Functional differentiation of mitral valve chordae tendineae

Impact of ring annuloplasty

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ABSTRACT

The studies for the present PhD dissertation were carried out at Institute of Experimental Clinical Research, Aarhus University and Department of Cardiothoracic and Vascular Surgery, Skejby Sygehus, Aarhus University Hospital.

Surgical techniques in mitral valve repair are applied without sufficient knowledge of the function of different types of chordae tendineae (CT). Free leading leaflet edge CT, primary, are assumed responsible for apposition of the leaflet edges while belly leaflet CT, secondary, are assumed to relieve leaflet stress and transmit force between the left ventricle and the mitral valve. Mitral ring annuloplasty (MRA) is known to reduce the effective occlusion area of the leaflets which is assumed to imply a relief of chordal tension.

Aims: 1. To measure leaflet area and record CT distribution in mitral valves from Danish Landrace Pigs plus compare data to available data on human mitral valves. 2. To analyze the temporal relation between CT tension and left ventricular pressure (LVP) in the beating porcine heart. 3. To compare tension in secondary and primary CT plus record anterior mitral leaflet occlusion area in beating porcine heart before and after MRA.

Methods and materials: Hearts from freshly slaughtered Danish Landrace pigs were used in study 1. In the remaining investigations an in vivo porcine model was used. This allowed simultaneous recording of chordal tension and LVP. Manipulation of pre- and afterload was possible, plus infusion of inotropic and chronotopic active drugs.

Results: Achieved data in study one exhibited great similarities with human data. Study two showed that important differences between primary and secondary chordal tension tracings exist and that tracings of chordal tension and LVP failed to be in complete synchrony. In study three, tension in primary CT was found to be 0.2 N and in secondary CT it was 0.7 N. Study four showed that MRA reduces tension in secondary but not in primary CT.

Conclusion: Porcine mitral valve anatomy is similar to human anatomy. Chordal tension is controlled primarily by LVP, but other factors contribute. A tendency towards an early tightening of primary chordae was found, substantiating primary CT as free edge controlling CT and secondary CT as load relievers. This was supported by the fact that secondary chordae were found to carry about thrice as much load as the primary chordae. Finally, the load in secondary CT was reduced by MRA, probably because of reduction in the occlusion leaflet area.

Future perspectives: Comparisons of microstructure in human and porcine valve tissue would be desirable as well mapping age dependent changes. Studies of chordal tension could be supplemented with simultaneous recording of valve morphology by means of integrated online echocardiography or use of radio opaque markers and fluoroscopy.