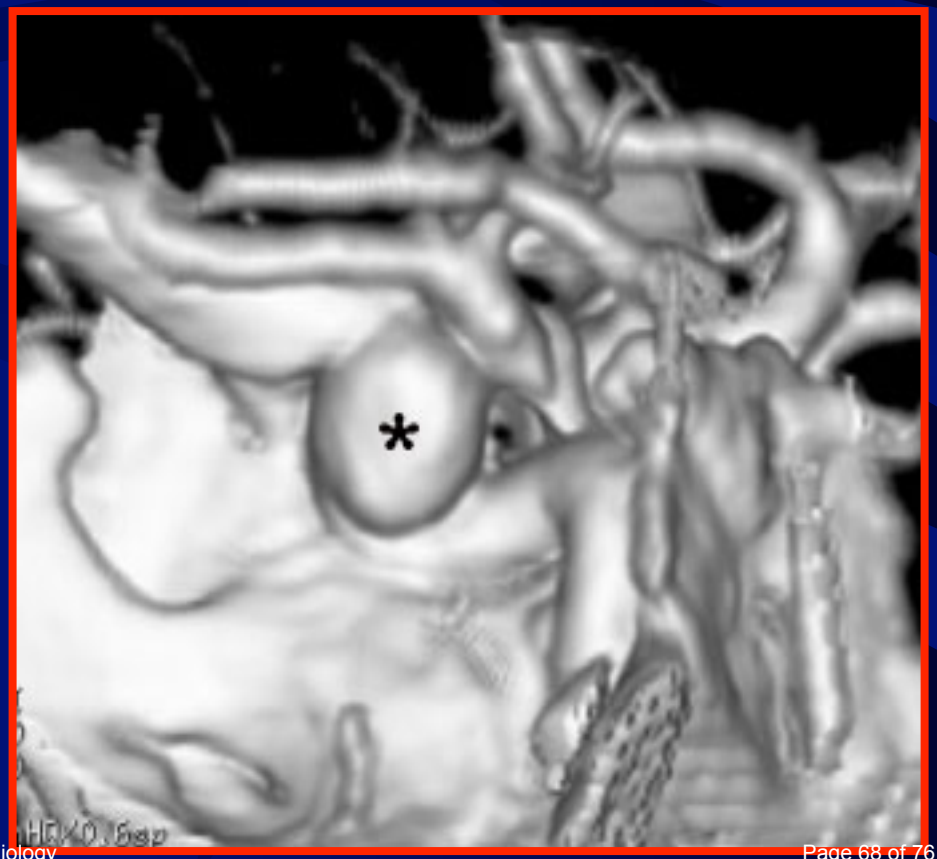
- MIP



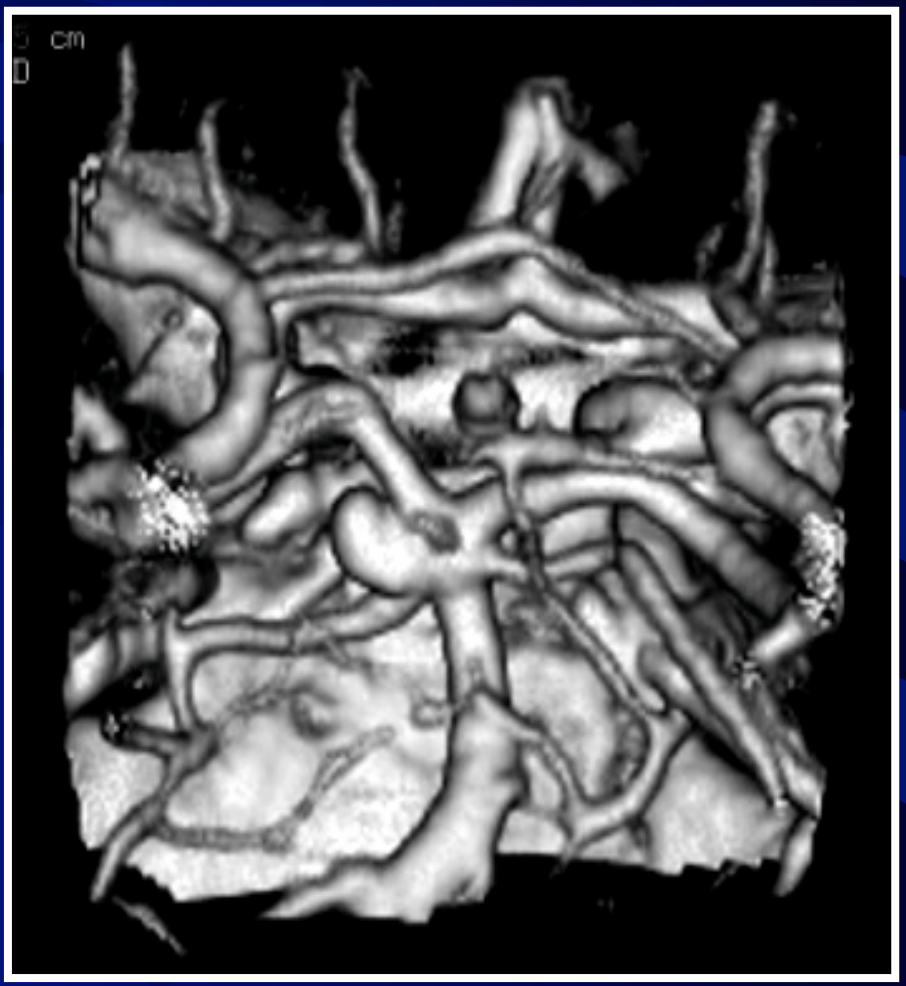
CTA
Postprocessed images

- Curved reformat

- Surface rendered



CTA
72 y/o with TIA vs stroke



Clinical Use of CTA & CTP

- Fast diagnosis of major vessel occlusion in a stroke patient
- Fast diagnosis of the presence of an aneurysm
- Screening of carotid stenosis or other vascular lesions

Neck Vessel CTA

- Arch

CTA

78 y/o with dizziness and abnormal US

- **R/O glomus jugulare tumor. Abnormal US**

- **MIP**

Carotid Dissection

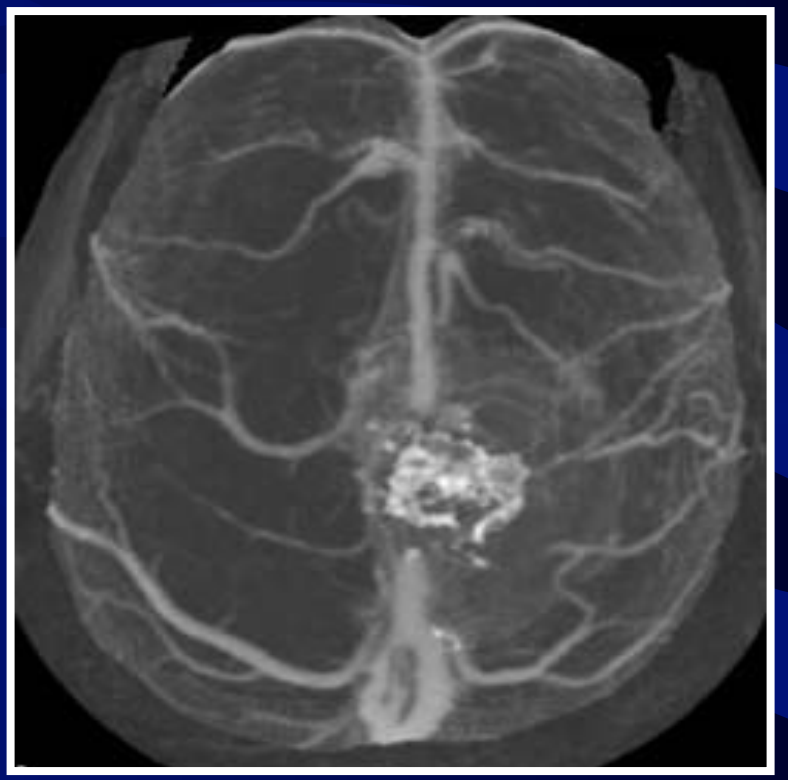
Curved reformatted image

- Source image

CTV

- Contrast enhanced CT

- CTV



CTV

The End

Thank You