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Short Communication

Catheter based renal sympathetic laser denervation

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DESCRIPTION

Renal Denervation (RD), a minimally invasive catheter-based procedure, has been suggested as an effective, evidence-based approach for controlling resistant hypertension (Krum et al., 2009). Recently, by using transcatheter application of 1064 nm Nd: YAG-laser light in a pig model successful renal denervation was described (Sagerer-Gerhardt et al., 2021).

A total of 74 continuous wave laser applications, energy densities ranged from 4.5 to 30 J/mm^2, were delivered via the cardiovascular laser catheter RytmoLas® (CE 0481) LasCor® GmbH, in the distal main renal arteries of 6 pigs (Weber et al., 2007). During laser application the catheter itself is not heated up. Laser application is performed under normothermic conditions. Heat is created by selective absorption of the laser light in the perivascular renal tissue, selectively by the perivascular renal Nerves. Based on the optical properties of the optical fibre used contiguous circular laser radiation of a 4-5 mm vascular segment in length was aimed at the inner lumen of the renal arteries (Figure 1).

Angiographically renal arteries were unchanged after laser application. There was no evidence of spasm, narrowing of the lumen or aneurysm formation following laser application including the angiograms of the pigs after a 4-week follow-up. Gross pathology, histopathologically and electron microscopically permanent renal denervation was achieved already after 4.5 J/mm^2 regardless of nerve distances from the renal artery. Importantly, healing process of the acutely mild thermal vessel injuries were almost completed after 4 weeks of follow-up. Anatomic integrity of the renal artery was always preserved including the specimens radiated with the highest energy densities of 30 J/mm^2. In contrast, electron microscopy revealed severe distinctive axonal anisometry with various densities of the axonal cytoskeleton, and granular disintegration of the renal nerves.

Deeper location of renal nerves may be the reason for limited success of RD when using other energy sources with insufficient penetration (Choe et al., 2019). In addition, other energy sources may cause severe adverse effects on tissue local to the side of treatment, on the artery as well as on soft periarterial tissue at distance (Sakaoka et al., 2018). In contrast, acute thermal damages to the arterial walls and connective and

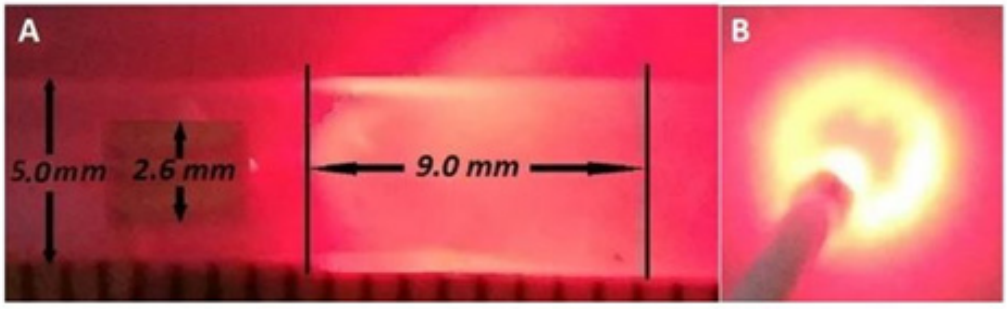

Figure 1. (A) Lateral view and (B) frontal view of the laser light distribution emanated from the optical fibre tip of the laser catheter RytmoLas®.

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fatty tissue were mild even after laser radiation at 30 J/mm^2 and were reversible after a follow-up of 4 weeks. Saline irrigation flow at room temperature may have contributed with its cooling effect to the protection of the arterial wall. However, cooling of the saline irrigation is a secondary effect, but it is a prerequisite when using laser catheter application in the cardiovascular system. Saline irrigation is needed for washing away the blood from the catheter endhole and for creating a clear pathway for the laser beam aimed at the inner surface of the artery, and, to avoid blood penetration into the catheter endhole that may burn the fibre and destroy the catheter.

All the animals survived the experiments without complications.

Success of Renal Sympathetic Laser Denervation (RSLD) comes down to the selective absorption and/or sensitivity of renal sympathetic nerves to the heat induced by the 1064 nm Nd: YAG laser. Besides the treatment of resistant hypertension RSLD could emerge also as an effective therapy for other clinical conditions associated with chronically elevated sympathetic activity (Zaldivia et al., 2017).

CONCLUSION

RSLD can achieve selective and permanent renal sympathetic denervation without long-term collateral damages to the renal artery wall itself and adjacent tissues. RSLD could be an intriguing alternative for renal sympathetic denervation for patients with resistant hypertension.

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None

CONFLICT OF INTEREST

None declared

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