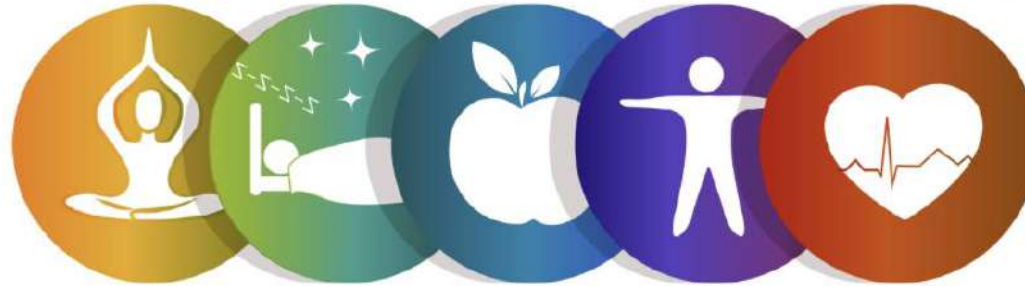


# I Mercoledì della Salute



Incontri di educazione alla salute, al benessere e alla prevenzione delle malattie

## IL RUOLO DELLA RADIOLOGIA INTERVENTISTICA NEL CAMPO DELL'ONCOLOGIA

G. Carrafiello    S.Carriero    S.Triggiani

*Department of Oncoematology  
Postgraduate School in Radiodiagnostics  
Università degli Studi di Milano*



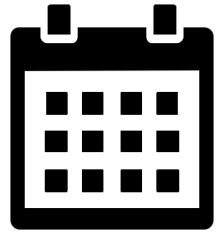
Fondazione IRCCS Ca' Granda  
Ospedale Maggiore Policlinico

Sistema Socio Sanitario



Regione  
Lombardia





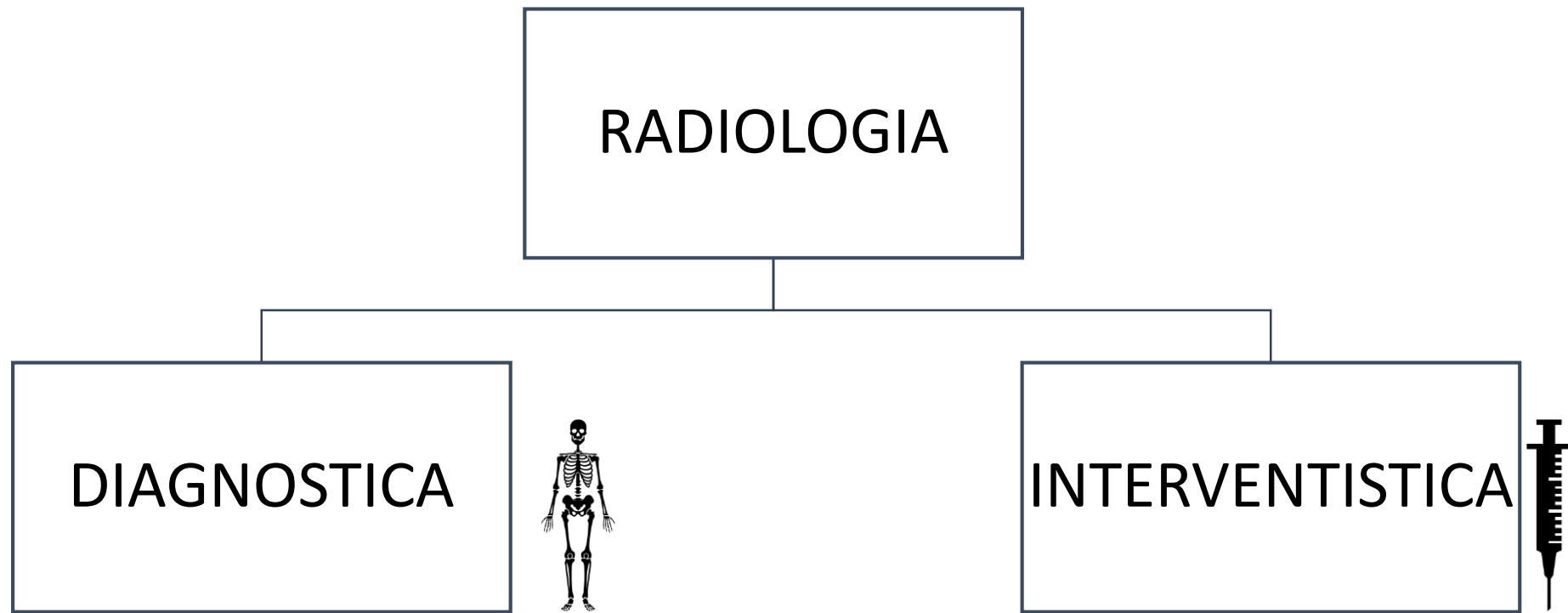
# AGENDA

1) RADIOLOGIA

2) RADIOLOGIA INTERVENTISTICA

i. trattamenti endovascolari

ii. trattamenti percutanei



La radiologia diagnostica è la branca della medicina che si occupa della acquisizione ed interpretazione delle immagini radiologiche, ottenute attraverso l'utilizzo di radiazioni ionizzanti (TC, RX) e non ionizzanti (US, RMN).

La Radiologia interventistica è la branca della radiologia che, attraverso la guida delle metodiche radiologiche, permette l'esecuzione di procedure invasive o mini-invasive, a fini diagnostici e terapeutici. Può essere suddivisa in vascolare, extravascolare ed oncologica.

# DIAGNOSTICA per IMMAGINI

Insieme di **ENERGIE** (ionizzanti e non) che ci permettono di **RAPPRESENTARE il CORPO UMANO**



**Energie** comunque provenienti dall'**esterno** dell'organismo, con cui interagiscono, producendo **informazioni** raccolte da un sistema rilevatore (**detettore**)

*“...mentre Roentgen lavorava in oscurità scoprì che alcuni cristalli esposti ad un “tubo di Crookes” diventavano **FLUORESCENTI**”*

**8 Novembre 1895**



Scoperta  
dei  
“Raggi X”

*“Il caso, nel campo delle osservazioni.....*

*.....favorisce solo le menti preparate” L.Pasteur*



# RAGGI X

sono **fotoni** , ovvero **onde elettromagnetiche** (Radiazioni non corpuscolari), la cui lunghezza d'onda è molto più piccola di quella delle radiazioni visibili .







22 Dicembre 1895 : moglie Berta

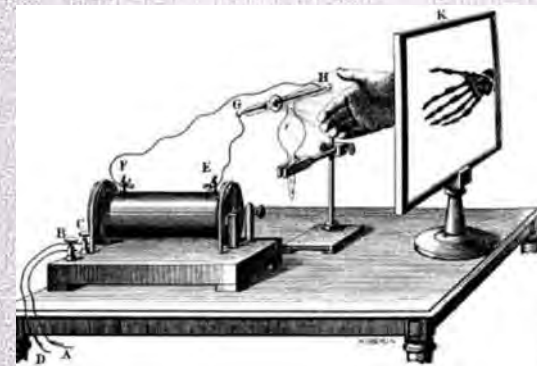
EINE NEUE ART

VON

STRAHLEN.

DR. WILHELM KONRAD RÖNTGEN

Ö. Ö. PROFESSOR AN DER K. UNIVERSITÄT WÜRZBURG.

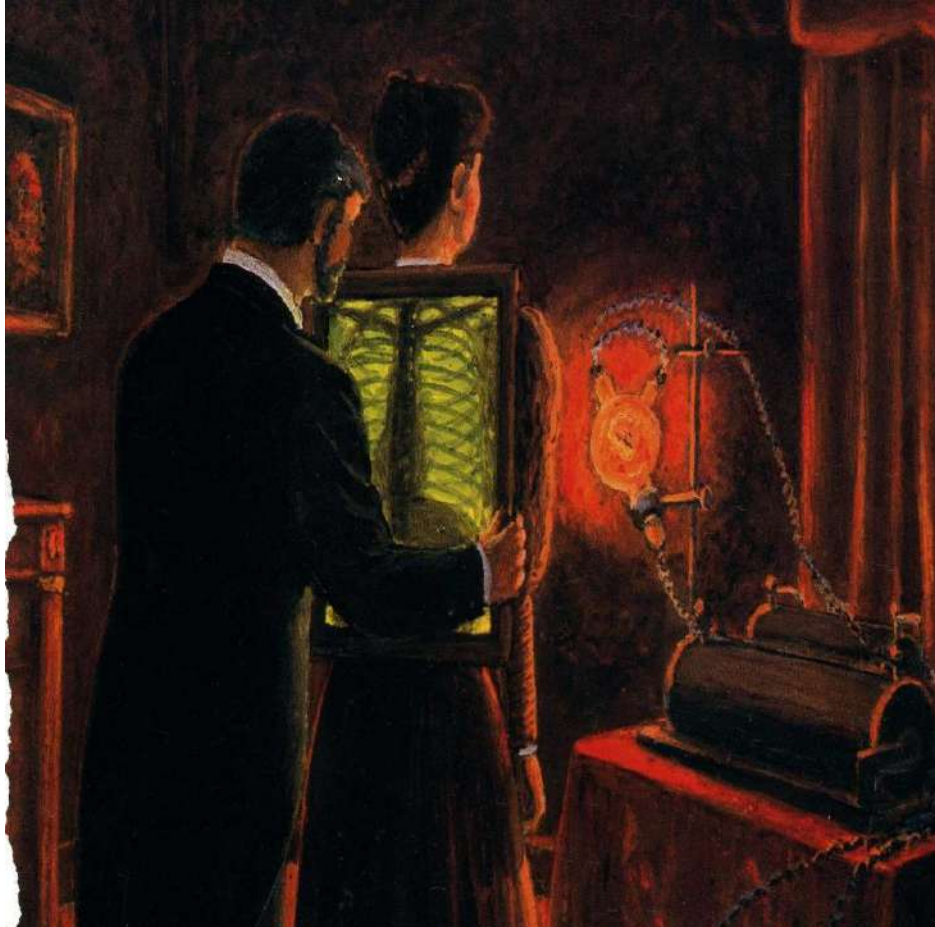


WÜRZBURG.

VERLAG UND DRUCK DER STAHEL'SCHEN K. B. HOF- UND UNIVERSITÄTS-  
BUCH- UND KUNSTHANDLUNG.

1896.





22 Dicembre **1895** : moglie Berta

# EINE NEUE ART

VON

## STRAHLEN.

I “**raggi X**” hanno la proprietà di:

- attraversare sostanze con differente attenuazione
- non subire la deflessione da parte di campi elettromagnetici

DR. WILHELM KONRAD RÖNTGEN

Ö. Ö. PROFESSOR AN DER K. UNIVERSITÄT WÜRZBURG.

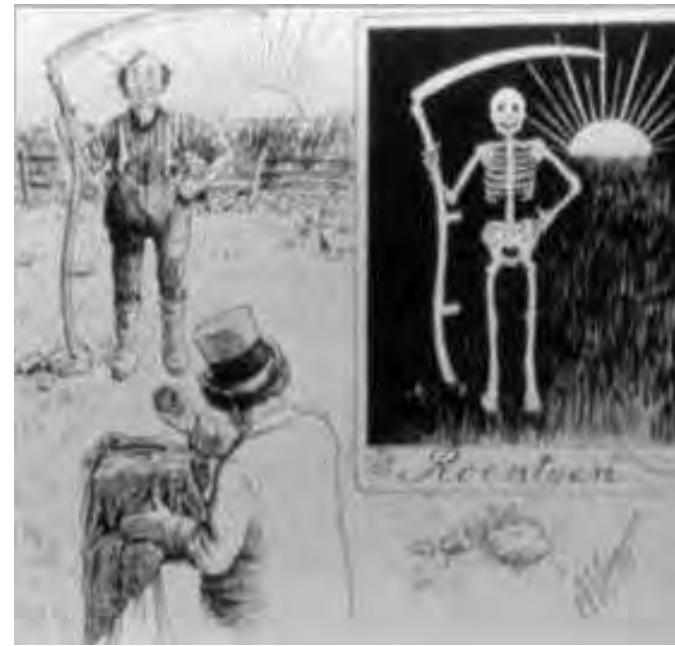
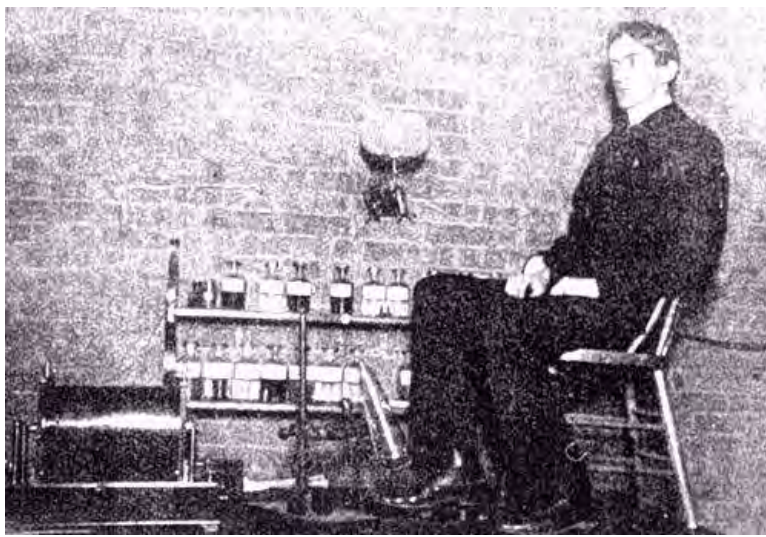
- produrre ioni
- dissociare la materia
- provocare lesioni cellulari
- impressionare le lastre fotografiche

WÜRZBURG.

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BUCH- UND KUNSTHANDLUNG.

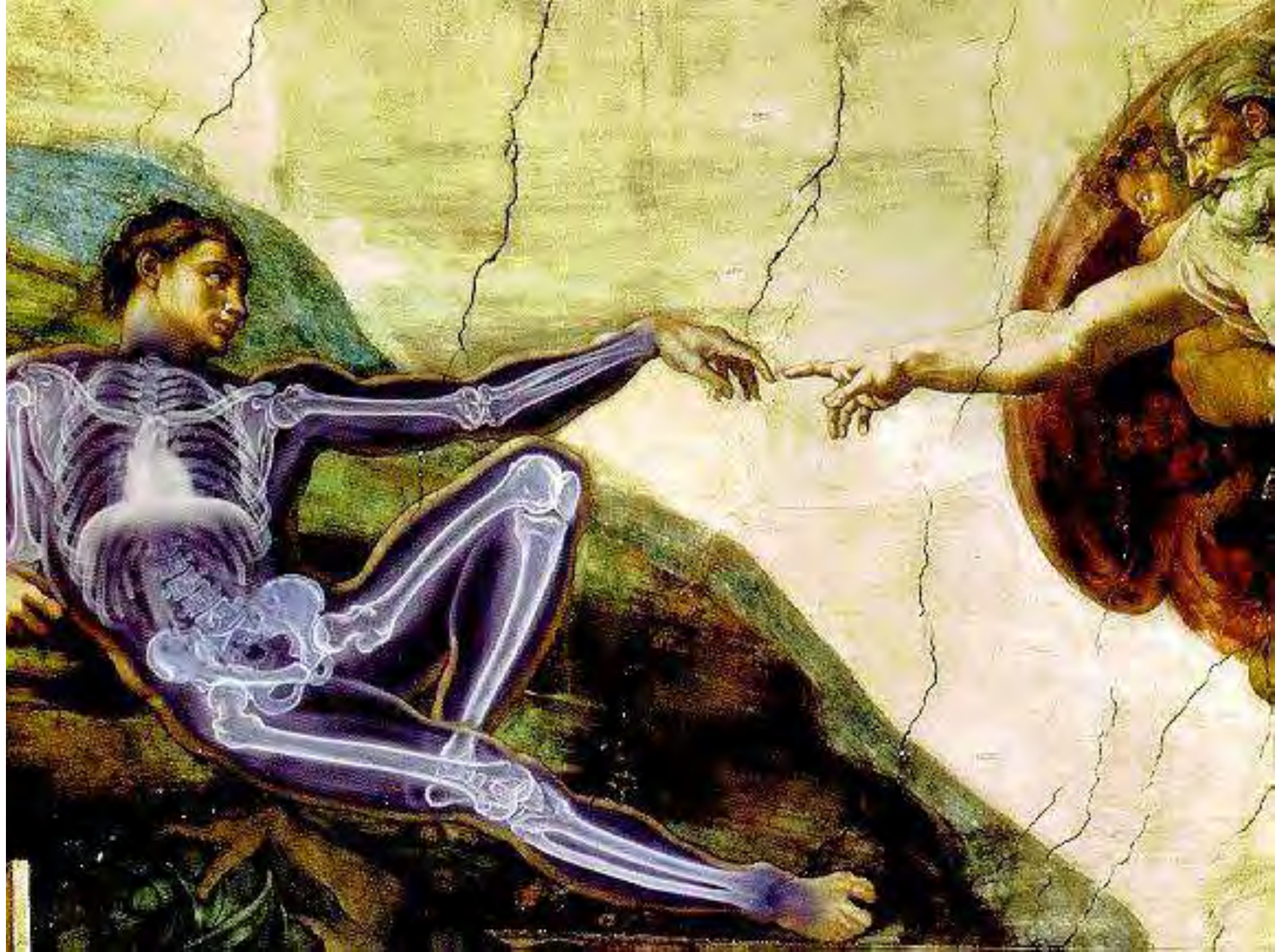
1896.



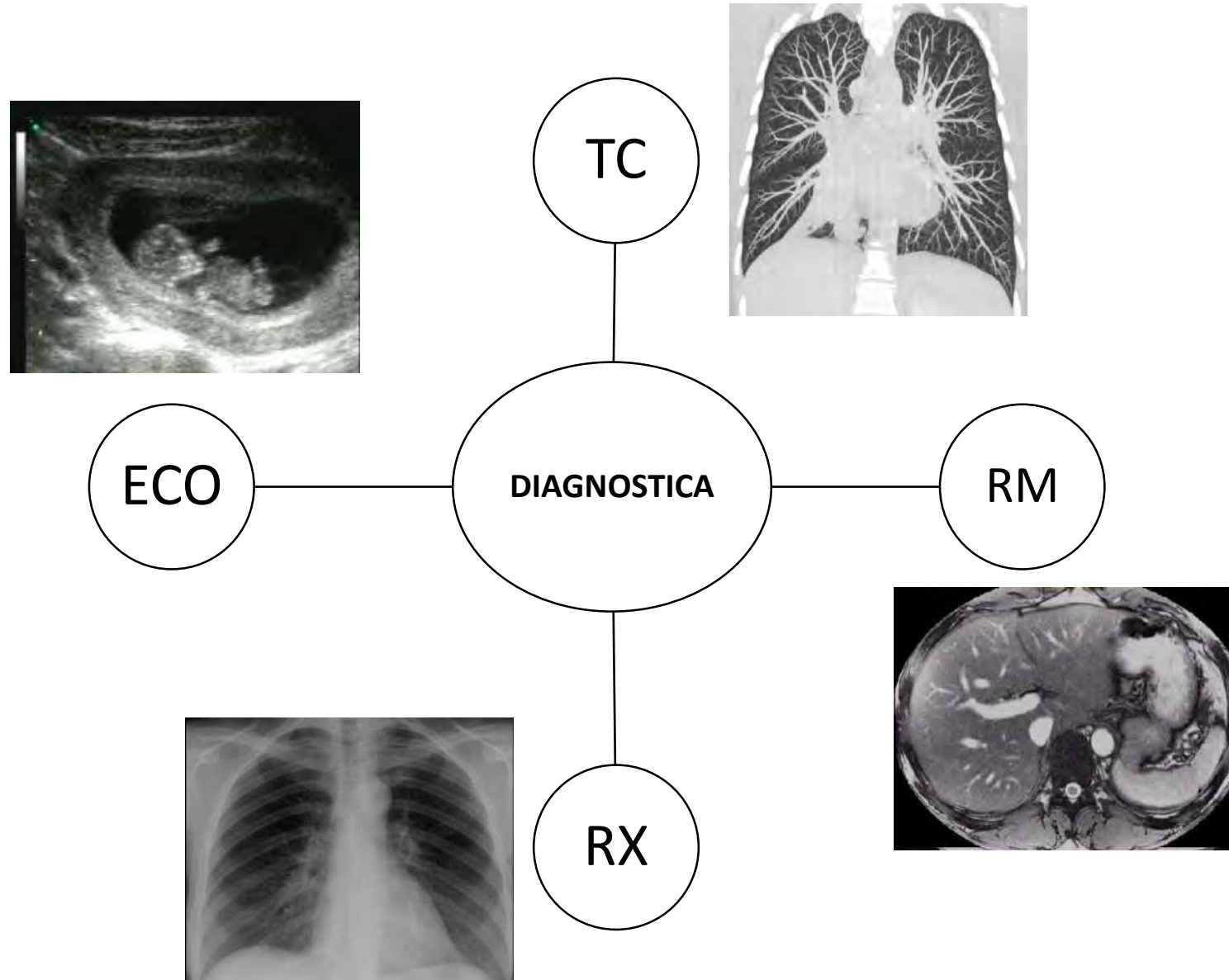


**Impiego sociale e "popolare" dei raggi X**





# METODICHE RADIOLOGICHE







TC



ECO

DIAGNOSTICA

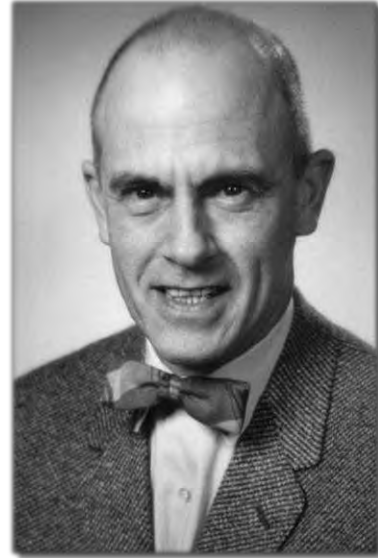
RM



RX



1964



## Charles Dotter

It was fathered by Charles Dotter with his idea that “catheters should replace scalpels.” Dotter initiated interventional radiology with “Transluminal Angioplasty” in January 1964 on a patient scheduled for leg amputation because of a focal arterial obstruction.

1964

1967



Alexander Margulis coined the term “**INTERVENTIONAL**” for these new techniques.

He stressed the need for special training, technical skill, clinical knowledge, ability to care for patients and close cooperation with surgeons and internists.



1964

1972



1967



- Embolizzazione di un ramo arterioso intestinale

1964

1972

1967

1974



Umberto I

I° Iliac Angioplastic

1964

1972

1967

1974



Andreas Gruentzig

First peripheral angioplasty with balloon on human patient



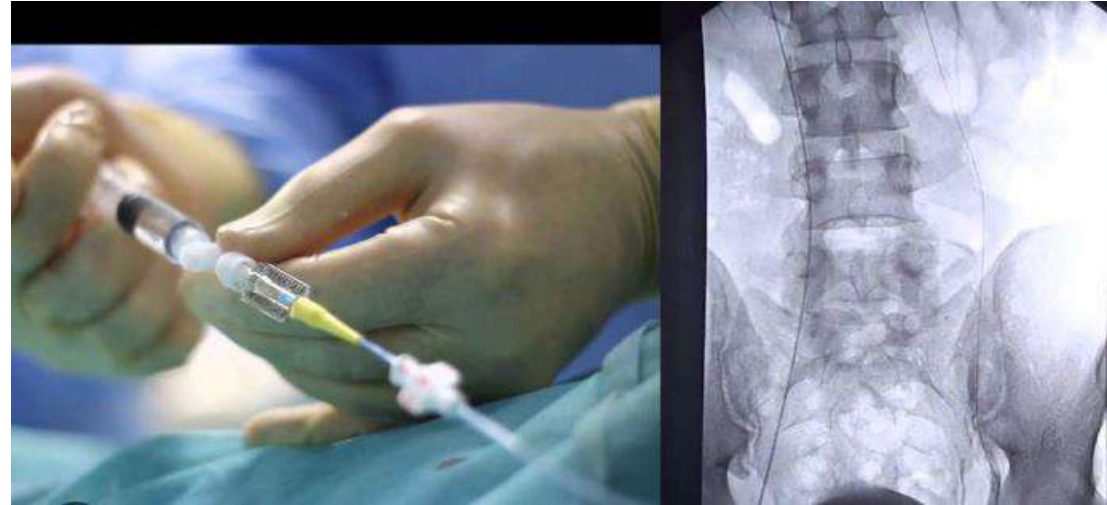
1964

1972

1977

1967

1974



Dr. Vittorio Iaccarino - Napoli

First percutaneous sclerotherapy of male varicocele

1964

1972

1977

1967

1974

1988



Figure 18. Coetz Richter and his clinical TIPS created with placement of Palmaz stents into the created intrahepatic tract (portogram reprinted with permission from reference 46).

1964

1972

1977

1992

1967

Alle Molinette

## Una protesi per salvare il fegato

E' stato eseguito nell'ospedale Molinette il primo intervento in Italia basato su una derivazione artificiale fra vena porta e vena sovraepatica nel fegato, per il trattamento della cirrosi epatica.

L'operazione è stata condotta da Maurizio Grosso, responsabile del servizio di angiografia dell'istituto di radiologia, coadiuvato da cinque radiologi. Consiste nell'inserimento di una protesi metallica nel fegato con una sonda che viene introdotta da una vena del collo e crea una comunicazione tra la vena porta e la vena sovraepatica.

1974

LA STAMPA

CRONACA DI TORINO

Rispetto alle tradizionali tecniche chirurgiche questa tecnica operatoria, già adottata con successo negli ospedali di Friburgo, Parigi e Heidelberg, ha il vantaggio di permettere, in seguito, il trapianto del fegato nei casi in cui la gravità della malattia lo renda necessario.

Il malato che si è sottoposto all'intervento è un uomo di 64 anni che era stato ricoverato d'urgenza nell'ospedale torinese.

1988







## Interventional Radiology Suite

- ASEPSIS rules
- High definition image machines
- Anesthesia equipment (Monitoring equipments ...)



# Interventional Radiology Suite





# HYBRID ROOM

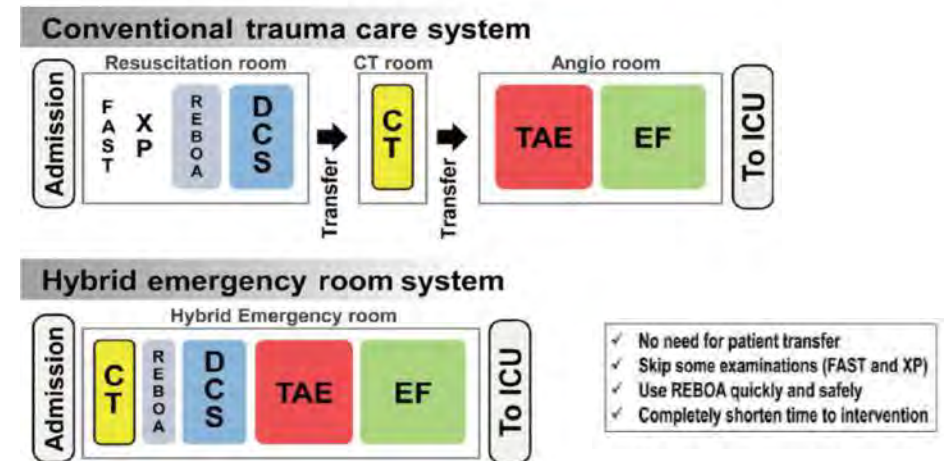
The hybrid emergency room system: a novel trauma evaluation and care system created in Japan

The founding members of the Japanese Association for Hybrid Emergency Room System (JA-HERS)\*



- Whole-body computed tomography examination
- Damage control surgery
- Transcatheter arterial embolization

AE in unstable patients can be considered in a **hybrid OR**, as a part of multidisciplinary interventions, and are performed after damage control procedures, as a completion of the hemostasis



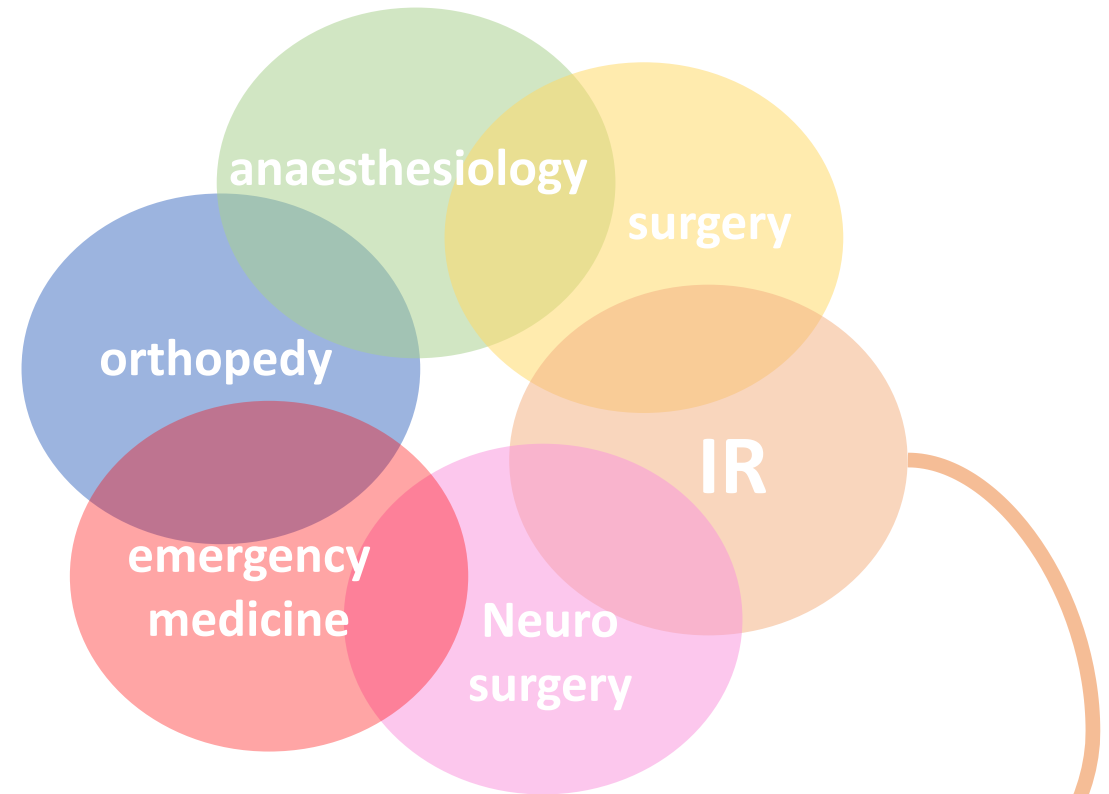


# HYBRID ROOM

Simultaneous damage control surgery and endovascular procedures for patients with blunt trauma in the hybrid emergency room system: New multidisciplinary trauma team building

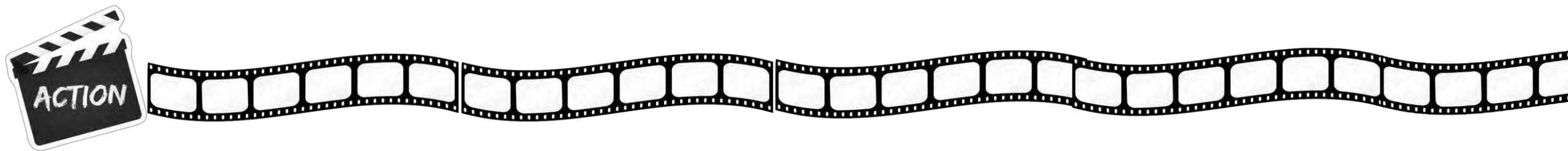
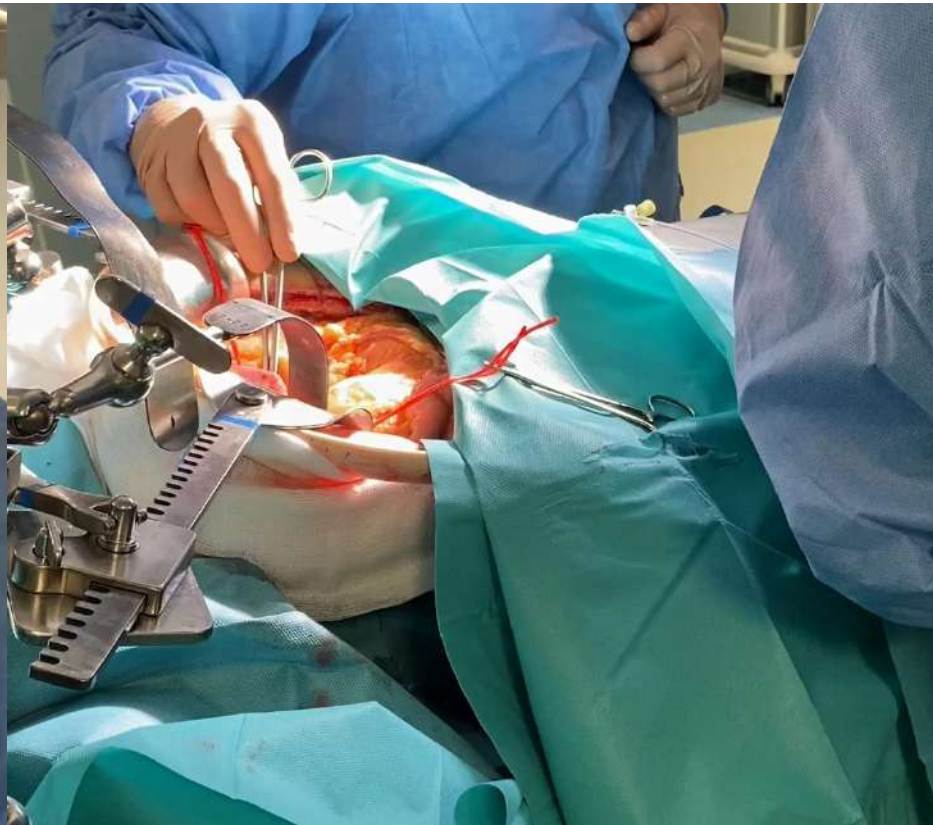
Kaori Ito, MD, Tsuyoshi Nagao, MD, Kahoko Nakazawa, MD, Akinori Kato, MD, Hiroto Chiba, MD, Hiroshi Kondo, MD, PhD, Yasufumi Miyake, MD, PhD, Tetsuya Sakamoto, MD, PhD, and Takashi Fujita, MD, PhD, Tokyo, Japan

The HERS is a novel tool for trauma patient care that enables the evaluation and treatment to be completed in a single room. Building a multidisciplinary team involving surgery, IR, anesthesiology, and EM is a crucial part of HERS-based trauma care.



**24h/day-7d/week  
perfect team work**

# HYBRID ROOM





# Interventional Radiology Team

## Team:

- Interventional Radiologist
- Residents
- Nurses
- Radiology technician



**Sister  
Sledge**

**WE ARE FAMILY**

## IR team must recognise and reduce

Complications of IR

Risks of ionizing radiation for the patient and IR staff





# INTERVENTIONAL RADIOLOGY

**FIRST LEVEL:** Invasive diagnostic and therapeutic procedures

- imaging-based biopsies (CT or US guided)
- mini-invasive management of post-surgical/clinical complications (percutaneous management of fluid collections)

**SECOND LEVEL:** Therapeutic interventional in vascular or extravascular fields

- recanalization of arterial trunks with angioplasty or stentig
- percutaneous biliary drenaige (benign or malign disease)
- urologic procedures
- Embolization
- TACE

**THIRD LEVEL:** High complexity interventies

- EVAR (Endovascular Aortic Repair)
- TEVAR (Thoracic Endovascular Aortic Repair)
- TIPS
- Angiographic neurointerventions

# INTERVENTIONAL RADIOLOGY

- ENDOVASCULAR
- EXTRAVASCULAR
- INTERVENTIONAL ONCOLOGY (IO)

## FOUR SUPER HEROES IN CANCER CARE

**SURGERY**



**ONCOLOGY**



**RADIATION**



**IO**



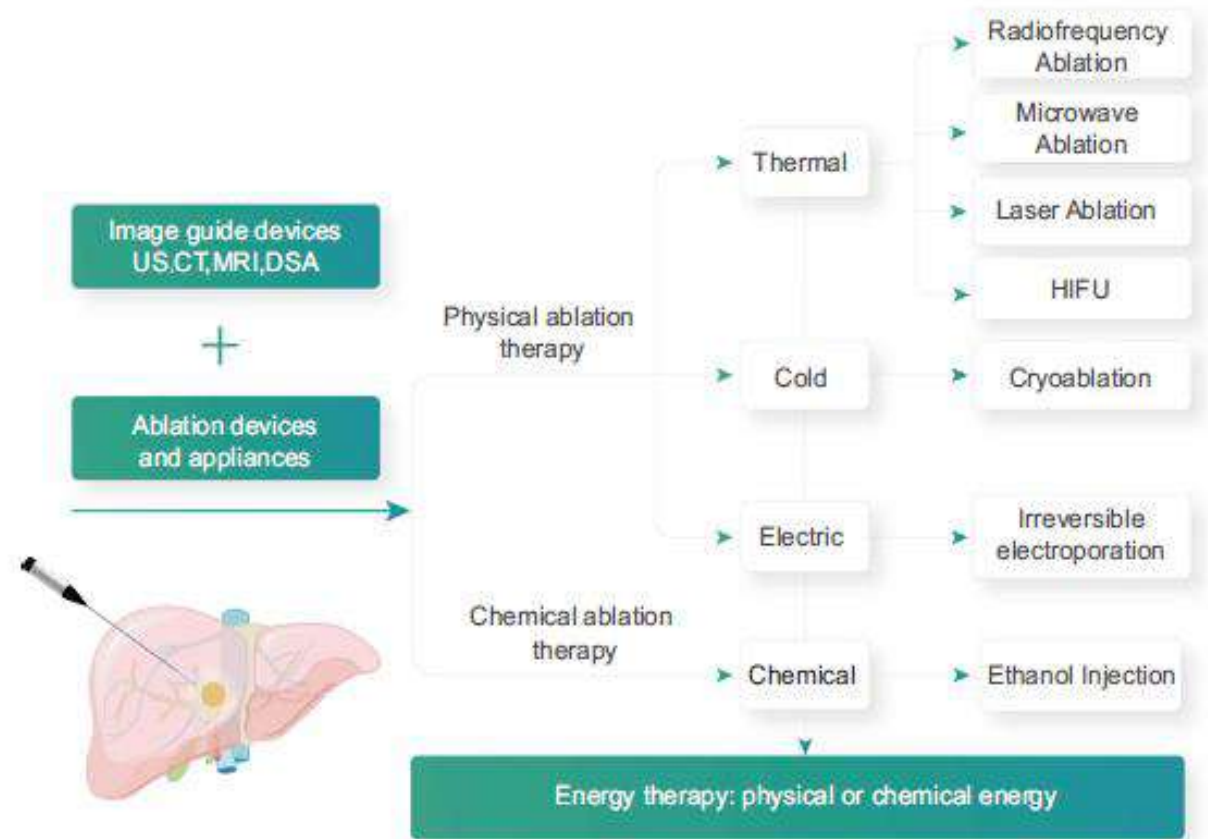


## IR: ONCOLOGY

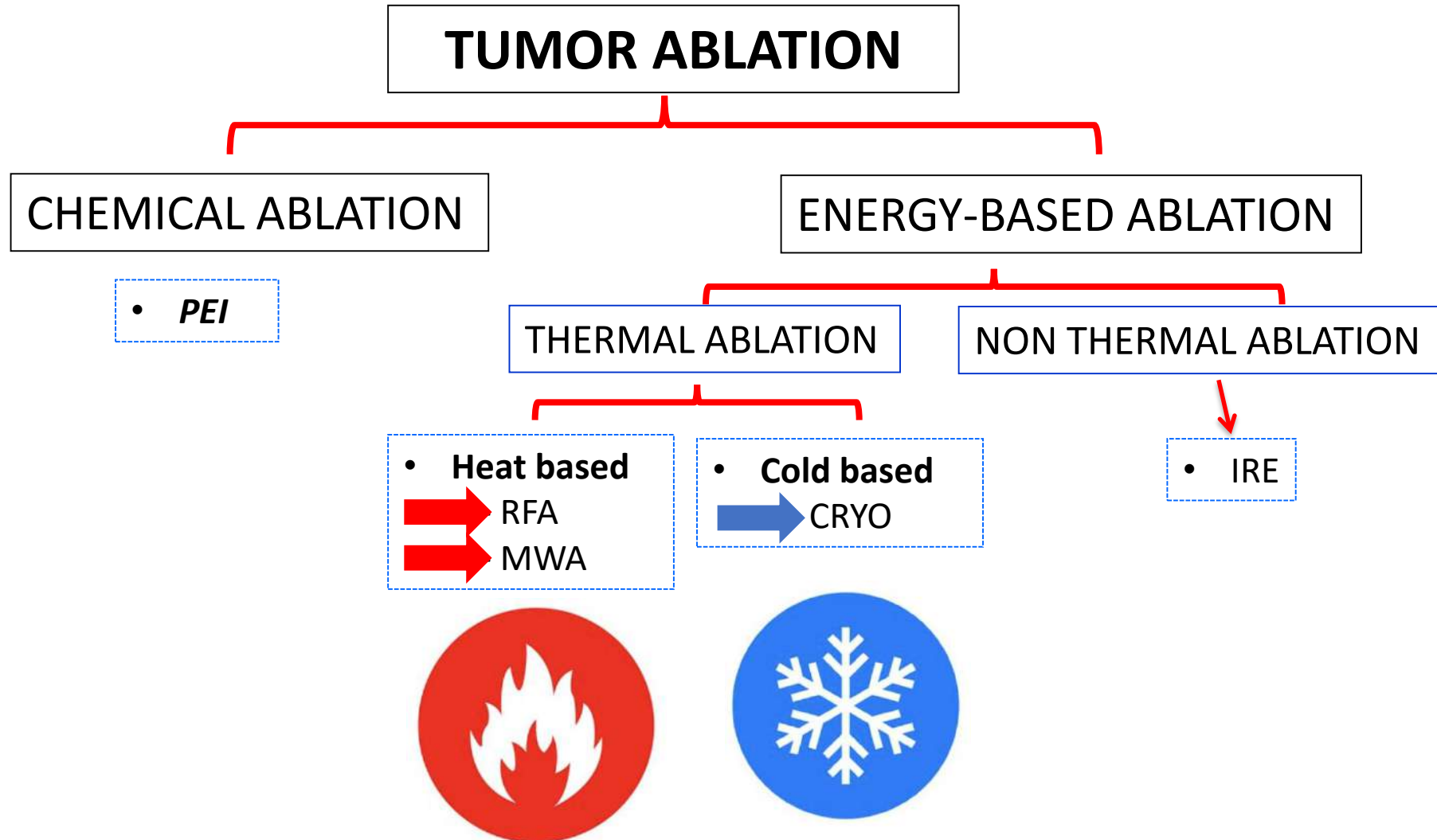
- Diagnostica invasiva
- Biopsie
- Fusion

# THERAPEUTICAL OPTIONS

- PERCUTANEE
- ABLAZIONE
  - RADIOFREQUENZA (RFA)
  - MICROONDE (MW)
  - CRIOABLAZIONE
  - ELETTROPORAZIONE IRREVERSIBILE (IRE)



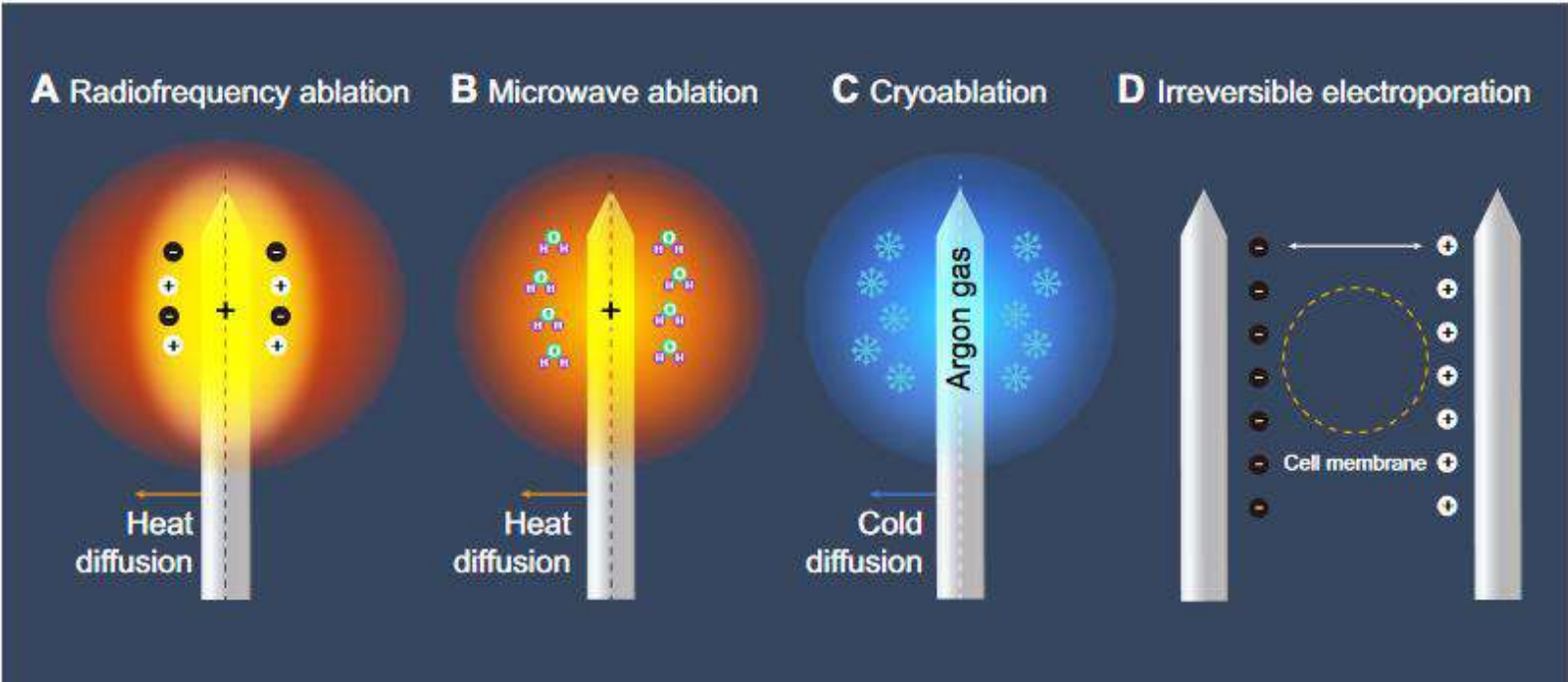
# Percutaneous Treatments





# THERAPEUTICAL OPTIONS

## TECNICHE ABLATIVE

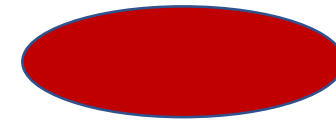


# THERAPEUTICAL OPTIONS

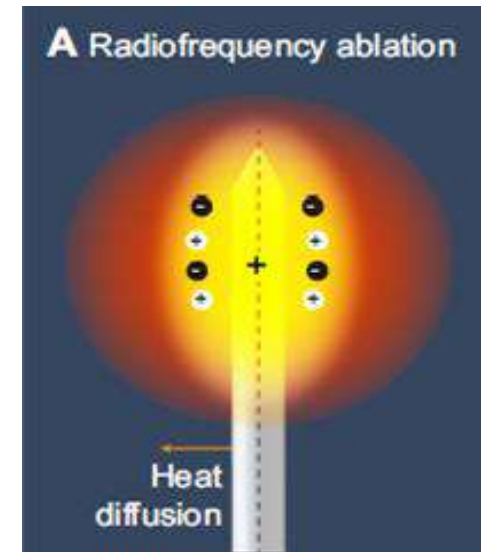


## RADIOFREQUENCY ABLATION

- **Thermocoagulative necrosis** is achieved via a **closed circuit of current** that flows through the patient (60-100°C)
- The current reaches the **electrode** inside the probe and generates **heat**
- An **elliptical-shaped ablation area** of around 2 – 5 cm is generated around the target of the tip
- Distance between the target and large blood vessels ( $\geq 3$  mm) can affect the complete ablation rate due to the “**heat sink effect**” of **vessel heat dispersion**



*Elliptical-shaped ablation area*

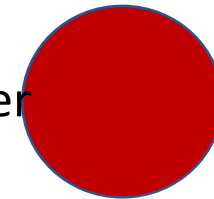
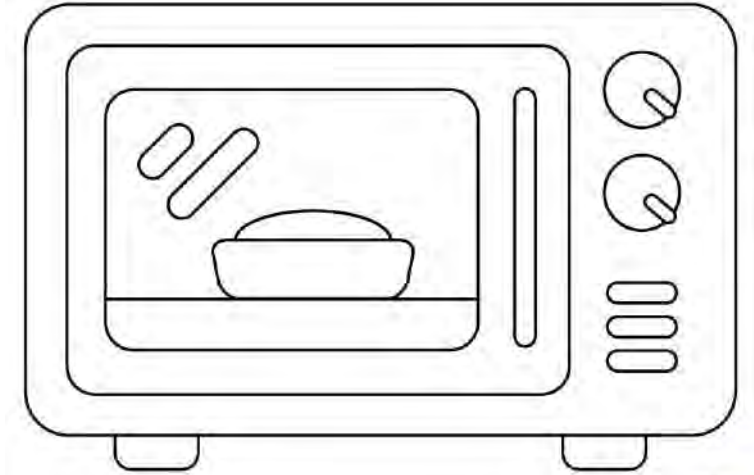


# THERAPEUTICAL OPTIONS

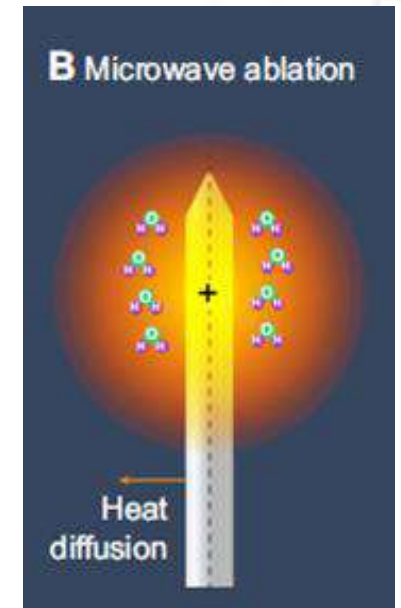


## MICROWAVE ABLATION

- Considered a **technical evolution** in comparison to RFA
- Heat is generated with a **microwave field** rapidly oscillating at **2,450 MHz** rotating polar molecules, primarily water (65-160°C)
- The motion of polar molecules is increased in **water and human tissues**
- The MWA technology allows the usage of **100 or 150 W** with larger ablation zones in less time
- **Thermosphere Technology** allows better control of the shape of the ablation zone



*Spherical-shaped ablation area*



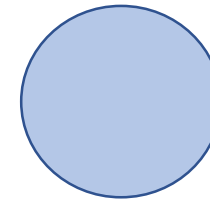
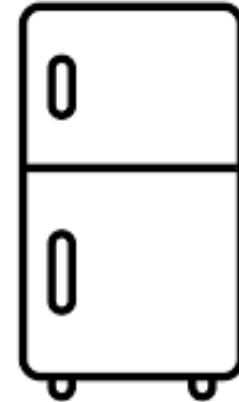


# THERAPEUTICAL OPTIONS



## CRYOABLATION

- Argon gas in the tip reaches temperatures as low as  $-40\text{ }^{\circ}\text{C}$
- **Cycling between freezing and thawing** alters the tonicity of the cells and creates focused tissue damage with **cell bursting**
- **Complication rate is higher than MWA and RFA for the treatment of liver focalities**
- The main advantage of cryoablation is that the **ice-ball** can be clearly monitored during the procedure thanks to CT or US guidance
- May have a **niche** in the treatment of tumors near vital structures



*Iceball*

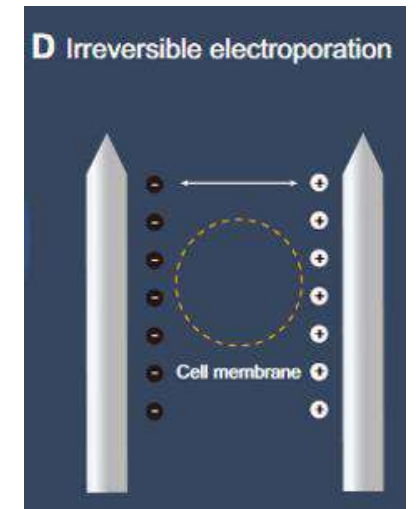
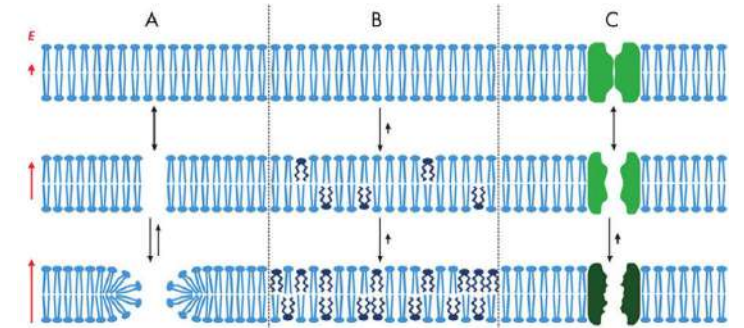


# THERAPEUTICAL OPTIONS

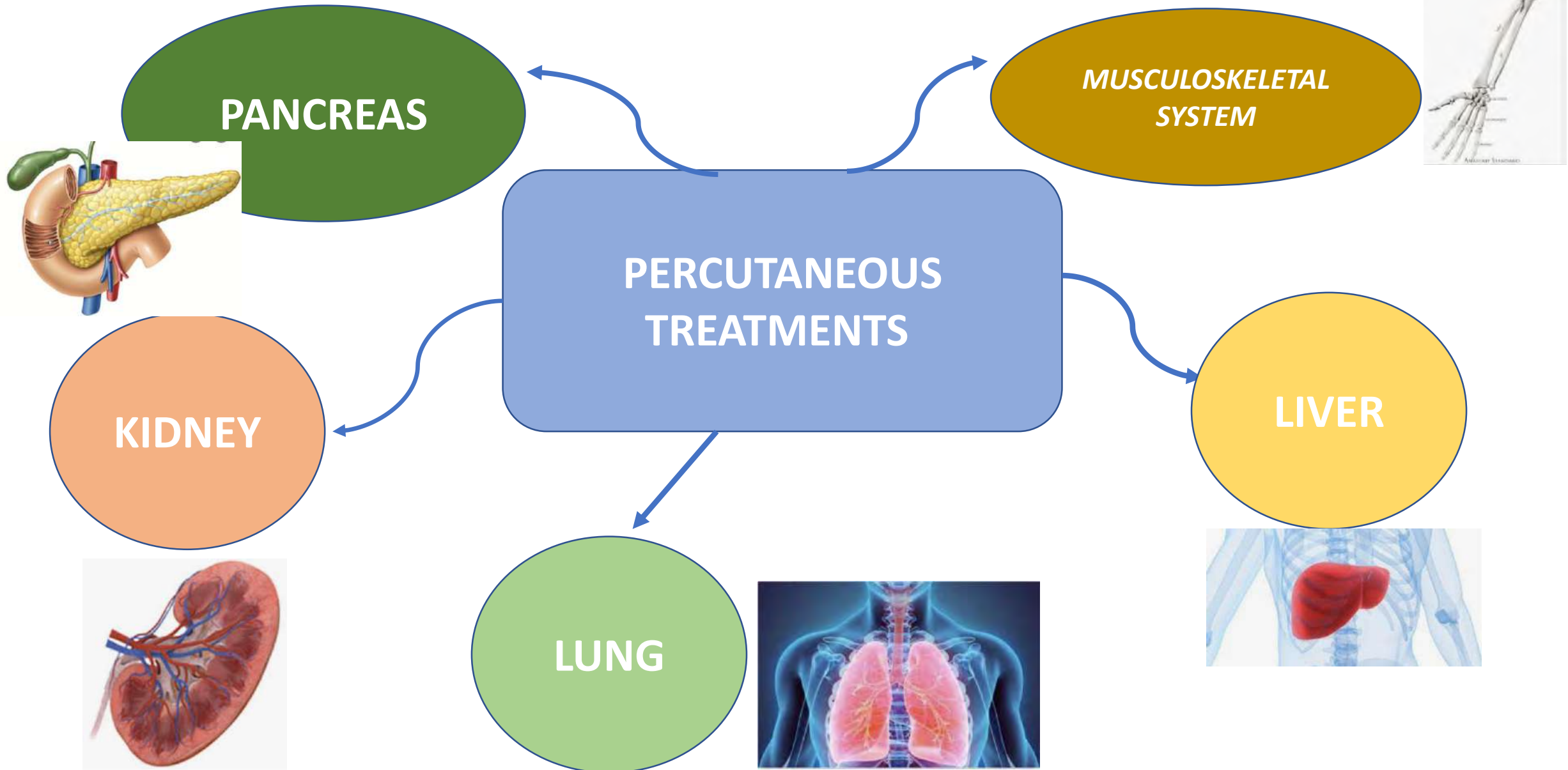


## IRREVERSIBLE ELECTROPORATION

- Irreversible electroporation is a **nonthermal ablation technique** using very short **current pulses** at **high voltage** (up to 3000 V in 70-80  $\mu$ s)
- The damage is caused by the **rupture of the cell membrane**, leading to a disruption in the homeostatic balance
- **The underlying matrix, vessels, nerves, and bile ducts are preserved by the ablation**
- The tissue's temperature always **stays under 50°C**, so there is no «heat sink» effect neither coagulation necrosis



# Thermal ablation guidance







2008

## Microwave tumors ablation: Principles, clinical applications and review of preliminary experiences

Gianpaolo Carrafiello<sup>a, \*</sup>, Domenico Laganà<sup>a</sup>, Monica Mangini<sup>a</sup>, Federico Fontana<sup>a</sup>, Gianlorenzo Dionigi<sup>c</sup>, Luigi Boni<sup>c</sup>, Francesca Rovera<sup>c</sup>, Salvatore Cuffari<sup>b</sup>, Carlo Fugazzola<sup>a</sup>

<sup>a</sup> Department of Radiology, University of Insubria, Varese, Italy

<sup>b</sup> Service of Anaesthesiology, Hospital of Varese, Italy

<sup>c</sup> Department of Surgical Sciences, University of Insubria, Varese, Italy

### ARTICLE INFO

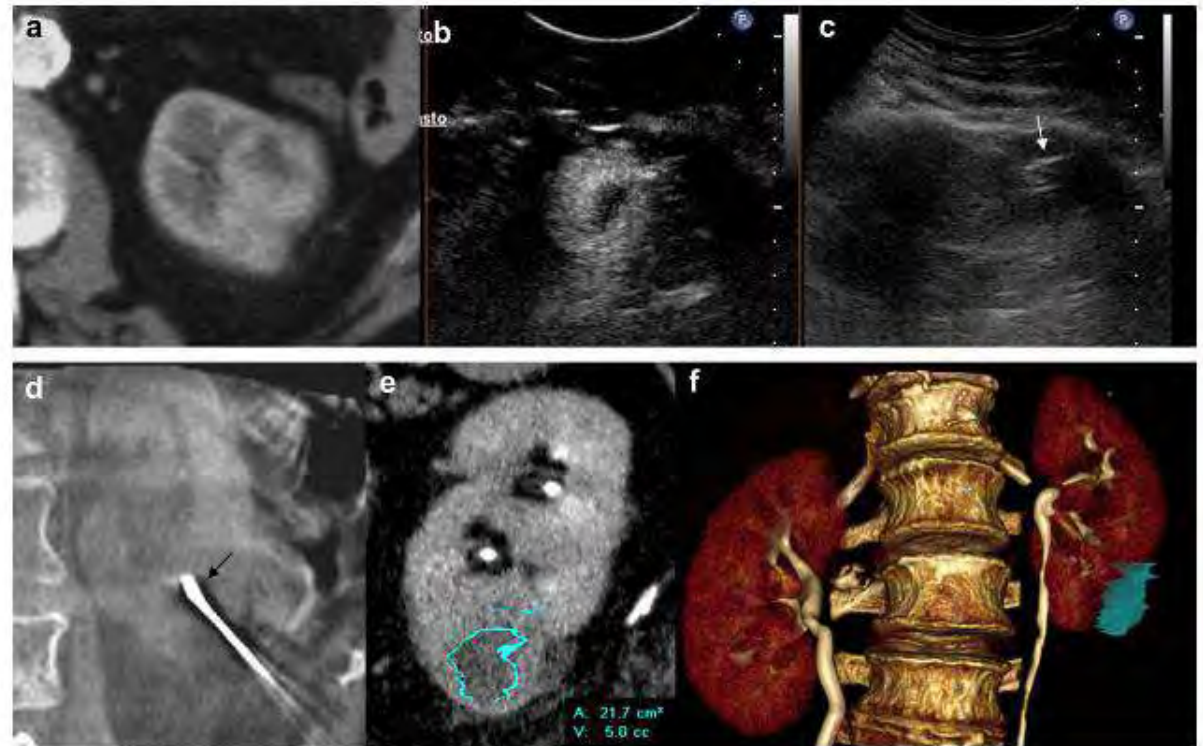
Article history:  
Available online 14 December 2008

Keywords:  
Microwave  
Tumors  
Ablation

### ABSTRACT

Local ablative techniques have been developed to enable local control of unresectable tumors. Ablation has been performed with several modalities including ethanol ablation, laser ablation, cryoablation, and radiofrequency ablation. Microwave technology is a new thermal ablation technique for different types of tumors, providing all the benefits of radiofrequency and substantial advantages. Microwave ablation has been applied to liver, lung, kidney and more rarely to bone, pancreas and adrenal glands. Preliminary works show that microwave ablation may be a viable alternative to other ablation techniques in selected patients. However further studies are necessary to confirm short- and long-term effectiveness of the methods and to compare it with other ablative techniques, especially RF.

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# Microwave

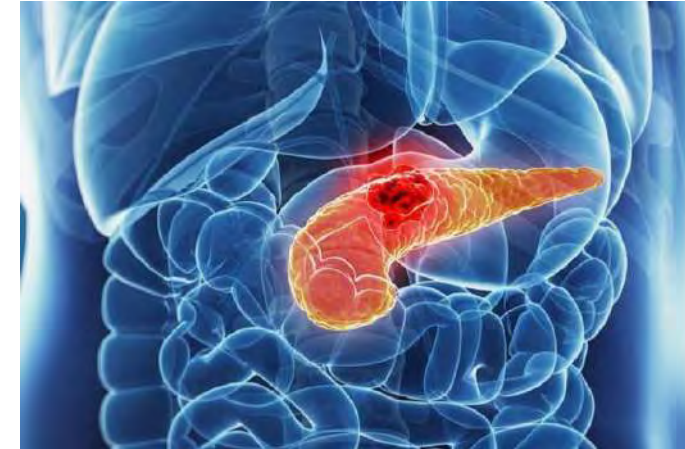
Cardiovasc Intervent Radiol (2012) 35:439–442  
DOI 10.1007/s00270-011-0189-8

LETTER TO THE EDITOR

## Microwave Ablation with Percutaneous Approach for the Treatment of Pancreatic Adenocarcinoma

Gianpaolo Carrafiello · Anna Maria Ierardi · Filippo Piacentino ·  
Natalie Lucchina · Gianlorenzo Dionigi · Salvatore Cuffari · Carlo Fugazzola

Received: 14 February 2011 / Accepted: 9 May 2011 / Published online: 2 June 2011  
© Springer Science+Business Media, LLC and the Cardiovascular and Interventional Radiological Society of Europe (CIRSE) 2011



Recently, this technique has been proposed in different organs, such as liver, lung, and kidney [10]. However, only few cases regarding the use of MWA in pancreatic cancer have been published and they were performed under laparotomy [5]. **To the best of our knowledge, our case represents the first pancreatic head cancer with the percutaneous approach treated with MWA.**

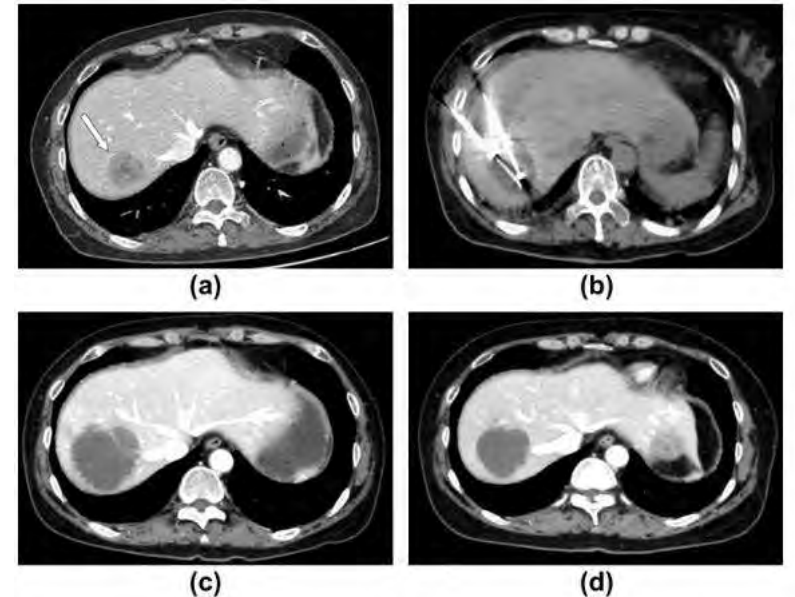
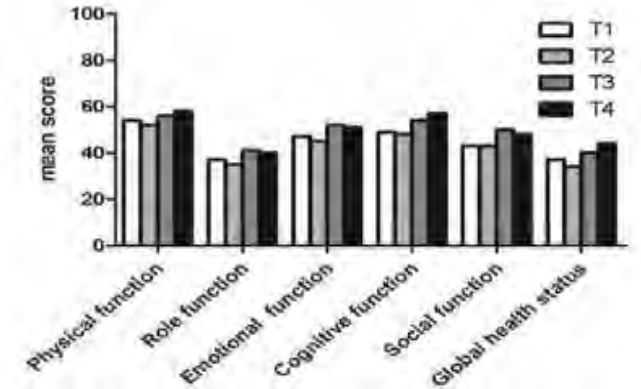




# Cryoablation

## Percutaneous cryoablation of liver metastases from breast cancer: Initial experience in 17 patients

- 17 patients with 39 inoperable breast cancer metastases were treated (**technical success** in 36/39 lesions)
- **No major complications**, such as **cryoshock** (linked to cryoablation, with multi-organ failure) were found
- **Quality of life** questionnaires gave encouraging results at 1 week (T2), at 1 month (T3), and at 3 months (T4) after initiation of cryoablation
- More studies on cryoablation are needed but may be useful in the **treatment of metastases near vital structures not treatable with thermal techniques**

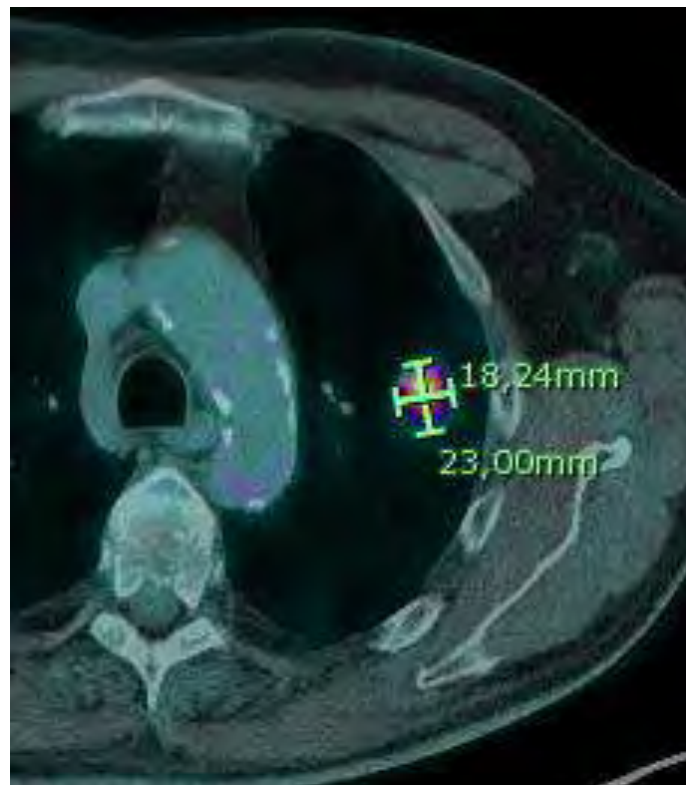
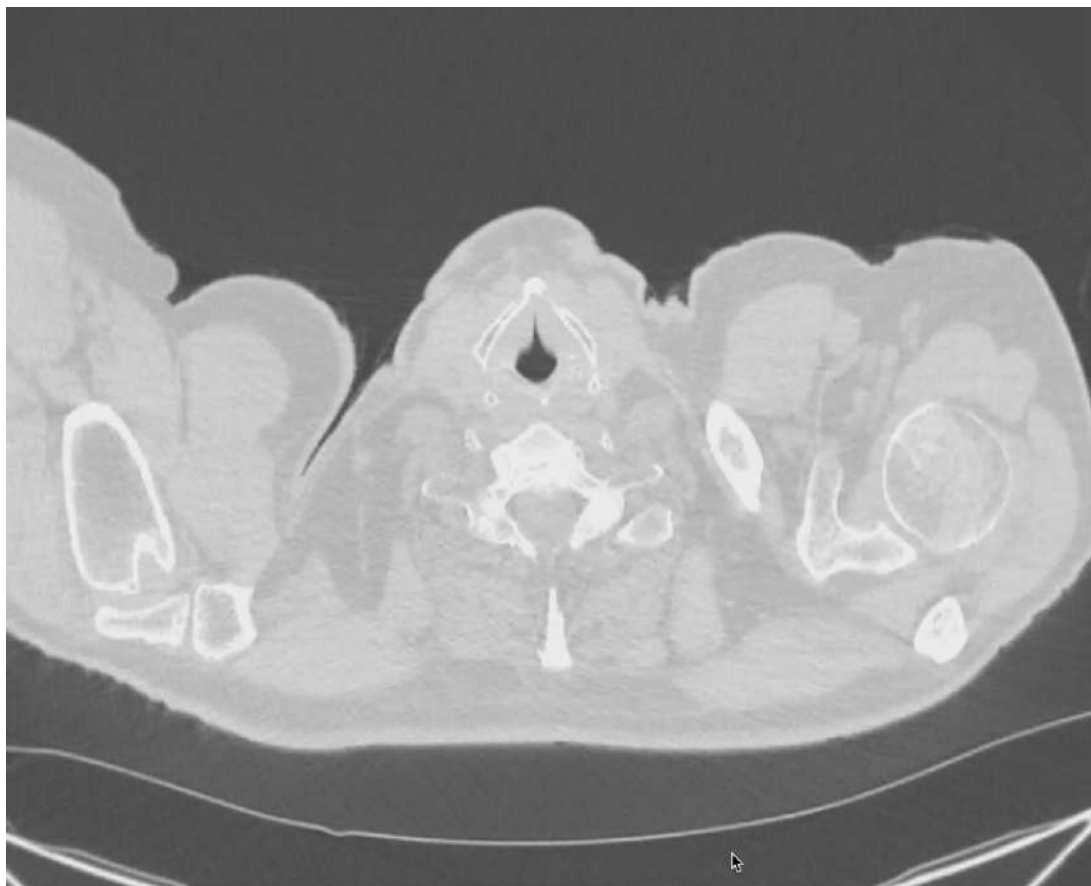






# Thermal ablation

## PRE-PROCEDURAL CT and PET CT



**Medtronic**

5.0cm

4.1cm

0.5cm

IN VIVO | LUNG | 150 WATTS | 04:00

EX VIVO **IN VIVO** LIVER **LUNG** KIDNEY

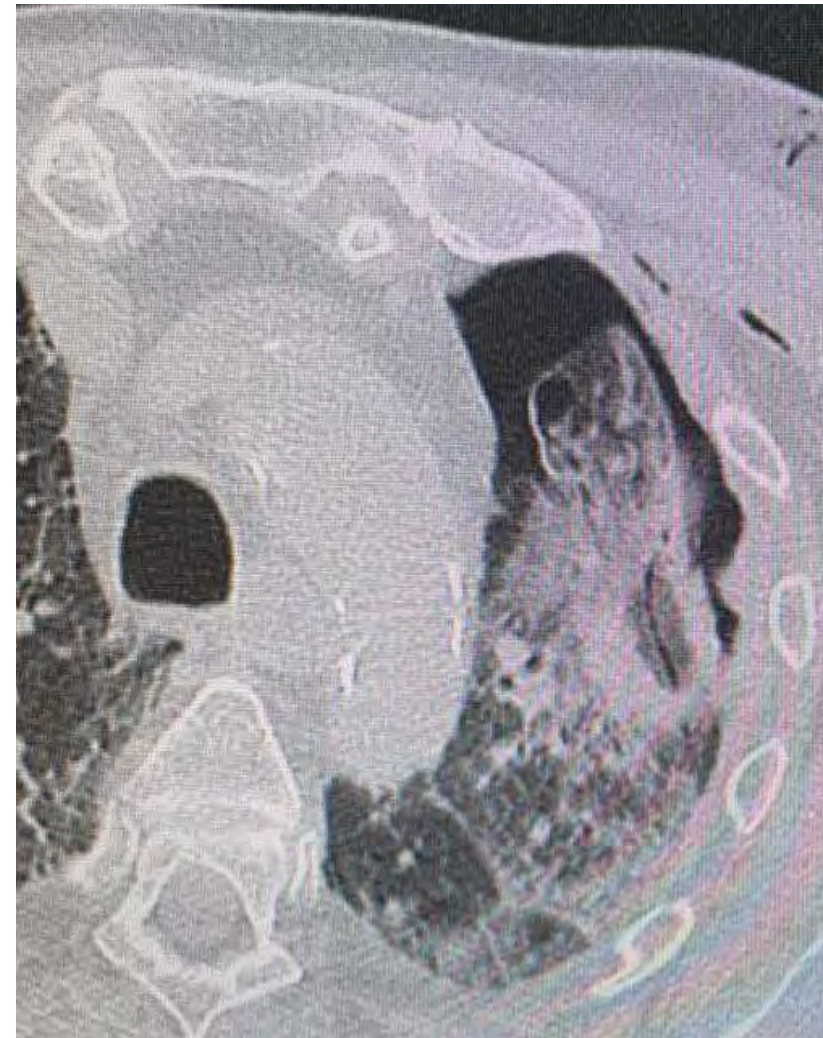
Power (watts) **150**

Time (mm:ss) **04:00**

**i** VOLUME  WIDTH



# Thermal ablation



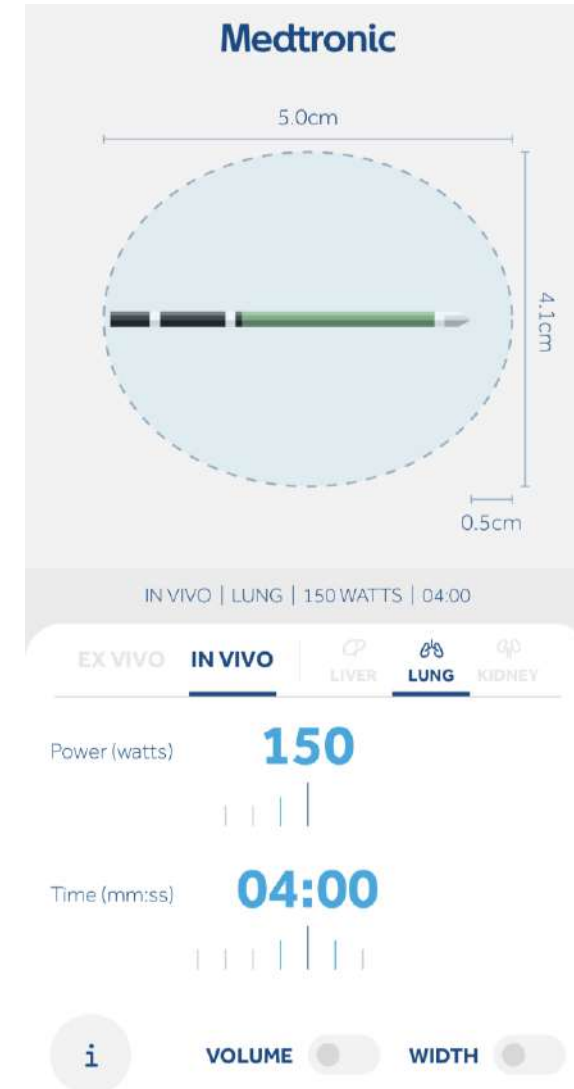
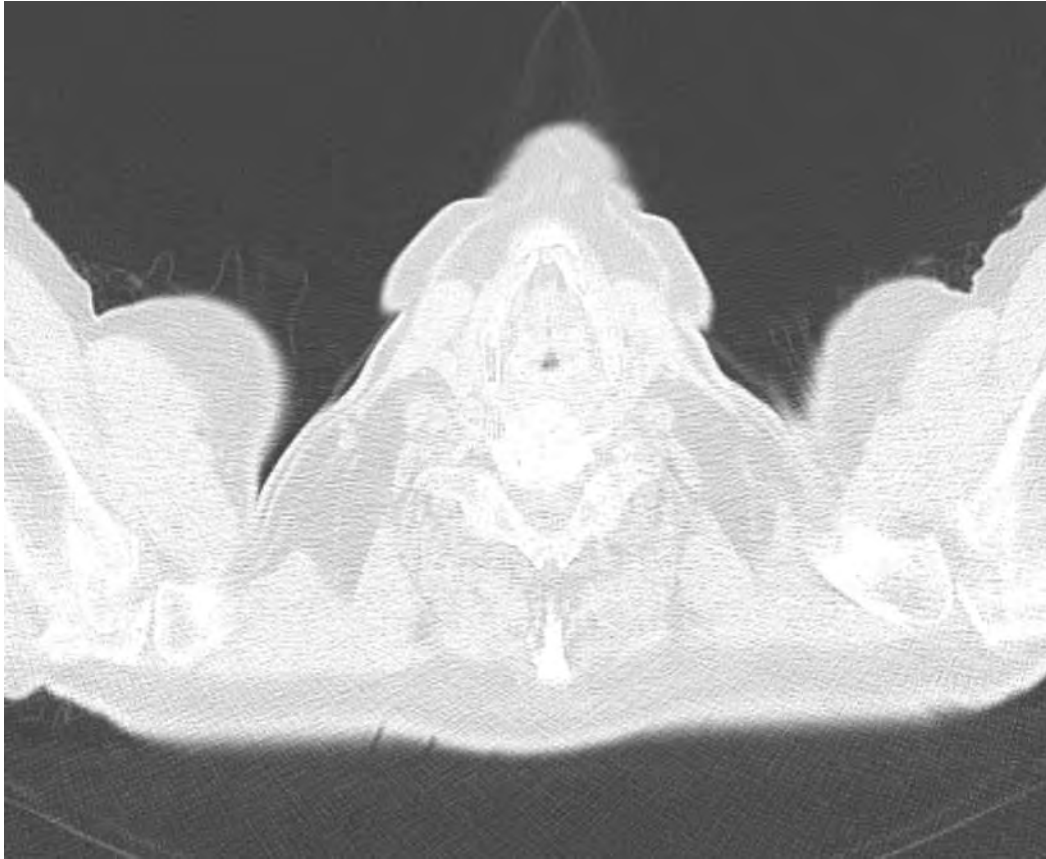
**MWA ABLATION 150 W for 4 min**





# Thermal ablation

## POST-PROCEDURAL CT

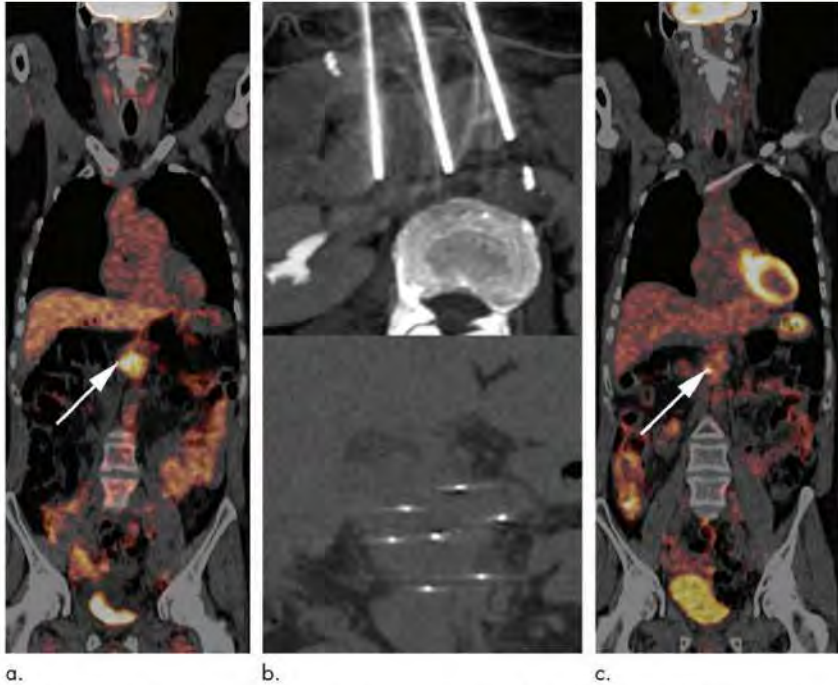


*Post-procedural CT-PET planned after 2 months*





# IRE



**Figure 2:** Images in a 49-year-old woman with a successfully eradicated locally advanced pancreatic tumor. **(a)** Fluorine-18 fluorodeoxyglucose (FDG) PET scan obtained before irreversible electroporation (IRE) (additional to protocol) shows an FDG-avid locally advanced pancreatic tumor (arrow). **(b)** Axial (top) and coronal (bottom) images obtained during IRE show three needles surrounding the tumor and seven needles covering the entire tumor, respectively. **(c)** FDG PET scan obtained 18 months after IRE shows residual ablation zone without tracer uptake (arrow).

## Percutaneous Irreversible Electroporation in Locally Advanced and Recurrent Pancreatic Cancer (PANFIRE-2): A Multicenter, Prospective, Single-Arm, Phase II Study

*Alette H. Ruarus, MD • Laurien G. P. H. Vroomen, MD, PhD • Bart Geboers, MD • Eran van Veldhuisen, BSc • Robbert S. Puijk, MD • Sanne Nieuwenhuizen, MD • Marc G. Besselink, MD, PhD • Barbara M. Zonderhuis, MD • Geert Kazemier, MD, PhD • Tanja D. de Gruijl, MSc, PhD • Krijn P. van Lienden, MD, PhD • Jan J. J. de Vries, MD • Hester J. Scheffer, MD, PhD • Martijn R. Meijerink, MD, PhD*

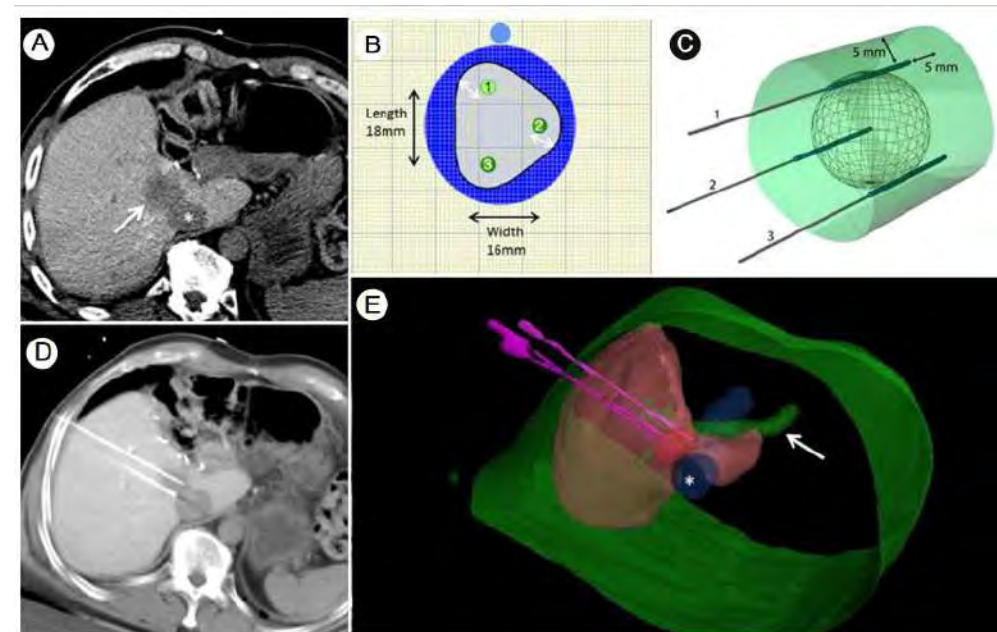
**Conclusions:** For patients with LAPC (stage III), the addition of IRE to conventional chemotherapy and radiation therapy results in substantially prolonged survival compared with historical controls. These results suggest that ablative control of the primary tumor may prolong survival.



## Irreversible Electroporation for Colorectal Liver Metastases

Hester J. Scheffer, MD,<sup>+</sup> Marleen C.A.M. Melenhorst, MD,<sup>+</sup> Ana M. Echenique, MD,<sup>†</sup> Karin Nielsen, MD, PhD,<sup>‡</sup> Aukje A.J.M. van Tilborg, MD,<sup>\*</sup> Willemien van den Bos, MD,<sup>§</sup> Laurien G.P.H. Vroomen, MD,<sup>\*</sup> Petrousjka M.P. van den Tol, MD, PhD,<sup>‡</sup> and Martijn R. Meijerink, MD, PhD<sup>\*</sup>

- Preliminary experience of IRE for the treatment of metastases
- Results indicate that IRE is currently only used as “last resort” curative treatment
- **IRE should then be reserved for well-selected patients with relatively small CRLM that are truly unsuitable for resection and thermal ablation**
- Tumors belonging to this category may interest the **portal triad or the hepatic venous pedicle, where thermal ablation is considered unsafe and less effective**



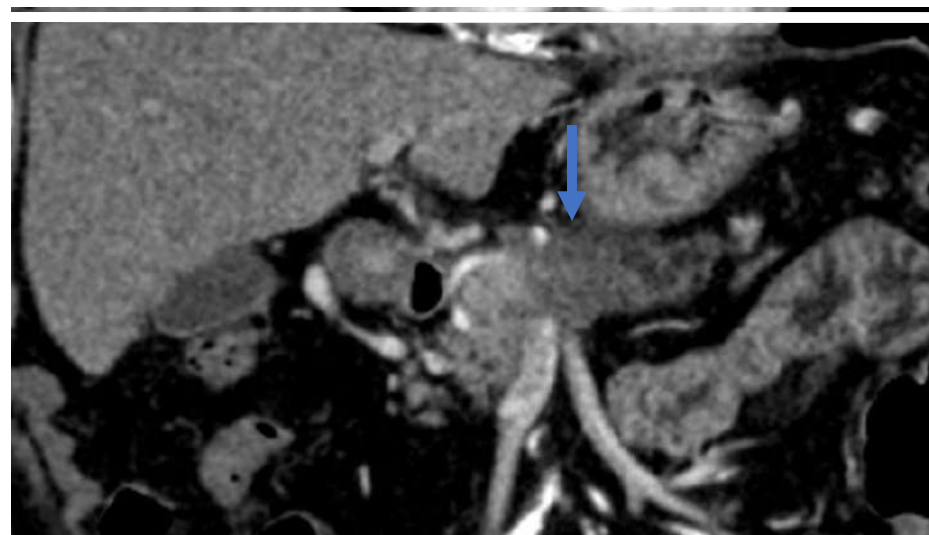
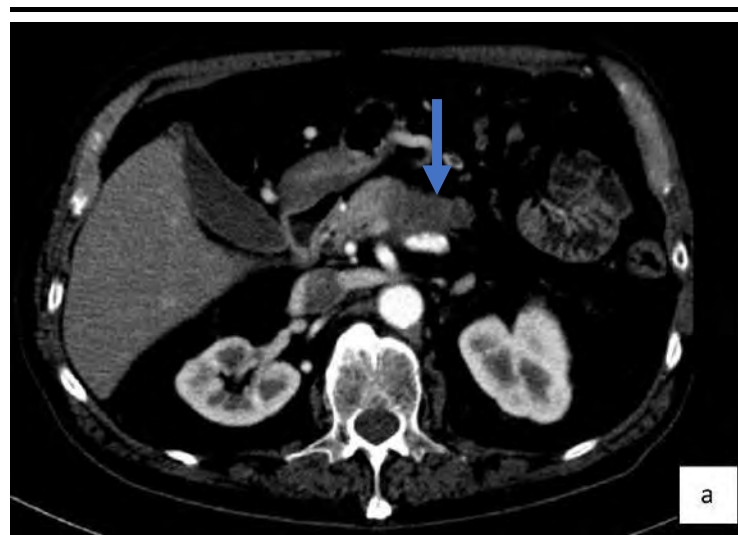
*Planning of electrode placement in a metastasis close to the Inferior Vena Cava*



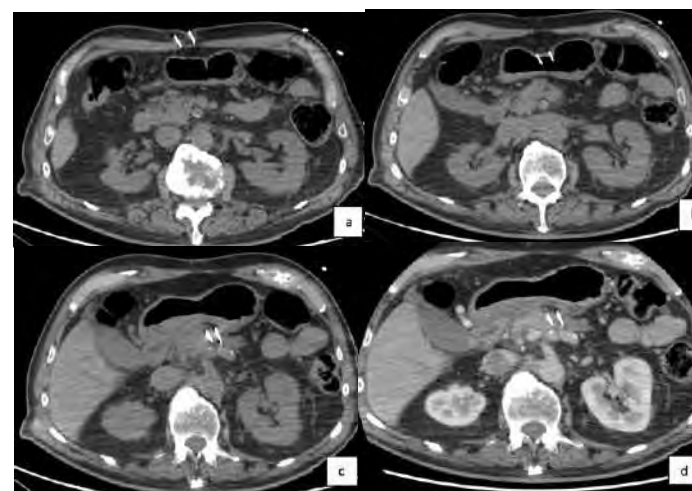


# IRE

CECT pre IRE



Needle positioning with US



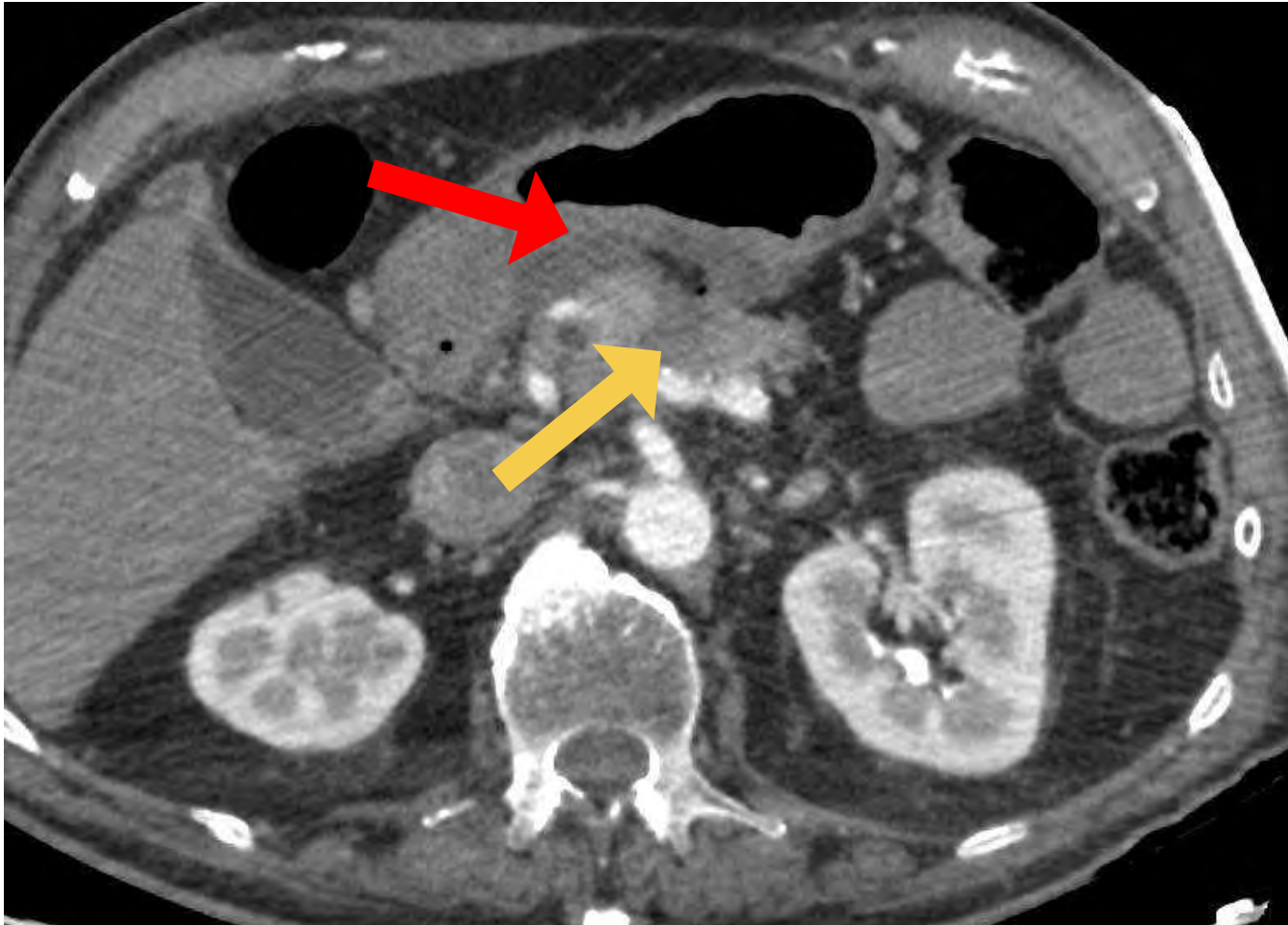
Check of positioning with CT





# IRE

Thin fluid layer between stomach and pancreas (red arrow)



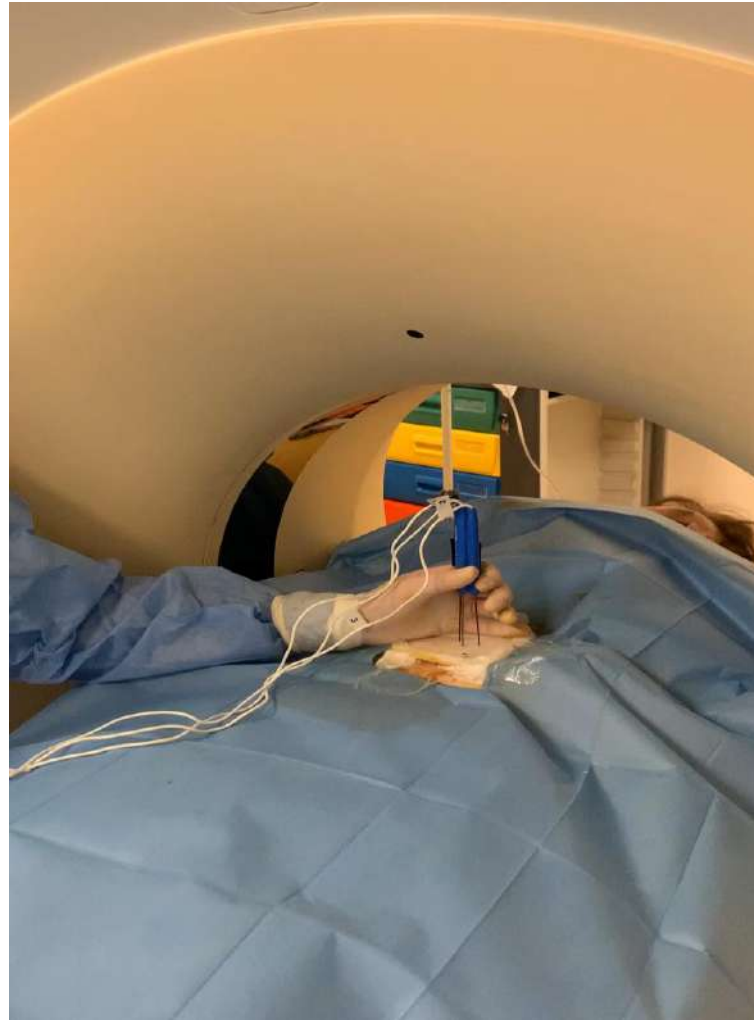
Target area seemed completely covered (yellow arrow)

**POST-  
PROCEDURAL  
CONTRAST  
ENHANCED CT**



# IRE

## IRE PROCEDURE



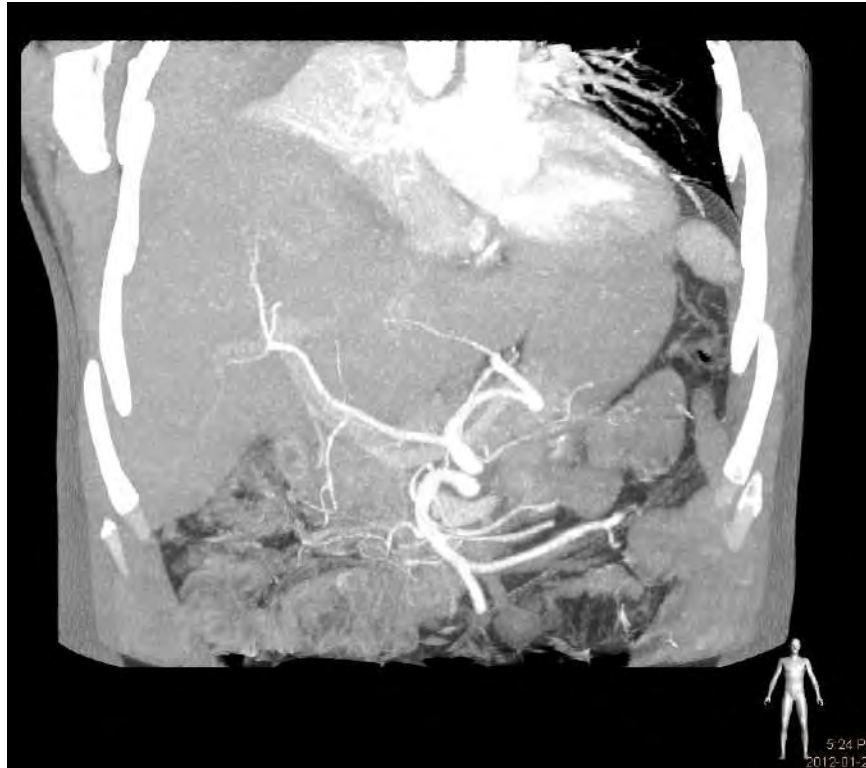
## THERAPEUTICAL OPTIONS

- ENDOVASCOLARI
  - TAE
  - TARE
  - TACE
    - C-TACE
    - DEB-TACE

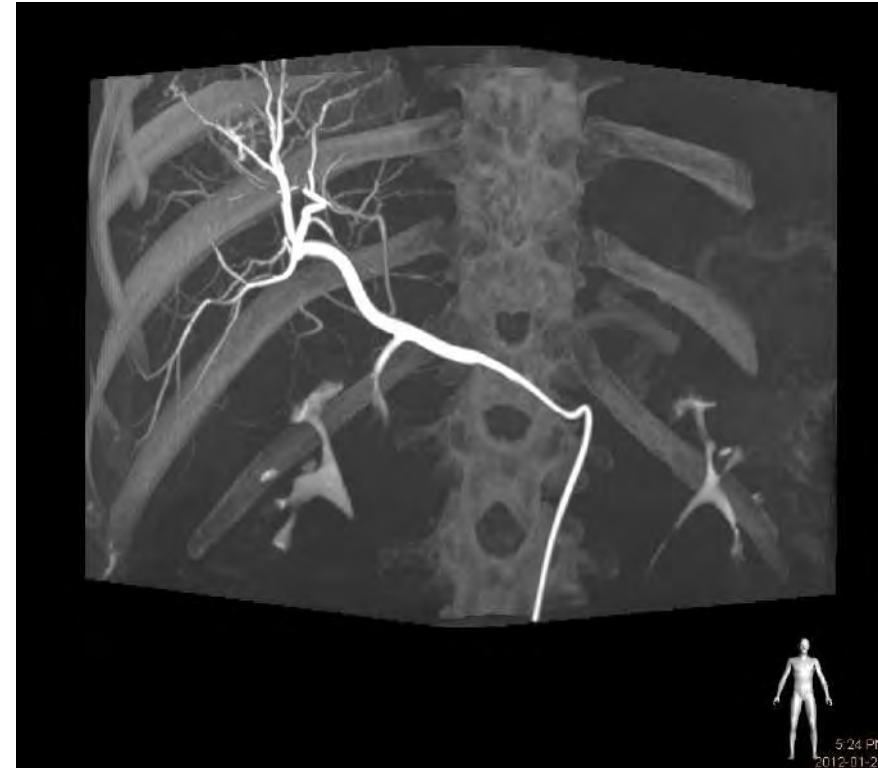


# TACE

## TACE & C-armCBCT Better visibility of feeding arterial anatomy



CE-MDCT



CE-CBCT

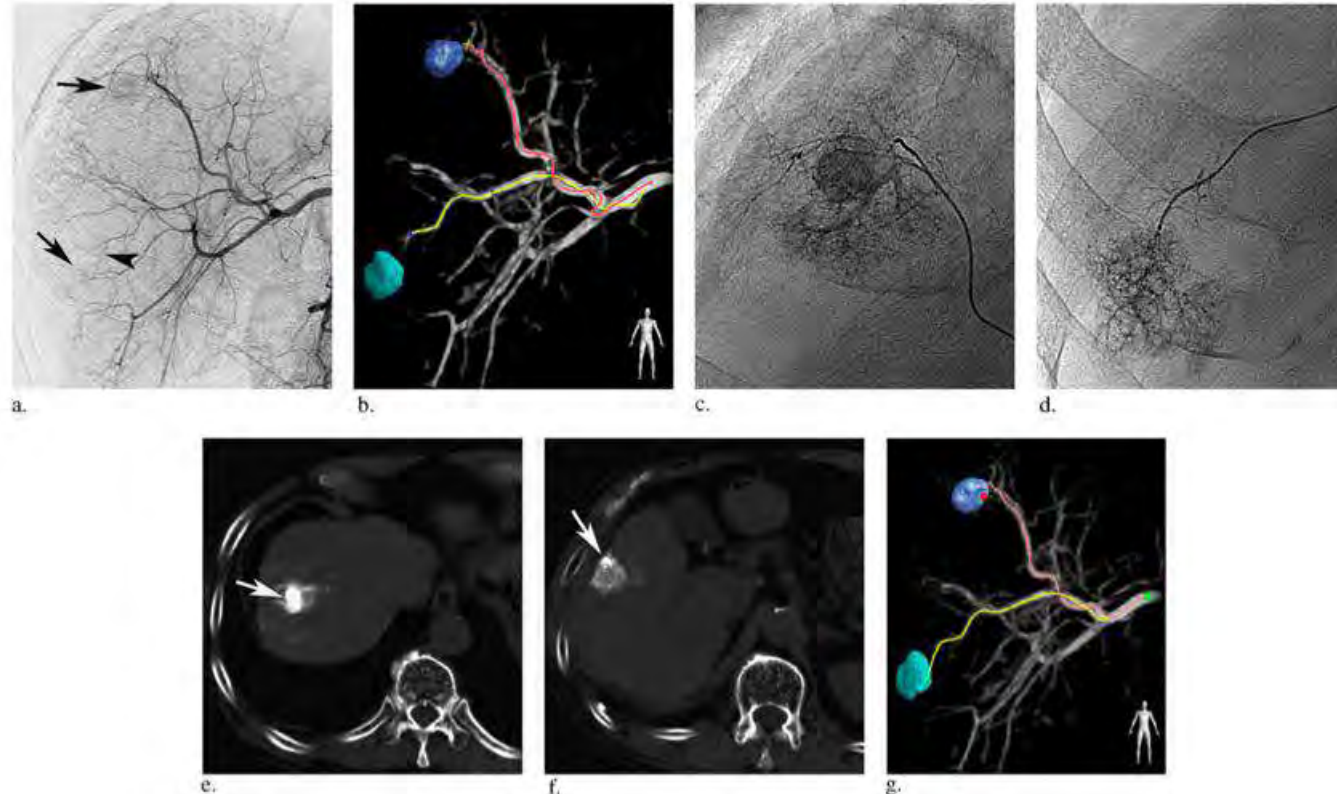
# TACE

## TACE & C-armCBCT

### Identification of Small Hepatocellular Carcinoma and Tumor-feeding Branches with Cone-beam CT Guidance Technology during Transcatheter Arterial Chemoembolization

*J Vasc Interv Radiol 2013; 24:501–508*

Shiro Miyayama, MD,  
Nanako Hashimoto



**Conclusions:** Transcatheter arterial chemoembolization guidance software with cone-beam CT technology has a sufficient performance level to detect small HCCs and their feeding branches.

# TACE

## TACE & C-armCBCT

### Pre-procedural Dual Phase CBCT with i.a. contrast medium

#### Contrast medium

300 mg/ml

- Celiac Trunck: 30ml-3ml/s
- Common Hepatic artery: 20ml 2ml/s
- Right/Left Hep.a.: 10ml/1ml/s

#### PROCEDURE PLANNING (Emboguide Software)

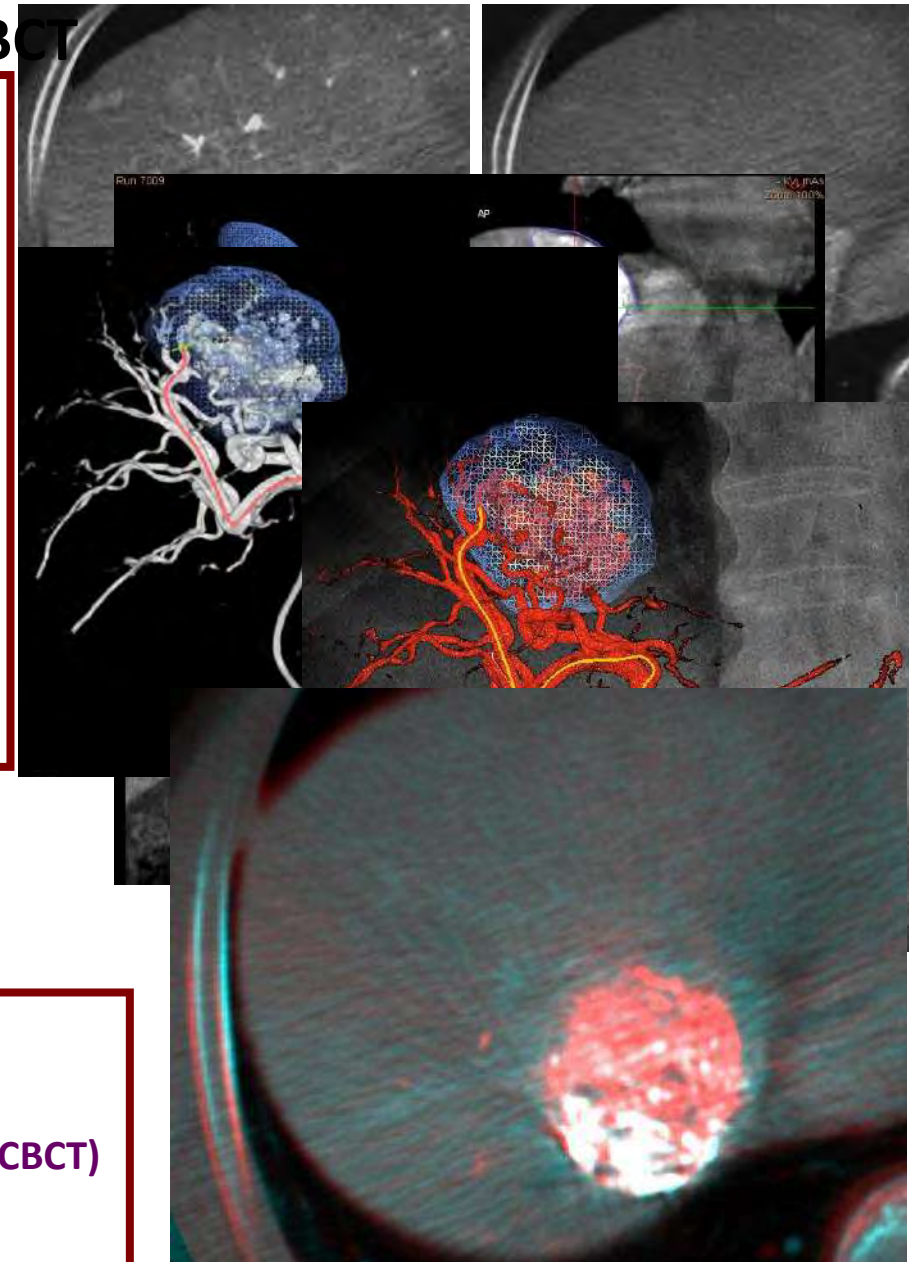
- Lesion Segmentation
- Arterial Feeders Mapping

*c-TACE*

### Post-Procedural CBCT w/o contrast medium

#### PROCEDURE MONITORING (co-registration pre & post CBCT)

- Drugs tumour filling

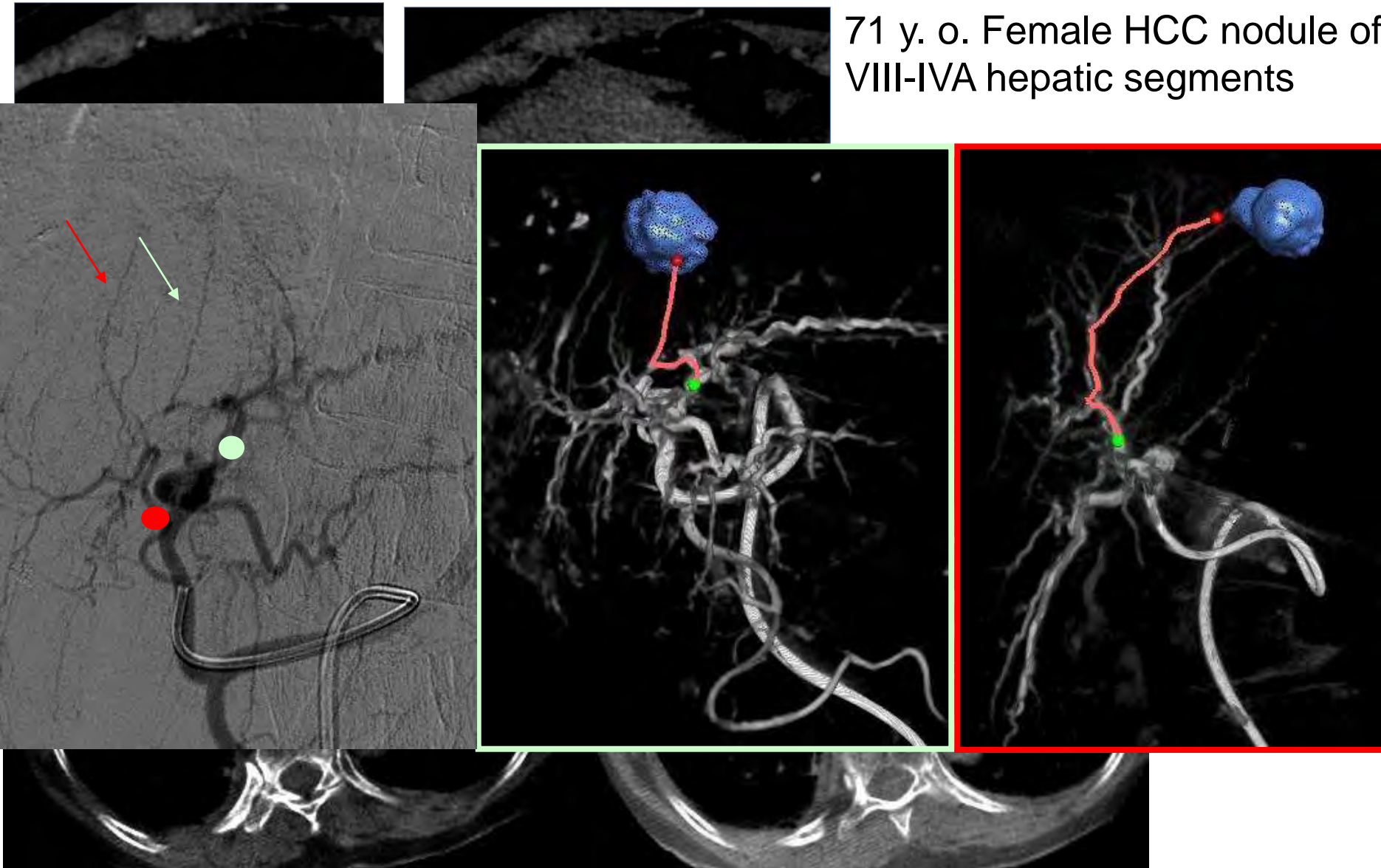




# TACE

## TACE & C-armCBCT

71 y. o. Female HCC nodule of VIII-IVA hepatic segments



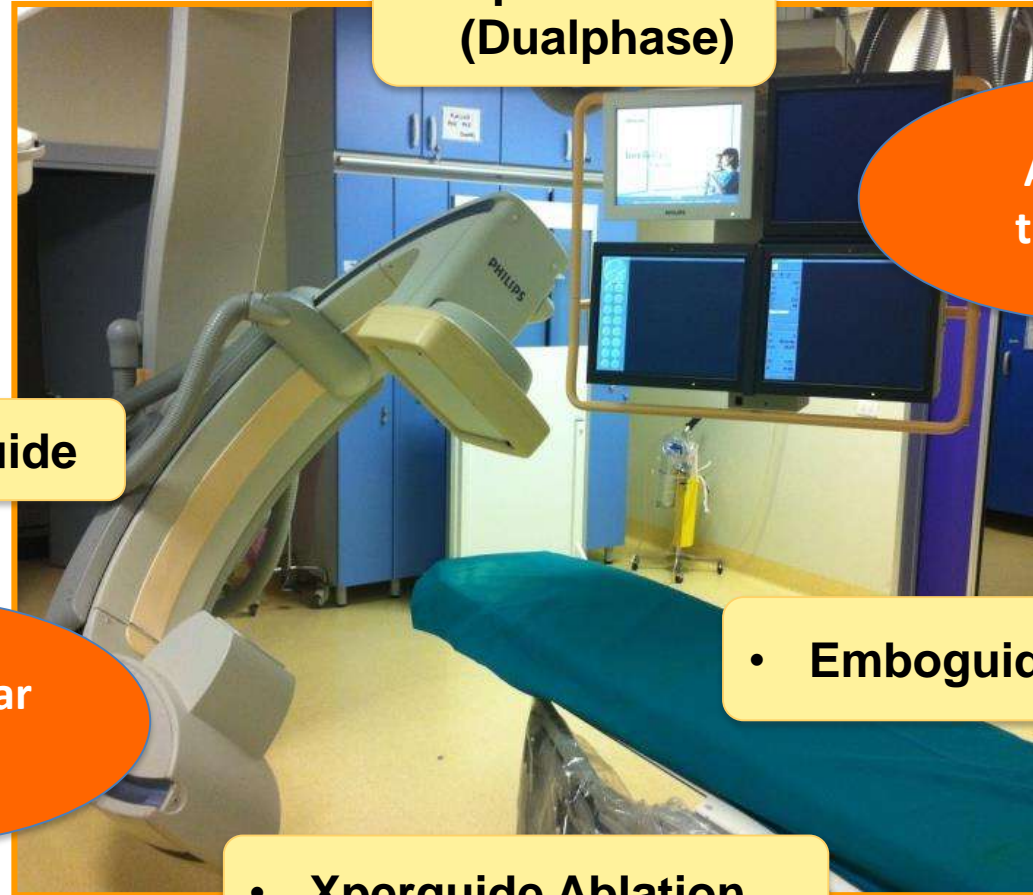
# Guidance Techniques

Radiol med  
DOI 10.1007/s11547-014-0429-5

VASCULAR AND INTERVENTIONAL RADIOLOGY

## C-arm cone-beam computed tomography in interventional oncology: technical aspects and clinical applications

Chiara Floridi · Alessandro Radaelli · Nadine Abi-Jaoudeh · Micheal Grass ·  
Ming De Lin · Melanie Chiaradia · Jean-Francois Geschwind · Hishman Kobeiter ·  
Ettore Squillaci · Geert Maleux · Andrea Giovagnoni · Luca Brunese ·  
Bradford Wood · Gianpaolo Carrafiello · Antonio Rotondo



- XperCT (Dualphase)

Ablation therapies

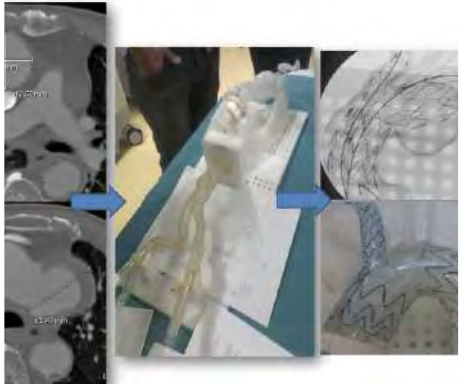
- Xperguide

Endovascular therapies

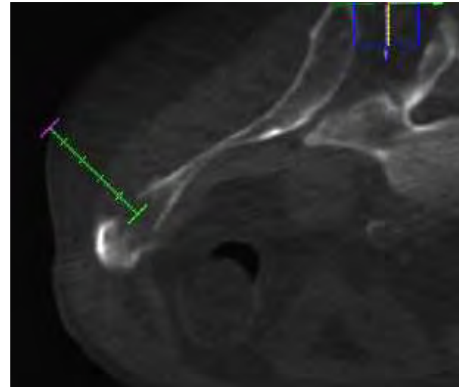
- Emboguide

- Xperguide Ablation

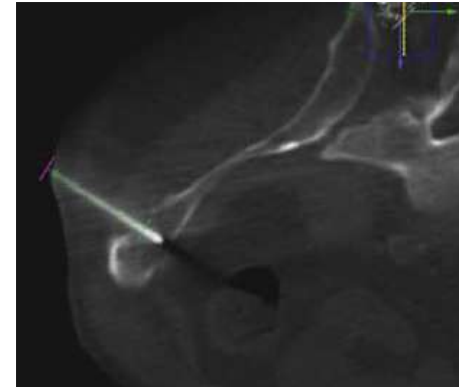
# Guidance Techniques



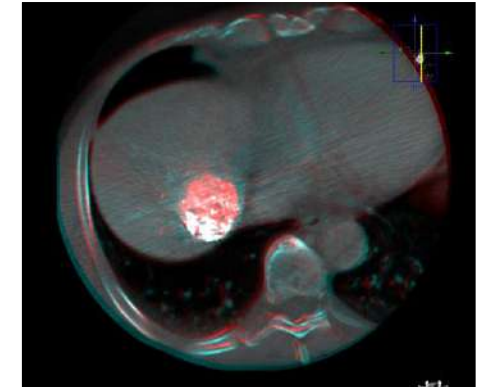
**PRE-  
PROCEDURAL**



**TARGETING**



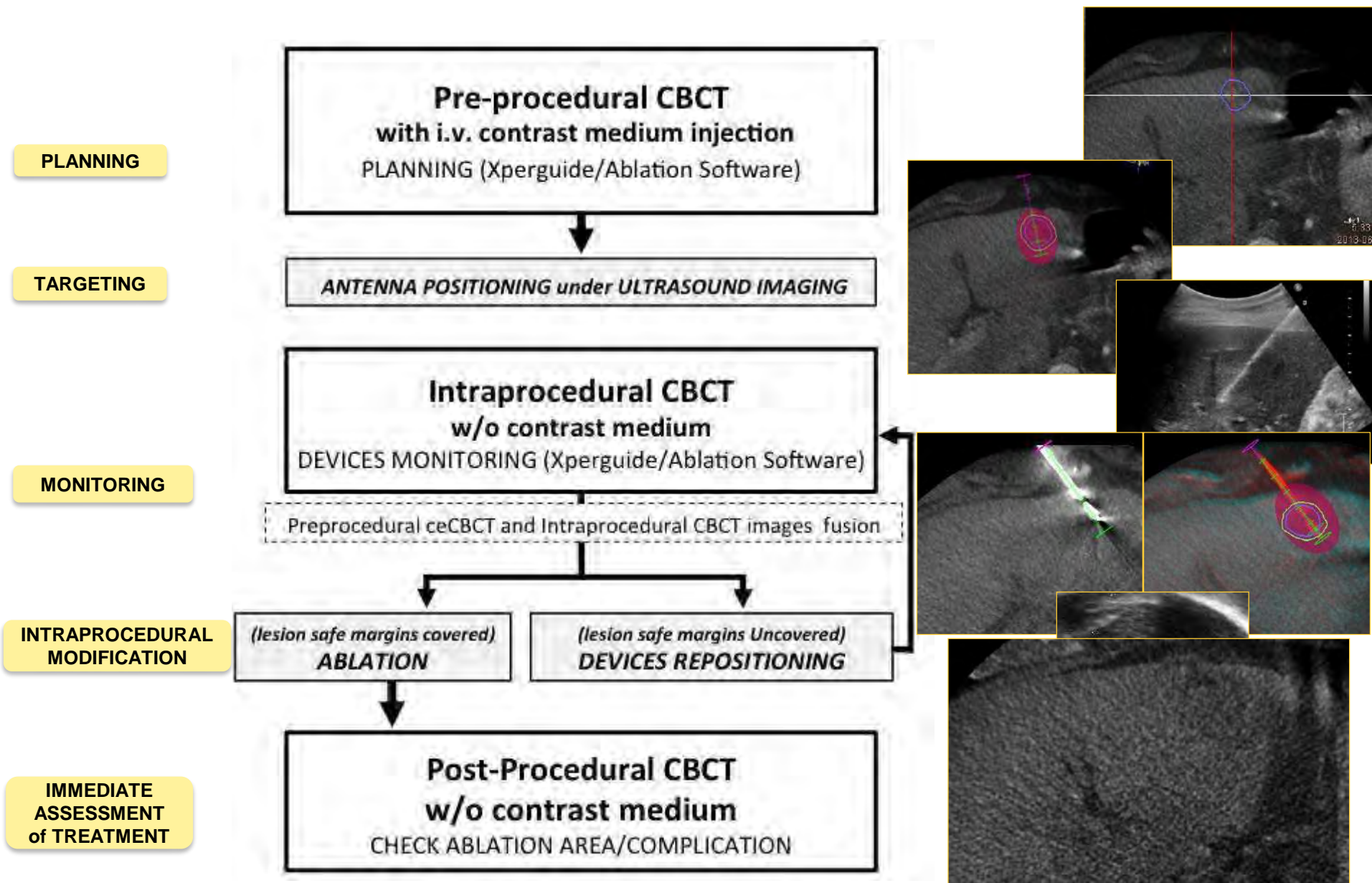
**MONITORING**



**POST  
PROCEDURAL**

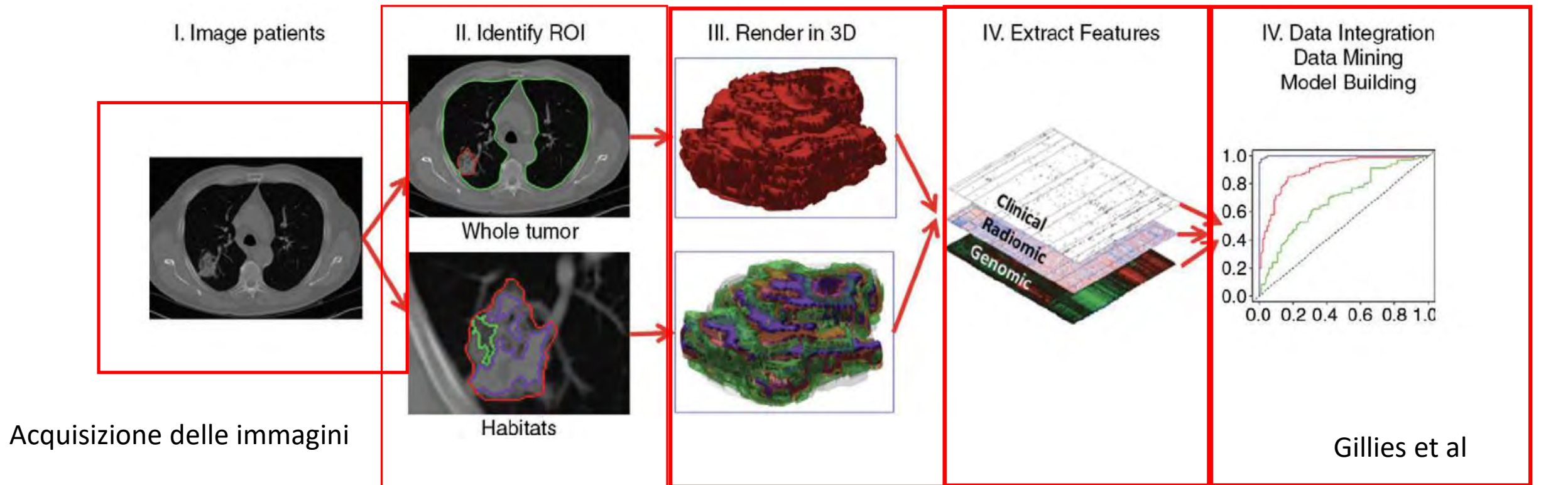


# Guidance Techniques



# Radiomics

## Radiomics framework



Identificazione e segmentazione della regione di interesse contenente tutto il tumore o Sub-regioni (habitats) all'interno del tumore

Estrazione e qualificazione delle features descrittive dai volumi e dagli habitats segmentati

Integrazione dei dati radiomici dal DB e sviluppo di Sistemi di classificazione per previsione outcome. Possibilità di integrare dati clinici/ genomici

# Texture Analysis

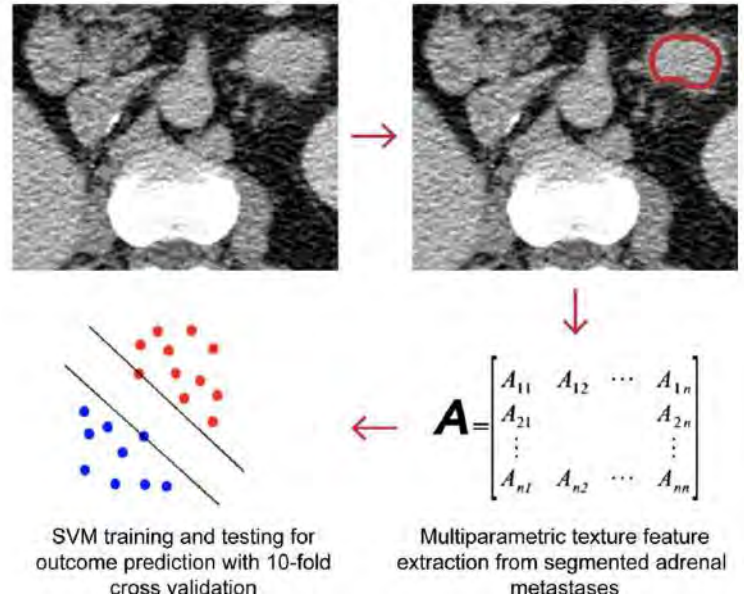
## Clinical and imaging decision support tools for treatment planning

Cardiovasc Intervent Radiol  
<https://doi.org/10.1007/s00270-019-02336-0>



CLINICAL INVESTIGATION OTHER

### CT Texture Analysis and Machine Learning Improve Post-ablation Prognostication in Patients with Adrenal Metastases: A Proof of Concept



CT texture features are being used as a marker of biological aggressiveness and responsiveness to percutaneous ablation.

5 Haralick image features were associated with local progression.

14 image features were associated with patient survival (7 Law and 7 Haralick features).



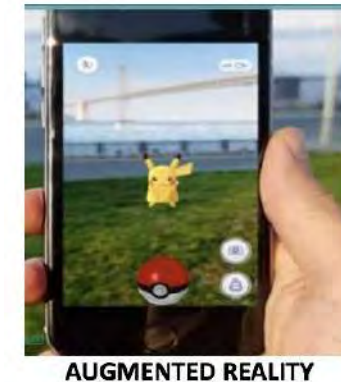
# Realities

## SPECTRUM OF REALITIES

**TABLE 1** The Extended Reality Spectrum

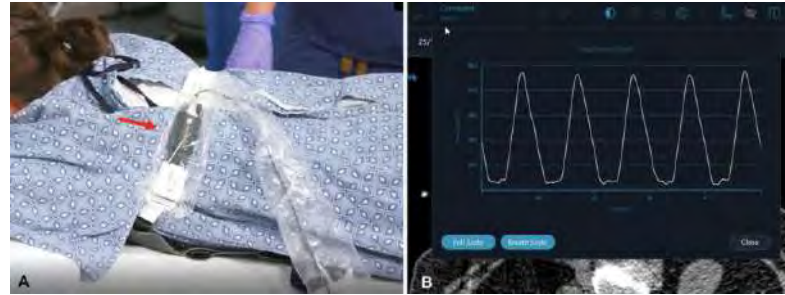
Virtual Reality	Merged Reality	Mixed Reality	Augmented Reality
Interactive virtual objects	Interactive virtual objects	Interactive virtual objects	Virtual objects
Virtual background	True background	True background	True background
Immersive display	Immersive display	See-through display	See-through display

← Fully Immersive Experience                      Unobstructed Experience →



# ROBOTIC

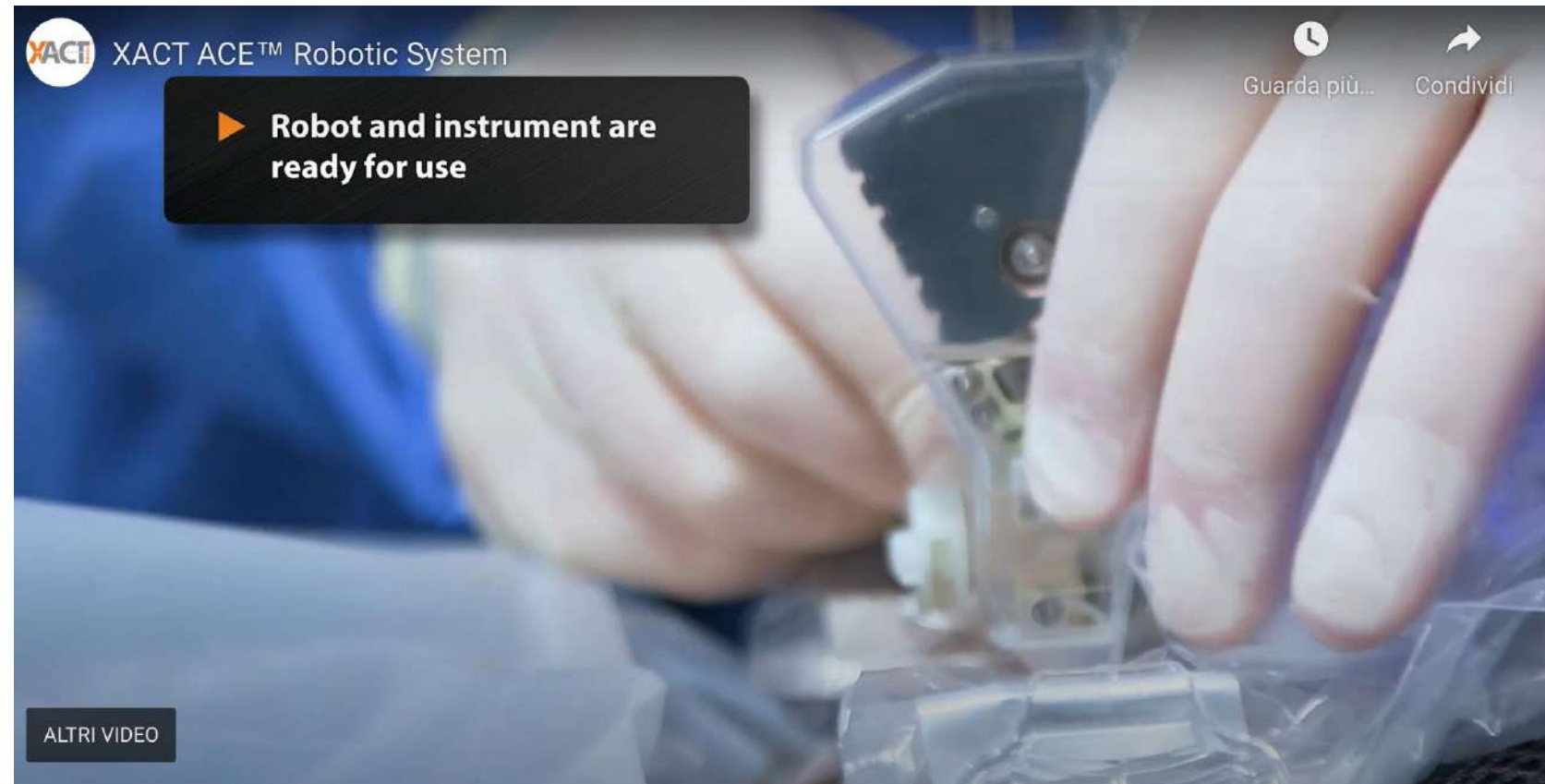
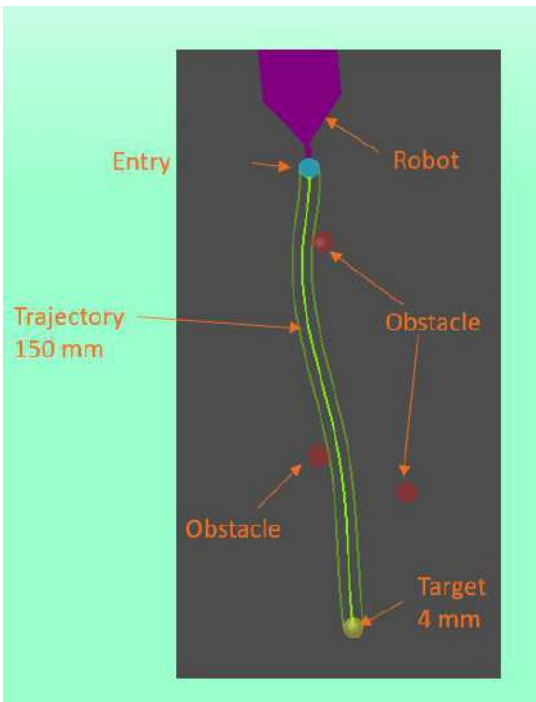
## ROBOTIC CT GUIDED PROCEDURES Patient-mounted mini robot



# ROBOTIC

## ROBOTIC CT GUIDED PROCEDURES

Intra-procedural correction trajectory misalignments  
“Goldberg-tested”





# ROBOTIC

## Angio Robots

**Corindus**  
A Siemens Healthineers Company



### PIATTAFORMA ROBOTICA

- A. Braccio robotico
- B. Cockpit di controllo
- C. Monitor ad alta risoluzione

# Interventional Oncology and Immunotherapy

IO

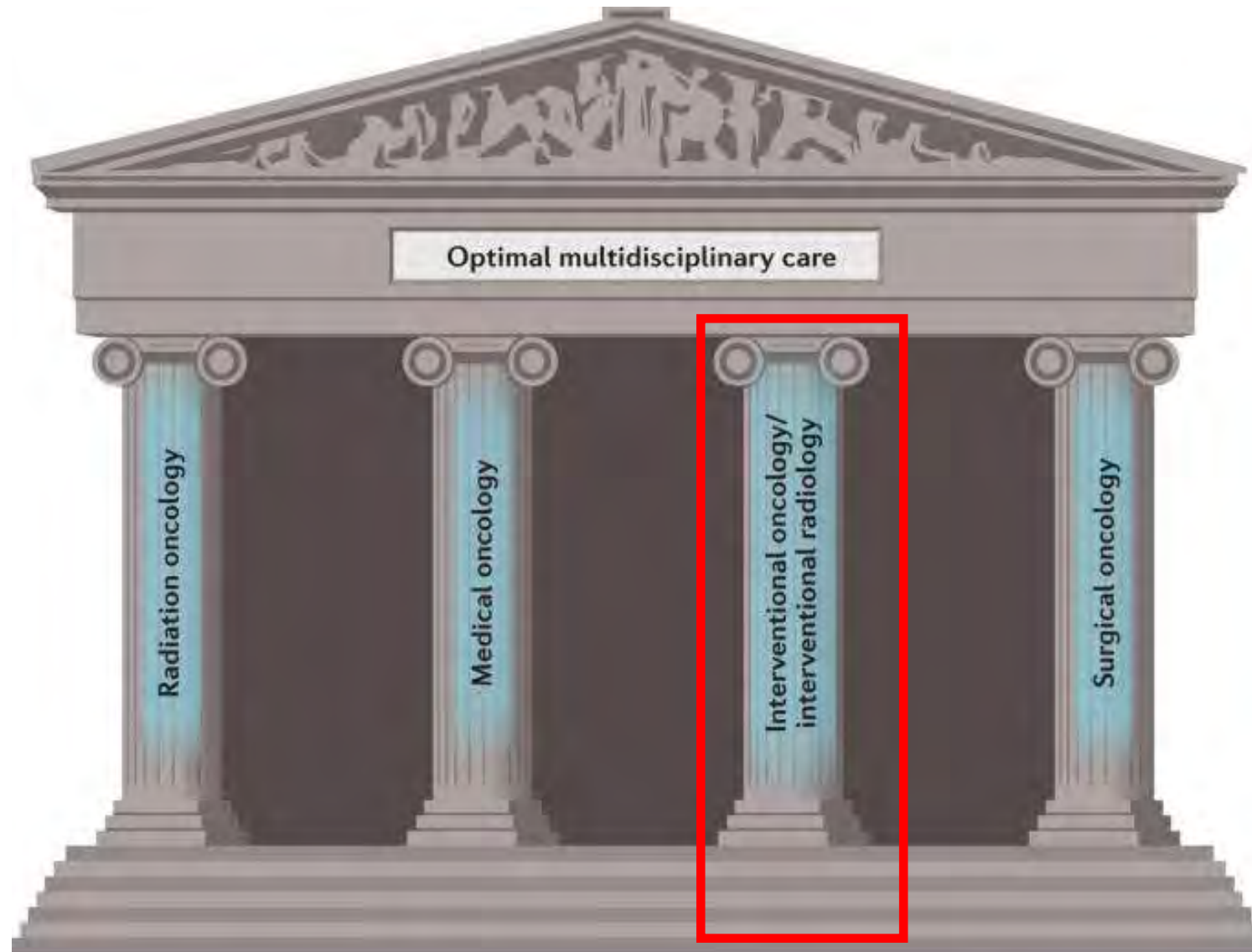


IO

**Interventional  
Oncology**

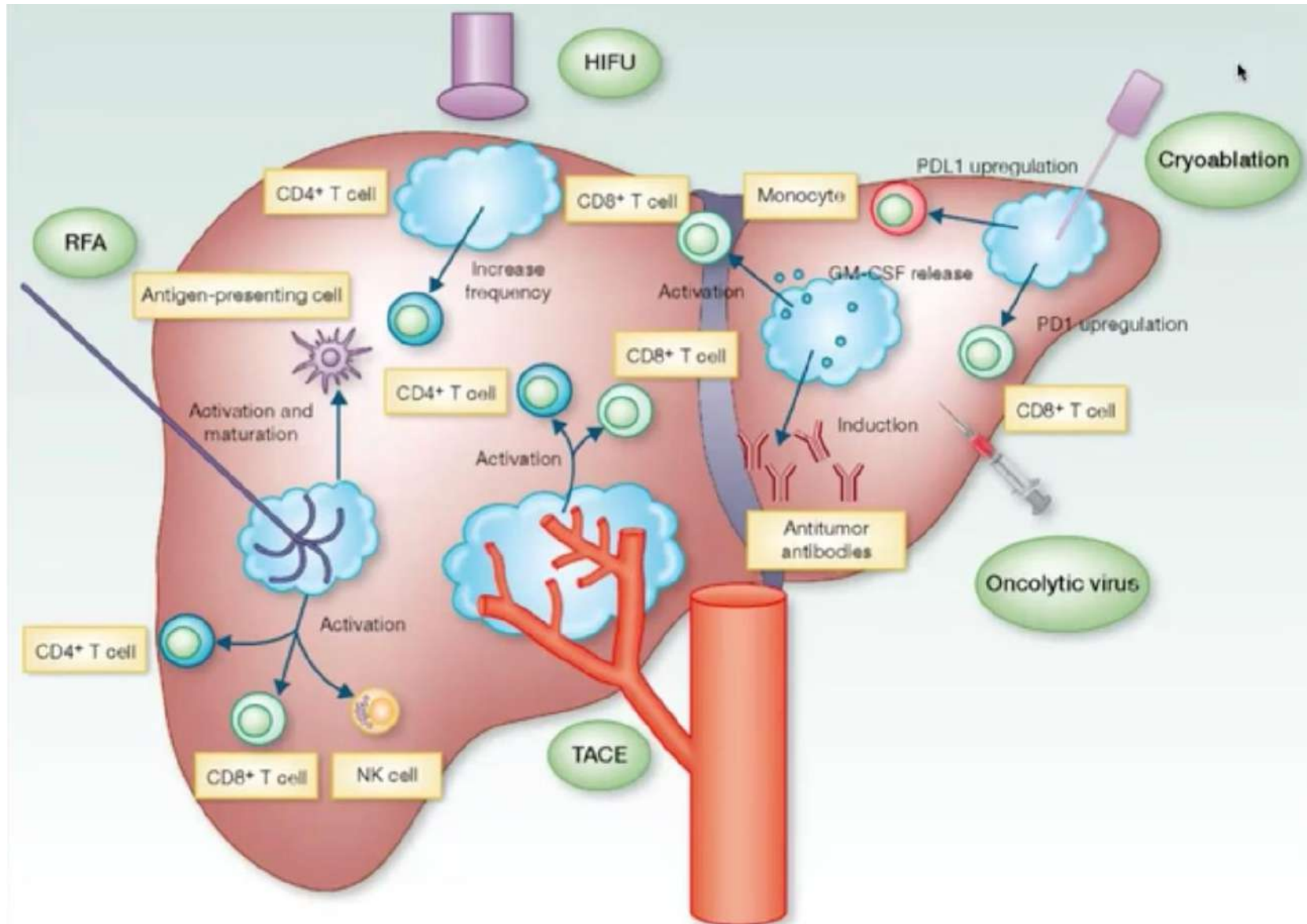
**Immuno-  
Oncology**

# Interventional Oncology and Immunotherapy





# Interventional Oncology and Immunotherapy



# Interventional Oncology and Immunotherapy

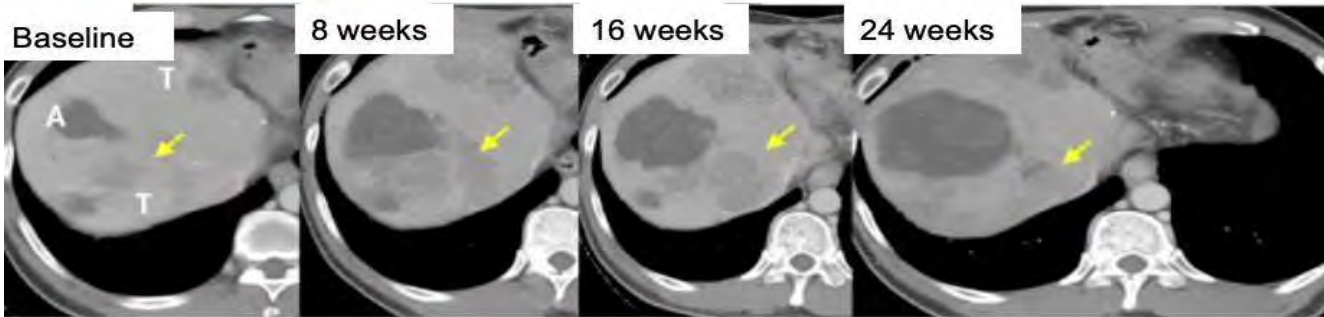
## Tremelimumab in combination with ablation in patients with advanced hepatocellular carcinoma

Austin G. Duffy<sup>1</sup>, Susanna V. Ulahannan<sup>1</sup>, Oxana Makorova-Rusher<sup>1</sup>, Osama Rahma<sup>1</sup>, Heiner Wedemeyer<sup>2</sup>, Drew Pratt<sup>3</sup>, Jeremy L. Davis<sup>4</sup>, Marybeth S. Hughes<sup>4</sup>, Theo Heller<sup>5</sup>, Mei ElGindi<sup>1</sup>, Ashish Uppala<sup>1</sup>, Firouzeh Korangy<sup>1</sup>, David E. Kleiner<sup>3</sup>, William D. Figg<sup>6</sup>, David Venzon<sup>7</sup>, Seth M. Steinberg<sup>7</sup>, Aradhana M. Venkatesan<sup>8</sup>, Venkatesh Krishnasamy<sup>8</sup>, Nadine Abi-Jaoudeh<sup>8</sup>, Elliot Levy<sup>8</sup>, Brad J. Wood<sup>8</sup>, and Tim F. Greten<sup>1,\*</sup>

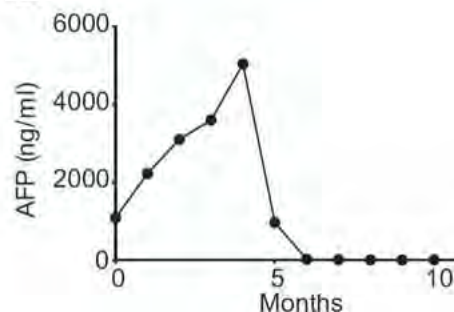
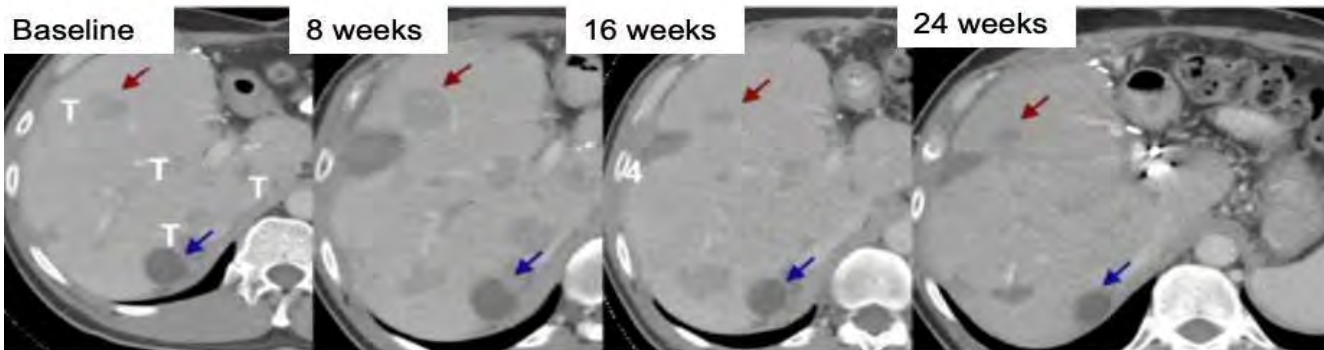
- **Ablative therapies** induce a peripheral immune response which may **enhance the effect of anti-CTLA4** treatment in patients with advanced hepatocellular carcinoma (HCC).
  - ✓ Positive clinical activity was seen, with a possible surrogate reduction in HCV viral load.
  - ✓ Killing of tumors by direct methods (ablation) → activation of the immune system.
- **Tremelimumab + TA** → potential new treatment for patients with advanced HCC, and leads to the **accumulation of intratumoral CD8+ T cells**.
  - ✓ immune system could potentially recognize and kill the cancer that is left behind.
  - ✓ checkpoint inhibitors could enhance this effect.

# Interventional Oncology and Immunotherapy

## "Pseudo-Progression" of Cancer After Immunotherapies



**Gets worse before it gets better** - from immune response



## Tremelimumab in combination with ablation in patients with advanced hepatocellular carcinoma

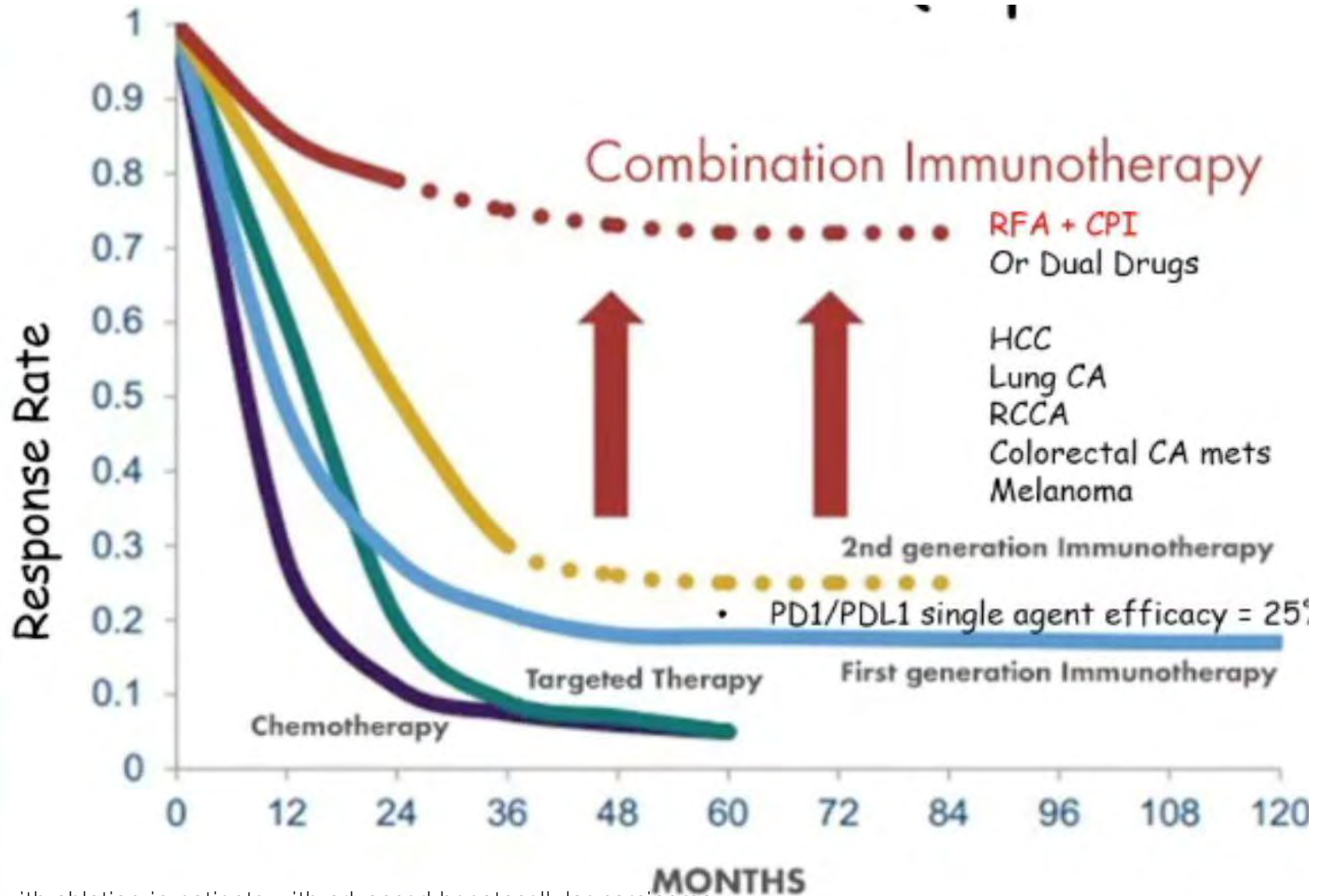
Austin G. Duffy<sup>1</sup>, Susanna V. Ulahannan<sup>1</sup>, Oxana Makorova-Rusher<sup>1</sup>, Osama Rahma<sup>1</sup>, Heiner Wedemeyer<sup>2</sup>, Drew Pratt<sup>3</sup>, Jeremy L. Davis<sup>4</sup>, Marybeth S. Hughes<sup>4</sup>, Theo Heller<sup>5</sup>, Mei ElGindi<sup>1</sup>, Ashish Uppala<sup>1</sup>, Firouzeh Korangy<sup>1</sup>, David E. Kleiner<sup>3</sup>, William D. Figg<sup>6</sup>, David Venzon<sup>7</sup>, Seth M. Steinberg<sup>7</sup>, Aradhana M. Venkatesan<sup>8</sup>, Venkatesh Krishnasamy<sup>8</sup>, Nadine Abi-Jaoudeh<sup>8</sup>, Elliot Levy<sup>8</sup>, Brad J. Wood<sup>8</sup>, and Tim F. Greten<sup>1,\*</sup>

- CT scan over 6-month time period for subject 3 showing an **increase in the ablated area** (denoted A) **in addition to changes in tumor size** (denoted T) on two separate cuts of the same scan demonstrating worsening appearances at 8 weeks with subsequent improvement and in some cases resolution at 24 weeks.

- **AFP** over time for subject 3



# Interventional Oncology and Immunotherapy





Non siete curiosi??

