Feasibility of CO$_2$-Angiography for EVAR in Patients with Chronic Kidney Disease

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Disclosure

Speaker name:

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I do not have any potential conflict of interest
CIN = Contrast-induced acute kidney injury (= CIAKI)

- ≥ 25% increase in baseline SCr 3 days after CM exposure
- associated with ↑ morbidity, mortality, hospital stay
- at risk: chronic kidney disease (>7-fold) + diabetes mellitus (>5-fold), age, PCI, gender (♀, ≥ 65 y)
- ATN: vasoconstriction & direct cytotoxic effects of CM

No specific treatment of CIN!

The best TX: PREVENTION!

- N-Acetylcysteine, Sodium Bicarbonate: conflicting data*
- iso-osmolar, low-osmolar, non-ionic contrast media**
- prophylactic volume expansion***
- lowest dose of CM consistent with a diagnostic/Tx result

* Brar SS et al. CliBrown JR et al. JACC 2009
** Aspelin P et al, NEJM 2003
*** Kotlyar E et al. Heart Lung and Circulation 2005
Carbon Dioxide (CO$_2$) Angiography

1914 CO$_2$ first described as contrast agent by E. Rautenberg & P. Rosenstein

Dtsch Med Wschr 1914; 40: 1205–1208
Zschr Urol 1921; 15: 447–458

1940 Venous application by RM. Moore

Ann Surg 1940; 112: 212–218

1980 Arterial application by FJ. Miller


How? CO$_2$ rapidly dissolves into the target blood vessel whereafter displacing the blood pool, a negative X-ray image can be produced outlining the lumen

Disadvantages
- Cardio Toxicity
- Neuro Toxicity
- Vapor-Lock-Syndrom (trapping of CO$_2$ at the origin of vessels), air embolism resulting in bowel ischemia, tissue infarction, or stroke
Endovascular Therapy by CO$_2$ Angiography to Prevent Contrast-Induced Nephropathy in Patients With Chronic Kidney Disease: A Prospective Multicenter Trial of CO$_2$ Angiography Registry


**Methods**
- CO$_2$ DSA-guided EVT; incomplete CO$_2$ DSA supplemented by IVUS, pressure wire, and/or minimal iodinated contrast media (IC)
- 98 pats w 109 lesions: renal (n=16), aortoiliac (n=31) fem. (n=62)
- eGFR baseline was 35.26±12.7 ml min$^{-1}$

**Results**
- The technical success rate was 97.9%
- Mean CO$_2$ volume = 281.46±155.8 ml, IC volume = 15.0±18.1 ml
- CIN was 5.1% (5/98)
- complications, mostly transient leg/abdominal pain in 17.3% (17/98)
- Two cases (2%): severe, nonocclusive mesenteric ischemia

**Conclusions** This trial showed that CO$_2$ angiography-guided angioplasty was effective for preventing CIN, however, its related complication was somewhat high
The only one CO$_2$-angiography device on the market 100%

- DIGITAL
- AUTOMATIC
- SAFE
- USER FRIENDLY

Aorta abd. 60-100 ml
Iliac artery 40-80 ml
Femoral Artery 20-60 ml
Injection pressure comparison...

Injection Pressure (mmHg)

Time (s)

Manual Kit
EVAR - renal failure due to CIN

- Reported in ~10% of cases, often transitory

- EVAR I and II trials: the rate of decrease in GFR following EVAR is slow, the increased rate in renal function deterioration is associated with endograft complications
  

- Renal failure itself is associated with a significant increase in hospital mortality
  
  *Song CV et al. Vasc Endovasc Surg 2008;42:427-32*
  

- Evaluate Creatinine levels for patient’s renal function and determine appropriate imaging modalities
EVAR - renal failure
72 y o male w. Chronic Kidney Disease

eGFR baseline: 25.10 ml min⁻¹
72 y o male w. Chronic Kidney Disease
72 y o male w. Chronic Kidney Disease
72 y o male w. Chronic Kidney Disease
72 y o male w. Chronic Kidney Disease
EVAR with carbon dioxide-guided angiography in patients w renal insufficiency


Methods - recorded data, **114** consecutive EVAR patients: 72 using CO$_2$, 42 using CO$_2$ + iodinated contrast (IC)
- additional arterial embolization in 16 cases

Results - **100%** successful graft deployments, no surgical conversions
- 20 Endoleaks identified (2 type 1, 16 type II, 2 type IV) and three unintentionally covered arteries
- operative time: (17 CO$_2$ 7 vs 194 m; \( P < .001 \)); fluoroscopy time: 21 vs 28 min; \( P = .002 \)), IC volume lower (37 vs 106 m \( P < .001 \))

Follow-up  CTA at 1, 6 & 12-month showed **well-positioned SG** with the expected patent renal and hypogastric arteries in **all patients** & no difference in endoleak detection compared w the IC-EVAR group.
71 y o male w. Chronic Kidney Disease

eGFR baseline: 35.7 ml min\(^{-1}\)
71 y o male w. Chronic Kidney Disease

AAA, Aneurysm of the right Common Iliac Artery
71 y o male w. Chronic Kidney Disease
71 y/o male w. Chronic Kidney Disease
71 y o male w. Chronic Kidney Disease

D.D. Do, Cardiance Clinic, Switzerland
71 y o male w. Chronic Kidney Disease
CO\textsubscript{2} Angiography - Summary

- CO\textsubscript{2} Angiography for EVAR is safe (no known renal or systemic toxicity, non-allergenic) and feasible to localize the renal as well as hypogastric artery
- CO\textsubscript{2} angiography is more sensitive to identify endoleaks
- Indications: in pats with pre-existing renal insufficiency or severe allergy to conventional contrast agent
- To avoid complications / to get best images: position of the patient, meticulous injection technique (rate, time interval …)
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