## Poster Session 2 (P2)

## Monday, June 25, 2018

in peak left ventricular outflow tract (LVOT) gradients (resting gradient, from 91.53±26.82 to 12.47±6.96 mm Hg, P<0.001; stress-induced gradient, from 143.57±67.21 to 31.06±16·6 mm Hg, P<0.001), and interventricular septum (IVS) thickness (anterior IVS, from 24.64±4.64 to 14.15±2.38 mm, P<0.001; posterior IVS, from 24.13±4.78 to 13.79±2.81 mm, P<0.001). The reduction in IVS thickness and LVOT gradient was associated with improvement in New York Heart Association class (from 2.60±0.51 to 1.00±0.00, P<0.001), total exercise time (from 6.67±1.63 to 9.60±1.84 min, P<0.001), the wave amplitude of Rv5+Sv1 (from 4.62±2.11 to 3.67±1.82 mV, P=0.023) , and pro-BNP levels (from 868.34±566.93 to 233.64±217.48 pg/ml, P=0.026). No patient had bundle branch block or complete heart block. **Conclusions:** Liwen procedure is a safe and efficacious treatment of symptomatic HOCM that leads to a persistent reduction in LVOT gradients and sustained functional improvement.

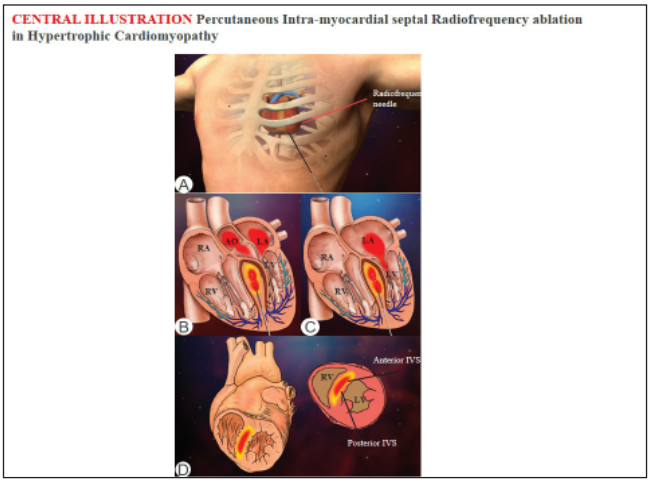
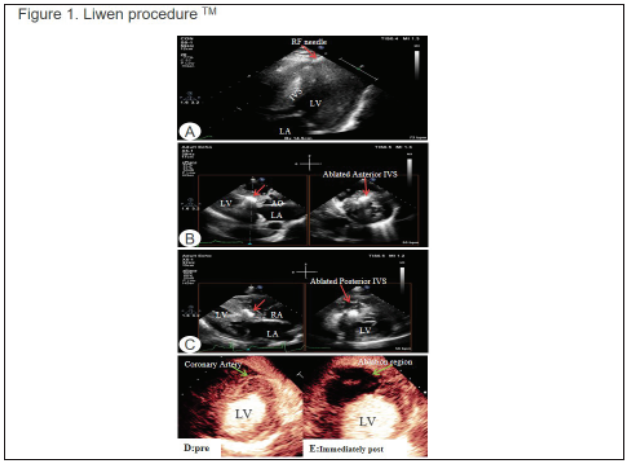
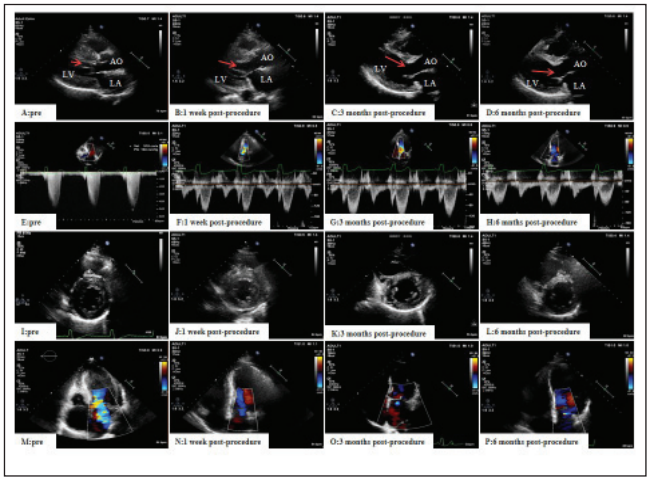



Figure 1. Liwen procedure ™




### P2-37 Moderated Poster

### Analysis of Aortic Stenosis using Artificial Intelligence

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**Introduction:** Echocardiographic (echo) evaluation of aortic stenosis (AS) requires measurements from multiple acoustic windows. Left ventricular outflow tract (LVOT) measurements are prone to error and variability, and are compounded in the aortic valve area (AVA) calculation which relies on multiplying and squaring the LVOT dimension. We evaluated whether artificial intelligence (AI) could impute the AVA from other echocardiographic data, without the need for any LVOT measurements but maintaining reproducibility. **Method:** We hypothesised that an AI model would use the phenotypic response of the heart to AS to generate a model to predict the AVA. Using data from the National Echo Database Australia (NEDA), we extracted 530,884 echocardiograms from 358,661 participants, with over 18,255,238 individual data points. Using a random 70% subset of the data we produced an AI model using multidimensional clusters, taught using the continuity equation and the known cardiac response to AS. Because of the real-world nature of the data, missing data was imputed using a multiple imputation model to build a complete data set. **Results:** Using duplicate data and withholding single parameters across the data set, the trained model imputed the missing data and showed minimal imputation error. The trained model was then tested against the remaining 30% of the data not previously seen by the AI, and again showed minimal imputation error. We then completely removed all LVOT measurements (velocity, gradient and diameter) and the AVA from the test set (n=24,748 studies), and asked the AI to predict the LVOT and AVA measurements. Severe AS was defined as AVA<1cm$^2$. The predicted AVA was then compared with the calculated AVA. The area under the receiver-operating characteristic curve (AUCROC) was 0.95, and area under the precision recall curve (AUCPR) was 0.73. Severe AS was present in 1834 studies (7.4%). The model performed equally well in impaired ejection fraction (EF<50%, 1391 studies, 10% with severe AS: AUCROC=0.96, AUCPR=0.78; EF<35%, 426 studies, 10% with severe AS: AUCROC=0.94, AUCPR=0.76). **Conclusion:** We have developed an AI system that completely removes the need for LVOT measurements in evaluation of AS. Our model performs equally in normal and impaired left ventricular (LV) systolic function, including severe LV dysfunction. Benefits of "smart" echo may include improved efficiency, and reduced study duration, cost and risk of sonographer injury.

### P2-38

### Acoustically Active Needle and Cannula for Navigation by Conventional Color Doppler Ultrasound Imaging

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**Background:** Fundamental limitations of B-mode ultrasound may compromise its ability to guide minimally invasive procedures. In particular, navigation of needles for percutaneous vascular entry or placement of a cannula for extracorporeal membrane oxygenation can represent a challenge. Our novel approach makes the needle or cannula tip acoustically active and, thus, identifiable by an instantaneous color marker in Doppler scans. The aim was to test acoustical navigation by color Doppler imaging in vivo. **Methods:** We installed 2-mm piezoelectric crystals at tips of a 16-gauge needle and a 5-mm in diameter cannula (Figure, A and B). Each of the crystals is driven by an external waveform generator. The vibrating crystal stimulates acoustical interactions with the transmitted ultrasound beam and generates a color Doppler marker (Figure, C and D). Tests were conducted in approximately 80-kg anesthetized closed- and open-chest adult pigs. The needle was navigated to the femoral artery. The cannula was inserted via the carotid artery and navigated to the ascending aorta. A linear array transducer was used for needle navigation and set in B-mode to 8 MHz and in color Doppler to 3.5 MHz. A phased array transducer was used for navigation of the cannula and set in B-mode to 1.7/3.4 MHz and in color Doppler to 2.0 MHz. **Results:** The needle was barely visible by B-mode imaging during insertion into the femoral artery, but its tip was clearly identified and tracked by the color Doppler marker (Figure C). The marker guided puncture of the artery. Note that blood flow patterns by color Doppler were fully preserved during acoustical navigation. The acoustic cannula tip was guided by its color Doppler marker to the ascending aorta (Figure D). In a short-axis view (Figure D, insert), the marker unambiguously localized the cannula tip within the aortic lumen. The Doppler gain was set to -20 dB in this open-chest scan. Such gain setting desirably eliminated depiction of blood flow patterns in the aorta. **Conclusion:** Our experimental tests demonstrate that color Doppler ultrasound can be used for a new purpose, ie, guidance of an interventional instrument, such as a needle or cannula. Acoustically active adaptation of their tips enabled unambiguous identification and instantaneous navigation with a conventional color Doppler echocardiography system.