

## Chapter 7

# SUMMARY & CONCLUSION



Anatomy of the heart was described in context of tricuspid valve, bicuspid valve, aortic valve and pulmonary valve by using 100 specimens of the heart. Variables of all valves in number of cusp, shape, number of papillary muscles attached, number of cleft present, number of scallops presents on each cusp were observed.

- **Tricuspid Valve:** Out of total specimen, 11% had abnormal tricuspid valve among which an additional cusp (four cuspidal) in 8 specimens and missing cusp (Bicuspidia) in 2 specimens and in one specimen single cusp was found which was extending along the entire peripheral margin of annulus. All cusps i.e. Anteriorsuperior cusp, Septal cusp, inferior cusp were of triangular shape in majority followed by rectangular and D shaped respectively. Additional cusp was found triangular shape in majority and D shaped. Additional cusp was observed in only 8 specimens with maximum frequency (n=7) for triangular shape. Most commonly 1-2 papillary muscles were attached to the cusps followed by 3-4 papillary muscles. Additional cusp was attached to maximum 2 papillary muscle not more than it. Clefts were observed in all cusps. Inferior cusp showed maximum clefts. Scallops was observed on all cusps. The mean length of antero-superior, septal, inferior cusp and additional was  $27.61 \pm 6.84$  mm,  $27.40 \pm 4.84$  mm,  $21.73 \pm 4.63$  mm,  $12.43 \pm 4.68$  mm respectively. The mean width of anterosuperior, septal, inferior and additional cusp was  $17.29 \pm 3.09$  mm,  $13.02 \pm 3.03$  mm,  $15.58 \pm 3.69$  mm,  $12.68 \pm 6.79$  mm. The annular circumference of tricuspid valve was measured as  $91.12 \pm 18.65$  mm.
- **Bicuspid Valve:** 04% specimen had abnormal valve having additional cusp in it. Both Anteromedial & Posterolateral cusps showed most commonly triangular shape followed D shaped and rectangular shape. Additional cusp was observed in 4% specimens showed triangular shape in all specimens. Papillary muscle were found to be attached with anteromedial, posterolateral and additional cusp which were anterior papillary muscle and posterior papillary muscle. Most commonly 1-2 papillary muscles were attached to the cusps followed by 3-4 papillary muscles. Additional cusp was attached to maximum 3 papillary muscle not more than it. Clefts were observed in all cusps. It was observed that maximum number of clefts

were present in posterolateral cusp. Scallops were observed on all cusps. In present study mean length of anteriomedial, posterolateral and additional cusp was 26.76 mm, 28.65 mm and 17.85 mm respectively. The mean length of posterolateral cusp was measured  $28.65 \pm 4.16$  mm followed by anteromedial cusp  $26.76 \pm 4.16$  mm and that of the additional cusp was  $17.85 \pm 4.48$ . The mean width of anteromedial, posterolateral and additional cusp was  $18.44 \pm 3.04$  mm,  $11.51 \pm 2.52$  mm,  $10.59 \pm 2.95$  mm respectively. The annular circumference of bicuspid valve was measured as  $84.11 \pm 14.25$  mm with values ranging from 65.23 to 130.41 mm.

- **Aortic Valve:** Aortic valve were observed in all the specimen. All aortic valves were normal having three cusps. Cusps were identified as right coronary cusp, left coronary cusp and non-coronary cusp. In the right coronary cusp 7 specimens were found with the position of the ostium Above Annulus (Tubular), whereas it was found below Annulus (Sinus) in 92 specimens. The position of ostium was at level of annulus (Sinotubular) in 1 specimen in the right coronary cusp. There were 11 specimens with the position of ostium above annulus (Tubular) and 89 specimens below Annulus ( Sinus ) in the left coronary cusp. Majority of the specimens (92%) had ostium positioned below the annulus in the right coronary cusp. Majority of the specimen (89%) had ostium positioned below the annulus in left coronary cusp. In present study mean length of right coronary, left coronary, non-coronary cusp was  $30.44 \pm 1.37$  mm, 30.73 mm and 30.22 mm respectively. The mean width of right coronary, left coronary, non-coronary was  $4.33 \pm 0.72$  mm,  $4.89 \pm 0.92$  mm,  $4.80 \pm 1.43$  mm respectively. The mean annular circumference of aortic valve was  $75.13 \pm 1.82$  mm. The mean distance of right coronary ostium from right and left side commissure of cusp was measured as  $11.29 \pm 1.21$  mm and  $11.97 \pm 1.93$  mm respectively. While the distance between right and left side of the left coronary cusp was measured as  $11.25 \pm 1.75$  mm and  $10.09 \pm 1.25$  mm respectively.
- **Pulmonary Valve:** Pulmonary valve were normal in all specimens having three cusps; right anterior, left anterior and posterior. The average value of length for right anterior cusp was  $22.56 \pm 4.08$  mm, left anterior cusp was  $23.27 \pm 4.49$  mm and that of posterior cusp was  $24.11 \pm 4.39$ mm. The average value of width for right anterior cusp was  $4.69 \pm 1.08$  mm, left anterior cusp was  $4.64 \pm 1.42$  mm and that of posterior cusp was  $4.71 \pm 1.03$  mm. The average annular

circumference of pulmonary valve was calculated as  $65.06 \pm 6.85$  mm with values ranging from 49.28 to 78.71 mm.

- **Papillary Muscle:** In the right ventricle, 132 anterior papillary muscle (APM), 154 posterior papillary muscle (PPM) and 69 septal papillary muscle (SPM) were present. While in left ventricle 116 anterior papillary muscle (APM) and 178 posterior papillary muscle (PPM) were observed. The mean length of APM was  $13.03 \pm 2.44$  mm and  $16.38 \pm 2.55$  mm on right and left side respectively. The mean length of PPM was  $10.09 \pm 2.89$  mm and  $21.01 \pm 2.20$  mm on right and left side respectively. The mean length of SPM was  $6.06 \pm 1.07$  mm and on right side. Shape of the tip of papillary muscle were identified as conical (69.85% and 50.50%), flat (16.90% and 16.2%), bifid (8.73% and 27.79%) or trifid (4.5% and 5.08%) on right and left side respectively. The shape of the septal papillary muscle, which was found only in the right ventricles, was found to be conical in 66 (94.65 %) and bifid in 03 (4.34%) of specimens. The shape of anterior papillary muscle in the right ventricle observed conical 53.78% and flat 28.03% were more than shape in left ventricle anterior papillary muscle. While anterior papillary muscle in left side were found bifid in 37.06% specimen and trifid 11.20% in specimen, which was higher than right sided papillary muscle. The shape of posterior papillary muscle in the right ventricle observed conical 72.07% was more than shape in left ventricle posterior papillary muscle. While posterior papillary muscle in left side were found flat in 16.26% specimens, bifid in 21.91% specimens, which was higher than right sided papillary muscle. The pattern of septal papillary muscles, present only in right ventricles, was in majority seen to be of classical variety in 37% followed by 2 group in 7% and 6 group in 3%.
- **Coronary Sinus And Thebesian Valve:** Thebesian valve was seen in 76% of the specimens. The mean cranio-caudal length with a Thebesian valve is  $6.84 \pm 2.85$  mm and without thebesian valve was  $8.23 \pm 2.69$  mm. The mean transverse length with a Thebesian valve was  $6.66 \pm 2.69$  mm. The mean length with thebesian valve was  $8.08 \pm 2.85$  mm. According to extent of attachment over the coronary sinus ostium the thebesian valve was typed as obstructive (22.36%) or non-obstructive (77.63%). Majority of the specimens (82.89%) had semilunar shape of the thebesian valve followed by fenestrated (9.20%), bi-concave-Band like (5.26%) and other shape (2.63%). 71.05 % specimens had membranous composition of the thebesian valve followed by fibromuscular in 17.10 % and fibrous in 11.84%.

- Eustachian Valve: 67% of the specimens showed presence of Eustachian valve with ridge like appearance in majority of the specimens (58.20%) followed by membranous appearance in 41.79% specimens. Majority of the specimens (82.61%) were not associated with chiari network.
- Chiari Network: Chiari network was present only in 14% of specimens which were in the form of reticular network of fine strand. All the cases were having primary attachment on valve of Inferior Vena Cava, then fine reticular chiari network was either extend up to coronary sinus in 8 specimen or towards atrium-wall or cavity 6 specimen. Out of 14 four specimens also showed presence of left venous valve remnant.
- Left Venous Valve Remnant: Left venous valve remnant with fibrous multiple strand and trabecular membranous were found in 5 specimens each while fibrous single strand type was observed only in 1 specimen. 36.36 % (04) specimen were showed presence of both left venous valve remnant and chiari network.
- Disorders involving the valves of the heart disturb the pumping efficiency of the heart. Valvular heart disease produces either stenosis (narrowing) or insufficiency. Valvular stenosis is the failure of a valve to open fully, slowing blood flow from a chamber. Valvular insufficiency, or regurgitation, on the other hand, is failure of the valve to close completely, usually owing to nodule formation on (or scarring and contraction of) the cusps so that the edges do not meet or align.
- An increased number and size of the papillary muscles, as well as their malformation, may cause left ventricular outflow tract obstruction and mitral regurgitation.
- The papillary muscles has complex and variable anatomy. Knowledge of this variation to the cardiac surgeons during reparative surgical procedures conducted for mitral/ tricuspid valve replacement is of utmost importance to prevent untoward event.
- The Thebesian Valve is an embryological remnant of the sinoatrial valve, guarding the coronary sinus ostium. Advanced invasive and interventional cardiac diagnostic and therapeutic tools include the coronary sinus ostium cannula. Obstructive Thebesian valves have been reported to lead to failed coronary sinus cannulation.
- The presence and shape of the Thebesian valve were studied in many previous study. Clinical data point to about 3.0% risk of failures in the CSO cannulation due to inability to locate the CSO, probably because of the prominent Thebesian

valve (Azizi et al., 2006; Gras et al., 1998). Complications accompanying CSO catheterization such as coronary venous dissection and perforation of the CS or cardiac veins occur respectively in 2.88% and 1.2% of cases.

- With the rapid acceleration in cardiac care, the coronary sinus has increased in importance from a procedural standpoint. Interventions such as catheter ablation of arrhythmias, cardiac resynchronization therapy, retrograde cardioplegia delivery, arrhythmia mapping, and percutaneous mitral annuloplasty all require access through the coronary sinus.
- The coronary sinus' diameter is of importance when considering mitral isthmus ablation. The isthmus is classically used as part of the treatment strategy in non-paroxysmal atrial fibrillation. It is traditionally accepted knowledge that the mitral isthmus block is difficult, and requires significantly longer radiofrequency ablation times, higher energy ablation and epicardial ablation from within the coronary sinus.
- Studying the anatomy and variations in the coronary sinus venous system is important for patient safety and to maximize therapeutic procedures. With so much variability in the coronary sinus venous system within the general population and with the advent of interventional cardiology, the importance has never been more important to have an intimate understanding of the cardiac veins. The venous system that drains the myocardium still has many unknowns, and a better understanding of the myocardial venous system will surely propagate our treatments of myocardial diseases.
- The fibrous strands of left venous valve remnants may become sites for thrombus formation. Also the fibres of the remnants are sometimes torn during life, these may break free and the further the emboli may reach the lung.
- The Eustachian and Thebesian valve persist as an unduly prominent membrane, it could obstruct tricuspid orifice and divert the inferior vena cava, coronary sinus or even the superior vena cava blood into the left atrium and thus retain its designed role during fetal circulation.
- In Eustachian valve associated with patent foramen ovale great attention should be paid while operating ASD as a large Eustachian valve can be mistaken for the lower margin of ASD.
- Chiari network should be considered in the differential diagnosis of right atrial mass in adults.

