In-vitro Training in Physics of Radio-Frequency Ablation for Physicians and Medical Engineering Students

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Introduction

- Radiofrequency (RF) Ablation is the most popular method in the treatment of supraventricular re-entrant and focal tachycardias, atrial fibrillation and an increasing number of ventricular tachycardias.
- Despite lots of developments, RF Ablation is still a complex procedure requiring the physician's electrophysiological experience and expertise, as well as profound physical science basics knowledge.
- Various complex and interdependent technical parameters have to be considered.
- There is a need of RF Ablation in-vitro training in order to school physicians and medical engineering students.

Aims

To improve training in Radiofrequency Catheter Ablation and to explain effects, observed in clinical routine, our aims were:

- to enable in-vitro training in RF Ablation through exemplary knowledge transfer of the referring physics science basics
- to clearly demonstrate the effects of different generators and their settings
- to give a sense of use and sensitive handling of the various ablation catheters
- to create an environment for the development, evaluation and testing of new catheter designs and electrodes

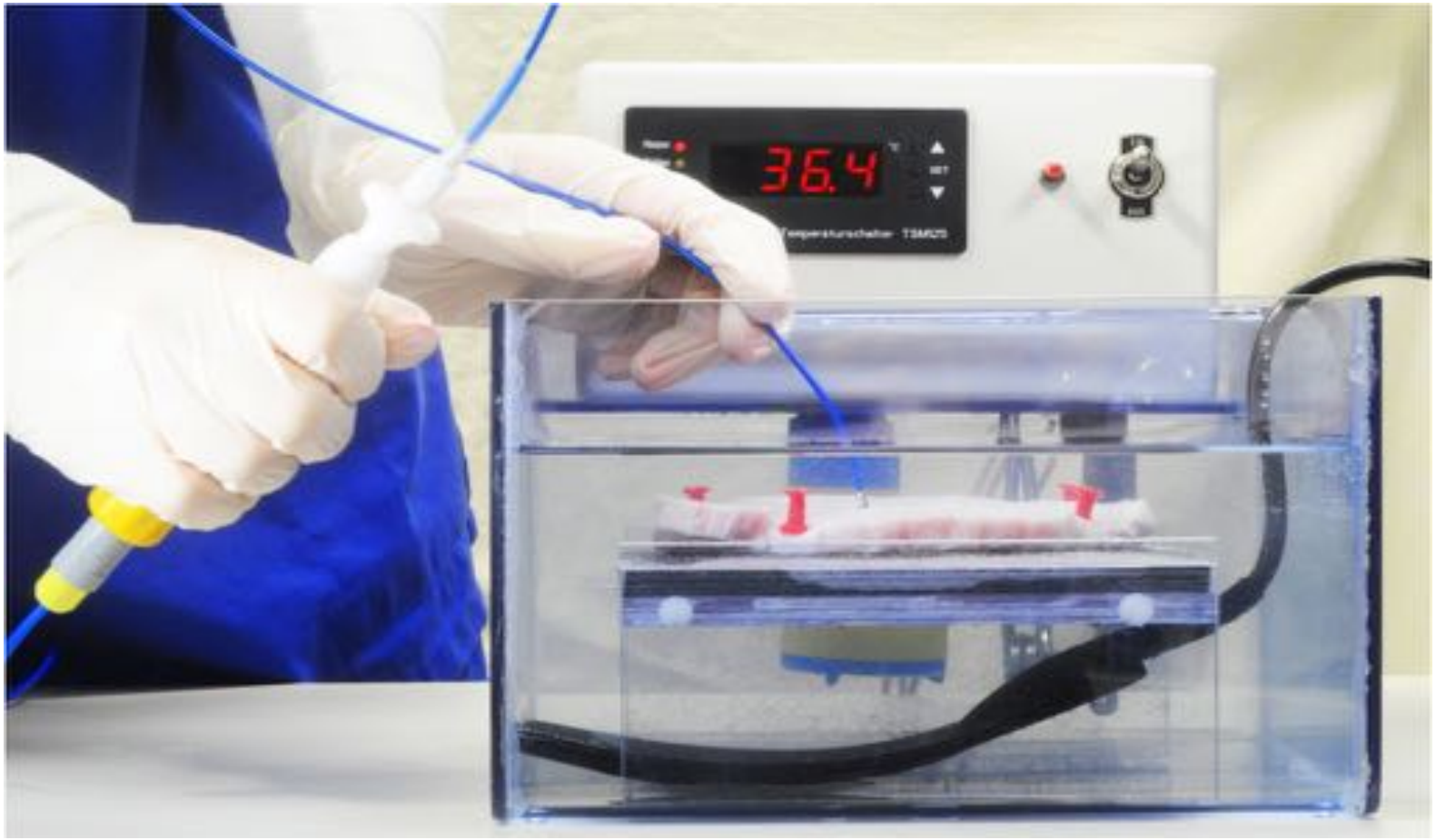
Methods

Therefore, in order to enable in-vitro RF Ablation experiments on pork in small learning groups…

- 6 workstations were equipped with identical computer-controlled RF Ablation generators, allowing a didactic data analysis through graphical and tabular recording and displaying of all relevant ablation parameters
- Universal connection boxes were prepared to do ablation experiments with catheters of different make and model
- Special wetlabs were established combining a basin containing isotonic saline solution with a thermostat and a pump to simulate blood flow

Methods

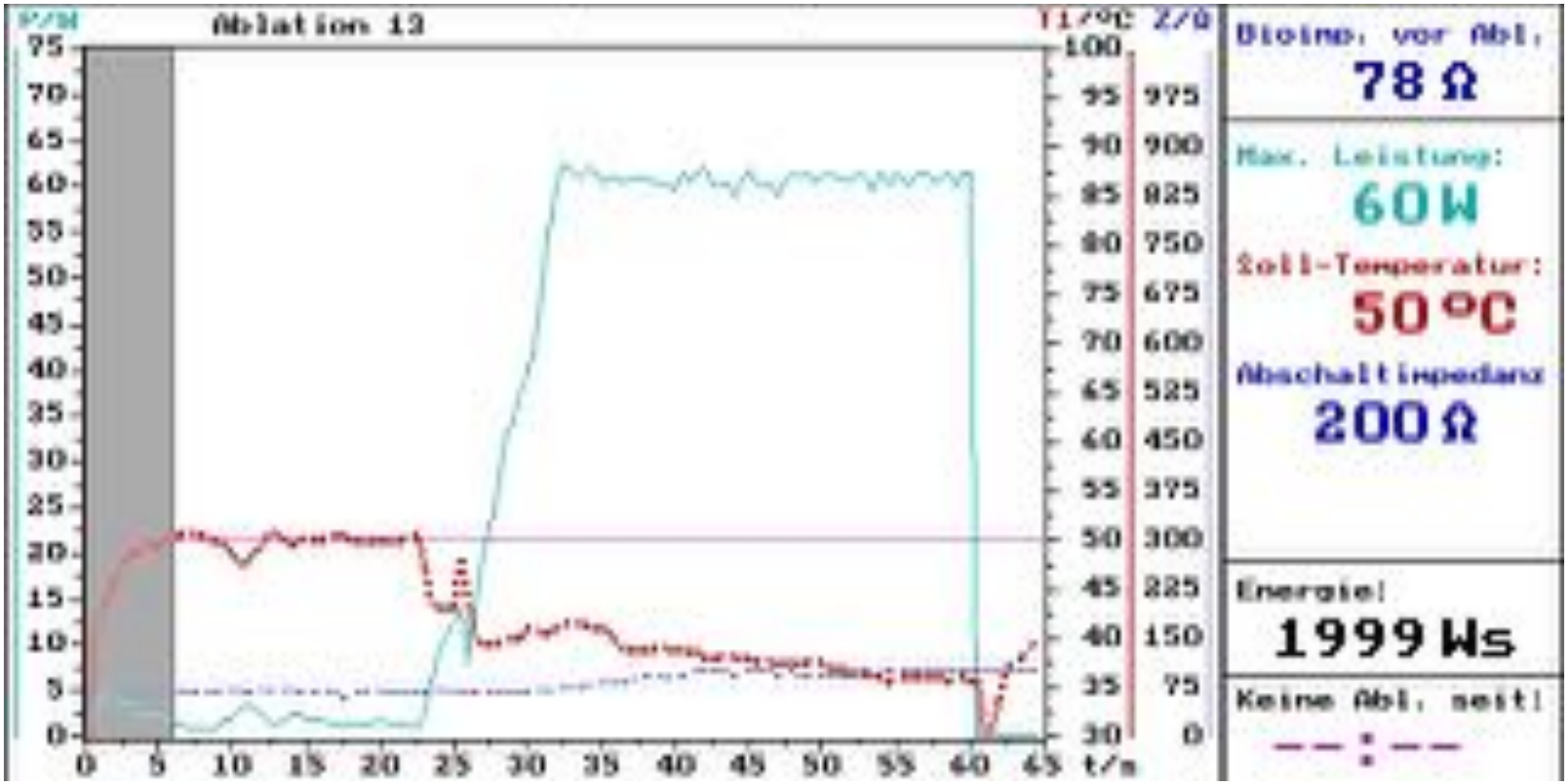
- In-vitro RF Ablation experiments on pork in the wetlab containing isotonic saline solution, heated to body temperature and simulating the cooling influence of the blood flow.



Methods

Continuous graphical recording of all relevant ablation parameters is helpful for learning different factors, affecting the results of the in-vitro ablations.

- Parameter course in an open-irrigated, temperature-controlled and power-limited RF Ablation.



Methods

- Hands-on seminar about physical science basics of Radiofrequency Ablation using 6 workstations
- Any workstation`s screen can also be displayed on additional large scale monitors for discussions of the observed effects

Methods

The Training System was also used to demonstrate the influence of different catheter tip materials on lesion size:

- In-vitro comparison of novel RF Ablation catheter (Cerablate, Osypka AG) with 8mm solid Gold RF-electrode against identical with platinum-iridium RF-electrode:

- Comparison of energy delivery and lesions at different temperature settings while operating the electrodes in the in-vitro training system.

Methods

- The practical benefits of the solid gold RF Ablation electrode compared to conventional platinum-iridium electrode could be clearly shown. No Popping or clotting was observed.

Material	Energy T=45°C	Energy T=55°C	Energy T=65°C
Platinum-Iridium	121J	227J	310J
Solid Gold	167J	474J	672J
Difference	38%	109%	117%

Methods

- Visual comparison of the lesions with 8mm solid gold (left) and platinum-iridium electrode (right) under identical generator settings (T = 65°C) and contact force

Results

The training system was successfully used to demonstrate the physical science basics of RF Ablation:

- It allows the illustration of differences in lesion size and geometry between standard 4mm and 8mm tip electrodes with single or dual sensor technology.
- It shows the impact of the position of the tip electrode with a specific angle and contact force to the myocardium.
- It offers the explication of larger and deeper lesion size using open and closed irrigated tip RF Ablation, the prevention of pops and the influence of blood flow.
- It delivers impressive results of larger and deeper lesion size using different electrode materials.
- It enables simple documentation and discussion of the experiments, using large scale monitors, as well as screen and video capture software.

Conclusions

- During internships of the biomedical engineering study path and in several workshops for physicians, the **Physics of Radiofrequency Ablation in-vitro Training System** provided excellent conditions to become acquainted with the physical science basics of RF catheter Ablation.

- It delivers an ideal environment, not only for practical learning of the various physical factors influencing the results of the treatment, but also offers unique possibilities of direct measurements.

- Visualization of those factors, associated with the direct measurement of results guarantee highest possible learning success.

Thank you very much!

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