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2017

CZ09 7F16001 THERMOMED

MINISTRY OF EDUCATION, YOUTH AND SPORTS

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Establishment of bilateral cooperation and exchange of experience in the field of medical infrared thermography

CZ09 7F16001 THERMOMED

Radiofrequency tissue ablation- thermographic study

- Study realized 2013-2016
- Faculty of Medicine MU + Faculty Hospital Brno
- Consist of ***ex vivo* experiments** and clinical study
- Original article in IRBM, 2014

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IRBM 35 (2014) 164–169
IRBM

Original article

Radiofrequency tissue ablation inside of metal stent – A thermographic study

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Available online 13 March 2014

Radiofrequency tissue ablation-thermographic study

Objectives and questions:

Describe the process of RFA within the

- temperature distribution
- dynamic of heating process
- monopolar and bipolar heating

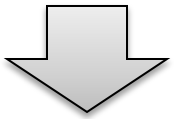
Focusing specifically on:

- position of stent and indifferent plate electrode
- effect of conductive contact of electrode and stent

Radiofrequency tissue ablation-thermographic study

Why stents?

- Biliary stents are mostly used to threat obstruction that occur in the bile ducts (cancer).
- Stents are blocked in a few months after their implanting.
- The inner space of stent make passable by RFA.

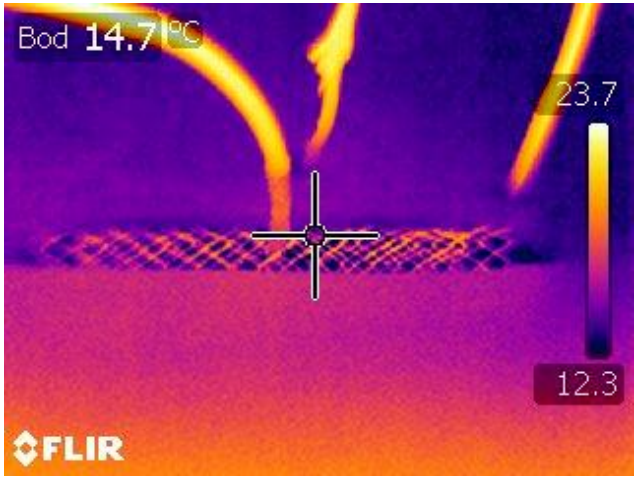


- How to use RFA in this case?
- What happen in case of the conductive contact stent-active electrode?

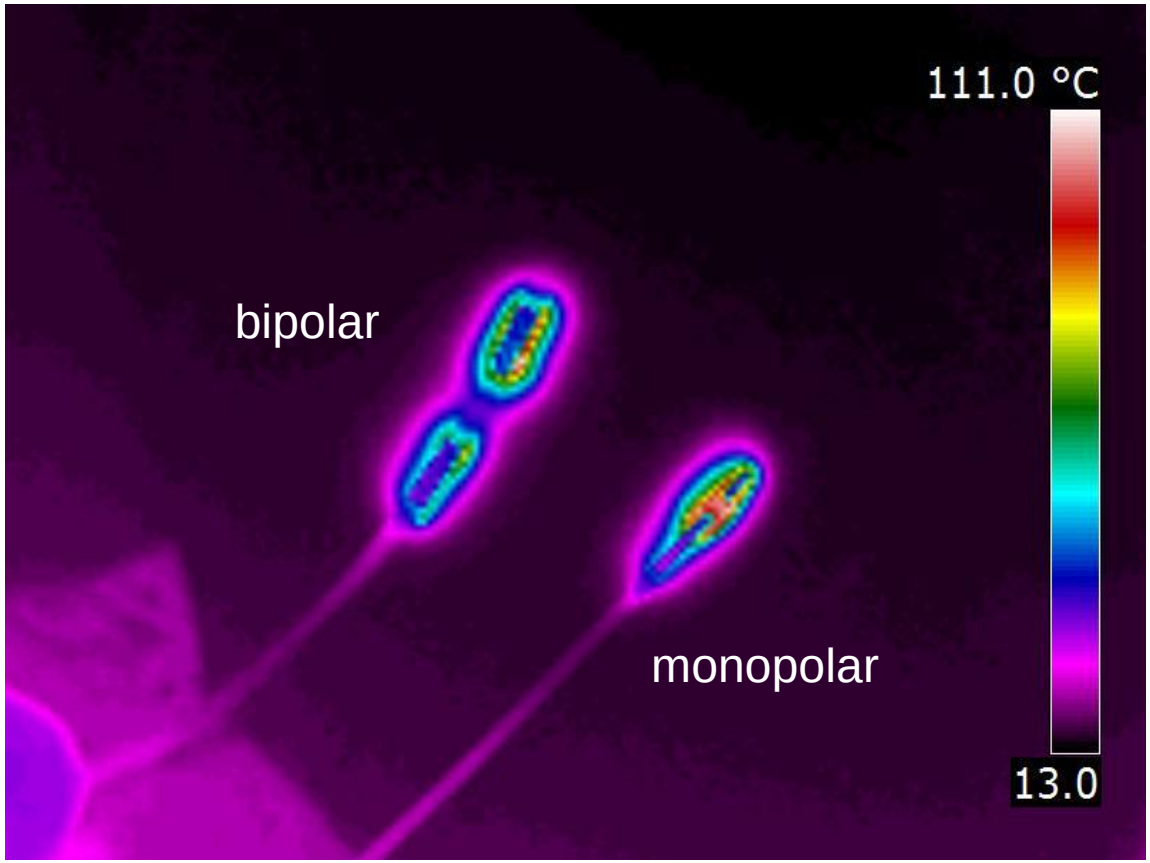
Radiofrequency tissue ablation- thermographic study

The experimental design: ex vivo experiment

- EGIS Biliary stents 10 mm x 80 mm
- Catether EndoHPB 8F 180 cm (monopole and bipole heating)
- RF generator Rita 1500X RF, 460 kHz
- Infrared thermal camera Flir B200, Flir i7



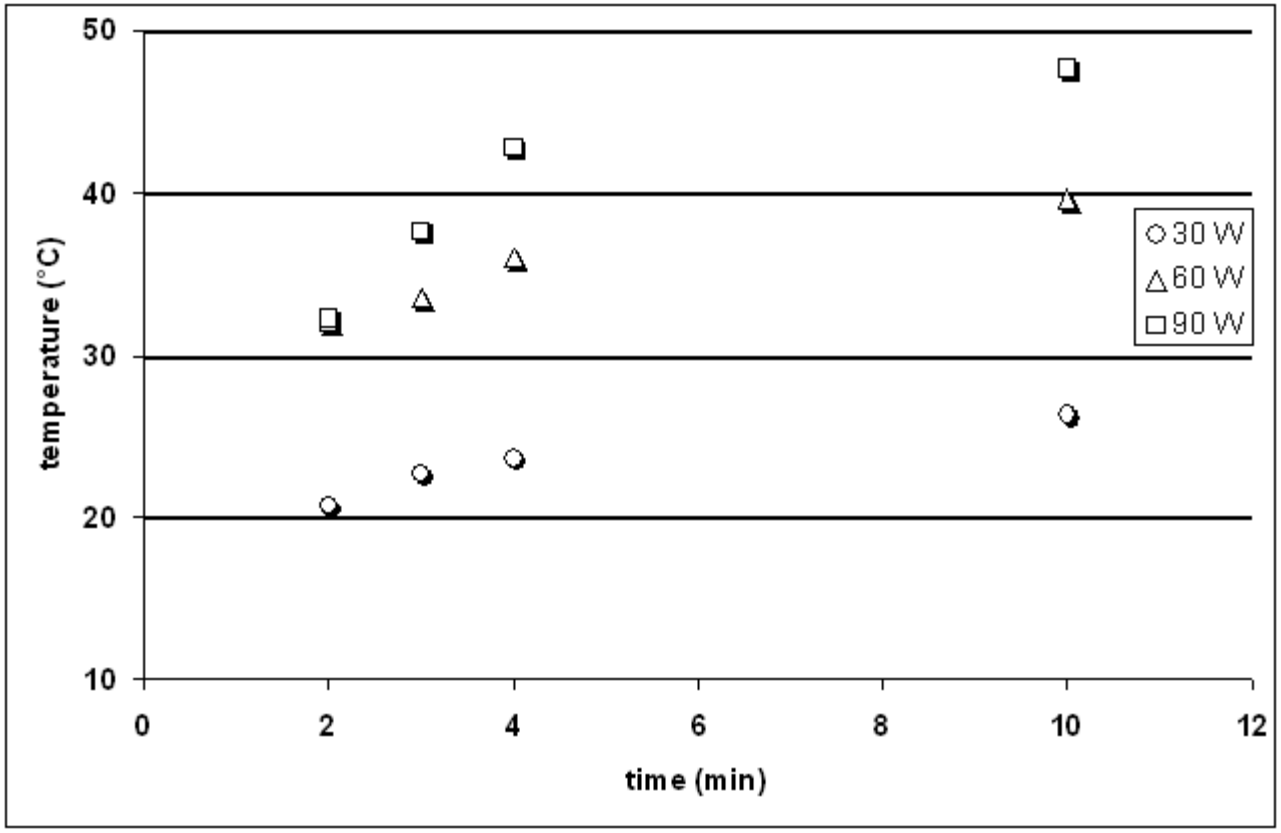
Radiofrequency tissue ablation- thermographic study



Time 2 min, power 60 W

The difference in size and shape of the affected area of tissue

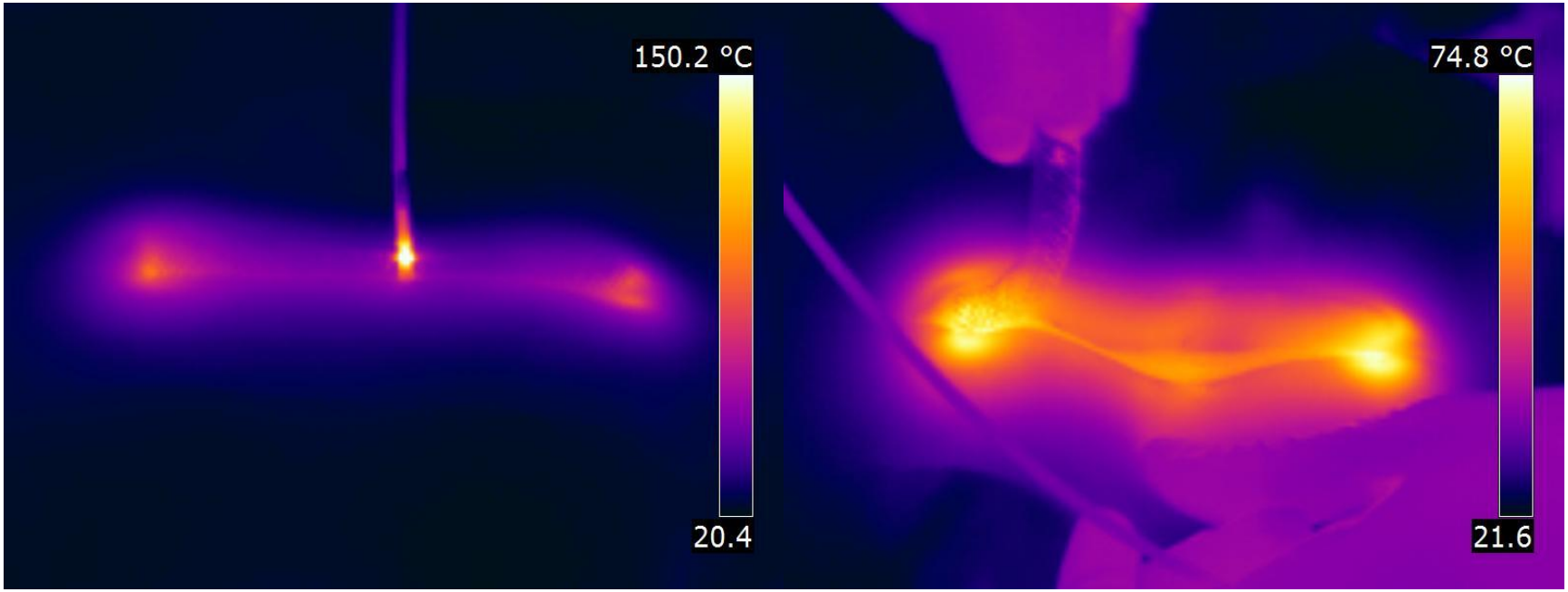
Radiofrequency tissue ablation- thermographic study



Monopolar mode

Temperature rises as a function of time and output power

Radiofrequency tissue ablation- thermographic study

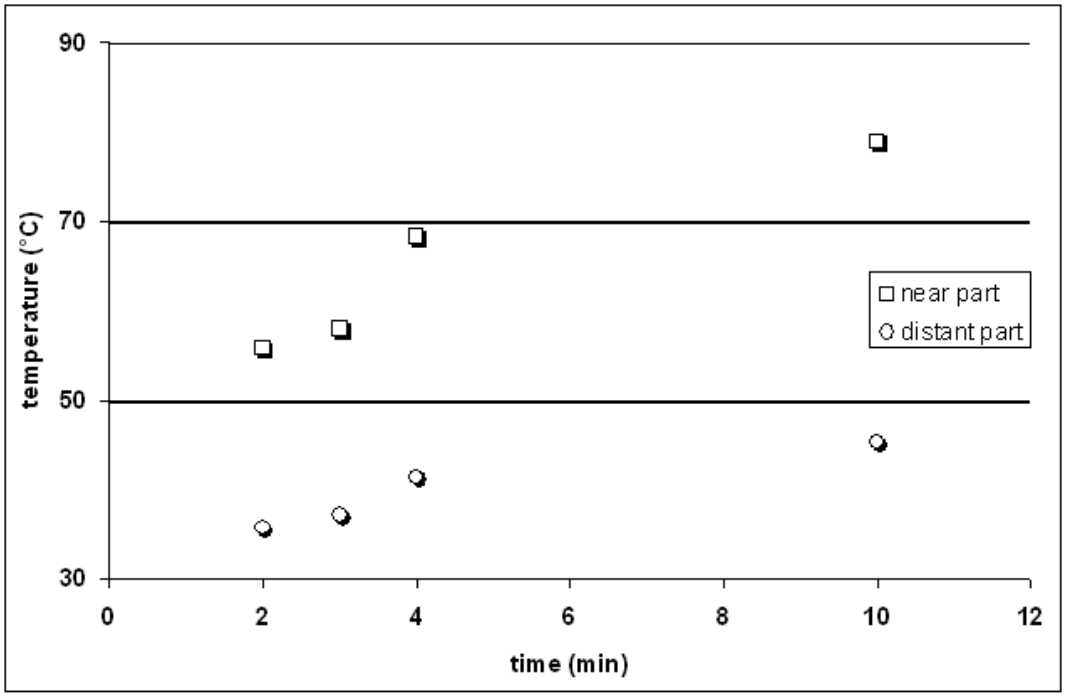


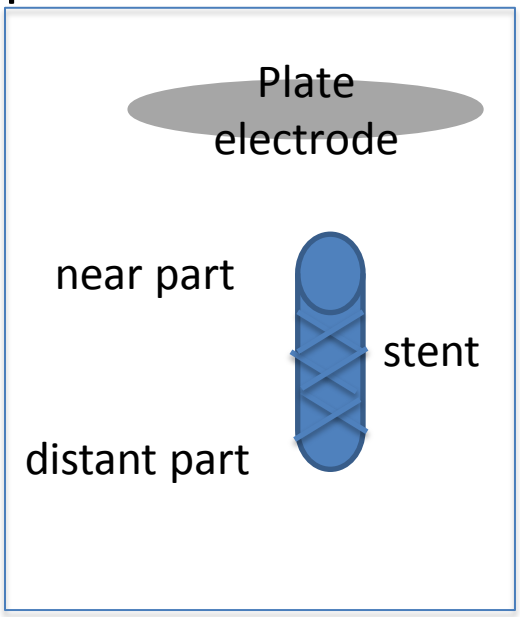
Time 4 min, power 60 W

Maximum temperature was observed in the terminal parts of the stent

Radiofrequency tissue ablation- thermographic study

Dynamic of heating of terminal parts of stent - in the case of asymmetrical position of stent towards to the plate electrode

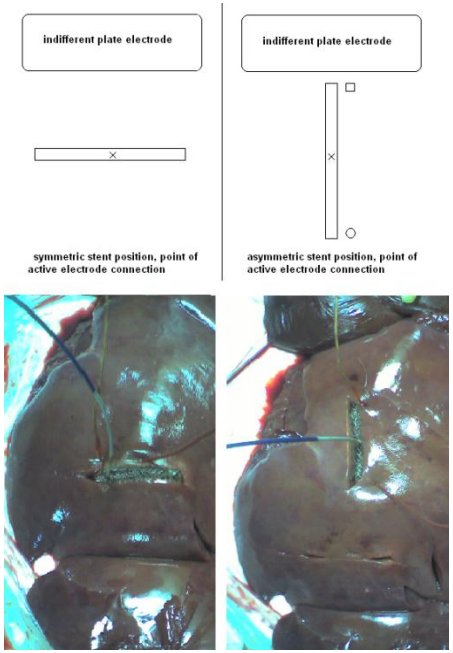


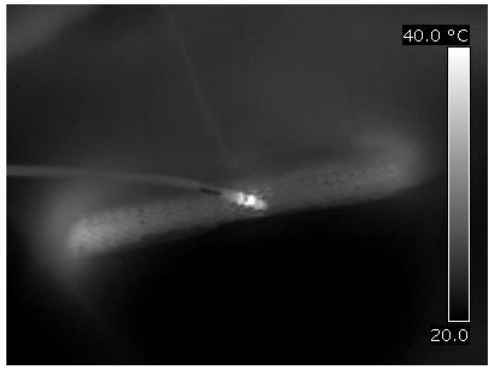


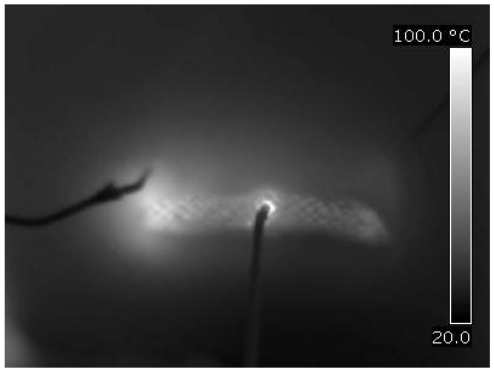
Temperature increase as a function of position of stent

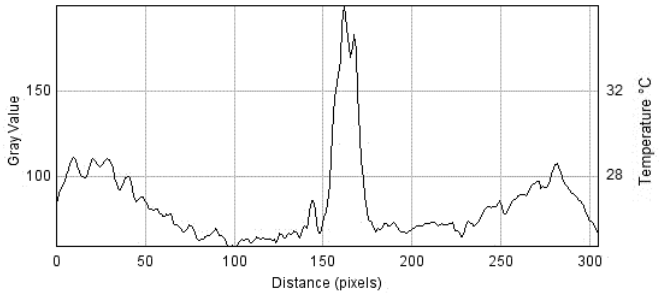
Radiofrequency tissue ablation- thermographic study

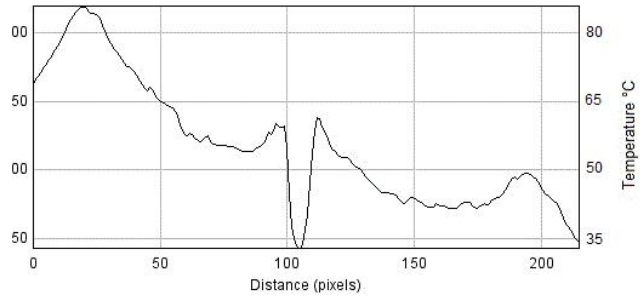
Observation of a stent with symmetrical and asymmetrical position towards to the plate electrode









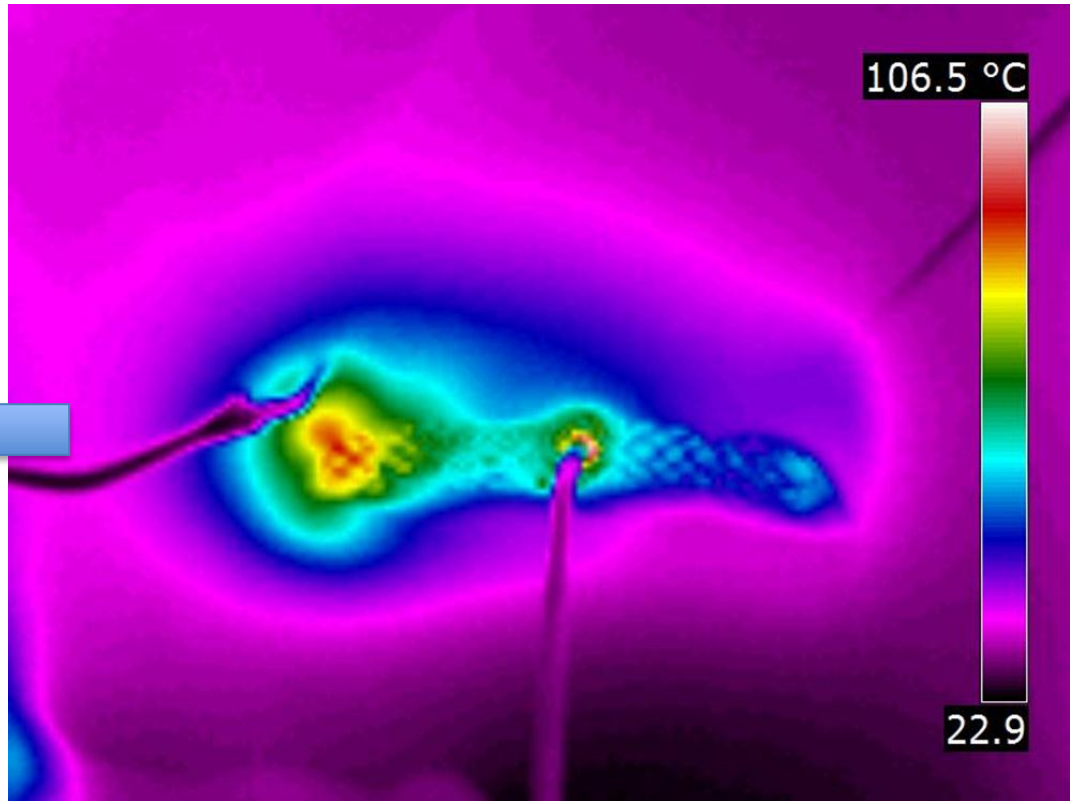


visible difference in the temperatures of terminal parts of the stent, depending on the position of indifferent plate electrode

Radiofrequency tissue ablation- thermographic study

Thermogram of a stent with asymmetrical position towards to the plate electrode

Plate surface electrode



Radiofrequency tissue ablation- thermographic study

Results

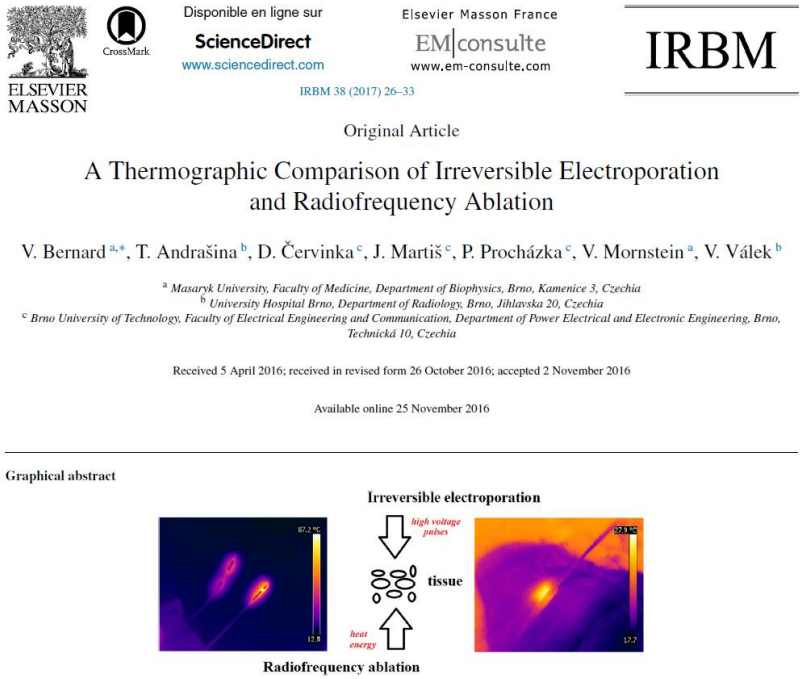
- The influence of output power and time duration of the RF on final temperature (of tissue or stent)
- The effect of increasing of temperature of the stent in the case of conductive connection of stent with the active electrode
- Increasing of temperature in the terminal parts of the stent compared to the middle part of stents
- The influence of the position of the indifferent plate electrode - symmetry, asymmetry- on the heating process

- Presented experiments have shown the possibility of using infrared thermal imaging camera for monitoring and visualization of the RF

A thermographic comparison of Irreversible Electroporation and RFA

- Study realized 2016-(2018)
- Faculty of Medicine MU + Faculty Hospital Brno + Brno University of Technology
- Consist of ***ex vivo* experiments**

  and in vivo animal model study
- **Testing of high-energy current generator of team´s own design**
- Original article in IRBM, 2017



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IRBM

IRBM 38 (2017) 26–33

Original Article

A Thermographic Comparison of Irreversible Electroporation and Radiofrequency Ablation

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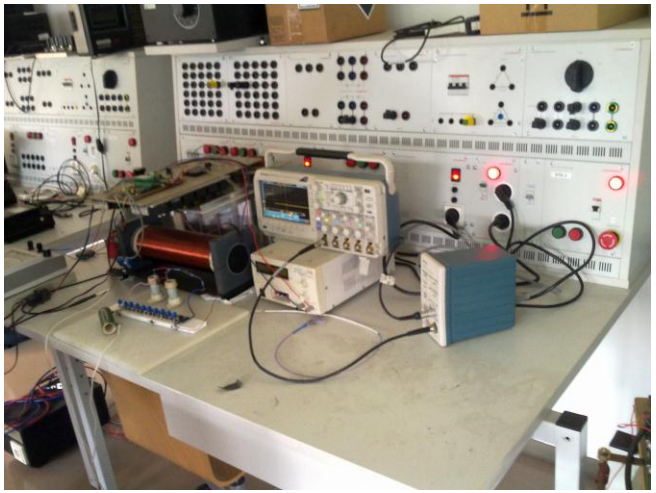
Graphical abstract

A thermographic comparison of Irreversible Electroporation and RFA

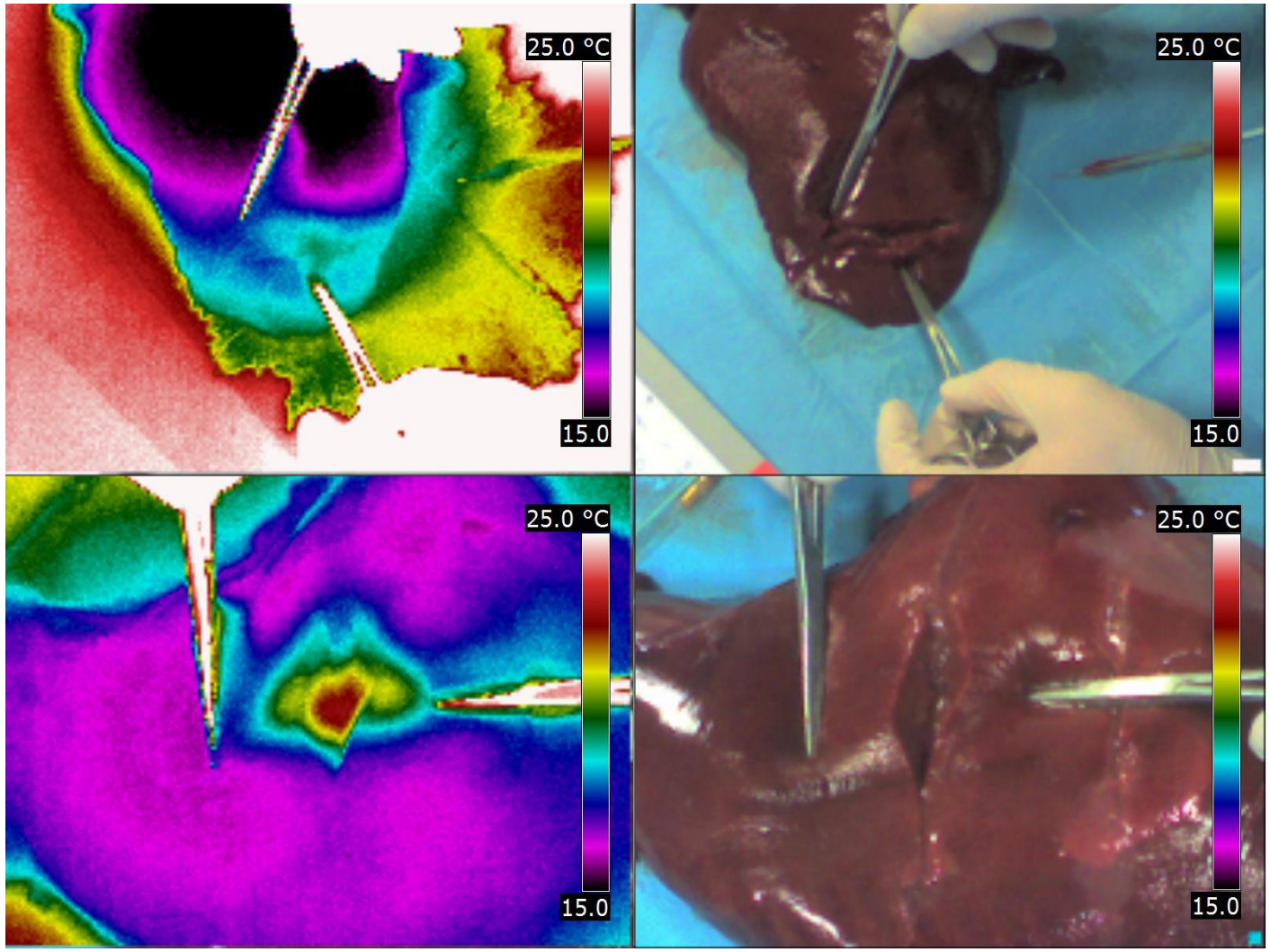
- IRE – new method used in ablation of parenchymal organs
- **Non-thermal effect**
- Application of very short pulses of electric current under high voltage
- Induced instability of polarized lipid bilayers with effect of creating pores in cell membranes
- The connective and fibrous tissues are not destroyed (vascular structure, biliary tract, …)
- Application in tumor treatment

A thermographic comparison of Irreversible Electroporation and RFA

- Ex vivo experiments on liver tissue
- Generator of own construction
- 50 pulses of 100 µs, output voltage 1500-2500 V, current 4-10 A
- New designed balloon catheter with 3 electr.
- Flir B200



A thermographic comparison of Irreversible Electroporation and RFA



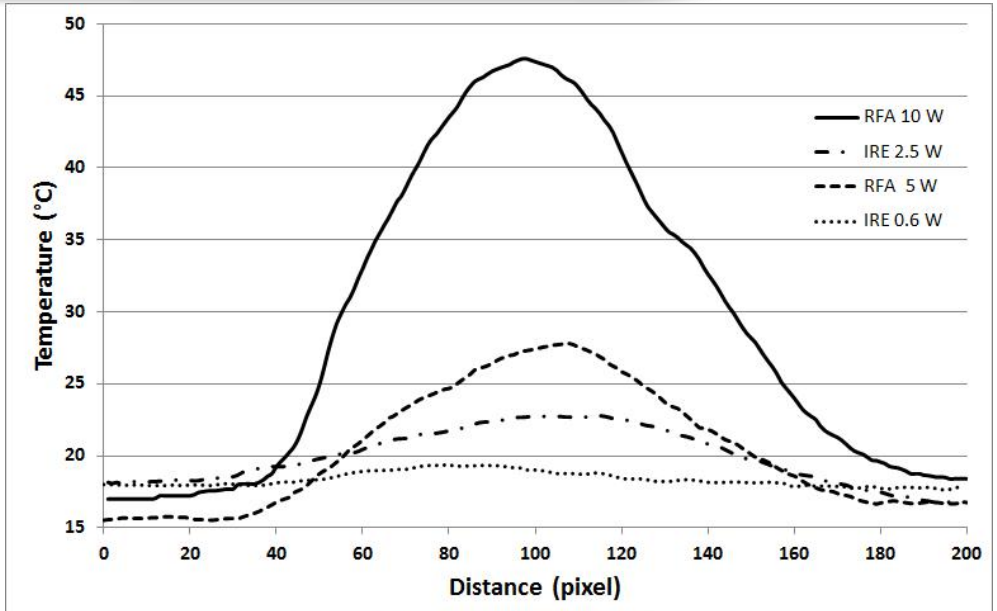
IRE, 150 pulses of 100 µs each

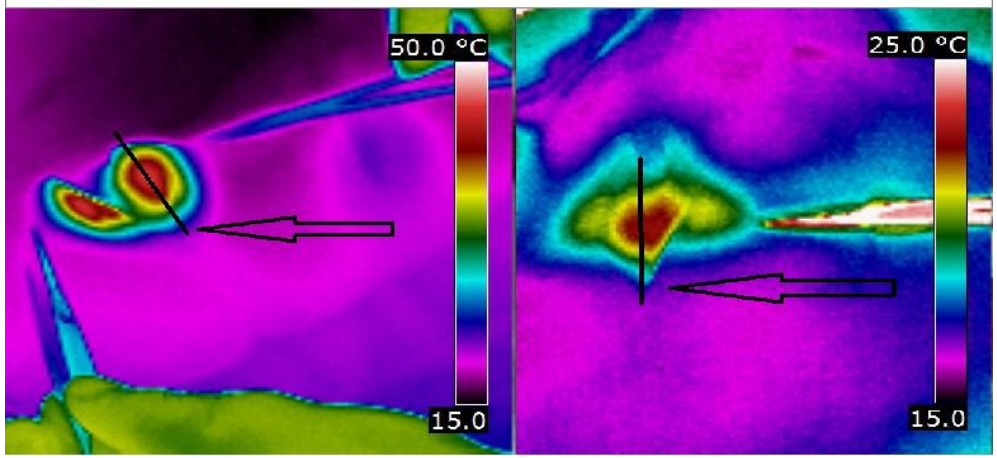
0.6 W (1500 V)

2.5 W (2500 V)

A thermographic comparison of Irreversible Electroporation and RFA

Temperature profile of tissue in position of IRE and RFA application





A thermographic comparison of Irreversible Electroporation and RFA

Results

- Verification of functions of the IRE device
- Characterization of heat process of IRE
- Comparing of IRE and FRA thermal effect in the same or similarly case of application

Thank you for your attention

Acknowledgment: The research leading to these results has received funding from the Norwegian Financial Mechanism 2009-2017 and the Czech Ministry of Education, Youth and Sports under Project Contract no. MSMT- CZ09 7F16001