CO2 Digital Angiography in Venous Diagnosis and Intervention

Hector Ferral, MD

Senior Clinician Educator
Section of Interventional Radiology
NorthShore University HealthSystem
Evanston, IL

NCVH
New Cardiovascular Horizons

19th Annual Conference

2018

May 30 - June 01

THE PERIPHERAL EVENT OF THE YEAR

Disclosures

- Consultant for Terumo
- Consultant for Gore
- Consultant for Cook Medical
- Teaching and training team for BTG
- Teaching and training team for BD

CO_2 in venous diagnosis and intervention

- **CO_2 is excellent for venous work**
- Particularly useful in selected cases
  - End stage renal disease patients who are not on dialysis
  - Dialysis patients who still make urine
  - Patients with severe contrast allergy, refractory to medication
  - Portal and mesenteric venous intervention

Basic rules for CO_2 in venous work

- *CO_2 does not behave like contrast*
  - Understand the behavior of the gas
  - Review images carefully
  - CO_2 does not always follows flow
- Gentle injection works much better
- Large volumes: not necessary (10-15 ml/injection)
- Always purge the catheter before injecting
- Use a reliable, low pressure CO_2 source

CO_2MMANDER- Reliable, low pressure CO_2 source

Diagnostic Venography

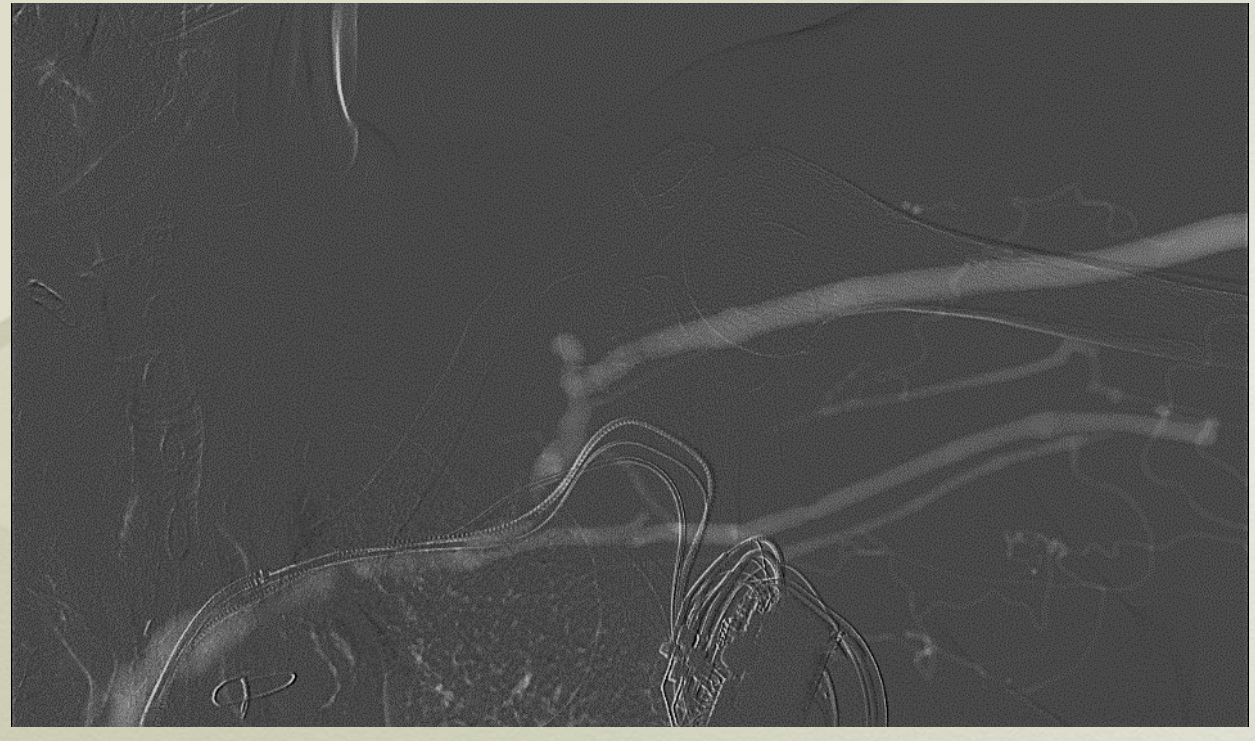
CO_2 in venous diagnosis and intervention

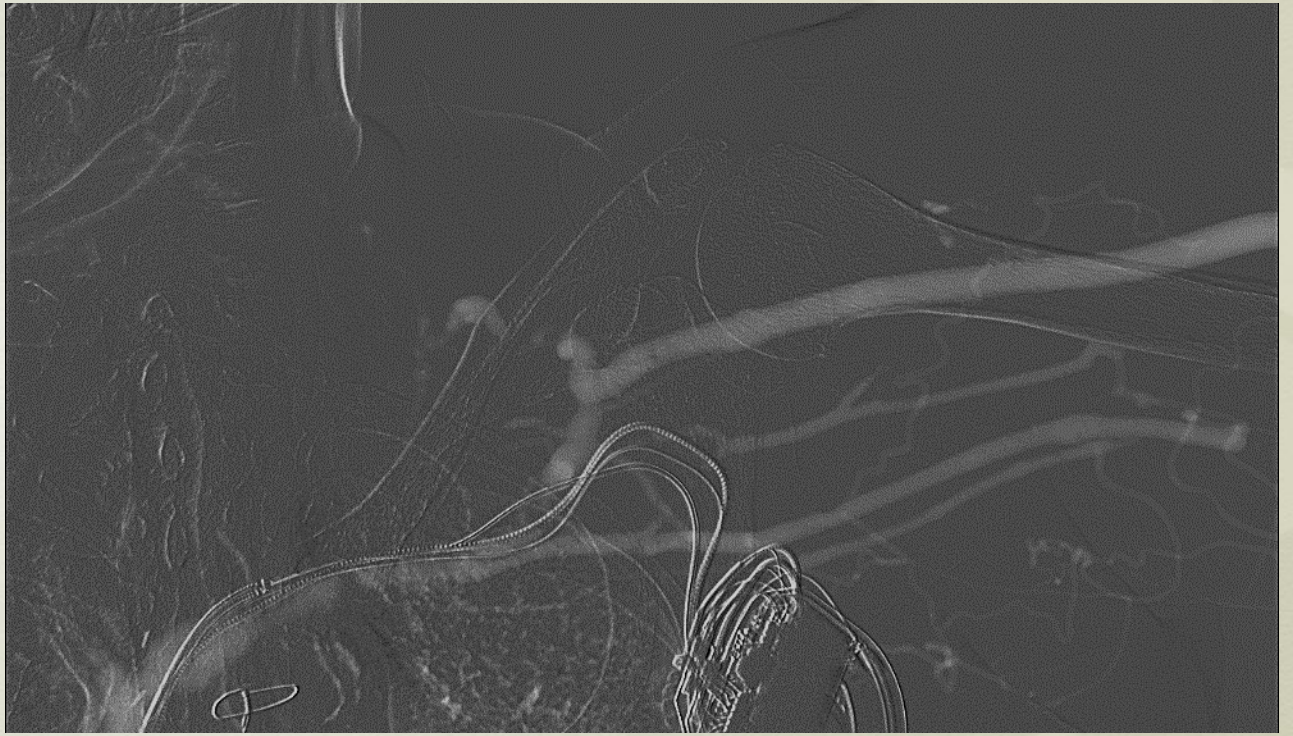
- **Diagnostic venography**
- Work-up for AV access creation
- Patients with end stage renal disease
- **Not on dialysis**
- History of previous catheterizations
- History of co-morbidities

Diagnostic Venography-Technique

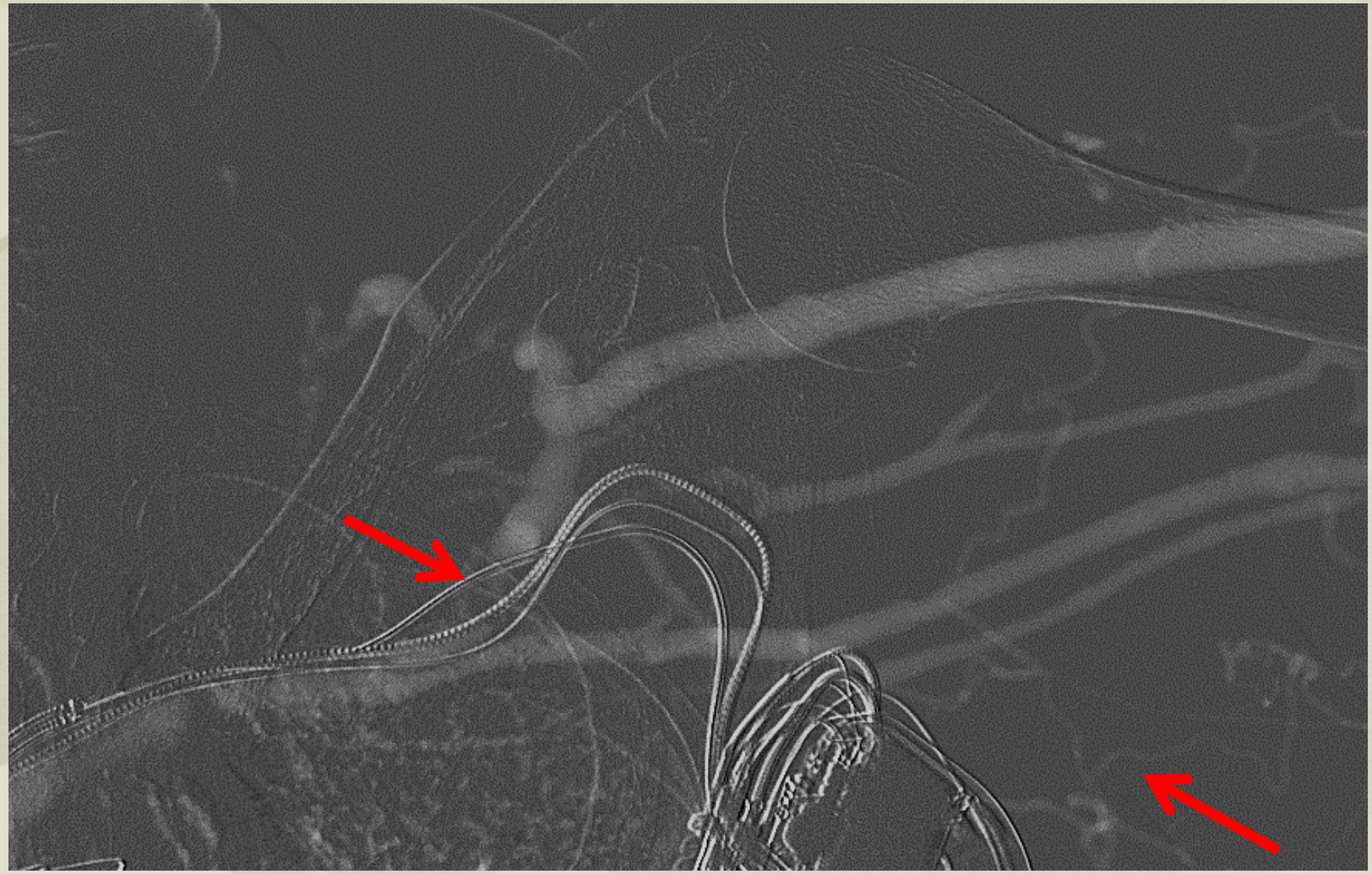
- May use a very small IV (20/22 gauge)
- Inner dilator of a micropuncture set
- Very gentle injection of 10-15 ml of CO_2
- Multiple views can be obtained
- DSA works better

Diagnostic venography





Diagnostic venography



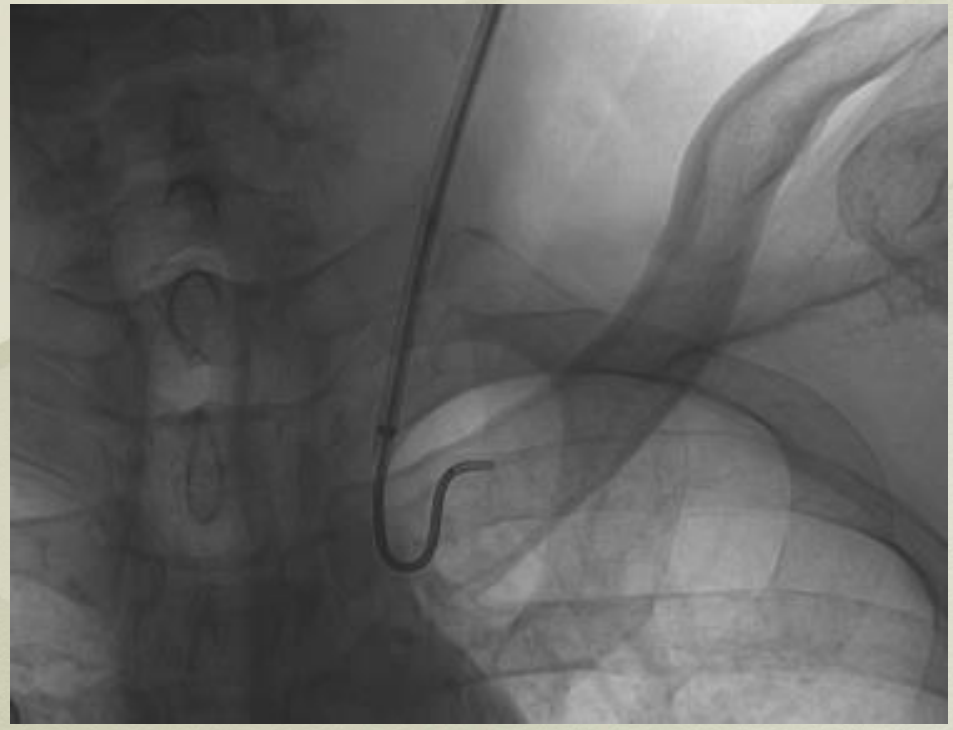
Contrast Adverse Reactions

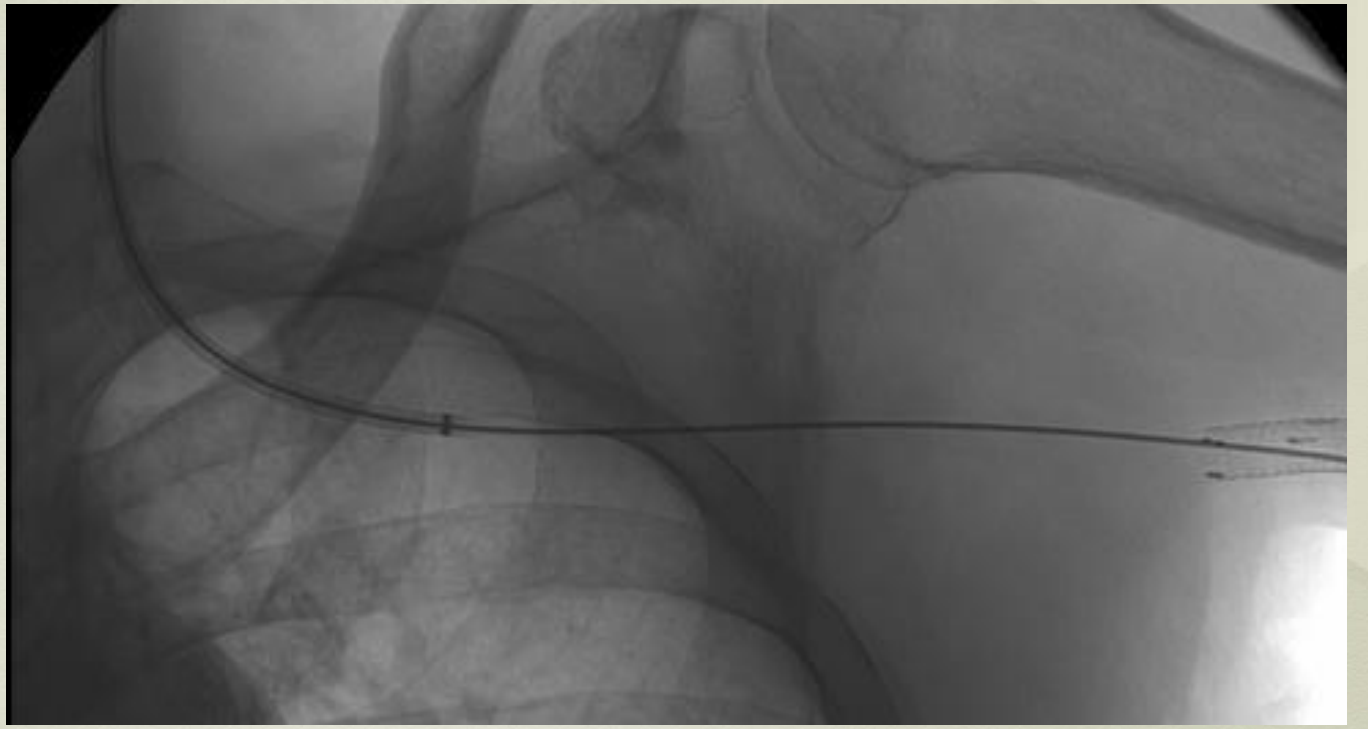
Contrast adverse reactions

- Adverse reactions to non-ionic contrast occur in 5-15% of patients *
- True allergic reactions are rare, in the order of less than 1%
- Most severe reactions occur within 20 minutes of administration
- Few patients have “delayed” reactions
- Most patients do well with premedication
  - Steroids and anti-histamines
- Small group of patients do not respond to premedication
  - Severe reactions
  - True contraindication to the administration of intravascular iodinated contrast

* ACR- Manual on contrast media , 2016

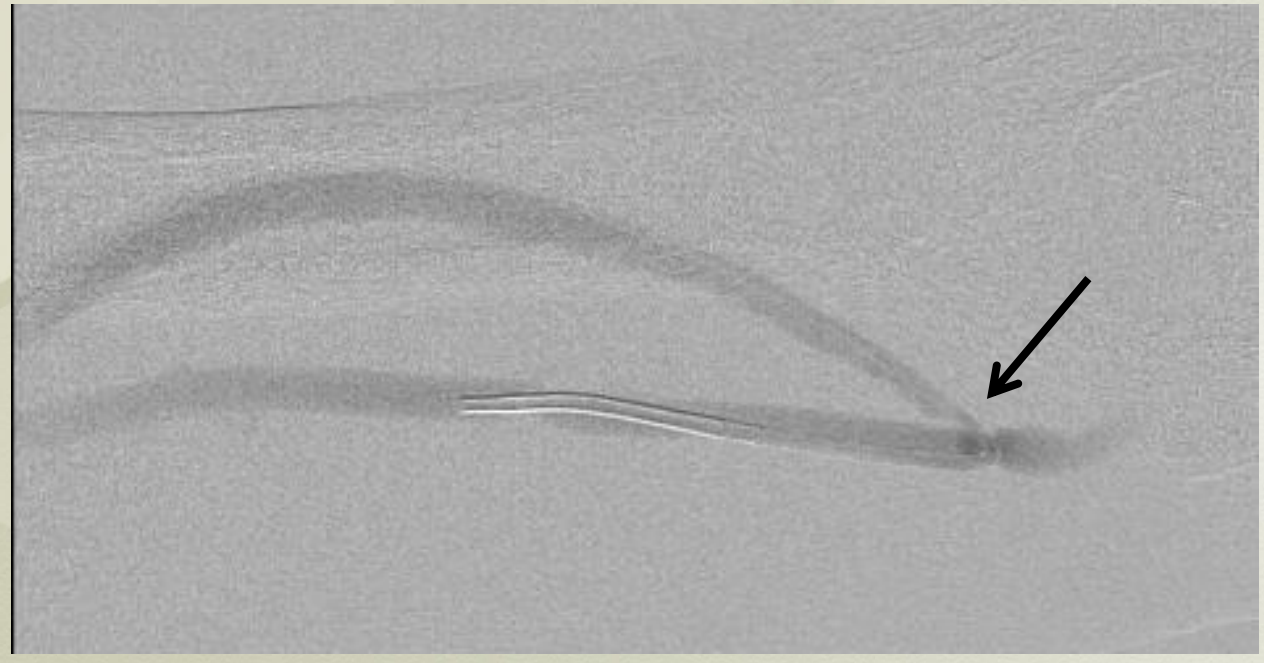
Contrast adverse reactions





74 year old man with severe contrast allergy
Presents with AV fistula in the left upper extremity with poor flows
Procedure performed via a transjugular approach using CO2

Contrast adverse reactions



Portal and Mesenteric Venous Intervention

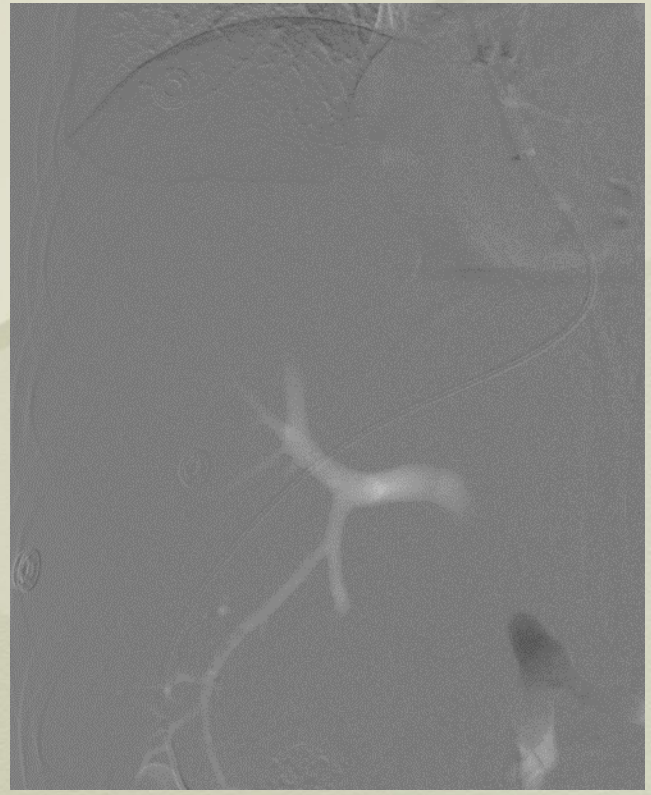
Portal and mesenteric venous intervention

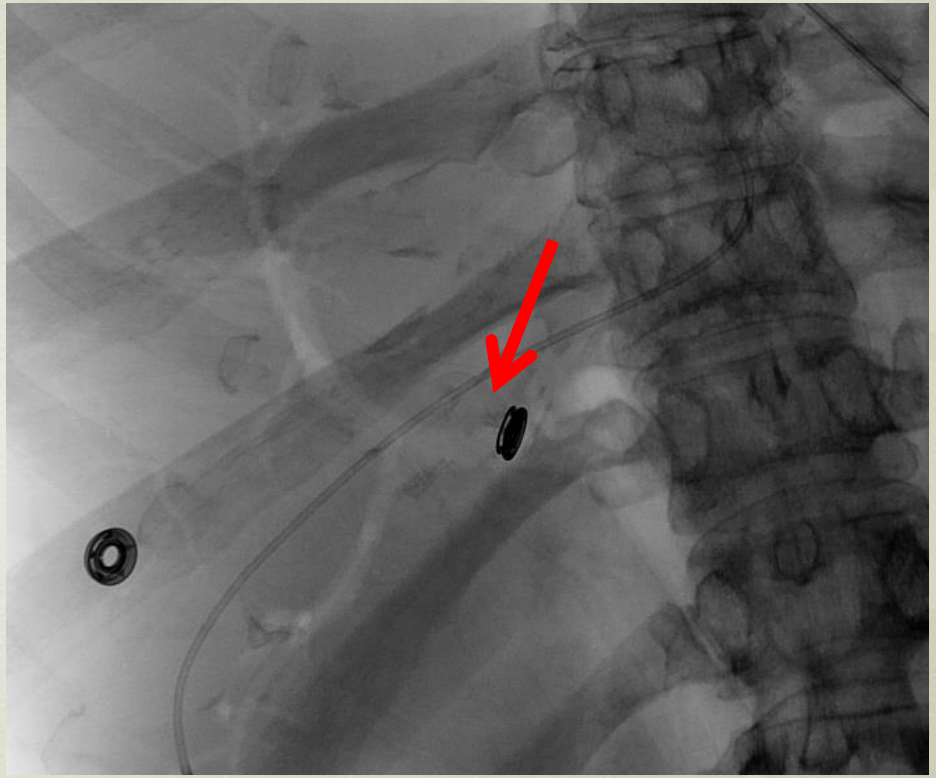
- CO_2 is useful for portal and mesenteric venography
- The buoyancy of the gas allows extensive distribution
- Applications:
  - Target of portal vein during TIPS procedures
  - *"CO_2 target"*
  - Evaluation of portal and mesenteric vein occlusions

TIPS procedures: CO_2 wedge injection-technique

- AP and left anterior oblique views
- Wedge injection
  - Wedged catheter or balloon catheter
  - ***Gentle*** injection of 15-20 cc
  - *Careful in patients with ascites*
- Intraparenchymal injection
  - Puncture needle is advanced into the liver parenchyma (0.5-1 cm)
  - ***Gentle*** injection of 15-20 cc

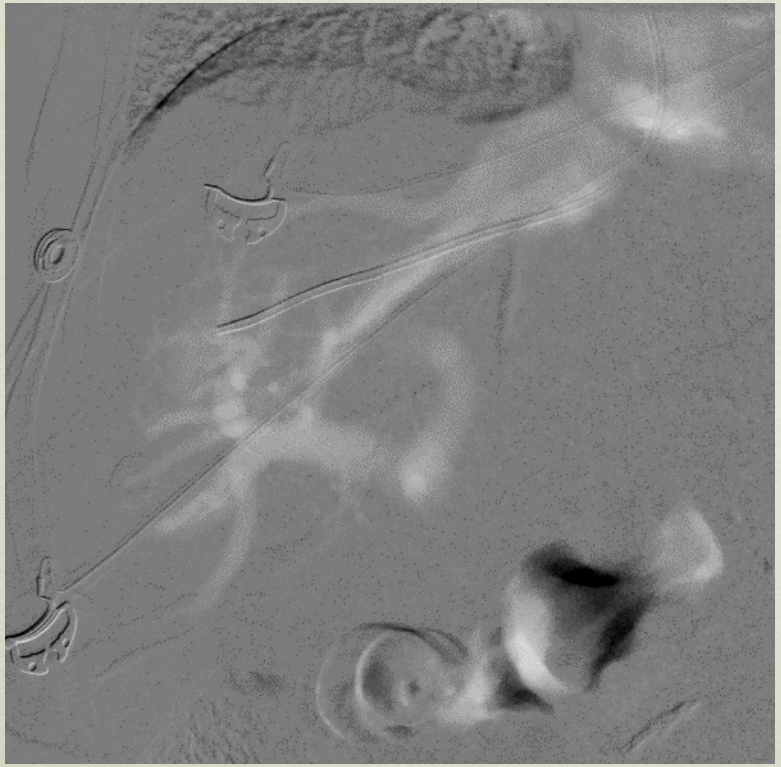
CO_2 Portogram



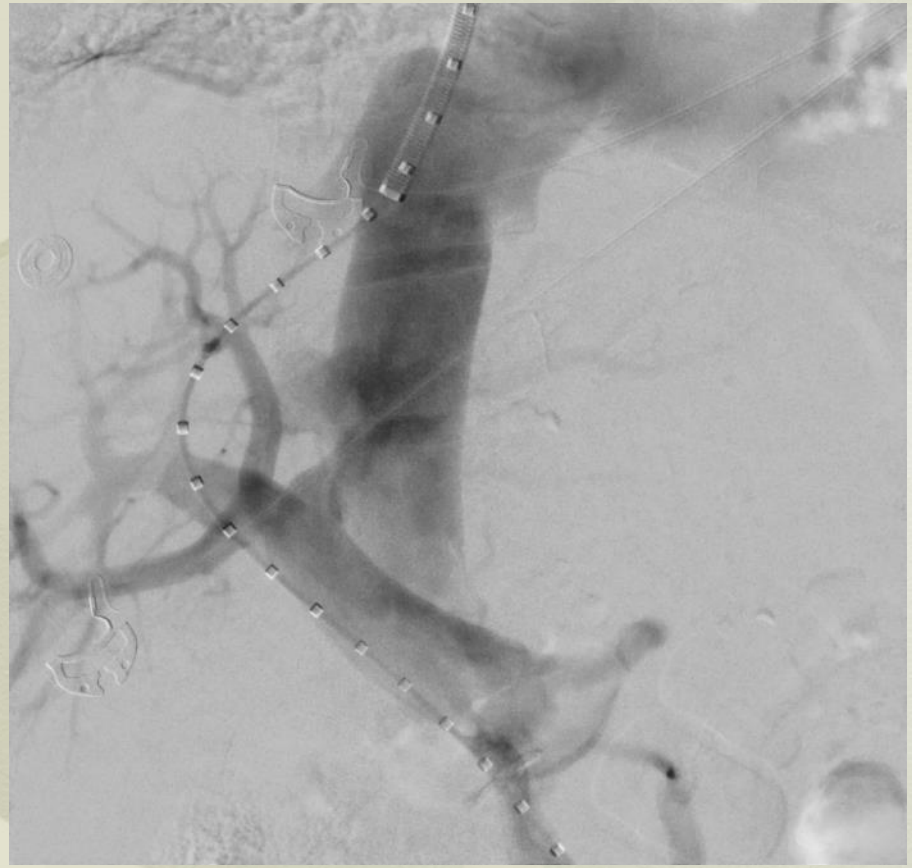


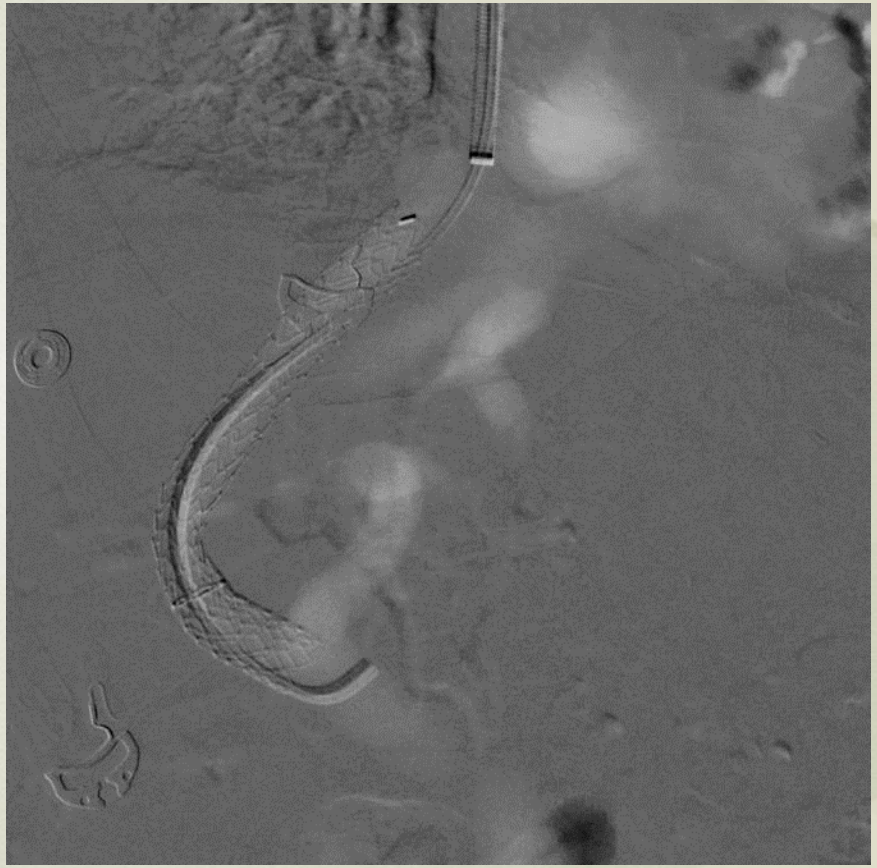
CO2 “target” : CO2 may remain in the portal vein for some minutes after injection
Assists in transhepatic puncture

CO_2 Portogram

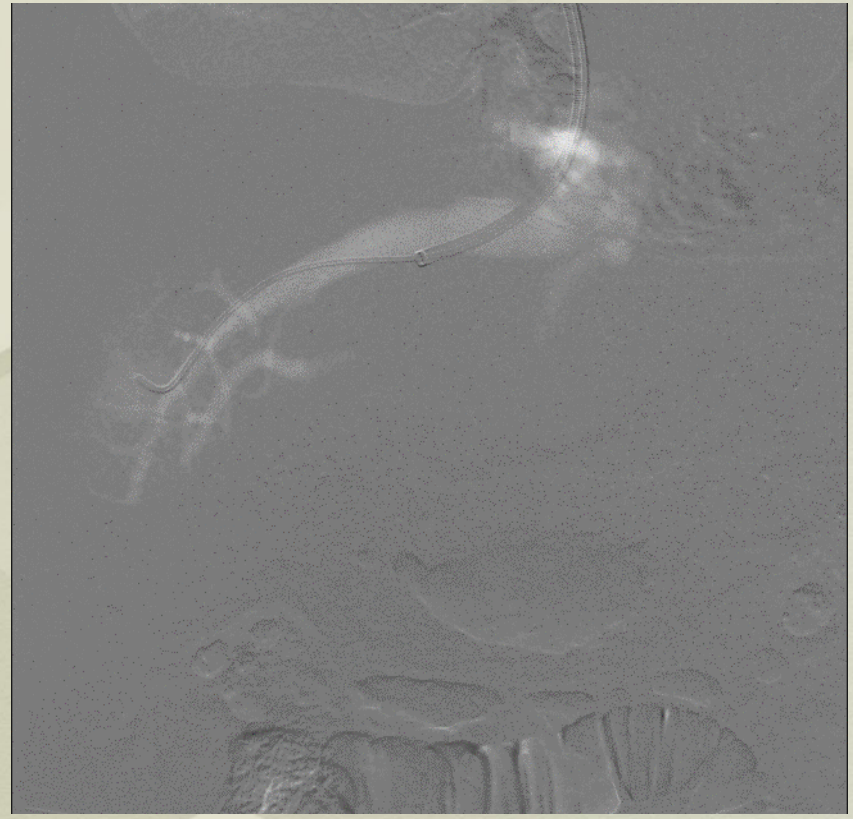


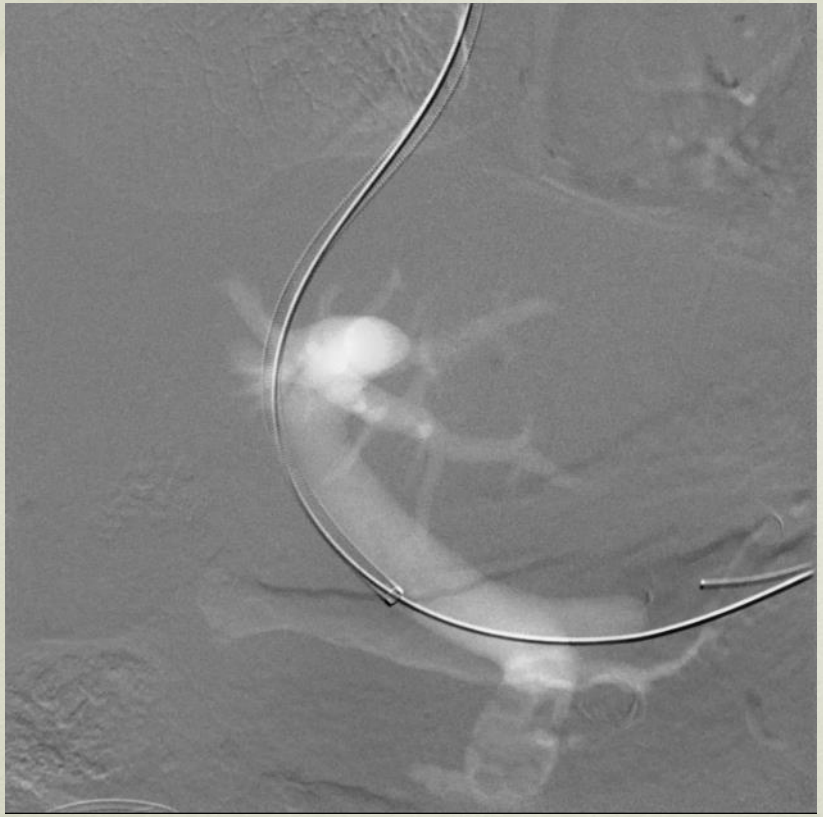
Track measurement and final portogram

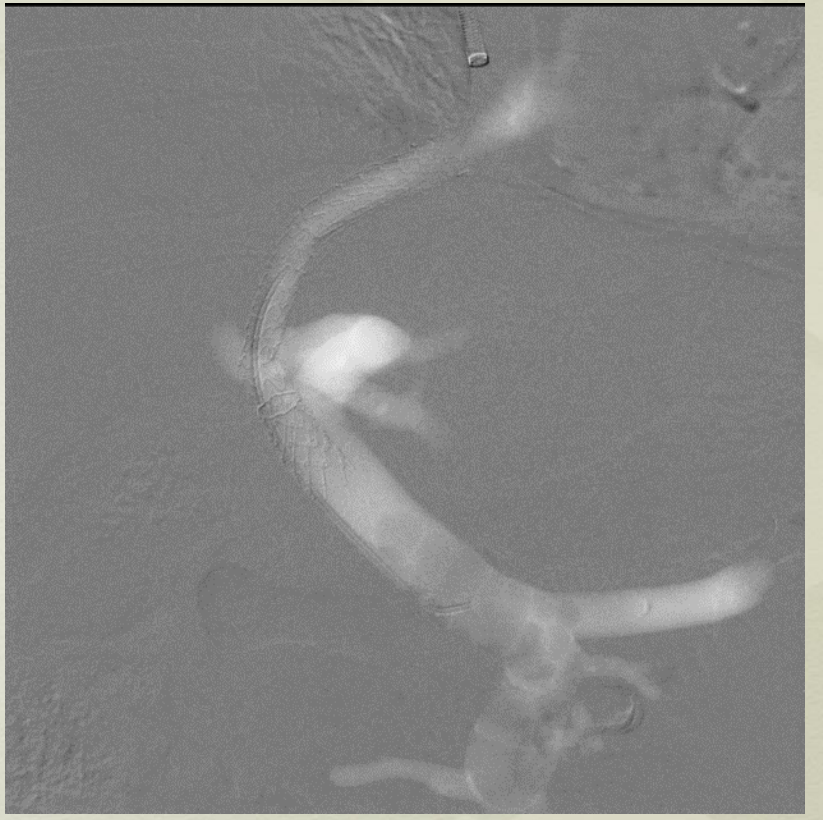




TIPS with CO_2

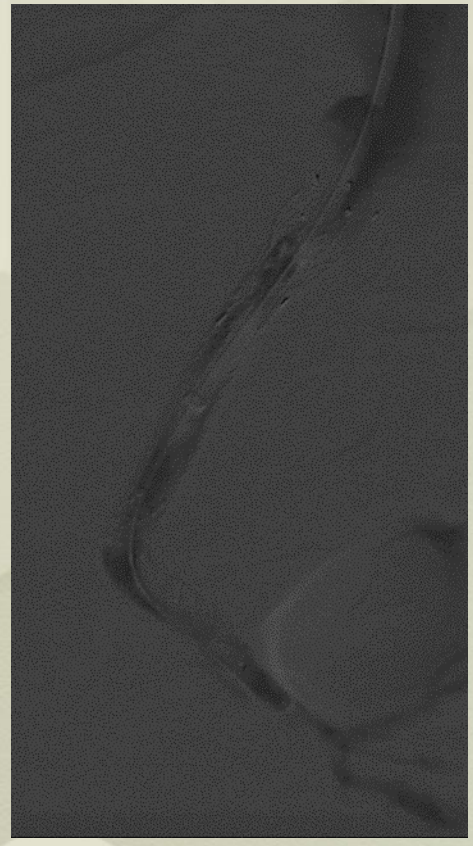


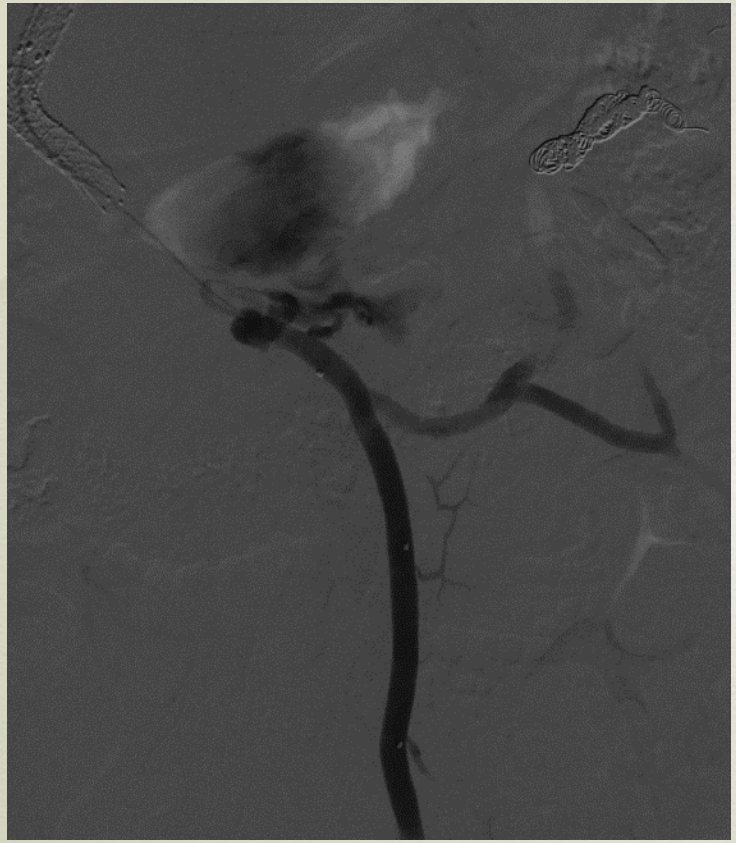




Mesenteric Venous Recanalization

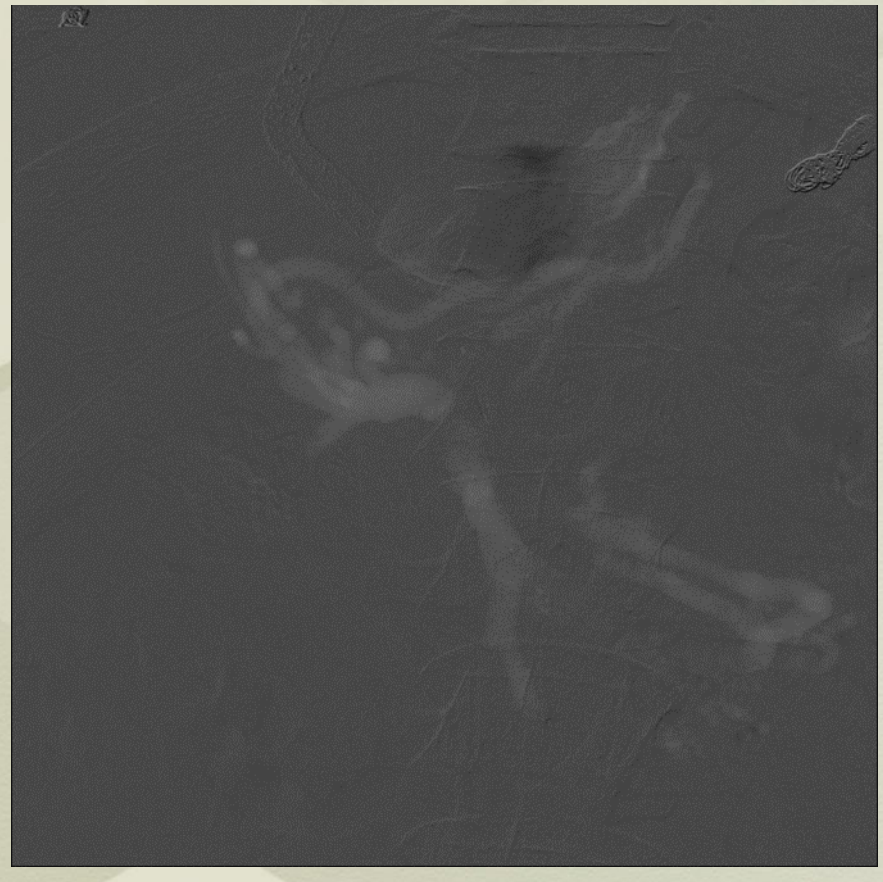
Mesenteric venous recanalization

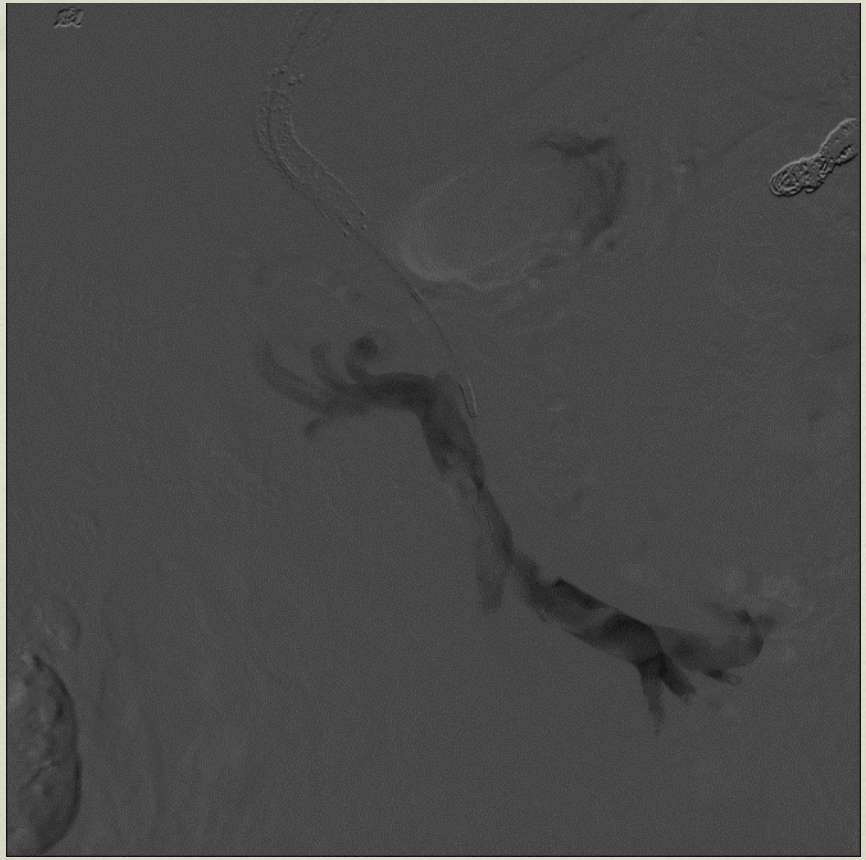




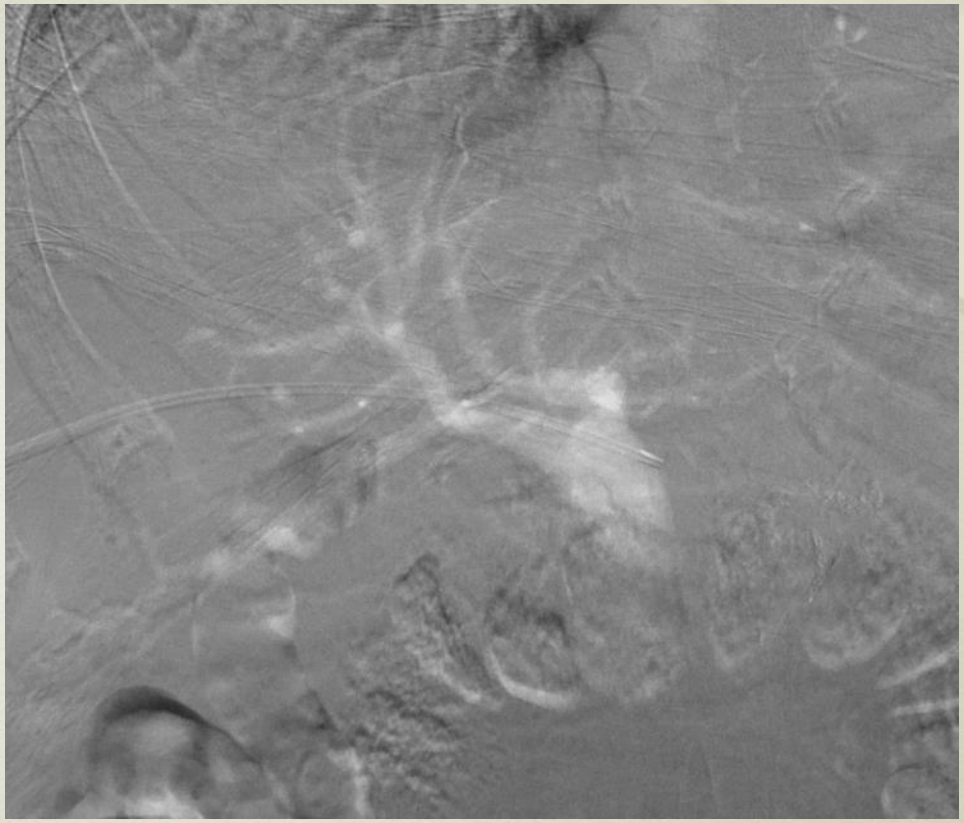
In this case, CO2 assisted in identifying the main mesenteric vein branch
The identified branch was the target for recanalization
The branch could not be identified with contrast

Mesenteric venous recanalization



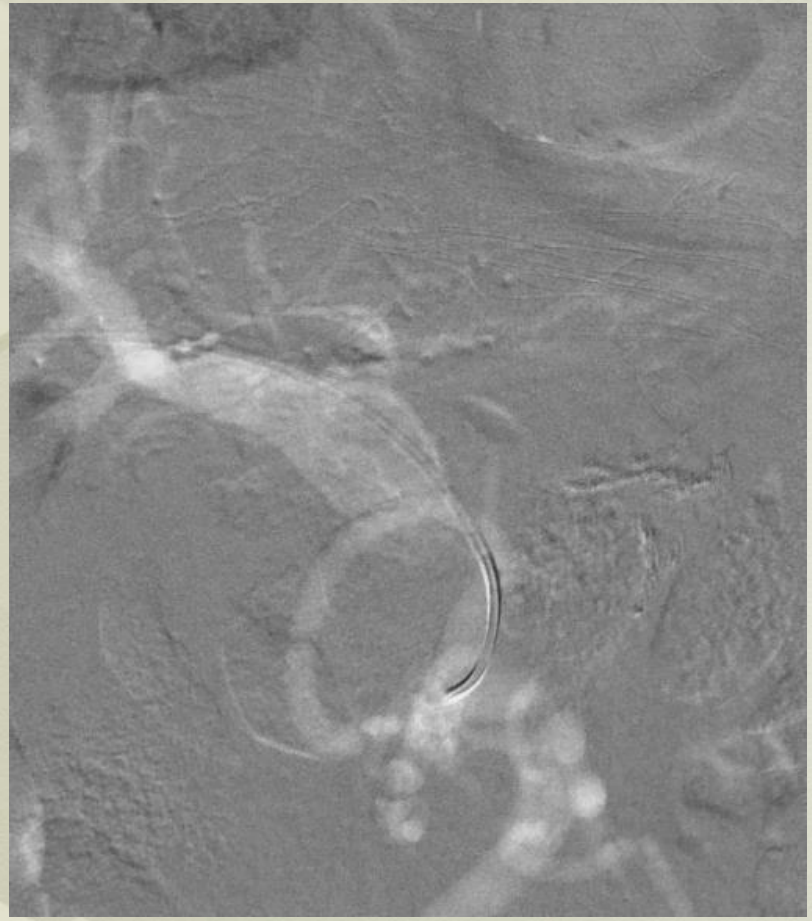


Portal venous recanalization and stenting



81 year old man with history of pancreatic cancer
End stage renal disease stage IV; GFR 29 ml/min
Presents with recurrent ascites and CT scan showing portal vein occlusion

Portal venous recanalization and stenting

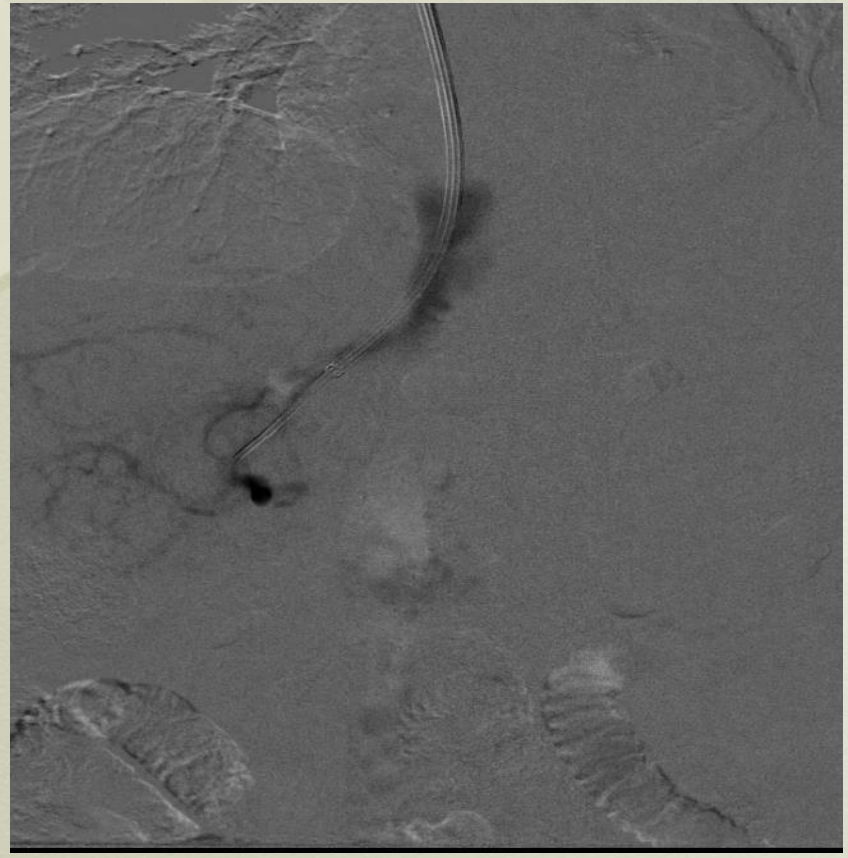


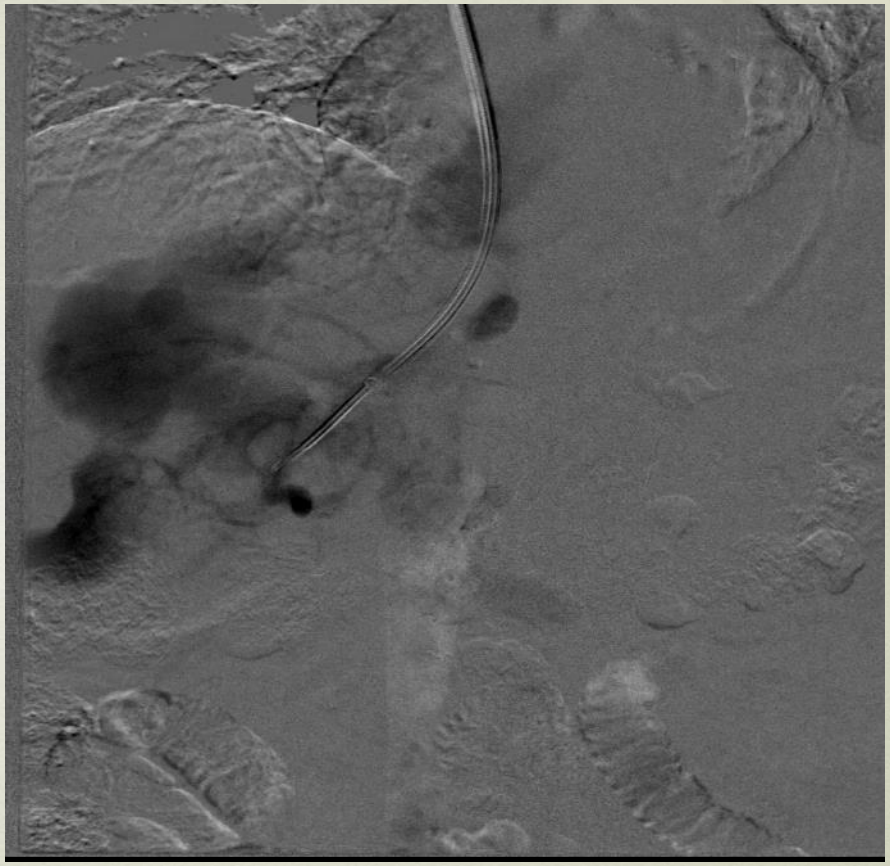
Stent deployed over a mesenteric vein branch
Renal function improved after procedure
Ascites under much better control

Complications and Precautions

- Complications do occur
- Most (if not all) complications are related to operator error
  - Using a suboptimal CO_2 source
  - Breach in technique
  - Lack of understanding of the behavior of the gas
- **Complications do not make CO_2 UNSAFE !!!!!**
  - **It is the operator who is dangerous, not the gas**

TIPS complication



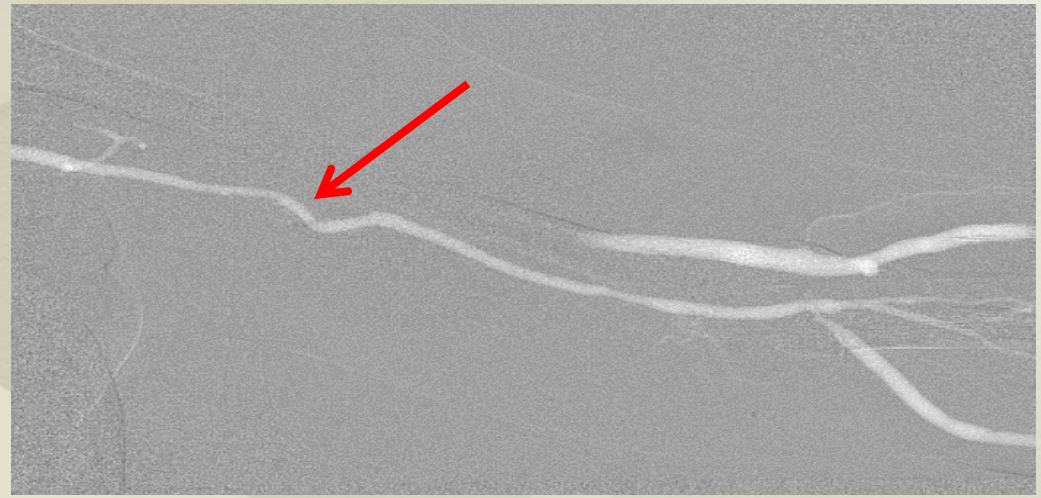


Complication during a wedge injection during a TIPS procedure
Patient had ascites / CO2 was injected forcefully

IR Safety Rounds

Transient Disorientation and Severe Bradycardia after Carbon Dioxide Angiography

Anil Kumar Pillai, MD, Amar Pravin Shah, MD, Hector Ferral, MD, Sreekumar Madassery, BS, Scott Asselmeier, MD, and Sudheer Paruchuri, MD



Discussion

- CO_2 is useful for endovascular intervention
- Practice expands indications
  - Patients with severe contrast allergy
  - Patients with borderline renal function
  - Patients with fluid overload
- *Careful technique is imperative*
- *Use of a low pressure system is imperative*

Thank you

Owl- Davide Salvadore

CO2 Digital Angiography in Venous Diagnosis and Intervention

Hector Ferral, MD

Senior Clinician Educator
Section of Interventional Radiology
NorthShore University HealthSystem
Evanston, IL

NCVH
New Cardiovascular Horizons

19th Annual Conference

2018

May 30 - June 01

THE PERIPHERAL EVENT OF THE YEAR