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Società Italiana di Ecografia
in Medicina e Chirurgia

II CORSO NAZIONALE E
SEMINARI DI
ECOGRAFIA CLINICA
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RIMINI,
4 - 7 OTTOBRE 2015
AQUA HOTEL + ARIA HOTEL

Policlinico S. Matteo, IRCCS, Pavia

VI Department of Internal Medicine

**L'evoluzione
tecnologica applicata
all'interventistica
eco-guidata**

Sandro Rossi M.D.

Tumor thermal ablation (TA)

- ✓ Ethanol injection
- ✓ Acetic acid injection
- ✓ Laser photocoagulation
- ✓ Radiofrequency ablation
- ✓ Microwave ablation
- ✓ Resective surgery

Physical Principles of RF/MW TLs

HEAT DEPOSITION IN THE TISSUE

- Active surface/electrode caliber
- Power setting
- Delivery time
- Energy delivered

Rossi S. 1987 Feb.



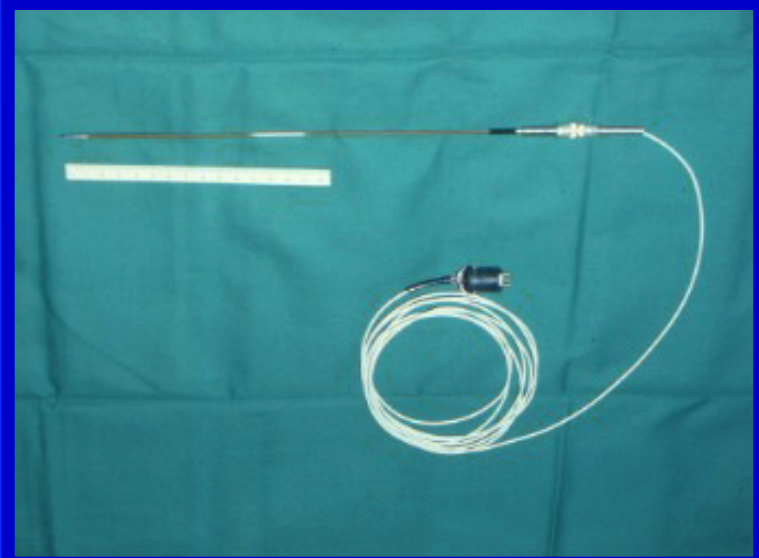
HEAT LOSS BY TISSUE CONVECTION

- Portal vein
- Hepatic artery
- Tumor vascularity

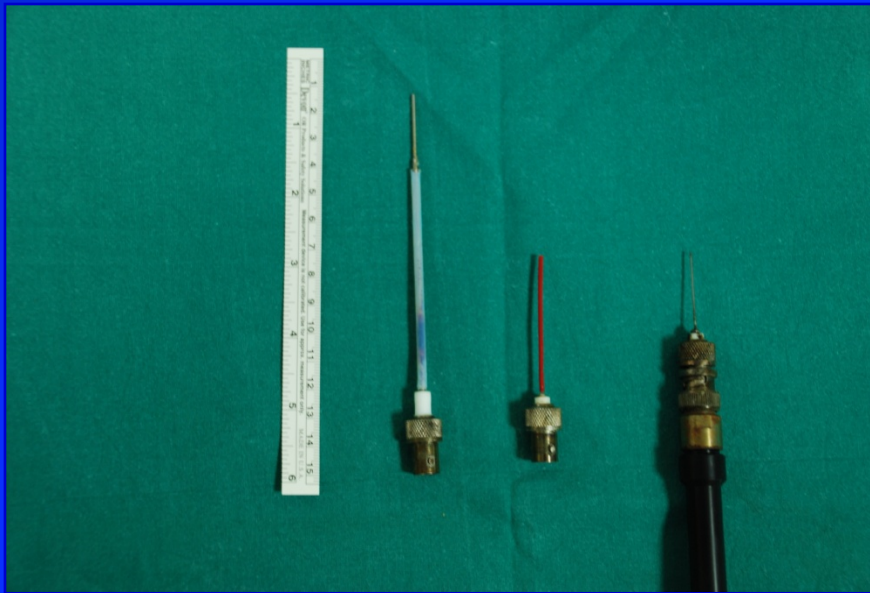
TISSUE PHYSICO-CHEMICAL CHARACTERISTICS

- Impedance values

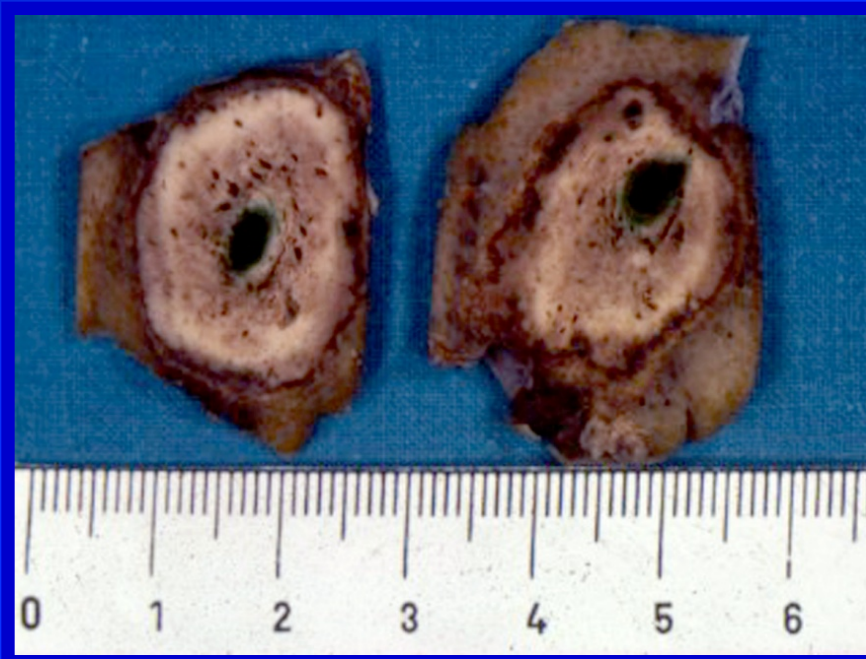
TA : RF system



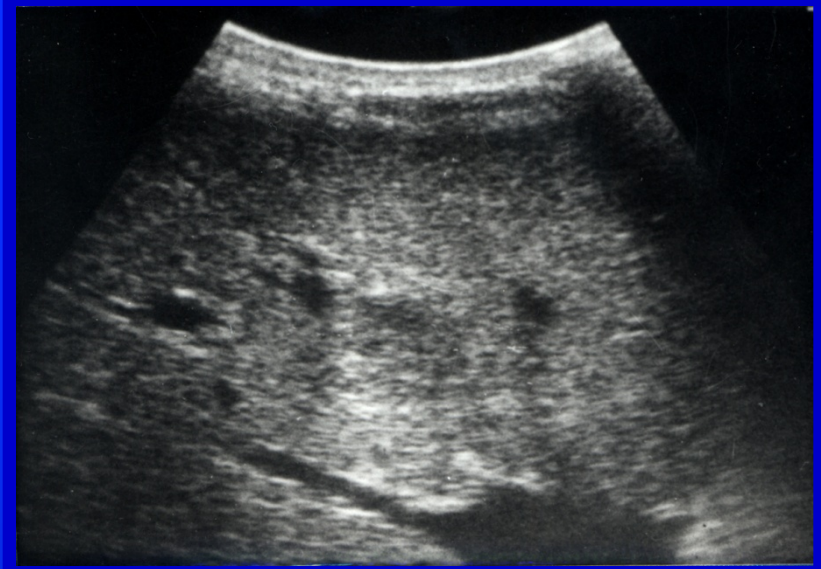
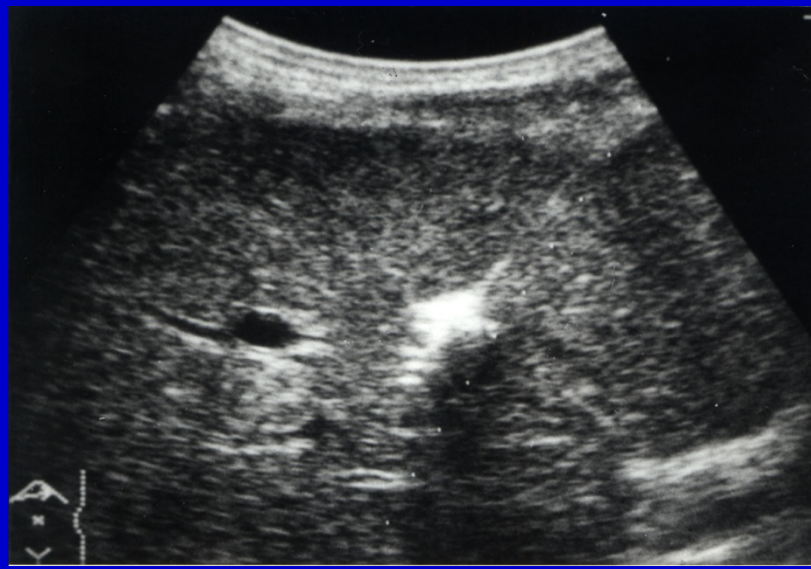
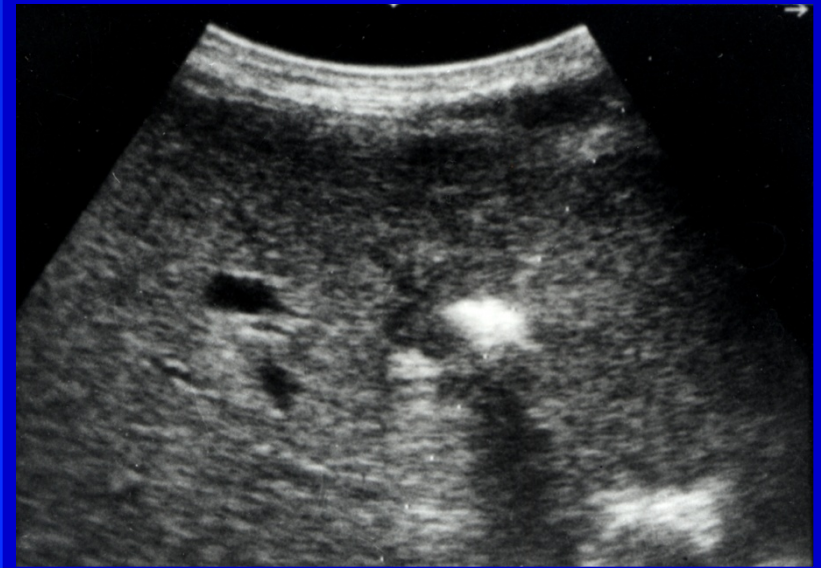
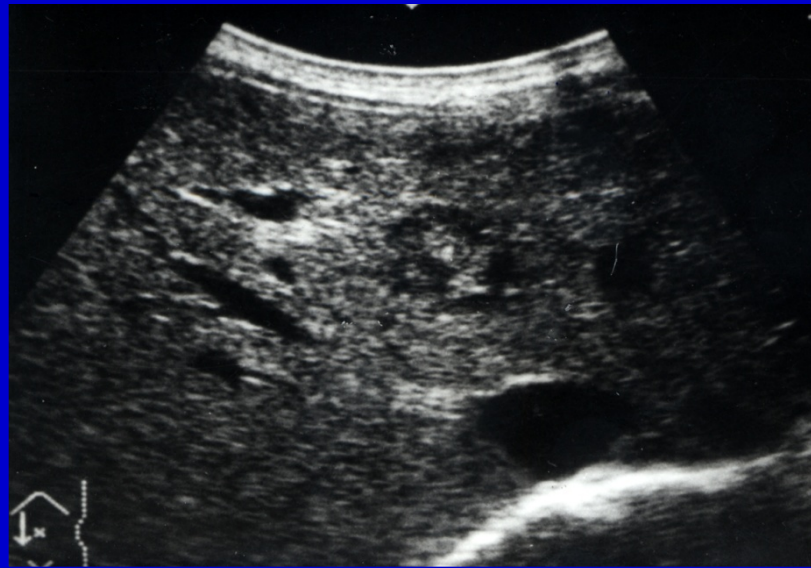
TA: MW system



TA : LASER system

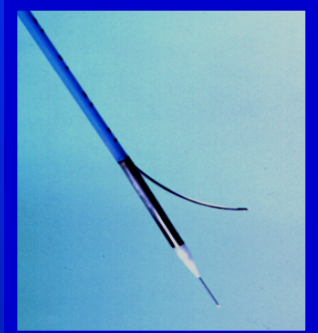
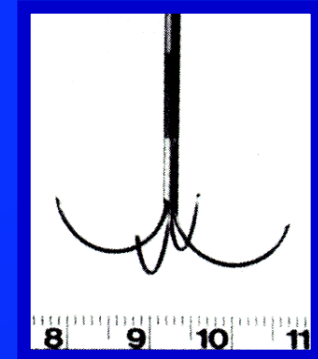


TA with monopolar RF system

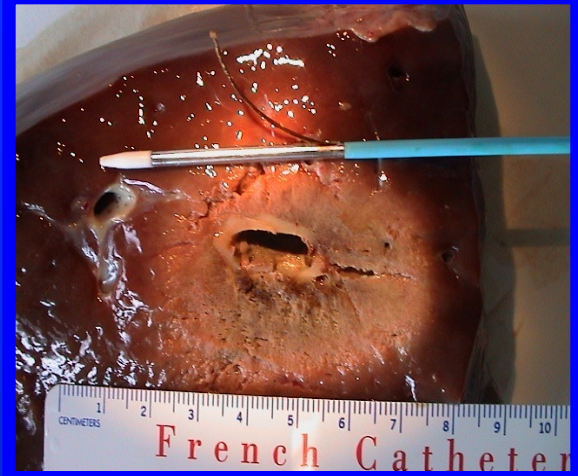
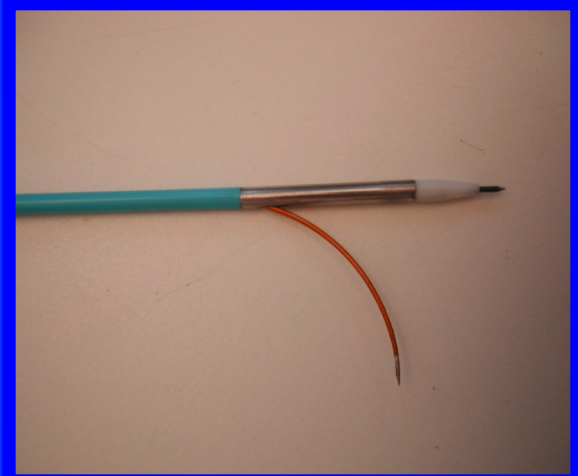
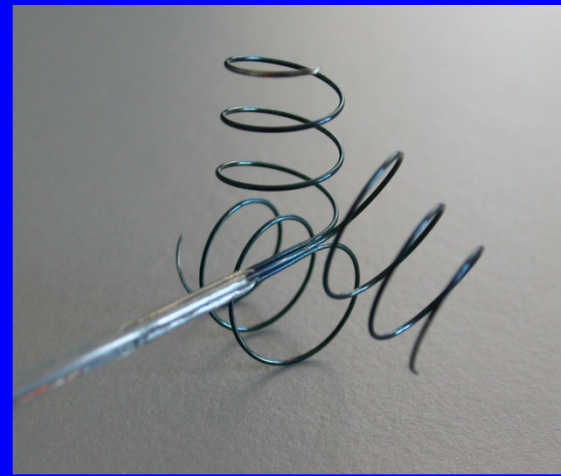
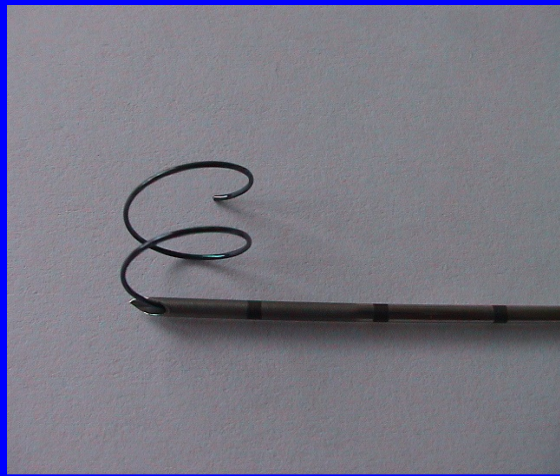


Radio-frequency Devices

- ✓ RF expandable needle electrode (16G)
(RITA Med System, Mountain View, CA)
- ✓ RF expandable needle electrode (14G)
(Radiotherapeutics, Mountain View, CA)
- ✓ Liver cooled electrodes (10G-19G)
(Radionix, Burlington, MA, Fogazzi, Concesio, I)



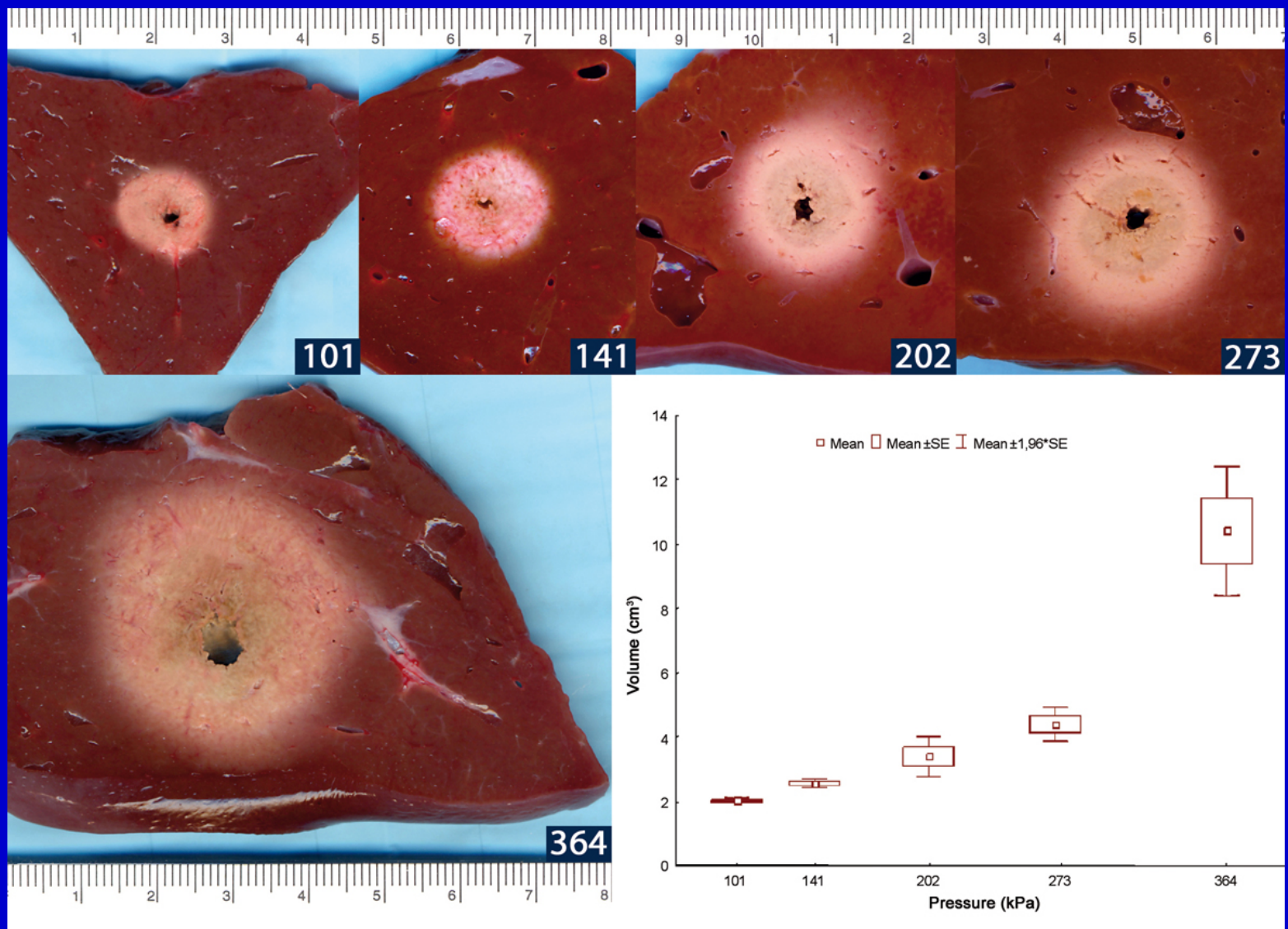
New RF active electrodes



TA: MW system

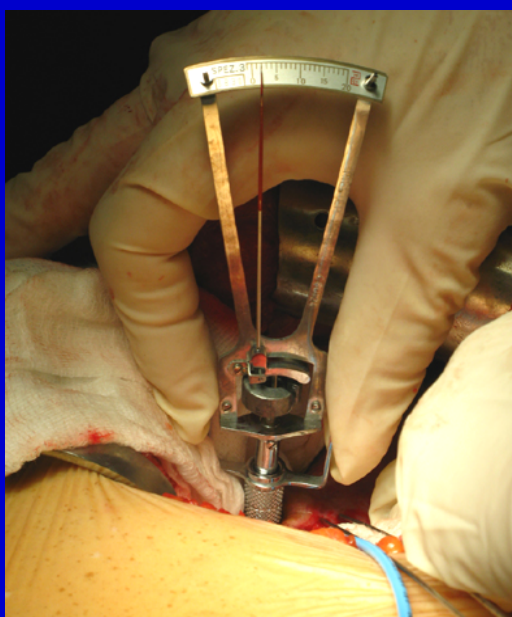
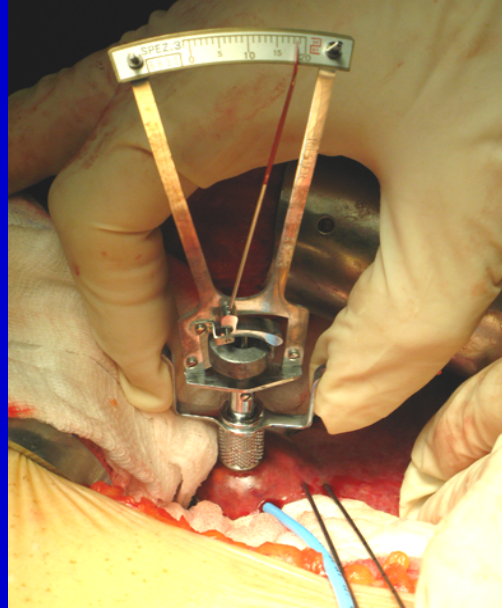
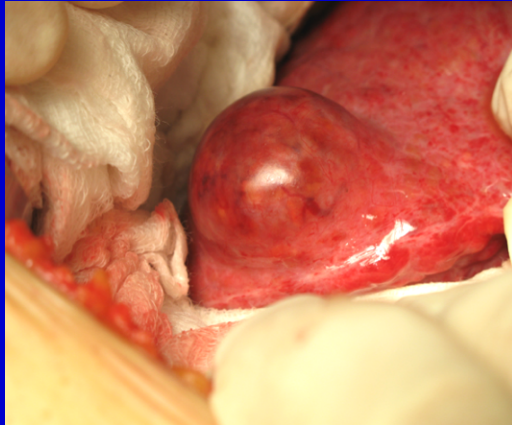


Effect of hyperbarism: Experimental evidences



Internal HCC pressure during RFA

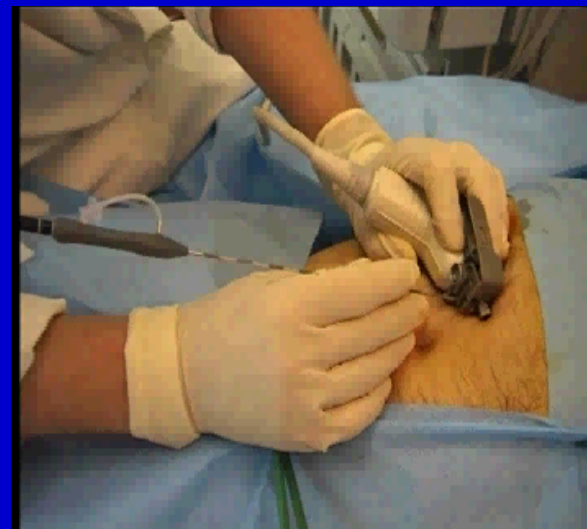
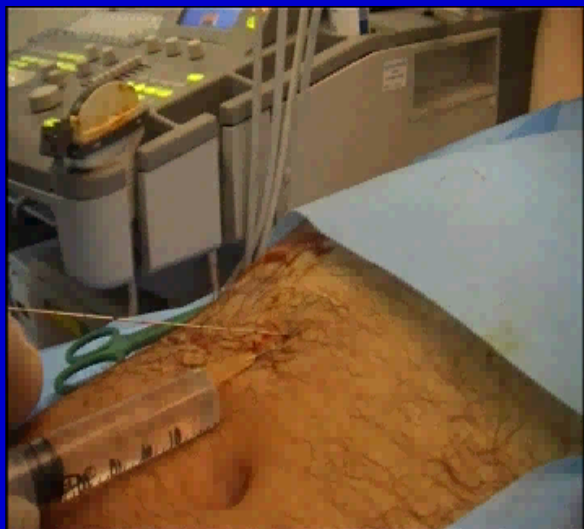
Encapsulated HCC: ideal tumor for RFA



- ✓ *“ Pressure cooking effect ”*
- ✓ Maximum pressure measured: 300 mmHg
- ✓ The measured pressures were compatible with the increase of volume based on experimental evidence

*Rossi S. et al. AJR
2007*

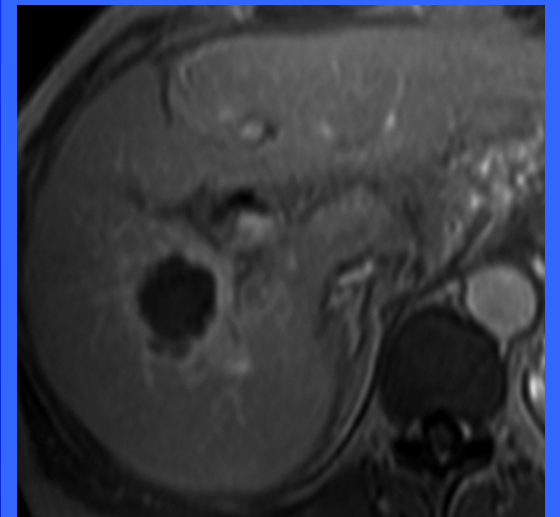
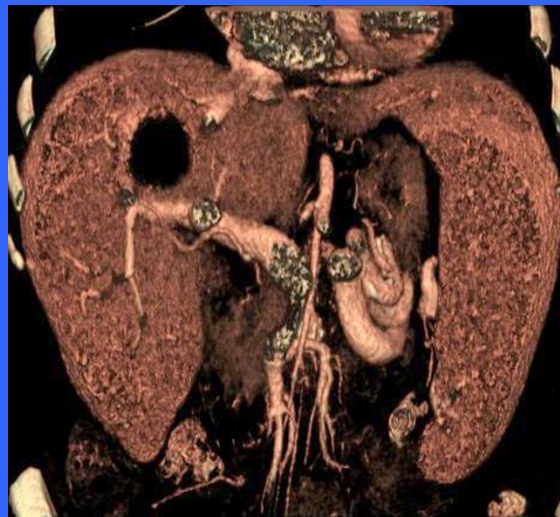
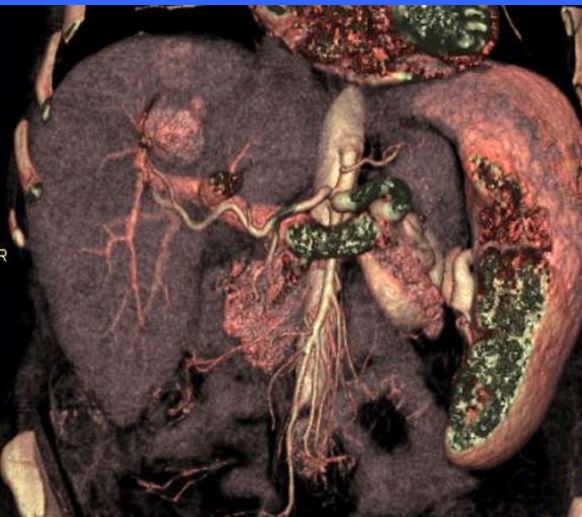
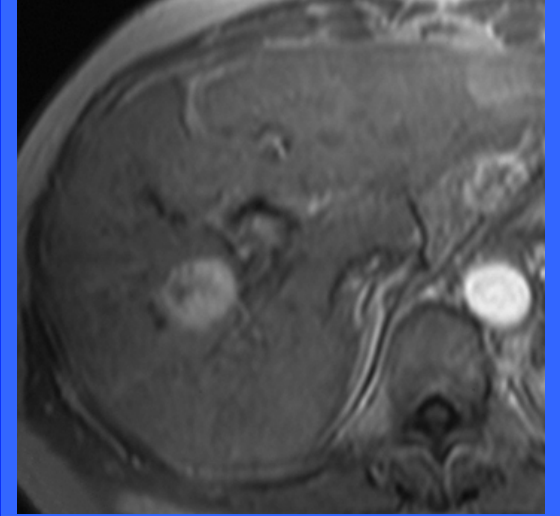
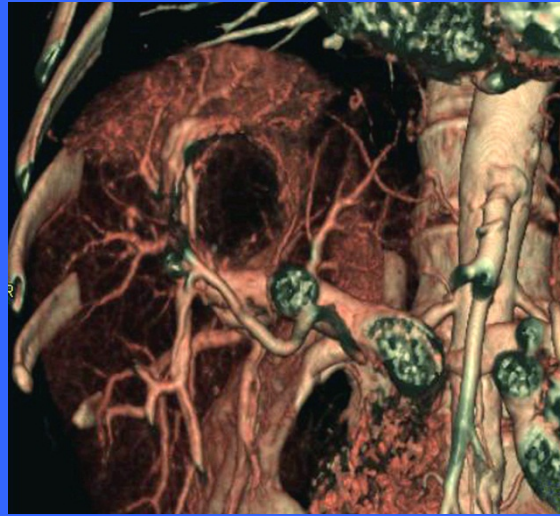
TA Technique: Percutaneous approach



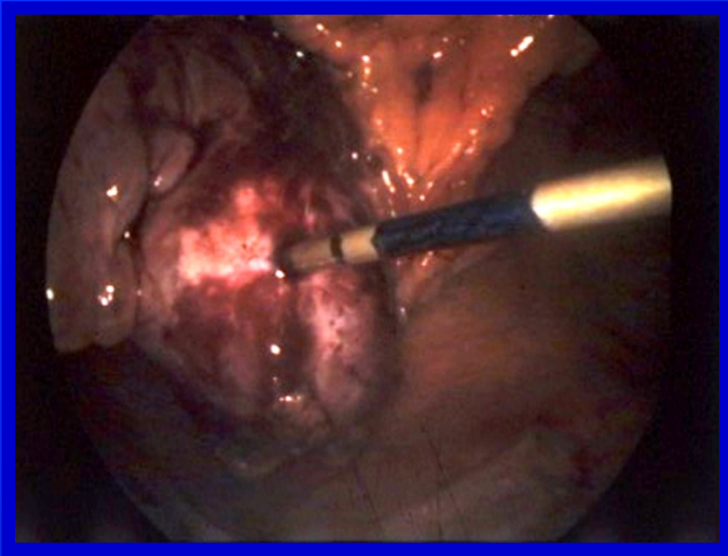
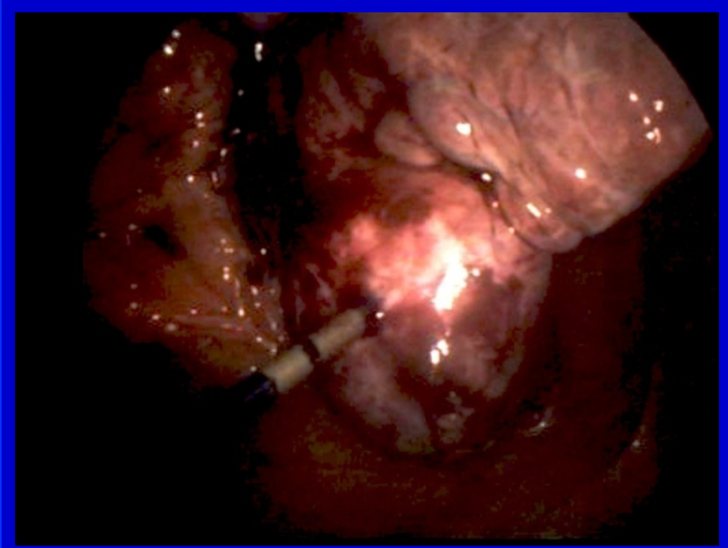
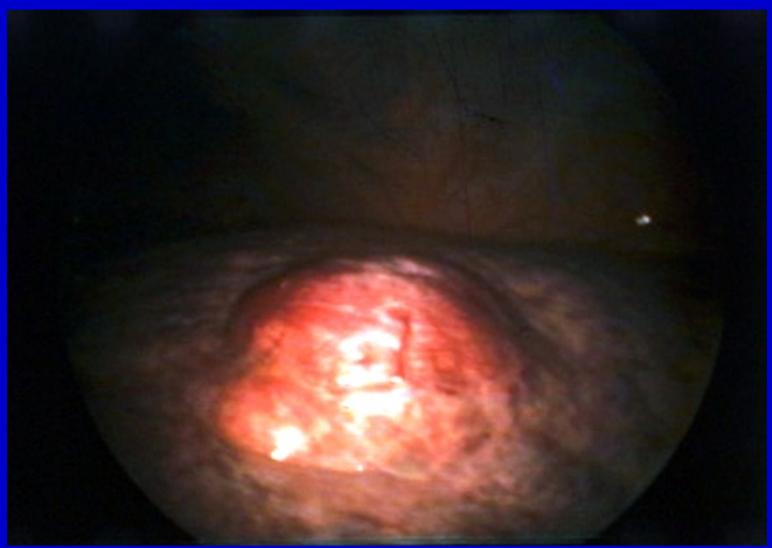
TA Technique: Percutaneous approach



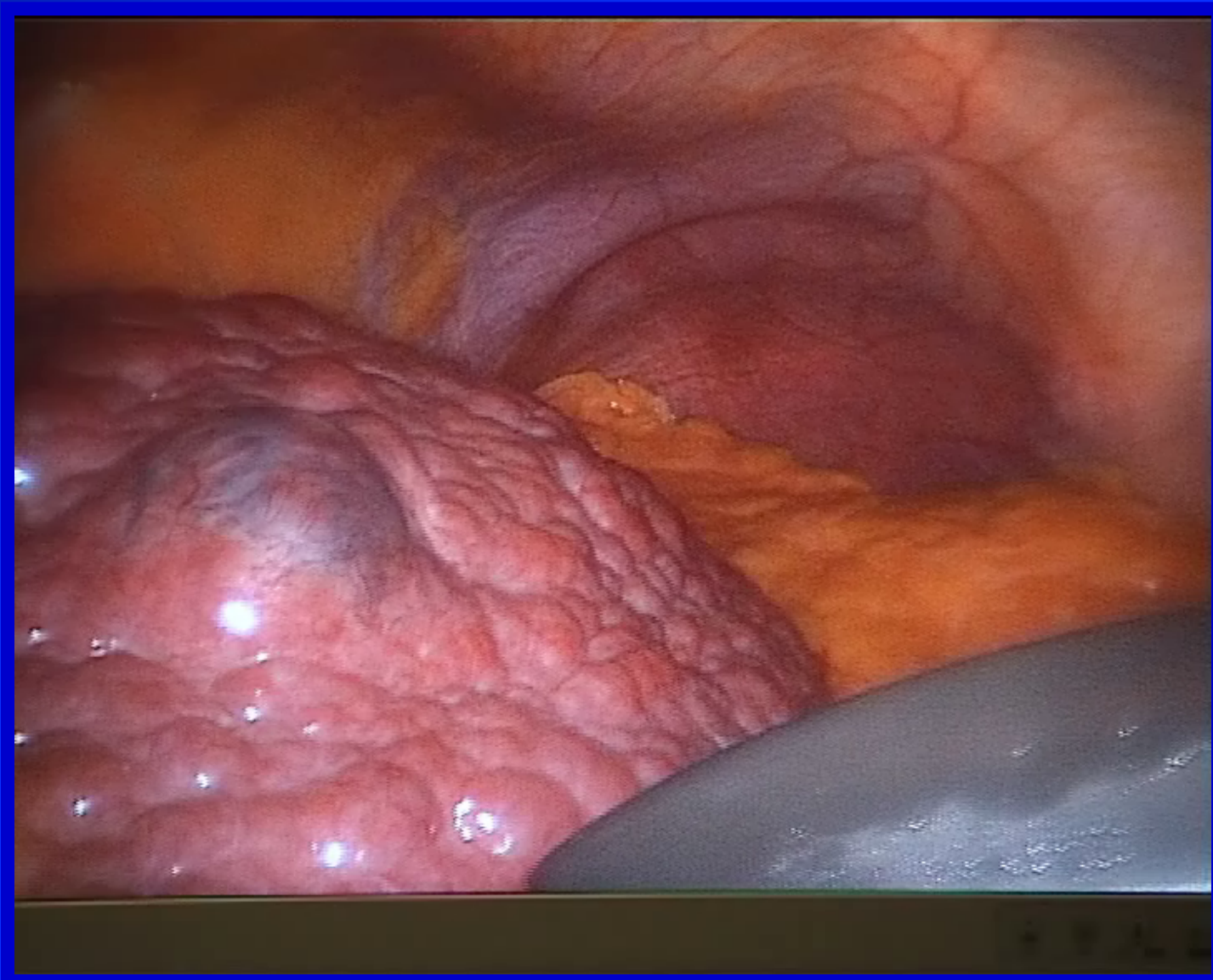
Post-treatment results : complete ablation



Laparoscopic approach



Laparoscopic approach



Intra-laparoscopic US during TA procedure



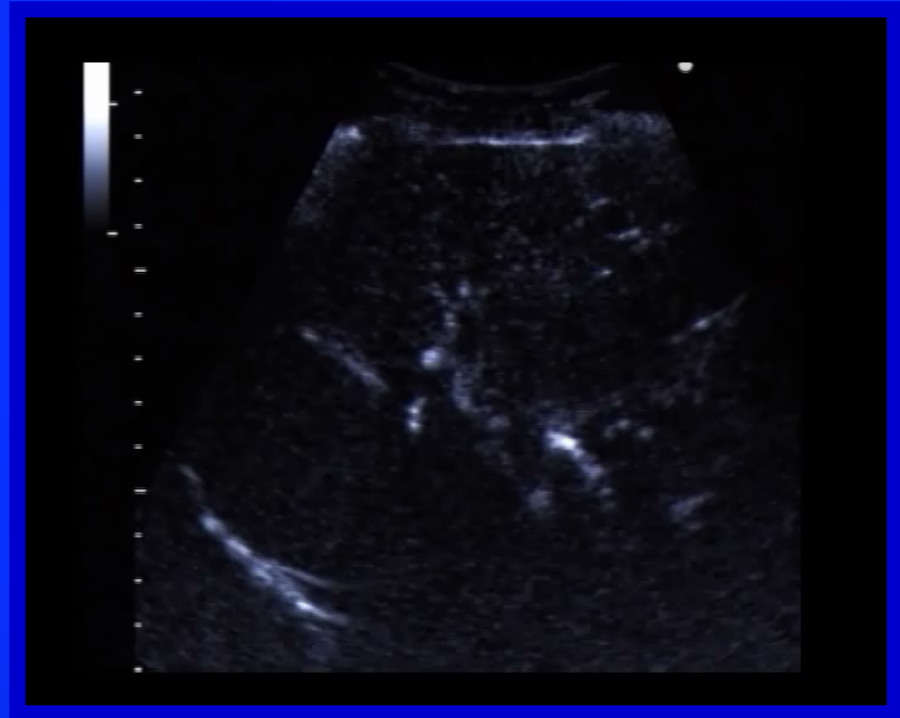
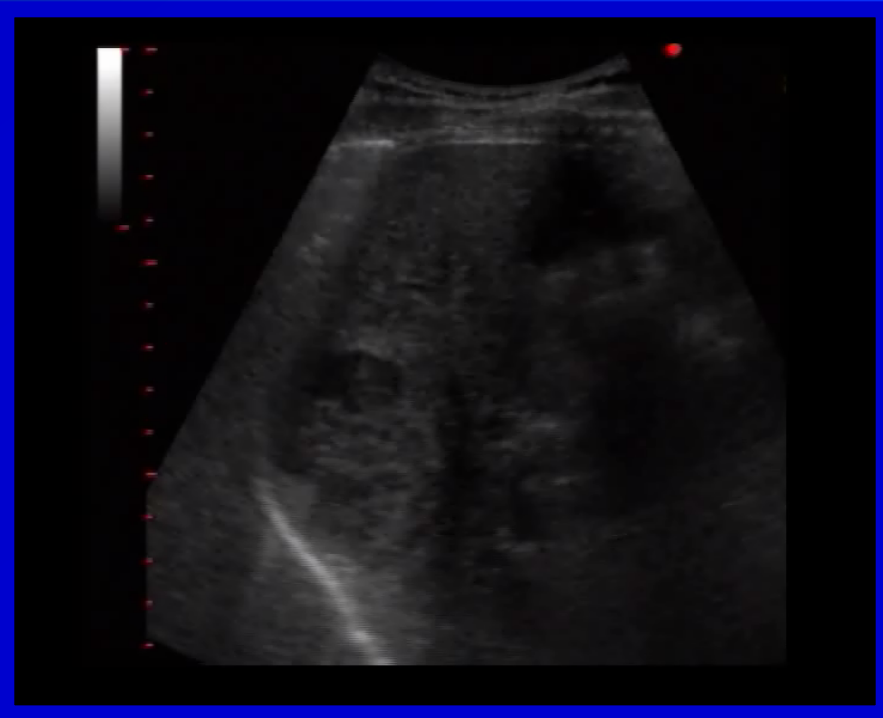
TA during occlusion of tumor arterial supply

Thermal lesion
obtained using a
14G expandable
electrode during
partial occlusion
of hepatic vein

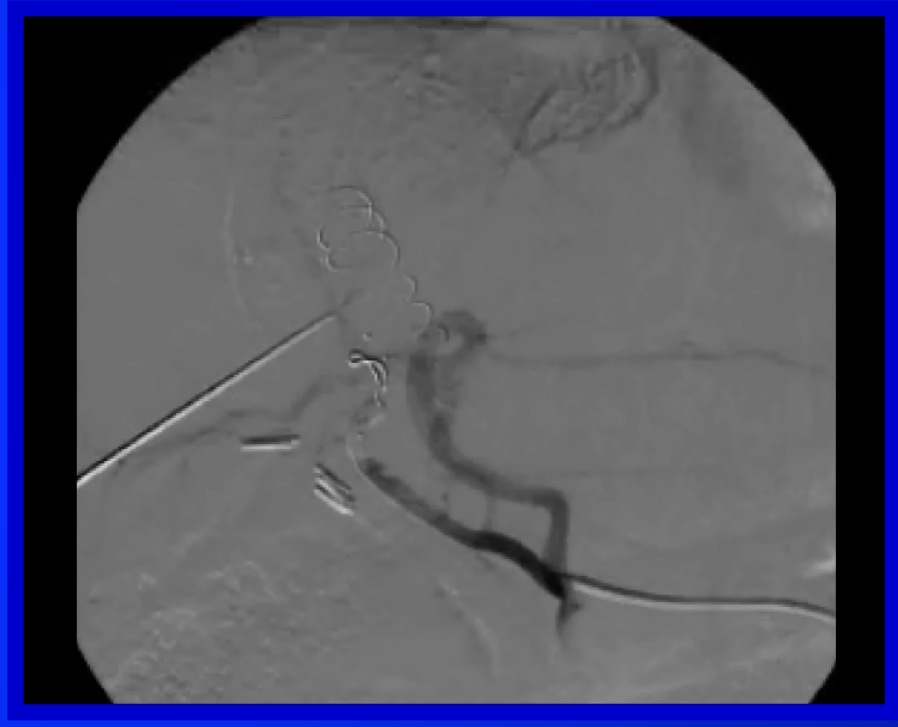
Rossi S, et al. Tumori 1999



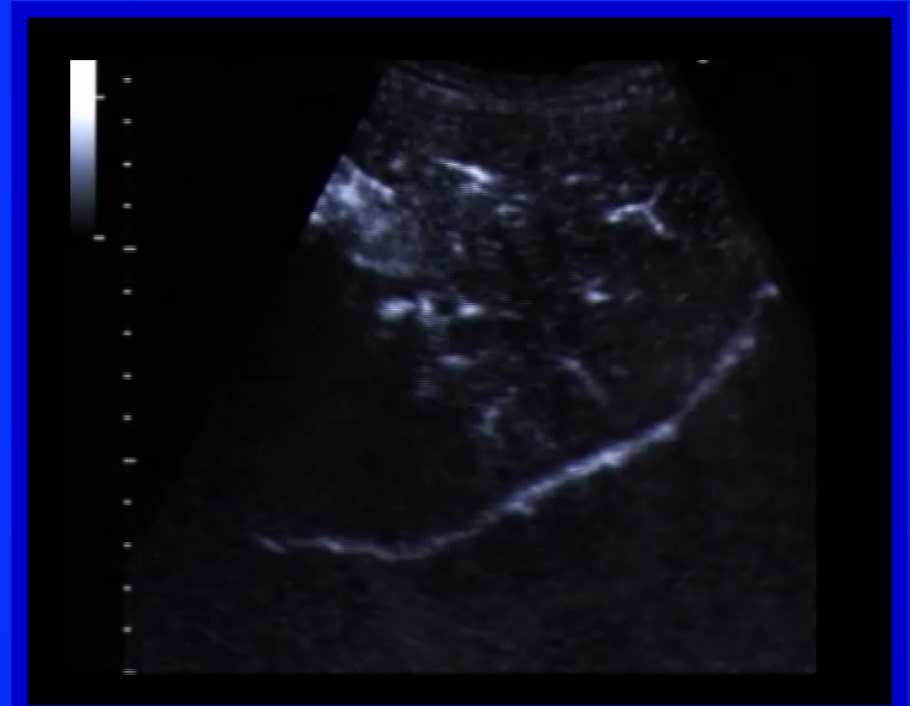
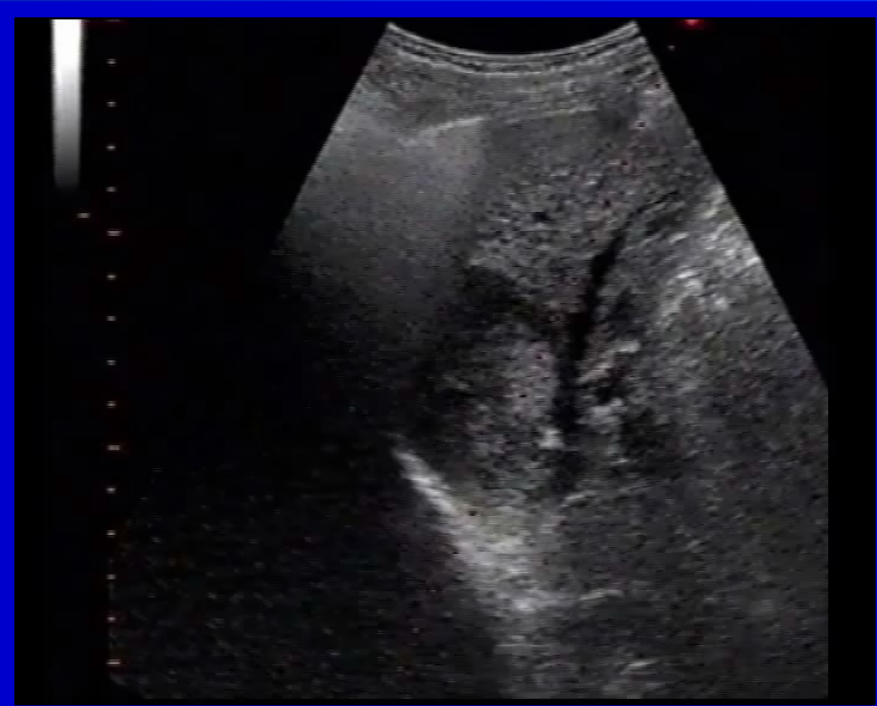
TA during occlusion of tumor arterial supply



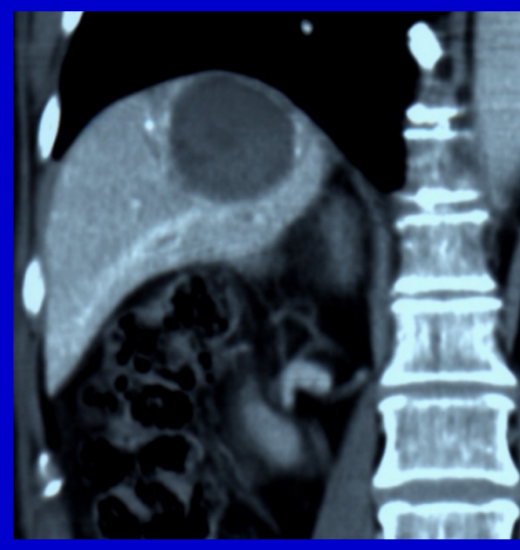
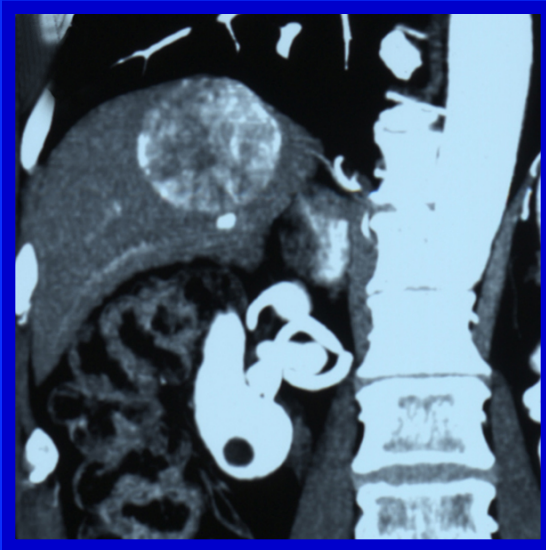
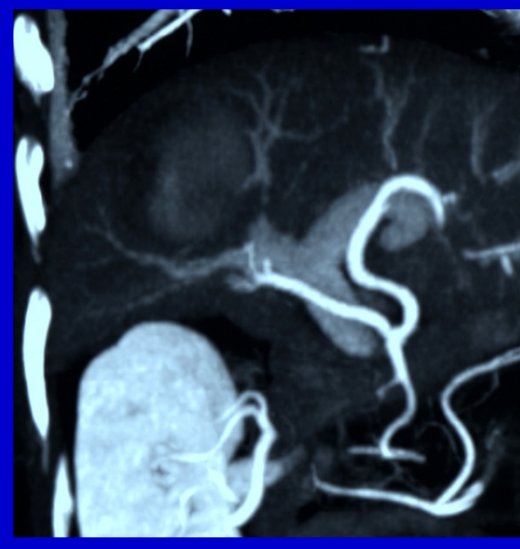
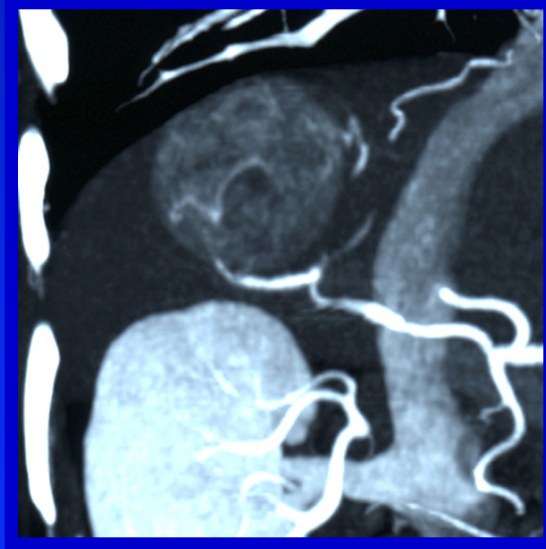
TA during occlusion of tumor arterial supply



TA during occlusion of tumor arterial supply



TA during occlusion of tumor arterial supply



HCC patients treated by TA (1997 – 2007)

- 706 cirrhotic pts. with 857 HCC nodules smaller than 35 mm

- Mean age, 68.9±6 y; M:503

- Etiology of cirrhosis

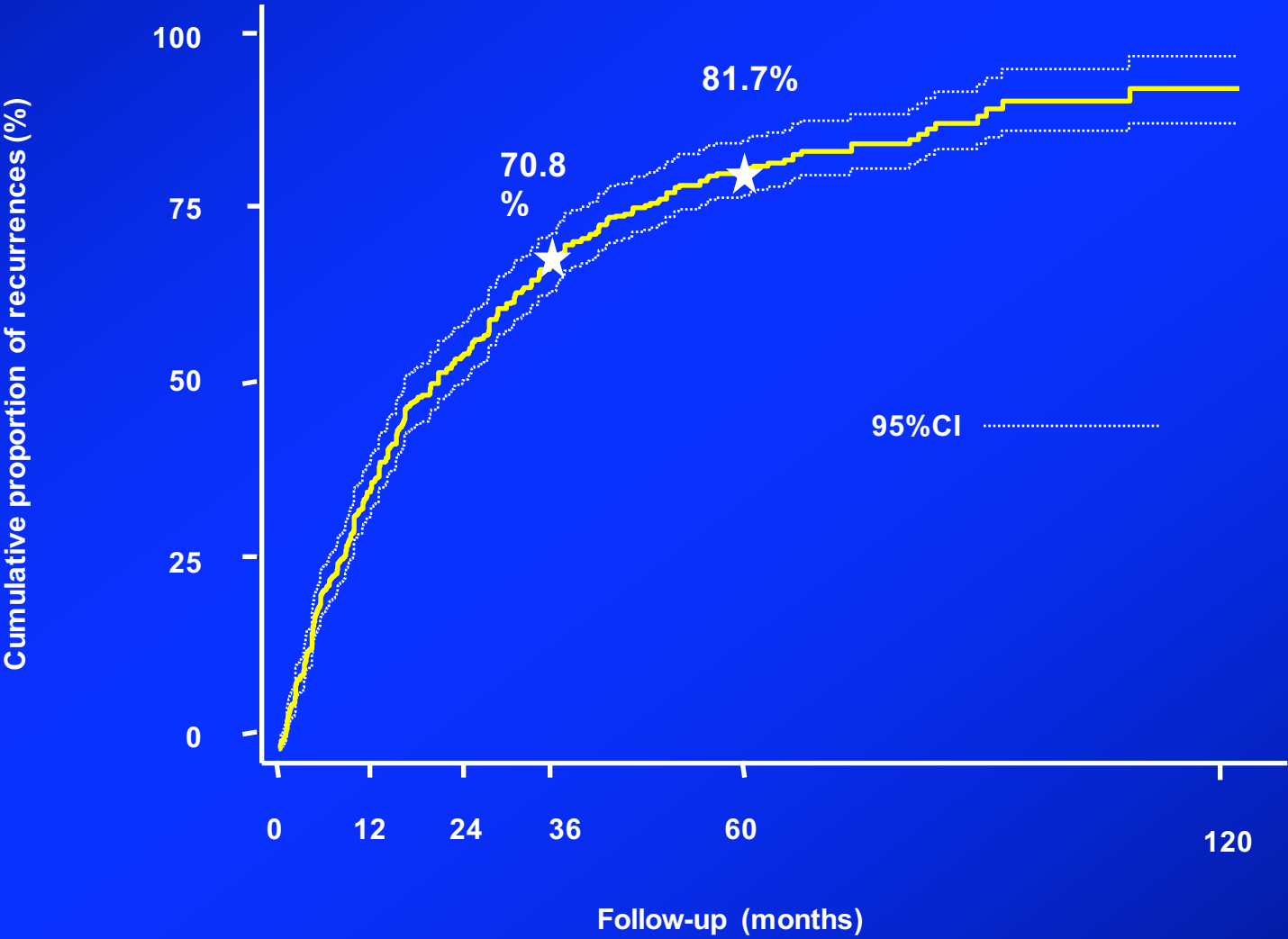
Viruses infection	94.0%
Alcohol	5.5%
Unknown origin	0.5%

- Residual liver function

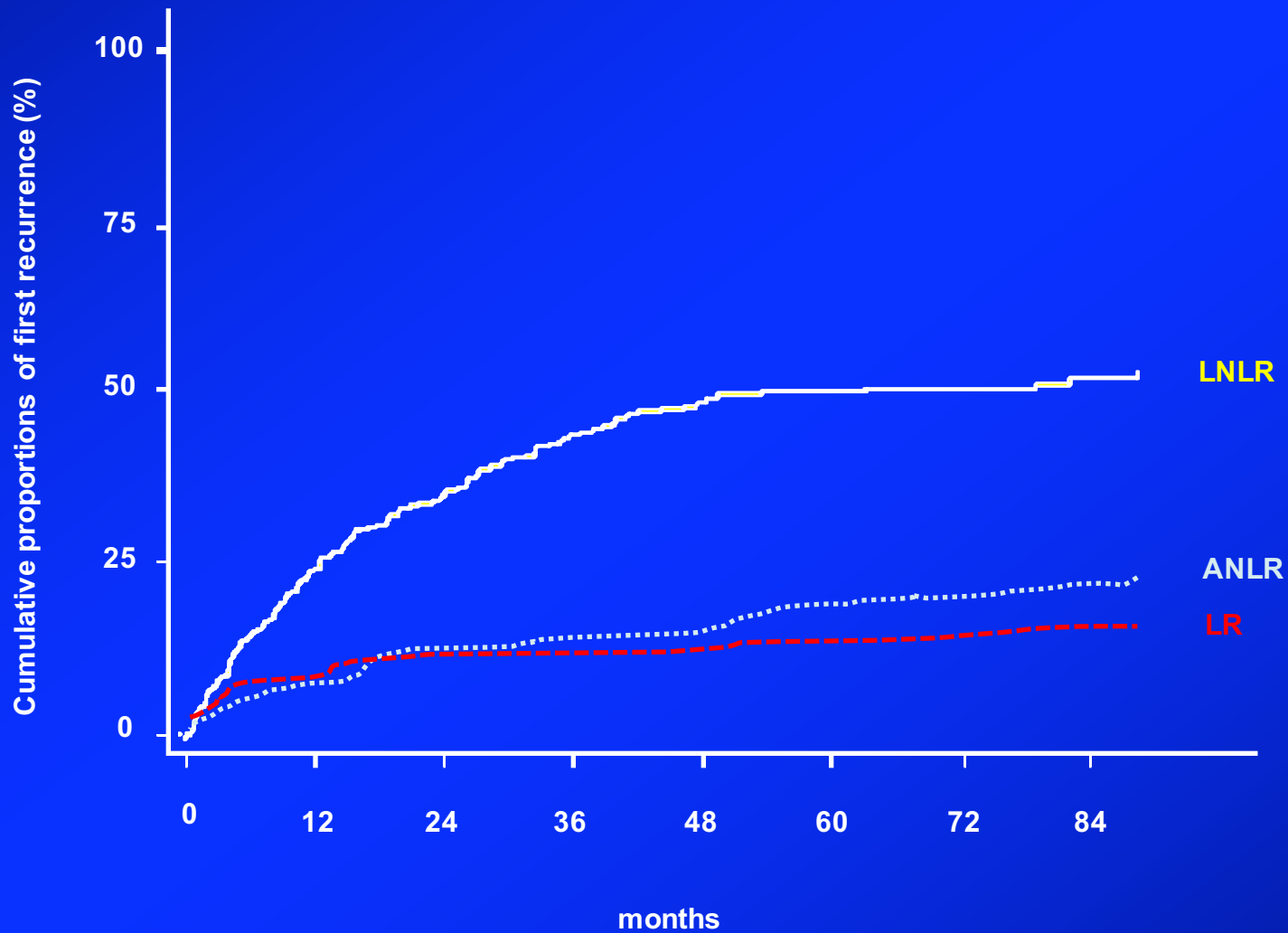
Child A5	64.9%
Child A6	19.8%
Child B7	15.3%

- AFP: < 20: 45.5%; >20<400: 44.1%; > 400:10.1%; NA: 0.3%

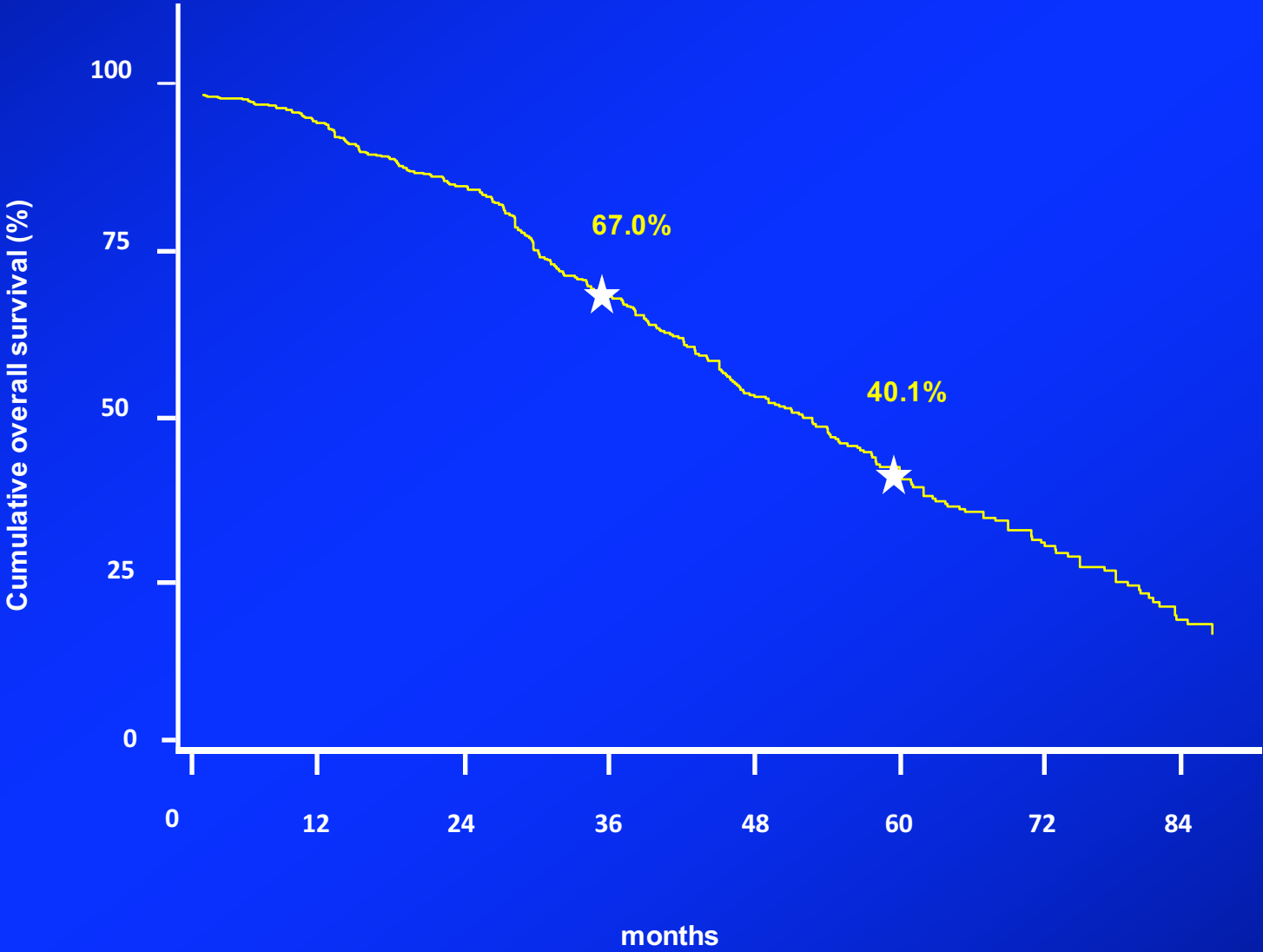
Cumulative incidence rates of first recurrences



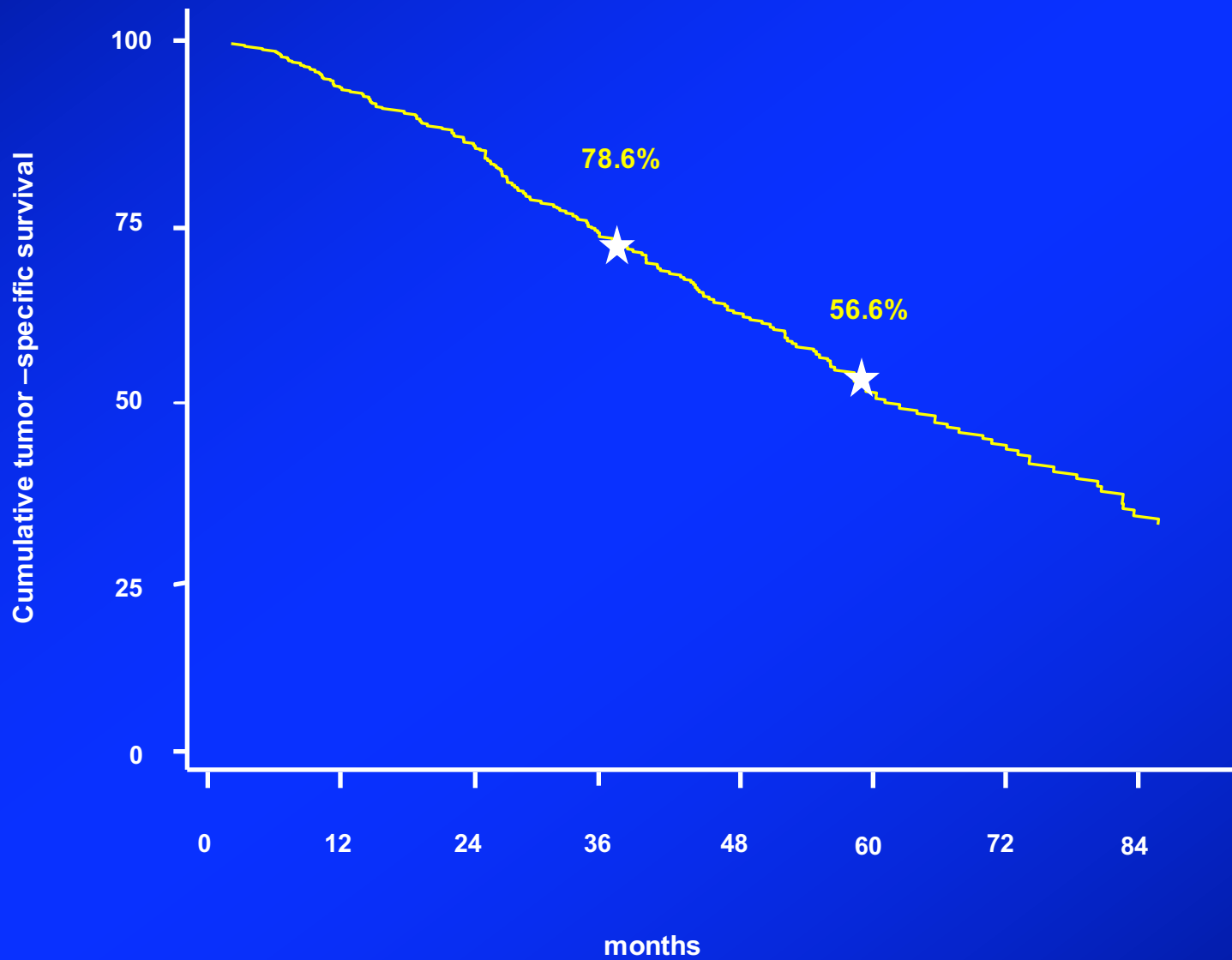
Cumulative incidence rates of first recurrence



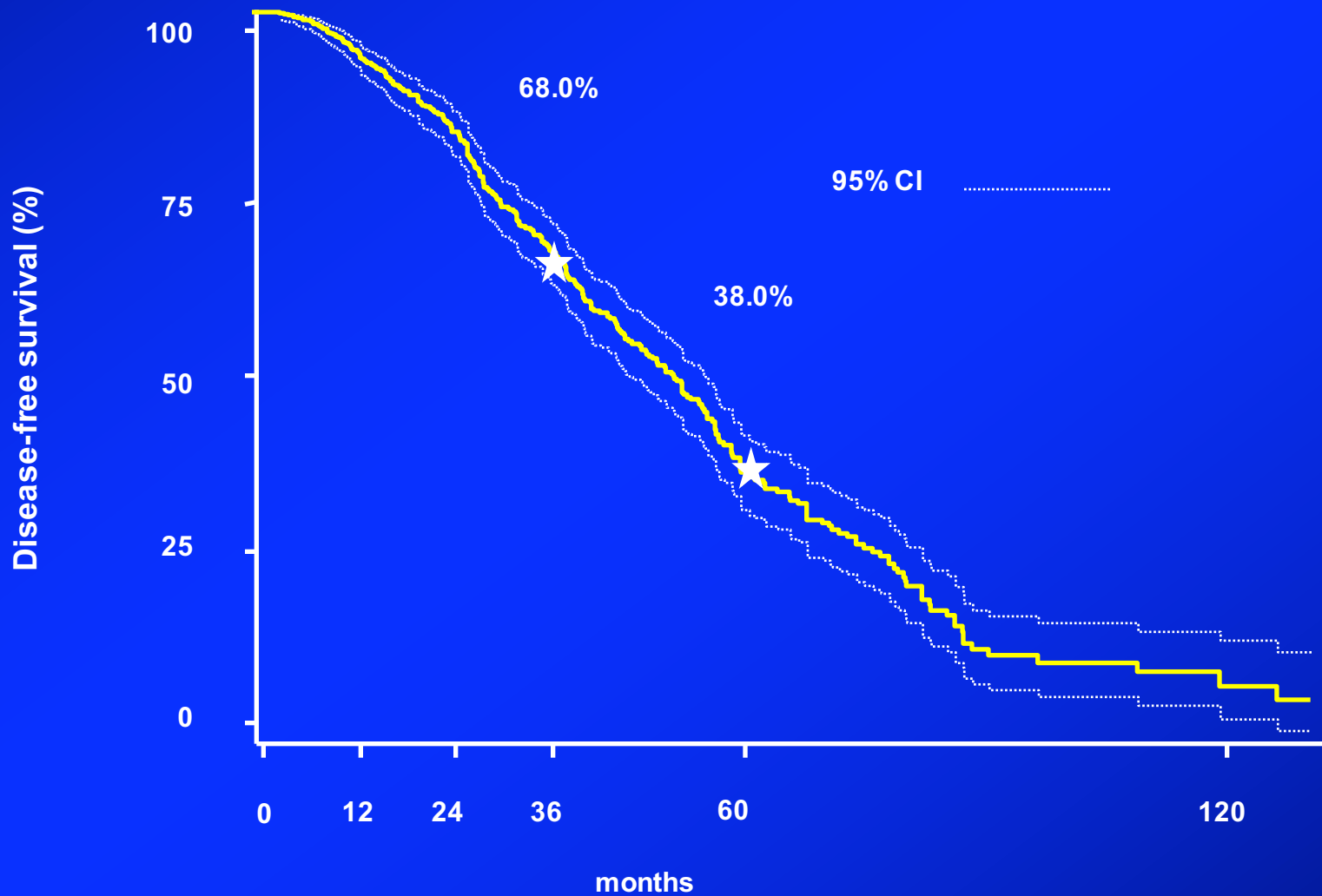
Cumulative overall survival rates



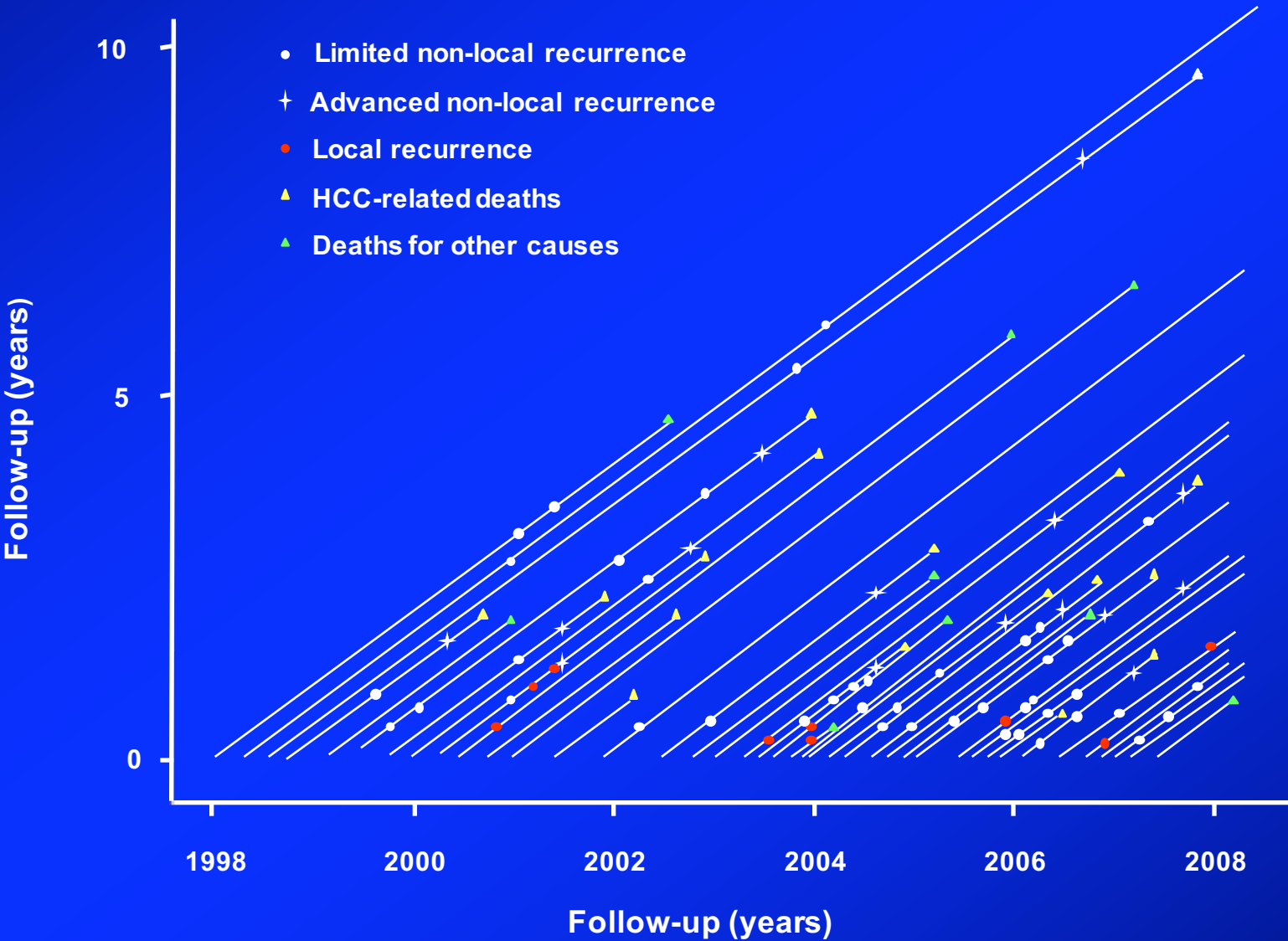
Cumulative tumor-specific survival rates



Cumulative disease-free survival rates (after repeated TAs)



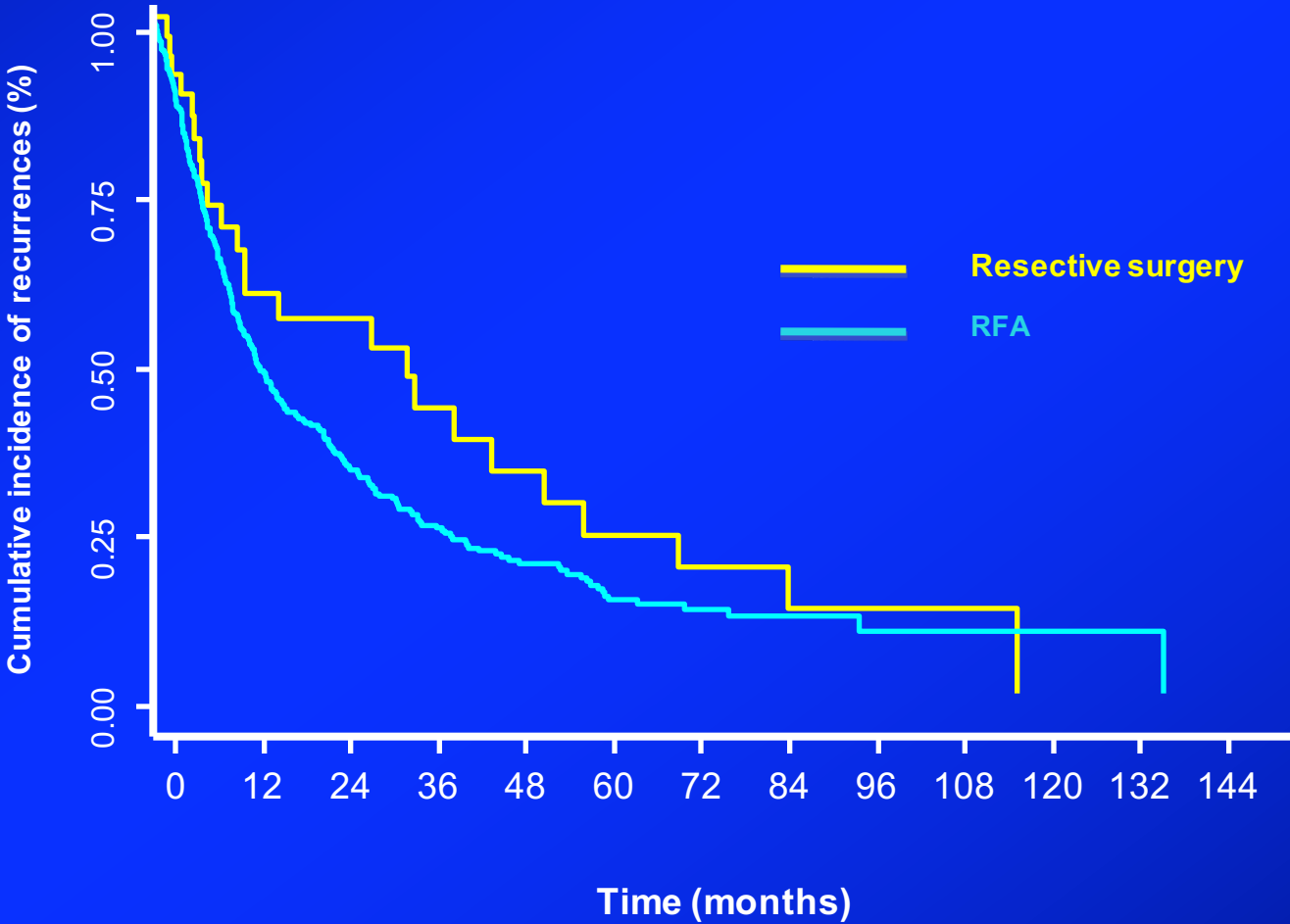
Random sample of 40 HCC Pts. (single, < 30 mm) treated by TA



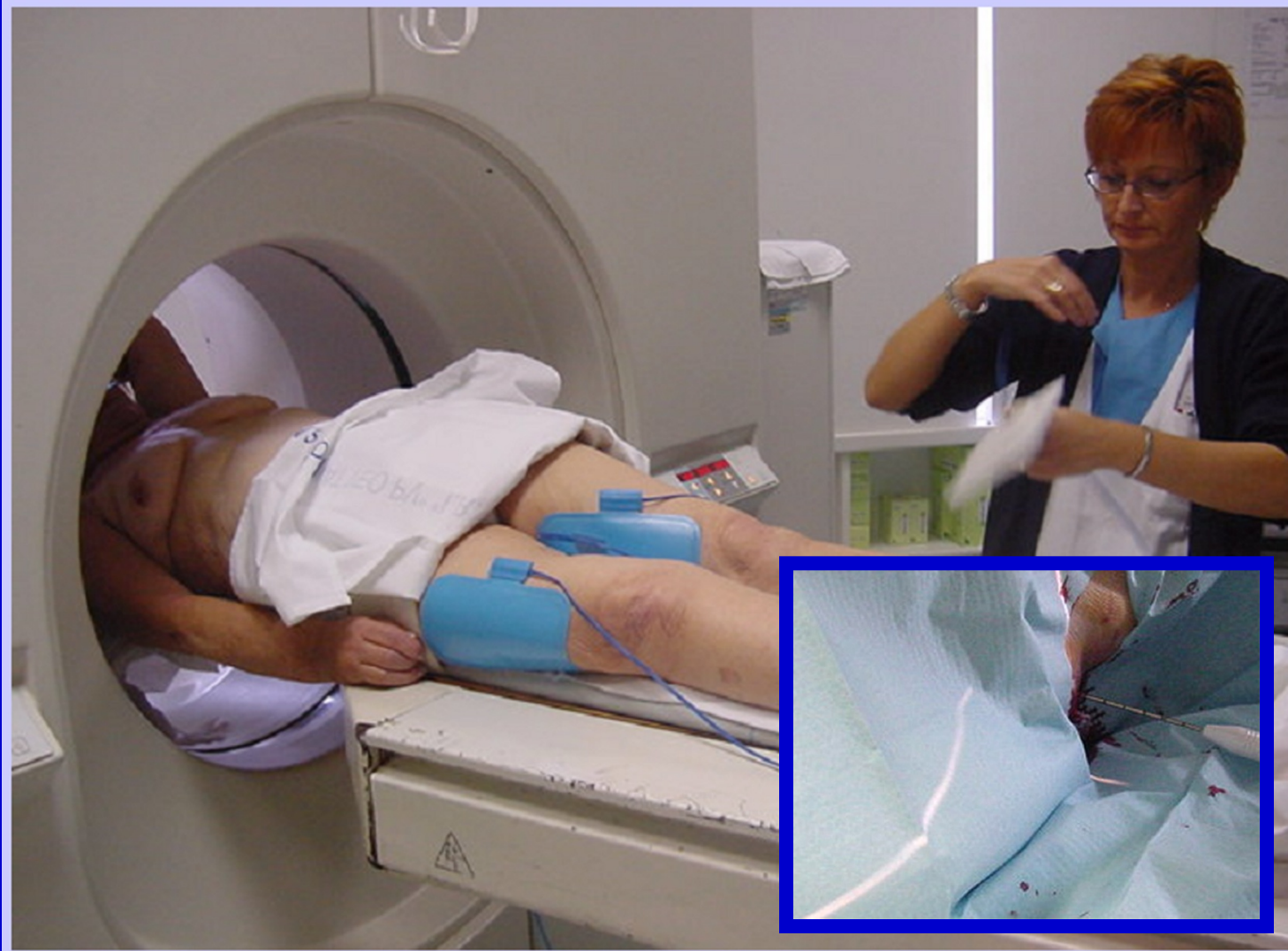
Kind of first recurrence by size of the treated HCC nodule

Size (cm)	≤ 2.0	$> 2.0 \geq 3.0$	$> 3.0 \leq 3.5$
Advanced	12.2	11.5	20.3
Local	5.7	8.2	13.8
Limited nonlocal	47.5	42.3	37.4
Disease-free	34.5	37.8	32.8

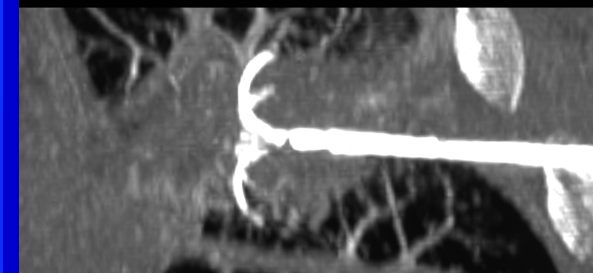
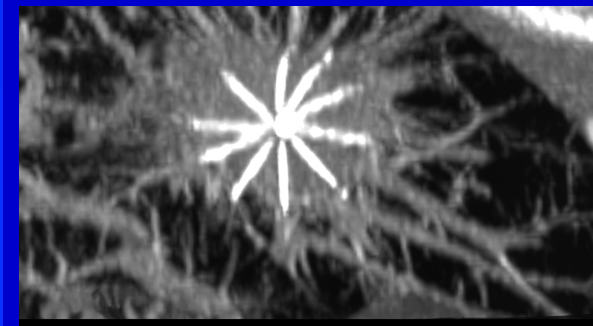
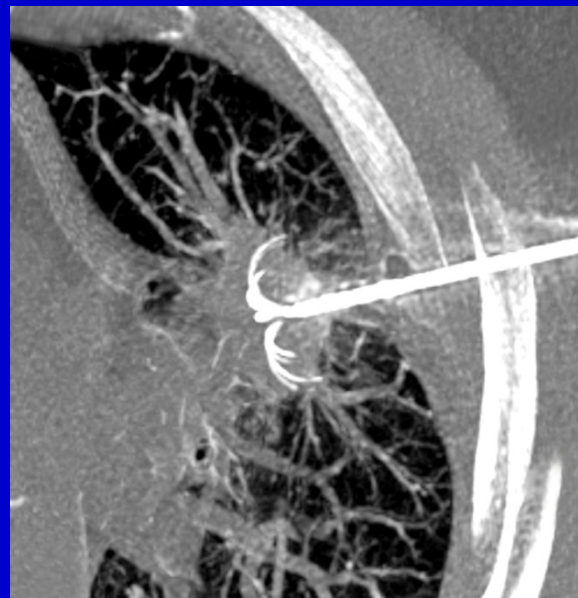
Cumulative incidence rates of first recurrences after resective surgery and TA



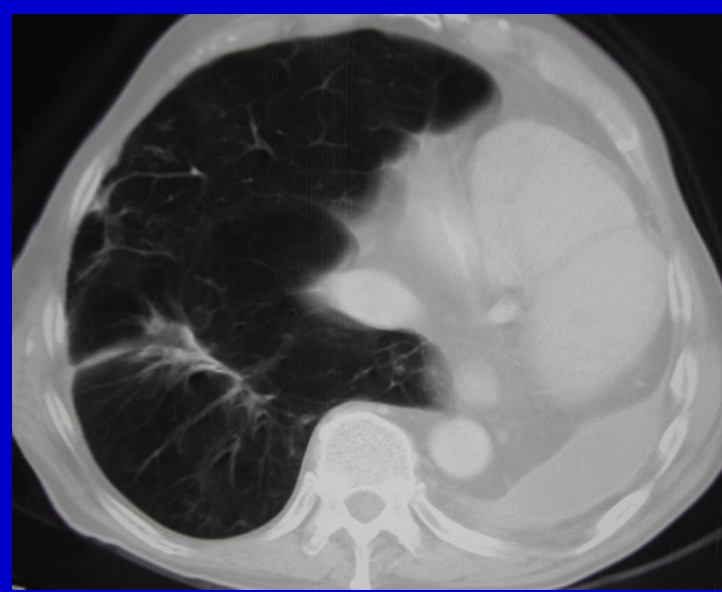
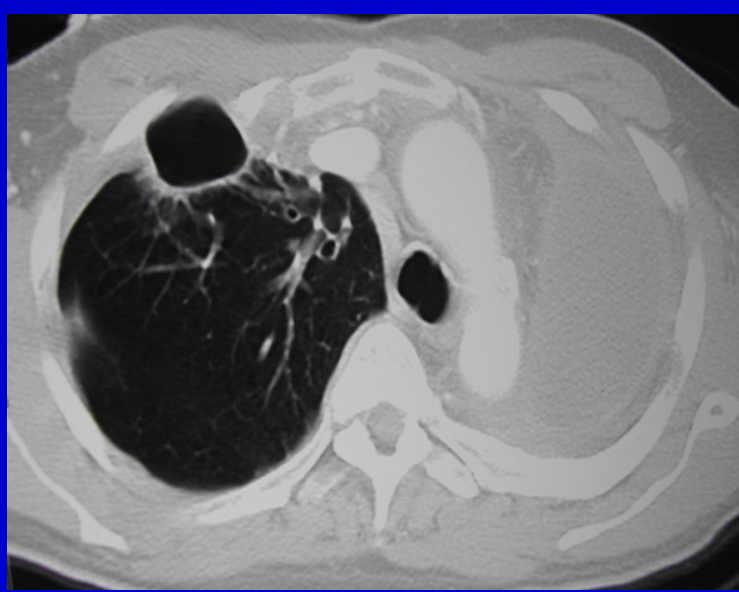
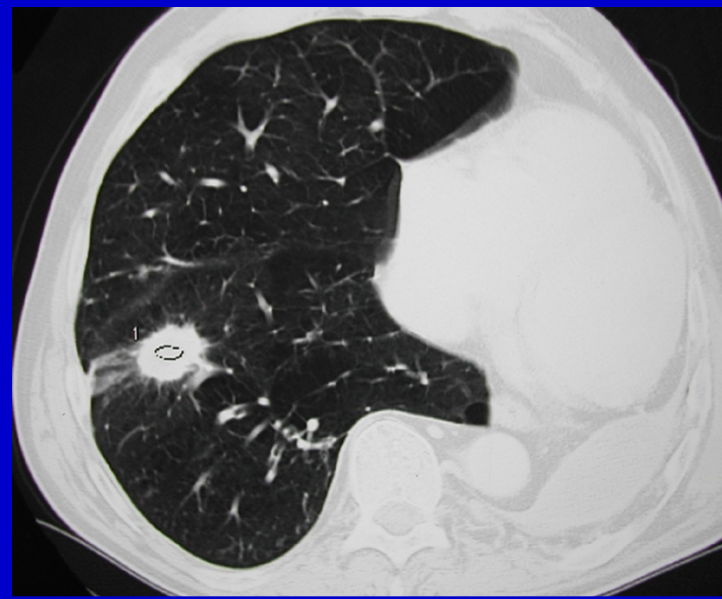
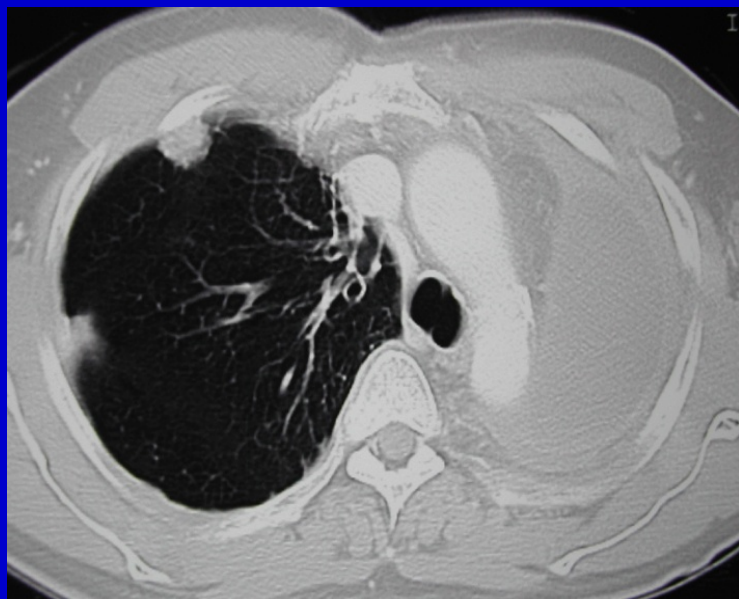
TA for lung tumors: Procedure



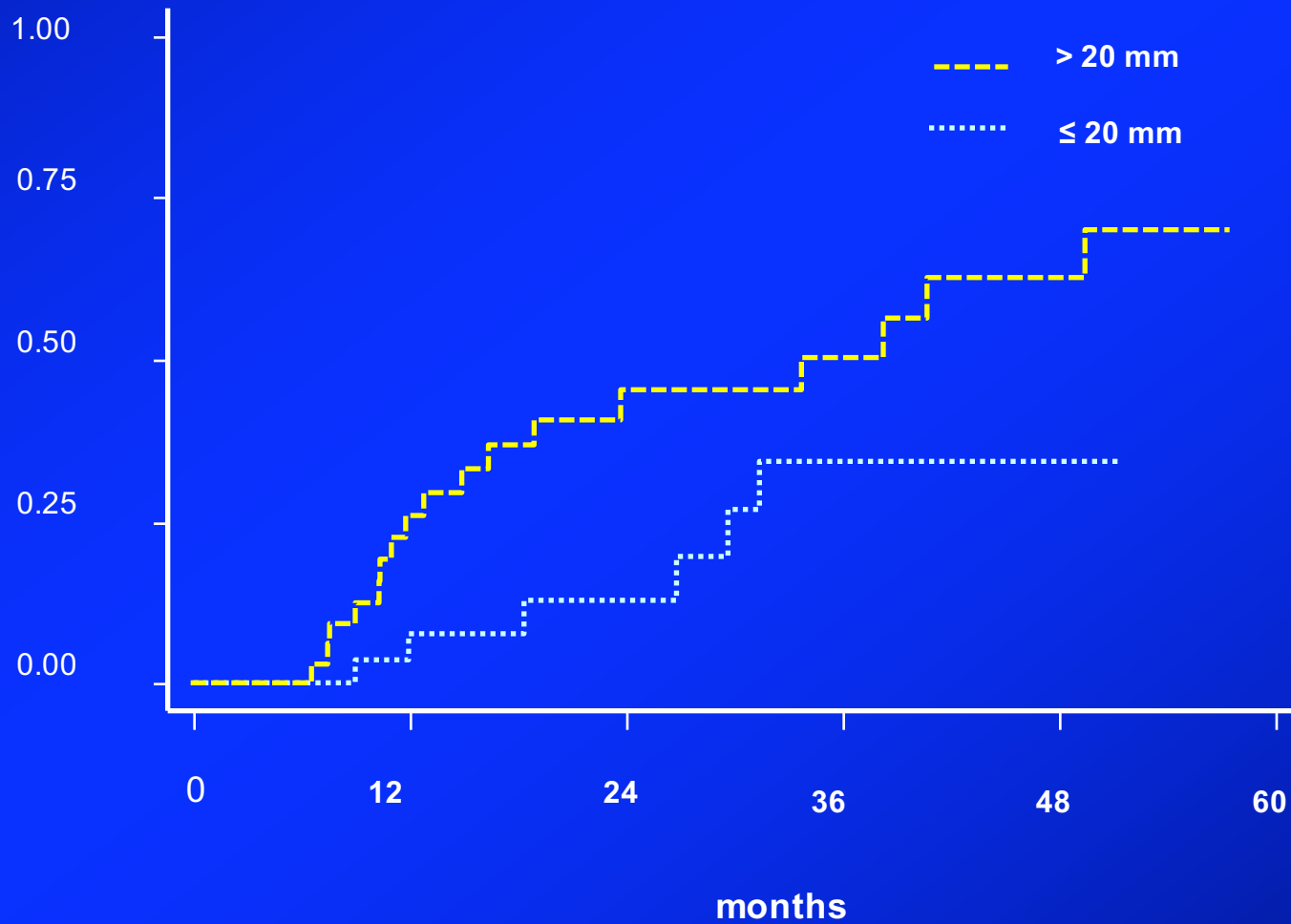
TA for lung cancer : Procedure



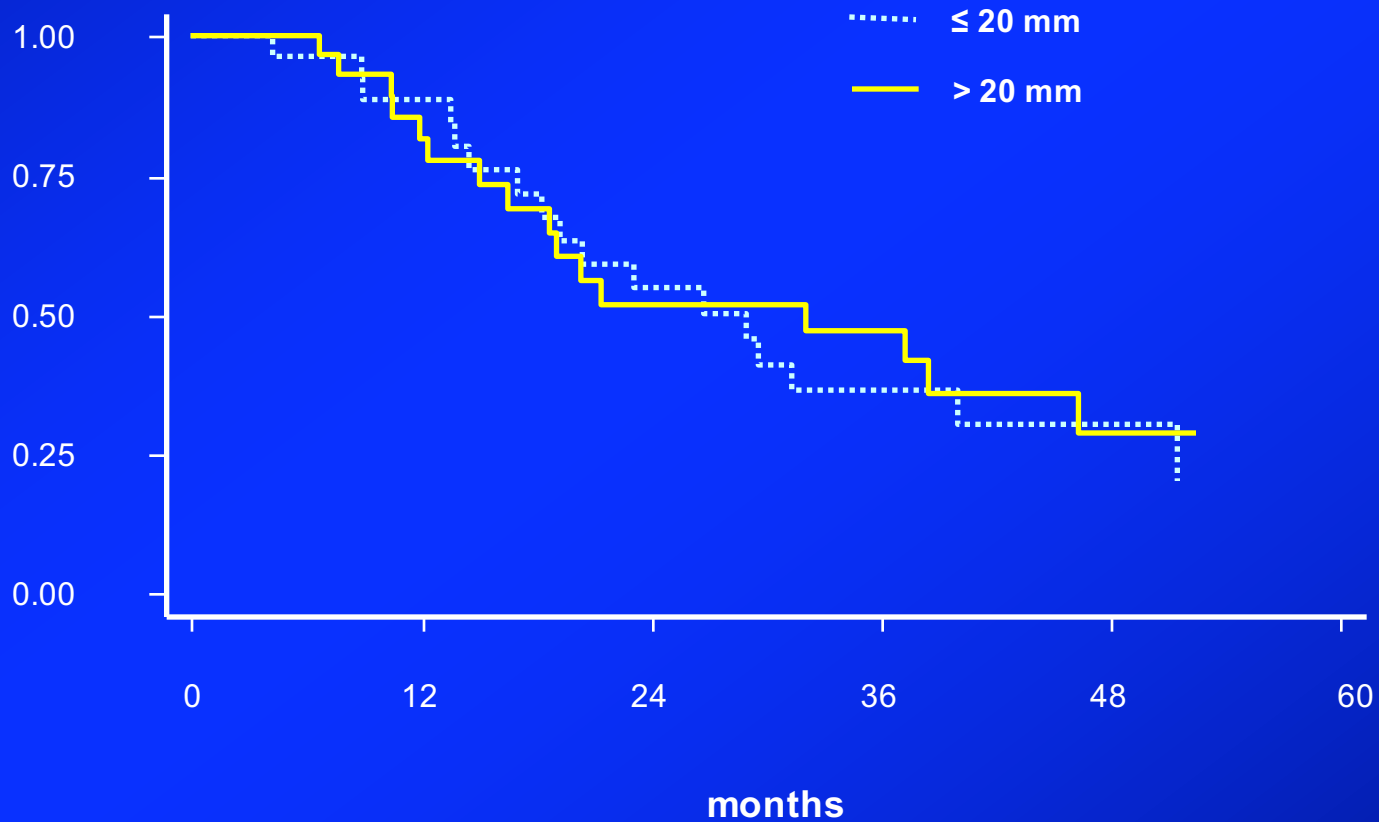
TA for NSCLC: long-term follow-up



Non small cell lung cancer (NSCLC) : LR by tumor size



NSCLC Kaplan-Meier survival estimates



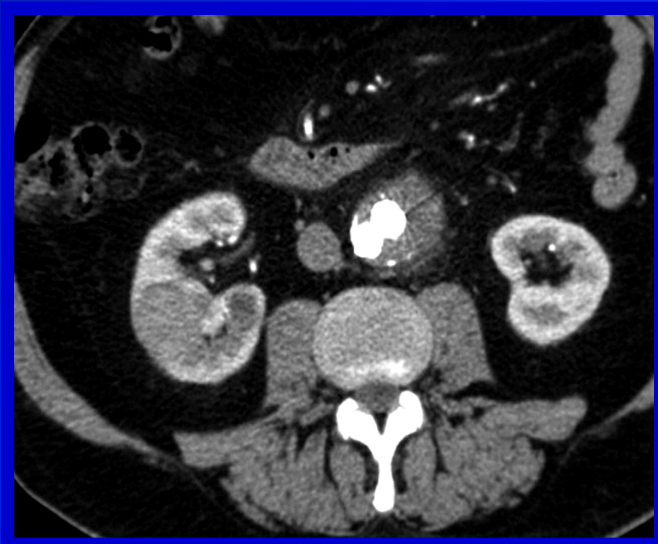
TA for kidney tumors: pre-procedure US



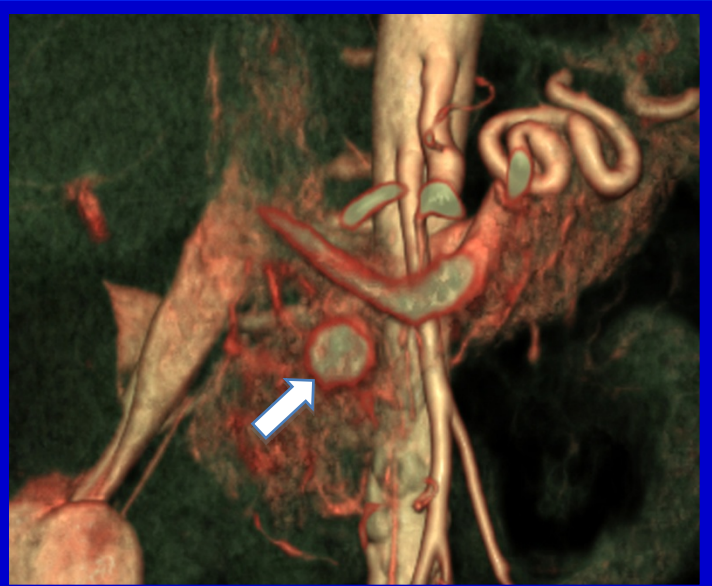
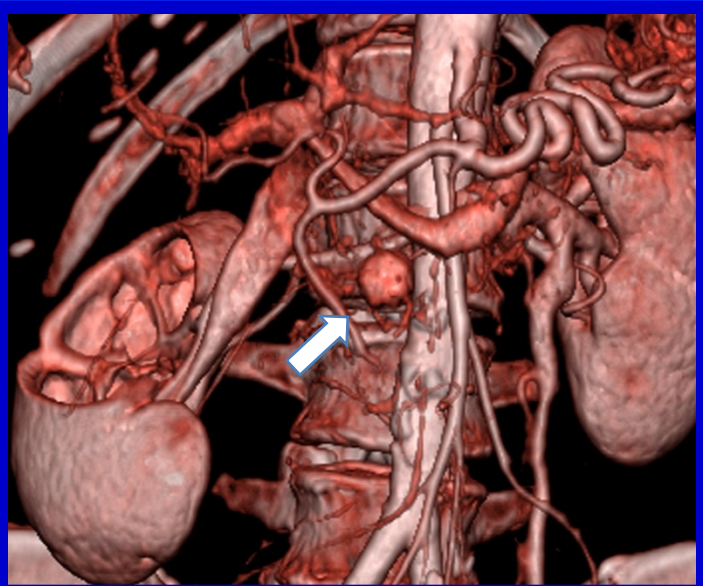
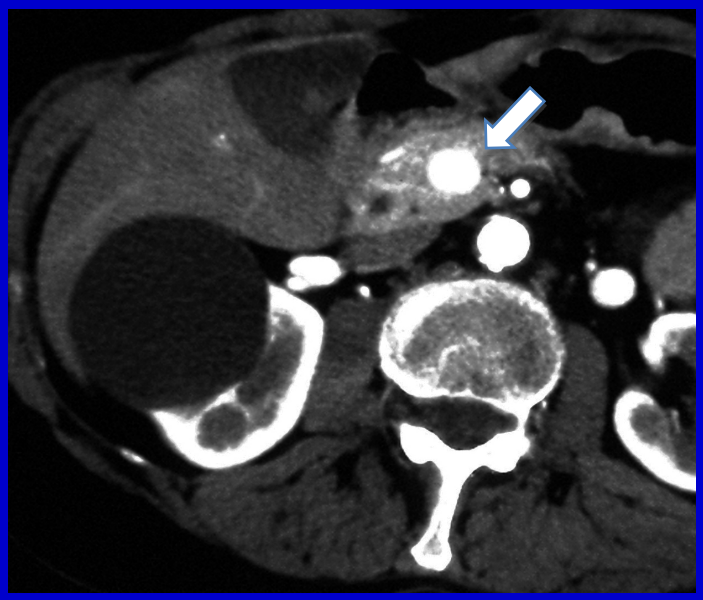
Kidney tumors: US-guided TA procedure



TA to treat kidney tumors: Results



TA for neuroendocrine pancreatic tumors



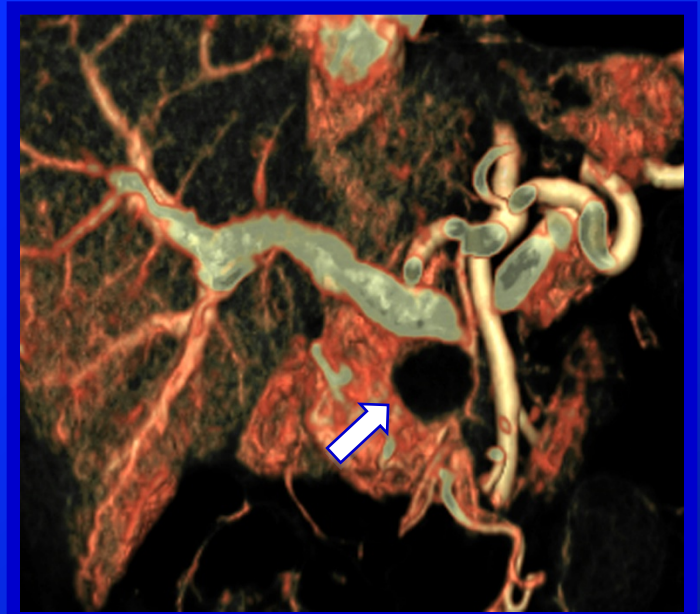
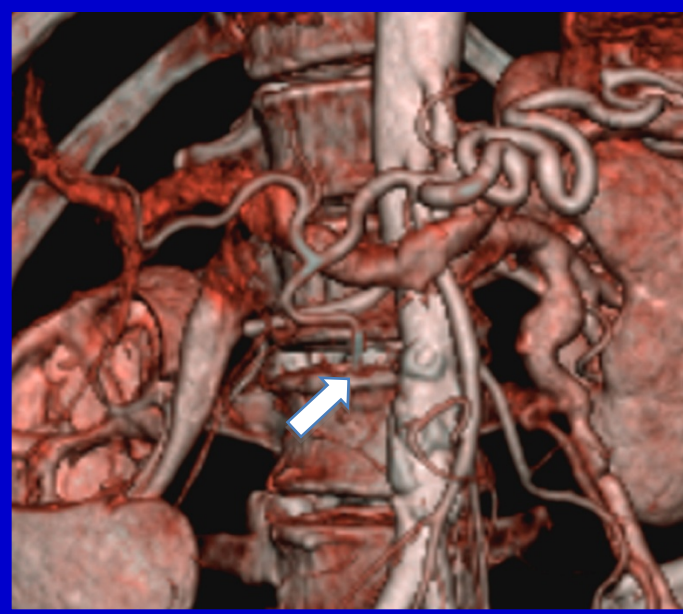
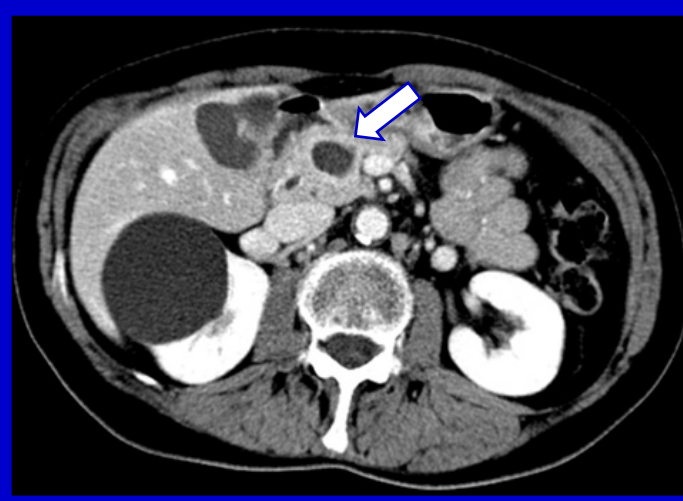
Percutaneous TA procedure



CEUS after TA procedure



CT arterial and portal phases after TA



What is need to improve minimally invasive treatment of tumors?

- ✓ **A better knowledge of the
 - **tumor biology**
 - **the mechanisms of electromagnetic/mechanic energy diffusion in the tissue****
- ✓ **The development of devices dedicate to a specific kind of tumor**
- ✓ **The improvement of radiological imaging techniques (i.e. 3D real time vision)**
- ✓ **The improvement of techniques of generation or subtraction of heat in the tissue (i.e. without damaging of the tissue)**
- ✓ **Institution of specific courses of study**