Tips and tricks to optimize preinterventional imaging with CO2 angiography and no-contrast MR angiography

Jos C. van den Berg, MD PhD
Ospedale Regionale di Lugano, sede Civico
University of Bern
Switzerland
Disclosure

Speaker name:

I have the following potential conflicts of interest to report:

☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☐ I do not have any potential conflict of interest
Zero Contrast Procedures

• Use of non-enhanced MRA and CO$_2$ angiography for work-up
  – (EVAR)
  – Peripheral applications
Iodinated contrast

- Nephrotoxicity
- Allergic reactions

Gd-based contrast

• Occurrence of nephrogenic systemic fibrosis
• Nephrotoxicity
  – Various case reports of acute renal failure at high dose
  – Safe in dosage <0.4 mmol/kg

Gemery et al, AJR 1998; 171:1277-1278
Kaufman et al, Radiology 1999; 212:280-284
Le Blanche et al, AJR 2002; 179:1023-1028
Roserioreanu et al, JVIR 2005;16:297-298
Nyman et al, Radiology 2002; 223:311-318
MRA without contrast

• In-flow techniques (TOF)
  – Limited FOV
  – Susceptible to artifacts

Wheaton AJ et al JMRI 2012;36:286–304
MRA-QISS

Figure 1: Diagram of QISS pulse sequence. A two-dimensional single-shot balanced steady-state free precession (bSSFP) pulse sequence is used to image arterial spins within the section during diastole, when flow is slow or absent. $k_y$ = phase-encoding line, $QI$ = quiescent interval, $\alpha/2$ = one half the radiofrequency excitation flip angle.
MRA-QISS

Edelman RR et al, Magnetom Flash 2014
QISS vs. CE-MRA PAD
QISS vs. CE-MRA PAD
QISS vs. CE-MRA PAD
QISS vs. CE-MRA PAD

QISS

CE-MRA

[Images of blood flow comparisons]
QISS MRA vs. CE-MRA
QISS-MRA vs. CTA vs. DSA

- QISS-MRA provides high diagnostic accuracy compared with DSA
- QISS-MRA less prone to image artifacts than CTA
- QISS-MRA better visualizes heavily calcified segments with impaired flow
- QISS-MRA obviates the need for contrast administration in PAD patients
- QISS and QIR/ECG-FSE MR angiography protocols demonstrate comparable diagnostic accuracies with high specificity
- In segment-based analyses, there was no difference between QISS-MRA and CE-MRA in sensitivity or specificity

Varga-Szemes A et al, JACC Cardiovasc Imaging 2017;10:1116-1124
Hanrahan CJ JVIR 2018;29:1585-1594
Wei LM, JET 2019;26:44–53
CO$_2$ angiography

- Lack of toxicity or allergic reactions
- Rapid intravascular clearance
- Buoyancy (potentially disadvantageous)
- Ultra-low viscosity/density
- Reflux (ostial depiction)
- Nonmiscibility (fluid displacement)
- Colorless and odorless (potentially dangerous with ‘old technology’)
- Compressibility (pressure build-up)

Sharafuddin MJ et al JVS 2017;66:618-637
Old technology
Hand-held injector
Automated CO$_2$ injector

Angiodroid
Case #1

Use ‘stacking of images’
Case #1

Use ‘stacking of images’
Case #2

- Severe iodine allergy
Case #2
Case #2

- Balloon inflation with Gd
Case #2

- Balloon inflation with Gd
- Balloon rupture!
Case #2
Conclusions

• Current technology (non CE-MRA and CO$_2$ angiography allows for zero-contrast procedures for peripheral arterial endovascular procedures

• Think about
  – ‘image stacking’
  – Use of Gd for balloon filling in allergic patients

• MORE CO$_2$!
MORE CO$_2$!
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