LARGE POSTERIOR CIRCULATION ANEURYSM TREATED WITH PIPELINE EMBOLIZATION DEVICE

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OUTLINE

• Patient presentation
• Neurointerventional techniques
• Treatment options for intracranial aneurysms
• Introduction to flow diverters
HISTORY OF PRESENT ILLNESS

• 63 y/o female with h/o SAH
• Clipping of two intracranial aneurysms about 20 years ago
• Lost to follow up for two decades
• Now presents after falling off a ladder
• CT and CTA performed upon admission
CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION
CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION
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CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION

rounded, peripherally calcified structure

PACS, BWH

C-, coronal head CT, brain window
CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION
CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION

PACS, BWH
C-, sagittal head CT, brain window
CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION
CT AT ADMISSION SHOWING CALCIFIED STRUCTURE IN PREPONTINE REGION

PACS, BWH

C-, axial head CT, bone window
CT INTERPRETATION

• CT showed a large, rounded, peripherally calcified structure in prepontine region
• CTA (not shown) suspicious of posterior circulation aneurysm
• Cerebral Angiogram needed for further evaluation
NEXT STEPS

• Angiogram performed six weeks after fall
  – Patient was placed on angiography table
  – Right common femoral artery was accessed
  – Live fluoroscopy and digital, biplane angiography with contrast injection was used for visualization of the aneurysm and surrounding vasculature
• The following images show digitally subtracted angiographies (DSA) in the anterior-posterior (AP) and lateral view
ANGIOGRAM OF THE RIGHT VERTEBRAL ARTERY SHOWING LARGE ANEURYSM
ANGIOGRAM OF THE RIGHT VERTEBRAL ARTERY SHOWING LARGE ANEURYSM

right posterior cerebral artery

left posterior cerebral artery

large aneurysm

basilar artery

right posterior inferior cerebellar artery

right vertebral artery

PACS, BWH

C+, AP DSA of right vertebral artery
ANGIOGRAM OF THE RIGHT VERTEBRAL ARTERY SHOWING LARGE ANEURYSM
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right vertebral artery

basilar artery

posterior cerebral artery

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PACS, BWH

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THREE-DIMENSIONAL CONE-BEAM CT ANGIOGRAPHY

• This technique allows for precise evaluation of the aneurysm in terms of
  – Size
  – Morphology
  – Relationship to parent vasculature

• The following images show three-dimensional reconstructions of a three-dimensional cone-beam CT angiography

• The later images indicate the measurements performed for planning of the treatment
C+, 3-D rotational angiography of right vertebral artery
PACS, BWH
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PACS, BWH
C+, 3-D rotational angiography
of right vertebral artery
3-D AP VIEW OF THE ANEURYSM

origin of the aneurysm off the right posterior inferior cerebellar artery and right vertebral artery

right posterior inferior cerebellar artery

right vertebral artery

basilar artery

PACS, BWH
C+, 3-D rotational angiography of right vertebral artery

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PERFORMING MEASUREMENTS FOR PLANNING OF FURTHER STEPS

measuring the width of the neck of the aneurysm

PACS, BWH
C+, 3-D rotational angiography of right vertebral artery
PERFORMING MEASUREMENTS FOR PLANNING OF FURTHER STEPS

measuring the surrounding vasculature

3.1 mm (2D)
7.4 mm (2D)
4.7 mm (2D)
3.3 mm (2D)
2.9 mm (2D)

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PACS, BWH
C+, 3-D rotational angiography of right vertebral artery
measuring the size of the aneurysm

PERFORMING MEASUREMENTS FOR PLANNING OF FURTHER STEPS

PACS, BWH
C+, 3-D rotational angiography of right vertebral artery
THREE-DIMENSIONAL CONE-BEAM CT ANGIOGRAPHY

- The three-dimensional information of the previous images can be reconstructed in different planes, just like a regular CT.
- In the following image, the aneurysm’s origin off the posterior inferior cerebellar artery and right vertebral artery can be appreciated in the sagittal plane reconstruction.
SAGITTAL RECONSTRUCTION

PACS, BWH
C+, 3-D rotational angiography
sagittal plane reconstruction
SAGITTAL RECONSTRUCTION

origin of the aneurysm off the right posterior inferior cerebellar artery and right vertebral artery

right vertebral artery

PACS, BWH
C+, 3-D rotational angiography sagittal plane reconstruction
TREATMENT OPTIONS FOR INTRACRANIAL ANEURYSMS

• Observation

• Neurosurgery
  – Clipping
  – Clip-reconstruction
  – Parent vessel takedown
  – Bypass

• Interventional neuroradiology
  – Coiling
  – Stent-coiling
  – Parent vessel takedown
  – Flow diversion
PIPELINE EMBOLIZATION DEVICE

- Recently introduced into clinical practice (FDA approval in 2011)
- Self expanding device made of 48 braided strands
- Classified as a flow diverter
- Higher metal coverage than regular stents (=lower porosity)
- Delivered through a microcatheter by an interventional neuroradiologist

source: www.ev3.net/neuro/intl/flow-diversion/embolization-device-product.htm
MECHANISM OF ACTION

1. Immediately
   - Diversion of pulsatile blood flow away from the aneurysm

2. Days to weeks
   - Intra-aneurysmal thrombus formation

3. Months
   - Remodeling of parent vasculature
   - Re-endothelialization of the stented segment
   - Exclusion of the aneurysm from the parent vasculature lumen followed by possible absorption of the aneurysm
MECHANISM OF ACTION

• Side branches have flow
  - Stay open

• Aneurysm lacks outflow
  - Thrombus forms

• This property is particularly interesting in segments of intracranial arteries that have important branches, such as the ophthalmic segment of the internal carotid artery
WHEN TO USE

• Particularly helpful for the treatment of challenging intracranial aneurysms (wide neck, large or giant size, complex relationship to parent vasculature)

• Mostly used for nonruptured aneurysms

• Initially intended only for anterior circulation and approved by FDA but now also used in posterior circulation (Off-label use)

• Successful deployment in 95%

• Successful obliteration in over 80%

• Complication rate 6%

• Mortality rate 1.5%
LIMITATIONS AND RISKS

- Prolonged anticoagulation (Aspirin and Plavix for up to 6 months, depending on the location of the aneurysm)
  - Aneurysm rupture
  - In-stent stenosis
  - Thromboembolism
  - Stent migration
  - Non-aneurysm related intracerebral hemorrhages
The actual interventional procedure was scheduled for one week after the diagnostic cerebral angiogram.

First, another biplane DSA of the right vertebral artery was performed to confirm that the aneurysm had not changed in size over the last week.

In this particular case, it was decided to coil the aneurysm before deploying the Pipeline Embolization Device. This was done because of the large size of the aneurysm.

Subsequently, the device was deployed successfully.

A follow-up run confirmed good flow through the right vertebral artery, the basilar artery, and the right posterior inferior cerebellar artery.
RIGHT VERTEBRAL ARTERY AP BEFORE EMBOLIZATION

PACS, BWH

C+, AP DSA of right vertebral artery
RIGHT VERTEBRAL ARTERY AP
AFTER COIL DEPLOYMENT
RIGHT VERTEBRAL ARTERY AP
AFTER COIL DEPLOYMENT

- Coil mass in the aneurysm
- Delivery catheter in right vertebral artery
- Leading microwire in basilar artery
- Pipeline Embolization Device being deployed

C+, AP DSA of right vertebral artery
RIGHT VERTEBRAL ARTERY AP
AFTER DEPLOYMENT OF PIPELINE
EMBOLIZATION DEVICE

UNSUBTRACTED IMAGE

DIGITALLY SUBTRACTED ANGIOGRAPHY

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PACS, BWH
C-, AP unsubtracted and DSA of right vertebral artery region
RIGHT VERTEBRAL ARTERY AP
AFTER DEPLOYMENT OF PIPELINE
EMBOLIZATION DEVICE

UNSUBTRACTED IMAGE

DIGITALLY SUBTRACTED ANGIOGRAPHY

old surgical clips

coil mass

proximal and distal ends of Pipeline Embolization Device

old surgical clips

coil mass

proximal and distal ends of Pipeline Embolization Device

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PACS, BWH

C-, AP unsubtracted and DSA of right vertebral artery region
RIGHT VERTEBRAL ARTERY AP
FINAL ANGIOGRAM TO CONFIRM FLOW IN PARENT VASCULATURE
RIGHT VERTEBRAL ARTERY AP
FINAL ANGIOGRAM TO CONFIRM FLOW IN PARENT VASCULATURE

neck of aneurysm

good flow in right posterior inferior cerebellar artery
FOLLOW-UP AXIAL CT SHOWING COIL MASS
SUMMARY

• Three-dimensional cone-beam CT angiography is the best modality for assessing intracranial aneurysms
• There are different treatment options for intracranial aneurysms including neurosurgery, endovascular treatment, and observation
• The recently introduced group of flow diverters open up new treatment options for difficult intracranial aneurysms but require prolonged anticoagulation
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REFERENCES


FURTHER READING

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• headneckbrainspine.org