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Novel surgical ablation technique using ultrasonic scalpel for atrial fibrillation in mitral valve surgery

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Objective: Radiofrequency, cryoablation and cut-and-sew technique have been used for surgical ablation to treat atrial fibrillation. Ultrasonic scalpel is a surgical instrument used to simultaneously cut and cauterize tissue by ultrasound vibration. This device causes minimal lateral thermal tissue damage and increases the tissue penetration depth linearly with time. These features are suitable for surgical ablation for atrial fibrillation. This study evaluated surgical ablation with ultrasonic scalpel for atrial fibrillation.

Methods: From October 2017 to February 2019, 46 patients (mean age: 71.8 years [46-86], 28 male) with mitral valve procedure underwent surgical ablation using ultrasonic scalpel for atrial fibrillation. The ablation lines were carried out with Cox maze procedure or pulmonary vein isolation (PVI) on cardiopulmonary bypass. Endocardial atrial wall was ablated by direct touch with blade in a few seconds at energy level 5. Pathological study of left atrial wall received ablation with ultrasonic scalpel was carried out.

Results: Type of preoperative atrial fibrillation was persistent in 33 and paroxysmal in 13 patients. Mean left atrial diameter was 49.0 mm (35-81). Surgical ablation using ultrasonic scalpel was carried out to left atrium only or PVI in 33 patients and both atria in 13 patients. Mean surgical ablation time was 4 minutes and 21 seconds. Mitral valve repair and replacement were performed in 33 and replacement in 13 patients, respectively. Simultaneous surgery included 43 tricuspid valve repairs, 11 aortic valve replacements, and 7 coronary artery bypass grafting. Cardiopulmonary bypass and aortic cross-clamp times were 142.6 (70-261) and 98.6 (47-202) minutes, respectively. No operative death or perioperative stroke were observed. Thirty-eight patients (82.6%) returned to sinus rhythm immediately after surgery. Sinus rhythm was maintained in 30 patients (65.2%) in the mid-term period with average 142.2 days after surgery (7-426 days). Pathological study showed the atrial walls were not ablated transmurally. No complications including bleeding and tissue injury were observed. Conclusion: Surgical ablation with ultrasonic scalpel for atrial fibrillation was feasible and provided satisfactory outcomes immediately after surgery and at mid-term. This technique can be performed in a short time without complications. Interestingly, pathological study showed no transmural tissue ablation despite of successful outcomes. This may imply transmural ablation is not necessarily mandatory for surgical ablation. Long-term follow-up are required to evaluate this technique.