Mechanism of endovenous laser ablation

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Abstract—The mechanism EVLA can be nominally divided in three phases: 1) Vaporization of blood and carbonization of fiber tip. 2) The direct influence of laser radiation on venous wall. It is the main factor in mechanism of EVLA. 3) If there is no traction of fiber or it is too slow, the overheated fiber tip damaged the vein wall. This mechanism is universal and independent from the wavelength.

I. OBJECTIVE

In 2002 the theory of stream bubbles influence on vein wall was offered as the main mechanism of endovenous laser ablation (EVLA). Nevertheless, the exact mechanism of action is still under debate.

II. METHODS

In the process of tumescent anesthesia, the vein is collapsed around the fiber, and its lumen is becoming close to the fiber diameter (up to 1 mm). Because of that, as a vein model a glass capillary was used, the inner diameter of it was 1 mm. Capillary was filled with heparinised blood; laser fiber was put into it. Energy parameters were 5, 7, 10, 12, 20 J in one impulse for 1030 nm laser, and 1, 3, 5, 12 J – for 1470 nm laser. In the next series of experiences, we simulated the endovenous laser ablation ex vivo. The great saphenous vein was filled with heparinised blood and put into transparent heat-shrinkable tube. Around the vein the imitation of tumescent anesthesia was created by a gelatin.

III. RESULTS

Complete vaporization of blood from the capillary and carbonization with heating of fiber tip occurred at energy density 10 J/sm for 1470 nm laser and 70 J/sm for the 1030 nm laser. These values of energy density in real EVLA are threshold. After that, the vein was filled by transparent gas (not vapor stream) and direct influence of laser radiation on venous wall is occurred.

IV. CONCLUSIONS

The mechanism EVLA can be nominally divided in three phases:
1) Vaporization of blood and carbonization of fiber tip.
2) After complete vaporization, the direct influence of laser radiation on venous wall is occurred. From our point of view, the direct laser influence on vein wall is the main factor in mechanism of EVLA.
3) If there is no traction of fiber or it is too slow, the overheated fiber tip damaged the vein wall.

This mechanism is universal and independent from the wavelength.