Technical solutions, and clinical utility of CO2 angiography

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Disclosure

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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 $O_2$
- 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 and advantages over iodinated contrast mediums

- Acute or chronic kidney impairment
- Allergies against iodinated 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 ventricleseptum 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 100ml per series
- interval of at least 1 min between series
- avoid application upper the diaphragma
- left side position when overdose (CO₂ can better diffuse to right atrium and ventricle)
- lay down the legs if heavy pain occur
maximal dosis of CO$_2$

- 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 CO$_2$ Protocol

Special DSA acquisition for CO$_2$:
- Frame rate of 7.5 p/sec
- Computation of moving average of all images of the
- Results in a high contrast image without bubbled gas
1st example

- kidney transplatation
- massive hypertonus because of a stenosis of the kidney arterie
- PTA and Stenting
2nd example

- PAOD
- Occlusive lesion R SFA (TASC II D)
- Heavily calcified
AFTER LASER ARTERECTOMY
SUPERA STENT IMPLANTATION
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 CO²
  • 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)