New radiative therapies in oncology: Microwaves and Electroporation

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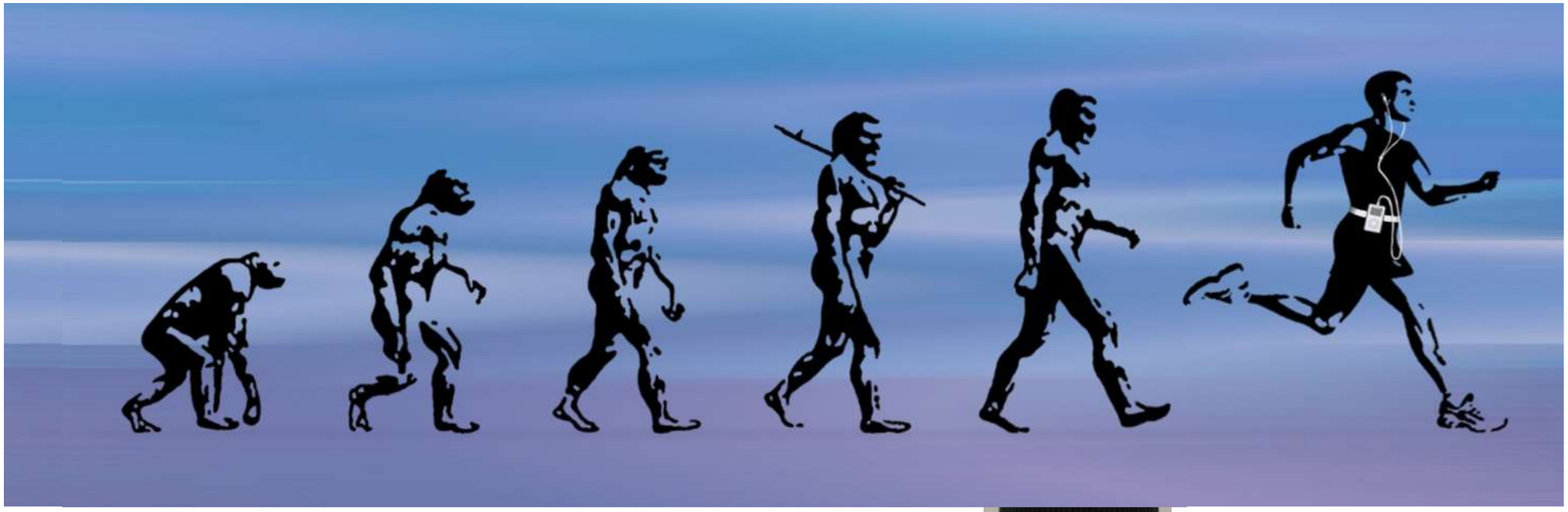
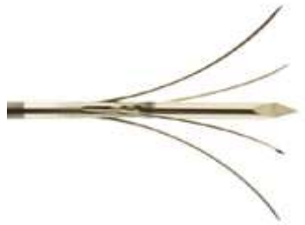
Diagnostic and Interventional Radiology
Chairman: Prof. C. Bartolozzi
University of Pisa

Mini invasive therapies in oncology…a continuous evolutive process





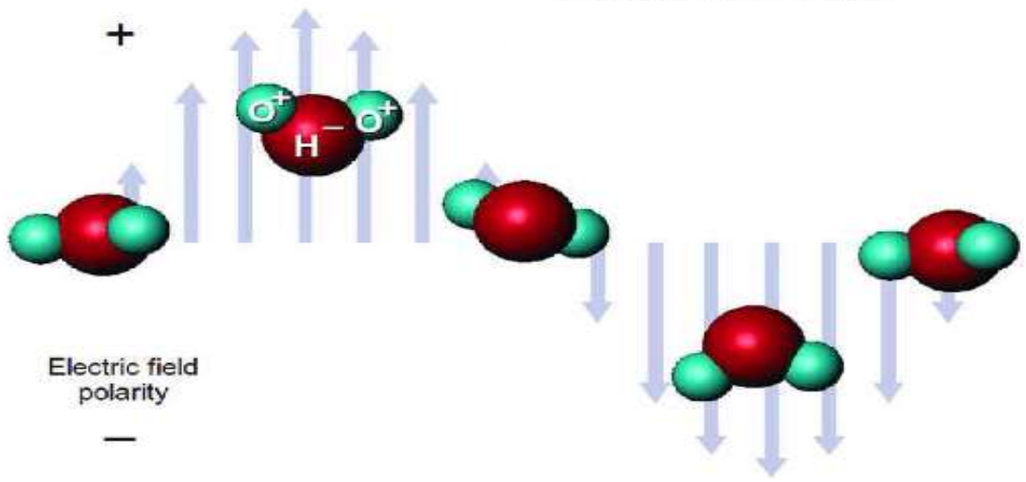
New "Radiative" Therapies

Microwaves
100MHz-300 GHz

Elettroporation
(Reversible/Irreversible)
≅5KHz

ElectroMagnetic Action !

Microwaves

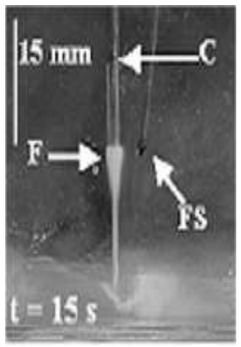


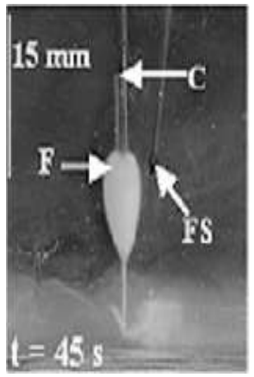
- Alternation of magnetic field determines continuous rotation and rubbing of H_2O atoms (2-5x10^6 times/sec): ⟶ kinetic effect ⟶ **THERMOGENESIS**

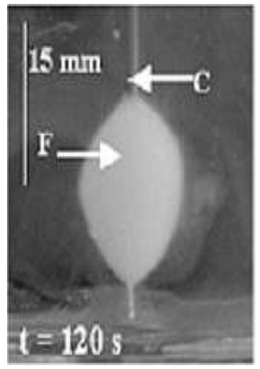
- Cell death because of ***coagulative necrosis*** (cell dehydration)

Microwaves advantages

- Homogeneity of treated volume
- No delay in thermal distribution (also through air and vacuum)
- No “heat sink effect”, even in proximity of venous vessels <5mm
- Very fast treatment even of large volumes
- High power of application (up to 80W) and high temperatures (up to 200° C)
- No “COMET EFFECT”

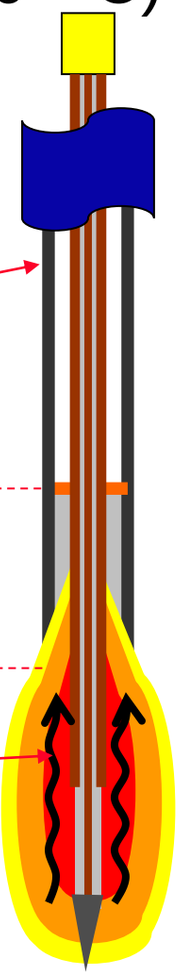




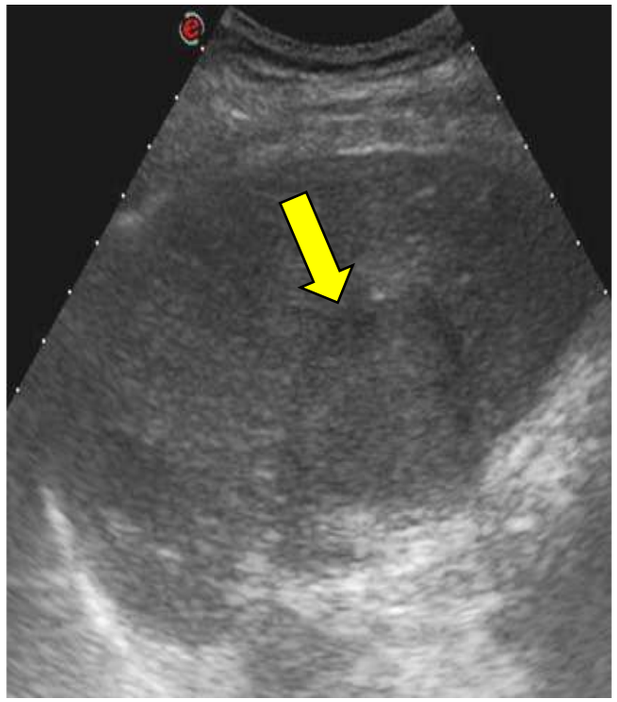


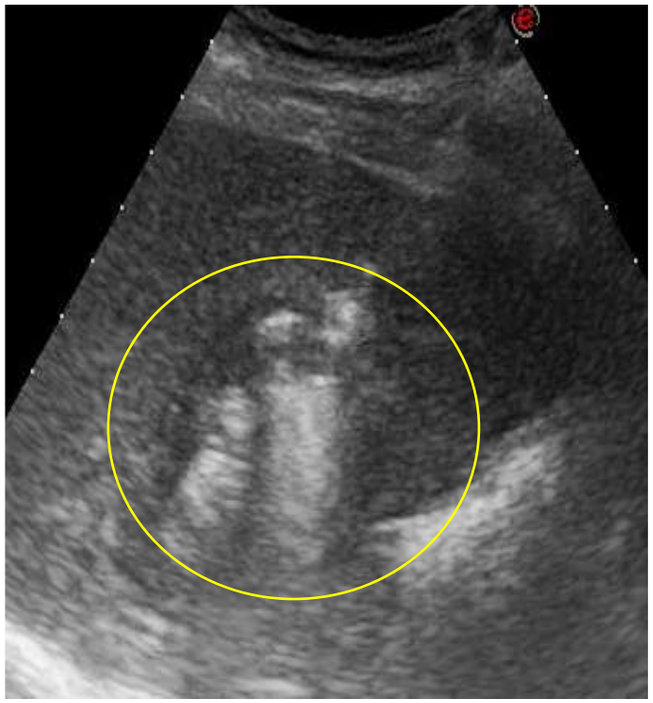
Con mini-choke

A Coaxial Antenna With Miniaturized Choke for Minimally Invasive Interstitial Heating

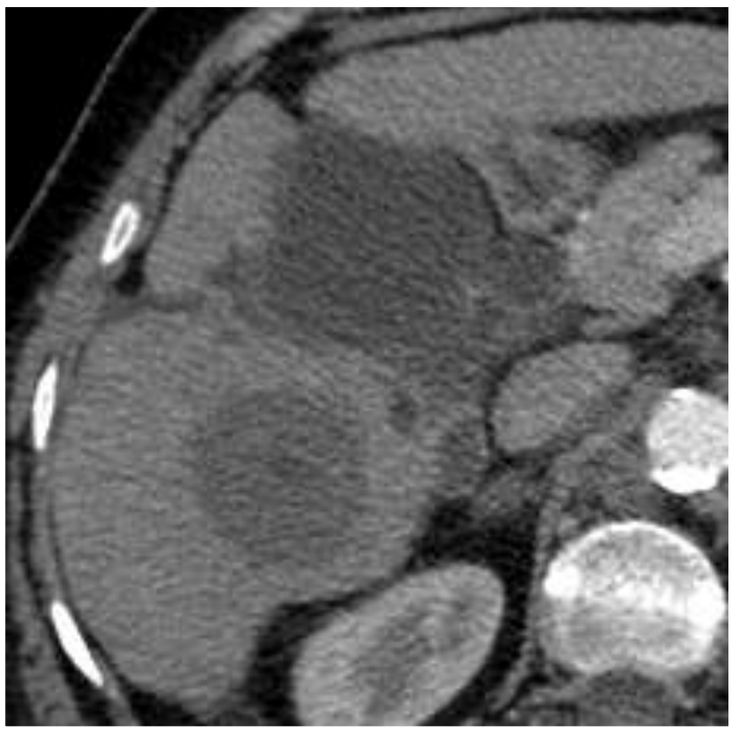


HCC on cirrhosis (4cm)





Treatment time: 4min
Power: 40 Watt



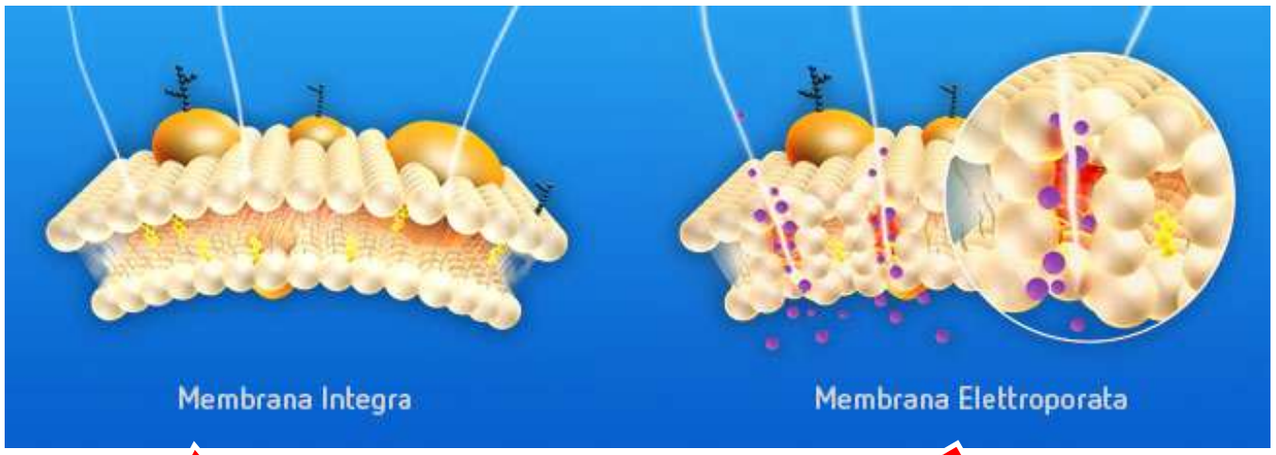
CT control 1month after treatment:

Complete Response (*mRECIST*)

Large, Round *necrosis volume with* ***just 1 application***

Electroporation: *the last bet*

- Alteration of cell membranes by High Voltage electric pulses
- Increase of cell membrane permeablity and subsequent loss of cell homeostasis (***permanent/transient***)
- No thermal effect!
- No damage on stromal structures: preservation of vascular, biliary and nervous structures
- Citolysis because of apoptosis (Irreversible); Increased citotoxicity (Reversible)
- Early start of healing process (within 24 hours); no scar



REVERSIBILE
(citotoxicity)

IRREVERSIBILE
(citolysis)

Azienda Ospedaliero-Universitaria Pisana

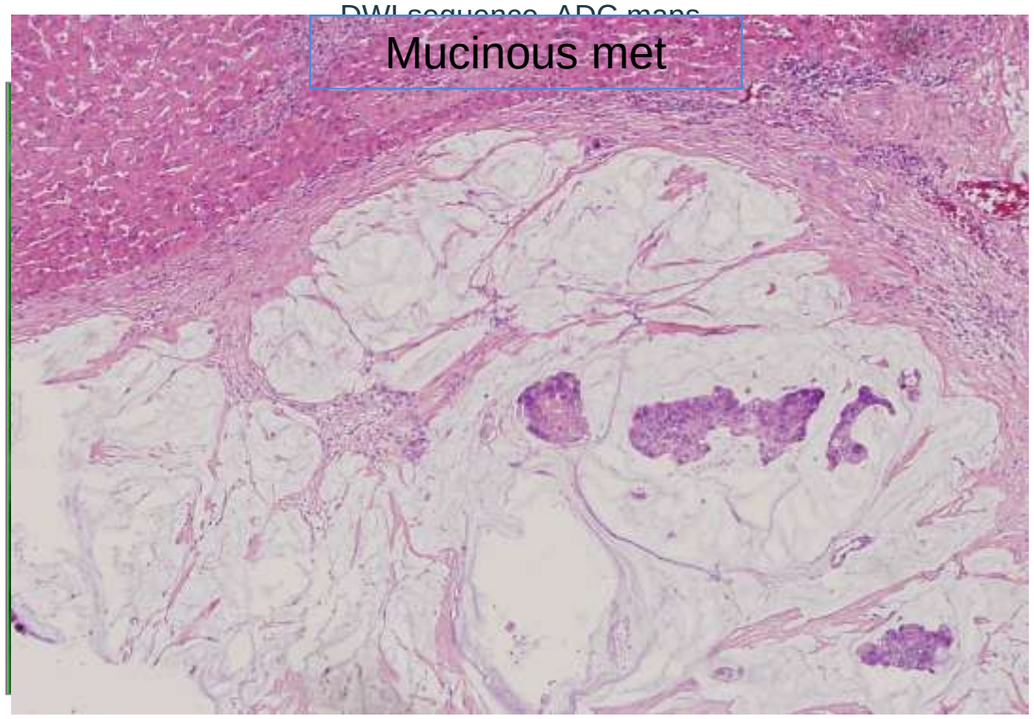
U.O. Chirurgia Epatica e del
Trapianto di Fegato
U.O. Radiodiagnostica 1*

Feasibility and safety of electrochemotherapy (*Reversible Electroporation*) of liver metastases from colon cancer not amenable to surgical treatment

V. Battaglia, L. Coletti, C. Bartolozzi*, F. Filipponi*

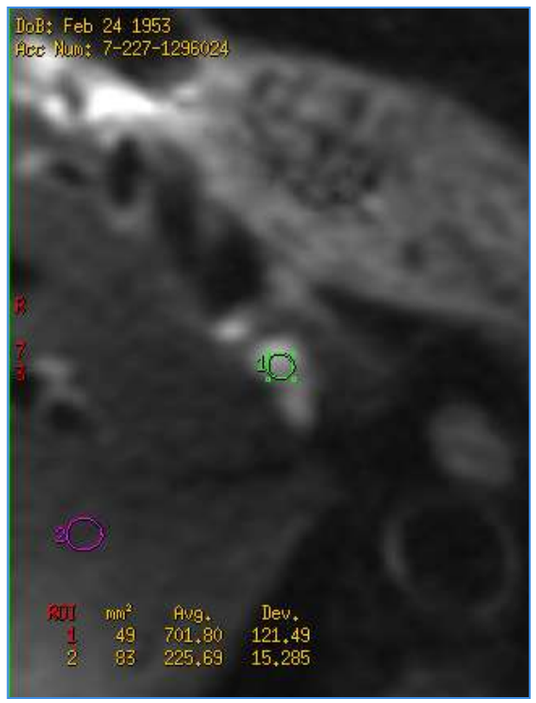
2° ECT International Users'Meeting
Bologna, 1-2 marzo 2013

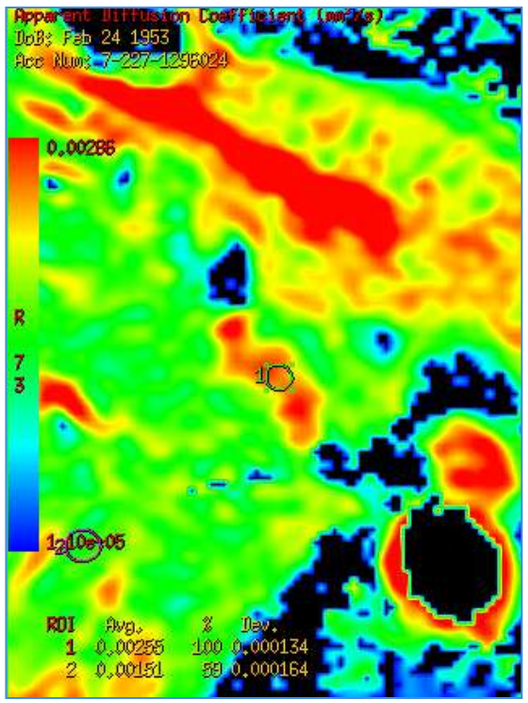
Liver met: Reversible electroporation



Pre treatment: Met ADC value: 2.57x10-3
Liver parenchyma ADC: 1.30x10-3

3 months follow up:
DWI sequence and ADC maps

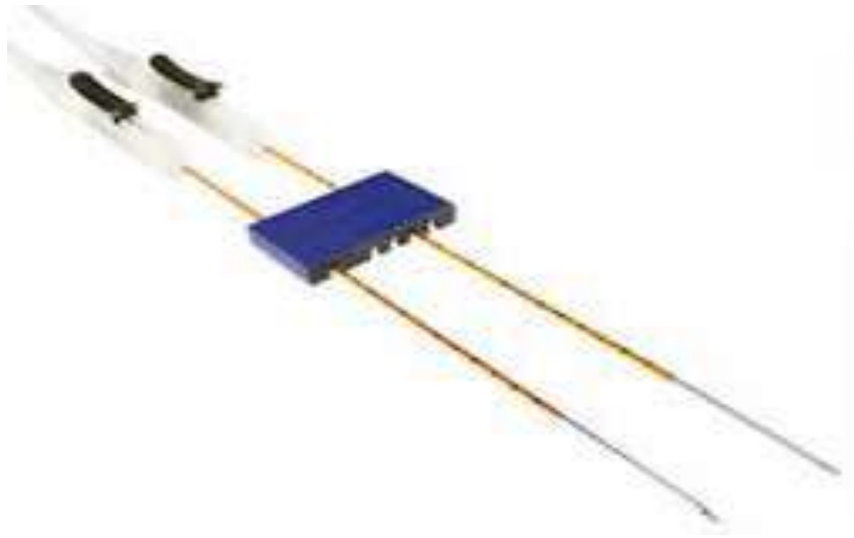




Intraoperative approach
Bleomicin injection
Needles probes lenght: 2-4cm

Treated area ADC value: 2.79x10-3
Liver parenchyma: 1.49x10-3

Irreversible Electroporation (IRE)



No pharmacologic therapy

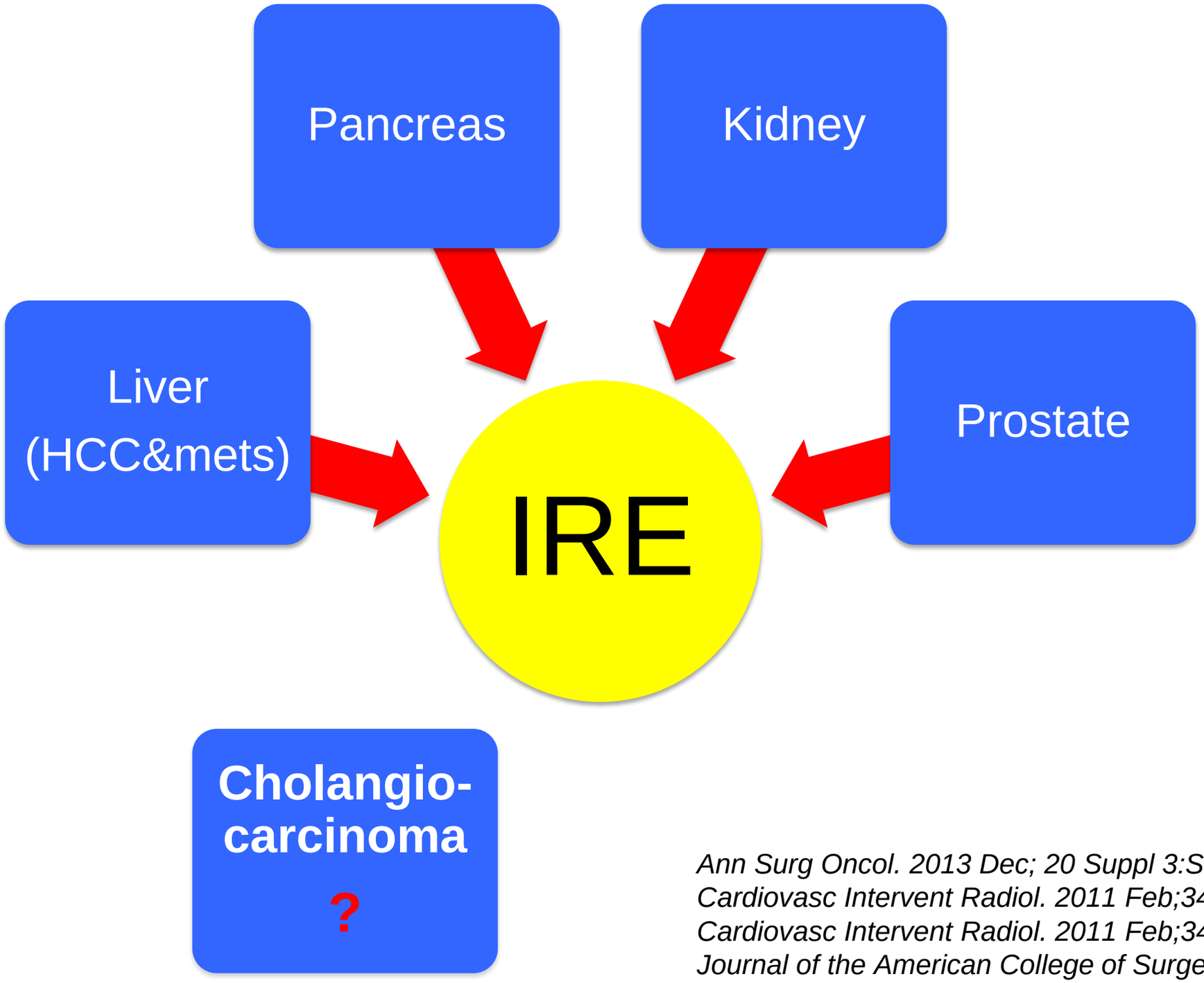
Percutaneous Approach!

Irreversible Electroporation: A New Challenge in **"Out of Operating Theater"** Anesthesia

Christine Ball, MBBS, FANZCA, Kenneth R. Thomson, MD, FRANZCR, FRCR,† and Helen Kavnoudias, PhD†*

Curarized patient, ***in a adequately equipped room***
(not necessarily in surgical theater)

Irreversible Electroporation & Solid Neoplasms



Ann Surg Oncol. 2013 Dec; 20 Suppl 3:S443-9.
Cardiovasc Intervent Radiol. 2011 Feb;34(1):132-8.
Cardiovasc Intervent Radiol. 2011 Feb;34(1):132-8.
Journal of the American College of Surgeons; Sep;215(3):379-8

Starting soon in Pisa…

Validation of Feasibility and Therapeutic Efficacy of Irreversible Electroporation (IRE) in peripheral, intrahepatic cholangiocarcinomas not amenable to surgery

- Monocentric (*Radiodiagnostica 1- AOUP*), pilot, single harm, not randomized, open study
- Enrolling period: 24 months from center activation
- 5 patients not amenable to surgery, non responding to 1° line chemotherap
- Maximum 2 lesions not greater than 4cm
- Follow up up to 6 months after treatment
- Primary End points:

  -Feasibility and safety of treatment

- Secondary End points:

  -To evaluate the response to treatment on the basis of RECIST and volumetric criteria
  -To evaluate the changes in ADC values measured on dedicated MR sequences (Diffusion sequences) in treated lesions in respect to pre-treatment control

NanoKnife-
Angyodynamics-
Saniter

Approved by Ethical Committee