

Biosimilar Heart Surgery Simulator Using Hydrogel Having Heating Temperature Memory Function



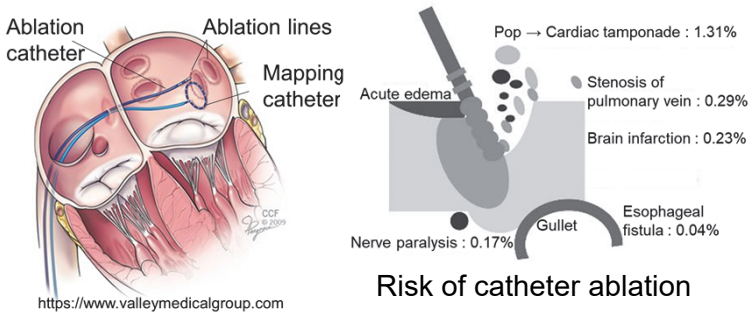
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目的温度に到達したモデル部位を色で検出!!

Background

Importance of training of catheter ablation



Conventional simulator for catheter ablation



3D transport of tip of catheter

Silicone model

× Ablation of model

Non-sensor model

× Skill evaluation

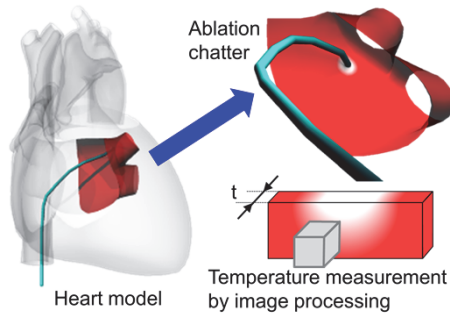
Purpose

• Fabrication of model by hydrogel with sensor

Heart model (JMC medical)

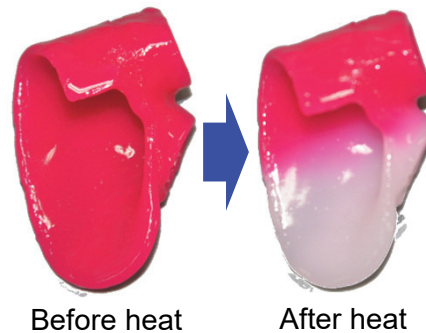
Concept

Concept of hydrogel heart model



Requirement:
 Detection of reaching range of target temp. (**55 °C**)

Record of temperature change by color change



Points

- Fabrication of model by hydrogel for catheter ablation
- Impregnation of irreversible temp. indicator as sensor

Fabrication of heart model

Materials of hydrogel heart model

Metamo Colorx	Polyurethane diacrylate	20%PVA	DIwater	Dimethyl sulfoxide	Lithium phenyl (2,4,6-trimethylbenzoyl)phosphate
10 g	20 g	20 g	150 g	10 g	200 mg

Parameter	Sample	Literature
Young's modulus	20.0 kPa	20.3 kPa
Electrical impedance	98.1Ω·cm	132 Ω·cm
Thermal conductivity	1.37 W/mK	0.47 W/m·K

Fabrication of heart model by 3D printer

Material of mold: Polydimethylsiloxane (PDMS)

UV source: UV curing (wavelength: 385 nm)

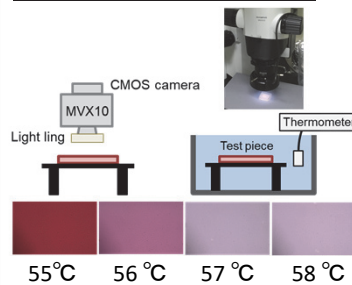


Reference

K. Hosono, H. Maruyama, S. Ikeda, F. Arai, Biosimilar Heart Surgery Simulator Using Hydrogel Having Heating Temperature Memory Function, Robomech2018, 1P2-E01, 2018

Experiment

Calibration method



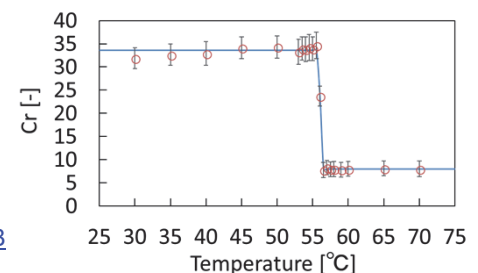
Color space conversion from RGB to YCrCb

$$Y = 0.299R + 0.587G + 0.114B$$

$$Cr = 0.500R - 0.419G - 0.081B$$

$$Cb = -0.169R - 0.331G + 0.500B$$

Calibration result of Cr with temperature



Target temperature for catheter ablation: 55 °C

This heart model can detect reaching range of 55 °C with high precision (±0.18°C).

Conclusions

Hydrogel heart model with temperature memory function was developed. (Precision ±0.18°C at 56°C, thickness : 2.0 mm)

