CHAPTER VI

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1. The hearts of parrot, owl, shrew, mongoose and hedgehog were studied in order to ascertain their anatomy particularly the nature of the sinuatrial and atrioventricular connections.

2. Relevant researches on the form, nature and functions of the sinuatrial and the atrioventricular conducting structures have been reviewed. The history of conducting structures of the heart of birds and mammals and other vertebrates has also been described.

3. Controversial aspects of the conduction in the hearts of birds and mammals have been highlighted. Lacunae in the present state of information and other inconsistencies in the literature have been recorded.

4. Comprehensive details regarding the experimental procedures adopted particularly pertaining to the staining methods have been given.

5. A comparative assessment has been made regarding the suitability or otherwise of the various staining techniques followed in this investigation. Difficulties and problems encountered have also been stated.

Psittacula eupatria

6. Histological observations on the heart of Parrot, Psittacula eupatria revealed the presence of distinct specialized connecting muscles and tissues. These are
purkinje fibres, sinuatrial node and atrioventricular bundle.

7. There are two distinct components in the sinuatrial node. These are separated from one another. The nodal tissue is cylindrical in appearance. Cells with large nuclei and clear perinuclear spaces have been observed in the substance of sinuatrial node. These cells appear oval or slightly elliptical and are almost of the same size. The enclosing nodal sheath has been found to be very thin. The smaller component of the sinuatrial node lies embedded in the interatrial septum forming a conelike structure. Ordinary and specialized purkinje fibres reach up to the atrioventricular junction from this component.

8. The atrioventricular node could not be located in the heart of parrot.

9. The atrioventricular bundle has been found as an irregular structure composed of specialized muscles and cells. The nuclei have strong affinity for stains. From the atrioventricular bundle arise a number of specialized muscle branches which extend into the ventricles. Accessory atrioventricular connections of Kent have been observed, which presumably form additional connecting pathways between the atria and the ventricles.

10. The examination of the nerve elements of the heart shows the presence of nerve bundles, nerve fibres,
ganglia and various forms of nerve endings.

11. In the vicinity of sinuatrial node, extensive distribution of nerves has been recorded. In the atrioventricular bundle, nerves have been observed in its substance. The nerve fibres formed at certain places peculiar synaptic points, both with the ordinary and the specialized purkinje fibres. Cardiac ganglia have been noted in the atria and the ventricles and also in relation to sinuatrial node. Nerve plexuses and various nerve endings have also been recorded in the heart.

_Tyto alba_

12. In the heart of Owl, _Tyto alba_ purkinje muscles, sinuatrial node, atrioventricular node and atrioventricular bundle form the specialized muscular structures of the heart. The purkinje fibres are present extensively in several tracts in the ventricles but their distribution in the atria is meagre.

13. The sinuatrial node is a spindlelike structure with characteristic connective tissue, nodal arteries, specialized muscles and cells. The specialized muscles of the sinuatrial node exhibited direct continuity with other parts of the atrial muscles.

14. The atrioventricular node is poorly defined. There is no direct muscular continuity between the sinuatrial node and atrioventricular node.
15. The atrioventricular bundle extends from the hinder part of the interatrial septum to the septum interventriculare. The main part of the bundle is composed of muscles and cells with bulging walls. The lateral branches from atrioventricular bundle insensibly transform into the ordinary muscles of the heart. Accessory atrioventricular connections of Kent lie close to the right and left atrioventricular apertures. These do not show the presence of purkinje fibres.

16. The intrinsic cardiac neurogenic structure comprise the nerve bundles, the nerve fibres, the nerve plexuses, the nerve endings and ganglia.

17. Nerve supply to the sinuatrial node is confined only to the surrounding muscles and is absent from its substance. The atrioventricular node is devoid of innervation. Nerve fibres traverse the cephalic and caudal portions of the atrioventricular bundle and branches. The innervation to the purkinje fibres is not uniform.

**Suncus murinus**

18. The chief constituents of the specialized muscle system of Shrew, *Suncus murinus* are purkinje muscle fibres, sinuatrial node, atrioventricular node and atrioventricular bundle. The purkinje muscles are more prominent in the ventricles and establish their continuity from the atrioventricular bundle to the lateral walls of the
ventricles. In the atrial portion, the distribution of these fibres is poor.

19. The sinuatrial node occupies a portion of the lateral wall of the right atrium. This structure on reconstruction appears crescentic in shape. Typical purkinje fibres appear to be absent from the substance of sinuatrial node.

20. The atrioventricular node resembles the sinuatrial node in histological details. Only ordinary muscle fibres form continuity between sinuatrial node and atrioventricular node.

21. The atrioventricular bundle is a conspicuous structure in the posterior part of the interatrial septum and extends into the interventricular septum. It forms the only connecting pathway between the atria and the ventricles. The atrioventricular bundle shows muscular continuity with other parts of ventricles, through the ordinary and purkinje-like muscles.

22. The essential intrinsic neurohistological structures of the heart are nerve bundles, nerve fibres, nerve branches, ganglia and various forms of nerve endings.

23. Nerve fibres are present in the peripheral portion of the sinuatrial node. The atrioventricular node is surrounded by nerves which ramify in the interatrial septum. The nerve supply to the atrioventricular bundle is prominent, only at one or two portions inbetween the
Specialized muscles. Few complex nerve nets have been observed close to the posterior part of the dioventricular bundle. The atrial ganglia are well developed than those of the ventricles.

Ptes mungo

Specialized muscles of the heart of Mongoose, Ptes mungo are structurally identical to those of shrew. The purkinje muscles are extensively distributed both the ventricles but seem to be absent from the atria except at the atrioventricular junction.

Sinuatrial node lies in the cranial wall of the lum dextrum and presents a crescentic structure. Specialized anastomosed muscles and prominent cells which are embedded in the connective tissue form the resistance of sinuatrial node.

Atrioventricular node is reduced in the heart of shrew and lacks muscular continuity with the atrial node.

Atrioventricular bundle forms the only pathway between the atria and the ventricles. This tissue is extensively reduced in size than that of shrew. Chief nerve elements of the heart are the same as those of shrew. The innervation at the atrioventricular junction is extensive and nerve fibres probe the ventricular valves. The innervation of the atrial node and atrioventricular node is not copious. Nerves ramify in certain portions of the purkinje fibres.
and in the atrioventricular bundle. The cardiac ganglia are of various shapes and sizes. These are more prominent in the atria than in the ventricles.

Paraechinus micropus micropus

29. The specialized muscles of the heart of the Hedgehog, Paraechinus micropus micropus are typical in their form, structure and position. The purkinje muscles in the right atrium are prominent particularly between the sinuatrial node and the posterior part of the myocardium. In the left atrium, purkinje muscles are present only at the atrioventricular junction.

30. The sinuatrial node is characterized by interlaced, wavy muscles. The nodal cells are sparingly distributed and the nodal arteries do not traverse it but lie in its vicinity.

31. A muscular continuity has been observed between the atrioventricular node and the atrioventricular bundle.

32. The atrioventricular bundle is a well organized structure in the posterior part of the atrioventricular junction. Branches from the atrioventricular bundle could be demarcated into the ventricles. Specialized thick muscles and cells chiefly constituted the atrioventricular bundle. Muscular continuity has been noted between the atrioventricular bundle and other parts of ventricle.

33. Though the usual components of the intrinsic innervation are the same as in other mammals, yet there is relative paucity of nerves in the heart of hedgehog. The
association between the nerves and specialized muscles is also not prominent.

34. Controversies regarding the existence of specialized muscles in the heart of birds and mammals have been discussed. It has been stated that in all these animals histologically distinct specialized muscles are found.

35. The various criteria for the identification of the purkinje fibres followed by various investigators have been discussed. It has been noted that there are many divergent views regarding their morphology. The purkinje muscles have been observed in the hearts of birds and mammals. These have been considered as specialized and not as embryonic structures.

36. It has been concluded that a generalisation could not be made regarding the thickness of purkinje muscles as these represent wide variations in different animals.

37. The controversies regarding the presence or otherwise about the sinuatrial node in the heart of mammals have been discussed. This structure has been found in all the animals. It has been argued that sinuatrial node is the site for the impulse initiation in all these animals.

38. The atrioventricular node has been described in the hearts of owl, shrew, mongoose and hedgehog. It has been suggested that atrioventricular node forms a part of the pathway between the atria and the ventricles. Impulses from this tissue are transmitted to the
atrioventricular bundle.

39. The poor development of atrioventricular node in the heart of owl and its complete absence in parrot has been considered as a functional adaptation correlated with the faster rate of heart beat in birds.

40. The atrioventricular bundle has been observed in all the birds and mammals at the atrioventricular junction extending into the ventricles. In the heart of mammals, the atrioventricular bundle is the only structure between the atria and the ventricles to conduct the stimulus of contraction. In the avian hearts in addition to the atrioventricular bundle, accessory muscular connections (connections of Kent) have also been noted at the atrioventricular junction.

41. The histology of muscles which connect the sinoatrial node to the other parts of the atria and the atrioventricular node has been discussed.

42. The nature of muscles which extend between the atrioventricular node and atrioventricular bundle has also been investigated and discussed.

43. The innervation of the ordinary muscles of the heart and the specialized muscles have been discussed. It has been noted that the extent of innervation to the specialized muscles of the heart in birds is much less than in mammals. This indicates that the influence of central nervous system is very moderate and the conducting system enjoys a fair degree of autonomy.
44. Myogenic and neurogenic theories of cardiac conduction have been discussed in the light of observations made on the hearts of these animals.

45. The validity or otherwise of the myogenic and neurogenic theories of conduction have also been discussed and the literature on this subject critically examined.

46. It has been suggested that ordinary and specialized muscles and the various forms of nerves collectively constituted intrinsic cardiac conducting system and the role of all these tissues should be examined in arriving at a definite conclusion.