Use of cutting-edge technology to learn myocardial cutting edge in septal myectomy

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Preoperative planning and simulation of septal myectomy using a 3-dimensional printed model.

Central Message

Use of 3-dimensional printing technology to learn septal myectomy is an excellent illustration of innovative thinking in cardiac surgery.

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Septal myectomy (SM) is among the most challenging procedures to learn and teach. Although schematic illustrations usually present a conceptually simple image of a knife resecting muscle protruding obviously into the left ventricular outflow tract,¹ in practice, ascertaining the appropriate amount of septal tissue to resect intraoperatively can be difficult and requires hands-on experience. The low volume of SM performed at most centers and the difficulty that trainees usually have visualizing the surgical field exacerbate this teaching challenge.

SM is the guideline-recommended first-line septal reduction therapy for patients with symptomatic obstructive hypertrophic cardiomyopathy.^{2,3} The main advantage that SM holds over alcohol septal ablation is the durability of long-term symptom relief and decreased need for subsequent reintervention.⁴⁻⁶ However, the difficulty of teaching SM has likely been an important factor in the current shortage of cardiac surgeons familiar with this procedure.⁷

Hermesen and colleagues⁸ propose an exciting solution to this problem: Expert-guided simulation of SM using 3-dimensional printed models. In their study,⁸ cardiac surgery trainees performed SM on a series of 5 hydrogel 3-dimensional models based on 5 actual patients with hypertrophic cardiomyopathy. As can be seen in the provided figures and video clip, the exercise offers an impressively realistic simulation of SM. The models replicate the experience of operating via an aortotomy and are printed with high enough fidelity that anatomic landmarks such as the right coronary ostium, right aortic annulus, and fibrous trigones can be identified.

The authors⁸ demonstrate that serial simulation improves the technical outcome. Whereas trainees initially tended to be overly cautious (resecting on average 3 cm³ of tissue compared with the 15 cm³ of tissue resected by the attending physician), during subsequent simulations they resected increasingly larger volumes (on average adding 3.6 cm³ per simulation). Given

that the success of SM and its advantage over alcohol septal ablation is primarily based on the ability to resect an adequate volume and extent of tissue, these results are impressive.

This report also highlights the subjective nature of SM.⁸ Each simulation was videotaped and assessed by multiple faculty members who assigned scores. Interrater agreement among these faculty assessments was poor. Given the same simulation, 1 of the 3 faculty raters gave significantly higher ratings compared with the others, suggesting that what appears to be an adequate resection to 1 surgeon may appear inadequate to the next. Inconsistency regarding the assessment of the resection presents a challenge to both teacher and student and is an area that calls for better standardization of SM.

Simulation might be further improved by incorporating pathologies of the mitral valve, which have been increasingly appreciated as a major player in the development of left ventricular outflow tract obstruction.⁹ A thorough curriculum would include teaching adjunctive procedures such as shaving of hypertrophied papillary muscles or plication of an abnormally elongated anterior mitral leaflet.

Nonetheless, innovations like those described by Hermesen and colleagues⁸ that incorporate cutting-edge technology to teach trainees how to determine the appropriate cut edge of the hypertrophied myocardium in SM are needed and should be commended.

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