The utility of carbon-dioxide angiography in peripheral interventions

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Disclosure

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I have the following potential conflicts of interest to report:

✔ Consulting Fees, Honoraria, Research Grants, Advisory Boards

B Braun Melsungen, C. R. Bard, Celonova, Endoscout, Fresenius Kabi, GE Healthcare, iVascular, Medkomp, Philips Healthcare, Siemens Healthcare, Spectranetics, Terumo Medical Corporation, W. L. Gore
Physical principles
Carbon-Dioxide

- very high compressibility and very low viscosity
- approximately 20 times higher solubility in blood than for example $O_2$
- dissociates in plasma quickly into $H^+$ and $HCO_3^-$
- very quick elimination via the lung (12-15 sec after i.v. injection)
- Positive contrast in DSA
Indications und 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
- Trendelenburg 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
- CO₂-acidosis
- vapor-lock
- livedo reticularis
- diarrhea
Precautions during the application of CO₂

- application of maximum 100ml per series
- interval of at least 1 min between series
- avoid application upper the diaphragma
- left side position when orderedose (CO₂ can better diffuse to right atrium and ventricle)
- lay down the legs if heavy pain occur
maximal dosis 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
OptiMed CO₂ Angioset
Siemens Artis zeego Q
HDR Detektor

GIGALIX X-ray tube
Even Flow CO$_2$ Protocoll

- DSA Frame rate with 7.5 P/sec.
- Summation of up to 7 Images into one
- 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
post dilatation (post dila)
Radix 5x17mm

Window/Level: 4095 / 2047

Series Description: CO2_evenflow
2nd example

- CKD V
- ulcera tooth on both sides and backfoot right
Conclusions

• Improved workflow
  • table tracking aligns the C-arm movements automatically to the table position
  • Movement of the C-arm only 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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