Contrast Enhanced Ultrasound: The State of the Art

Stephanie R Wilson
University of Calgary

Disclosure

- Definity (Lantheus Medical Imaging, Billerica MA)
- Will describe off label use

What are US Contrast Agents?
- Comprised of Microbubbles (MBCA)
- Perfluoropropane gas in supporting lipid shell
- Tiny - 1 to 7 μm (~RBC)
- Purely intravascular
  - 200-2,000 microbubbles/ml of blood
- Require NO ionizing radiation
- NO nephrotoxicity
- Robust versatile imaging

Imaged with Specialized Techniques

AP High Vascular Volume, HCC

Pre-injection Low MI

PVP "washout" MALIGNANT
A very bumpy road

- No approval for CEUS in USA
- Black Box labeling in 2007
- Production problem in 2012

Status of MBCAs

- Approved in > 70 countries
- Canadian approval in 2002
- LIVER MASS CHARACTERIZATION is the Approval INDICATION for CEUS
- I am largest single user of MBCA in NA
- Use for Liver and Off – Label for Kidney, GIT, pancreas...........

Objectives

- ...in the imaging of FOCAL LIVER DISEASE
- To show the advantages of CEUS DYNAMIC REAL TIME MIP IMAGING INTRAVASCULAR BUBBLE
- To emphasize the sensitivity of CEUS to show enhancement regardless of intensity or duration

ALGORITHMS for Diagnosis

- Similar to those for noninvasive diagnosis of liver masses on CT and MR scan
- Based on enhancement characteristics in AP and PVP
- CEUS – unique advantage of temporal resolution and also vessel morphology

Wilson SR and Burns PN
Algorithm AJR 2006
CEUS
- HUGE ADVANTAGE in AP
- Temporal Resolution
- Vessel morphology
- Morphology is most important for liver mass diagnosis

Benefit of PVP Enhancement
- WASHOUT 92% PPV of malignancy
- SUSTAINED ENHANCEMENT 93% PPV of benignancy

Wilson SR and Burns PN
Algorithm
AJR 2006
CEUS – Improves DETECTION

- CEUS in PVP improves detection of metastases over baseline
  - Improves conspicuity
  - See more and smaller lesions

- Equivalent to CT scan and superior in some circumstances


Baseline

Nobody WOULD interpret the CT scan without contrast. Nobody SHOULD interpret the US scan without contrast either.

PVP

BOTH CT and US require contrast agents for detection and characterization of liver masses!!
Generally high agreement of CEUS with CECT/MR especially in AP Burns and Wilson Radiology 2007

**CT and MRI Contrast**
- Rate of enhancement
  - Arterial or portal supply
- Intensity of enhancement
  - Vascular volume
  - Vessel permeability

**Microbubble Contrast**
- Rate of enhancement
  - Arterial or portal supply
- Intensity of enhancement
  - Vascular volume

**Conclusion**
- CEUS is excellent for *characterization* and *detection* of focal liver masses
- Excellent *agreement* with CECT and MR
- Occasional *discordance* shows the advantage of realtime US with purely intravascular MBCAs

Thank you