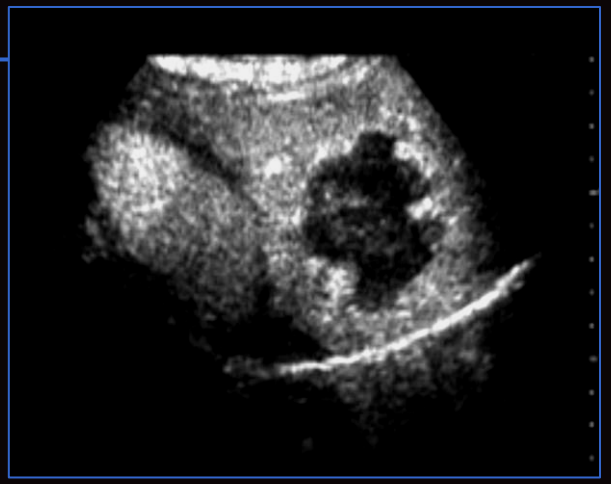
Liver CEUS

Bohatá Šárka
Radiology Department of Faculty Hospital Brno
(Head of the dept.: Prof. V.Válek),
Faculty of Medicine, Masaryk University Brno,
Czech Republic



Why to use US contrast media (CM) in general?

- To detect flow in the circulation at a level that is lower than would otherwise be possible
- Doppler is a method that succesfuly separates echoes from blood and tissue
  - it is valid for flow in large vessels
  - it does not work for flow at the parenchymal level, where the tissue is moving at the same speed or faster than the blood which perfuses it (flash artifact)
- Thus, true parenchymal flow cannot be imaged using conventional Dopler

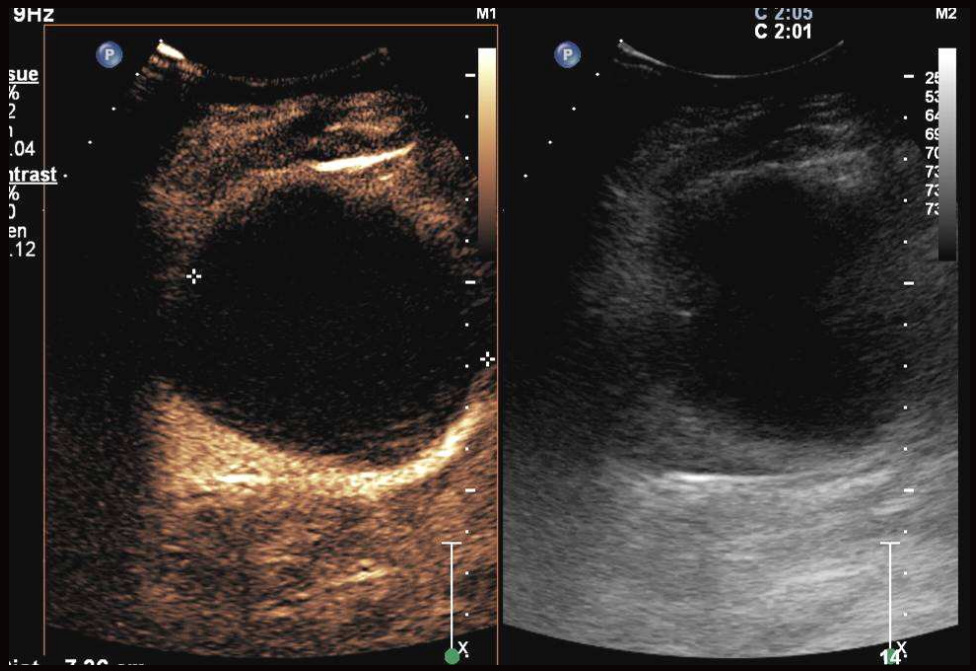
- Why do not we use just simple subtraction of a preinjection and the postinjection image (as in X-ray angiography)?
  - US is real time imaging of moving structures
  - If we subtract two consecutive US images of an abdominal organ, we are likely to get a third ultrasound image, produced by the shift between acquisitions

- How then might CM be used to improve the visibility of small vascular structures within tissue?
  - Method that could identify the echo from the CM and thereby suppress that from solid tissue - provides a real-time „subtraction“
- Contrast specific imaging (= nonlinear imaging) provides such a method

Why to use CEUS in liver imaging?

B-mode

- Allows for the definite diagnose:
  - typical liver cyst (round, non-echogenic smooth surface, sharp borders, lateral shadowing, posterior echo enhancement)
  - calcifications (echo-rich with acustic shadows)



- All other focal liver lesions are characterised not only by analysis of differences in echogenicity from the surrounding tissue, but also by the detection of hyper- or hypovascularization and by changes occurring in inflow kinetics (enhancement) of CM.

- As a result of dual blood suply via both the portal vein and the hepatic artery, focal lesions in the liver often exhibit no sustained hyper- or hypoperfusion, but depending on the perfusion phase and the histology, present with a complex spatio-temporal picture of increased and reduced contrast enhancement.

Why CEUS?

- no radiation
- real-time imaging
- possibility of quantification (Q-LAB)
- chance of application second CM injection after few minutes
- higher sensitivity and specificity in small leasions (below 1cm)

How to do it?

- What we need:
  - US machine that allows contrast-specific imaging
  - contrast media for ultrasound imaging
  - contrast aplication: provided by one nurse and one M.D.
  - knowlege of image interpretation

Contrast US examinations

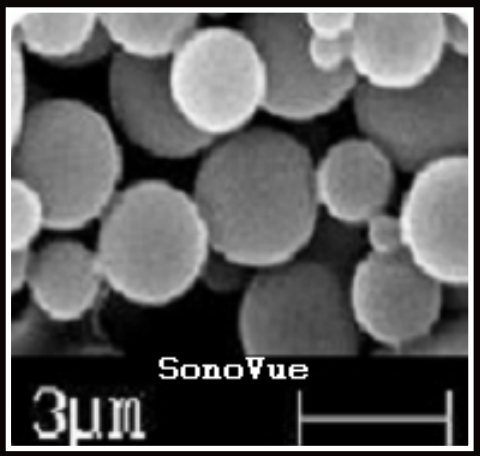
- What do we use?
  - SonoVue (Bracco, IT) is not refunded by Health insurance companies
  - However is approved to use

CAVE: intravascular contrast agent – no penetration to the extracellular space !!

SonoVue® (Bracco)

- Microbubbles stabilized by phospholipids and containing sulphur hexafluoride (SF6)
- Stability more than 6 hours after preparation of solution
- Resistance to pressure changes occuring in the left ventricle and pulmonary capillaries
- Persistance in blood-pool nearly 10 min after i.v. bolus (dependent on presetting of MI)

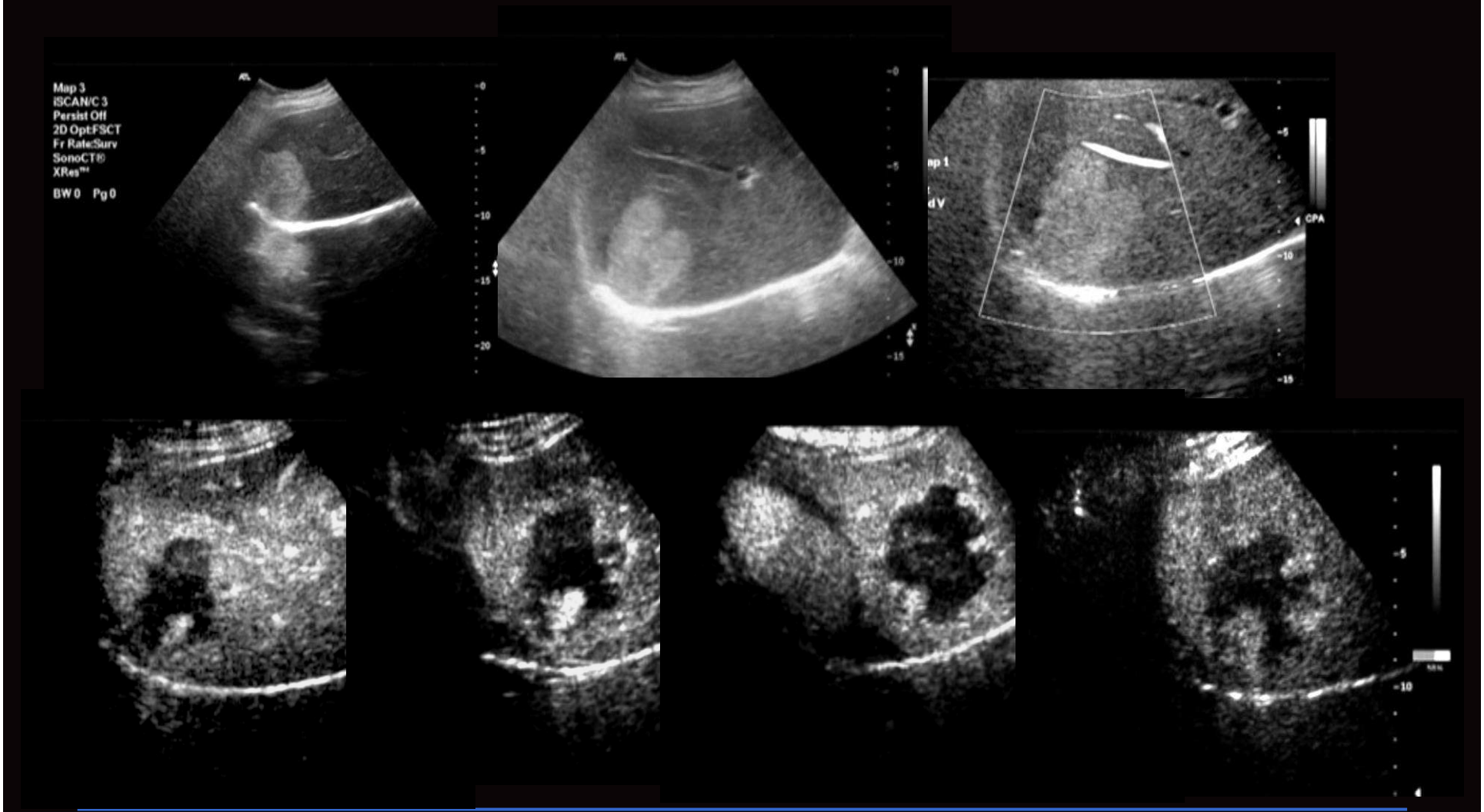
Our experience started from: 2004 – 2005
Multi-center international study (Bracco): liver



How to do it? - dose

- Normal liver
  - Leasion in near field, slim patient
    - 1ml i.v. bolus + 10ml saline flush
  - Deep localised leasion, problematic patient
    - 1,5ml i.v. bolus + 10ml saline flush
- Cirrhotic liver
  - Leasion in near field, slim patient
    - 1,5ml i.v. bolus + 10ml saline flush
  - Deep localised leasion, problematic patient
    - 2,0 ml i.v. bolus + 10ml saline flush

Liver contrast US: Hemangioma

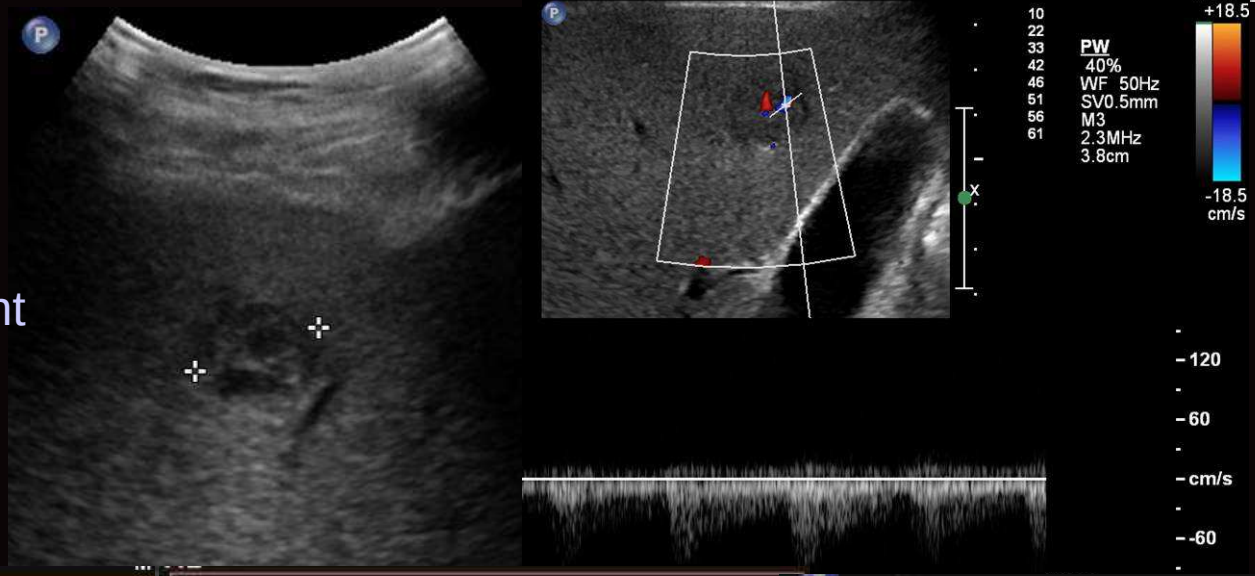


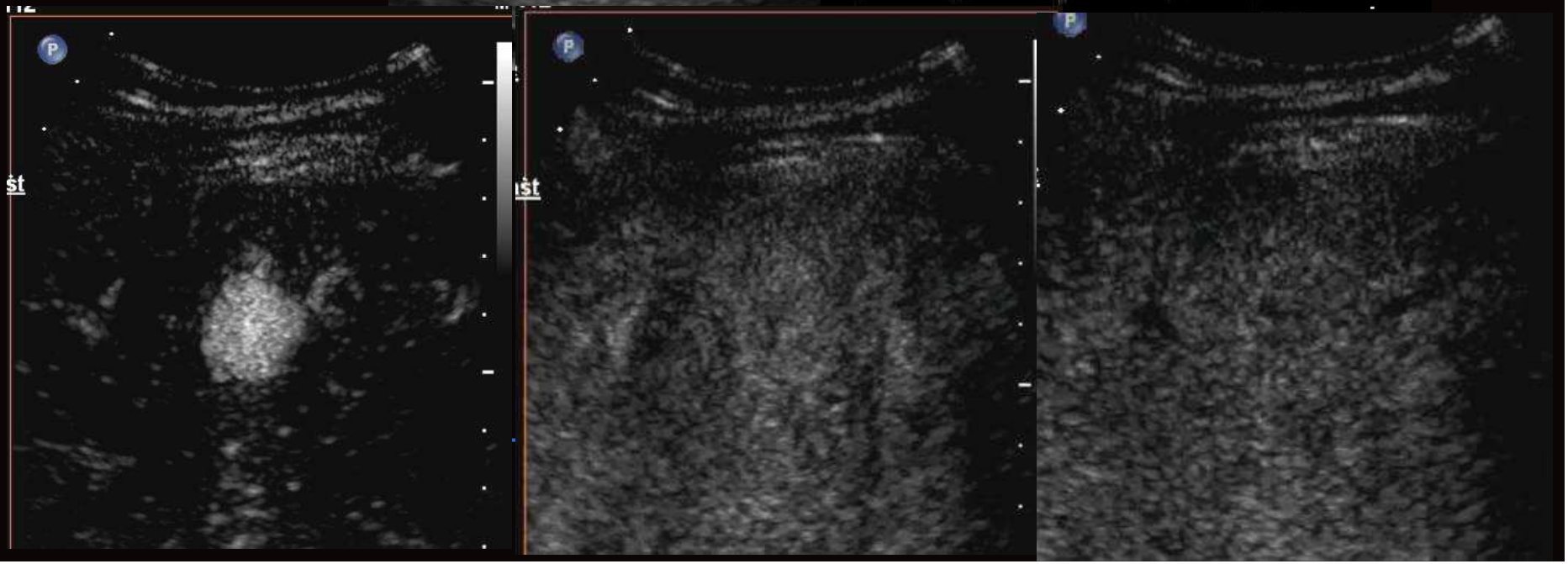
Characteristic vascular picture: iris diafragm phenomenon

Focal nodular hyperplasia

Characteristics:

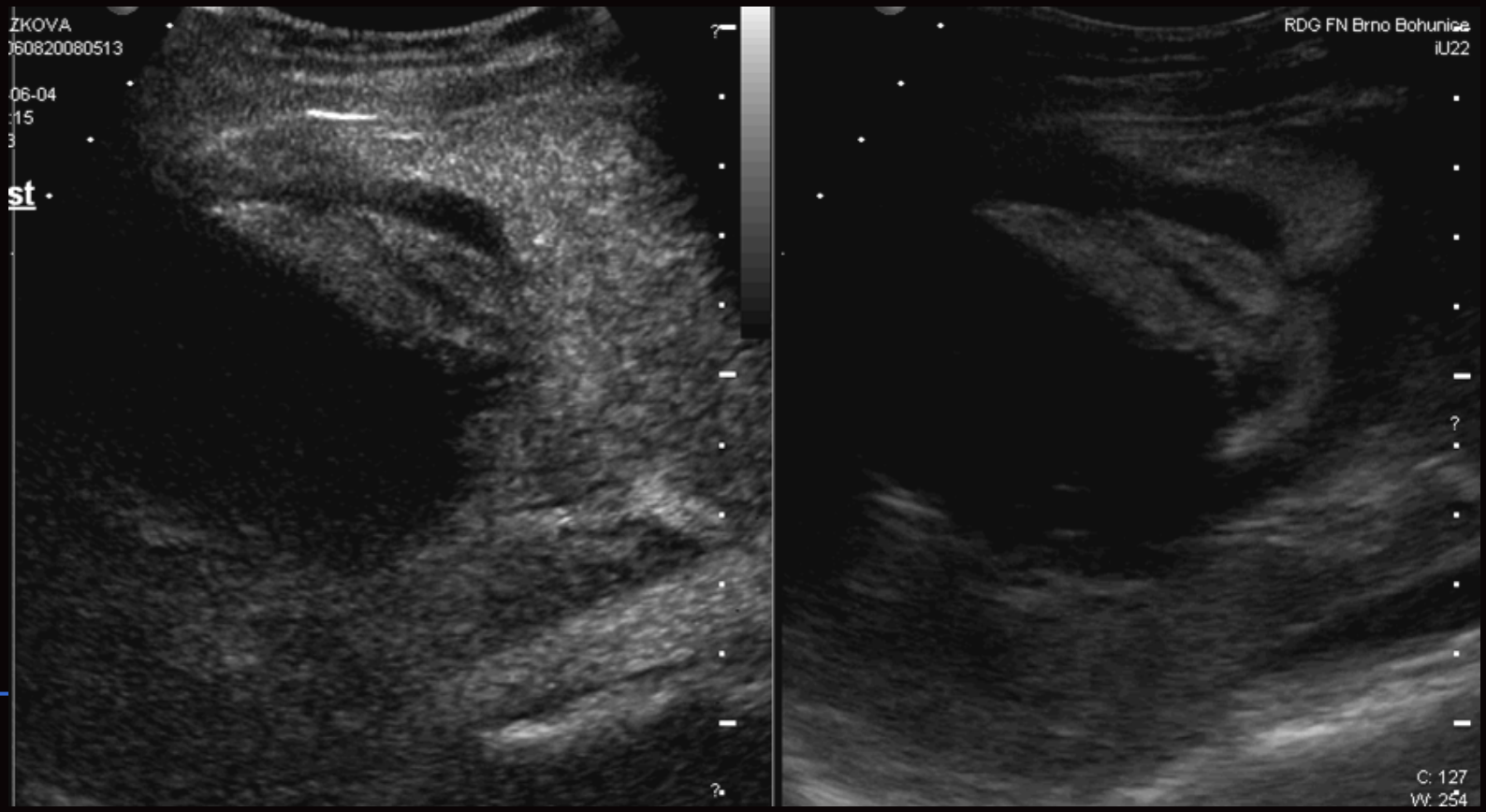
- spoke-wheel phenomenon
- arterial enhancement
- no wash-out
- central scar (!)





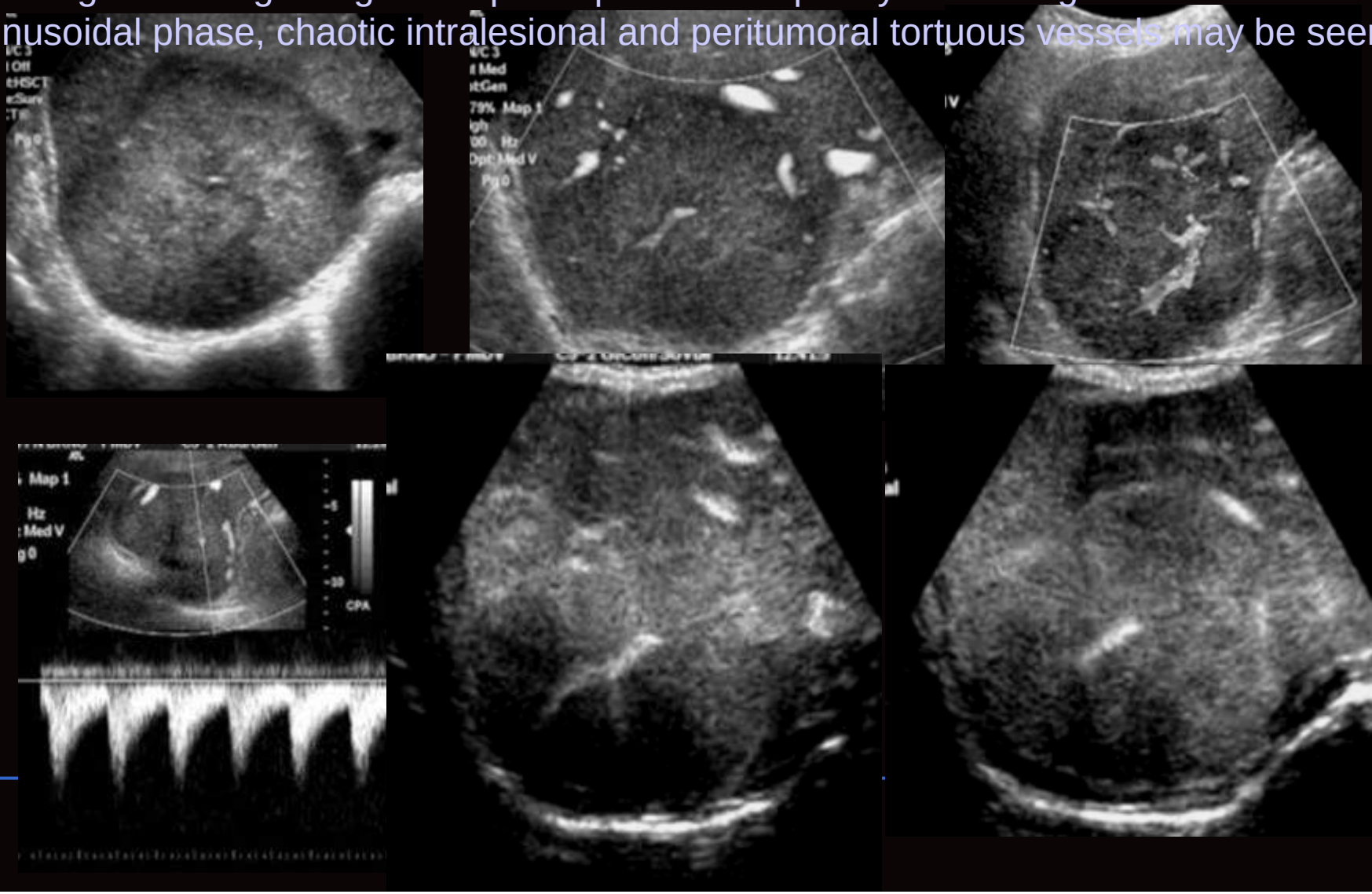
Hepatocellular adenoma

Histologically no portal veins and no bile ducts are present in adenomas, high lipid content of hepatocytes – hyperechoic parts, bleeding – inhomogeneity (hyperechoic areas in acute bleeding, hypo- to anechoic areas corresponding to older hemorrhages, homogenous enhancement during arterial phase, no enhancement in portal-venous phase, barely visible in the late phase (sinusoidal), pericapsular feeding vessels

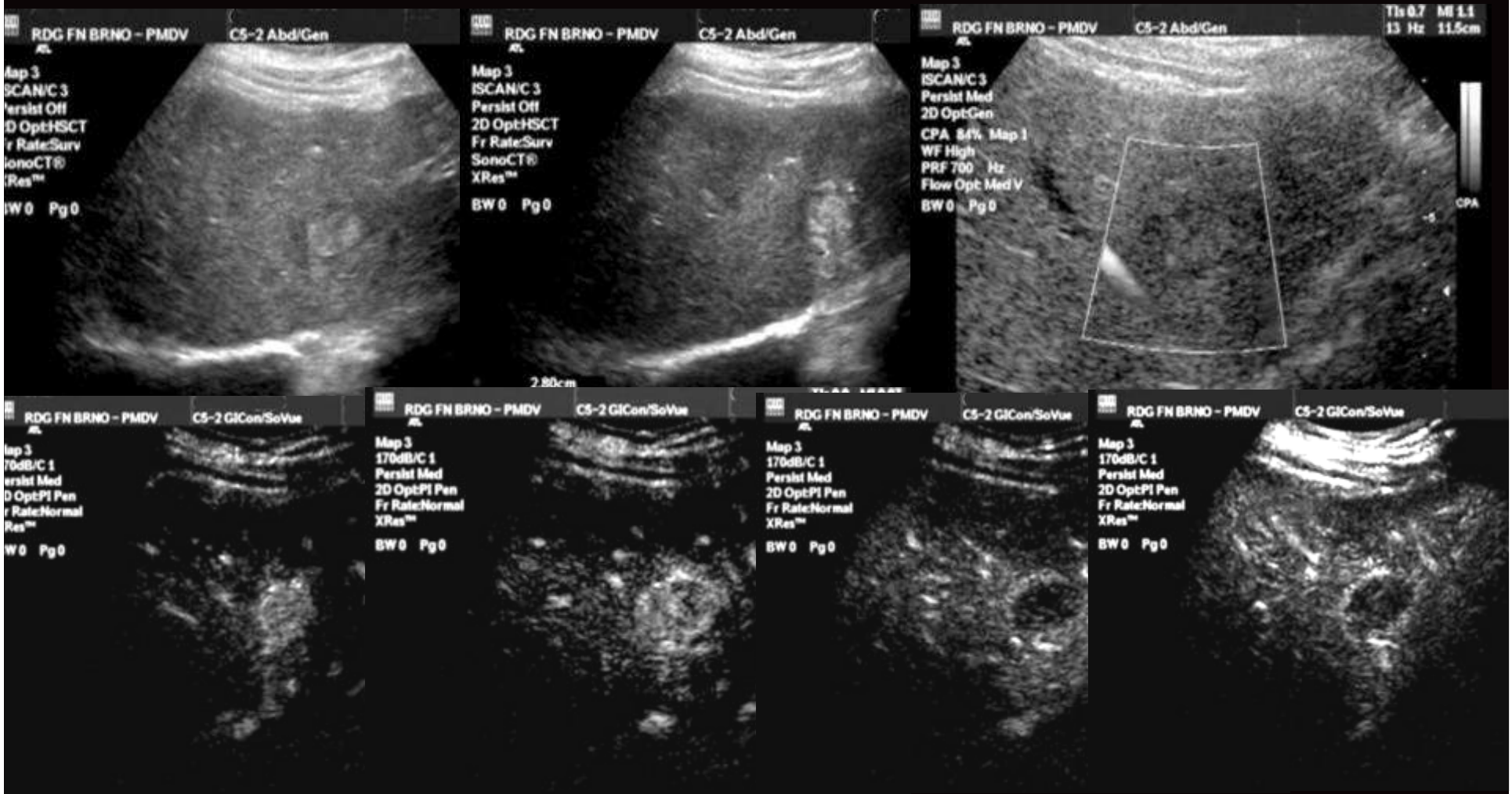


Hepatocelullar carcinoma

Intense and fast peak of enhancement in the arterial phase, relatively quick wash-out starting in the beginning of the portal phase and quickly increasing towards the sinusoidal phase, chaotic intralesional and peritumoral tortuous vessels may be seen

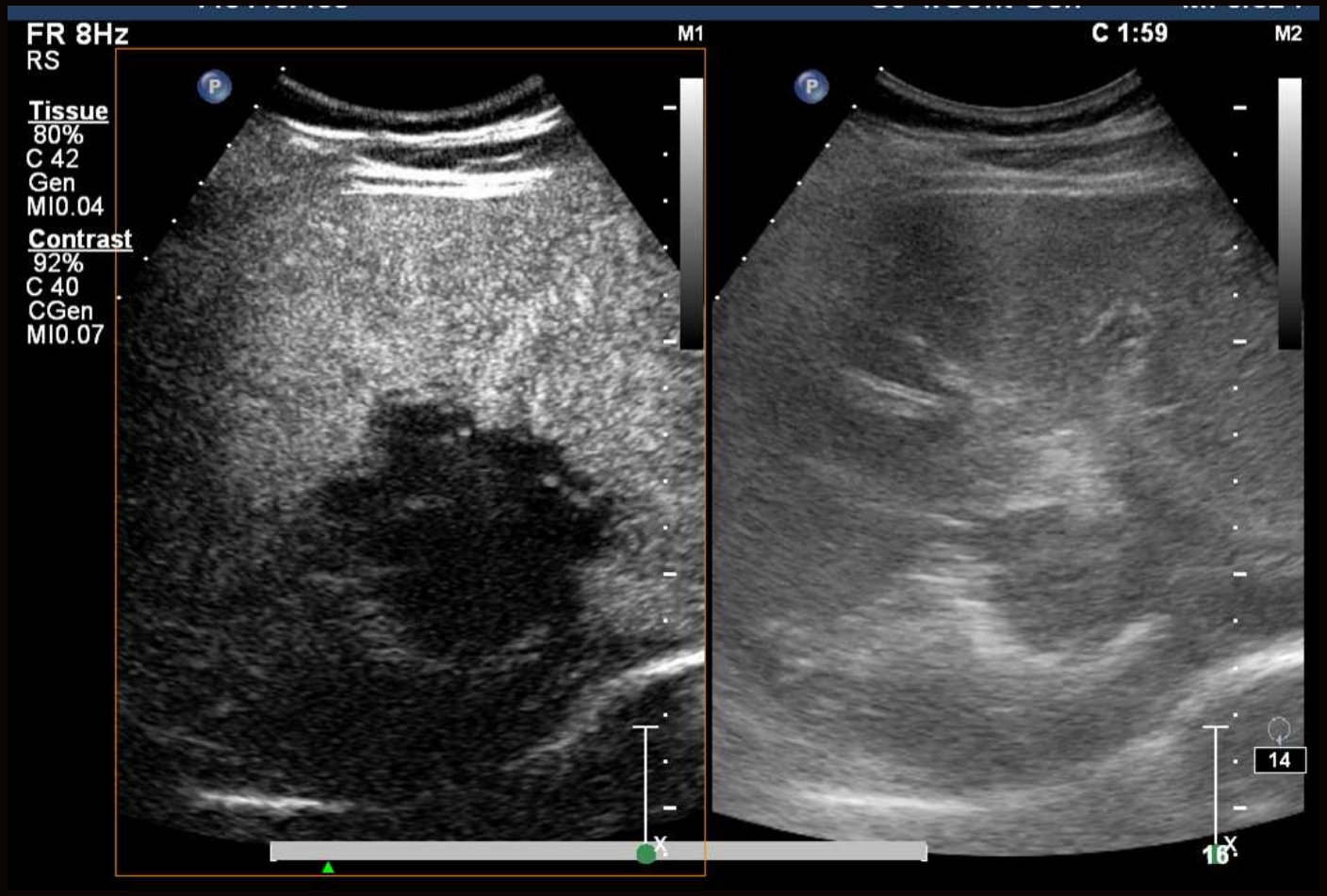


Colorectal cancer liver metastasis



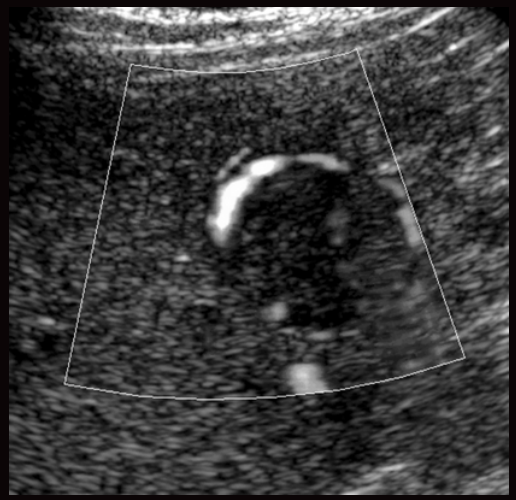
Fast transient arterial ring enhancement, rapid wash-out.

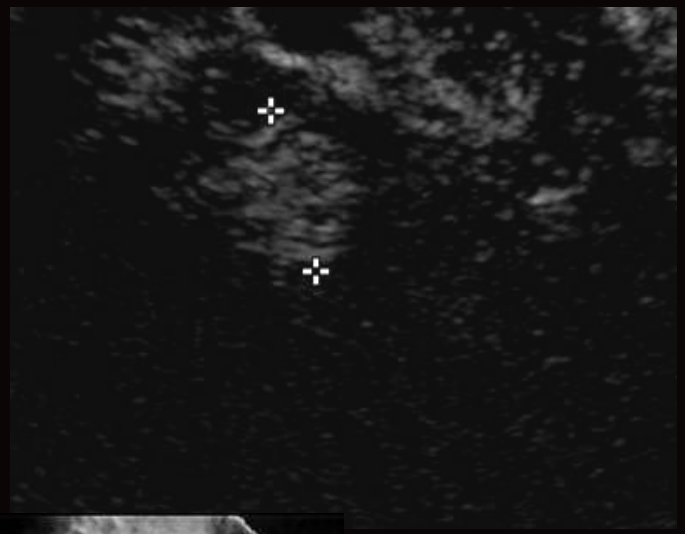
Liver metastasis – after RFA

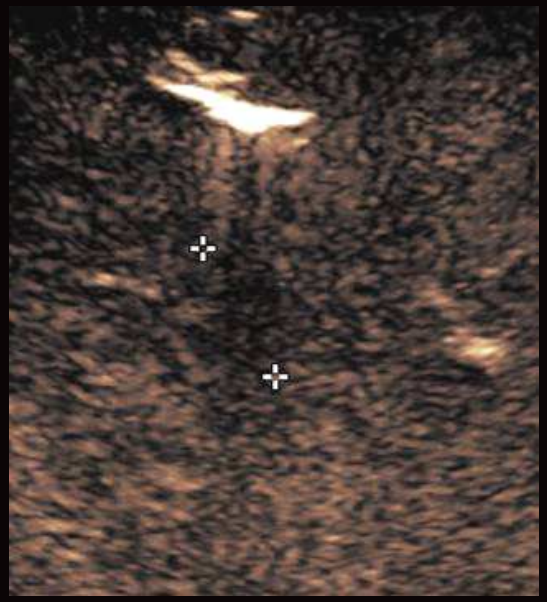


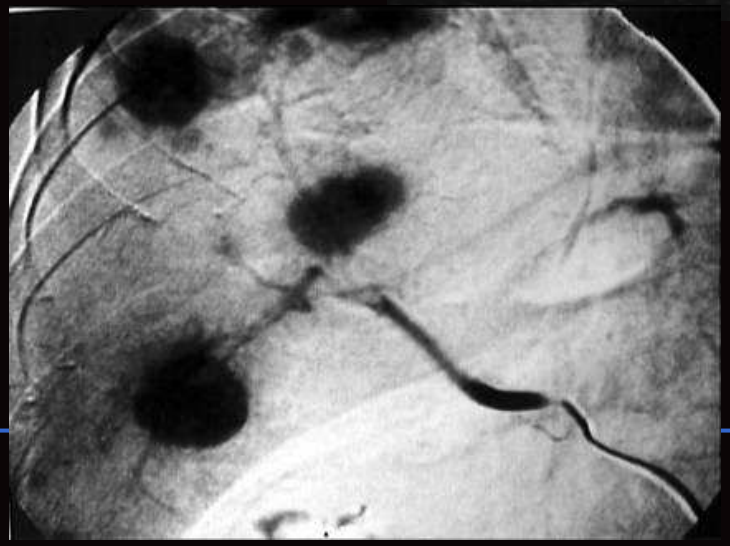
No enhancement of necrotic tissue should be seen, vessels going through the lesion, surrounding hyperemia up to 1 month.

Hypervascular metastases (carcinoid)









Intense fast peak of enhancement in the arterial phase, quick wash-out

Selected References

- Lencioni R. et al., Enhancing the Role of Ultrasound with Contrast Agents, Springer-Verlag, IT, 2006
- Solbiati L. et al, Contrast-enhanced ultrasound of liver diseases, Spronger-Verlag, IT, 2003
- Leen E., The role of contrast-enhanced ultrasound in the characterisation of focal liver lesions. Eur. Radiol 11 (Suppl 3), p.27-34
- Oldenburg A., Hochmann J., Foert E. et al., Detection of hepatic metastases with low MI real time contrast-enhanced sonography and SonoVue, Ultraschall Med 26. p.277-284
- Albrecht T, Hoffmann C, Schmitz S et al, Detection of liver metastases: comparison of contrast-enhanced phase inversion ultrasound and dual phase spiral CT with intraoperative sonographic correlation. Radiology 207, p.459
- Averkiou M., Powers J., Ultrasound contrast media in the characterization of soft tissue leasions : ongoing research, Medica mundi 51/2+3 2007/11