Hypertrophic Obstructive Cardiomyopathy (HOCM)

HOCM is partly a familial disease affecting one out of 500 people. Anatomically, HOCM is characterized by an asymmetrically hypertrophied interventricular septum causing a dynamic obstruction of the left, and in some patients also of the right ventricular outflow tract (1). The disease is often accompanied by a severe diastolic dysfunction of the left ventricle, dysfunctions and deformations of the mitral valve apparatus, and by ischemic heart disease (2).

Major clinical symptoms include exercise- induced breathlessness and syncope, angina, and a high risk of sudden cardiac death (3,4). The incidence of sudden death in HOCM is 2-6% per year (5). In young patients up to 30 years of age, HOCM is the most frequent cause of sudden cardiac death (6).

The treatment of symptomatic HOCM patients is focusing on the reduction of elimination of the dynamic intra-ventricular obstruction.

Drug treatment

Neither negative inotropic drugs such as beta- and calcium-blockers, nor Amiodarone clearly reduced interventricular obstruction or the incidence of sudden cardiac death (7,8).

Cardiac pacing

Atrial or dual chamber pacing with short atrio-ventricular interval can reduce or even abolish outflow tract obstruction acutely, but long term results were disappointing (9).

Surgery

Surgical reduction of the hypertrophic interventricular septum can be performed by trans-aortic myotomy/myectomy. Perioperative complications include defects of the interventricular septum (1.9%), complete atrio-ventricular block (4.3%), cerebral embolism (1.1%) especially after the relatively often needed re-interventions (10).

Transcoronary Ablation of Septal Hypertrophy (TASH)

During catheterization of coronary arteries, reduction of intra-ventricular obstruction was observed when the septal coronary branch was occluded temporarily with a balloon. Based on this observation, a permanent “ablation” of the hypertrophied septum was attempted by selective alcohol injection into the septal branch via a coronary catheter (11). The injected alcohol, the transcoronary alcohol ablation, produces a chemical infarction with an increase of Creatinkinase up to 2500 IU/l and is followed by subaortal scarring. However, in some cases atrioventricular conduction disturbances occur with the need for implantation of a permanent pacemaker. The TASH is still entirely on experimental field and not yet a routine procedure.

Laser Coagulation of Septal Hypertrophy (LCSH)

Experimental studies with laser catheter applications in the beating heart of dogs showed, that deep clear-cut homogeneous lesions of coagulation necrosis can be produced by using a special catheter system, the MyoLas, LasCor GmbH. By means of this catheter system transmural laser lesions can be produced within seconds in a controllable manner and without unwanted effects on the heart (Figure 1).
**Fig. 1** Section through a laser lesion produced in the left ventricular free wall in the beating heart of a dog by transcatheter endocardial laser application at 20 W / 60 s, via the laser catheter system *MyoLas*. The arrow indicates the assumed orientation of the laser catheter during laser application. **Note:** the three-hours-old lesion, conspicuous by a pale clear-cut area of homogeneous transmural coagulation necrosis was produced without endocardial charring, without tissue vaporization and crater formation. The endocardium and epicardium are undamaged, the anatomic integrity of the myocardial wall is fully preserved.

During laser application, on-line monitoring of thermal effects on the irradiated myocardium is practicable by continuous monitoring of the local intracardiac electrograms recorded via the tip-electrodes of the *MyoLas*. Simultaneously with the application of the laser light, amplitudes of potentials displayed on the monitor are dwindling gradually, until abolished (figure 2).

**Fig. 2** Surface lead-ECG I, and intracardiac bipolar mapping electrograms (MAP 1,2,3) recorded via the tip-electrodes of the *MyoLas*, during the creation of the lesion shown in figure 1. With the onset of irradiation intracardiac mapping electrograms (MAP 1,2,3) show a gradual abatement of the amplitudes of electrical potentials from $V_0$ to $V_1$. 
The MyoLas consists of an electrode laser catheter and a preshaped guiding and introducer set adapted for orthogonal targeting the interventricular septum from the right ventricle (Figure 3).

**Fig. 3** Scheme showing the distal intracardiac end of the steerable MyoLas. The electrode catheter (1) is advanced beyond the endhole of the preshaped inner sheath (2), which is advanced beyond the endhole of the overriding outer sheath (3).

The MyoLas can be manipulated by advancing and by withdrawing the laser catheter or the overriding sheath one upon the other (straight arrows), and by twisting the entire catheter system or individually one of the sheaths (circular arrows).

By manipulation (telescoping) of the flexible sheath one upon the other gradual modification of the preshaped curves of each of the sheaths is practicable. Besides of the selfguiding effect this maneuver allows for detailed mapping and precise orientation of the catheter system upon all of the septal areas. Flexibility of the sheath material allows for a stable orthogonal position of the catheter in the beating heart.

pervenous access helps avoid the inherent risks of the arterial puncture and the retrograde catheterization of the left heart. For the patients the LCSH is painless and a less straining, less risky procedure than the other methods of septal ablation. LCSH does not damage coronary vessels (12) or the anatomical integrity of the heart (13).

**Own Experiences**

After venous puncture in the groin (Seldinger technique) and removal of the needle, insertion of the guiding-introducer set G-01-225-L-090 and advancement under X-ray control in the right ventricle. The preshaped curves of the guide are stretched during insertion of the guide, but will regain their configuration after removal of dilator and wire (“memory” effect) due to the flexibility and resilience of the sheath material.

The laser catheter itself introduced through the hemostatic valve of the guide is advanced under X-ray control and continuous saline flushing up to the right ventricle and is brought with its tip in intimate contact with the most hypertrophied region of the septum. Immediately with the advancement of the tip-electrodes of the laser catheter beyond the endhole of the guide bipolar intracardiac electrograms are displayed on the monitor.

While in stable orthogonal position upon the hypertrophied septum Nd:YAG laser irradiation at 20 W is applied for 40-60 s. Effective coagulation and growing of lesion in the myocardial wall is ensured by the gradual dwindling of the amplitudes of electrical potentials in the local electrograms. If potentials are practically abolished permanently, the catheter is repositioned and the procedure is repeated in an adjacent area until the dynamic left ventricular outflow tract obstruction is released permanently. The result is documented by pressure measurements simultaneously in a femoral artery (needle puncture) and left ventricle (transseptally) and by left ventricular angiography (figure 4).
Fig. 4 Left ventricular angiography and simultaneous pressure measurements in the femoral artery (needle puncture) and left ventricle (transseptally) prior to (left) and after (right) laser coagulation of the hypertrophied interventricular septum in a 35 years old patient with HOCM, showing elimination of left ventricular outflow tract obstruction by abolishing pressure gradient and widening of the outflow (arrows).

LCSH can abolish hyperdynamic obstruction of the left ventricle permanently within a few minutes in a controllable manner. Procedure related risks did not occur up to now.

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