

Fiber-optic laser energy for pulmonary artery denervation: results of an experimental study

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Background/Introduction: Pulmonary artery denervation (PADN) is an interventional procedure aiming to modulate and correct pulmonary artery (PA) pressure. New technologies and energy sources are being tested currently. However, the effects of laser energy on the PA wall are unknown.

Purpose: To assess the acute effects and impact of laser energy for PADN procedure in normotensive sheep by applying different power settings and session times.

Methods: A total of 10 normotensive Katumsky sheep were included in the experiment. Percutaneous vascular access was performed under general anesthesia. A fiberoptic open-irrigated non-steerable catheter was introduced via a femoral vein through a steerable sheath. Laser applications were applied in the PA trunk and the proximal areas of the right and left PA under fluoroscopic guidance with a 5mm distance between points in the anterior, posterior and lateral walls. Applications were delivered with power 10–30W, 10–35s in duration; irrigation flow 40ml/min. After the procedure, experimental animals were euthanized and underwent an autopsy. PA samples were obtained regardless of the absence of visible laser-related lesions for histological analysis (hematoxylin staining) and immuno-histochemical labelling (S100).

Results: A total of 108 ablation sessions were performed, 33 in the right

PA, 30 in the left PA and 42 in the PA trunk. During macroscopic examination, laser-related lesions described as irregular brown hemorrhage spots and rough defects observed in the PA endothelium were not homogenous in all experimental animals. Thermal injuries either in the left or right lung lobes were identified in 5 (50%) experimental animals when using 30W during 10–20sec. In 5 (50%) sheep no collateral lung injuries were identified when using 10–20W from 20–35s. A total of 64 PA fragments underwent microscopic examination, acute thermal tissue lesions were observed in all experimental animals despite the absence of laser-related lesions in the PA endothelium; dissection, edema, disruption through tunica layers, hemorrhage and necrosis at different depth walls. The most frequent nerve damage was obtained with 20W ablation: 5/8 PAs vs, 1/6 with 10–15W and 1/14 with 25–30W ($P=0.01$). At the same time, there was no difference in intima necrosis between the groups (1/6, 2/8 and 4/14 for 10–15, 20 and 25–30W groups, respectively).

Conclusion(s): Percutaneous PA laser ablation is feasible, reduction of perivascular nerve expression is seen most frequently, when 20W/20–35 s ablation is performed. PA lesions may differ in depth and characteristics, and perivascular nerve damage might be seen in cases with preserved intima.