proLékaře.cz | 24.11.2026

BEATING HEART TREATMENT OF ATRIAL FIBRILLATION

P. Suwalski

In recent years, alternative concepts to the "classical" MAZE procedure have been developed leading to the use of diverse energy sources to create different lesion patterns in the atrium. The development of surgical techniques, such as off-pump surgery, and growing need of widening the indications for ablation, resulted in an use of epicardial approach for surgical AF ablation. Numerous systems have been applied in the epicardial treatment of AF. In spite of this, the scientific discussion is still open including the issue of transmurality of the scar created by the epicardial ablation, especially in beating heart conditions.

In spite of reported good clinical results, experimental data shows that none of the available unipolar devices are able to predictably create a transmural lesion epicardially, especially on beating heart. It was shown by Maessen et al. with microwave ablation operations that lesions are seldom transmural. A similar relationship between lesion transmurality and thickness of the tissue were presented by Santiago et al and Bugge et al. Doll has questionned the ability of cryothermy, even after long application in very low temperature to achieve transmurality on beating heart. So called "heat sink effect" which is due to convective endocardial cooling by flowing blood within the heart chamber. The same problem creates fat and trabecular regions of the atria.

In this context, bipolar RF energy is attractive. Clamping the target structures prevents the "heat sink effect", another advantage is that compression of the atrial wall improves contact and reduces overall tissue thickness. The ability of the bipolar RF devices to create reliably transmural lesions in pigs were shown acutely and with short-term follow-up by Prasad and Bonanomi. There is growing experimental evidence that bipolar energy may have higher rates of transmurality than any unipolar device. In Bugge's study inability to entrain the LA from the pulmonary vein significantly predicted transmurality. The double ablation resulting in very high probability of gaining a transmural lesion is recommended.

Electrophysiologists have shown that the origin of paroxysmal atrial fibrillation resides from the pulmonary veins as focal triggers. These triggers can easily be eliminated by isolation of the pulmonary veins. On average 20% of paroxysmal AF degenerates to persistent AF. After one year, persistent AF converts to permanent AF in the majority of cases. There is growing evidence, that the substrate of permanent AF must be treated differently than paroxysmal AF. To treat permanent atrial fibrillation connecting lines between the mitral annulus and the pulmonary veins may be necessary to control postoperative arrhythmias such as atrial flutter or SVT. These arrhythmias may be less tolerated by the patient than AF itself. Due to the presence of the circumflex artery in this area, the unquestioned challenge for the future is how to create the connecting lines, especially the one leading to the mitral annulus, in a safe mannner without placing the patient on-pump.

There is still confined but dynamically rising data showing very effective beating heart bipolar radiofrequency ablation in OPCAB operations. We are still waiting for the more publications regarding ultrasound ablation in off-pump technique. Numerous devices have been invented to perform ablation also in stand alone AF patients – especially in minimally invasive techniques.

In conclusion, new options in the surgical treatment of atrial fibrillation should respond to the current trends in cardiac surgery like beating heart techniques. More scientific data regarding this interesting matter is required to confirm its feasibility and efficacy but today in many cases this kind of ablation is possible. Nevertheless, there are still some challenges, like full line patterns of ablation – however first steps have been done.

References/Literatura

1. Cox JL, Ad N, Palazzo T et al. Current status of the Maze procedure for the treatment of atrial fibrillation. Semin Thorac Cardiovasc Surg 2000; 12(1): 15–19.

2. Maessen JG, Nijs JF, Smeets JL et al. Beating-heart surgical treatment of atrial fibrillation with microwave ablation. Ann Thorac Surg 2002; 74: 1307–1311.

3. Santiago T, Melo J, Gouveia RH et al. Epicardial radiofrequency ablations: in vitro and in vivo studies on human atrial myocardium. Eur J Cardiothoracic Surg 2003; 24: 481–486.

4. Doll N, Kornherr P, Aupperle H et al. Epicardial treatment of atrial fibrillation using cryoablation in an acute off-pump sheep model. Thorac Cardiov Surg 2003; 51: 267–273.

5. Bonanomi G, Schwartzman D, Francischelli D et al. A new device for beating heart bipolar radiofrequency atrial ablation. J Thorac Cardiovasc Surg 2003; 126: 1859–1866.

6. Prasad SM, Maniar HS, Diodato MD et al. Physiological consequences of bipolar radiofrequency energy on the atria and pulmonary veins: a chronic animal study. Ann Thorac Surg 2003; 76: 836–841.

7. Hamner CE, Potter DD Jr, Cho KR et al. Irrigated radiofrequency ablation with transmurality feedback reliably produces Cox maze lesions in vivo. Ann Thorac Surg 2005; 80(6): 2263–2270.

8. Guiraudon GM, Klein GJ, Gulamhusein S et al. Surgical section of the bundle of Kent in the closed heart. Arch Mal Coeur Vaiss 1984; 77: 600–605.

9. Gage A, Baust J. Mechanisms of tissue injury in cruosurgery. Cryobiology 1998; 37: 171–186.

10. Lustgarten D, Bell S, Hardin N et al. Cryothermal ablation: Mechanism of tissue injury and current experience in the treatment of tachyarrhythmias. Progress in Cardiovascular Diseases 1999; 41: 481–498.

11. Khairy P, Chauvet P, Lehmann J et al. Lower incidence of thrombus formation with cryoenergy versus radiofrequency catheter ablation. Circulation 2003; 107: 2045–2050.