

## Lesson 12: MRI image quality

# Aims

- Learning the effective parameters on MRI image quality.

# MRI image quality

- Signal to noise ratio (SNR)
- Contrast to noise ratio (CNR)
- Spatial resolution
- Scan time

# Signal to noise ratio (SNR)

- SNR may be increased by using:
  - 1) Spin echo (SE) and fast spin echo (FSE) pulse sequences
  - 2) A long repetition time (TR)
  - 3) A short echo time (TE)
  - 4) A flip angle of  $90^\circ$

## SNR (continue)

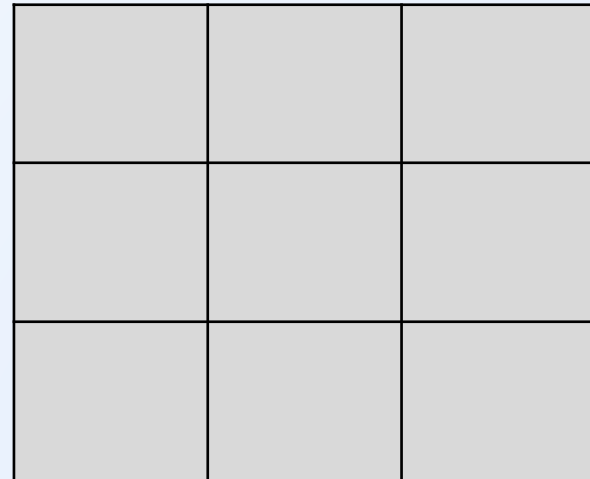
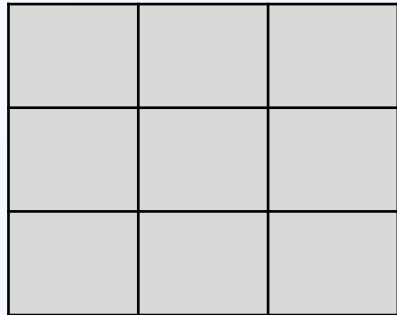
5) A large pixel size

(Pixel size = FOV/matrix size)



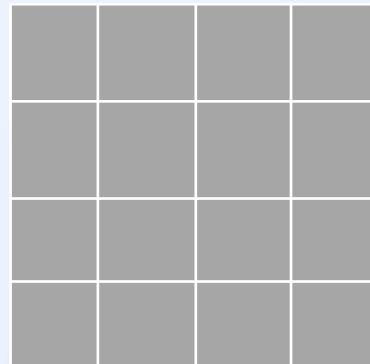
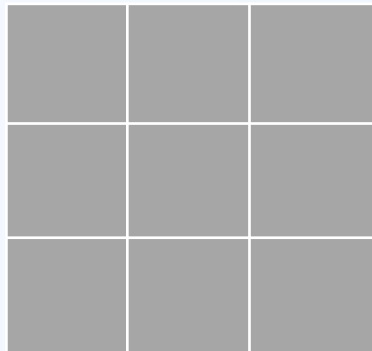
## SNR (continue)

6) A large FOV



## SNR (continue)

- 7) A smaller matrix size →
- A larger pixel size
- For example, a matrix size of  $256 \times 256$  contains larger pixels than that of  $512 \times 512$  matrix.



## SNR (continue)

- 8) Thick slices
- 9) A correctly sized coil
- 10) As many number of excitations/signal averages (NEX/NSA) as possible
  - NEX (the number of times we repeat the whole sequence)



# Contrast to noise ratio (CNR)

- The difference in the SNR between two adjacent areas.
- It is controlled by the same factors that affect the SNR.

# CNR

- CNR can be increased by:
- Administration of contrast agents
- Utilization of T2 weighted sequences
- Suppression of normal tissues

# Spatial resolution

- The ability to distinguish between two points as separate and distinct.
- It is controlled by the voxel size.

# Spatial resolution

- Spatial resolution may be increased by selecting:
- Thin slices
- Large matrix size
- A small FOV

# Scan time

- The time required to complete the acquisition of data.
- Longer scan time → ..... image quality
- lower

# Acquisition time

- Acquisition time =  $(TR)(N_y)(NEX)$
- The acquisition time depends on:
  - TR
  - $N_y$  (the number of phase-encoding steps)
  - NEX (the number of times we repeat the whole sequence)
- Acquisition time =  $(TR)(N_y)(NEX)/ETL$

# Example

- $TR = 1000 \text{ msec}$ ,  $N_y = 256$ ,  $NEX = 1$
- Acquisition time = ?
- Acquisition time =  $(TR) (N_y) (NEX)$   
=  $(1000 \text{ msec}) (256) (1)$   
=  $256 \text{ sec}$   
=  $4.27 \text{ min}$

# Summary

- Effective parameters on MRI image quality:
- Signal to noise ratio (SNR)
- Contrast to noise ratio (CNR)
- Spatial resolution
- Scan time



# References

- Westbrook C, Handbook of MRI technique, Blackwell Science, Second edition