MR Angiography

Expires Wednesday, May 31, 2023   Radiology   William G Bradley , MD, PhD, FACR

Examination

1. In most clinical cases, the question will only involve arteries or veins but not both. In TOF MRA, a 90° pulse, which is called a _____ is applied above or below the imaging volume to eliminate the signal from spins entering in the unwanted venous or arterial vessels.
   a. SatPulse
   b. MIP
   c. Venc
   d. Venetian blind
   e. Targeted MIP

2. Two-dimensional TOF MRA consists of
   a. a signal that is based on the phase gained (or lost) as the spins move through a magnetic field gradient.
   b. a signal that is acquired from a 3 to 6 cm thick slab.
   c. multiple 2 to 3 cm thick slabs covering the anatomy of interest.
   d. single slice gradient echoes, sequentially acquired in the direction countercurrent to flowing blood.
   e. a series of acquisitions that are acquired following injection of gadolinium

3. To image the jugular veins by 2D-TOF, you would
   a. want to start from the top and go down.
   b. start at the bottom and go up.
   c. acquire a 3 to 6 cm thick slab of the neck area.
   d. obtain a series of acquisitions following the injection of gadolinium.
   e. obtain multiple 2 to 3 cm thick slabs that cover the neck area.

4. The slice thickness in 2D-TOF techniques is generally on the order of _____ depending on the application.
   a. 0.5 to 1 mm
   b. 1 to 2 mm
   c. 2 to 4 mm
   d. 5 to 7 mm
   e. 7 to 9 mm

5. In 3D-TOF MRA,
   a. signal is acquired from multiple 2 to 3 cm thick slabs.
   b. the thinner slab increases the signal-to-noise (S/N) ratio compared to 2D-TOF).
   c. the thinner slab improves spatial resolution.
   d. because the slab is thinner than the slices used for 2D-TOF MRA, the spins may be exposed to more than one RF pulse.
   e. because the spins may be exposed to more than one RF pulse, this may lead to loss of magnetization and saturation, eliminating signal from the vessel.

6. In the gradient echo acquisition of 3D-TOF MRA, saturation effects are more pronounced
   a. with smaller flip angles and shorter repetition times (TR).
   b. with smaller flip angles and longer repetition times (TR).
   c. with larger flip angles and longer repetition times (TR).
   d. with larger flip angles and shorter repetition times (TR).

e. when the flip angles equal the repetition times (TR).

7. **In the gradient echo acquisition of 3D-TOF MRA, one of the ways to decrease the saturation effects includes**

   a. decreasing the flip angle.

   b. decreasing the TR.

   c. increasing the slab thickness.

   d. avoiding the use of gadolinium.

   e. the use of targeted MIP's.

8. **MOTSA (Multiple Overlapping Thin Slab Acquisition)**

   a. consists of a 3 to 6 cm thick slab covering the anatomy of interest.

   b. has the unlimited coverage of 2D-TOF.

   c. has the low spatial resolution of 3D-TOF.

   d. is more efficient than 3D-TOF MRA.

   e. will occasionally have minor saturation effects that remain, producing low intensity bands at the junctions between the slabs known as "SatPulse's".

9. **When limited coverage is needed (for example, an evaluation of the circle of Willis in an acute cerebral infarct),**

   a. MOTSA is used.

   b. 2D-TOF is used.

   c. 2D-TOF followed by MOTSA is used.

   d. Phase contrast MRA is used.

   e. a single 3D-TOF slab is used.

10. **When greater coverage is required (for example, an evaluation of carotid artery stenosis or to screen the entire brain for an aneurysm)**

    a. a single 3D-TOF slab is used.

    b. multiple 3D-TOF slabs are used.

    c. MOTSA is used.

    d. Phase contrast MRA is used.

    e. Phase contrast MRA followed by 2D-TOF is used.

11. **Once a series of 2D or 3D slices has been acquired, to be displayed in angiographic format,**

    a. they are viewed directly as 64 separate images.

    b. they are scrolled consecutively on a workstation.

    c. a maximum intensity projection algorithm is generally used.

    d. Venetian blind artifacts must be produced.

    e. the Venc parameter must be set.

12. **One of the potential problems with the maximum intensity projection algorithm is that it includes anything that is**

    a. bright on the T1-weighted source images, including subacute hemorrhage and fat.

    b. dark on the T1-weighted source images, including chronic hemorrhage and cysts.

    c. bright on the T2-weighted source images, including hyperacute hemorrhage and fibrous tissue.

    d. dark on the T1-weighted source images, except those entities that enhance with gadolinium.

    e. bright on the T1-weighted source images, including bone and fibrous tissue.

13. **To determine if something is showing up on the MIP images that doesn't represent flowing blood, it may be desirable to acquire a**

    a. phase contrast MRA.

    b. 2D-TOF MRA.

c. 3D-TOF MRA.

d. MOTSA.

e. MRA that uses gadolinium.

14. **Which of the following statements is true?**

a. The MIP algorithm has an S/N ratio threshold for what is included in the image, so very large vessels with slow blood flow may not be visualized.

b. Because the MIP algorithm may not visualize tight stenoses, it is important to review the individual source images before diagnosing a complete stenosis.

c. The source images are not useful in diagnosing the small lenticulostriate collaterals in moyamoya disease.

d. The MIP algorithm has an S/N ratio threshold for what is included in the image, so very small vessels or tight stenoses will nearly always be visualized.

e. Moyamoya disease is a well-understood genetic disorder of veins.

15. **The phenomenon where the spins appear to be moving at maximum velocity in one direction in one pixel and then, in the next pixel, they appear to be moving at maximum velocity in the opposite direction, is called**

a. the Venc

b. encoding velocity

c. velocity aliasing

d. the Satpulse

e. Venetian blind artifacts.

16. **In PC MRA, the strength of the phase encoding gradient is determined by setting a parameter called the**

a. Satpulse

b. slab thickness

c. MIP

d. xyz gradient

e. Venc

17. **Phase contrast MRA typically takes 4 times longer than a TOF technique with the same TR and matrix, and for this reason, it is rarely used. In which clinical setting listed below, might PC MRA be of use?**

a. A stenotic internal carotid artery

b. Identifying the collaterals in moyamoya disease

c. Identifying the vessels leading to a meningioma

d. A ruptured dermoid

e. A chronic subdural hematoma

18. **Contrast enhanced MRA has become the preferred technique for imaging arteries everywhere in the body EXCEPT for the**

a. kidney

b. neck

c. liver

d. brain

e. lower extremities

19. **Which of the following statements is true regarding CE MRA?**

a. With modern echo planar imaging capable MRI systems, the stronger, faster gradients allow an image to be acquired during the brief time that gadolinium is in the venous phase before it gets to the arteries.

b. CE MRA is essentially a time-of-flight technique without saturation effects.

c. In the standard k-space acquisition mode, the exact time of arrival of the gadolinium bolus needs to be known.

d. When the exact time of arrival of the gadolinium bolus is known, an "elliptical-centric" MRA technique (which is less sophisticated) allows a lower resolution image to be acquired.

e. When the exact time of arrival of the gadolinium bolus is not known, a more sophisticated acquisition is acquired, but only at 30 seconds.

20. **Some MR manufacturers also have automated bolus detection software to determine when the gadolinium bolus arrives at the anatomic level of interest. This works particularly well for**
   a. carotid MRA
   b. circle of Willis MRA
   c. collateral detection in moyamoya disease
   d. collateral detection around a meningioma
   e. abdominal and runoff angiography

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