

Mezzi di contrasto ecografici: fisica e applicazioni cliniche



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**Ecografia con
contrasto (CEUS)**

**Mezzo di contrasto
ecografico**

**Apparecchiatura
dedicata**



Mezzo di contrasto ecografico



E' una sospensione acquosa di **microbolle gassose** stabilizzate mediante un **guscio** di varia composizione

Ultrasound contrast agents (UCAs) currently approved by the European Medicines Agency for use in European countries

Levovist : introduced in 1996. Production of levovist has been discontinued.

Optison: sole indication to date is cardiac

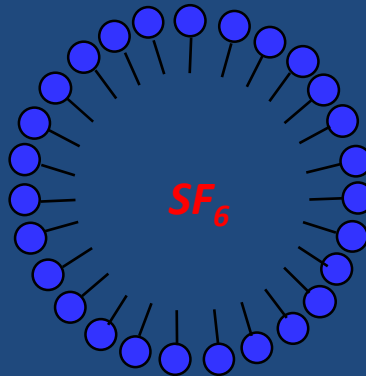
Luminity: sole indication to date is cardiac

SonoVue: approved indications are cardiac, macrovascular, liver and breast lesions. This is the main agent in general use.

SonoVue

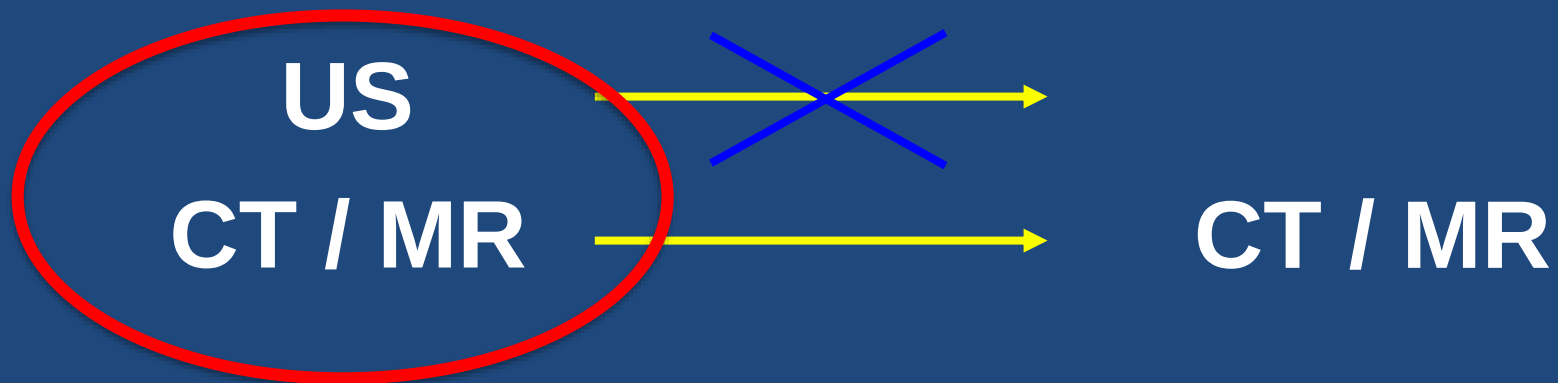
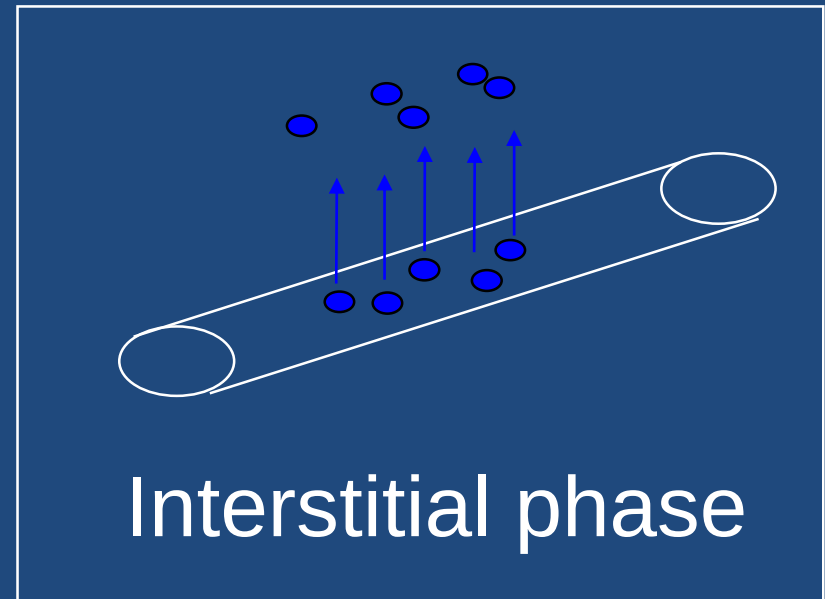
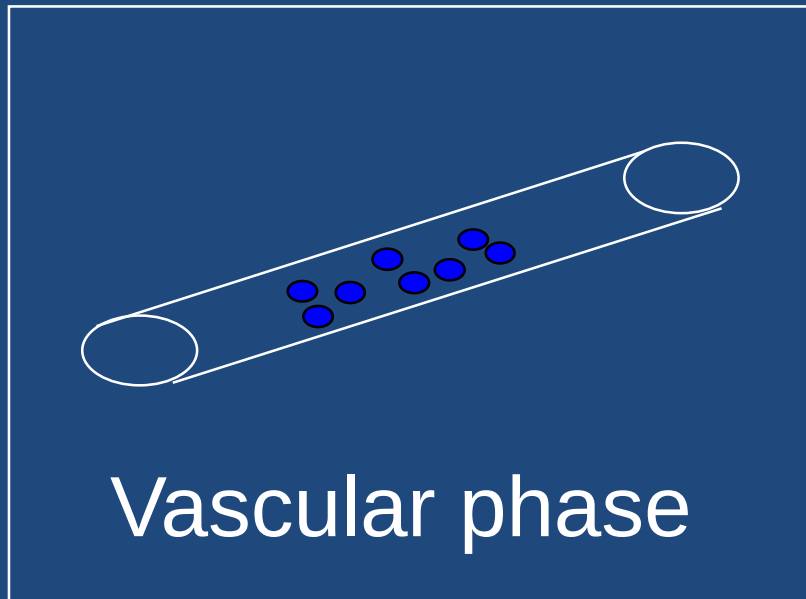


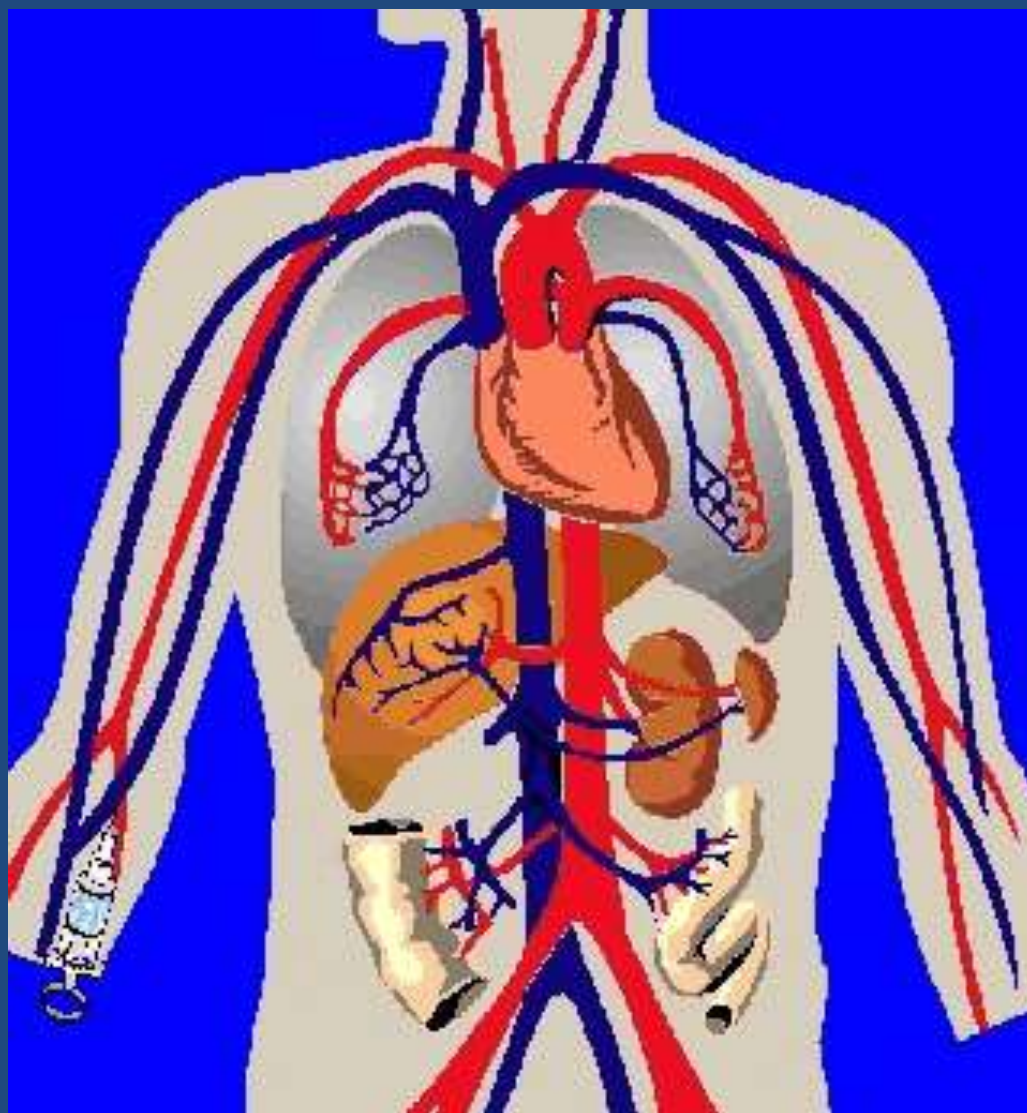
Il gas è **esafluoruro di zolfo**, gas inerte più denso dell'aria, ed il guscio è costituito da fosfolipidi

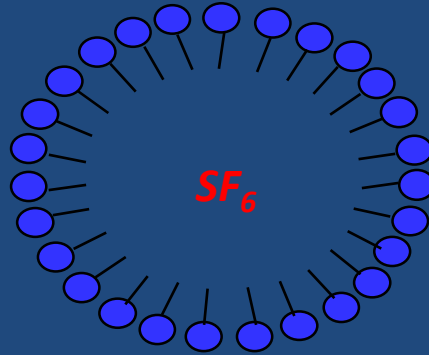


Le microbolle hanno un **diametro (3-5 micron)** tale da poter attraversare il filtro capillare polmonare ma non da diffondere al di fuori del letto vasale

US Contrast Agents vs CT / MR Extracellular Agents

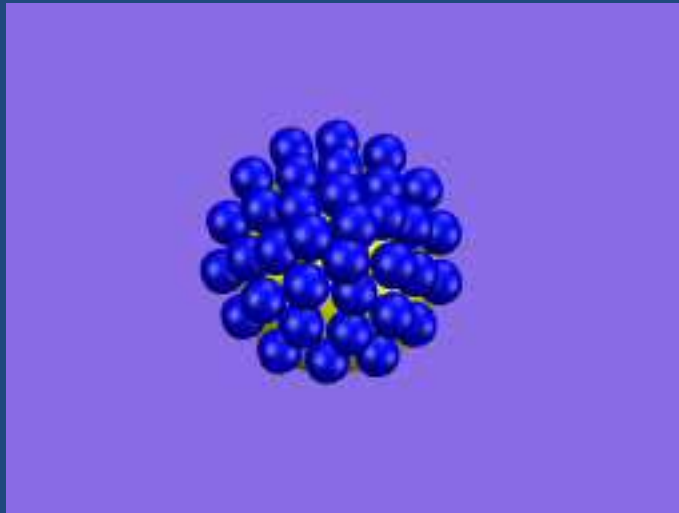






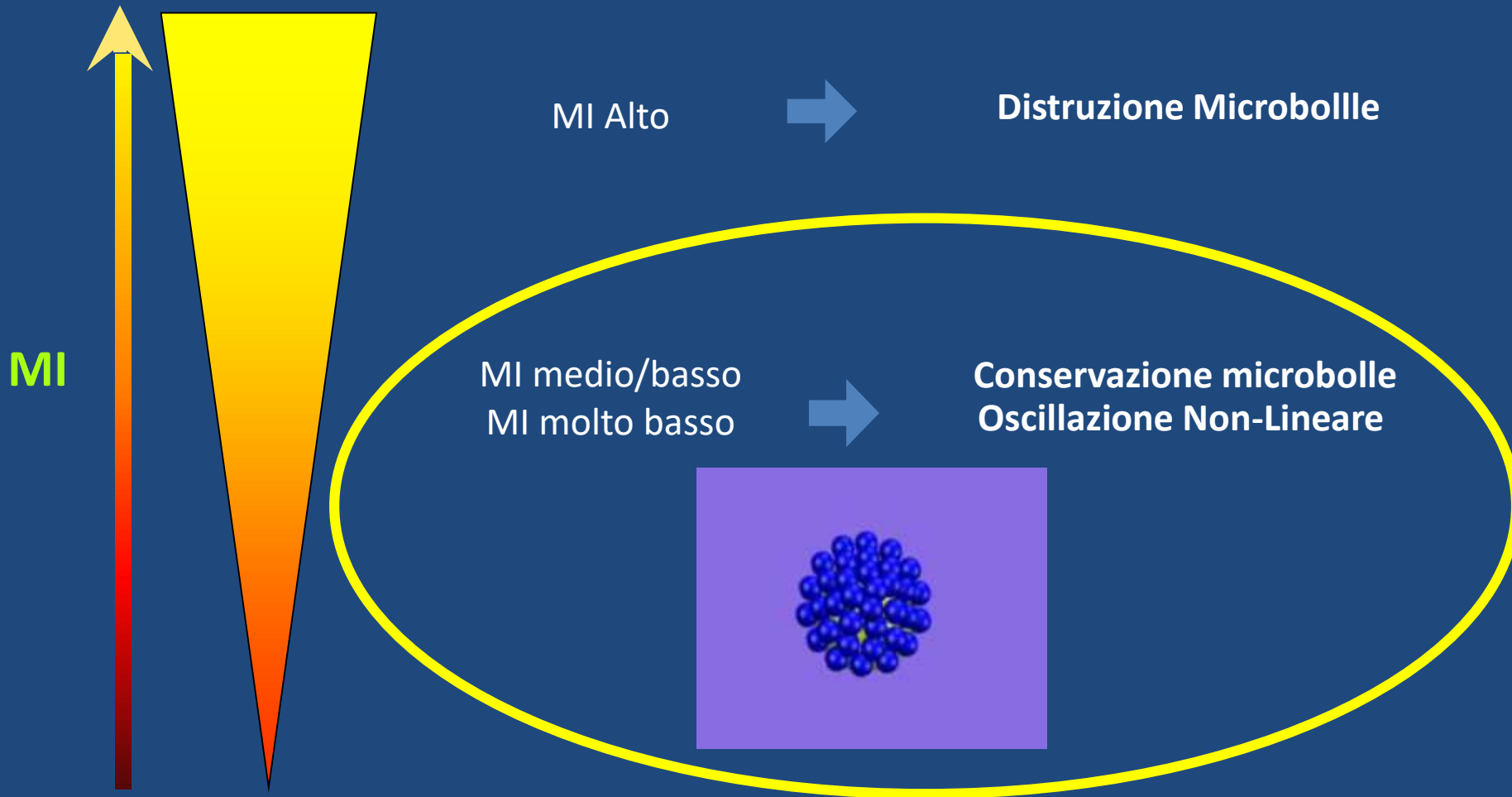
- La **durata** delle microbolle nell' organismo, se non sono sottoposte ad alcuno stimolo, è di alcuni minuti.
- L' **eliminazione** della componente gassosa avviene per via polmonare, mentre l' eliminazione del guscio avviene per via epatica

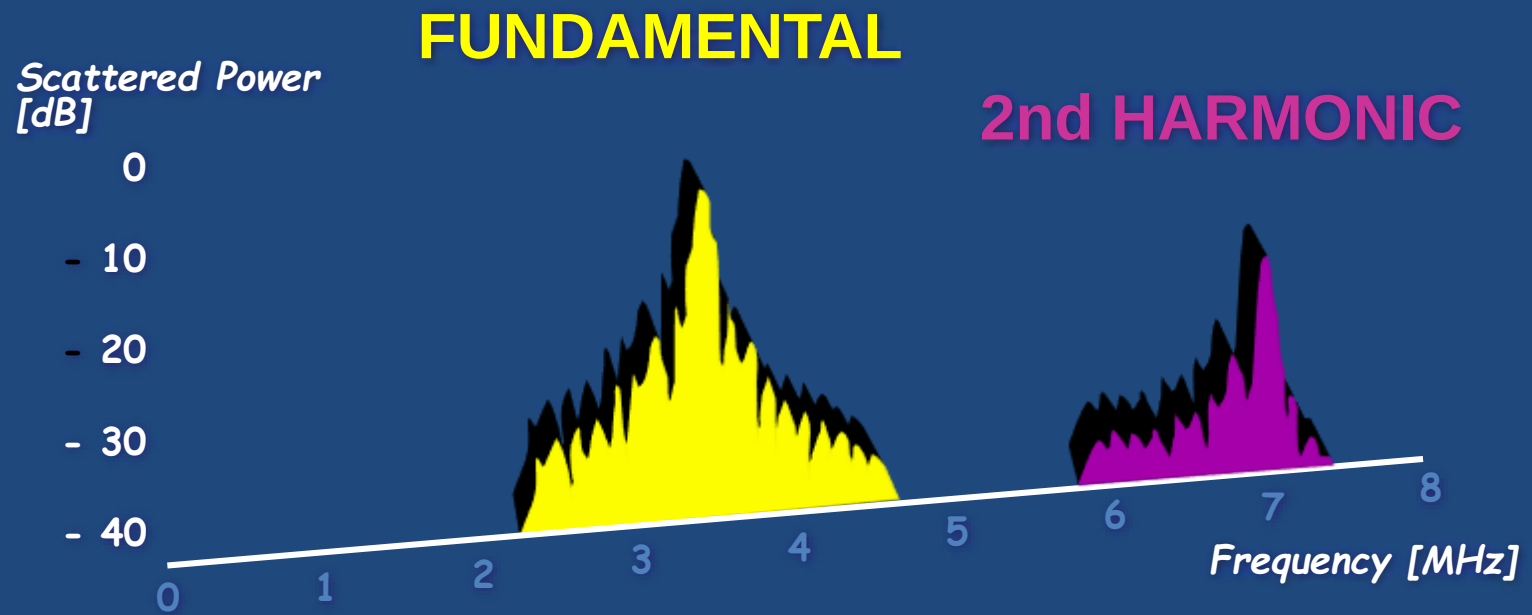
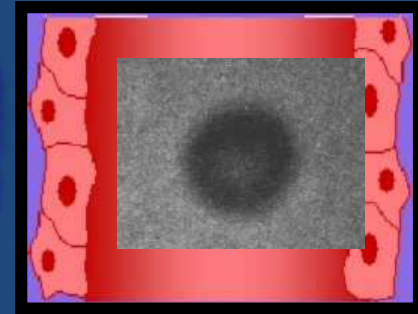
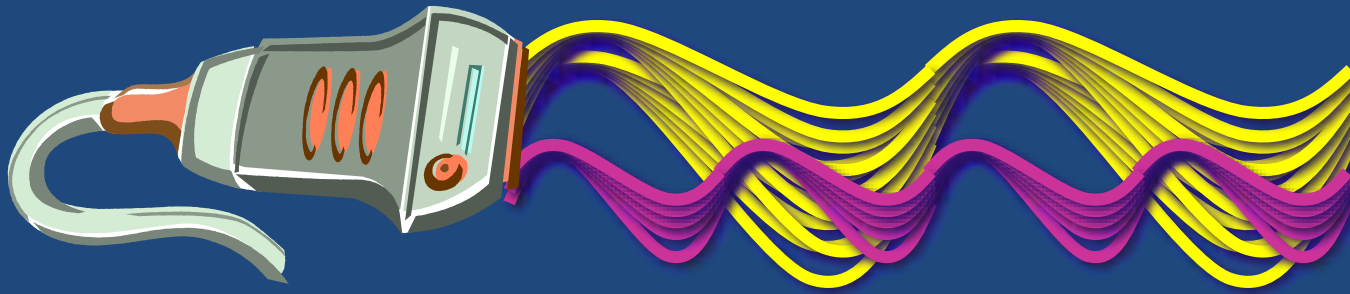
La caratteristica fisica più rilevante delle microbolle è la **fragilità**: se sottoposte ad un fascio di ultrasuoni alla pressione acustica generalmente impiegata nell' imaging ecografico, esse sono quasi istantaneamente distrutte generando un segnale molto intenso e transitorio

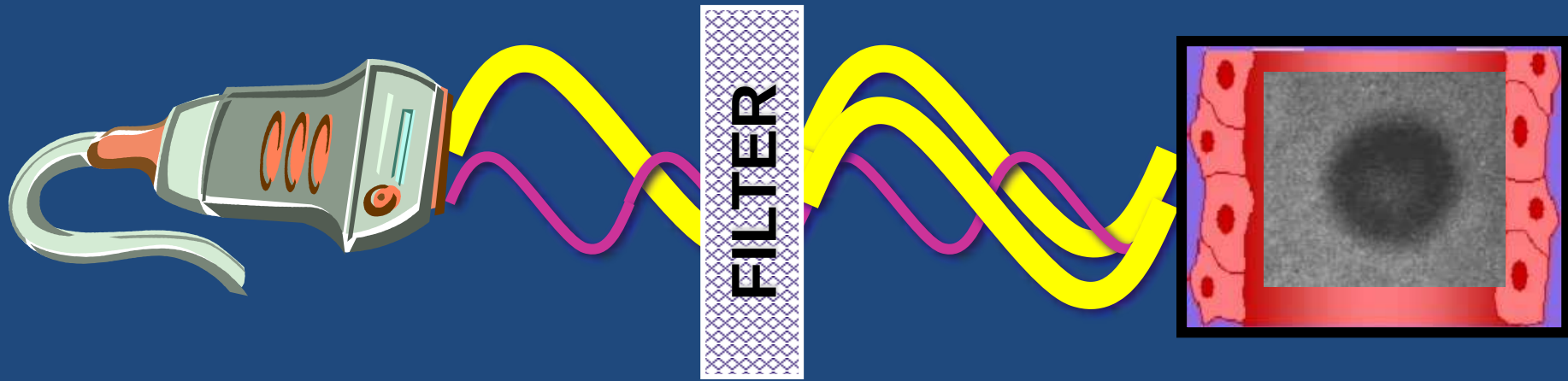


Comportamento Acustico delle Microbolle di SonoVue®

In funzione della pressione acustica applicata







Only harmonics can pass through, giving almost a “pure” image of the contrast agent

↓
CEUS

**Inconvenienti
dell'indagine
con MI basso**

Riduzione della risoluzione spaziale

Riduzione del potere di penetrazione del fascio

**Limiti
dell'indagine
con MI basso**

- **Meteorismo**
- **Obesità**
- **Sede profonda delle lesioni**

**Ecografia con
contrasto (CEUS)**

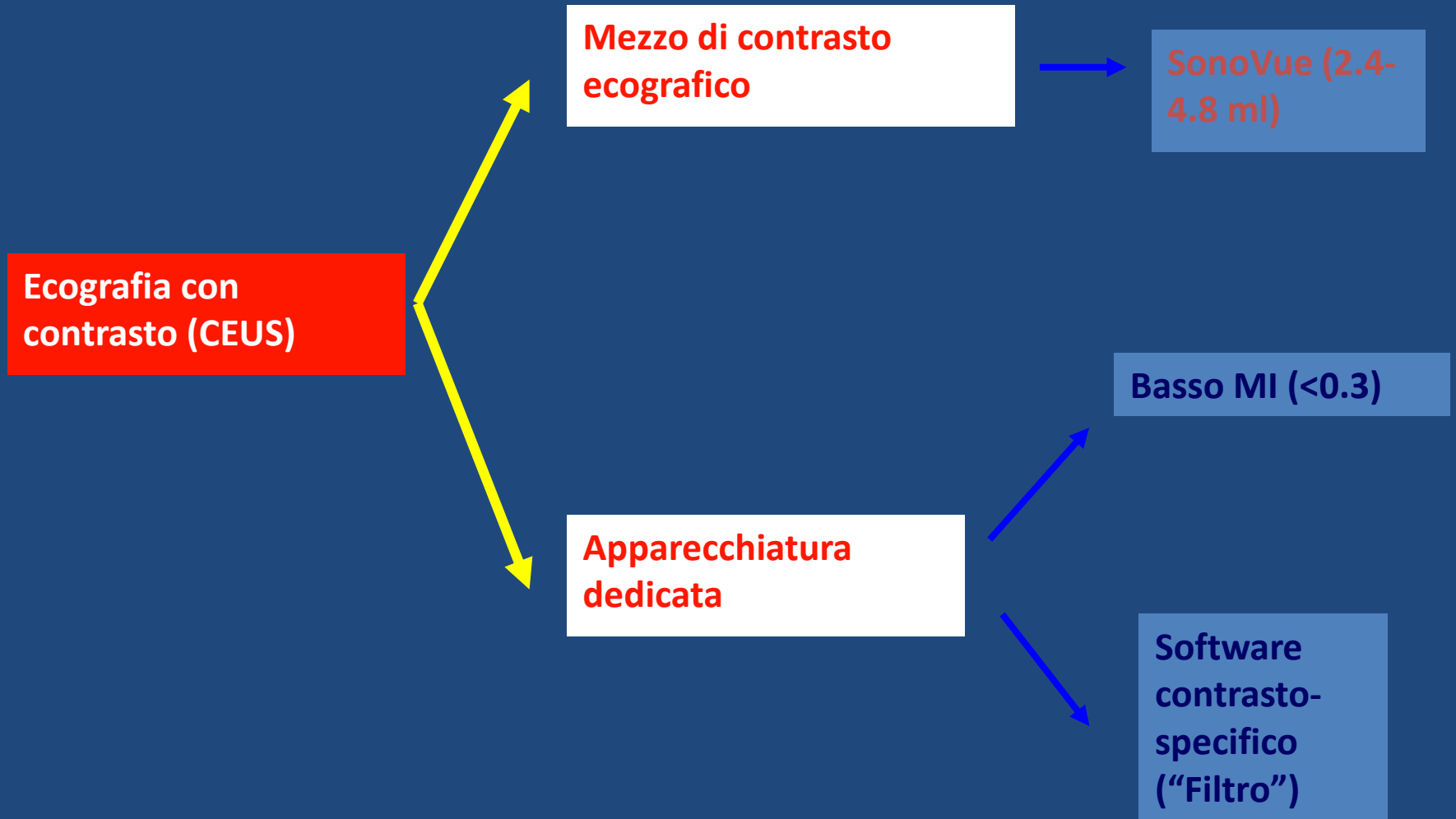
**Mezzo di contrasto
ecografico**

**SonoVue (2.4-
4.8 ml)**

**Apparecchiatura
dedicata**

Basso MI (<0.3)

**Software
contrasto-
specifico
("Filtro")**

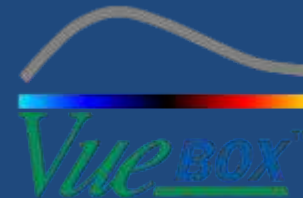


Quantitative assessment

Analysis of time-intensity curves
by dedicated software

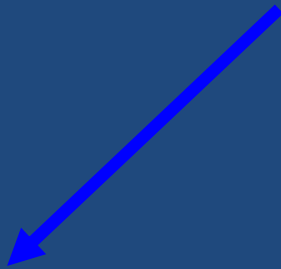
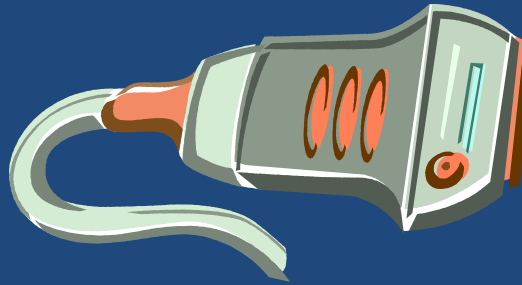
QLAB (Philips)

Qontrast



(Bracco)

Ecografia con contrasto: applicazioni cliniche



**Studio del
macrocircolo**

**Studio del
microcircolo e
dei tempi di
perfusione**

Guidelines and Good Clinical Practice Recommendations for Contrast Enhanced Ultrasound (CEUS) in the Liver - Update 2012

A WFUMB-EFSUMB Initiative in Cooperation With Representatives of AFSUMB, AIUM, ASUM, FLAUS and ICUS

Authors

M. Claudon^{1*}, C. F. Dietrich^{2*}, B. I. Choi³, D. O. Cosgrove⁴, M. Kudo⁵, C. P. Nolsøe⁶, F. Piscaglia⁷, S. R. Wilson⁸, R. G. Barr⁹, M. C. Chammas¹⁰, N. G. Chaubal¹¹, M.-H. Chen¹², D. A. Clevert¹³, J. M. Correas¹⁴, H. Ding¹⁵, F. Forsberg¹⁶, J. B. Fowlkes¹⁷, R. N. Gibson¹⁸, B. B. Goldberg¹⁹, N. Lassau²⁰, E. L. S. Leen²¹, R. F. Mattrey²², F. Moriyasu²³, L. Solbiati²⁴, H.-P. Weskott²⁵, H.-X. Xu²⁶

1. CEUS for characterization of focal liver lesions
2. Detection of malignant FLL: transabdominal approach
3. Intraoperative CEUS
4. Monitoring ablation treatment
5. Liver transplantation
6. Contrast quantification and monitoring systemic treatment of malignancies

The EFSUMB Guidelines and Recommendations on the Clinical Practice of Contrast Enhanced Ultrasound (CEUS): Update 2011 on non-hepatic applications

- Pancreas
- CE-EUS
- Gastrointestinal tract
- Spleen
- Kidney
- Vesico-ureteric reflux
- Scrotum
- Abdominal trauma
- Lung and pleural lesions
- Vascular
- Cerebral vessels
- Inflammatory joint diseases
- Intracavitary uses
- Lymph Nodes
- Tumour response assessment
- Breast
- Adrenal glands

Emerging perspectives and potential future applications for CEUS:

- Obstetrics and Gynaecology
- Perineum
- Urinary bladder
- Transplanted kidney
- Prostate cancer
- Aorto-caval fistula
- Free tissue transplants
- Biliary disease

Use of CEUS in patients with renal failure

Guidelines and Good Clinical Practice Recommendations for Contrast Enhanced Ultrasound (CEUS) in the Liver - Update 2012

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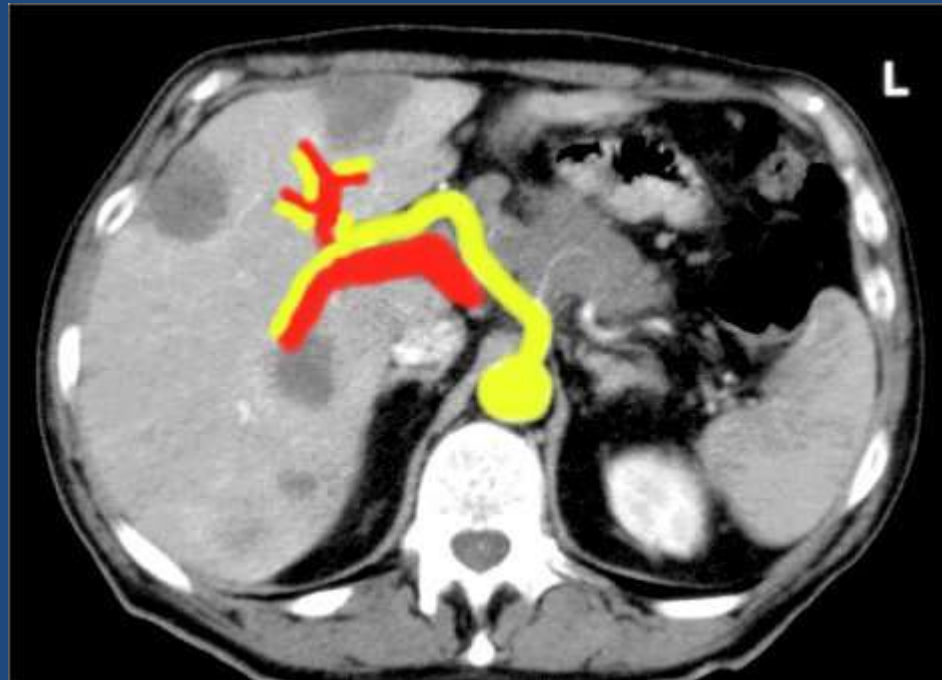
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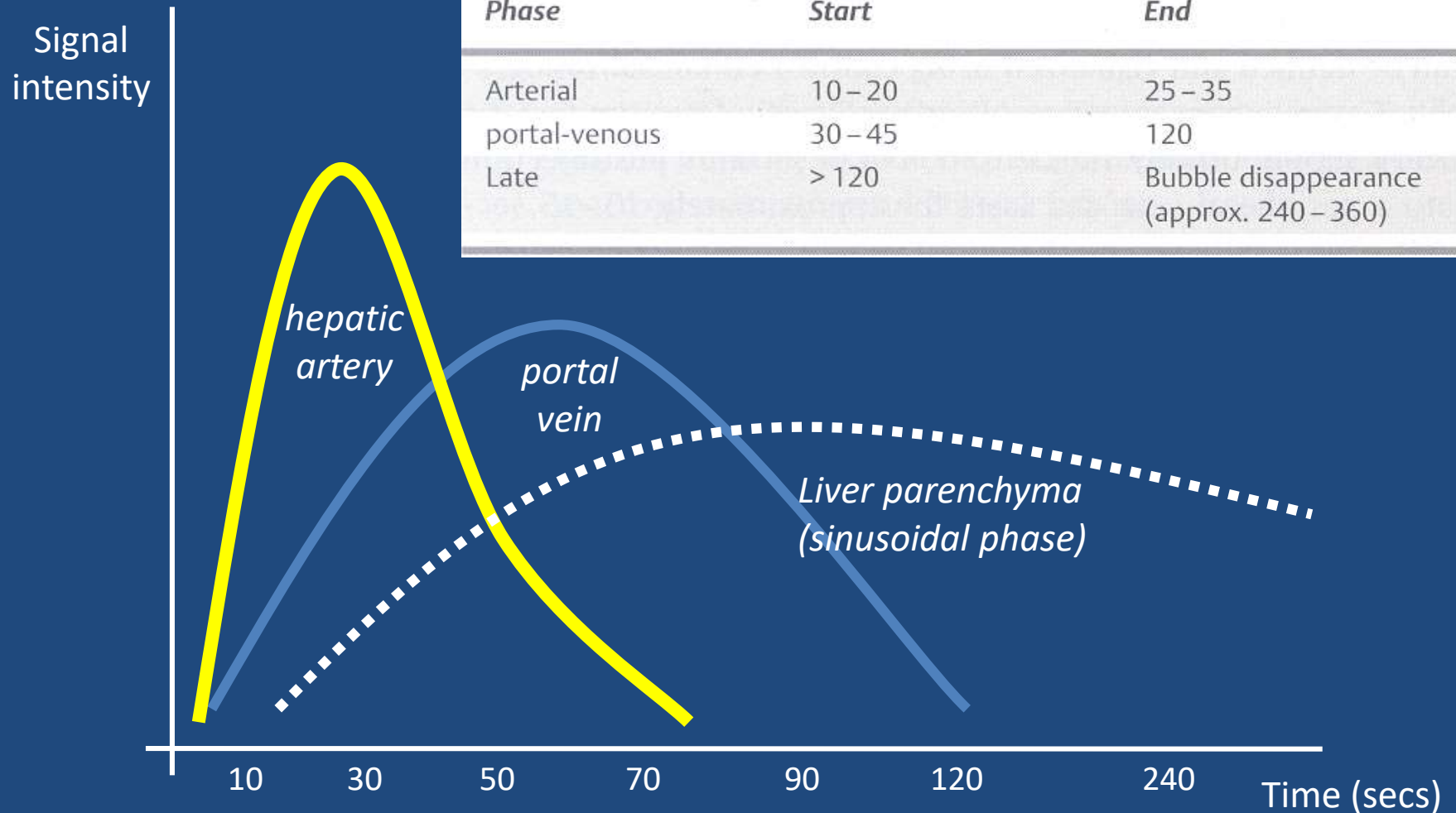
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Liver vascular inflow

- Double vascular inflow
 - Arterial (25-30%)
 - Portal (70-75%)



Kinetics of US contrast agents





2.8



13.11.28

4C1-3 12Hz

40020 190mm

ASD

GENERALE

Pat=0dB HI=1.9

50dB T1/+2/3/2

Good= 14dB Δ=2

Addome

Duplex

Sonda Rotina / 3.5MHz

Spes marcat

**Tipizzazione delle lesioni
focali del fegato in base
al pattern vascolare**

fase arteriosa

fase porto-tardiva





Tipizzazione delle lesioni focali del fegato in base al pattern vascolare **in** **fase arteriosa**

Presenza o assenza di **enhancement** in
confronto al parenchima circostante

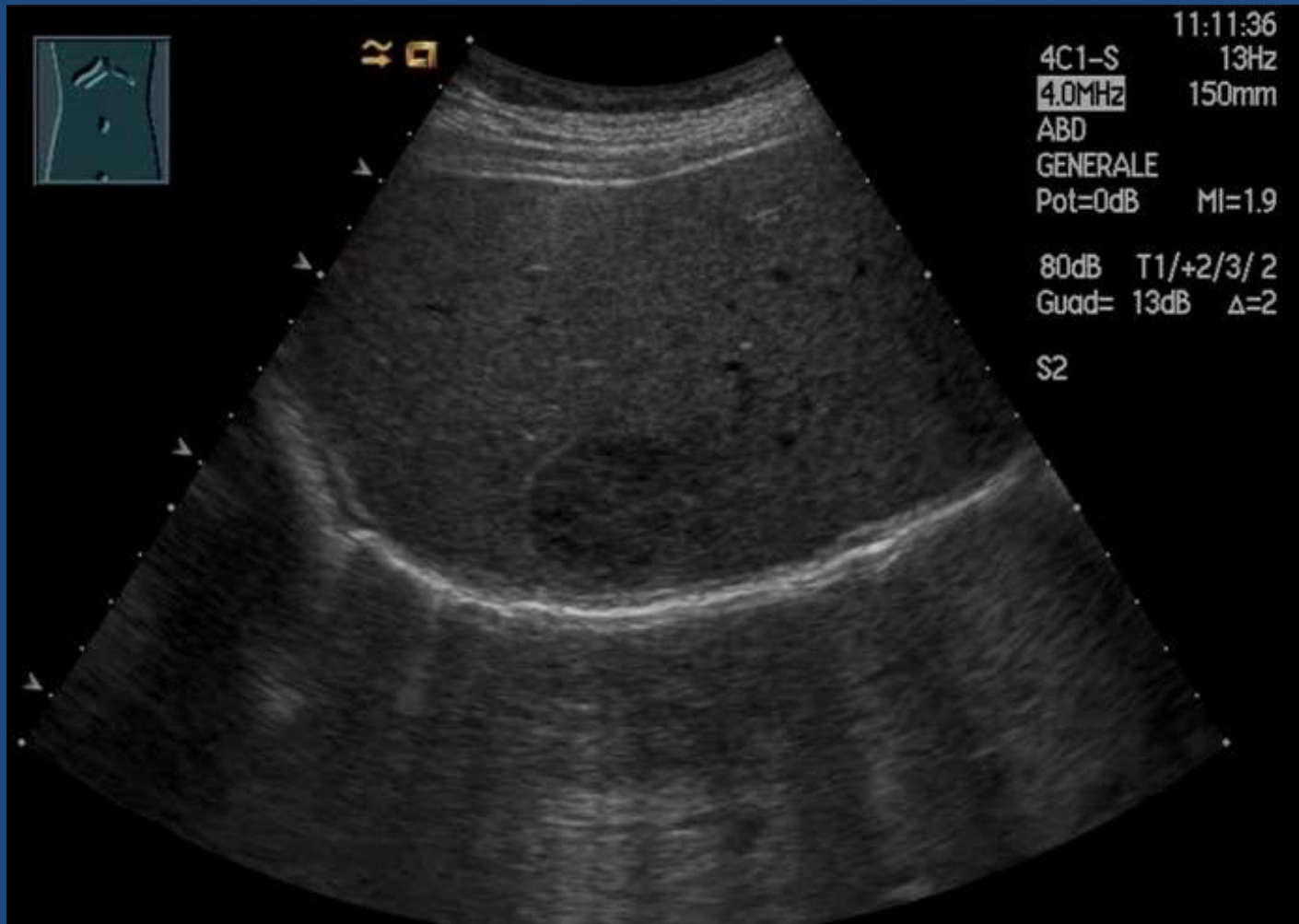
Pattern vascolare specifico (pattern
a ruota di carro, periferico
nodulare, rim-like, arterie irregolari,
ecc)

Sede dell' iniziale enhancement nella
lesione (centrale, periferico) e **modalità**
di **perfusione** (centripeta, centrifuga)



Figure 1. Different contrast enhancement patterns in focal liver lesions. Absent (A), dotted (B), peripheral rimlike (C), peripheral nodular (D), central with spoke wheel-shaped (E), diffuse homogeneous (F), and diffuse heterogeneous (G) enhancement patterns are shown.

Angioma



Enhancement periferico globulare

Epatocarcinoma



Enhancement diffuso omogeneo

Colangiocarcinoma intraepatico



Enhancement diffuso disomogeneo

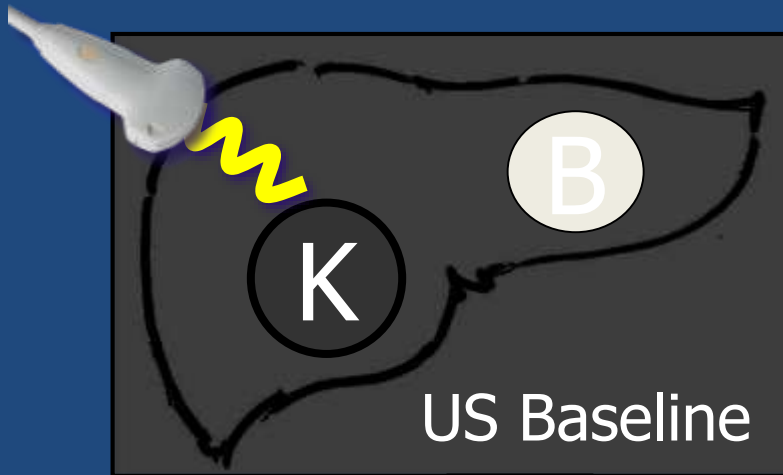


Tipizzazione delle lesioni
focali del fegato in base
al pattern vascolare **in**
fase tardiva

Lesione iso-iperecogena

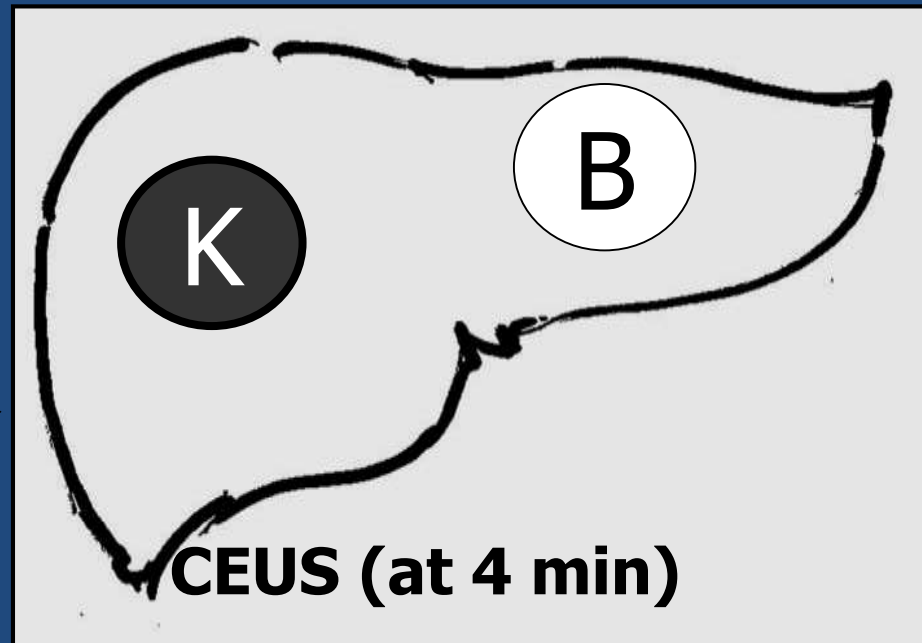
Lesione ipoecogena

“impregnazione” in fase tardiva



MDC

Specificità per la
caratterizzazione delle FLL
= 95-100% *



*Albrecht T, Eur Radiol 2004; *von Herbay A, J Ultrasound Med, 2004;* Bleuzen A, Eur Radiol,2004

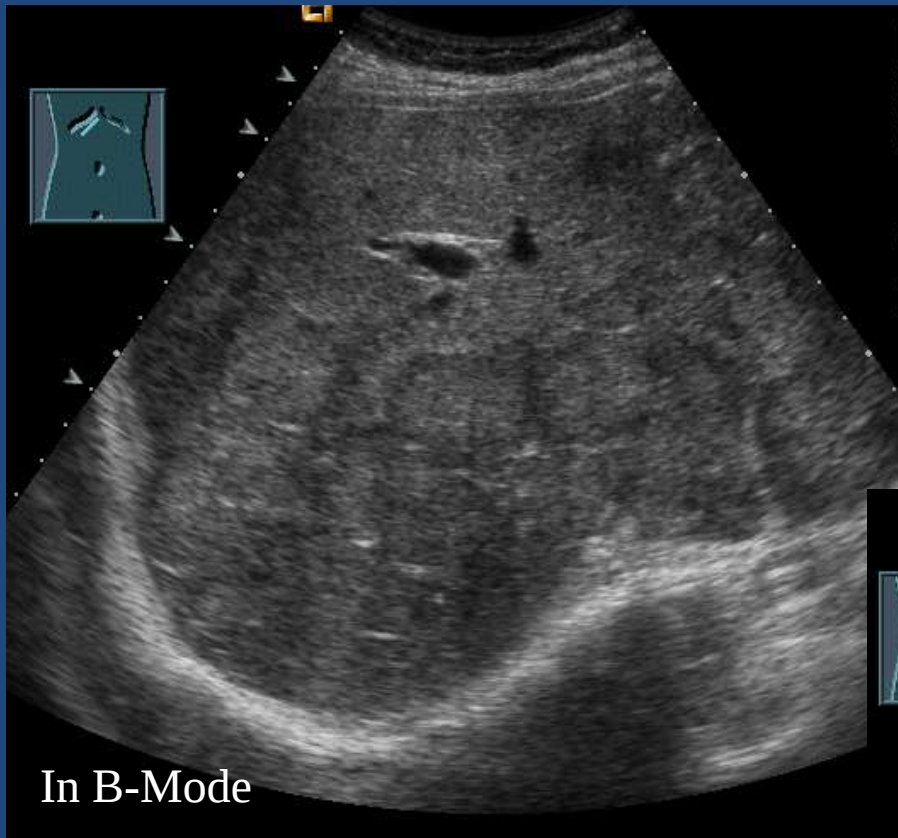
*EFSUMB Study Group et al.,Ultraschall in Med 2008



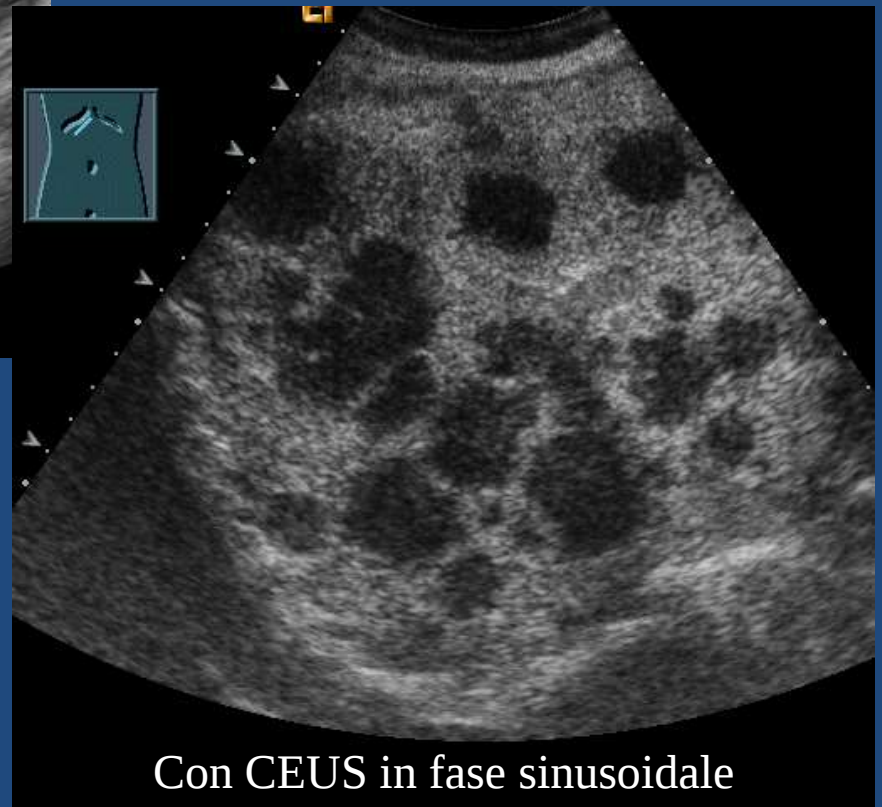
Iperplasia nodulare focale

Metastasi epatica da Ca retto





**Metastasi isoecogene con alone
da carcinoma del colon**



Contrast-enhanced ultrasound for the characterization of focal liver lesions – Diagnostic accuracy in clinical practice (DEGUM multicenter trial)

CEUS	Sensitivity	Specificity	Diagnostic accuracy
All lesions (n.1328)	95.8%	83.1%	90.3%
Lesions > 2 cm (n.999)	96.5%	86%	92.2%
Lesions ≤ 2 cm (n.329)	93.3%	75.9%	84.5%

The overall diagnostic accuracy of CEUS in the differentiation of malignant and benign liver lesions was 90.3%

THE SAFETY OF SONOVUE® IN ABDOMINAL APPLICATIONS: RETROSPECTIVE ANALYSIS OF 23188 INVESTIGATIONS

L. Aiani, M. Luigi Angeli, V. Arienti, L. Barozzi, R. Basilico, M. Bertolotto, E. Biasini, P. Busilacchi, F. Calliada,* M. Caremani, E. Caturelli, N. Celli, A. Colecchia, L. Cova, M. Assunta Cova, L. Crocetti, I. de Sio, F. Drudi, G. Ferraioli, C. Filice, F. Fornari, S. Gaiani, F. Giangregorio, A. Giorgio, T. Ierace, R. Lencioni, T. Livraghi, F. Magnolfi, A. Martegani, F. Meloni, G. Menozzi, G. Pelosi, M. Pompili, L. Riccardi, P. Ricci, L. Rubaltelli, D. Sacerdoti, G. Serafini, C. Serra, L. Solbiati, D. Tacconi, M. Valentino, G. Vidili and F. Vitali

F. Piscaglia, *Ultrasound in Medicine and Biology*, 2006

THE SAFETY OF SONOVUE® IN ABDOMINAL APPLICATIONS: RETROSPECTIVE ANALYSIS OF 23188 INVESTIGATIONS

No fatal event occurred.

Adverse events were reported in **29 cases**, of which **only two were graded as serious**; the rest, 27, were nonserious (23 mild, three moderate and one severe). The overall reporting rate of serious AE was 0.0086%. Overall, **only four AEs required treatment** (two serious, two nonserious including one moderate and one severe AEs).



AE “serious” = 0.009% (1/10.000 patients)

F. Piscaglia, Ultrasound in Medicine and Biology, 2006

THE SAFETY OF SONOVUE® IN ABDOMINAL APPLICATIONS: RETROSPECTIVE ANALYSIS OF 23188 INVESTIGATIONS

Description of the two **serious adverse events** (AEs) reported in the present series

1) **Dyspnoea, bronchospasm, slight hypotension and bradycardia**

Onset time: 1 min; recovered after 2 g of i.v. corticosteroids antihistamines

2) **Clouding of consciousness, dursolumbar pain, severe hypotension, cutaneous rash**

Onset time: 2 min; hypotension lasted 30 min and slowly recovered after administration of 1 g of hydrocortisone and vasoactive amines. CT examination performed 6 h after the reported events showed occlusion of the stent previously positioned in the right renal artery.

Some of the reported AEs (dizziness, nausea, vomiting, cold sweat, hypotension etc.) may be due to **vasovagal reaction**. Some (including the two serious AEs and one nonserious and severe AE) had signs or symptoms of **anaphylactic-anaphylactoid reactions** (Hagan 2004), with an overall reporting rate for this type of reaction of 0.013% (3/23188), lower than that reported for other contrast media and similar to that of some commonly used drugs such as analgesics or antibiotics of common use (0.005 to 0.015%)

Eventi avversi del SonoVue

In pazienti con preesistente patologia coronarica, i fenomeni di bradicardia e ipotensione sono stati accompagnati da ischemia miocardica e/o infarto del miocardio.

Attenzione!!



Sono stati segnalati 3 casi di decesso in associazione temporale con l'uso di SonoVue, tutti pazienti con grave cardiopatia ischemica.

Eventi avversi del SonoVue

Controindicazioni

- Nota ipersensibilità all'esafluoruro di zolfo
- **Sindrome coronarica acuta di recente evoluzione**
- **Ischemia cardiaca clinicamente instabile: Infarto del miocardio in corso o in evoluzione, angina instabile, recenti by-pass aortocoronarici**
- **Insufficienza cardiaca acuta o cronica di classe III e IV**
- Aritmie di grado severo
- Grave ipertensione polmonare
- Ipertensione sistemica non controllata
- Sindrome da distress respiratorio
- Shunts destro-sinistro

Precauzioni



- Osservazione del paziente per almeno 30 minuti dopo la somministrazione (??)
- Disponibilità di attrezzature per interventi di emergenza
- Consenso informato

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www.gastroenterologia.arezzo.it