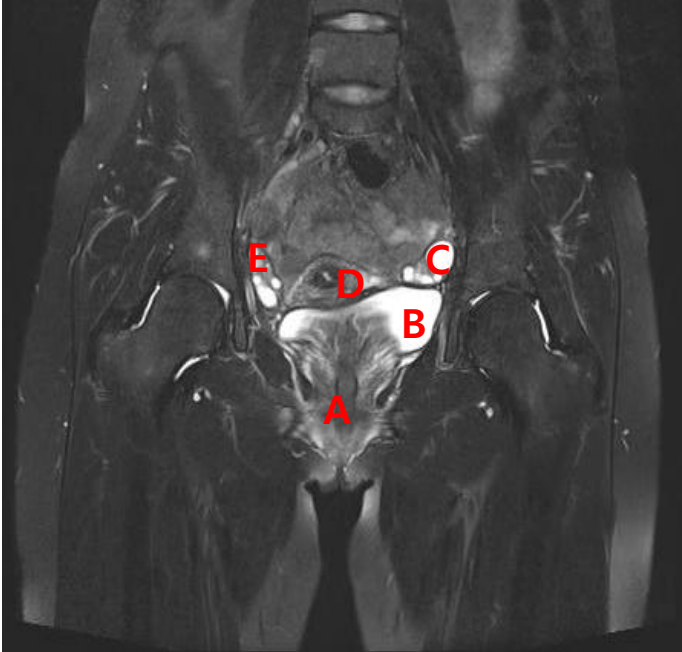


# 2016MR

CODE 2-6-3 medium

1. Choose letters correspond to name of the anatomy?

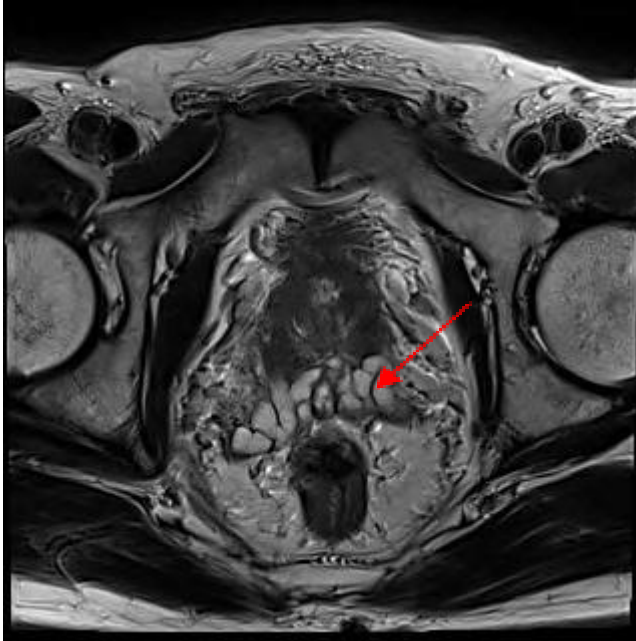


A - Vagina  
C - Ovary  
E - Fallopian tube

B - Uterus  
D - Bladder

- A. A, B
- B. C, D
- C. A, C
- D. B, D

CODE 2-6-5 medium

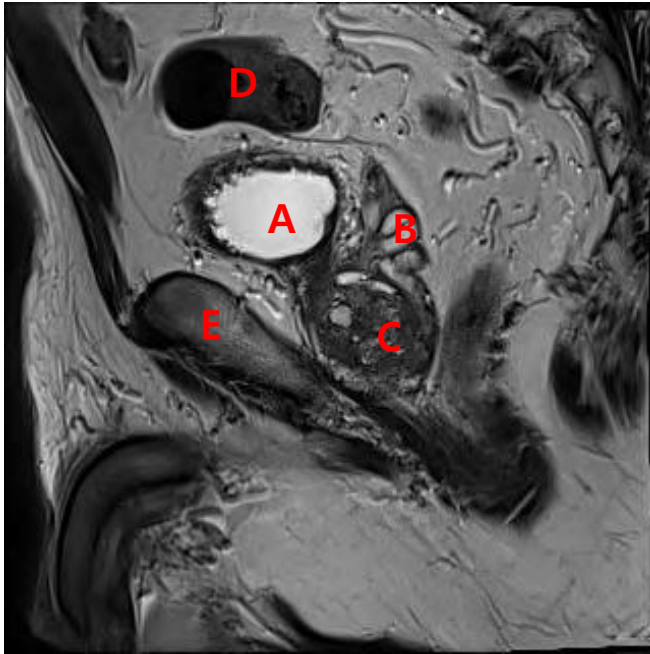


2. What does the arrowed area represent?

- A. Prostate
- B. Epididymis
- C. Testis
- D. Seminal vesicle

CODE 2-6-5 high

3. Choose letters correctly representing the anatomy.

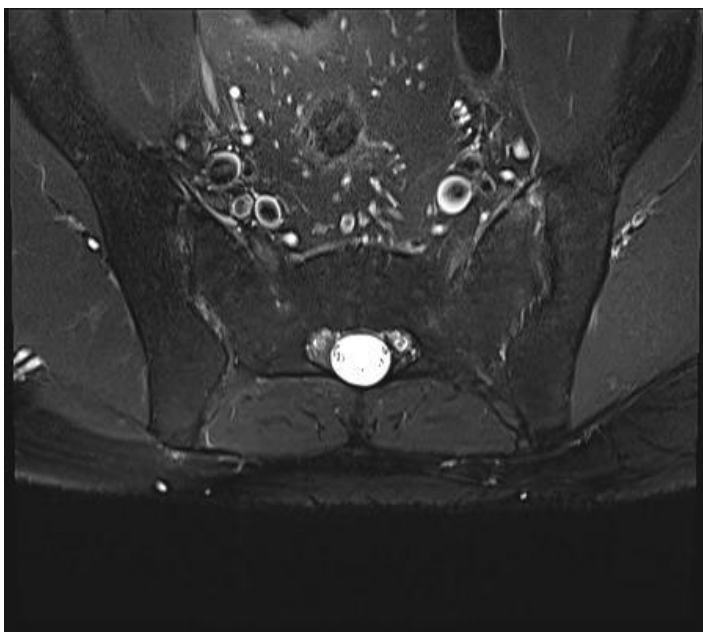


A - Uterus	B - Seminal vesicle
C - Prostate	D - Epididymis
E - Bladder	

- A. A, B
- B. C, D
- C. A, E
- D. B, C

Code 2-6-1 low

4. Choose letters which are not observed in the following image.



A - Bladder	B - Iliac bone
C - Sacrum	D - S-I joint
E - Seminal vesicle	

- A. A, B
- B. C, D
- C. A, E
- D. B, C

Code 2-8-2 medium

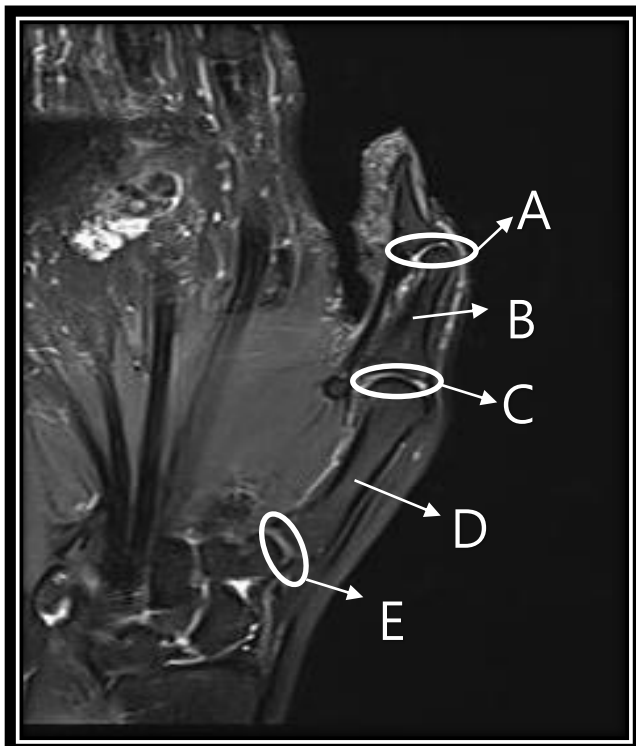
5. What does the arrow represent?



- A. Anterior Cruciate Ligament
- B. Posterior Cruciate Ligament
- C. Lateral Ligament
- D. Medial Ligament

Code 2-7-2 medium

6. Choose letters correspond to name of the anatomy.

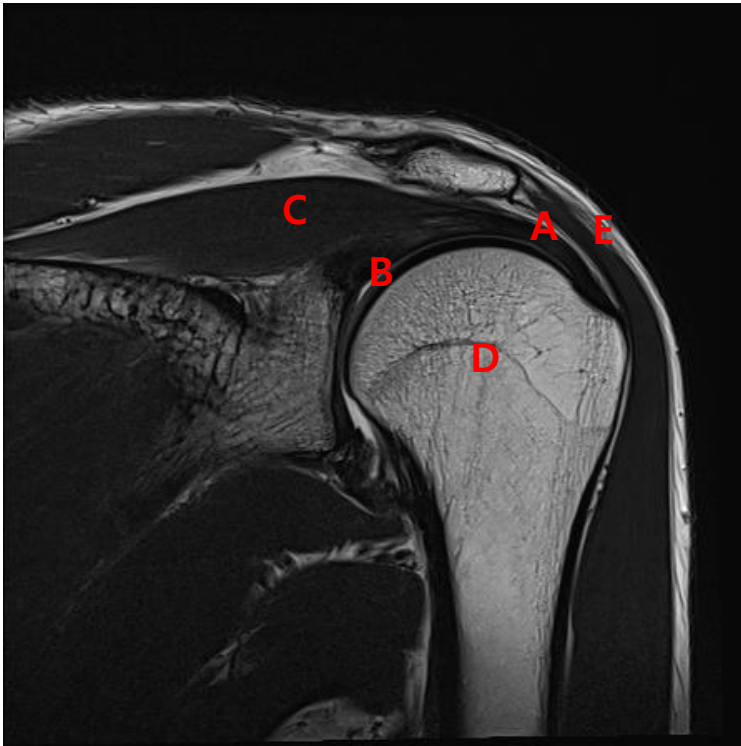


A – IP joint	B – Metacarpal
C – MCP joint	D – Proximal phalanx
E – CMC joint	

- A. A, B
- B. C, D
- C. A, C, E
- D. A, D, E

Code 2-7-1 medium

7. Choose letters correctly representing the anatomy.



C - Supraspinatus muscle	D – Humerus head
E – Biceps tendon	

- A. A, B
- B. C, D
- C. B, E
- D. A, C, D

Code 2-7-5 high

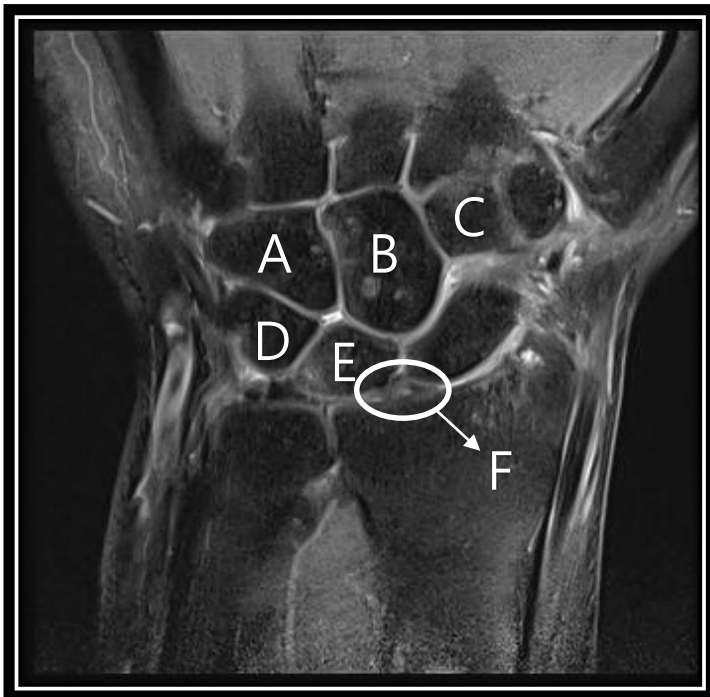
8. What does the arrowed area represent?



- A. Extensor tendon
- B. Radial collateral Ligament
- C. Ulnar collateral Ligament
- D. Articular cartilage

Code2-7-4 low

9. Choose letters correctly representing the anatomy.

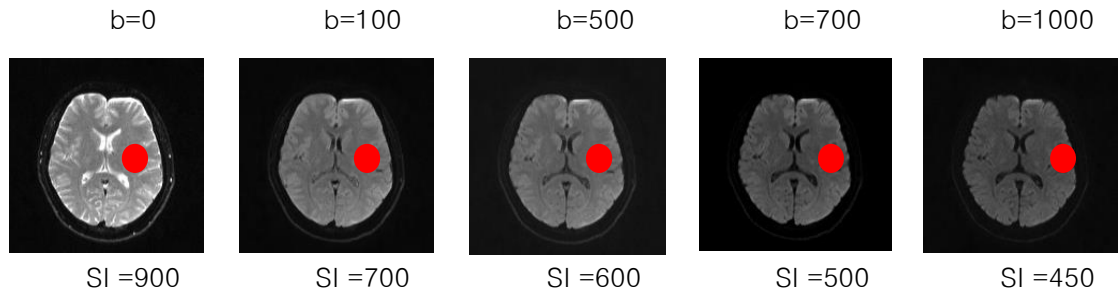


A - Scaphoid	B - Trapezoid
C - Lunate	D - Radial collateral ligament
E - Triquetrum	F - Scapholunate ligament

- A. A, B
- B. C, D
- C. D, E
- D. F

Code1-4-5 medium

10. What is the value of ADC in b-value from 0 to 1000?



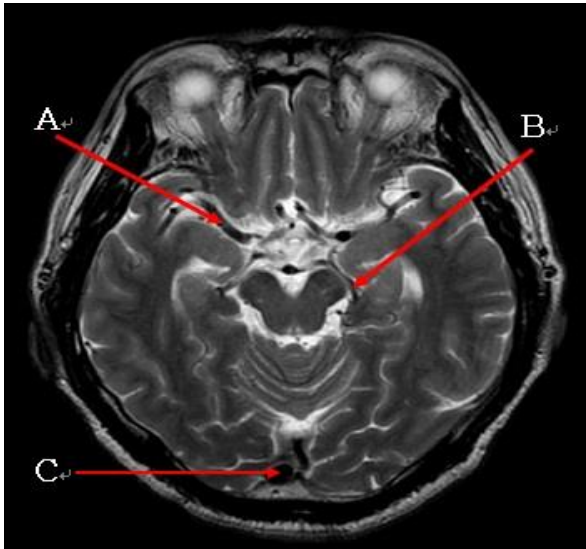
Ex)  $\ln 1.5 = 0.41$ ,  $\ln 2 = 0.69$

- A.  $0.41 \times 10^{-3} \text{ (mm}^2\text{/sec)}$
- B. 0.41 (mm<sup>2</sup>/sec)
- C.  $0.69 \times 10^{-3} \text{ (mm}^2\text{/sec)}$
- D. 0.69 (mm<sup>2</sup>/sec)



Code2-1-10 medium

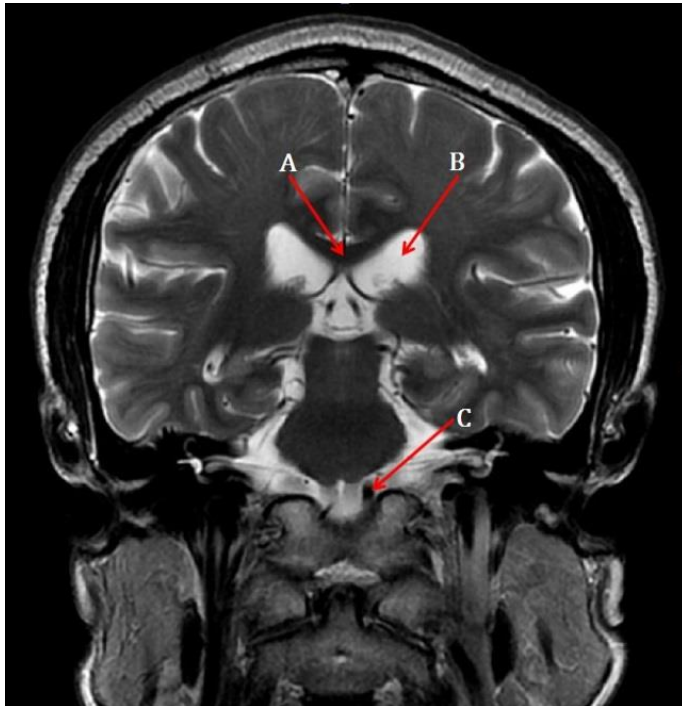
11. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Anterior cerebral artery	Cerebral aqueduct	Hippocampus
B	Middle cerebral artery	Cavernous sinus	Sagittal sinus
C	Inferior cerebral artery	Optic chiasm	Straight sinus
D	Middle cerebral artery	Posterior cerebral artery	Sagittal sinus

Code2-1-10 medium

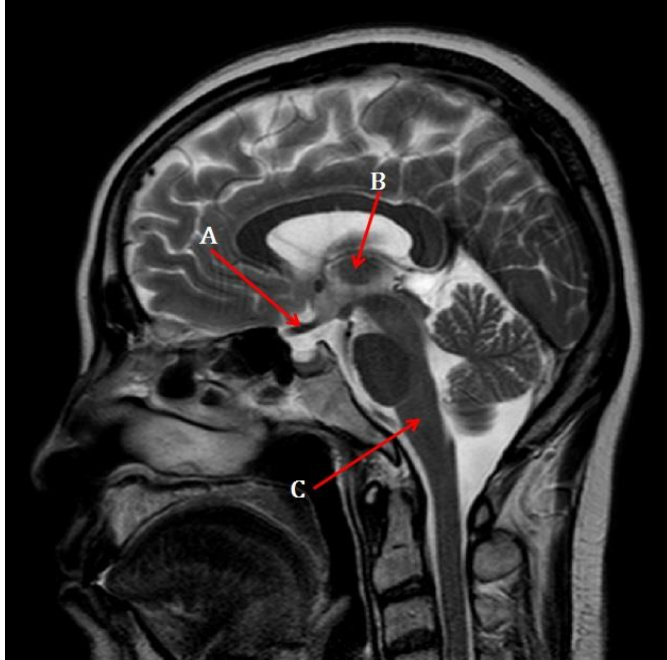
12. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Caudate nucleus	3 <sup>rd</sup> ventricle	Cerebral aqueduct
B	Hippocampus	Pineal gland	Falx cerebri
C	Thalamus	Optic chiasm	Straight sinus
D	Corpus callosum	Lateral ventricle	Vertebral artery

Code2-1-10 medium

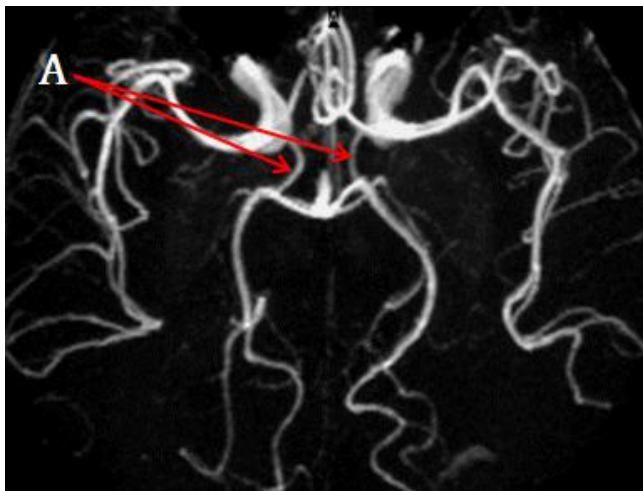
13. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Optic chiasm	Thalamus	Medulla oblongata
B	Basilar artery	Cavernous sinus	Cerebellar tonsil
C	Cerebral aqueduct	Mid brain	Trigeminal nerve
D	Hippocampus	Red neucleus	Olfactory nerve

Code2-1-4 medium

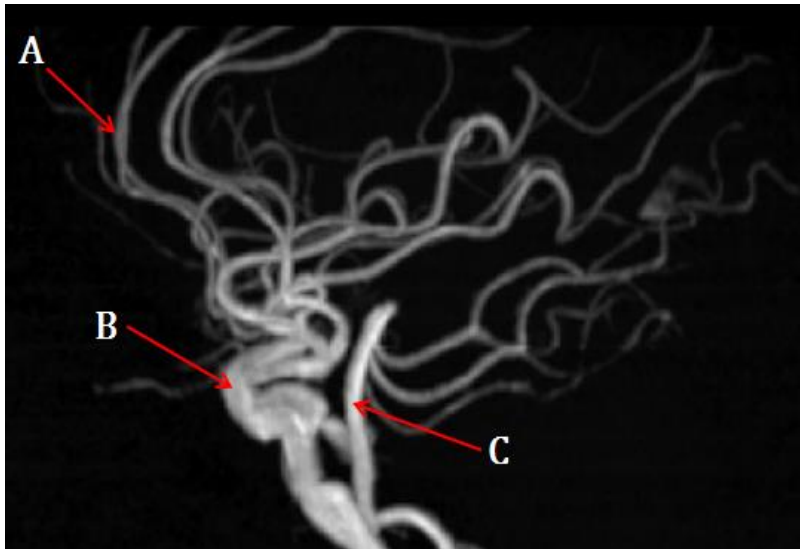
14. Choose the name the arrowed parts.



- A. Anterior cerebral artery
- B. Middle cerebral artery
- C. Inferior cerebral artery
- D. Posterior communicating artery

Code2-1-4 medium

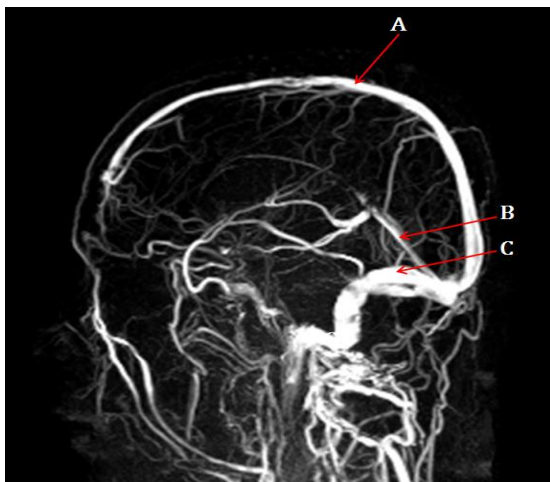
15. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Anterior cerebral artery	Common carotid artery	Vertebral artery
B	Middle cerebral artery	Anterior communication artery	Internal carotid artery
C	Inferior cerebral artery	External carotid artery	Internal carotid artery
D	Anterior cerebral artery	Internal carotid artery	Basilar artery

Code2-1-9 medium

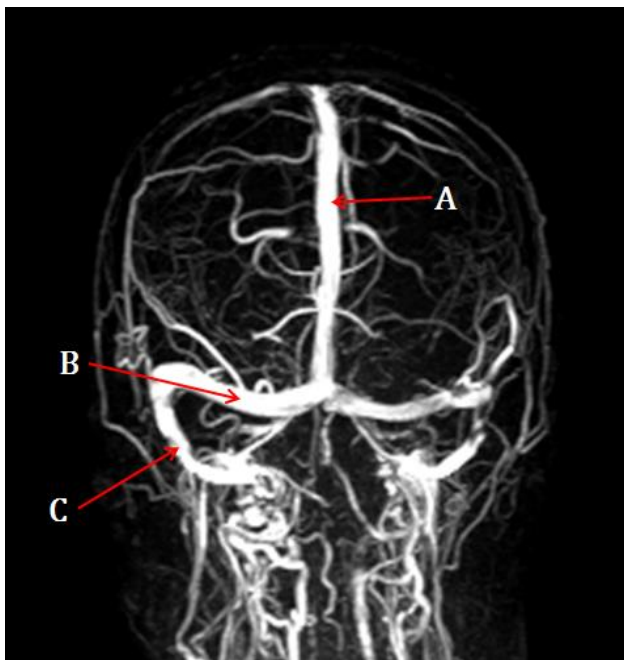
16. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Anterior frontal vein	Sigmoid sinus	Transverse sinus
B	Posterior frontal vein	Internal jugular vein	Straight sinus
C	Trolar vein	Transverse sinus	Internal jugular vein
D	Superior sagittal sinus	Straight sinus	Transverse sinus

Code2-1-9 medium

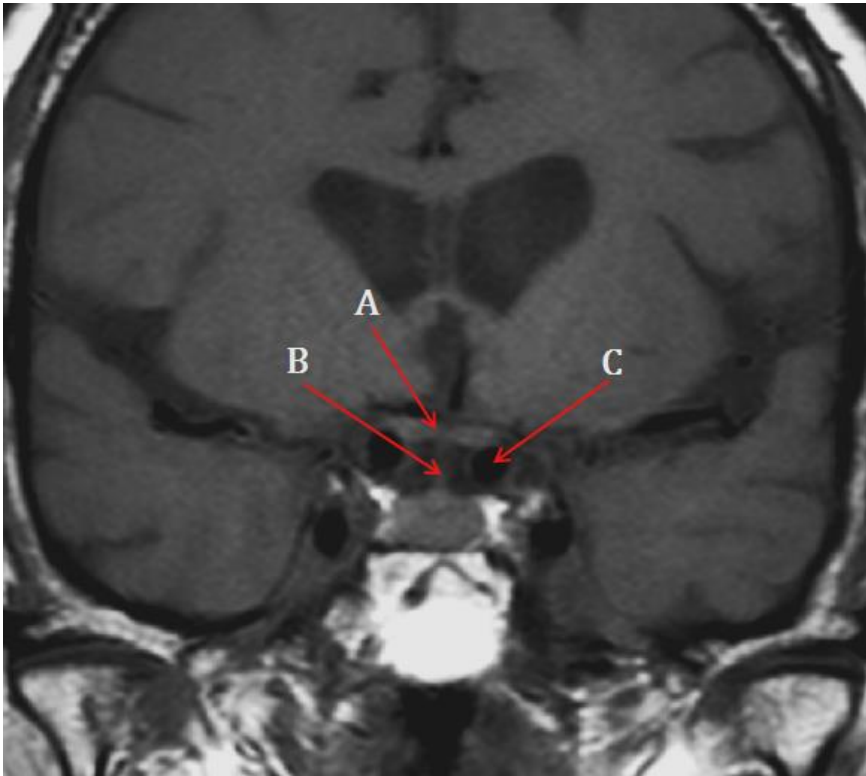
17. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Anterior frontal vein	Sigmoid sinus	Transverse sinus
B	Posterior frontal vein	Internal jugular vein	Straight sinus
C	Trolar vein	Transverse sinus	Internal jugular vein
D	Superior sagittal sinus	Straight sinus	Sigmoid sinus

Code2-1-10 high

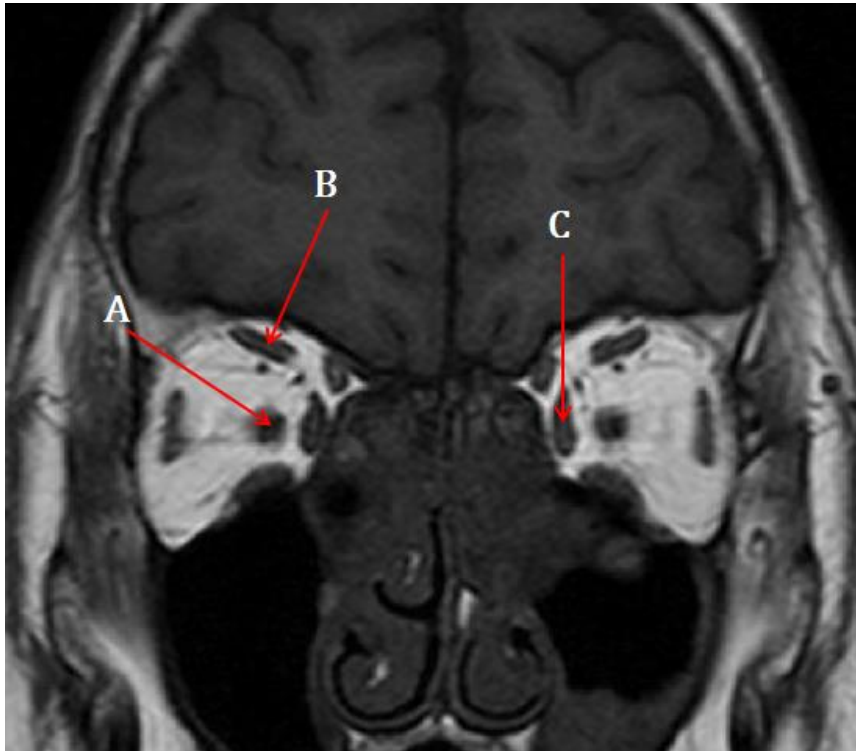
18. Choose correct names corresponding to of each letters (arrows).



	A	B	C
A	Cerebral aqueduct	Cranial nerve	Vertebral artery
B	Olfactory nerve	Cavernous sinus	Sagittal sinus
C	Optic chiasm	Pituitary stalk	Carotid artery
D	Pituitary gland	Internal cerebral vein	Internal jugular vein

Code2-1-6 low

19. Choose correct names corresponding to of each letters (arrows).

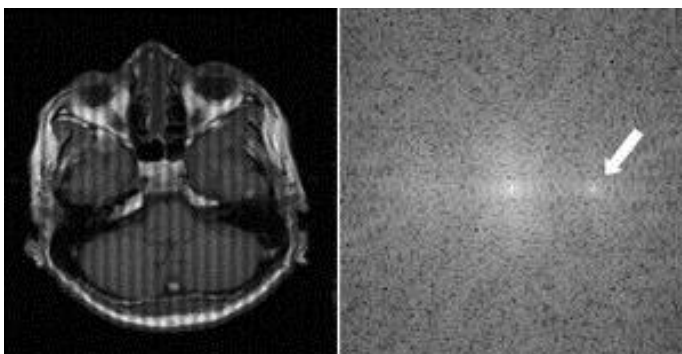


	A	B	C
A	Optic nerve	Optic chiasm	Olfactory nerve
B	Optic chiasm	Optic nerve	Lacrimal gland
C	Lacrimal gland	Optic chiasm	Optic nerve
D	Optic nerve	Superior rectus	Medial rectus

Code1-5-5 medium

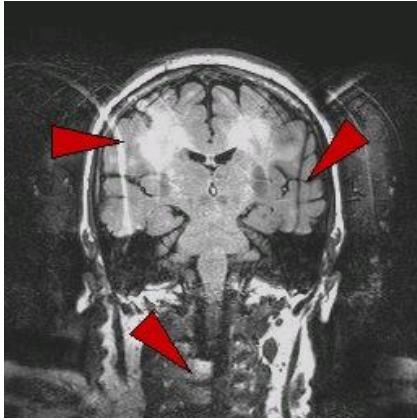
20. In MRI, artifacts are frequently generated due to various factors. Choose the artifact image resulting from K-space.

A.

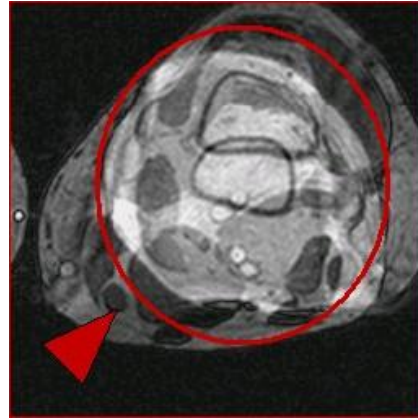




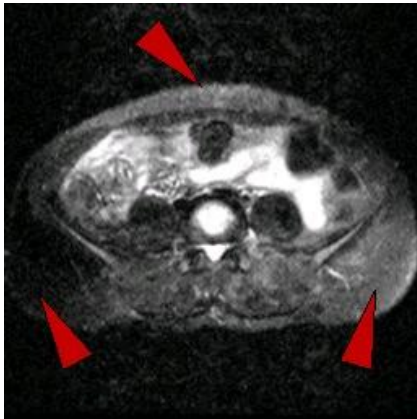
B



C

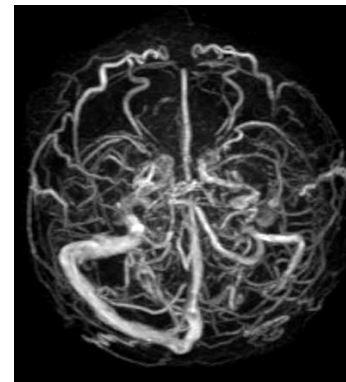
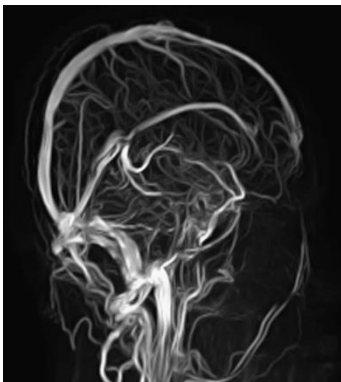


D



Code1-8-1 low

21. Choose the right one below MR Venography.

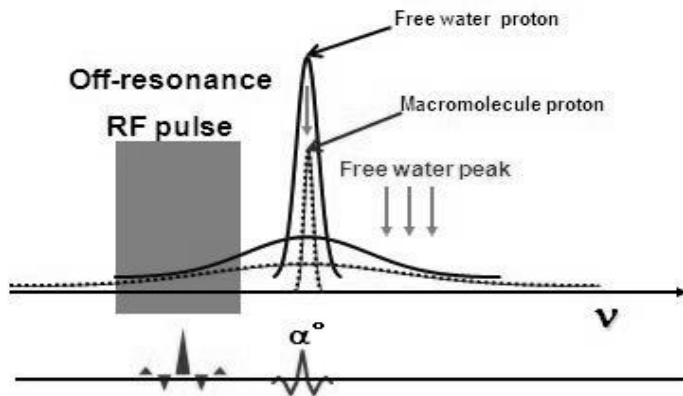


- A. The position of saturation pulse is under FOV.
- B. It makes respiration compensation
- C. It uses EPI(echo planar imaging) pulse sequence
- D. It uses 80msec TE



Code1-8-2 high

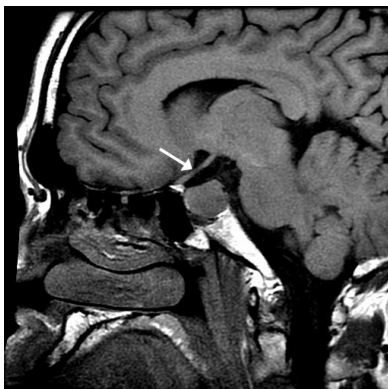
22. Which is not correct about the figure describing the MRA technique below?



- A. Applying the off resonance RF pulse on the gradient echo sequence, signals of fat, CSF and blood do not change.
- B. Small vessels appear by applying this technique on the 2D or 3D TOF images to reduce the signals of muscle or gray matter of brain.
- C. It uses CHES pulse.
- D. The methemoglobin appears bright similar to the blood flow.

Code 2-7-4 medium

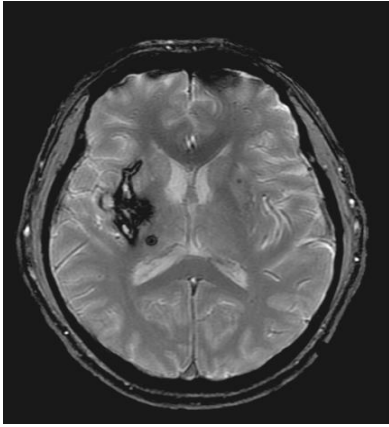
23. Which of the following arrow indicate?



- A. Oculomotor nerve
- B. Optic chiasm
- C. Vestibulocochlear nerve
- D. Trigeminal nerve

Code1-4-3 medium

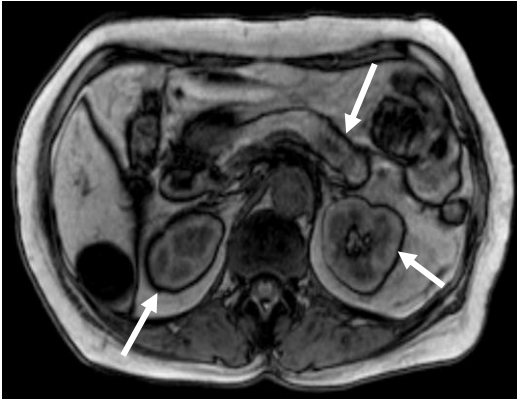
24. What is this kind of effect increased?



- A. Reduced TE
- B. High magnetic field is more effective
- C. FSE technique efficient more than GRE
- D. Thin slice thickness

Code1-10-1 high

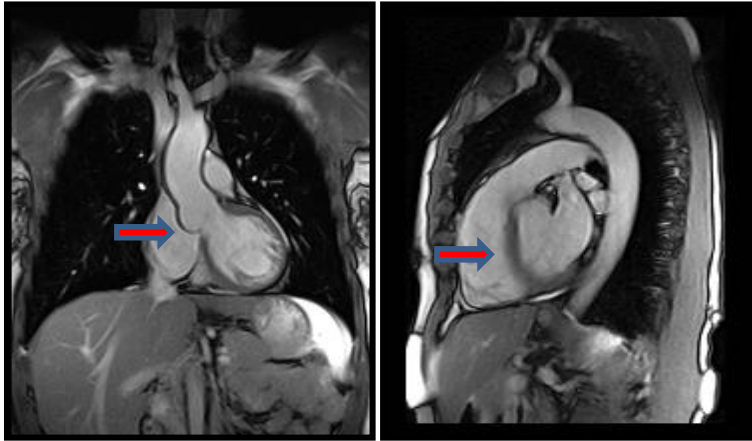
25. What kind of artifacts is seen in this image (arrow) and what is this image?



- A. Motion Artifact, In phase
- B. Truncation Artifact, Out of phase
- C. Partial Volume Artifact, In phase
- D. Chemical Shift Artifact, Out of phase

Code 2-7-4 medium

26. Which of the following arrow indicate?



- A. Left Ventricle.
- B. Aorta.
- C. Right Ventricle
- D. pulmonary artery

Code1-8-5 medium

27. Choose the incorrect one about Dynamic contrast enhanced MRI(DEC).

- A. It uses One compartmental model that , MR contrast media can't pass the BBB(Blood Brain Barrier)
- B. It doesn't have signal increase because MR contrast media can't pass BBB in normal Brain.
- C. MR contrast media that flows in extravascular-extracellular space decrease T1 and increase SI.
- D. It estimates permeability between Blood plasma and extevascular-exteacellular space(EES)

Code2-1-5 medium

28. Choose right one that explain precentral gyrus & postcentral gyrus.

- A. precentral gyrus – motor area , postcentral gyrus – sensory area
- B. precentral gyrus – sensory area, postcentral gyrus – motor area
- C. precentral gyrus – visual area, postcentral gyrus – sensory area
- D. precentral gyrus – motor area, postcentral gyrus – language area

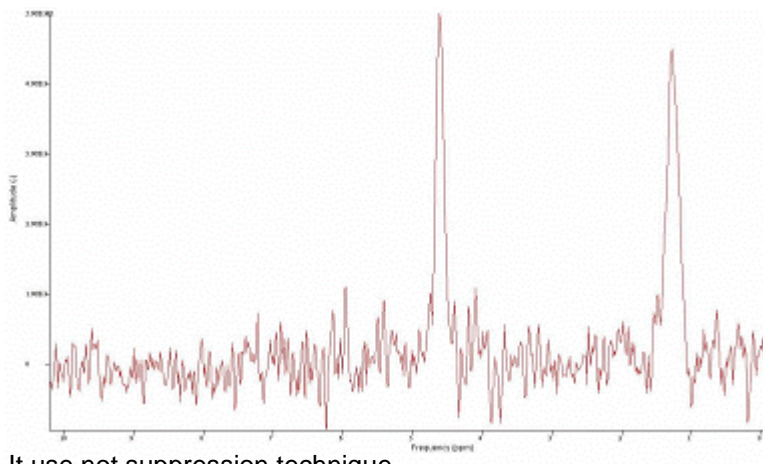
Code1-8-4 medium

29. Choose the right one that explain the effect of BOLD(blood oxygen level dependent).

- A. Deoxyhemoglobin has the longer T2 than oxyhemoglobin.
- B. Hemoglobin shows the metabolism variation of tissue according to the state of carbon dioxide combination.
- C. Deoxyhemoglobin shows paramagnetism more than oxyhemoglobin.
- D. Hemoglobin shows the metabolism variation of tissue according to the state of combination from oxygen.

Code1-8-3 medium

30. Choose the one that is right in the below graph.



- A. It use not suppression technique.
- B. It shows that one molecule has its own peak.
- C. It uses Hz that doesn't depend on the strength of a magnetic field.
- D. One can know various part information from CSI(chemical shift imaging).

Code1-4-5 medium

31. In order to obtain three-dimensional diffusion tensor images, in how many directions diffusion weighted imaging has to be done?

- A. 2 directions
- B. 3 directions
- C. 6 directions
- D. 9 directions

Code1-6-3 medium

32. Choose the correct about flip angle.

- A. In the case of  $TR > T1$ , the smaller the flip angle than 90 degrees, the bigger the MRI signals.
- B. The flip angle is set by RF-pulse frequency.
- C. In the case of  $TR > T1$ , MRI signals increase in reverse proportion to the flip angle.
- D. In Gradient echo technique, smaller flip angles mean contrast closer to T2 weighted imaging.

Code 1-4-5 medium

33. Choose the correct about EPI-Diffusion Weighted Imaging.

- A. White noise increases SNR of perfusion and diffusion imaging.
- B. Imaging distortion due to an eddy current normally occurs in the direction of phase encoding.
- C. The bigger the b-value, the more tissue signals.
- D. Hyper acute cerebral infarction is detected by low signals in DWI and high signals in ADC.

Code 1-1-2 medium

34. Choose the correct about Magnetic resonance image.

- A. B1 inconsistency, which is caused by the reduced length of RF waves, normally occurs in high magnetic fields.
- B. Magnetic resonance increases when T1 is longer than TR.
- C. The contrast of magnetic resonance images increases when NEX increases.
- D. Spin Echo signals decrease faster than FID signals.

Code 1-5-4 medium

35. Choose the correct about slope magnetic fields.

- A. Magnetic field gradients are overlapped repeatedly.
- B. Gradients change the magnetic field and eventually create changes in resonance frequency or phase.
- C. Phase encoding gradient is used to choose the interesting slice.
- D. After Fourier transforming, it has two peaks instead of one. One of the peaks refers to the voxel in the lower magnetic field, and the other refers to the voxel in the higher magnetic field.

Code 1-5-5 medium

36. The following is explanations about K space. Which is NOT true?

- A. It means space Fourier transformed from three-dimensional coordinates(x,y,z).
- B. It contains both information on contrast and each location and refers to a collection of raw data needed to create one image.
- C. The center of K space is represented by low-amplitude signals and has contrast information about tissues.
- D. The external part, which refers to low-amplitude signals corresponding to the phase axis and frequency axis, is filled with data quite capable of dismantling space and shows the boundaries between tissues.

Code 1-3-2 medium

37. What is NOT true about Larmor frequency and radio frequency?

- A. The gyromagnetic ratio increases in proportion to the strength of the magnetic field.
- B. They adjust the amount of energy they deliver by controlling RF frequency.
- C. Resonance is influenced by the intensity of the external magnetic fields( $B_0$ ).
- D. Resonance occurs only when the same radio frequency as the precessional frequency of a nucleus spin is applied.

Code 1-4-2 medium

38. What is NOT true about transverse decay?

- A. It is only caused by the inhomogeneity of a magnetic field device.
- B. Transverse magnetization decreases as soon as RF-pulse is interrupted.
- C. It means a decrease in magnetic resultant vector on x, y coordinates.
- D. It is caused by the inhomogeneity of local magnetic fields created by the nearby nucleus.

Code 1-4-4 medium

39. Which does NOT affect the signal intensity of blood flow during magnetic resonance imaging?

- A. Blood velocity
- B. Pulse sequence
- C. Cardiac gating
- D. FOV (field of view)

Code 1-4-5 medium

40. Choose the correct about "False-positive" phenomenon that can often be observed in diffusion weighted images.

- A. T1 effects
- B. T2 effects
- C. Anisotropy
- D. Magnetization transfer

Code 1-3-1 medium

41. Choose the correct about the basic principles of MRI.

- A. A decrease in magnetic resonance signals means a decrease in  $M_{xy}$ , a component of transverse magnetization.
- B. The T2 relaxation period is influenced by the size of molecules.
- C. The size of a magnetic resonance signal is proportional to the size of longitudinal magnetization right before high frequency pulses are applied.
- D. The T2 relaxation time is longer or the same as the T1 relaxation time.

Code 1-6-2 medium

42. Choose the correct about SPIR(spectral pre-saturation inversion recovery) technique and STIR(short tau inversion recovery)technique used in Fat suppression ?

- A. SPIR technique does not significantly affected by the  $B_0$  field inhomogeneity compared with STIR.
- B. SPIR the fat suppression technique is based on the chemical shift theory.
- C. After contrast injection do not acquire images with STIR technique, because to long scan time.
- D. The highest magnetic field, STIR technique is better than SPIR techniques to fat suppression.

Code 1-9-3 medium

43. Choose the correct about the SAR.

- A. TSE (turbo spin echo) technique, the SAR can be reduced by reducing the echo spacing.
- B. The SE (spin echo) sequence of the series can be lowered the SAR by reducing refocusing angle.
- C. Lower the slew rate of the Gradient can reduce the SAR.
- D. The higher flip angle of the excitation RF pulse can decrease the SAR.

Code 1-6-2 medium

44. Try to obtain a sagittal image of patients who received spinal fusion (spondylodesis) with surgical inflammation. Which is proper technique?

- A. SE T1WI
- B. TSE T1WI fat sat
- C. SPAIR T2WI
- D. STIR T2WI

Code 1-5-3 medium

45. Choose the correct about the signal from minimizing the strength of the Phase encoding gradient.

- A. Signal on the greatest impact on the resolution of the image.
- B. Increase the contrast of the image when obtained repeatedly.
- C. The smaller the most size of the signal obtained in k space.
- D. Signal receive the greatest effect on movement of the patient.

Code 1-4-5 medium

46. DWI is influenced from diffusion and T2 relaxation time due to T2 relaxation time long tissue is even apparent diffusion coefficient is high, it may receive high signal intensity on DWI. What is it?

- A. Magic angle effect
- B. T2 shine-through effect
- C. Heel effect
- D. Peak shift effect

Code 1-3-1 low



47. Which of the following best describes the Net magnetization?

- A. The excess number of hydrogen nuclei aligned opposite to the direction of the applied magnetic field (high energy state)
- B. The excess number of magnetic fields applied to the tissue
- C. The excess number of hydrogen nuclei spinning
- D. The excess number of hydrogen nuclei aligned in the direction of the applied magnetic field (low energy state)

Code 1-3-1 low

48. Which of the following components in the B1 field MRI system?

- A. Main magnet
- B. Gradient system
- C. Radiofrequency system
- D. Shim system

Code 1-3-1 low

49. What is Tesla in a Gauss?

- A.  $10^{-5}$
- B.  $10^5$
- C.  $10^{-4}$
- D.  $10^4$

Code 1-1-1 low

50. Choose the correct to a magnetic field strength of the permanent magnet.

- A. 0.5 ~ 1 T
- B. 3 ~ 7 T
- C. 0.06 ~ 0.35T
- D. 1 ~ 3 T

Code 1-5-3 medium

51. Which of following as the result expected is correct when increasing the number of Phase encoding step? (There is no change in the other imaging parameters).

- A. Decrease of image resolution.
- B. Decrease contrast of the image
- C. Decrease SNR of the image
- D. Decrease acquisition time of the image

Code 1-6-1

52. Normal Brain T1-weighted images in the TSE SE (spin echo) technique when acquired TSE(turbo spin echo) technique is correct about a change of image?

- A. Increase of contrast both white matter and gray matter
- B. Signal a decrease in fat in the ventricles (ventricle)
- C. The overall increased in the SNR of image.
- D. Magnetic susceptibility artifact decrease

Code 1-6-1 medium

53. The following is explanations about the process of obtaining space information, which is called spatial encoding medium. Which is NOT true?

- A. Magnetic field gradients are overlapped repeatedly.
- B. Gradients change the magnetic field and eventually create changes in resonance frequency or phase.
- C. Phase encoding gradient is used to choose the interesting slice.
- D. After Fourier transforming, it has two peaks instead of one. One of the peaks refers to the voxel in the lower magnetic field, and the other refers to the voxel in the higher magnetic field.

Code 1-2-2 high

54. Which of the following formulas related to the Faraday induction law?

- A. W/kg
- B.  $\omega_0 = B_0\gamma$
- C.  $\Delta V = \Delta B / \Delta T$
- D.  $B = \mu_0 H$

Code 1-4-4 low

55. Which of the following Gradient strength (amplitude) select the unit of measure?

- A. mT/M
- B. G/cm
- C. T/m/s
- D.  $\mu s$

Code 1-5-5 medium

56. Choose the correct about keyhole filling technique.

- A. Perfusion image
- B. Diffusion weighted image
- C. Contrast enhance image
- D. Functional MRI

Code 1-5-5 medium

57. Which is NOT true about K space?

- A. K space is an image.
- B. All the data points in K space have the information generated by partial slices.
- C. In K space, data are symmetric.
- D. The data obtained from the inner lines of K space contribute to signaling and contrast, whereas the ones from the outer lines contribute to resolution.

Code 1-1-4 medium

58. Choose the incorrect a task done by a gradient.

- A. Locate the slice on the selected scan page.
- B. Referring to the short anatomical axis, locate signals.
- C. Referring to the long anatomical axis, locate signals.
- D. Align the spins of the nucleus in the direction of the main magnetic field.

Code 1-8-1 low

59. Choose the more fast blood flow velocity?

- A. Aorta
- B. Carotid artery
- C. Cranial artery
- D. Femoral artery
- E. Vein

Code 1-8-1 low

60. Choose the correct the formula in blood flow and blood flow velocity? ( $v$ = average flow velocity,  $Q$ = volume,  $A$ = Cross-sectional area of the blood vessel).

- A.  $v = Q/A$
- B.  $A = Q \times v$
- C.  $v = Q + A$
- D.  $Q = v / A$

Code 1-8-1 low

61. Choose the closest flow related enhancement effect relationship.

- A. PC(phase contrast)
- B. TOF(time of flight)
- C. Contrast enhanced MRA
- D. Time resolved MRA

Code 1-8-1 low

62. Choose the incorrect MRA technique to reduce saturation effect.

- A. Increase flip angle
- B. Increase TR
- C. Use of Contrast enhanced MRA
- D. Use of MOTSA.
- E. Use of TONE

Code 1-8-1 low

63. Choose the incorrect explanation of contrast enhanced MRA.

- A. Less sensitive to the opposed phase
- B. It can be checked at high speed
- C. Without the use of contrast medium can be obtained MRA image
- D. There is no directional information

Code 1-7-3 low

64. Which is the parameter indicating the highest spatial resolution?

- A. 256X256, 3mm slice thickness, 12cm FOV, 1 NEX
- B. 256X256, 6mm slice thickness, 24cm FOV, 2 NEX
- C. 512X512, 3mm slice thickness, 12cm FOV, 2 NEX
- D. 128X128, 3mm slice thickness, 12cm FOV, 1 NEX

Code 1-7-4 low

65. In case, signal average is increased by two times. How can SNR be changed?

- A. 2 times increase
- B. 1/2 increase
- C. 1/4 increase
- D.  $\sqrt{2}$  increase

Code 1-9-3 medium

66. Which is correct to decrease SAR?

- A. FOV 20% increase
- B. Increase number of ETL
- C. Increase TR
- D. Increase flip angle

Code 1-9-1 medium

67. Which of the following is correct?

- A. In order not to get the patient hands hurt patient both hands must be hold at the same time
- B. Pacemakers recently inserted are MRI safe and screening is not needed.
- C. 5 Gauss line should be set outside of the MRI room.
- D. More attention is needed in EPI sequence than the SE sequence in PNS(peripheral nerve stimulation)

Code 1-7-3 high

68. Matrix size 4X4, slice thickness 10mm, FOV 40mm. When FOV is changed from 40mm to 20mm, how to SNR?

- A. Increased 50%
- B. Decreased 50%
- C. Decreased 25%
- D. Decreased 75%

Code 1-8-3 high

69. Which is the metabolic material not to be detected long TE in brain MR spectroscopy?

- A. ml(myoinositol)
- B. NAA(N-acetyl aspartate)
- C. Cho(Choline)
- D. Lac(Lactate)

Code 1-7-13 medium

70. What makes TR when use ECG triggering?

- A. The number of phase encoding
- B. Depends on user
- C. The number of frequency encoding
- D. Patient's heart rate

Code 1-7-6 medium

71. Which of the following is correct, when receiver bandwidth is reduced?

- A. Decreased SNR, decreased noise
- B. Increased SNR, decreased noise
- C. Decreased SNR, increased noise
- D. Increased SNR, increased noise

Code 1-10-1 low

72. Which is not correct about the "Crosstalk artifact"?

- A. This artifact occurs when the RF profile is narrower than the slice profile.
- B. This artifact occurs a result of this the adjacent slices overlap.
- C. This artifact can be eliminated by using the sequential acquisition technique.
- D. Tissue in that overlapping region results in increased signal intensity.

Code 1-7-3 medium

73. If a matrix 256\*128, FOV 24cm, slice thickness 3mm which is voxel volume?

- A. 3.57 mm<sup>3</sup>
- B. 5.27 mm<sup>3</sup>
- C. 1.875 mm<sup>3</sup>
- D. 0.9375 mm<sup>3</sup>

Code 2-3-1 medium

74. There is spin and spin quantum number explanation. What is true?

- A. <sup>1</sup>H has spin quantum number 1/2, -1/2.
- B. <sup>1</sup>H has 1/2 and -1/2 a dipole energy state, a nucleus spin 2
- C. <sup>1</sup>H, <sup>13</sup>C, <sup>19</sup>F, <sup>31</sup>P has integral spin
- D. A nucleus of quantum number 1 has -1,1 of two energy state

Code 1-8-1 medium

75. Which is the residual spin spoiling method with strong gradient spoiler without refocusing M<sub>xy</sub> component that remains in the x-y plane?

- A. FLASH(Fast Low Angle Shot)
- B. SE(spin echo)
- C. FISP(Fast Imaging with Steady Precession)
- D. TSE(Turbo spin echo)

Code 1-3-3 medium

76. There is receive bandwidth and SNR explanation. What is true?

- A.  $SNR \propto \sqrt{\text{old bandwidth} / \text{new bandwidth}}$
- B. Widen receive bandwidth, higher SNR
- C. Widen receive bandwidth, higher TE(echo time)
- D. Widen receive bandwidth, increased chemical artifact

Code 1-7-5 medium

77. What is name of gradient, which is variable amplitude in TR?

- A. Slice selective gradient
- B. Frequency encoding gradient
- C. Phase encoding gradient
- D. Phase and Frequency encoding gradient

Code 1-9-3 medium

78. Which is method to decrease SAR(Specific Absorption Rate)?

- A. Shorten TR
- B. Shorten TE.
- C. Decrease flip angle.
- D. Increase the number of excitations

Code 1-10-1 medium

79. What is name of artifact used to small FOV in over loaded gradient echo?

- A. Shading Artifact
- B. Aliasing Artifact
- C. Zebra stripe Artifact
- D. Magnetic susceptibility Artifact

Code 1-1-1 medium

80. Which of the following is a true explaining about wash-out effect?

- A. Blood signal is darken at T2 spin echo
- B. Blood signal is brighten at GE echo
- C. Blood signal is darken at T1, brighten at T2
- D. Blood vessel signal is not relate of slice thickness

Code 1-4-4 high

81. Which is not true about flow enhancement effect?

(V : velocity, Dz: Slice thickness, Mz: transverse magnetization)

- A. In  $V = 0$ , produce a signal lesser than the saturated Mz.
- B. In  $V < Dz/TR$ , some part of the signal is larger than Mz and some other part of the signal is smaller.
- C. In  $V = Dz/TR$ , produce a signal greater than Mz.
- D. In  $V > Dz/TR$ , produce a greater signal in proportion than those of  $V = Dz / TR$

Code 1-7-8 medium

82. Which is the true in 3D method?

- A. Phase encoding gradient is added to the direction of slice selection gradient.
- B. Slice selection gradient is added to the direction of slice encoding gradient.
- C. Frequency encoding gradient is added to the direction of slice encoding gradient.
- D. Phase encoding gradient is added to the direction of frequency encoding gradient.

Code 1-8-5 high

83. Which is the metabolic material hypoxic ischemic encephalopathy in brain MR spectroscopy?

- A. N-acetylaspartate
- B. Creatine
- C. Glutamate
- D. Choline

Code 1-8-1 low

84. What is the not concern about CE-MRA?

- A. Bolus track
- B. Time resolved MRA
- C. Test dose
- D. Flow related enhancement

Code 1-5-3 medium

85. Which is correct in Frequency encoding and phase encoding of the description?

- A. Frequency encoding is changed in every TR.
- B. The increase in the number of frequency encoding, the spatial resolution increases.
- C. The frequency is used to find out the position of the magnetic resonance signal
- D. In phase encoding.

Code 1-8-1 medium

86. What is the suitable VENC velocity encoding at circle of willis(3D PC MRA)?

- A. 5cm/s
- B. 10~30cm/s
- C. 30~45cm/s
- D. 60~80cm/s

Code 1-4-6 high

87. Which of the following is a right explaining about magnetization transfer(MT)?

- A. MT is energy chemical exchange between free water of tissue proton and fat proton
- B. It is used of reduce for background noise at TOF
- C. Resolution increase of 3D TOF
- D. It is increased of free water of tissue proton signal



Code 1-4-4 medium

88. Which of the following is factor of not increase wash-out effect in spin echo?

- A. Increase of blood velocity
- B. Increase of TR
- C. Increase of TE
- D. Decrease of slice thickness

Code 1-7-9 medium

89. Ernst angle is \_\_\_\_\_?

- A. Increasing SNR in low flip angle.
- B. The flip angle making maximum signal.
- C. Almost T2WI (flip angle>Ernst angle)
- D. Almost T1WI (flip angle>Ernst angle)

Code 1-4-1 medium

90. Choose the correct about T1 relaxation tissue

- A. Malignancy tissue almost short T1 relaxation time.
- B. Macro molecular of proton difficult signal detection because of decay T1 relaxation time and transverse magnetization too fast.
- C. Likely CSF(central spinal Fluid) very short T1 relaxation time 100~200msec
- D. Soft tissue T1 relaxation time longer than CSF(central spinal Fluid)