Optimisation of angioplasty workflow for CO2-angiography in patients with kidney impairment

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Disclosure

Speaker name: Ulf Teichgräber, MD, MBA

Potential conflicts of interest related to the presentation:
- Research grant, honoraria: Siemens Healthcare, Angiodroid

Potential conflicts of interest not related to the presentation:
- Master research agreements with Siemens Healthcare, GE Healthcare
Physical principles
Carbon-Dioxide

- very high compressibility and very low viscosity
- approximately 20 times higher solubility in blood than for example O₂
- dissociates in plasma quickly into H⁺ and HCO₃⁻
- very quick elimination via the lung (12-15 sec after i.v. injection)
- Positive contrast in DSA
Indications and advantages over iodinated contrast mediums

- Acute or chronic kidney impairment
- Allergies against iodated contrast media
- Hyperthyreosis
- Search for bleedings or endoleaks (because of the higher viscosity and better spreading)
- Better filling of collateral vessels and small vessels
- Cheapest contrast medium
Disadvantages and contraindications

- decreased or non-contrastation of dorsal laying vessels
- Trendlenburg position (head down)
- „vapor lock“ as a result of high injected volumina
- no usage cranial the diaphragma (expect forearm, dialysis shunts)
- pulmonal AV-malformations, (atrial-) or vetricleseptum defects
Unwanted side effects and complications

- nausea, vertigo and probably vomiting
- paresthesia
- pain in distal extremities
- tachycardia
- CO$_2$-acidosis
- vapor-lock
- livedo reticularis
- diarrhea
Precautions during the application of CO₂

- application of maximum 100 ml per series
- interval of at least 1 min between series
- avoid application upper the diaphragma
- left side position when overdosed (CO₂ can better diffuse to right atrium and ventricle)
- lay down the legs if heavy pain occurs
maximal dosage of CO₂

- Aorta abd. 60-100 ml
- Iliac arteries 40-80 ml
- Kidney arteries 20-40 ml
- Mesenterial arteries 20-40 ml
- HD-Shunts 20 ml
- TIPSS 20-40 ml
- Venous 20-40 ml
- Brachial arteries 20 ml
Angiodroid CO² Injector
Connection to the catheter
Siemens Artis zeego Q
HDR Detektor

GIGALIX X-ray tube
Even Flow CO$_2$ Protocol
Even Flow CO² Protocol

Special DSA acquisition for CO²:
- Frame rate of 7.5 p/sec
- Computation of moving average of all images of the series
- Results in a high contrast image without bubbled gas
1st example

- kidney transplantation
- massive hypertonus because of a stenosis of the kidney artery
- PTA and Stenting
2nd example

- PAD
- Rutherford III
- Occlusive lesion left SFA (TASC II C)
Guide-Wire-Passage
PTA Luminor 5 x 150mm
PTA Luminor 5 x 150mm
Post-PTA
Post-PTA
Run-Off BTK
On going RCT

- RCT CO$_2$ vs. iodinated contrast media
- Inclusion criteria:
  patients without kidney impairment and planned peripheral artery intervention of the lower extremity
Recruiting of patients with indication for an intervention of the peripheral arterial vessels of the lower extremity without contraindication especially **without kidney disease**

Inclusion and randomisation

**Diagnostic angiography with iodinated contrast**

Intervention and outflow with CO2

**Diagnostic angiography with CO2**

Intervention and outflow with iodinated contrast

Evaluation of the CO2-angiography and iodinated comparative series of target limbs with a **quantitative graduation** tool of the angiosuitesoftware
Prospectives

Aim:

• Evaluation and comparison of the image quality of iodinated CM and CO₂

• If the results show a non-inferiority of the image quality of CO₂, we will try to establish CO₂ as the primary contrast medium
Conclusions

• Improved workflow
  • table tracking aligns the C-arm movements automatically to the table position
  • Movement of the C-arm without any table movement (“frozen patient position”)

• Enhanced image quality for CO$_2$
  • GIGALIX x-ray tube (high spatial resolution)
  • HDR detector (enhanced contrast, dose efficiency)
  • Even Flow (automatic summation of images results in less bubbled gas and imaging excellence)
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