The effect of variable bipolar configurations, ablation time and contact force conditions during radio-frequency ablation on myocardia

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Introduction: Some studies have demonstrated that bipolar radiofrequency ablation (bRFA) can potentially create deeper and larger lesions. However, there remains a little of data regarding optimal catheter orientation and contact forces for bRFA. So we sought to evaluate the efficiency and safety of variable bipolar configurations and different contact forces during bRFA.

Methods: Swine hearts were excised within 1 hour of experimentation. The catheter tips were oriented in various combinations perpendicular or parallel to the myocardium. During bRFA, the contact force varied from (10-30)±3g, ablations were performed at 20-60W for 60-120s.

Result: (1) When bRFA were performed at 25W for 90s, with perpendicular configurations catheters, the ablation lesion volumes of 10±3g, 20±3g, 30±3g were 382.3±14.9uL, 482.9±16.9uL, 512.3±19.3uL, respectively. The ablation lesion depths of 10±3g, 20±3g, 30±3g were 12.6±0.3mm, 13.6±0.2mm, 14.2±0.3mm, respectively. There was no significant difference in the POP rate between the three groups (P=0.53). 30±3g group achieved the highest transmurality. No transmurality was achieved in the 10±3g group. (2) When bRFA were performed at 25W with the contact force of 10±3g, with perpendicular configurations catheters, the ablation lesions of 60s, 90s, 120s were 337.5±19.9uL, 382.3±14.9uL, 382.8±17.4uL, and the lesion depths were 11.8±1.2mm, 12.6±0.3mm, 12.8±0.4mm. There were no significant difference in lesion volumes and depths between 120 seconds and 90 seconds group, and no significant difference in POP rate of three groups. Three groups all did not achieve transmurality. (3) When bRFA were performed for 60s with the contact force of 10±3g, with perpendicular configurations catheters, the ablation lesions volumes of 20W, 25W, 30W, 60W were 219.7±18.4uL, 337.5±19.9uL, 366.7±19.7uL, 366.5±24.0uL, and the lesion depths were 7.5±0.6mm, 11.8±1.2mm, 13.3±0.8mm, 13.1±0.8mm. There was no significant difference of lesions volumes and depths between the 50W group and the 60W group. The POP rate and the transmurality rate were the highest in the 60W group. (4) When bRFA were performed at 25W for 90s with the contact force of 20±3g, the ablation lesions volumes of perpendicular to-perpendicular group, parallel to parallel group, perpendicular to parallel group were 482.9±16.9uL, 447.7±25.7uL, 470.0±25.4uL, and the ablation lesions depths were 13.6±0.2mm, 10.9±0.5mm, 12.4±0.3mm. There was no significant difference in POP rate and transmurality rate between groups.

Conclusion: In the scope of the 30±3g, with the increase of contact force, the ablation lesions volumes, depths, transmurality rate of bipolar radiofrequency ablation increase. But the POP rate did not obviously change when the contact force changed. In the scope of ablation time of 90s, with the extension of time, the ablation lesions volumes, depths of bipolar radiofrequency ablation increased significantly. Ablation power have a significant impact on bipolar radiofrequency ablation lesions volumes, depths, with the increase of power, the depths and volumes of ablation lesions increased, as
well as the POP rate and transmurality rate. The largest lesions volumes and depths were achieved with both catheter tips oriented perpendicular to the myocardium, and the smallest with both catheter tips oriented parallel to the myocardium. There was no significant correlation between the POP rate and the catheter tips orientation.