



(Very) High Power Radiofrequency



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Speaker honoraria:

- Biosense-Webster
- Abbott Medical
- Boston Scientific
- Bristol Myer Squibbs
- Bayer Medical
- Daiichi-Sankyo

Clinical studies and research grants:

- Biosense-Webster
- Abbott Medical
- Boston Scientific

How to increase effectivity in ablation?

Catheter tip size

- 8mm vs. 4mm solid tip

Contact/stability

- The more contact, the better (?)

Temperature

- the hotter, the better (?)

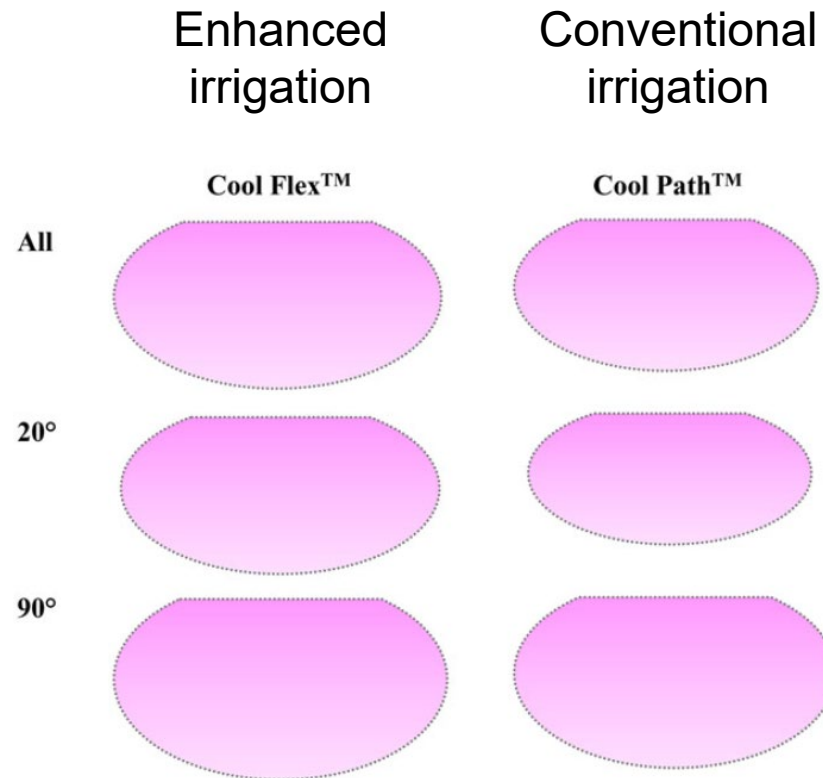
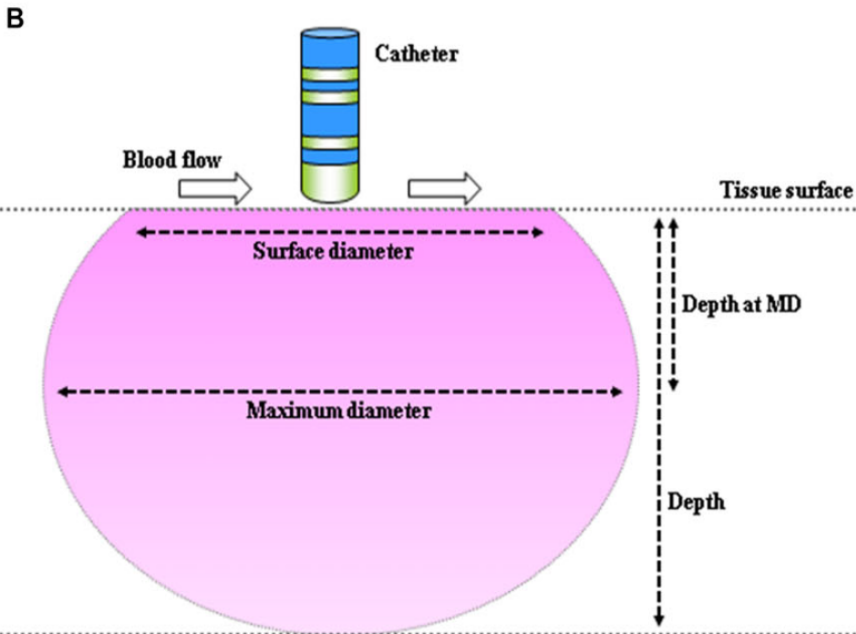
Irrigation

- Cool it ! ...then you can increase power

Power

- Deliver the maximum!
(..without charring the catheter)

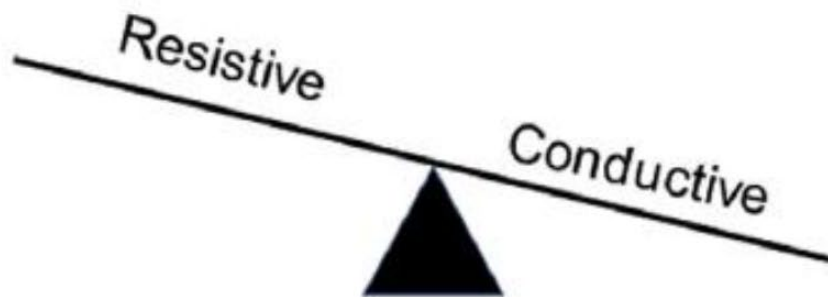
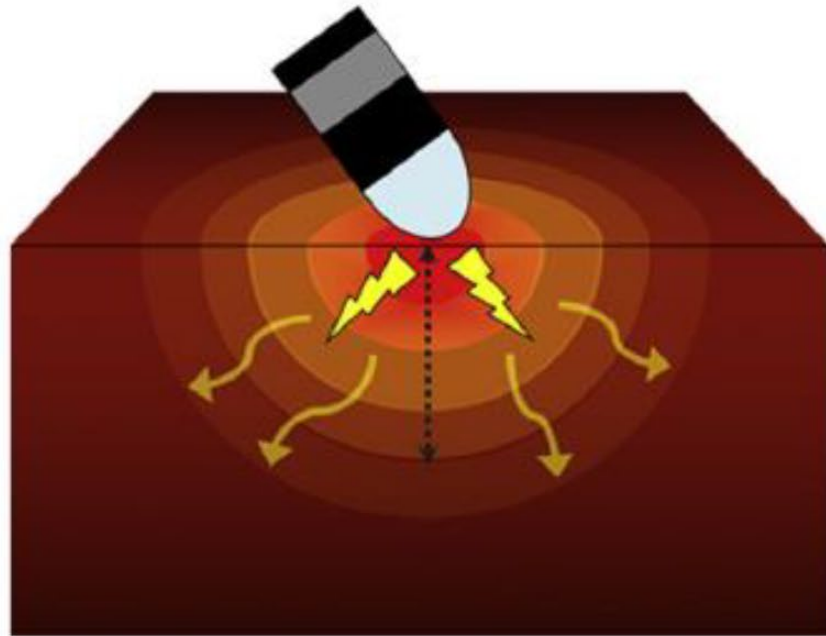
Open-irrigated tip catheters with standard power settings: Teardrop shaped lesion, maximum diameter not at surface



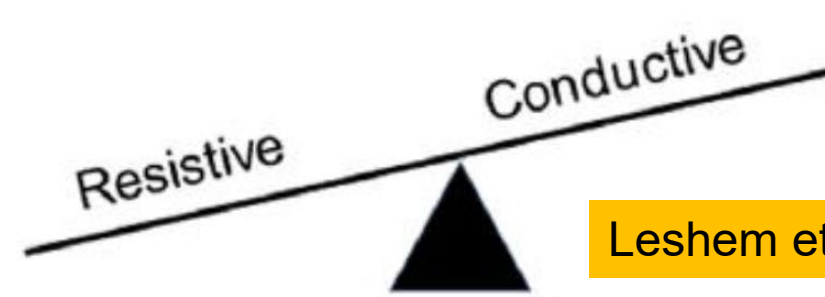
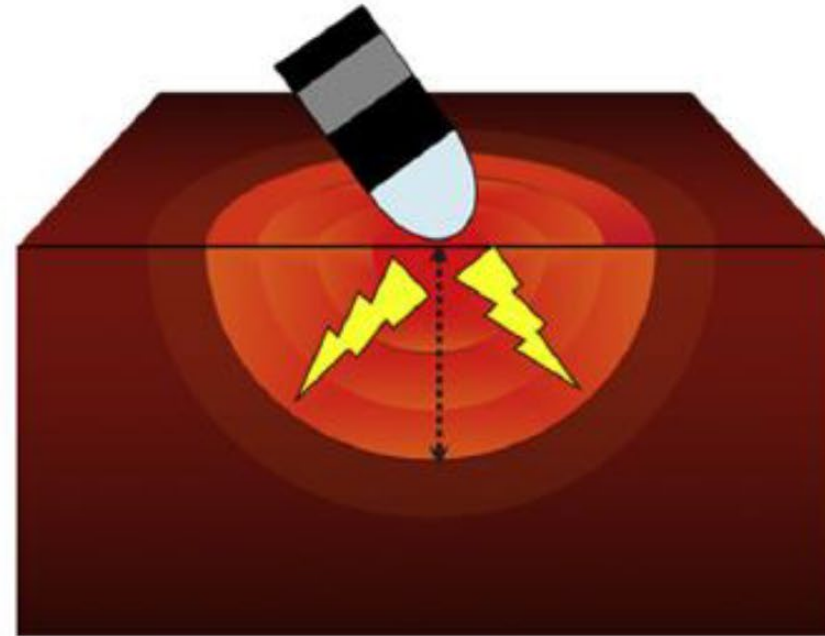
- Hottest spot at some distance to the surface
- Majority of the lesion is created by convective heating
- Catheter charring is avoided by cooling the tip
- Enhanced irrigation (by tip design or increased flow) leads to deeper lesions
- Occurrence of steam pops seems unpredictable

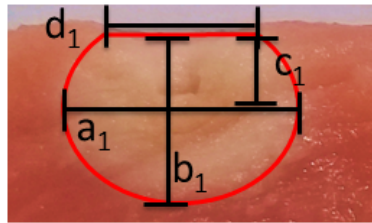
High Power Short Duration: technical considerations

A Standard



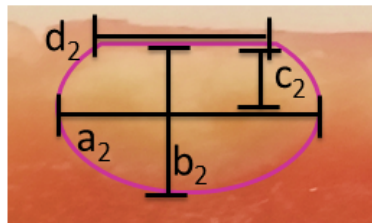
B High-Power Short-Duration





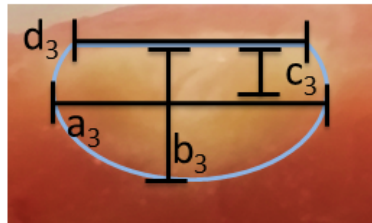
Standard 30W, 30s, 15-20g

$a_1 = 8.9 \pm 0.6 \text{mm}$ $c_1 = 2.2 \pm 0.5 \text{mm}$
 $b_1 = 5.7 \pm 0.6 \text{mm}$ $d_1 = 7.5 \pm 0.6 \text{mm}$
 $\text{Volume}_1 = 271 \pm 46 \text{mm}^3$



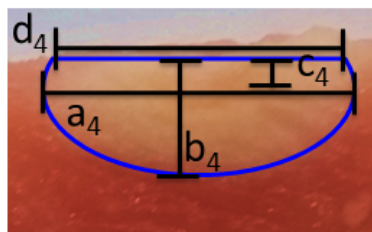
HP50W, 13s, 15-20g

$a_2 = 10.2 \pm 0.5 \text{mm}$ $c_2 = 1.0 \pm 0.4 \text{mm}$
 $b_2 = 4.7 \pm 0.6 \text{mm}$ $d_2 = 8.9 \pm 0.4 \text{mm}$
 $\text{Volume}_2 = 274 \pm 34 \text{mm}^3$



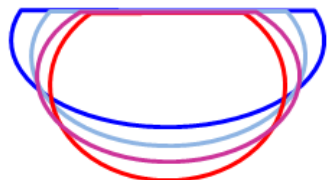
HP60W, 10s, 15-20g

$a_3 = 10.4 \pm 0.6 \text{mm}$ $c_3 = 0.6 \pm 0.3 \text{mm}$
 $b_3 = 4.3 \pm 0.5 \text{mm}$ $d_3 = 9.4 \pm 0.5 \text{mm}$
 $\text{Volume}_3 = 259 \pm 36 \text{mm}^3$



HP70W, 7s, 15-20g

$a_4 = 11.2 \pm 0.5 \text{mm}$ $c_4 = 0.6 \pm 0.2 \text{mm}$
 $b_4 = 3.9 \pm 0.5 \text{mm}$ $d_4 = 10.3 \pm 0.6 \text{mm}$
 $\text{Volume}_4 = 272 \pm 40 \text{mm}^3$



Overlay view of schematic lesion geometries

(30W 30s red, 50W 13s purple, 60W 10s light blue, 70W 7s blue)

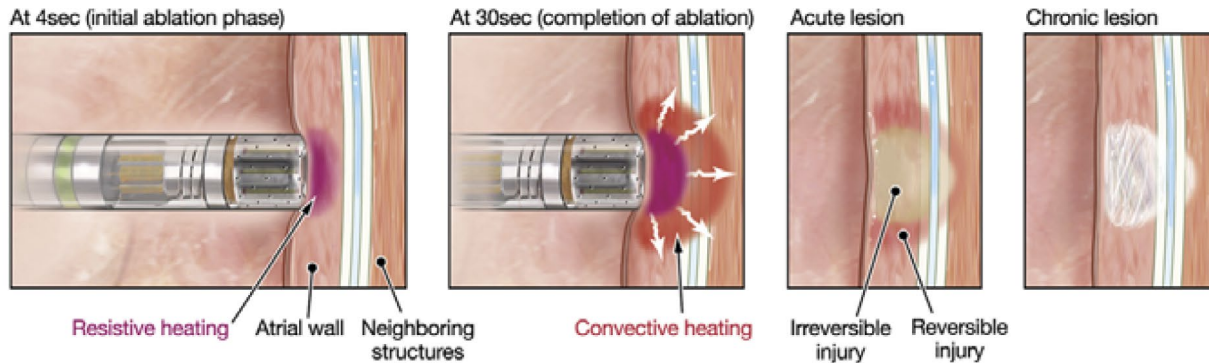
HPSD lesions:

- Shallow lesion
- wide diameter lesion
- No teardrop shape

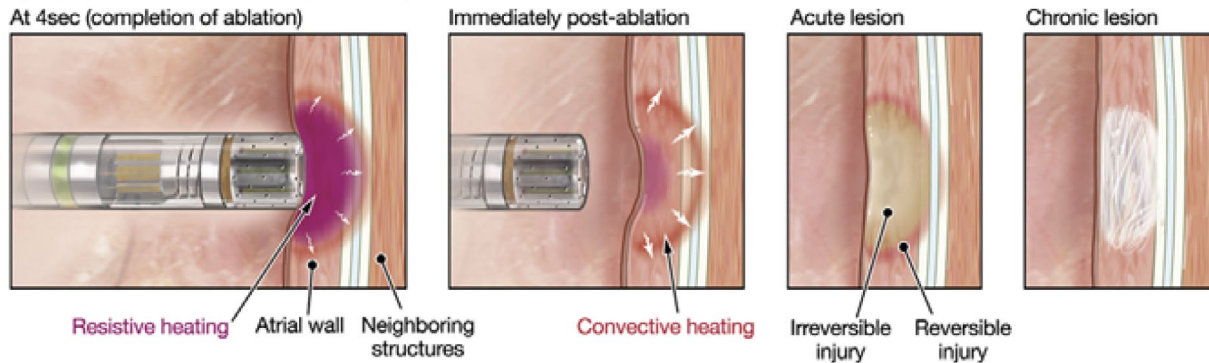
HPSD Power settings

- The higher the power, the „better“ the lesion
- The shorter the duration, the shallower the lesion

(A) Moderate power and duration (30W/30sec)



(B) High power, short duration (90W/4sec)



6 pigs

2 RA ablation lines

RSPV isolation

- 30W/30s
- 90W/4s

Acute:

same results for both strategies
80% shorter RF duration

Chronic:

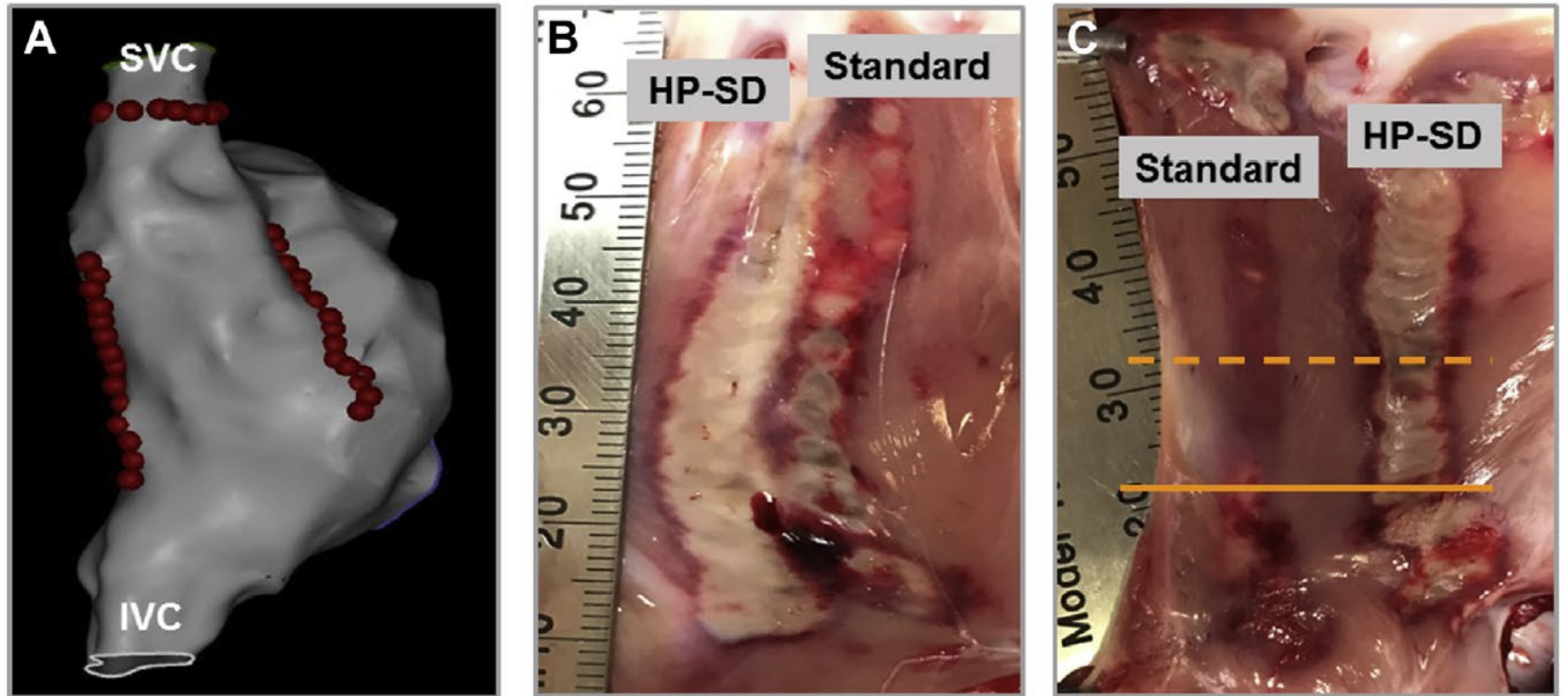
4/6 lines vs. 1/6 complete

(Very) HPSD RF delivery: typical lesions

20 pigs

- Different settings of HPSD
- RA ablation lines
- Acute and chronic assessment

FIGURE 5 Comparison of Right Atrial Lines Between HP-SD and Standard Ablation



HPSD clinical data DHM: baseline characteristics



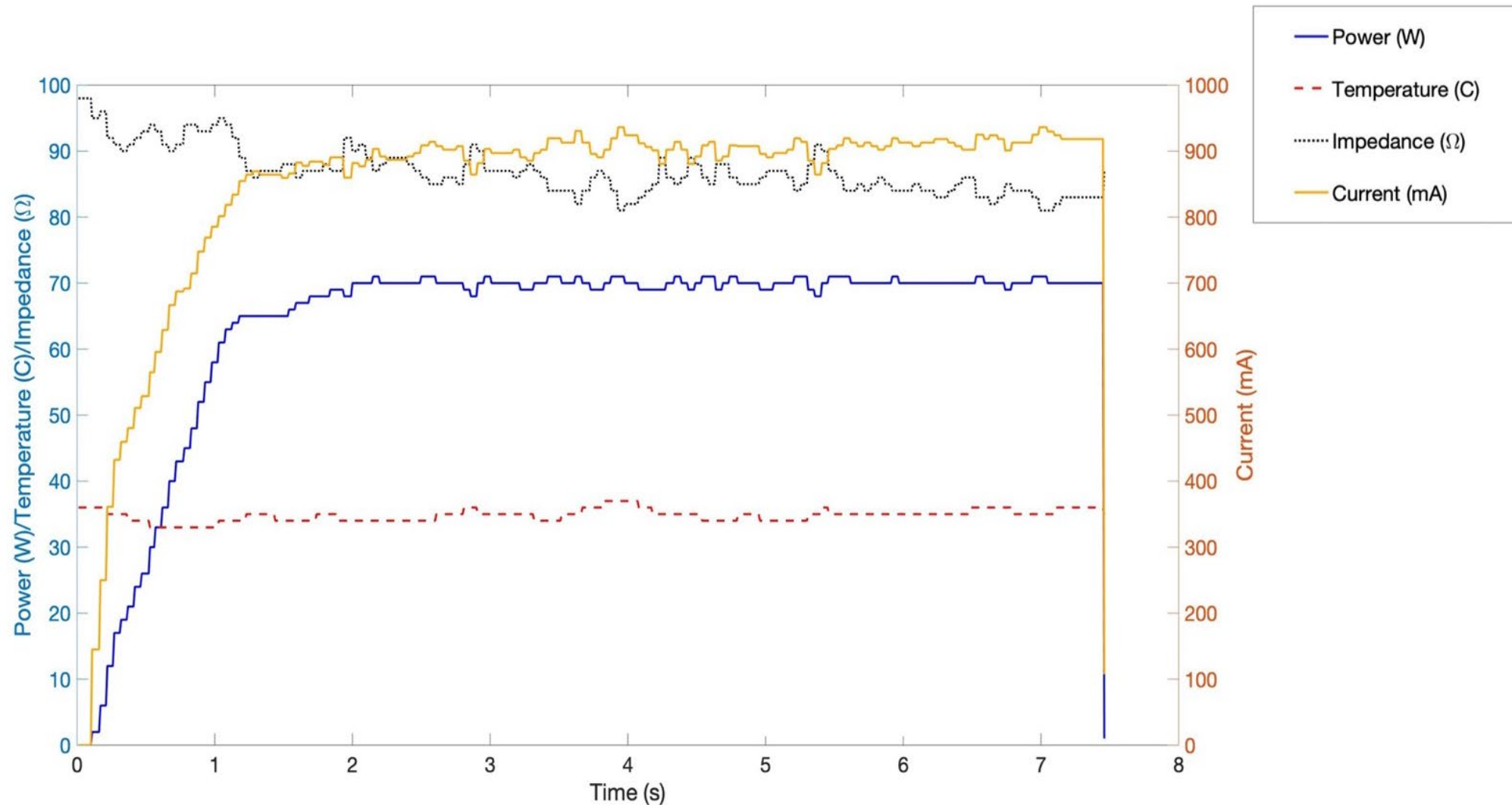
- Prospective patients cohort
- Compared to control group

HPSD settings:

- Flexability SE
- 70W/5-7s
- Irrigation 20ml/min

	HPSD (n=97)	Standard (n=100)	p-value
Age (years)	60.8 ± 13.9	60.8 ± 10.5	0.99
Gender (male)	n=57	n=60	0.89
Hypertension	n=56	n=58	0.77
CAD	n=13	n=9	0.5
History of stroke	n=6	n=7	1.0
EF (%)	57±5	55±9	0.3
BMI	27.9 ± 4.0	28.0 ± 4.5	0.9
CHADSVASC Score	1.95 (median 2)	1.64 (median 2)	0.21

HPSD clinical data : typical ablation graph



Courtesy Dr. Marc Kottmaier, presented at HRS 2019, under review

HPSD clinical data: procedural data



- Prospective patients cohort
- Compared to control group

HPSD settings:

- Flexability SE
- 70W/5-7s
- Irrigation 20ml/min

	HPSD (n=97)	Standard (n=100)	p-value
Procedural duration (min)	89.5 ± 23.9	111.15 ± 27.9	<0.001
Fluoroscopy duration (min)	6.3 ± 3.9	6 ± 3.8	0.64
Fluoroscopydose (cGym ²)	340.4 ± 600	276.1 ± 360	0.37
RF time (min)	12.4 ± 3.4	35.6 ± 12.1	<0.001
Dormant conduction during adenosine testing	n=13	n=55	<0.001

HPSD clinical data DHM: Complications



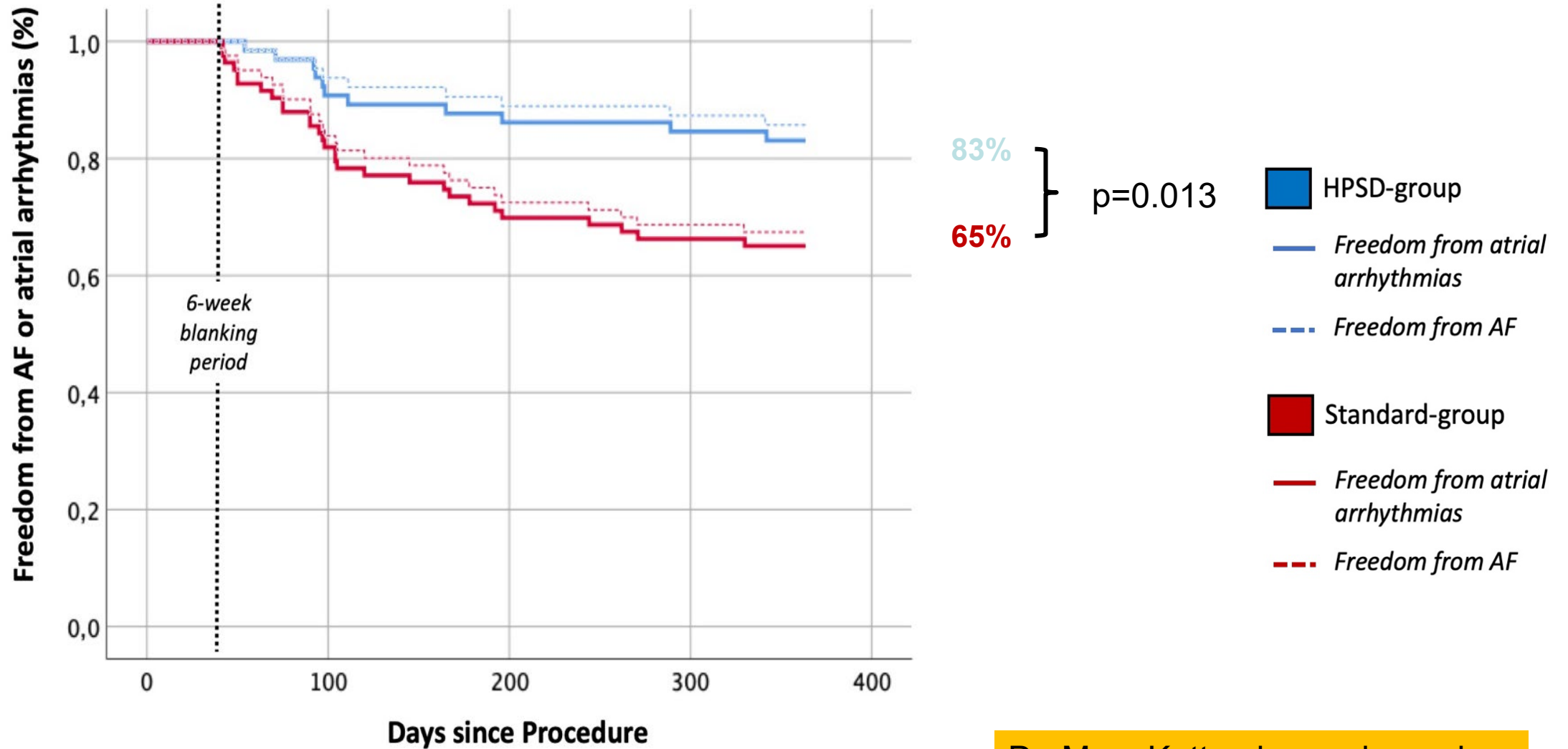
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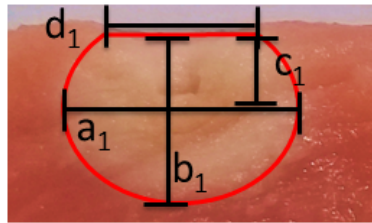
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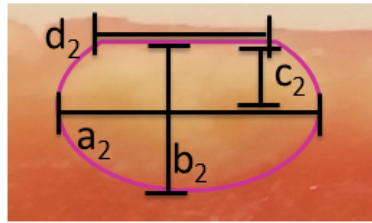
	HPSD (n=97)	Standard (n=100)	p-value
Pericardial effusion >5mm (without tamponade)	n=3	n=2	0.68
Tamponade	n=0	n=0	
Thrombembolic complications	n=0	n=0	
Groin complications	n=10	n=15	0.4
Atrioesophageal fistula	n=0	n=0	

HPSD clinical data: One year outcome

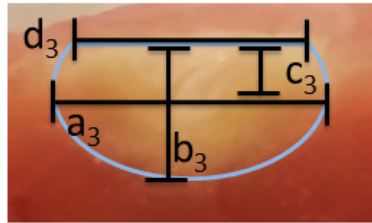




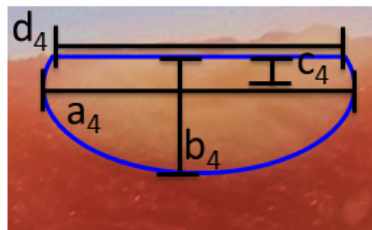
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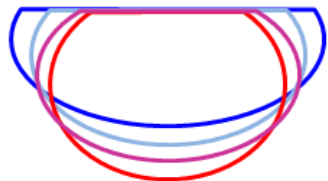
HPSD 50W, 13s, 15-20g
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 $\text{Volume}_2 = 274 \pm 34 \text{ mm}^3$



HPSD 60W, 10s, 15-20g
 $a_3 = 10.4 \pm 0.6 \text{ mm}$ $c_3 = 0.6 \pm 0.3 \text{ mm}$
 $b_3 = 4.3 \pm 0.5 \text{ mm}$ $d_3 = 9.4 \pm 0.5 \text{ mm}$
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HPSD 70W, 7s, 15-20g
 $a_4 = 11.2 \pm 0.5 \text{ mm}$ $c_4 = 0.6 \pm 0.2 \text{ mm}$
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HPSD:

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- No teardrop shape

Ablation parameters with unclear significance:

- „best“ tip temperature
- „best“ irrigation rate
- „best“ contact force

High power short duration

- Better lesion geometry
 - Larger lesion diameter → better contiguity
 - Shallower lesions
- Significantly reduced RF duration, and procedure duration
- Safety: seems comparable to standard settings; maybe improved (!)
- Outcome improved in a first series; needs to be confirmed in a randomized trial

Advantages probably most impressive at power settings >60W

...still some questions...

- Does a temperature controlled mode increase safety?
- In HPSD ablations, resistive heating (and not conductive heating) is the driving component of the lesion formation. What is the single most important parameter to increase the size of the tissue reached by resistive heating ??

....

Vielen Dank für Ihre Aufmerksamkeit



HPSD lesions: in vivo data – animal experience

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RSPV isolation

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- 90W/4s

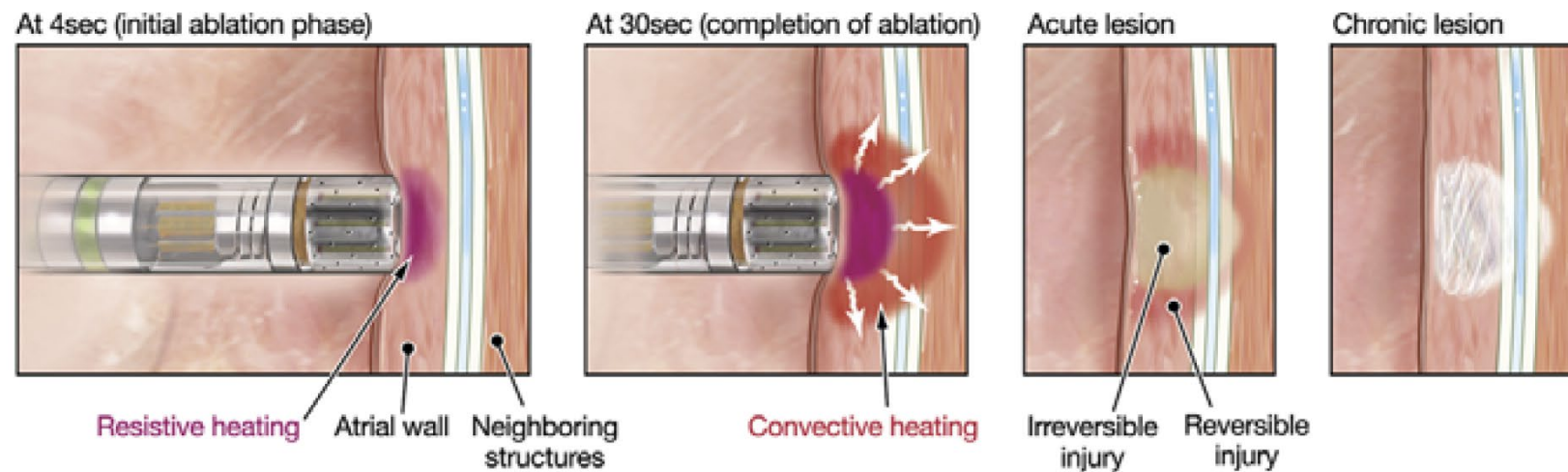
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