Ultrasound Image-guidance (US) as the Sole Image-Modality for Positioning a Mechanical Aortic Valve Introduced in the Beating Heart via the Universal Cardiac Introducer® (UCI), in the Pig: A Pilot Study

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**Objective:** The aim of this study was to evaluate US as the sole image-guidance modality for implanting a mechanical aortic valve (AV) in the beating heart using the UCI attached to the left ventricular (LV) apex. This new approach is being developed to offer a preferred choice over catheter and open-heart techniques.

**Methods:** In 6 pigs, a TEE probe was inserted. LV apical port access was created via the UCI using a 12 mm diameter punching-tool. A 3D US probe applied the UCI evaluated the anatomy of the LV port and aortic annulus. The AV with its holder was introduced via the UCI into the LV, and navigated under TEE guidance to the LV outflow tract and into an adequate position within the AV annulus. Pre-implantation TEE provided a good view of the LV cavity, the mitral valve apparatus, the LV inflow and outflow tracts, and the AV annulus anatomy and size. 3D US provide useful guidance for AV introduction. The AV prosthesis was well visualized. Digression from the LV outflow tract into the septum or MV apparatus was readily identified. Mitral valve regurgitation was monitored. The AV positioning was determined by superimposition of the AV ring and annulus. The AV was maintained functioning in position for 15 min, before the pigs were terminated. Positioning was evaluated in situ and in the excised heart.

**Results:** US provided precise guidance with intuitive display to the surgeon, preventing digression into the MV apparatus. 3D US provided good evaluation of the anatomy of the LV port for easier introduction. The AV was well seated over the AV annulus, without obstructing the coronaries. Hemodynamic stability was present in all pigs.

**Conclusion:** US used alone provide excellent guidance throughout introduction via the LV port, navigation and positioning of the mechanical AV on the beating heart, by displaying all the necessary landmarks for intuitive and accurate guidance. Tracked US guidance augmented with virtual reality will add virtual representation of tools, eliminating the need for fluoroscopy and making this new surgical approach simpler, safer and more effective by duplicating open-heart techniques on the closed beating heart.

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