Cardiac hypertrophy (CH), a prominent feature that predisposes the heart to failure, is associated with the activation of multiple molecular and cellular changes in the circulation and heart. The Na+/H+ exchanger isoform 1 (NHE1) has been implicated in the development and progression of CH. To better understand the involvement of NHE1, transgenic mice that express cardiac specific active NHE1 expression were studied. N-line mice expressed wild-type NHE1, and K-line mice expressed activated NHE1. NHE activity of adult ventricular cardiomyocytes and protein expression were elevated by approximately 2 and 3-fold in the N- and K-line mice vs. control. The K-line mice assessed by echocardiography demonstrated significant global cardiac dysfunction. Left ventricular fractional cell shortening and ejection fraction were significantly decreased in the K-line mice (23.1 ± 3.8% and 45.2 ± 6.9% K-line vs. 36.5 ± 1.1% and 66.4 ± 1.5% control, respectively; p<0.05). The K-line mice also exhibit myocardial remodeling. The heart weight to body weight ratio was significantly greater in the K-line mice (143 ± 10.0% of control; P<0.05). Cross sectional area (K-line 195.6 ± 16.4% of control; p<0.05) and interstitial fibrosis (K-line: 275.4 ± 11.6% of control; p<0.05) were also elevated. Genechip analysis also revealed that expression of active NHE1 upregulated osteopontin (OPN) gene expression (>1,500 fold change) and its signaling pathways. OPN is a matricellular protein and a cytokine induced upon tissue injury and remodeling of various organs, including human heart failure (HF). Our study shows that expression of activated NHE1 induces CH and elicits specific molecular changes that lead to CH.

Urinary bladder cancer is one of the most common cancers worldwide and has a high recurrence rate. It has the highest lifetime cost of care per patient due to long follow-up cystoscopic surveillance after surgery to detect the high risk of recurrence.

This research develops a portable custom cystoscopic procedure to improve the efficiency and accuracy of the bladder cancer surveillance. The system uses a segmented bending mechanism that is inserted into the bladder via the urethra to steer a flexible imaging probe to provide a comprehensive diagnostic tool for review by an urologist as illustrated in Fig. 1. The position and orientation of the camera locating at the tip of the probe can be automatically controlled remotely to scan the entire bladder surface.

The structure of the bending segment is shown in Fig. 2. The segment bending is tendon driven. Four distributed small wires are connected to the segment body via guiding rings. The wires to control the distal segments are also guided through the mechanism via the rings of proximal segments. The bending angle and bending direction of a segment can be controlled by pulling and releasing its four wires accordingly. The design of the mechanism and the forward/inverse kinematics simulation were finished. A mockup model is under construction to verify the proposed design.

Images abstracted from the video are used to reconstruct a 3D panorama of the whole bladder surface. Our 3D and image mosaicking software is under developed by our collaborator at University of Washington, USA.