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Dissection of the Right Trigone of the Heart

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Abstract

Dissection of "Right trigone of the heart". The fibrous skeleton of the heart and right trigone is those tissues at the base of the heart which consists of dense collagen fibers which remain stationary with respect to functionally moving parts of the heart namely myocardium, valve leaflets and elastically distensible arteries arising from the heart. So far no clear guidelines are available for dissecting the fibrous skeleton of the heart and right trigone of the heart. The present study evolves the steps in dissecting the fibrous skeleton and right trigone of the cadaveric hearts. Its morphological features such as position, shape and extent are noted. Aim of the study is to dissect the right trigone of the heart and explain its dissection steps and morphology. Right trigone of the heart is situated at the base of the heart where four functional apertures of the ventricles are crowded together, which appears as figure of 8. In the central portion of the figure 8 right trigone of the heart is situated. The atrioventricular conducting bundle is only physiological connection between the atria and ventricle across the fibrous ring. The right and left trigone were dissected and observed. It feels cartilaginous and also called as key stone of the heart. It is triangular in shape and shoes extensions membranous septum, tendon of todaro, anterior fila coronaria of the right atrioventricular annulus. When it is viewed from superior aspect it looks like as head of the cow. Right trigone of the heart & its three dimensional views are helpful for both undergraduate and post graduate students of anatomy and cardiology. It would also help cardio-thoracic surgeons in Annuloplasty operations.

Keywords: Right Trigone of the Heart; Key Stone; Left Trigone; Conus Ligament; Annuli.

Introduction

Operative surgery concerns itself with the production of therapeutically desirable change in the anatomy of the body. The introduction of surgery to any special region of body places it's anatomy in a new perspective. In order to avoid injury to essential structures, surgeons need recognizable landmarks, which will indicate their presence or proximity.

Any student studying the anatomy of the heart is cognizant of the difficulty in describing this organ in terms, which are meaningful and readily understood. Since the two dimensional picture is most readily available teaching aid, the description of the heart, usually found in the standard anatomical texts, concentrate heavily on the inner and outer chambers.

In addition the heart is in state of incessant motion which cannot even temporarily be ignored or dissociated with its functional anatomy. Such framework is analogous to the skeleton as it is related to soft tissue of the body. At the base of the heart there does exist, in fact, such a structure which has been named by early French anatomist as "Fibrous skeleton of the heart" [1].

Right trigone of the heart is a high density single structure of connective tissue that forms and anchors the valves and influences the forces exerted through them.

The fibrous skeleton of the heart is best defined as those tissue at the base of the heart which consist of dense collagen fibers which remain stationary with respect to functionally moving parts of the heart namely myocardium, valve leaflets and elastically distensible arteries issuing from the heart. There have

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been no clear guidelines given so far regarding how to dissect out the right trigone of the heart.

The present paper evolves the steps for dissecting the right trigone of the cadaveric heart during routine dissection based on my personal experience. Such frame work is analogous to the body skeleton as it is related to the soft tissue of the body.

Aim

Aim of the study is to dissect the right trigone of the heart, explain its dissection steps and its morphology

Instruments used

Scalpel, forceps, knife, dissection microscope, cotton, water and gauze piece, Chemicals used Formalin and Glycerin.

Material and Method

So far no clear guidelines are available for dissecting the right trigone of the heart. The present study evolves the steps in dissecting the right trigone of the adult cadaveric hearts.

Its morphological features such as position, shape and extent are noted. Before dissection, it is useful to appreciate the anatomy of the fibrous skeleton of the heart.

a. Inter valvular fibrosa -Right trigone, Left trigone and Conus ligament
b. Four valvular annuli - Tricuspid, Mitral, Pulmonary and Aortic.
c. Extensions- Tendon of Todaro and Membranous septum Sub-aortic curtain, which is nothing but the continuation of anterior leaflet of the bicuspid valve attached to the aortic annuli in between the non-coronary and left coronary annuli.

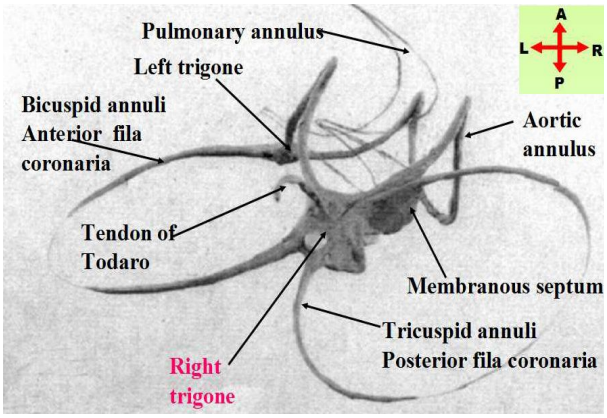

Fig. 1: Right trigone and fibrous skeleton of the heart from journal of thoracic and cardiovascular surgery by Zacob Zimmerman and Charls Bailey

Dissection Steps

A. Removal of heart
B. Dissection of heart from superior aspects
C. Dissection of heart from inferior aspects.

Removal of Heart

Remove the heart from the pericardial cavity by placing the finger in the transverse sinus and cutting through the aorta and pulmonary trunk as they leave the heart, inside of the pericardium. Sever the superior and the inferior vane cave as they enter the right atrium. Identify the four pulmonary veins on the posterior surface of the heart and, working from the oblique sinus, cut each.

Review the cut edges of the pericardial reflection both on the heart and on the posterior wall of the pericardial cavity. Carefully examine the removed heart, using borders, surfaces, sulci, and great vessels for proper orientation. Heart is removed without cutting the root of aorta, pulmonary trunk, bicuspid and tricuspid annulus. To increase the hardness it is

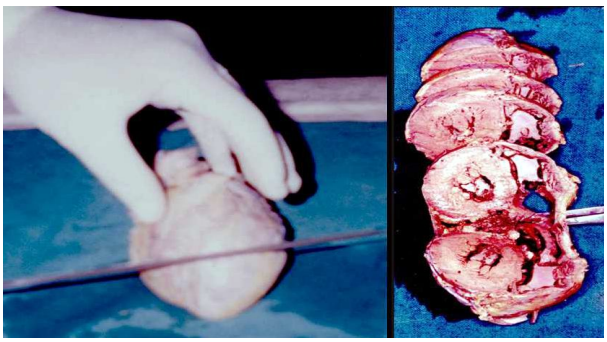

Fig. 2: Step- I Dissection of heart: inferior aspect

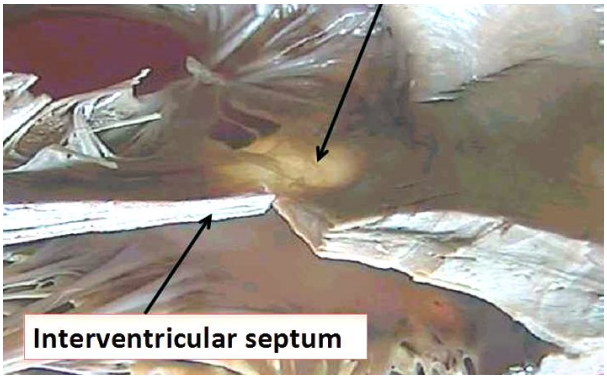

Fig. 3: Step-III Dissection of heart from inferior aspect Membranous septum of the heart

kept in the formalin for 2 to 3 weeks.

Dissection of Heart from Inferior Aspect

Step I

Put the heart in anatomical position with left hand and cut with the knife by right hand up to the annulus from inferior aspect.The section of two ventricles with the inter-ventricular septum is seen (Figure 2).

Step II

Interventricular septum is cut and with piece meal dissection. Heart is clean with the tap water and the clots are removed the glycerin is added to increase the shining.

Step III

Membranous septum of the heart is dissected which is inferiorly semilunar in shape (Figure 3).

The annulus gives attachment to the ventricular as well as atrial muscles these muscles are dissected by piecemeal until you get the white fibrous annuli [2].

The fixed part of the leaflets is also cut towards the fibrous ring by scalpel by keeping intact anterior leaflet of the bicuspid valve. Interventricular septum continues with the membranous septum which is the extension of the right trigone and anteriorly it extend up to the aortic annulus so you have to cut the muscular part of the interventricular septum with the scalpel. Dissection of bicuspid and tricuspid annulus both are connected with each other by aortic annulus, right and left trigone (Figure 3).

Dissection of Heart from Superior Aspect

All these annuli are attached to each other at clinical base of the heart Conus ligament is connection between the aortic annuli and pulmonary annuli.

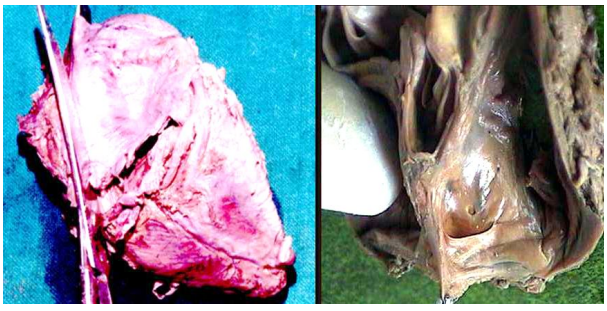

Fig. 4: Step- I Dissection of heart: Superior aspect Interior of the right atrium with triangle of Koch's

Step I

Right Atrium is cut by passing the seizer in between the superior and inferior vena cava the tricuspid annuli is seen along with the tendon of todaro and right fibrous trigone (Figure 4).

Cut the tendon of todaro, which is 1mm in diameter with the scalpel. Cut the atrial muscles and its wall by scalpel and with the forceps with the forceps do piecemeal dissection of tricuspid annuli (Figure 4).

Step II

Left Atrium is cut by passing the seizer in between the pulmonary veins now you can see the bicuspid annuli and right fibrous trigone (Figure 5). Cut the left atrial muscles by scalpel and do piecemeal dissection up to the bicuspid annuli. Now you can see the right and left trigone at the root of aorta.

Step III

Aortic Annuli is dissected with the scalpel the arterial part of the aorta is cut and simultaneously the aortic leaflet up to the annulus. The aortic annulus

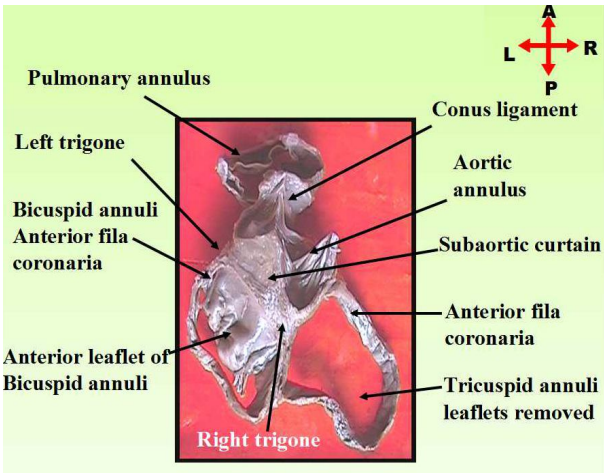

Fig. 5: Fibrous skeleton of the heart (Dissected)

looks like as three scalloped lines. The subaortic curtain is kept intact because it is continuous with the anterior leaflet of the bicuspid leaflets. The tendon of todaro is the extension of the right fibrous trigone in right atrium which is sub-endocardial 1 to 2 mm. in diameter is also dissected by forceps and scalpel (Figure 4).

Step IV

The right trigone of the heart is dissected from superior, inferior, right and left aspect by piece-meal dissection. It shows convex slope from superior aspect

so the trigone is clearly seen (Figure 6).

Superiorly all the musculature and the fine connective tissue is dissected with small scalpel up to the thin fibrous tissue which fells cartilaginous i.e. Right trigone of the heart

Right side trigone is related to the tricuspid valve and gives attachment to the septal leaflet of the tricuspid valve which is also dissected up to fibrous tissue and continues as membranous septum.

Left side trigone is related to the bicuspid valve and gives attachment to the small part of posterior and anterior leaflet of the bicuspid valve which is also dissected up to fibrous tissue

Posteriorly it is narrower and pointed shows posterior fila coronaria of the bicuspid valve on the left side which gives attachment to posterior leaflet of the bicuspid valve and on the right side posterior fila coronaria of the tricuspid valve gives attachment to the posterior leaflet of the tricuspid valve. The posterior leaflets on both the sides dissected with the scalpel.

From the left side tendon todaro arises and apex is narrower. The peripheral parts of the atrioventricular valve were cut along with pulmonary annuli and aortic annuli (Figure 6).

The membranous septum and tendon of todaro is kept intact. Two trigones provide anchorage for the structures which partitions the single left ventricular opening into inflow & outflow areas. Two atria & two ventricles attach to a pair of conjoin fibrous ring which is in the form of figure 8 lies in sagittal plane (Figure 7)[3].

Observation

The right trigone is situated at the base of the heart where four functional apertures of the ventricles are

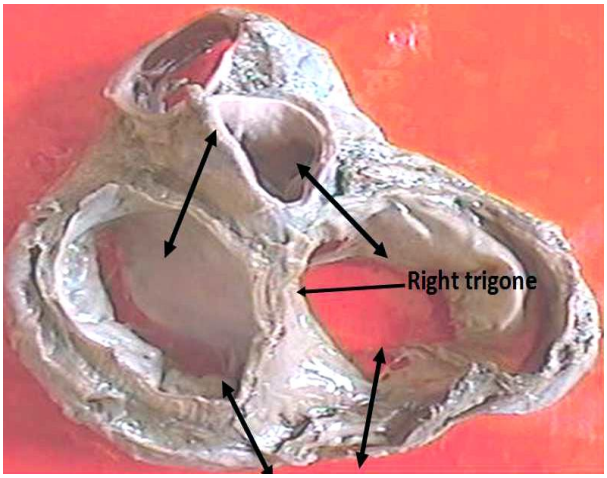

Fig. 6: Step- IV Right trigone of the heart dissected

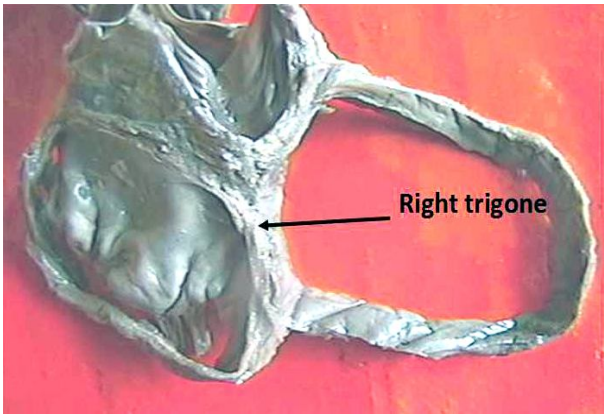

Fig. 7: Right trigone of the heart dissected figure of 8

crowded together. The atrioventricular annulus moves forward and to left during systole and retraces the move during diastole. In fetal life the atrioventricular annuli are in the same plane but in adult they are oblique i.e. at 45^0 and are connected with each other by right and left trigone [4].

Extending from the right fibrous trigone the component of central fibrous body are a pair of curved, tapered, sub-endocardial tendons or 'prongs' (fila coronaria) which partly encircles the circumference: the latter is completed by more tendinous, deformable fibroblastic areolar tissue [5]. The tissue within the atrioventricular junction around the tricuspid orifice is less robust than the similar element found at the attachment of the mitral valve.

In the tricuspid valve, the topographical 'attachment' of the free valvular leaflet does not wholly correspond to internal level of attachment of the fibrous core of the valve to the junctional atrioventricular connection tissue. It is line of attachment of the leaflet which it is best appreciated in the heart when examined grossly. The extent of fibrous tissue is varies age and sex [6].

The Right Fibrous Trigone (Figure 8 & 9)

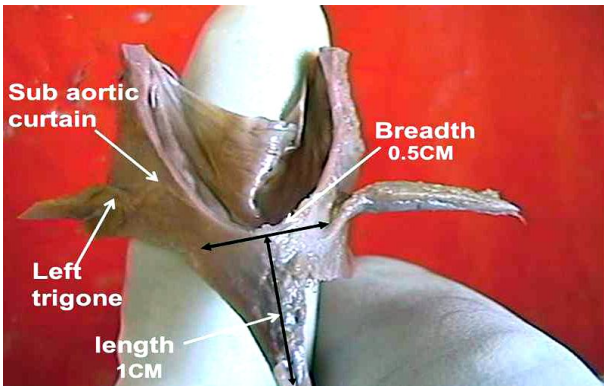

Fig. 8: Right fibrous trigone (Dissected)

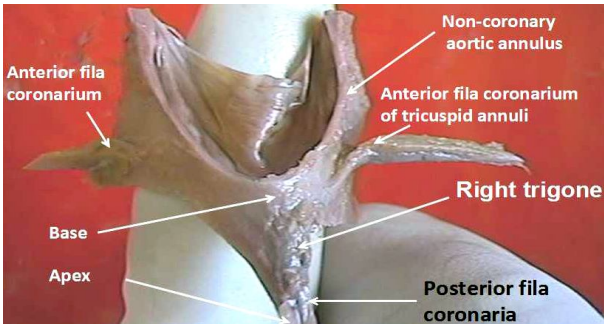

Fig. 9: Right fibrous trigone (Dissected)

(Trigonum fibrosum dextrum, Central body of the heart, Keystone of the heart)

Shape

It is triangular in shape.

Situation

It is situated at the center of the heart, fused together with mitral, tricuspid and aortic valves.

Apex

It is directed backwards and downwards and slightly towards right side it continues as posterior fila coronaria of the right and left atrioventricular valves.

Base

It is directed upwards at the root of the aortic annulus and left arising from base of right posterior aortic annulus, it is half centimeter

Measurements

Anterio-posteriorly 10 mm on length and breadth at base is 5mm. (viewed from above)

Palpation

It feels cartilaginous.

Slopes

Superiorly convex and inferiorly concave.

Extensions

Membranous septum, tendon of todaro fibrous tissue to the left trigone of attach to subaortic curtain and fila coronaria.)

Anchored to

Free edge of interventricular muscular septum between right ventricle inflow opening and common left ventricular aperture. Two trigone provide anchorage for the structures which partitions the single left ventricular opening into inflow and outflow areas.

Development

Derived from ingrowth of the dorsal mesocardium and atrioventricular sulcus.

Histology

Show dense bundle of collagen fibers, elastic fibers and fibroblast. The right trigone looks like as head of the cow (Figure 10 & 11) [1].

Two horns represents ascending limb of non-coronary aortic annulus arising from the base directed upward and laterally.

Fig. 10: Right fibrous trigone (Dissected) look like head of a cow

Fig. 11: Right fibrous trigone (Superior aspect) (Inferior aspect)

Two ears represents the anterior fila coronaria of the right atrioventricular annuli and on the left side it extend as a fibrous tissue to left trigone of the heart.

Upper and lower jaw represents posterior fila coronaria of right and left atrioventricular annuli extending from the apex of the right trigone

Tendon of Todaro (Figure 12 &13)

It is a small ribbon of connective tissue deeply located not connected to the endocardium. It is an

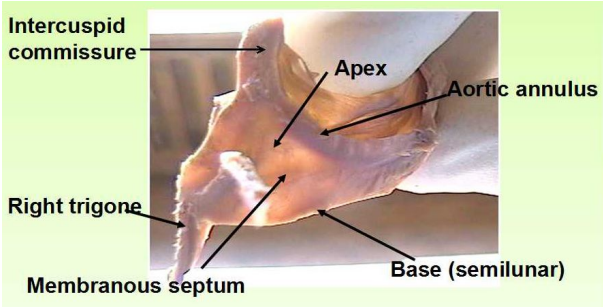

Fig. 12: Right trigone with Membranous septum (Dissected)

extension of the right trigone of the heart (Figure 13).

Situation: It is situated between the triangle of Koch and fossa ovalis in the right atrium. Contents: It contains collagen Fibres (white glossy)

Shape: It is rounded it may be hook like or straight tendon

Length: 4mm.

Diameter: 1mm.

Staining: Missions method

Importance- It forms superior boundary of triangle of Koch's.

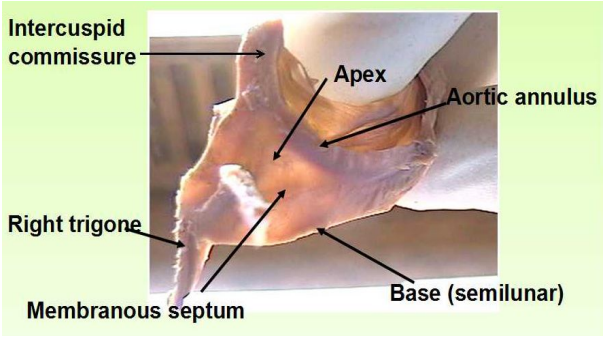

Fig. 13: Right trigone with tendon of todaro

Surgical Application

In general the fibrous skeleton of the heart is capable of holding the sutures securely under the persistent tension. Suturing and patching up the perforation of the septum restores the heart complete integrity [7].

It is an important landmark for surgical orientation in case of the high ventricular septal defect in the most commonly encountered type these defect occupies the subaortic span between non coronary and right coronary cusp attachment.

Right trigone is the key stone of the skeleton, the rigid fixation to tricuspid, mitral valve and aortic wall to each other and ventricular septum is disrupted [8].

In mitral stenosis reorganization of the two dimples of the right trigone provide proper orientation for refashioning the distorted valves it may lead to aortic regurgitation. It is also an important landmark for surgical orientation.

Surgery for infective endocarditis with para-ventricular abscess and the fibrous body destruction have a highest mortality and morbidity in high surgical risk [2].

Membranous septum is the integral part of the fibrous skeleton it links together three of four chambers and three of the four valves. When it is defective and this by most congenital malformation consequences are not only depend on only the size of the defect but also upon whether it is an isolated lesion or part of complex combination of malformation such as are found in the endocardial cushion defect, tetralogy of Fallot and many varieties of transposition [9].

Fila coronaria can be used for the reduction of the size of atrioventricular passage to produce the competent valve mechanism. Shortening these tendons of myocardium tend to draw the rim of the ventricle with the attached mural portion of the valve closer to the septal component which is attached to the quasi stationary root of aorta [10].

Conclusion and Results

The dissected specimen of the right trigone and Fibrous skeleton of the heart & its three dimensional views are helpful for both undergraduate and post graduate students of anatomy and cardiology. It would also help cardio-thoracic surgeons in Annuloplasty operations.

References

1. Zimmerman J, Bailey CP. The surgical significance of the fibrous skeleton of the heart. Journal of thoracic and Cardiovascular surgery. 1962 Dec ; 44 (6): P 701–712.
2. RH. Anderson, Slide Atlas of Cardiac Anatomy 5: The Cardiac Skeleton and Musculature - The Fibrous Skeleton of the Heart, The Orientation of Fibres within the Ventricular Mass Gower Medical Publishing inc.Edinburgh London New York: 1980
3. Chummy S, Sinnatabamby, Last anatomy regional and applied.11th.United Kingdom: Churchill Livingstone, Elsevier; 2006.
4. AK. Datta. Essentials of human anatomy:skeleton of the heart.9th Edition.Calcutta: Current book international; 2014.
5. Standring S, Borley NR. Grays anatomy the anatomical basis of clinical practice .40th.United Kingdom: Churchill Livingstone, Elsevier; 2008.
6. Walmsley R and Watson H. Clinical anatomy of the heart. British Journal of Surgery. 1978 June; 66(6): 448,
7. L.Holadan, J. Langon manual of dissection of human body 4th page 155 J&A churchil 1879
8. KL Moore. AF Dalley, Clinically oriented anatomy.6th Edition. Philadelphia; Lippin cott Williams & Wilkins: 2009
9. FH. Netter, Atlas of human anatomy. 4th

Edition.Philadelphia: Elsevier: 2006.

10. Zimmerman J.The functional and surgical anatomy of the heart. Annals of the royal college of surgeons of England. 1966 Dec; 39(6): 348–366.