Histology of Sinoatrial Node in the Dromedary Camel Foetus

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Abstract The histological structure of the sinoatrial node (SAN) in the dromedary camel foetus was investigated using routine histological techniques and some special stains. Twenty foetuses were used. They were divided into two groups 10 foetuses were in the second trimester (131-260 days); the rest in the third trimester (261-423.5 days of gestation). Samples were collected from the right atrium cranial to the opening of cranial vena cava. The SAN in the camel foetus was found in subepicardial region cranial to the opening of cranial vena cava at the junction between the cranial vena cava and right atrium. Two types of cells were observed; the first type had dark cytoplasm and large spherical lightly stained nucleus. The cells of the second type were small and spindle in shape with dark small nuclei. It is concluded that SAN in camel foetuses in the second and third trimesters had the same location as in the adult and also had two types of cells as in other animal species.

Keywords Camel; Foetus; Histology; Sinoatrial Node

1. Introduction

It is well known that SAN in the adult animals is located in the upper part of the right atrium at the junction between the right atrium and the opening of the cranial vena cava; its function is to provide the electrical impulse responsible for normal cardiac rhythm (Ghazi and Tadjalli, 1996; Sánchez-Quintana and Yen Ho, 2003; Nabipour, 2012).

Walls (1947) studied the development of the specialized conducting tissue of the human heart and found that the sinus node can be identified at 10 mm foetus. The sinus node of yak was studied using the histological methods (Duan et al., 2012).

Histological features of the sinus node include the cells, nodal artery, collagen framework, and nerves (Nabipour, 2012).

In the heart of the adult dromedary camel the sinus node was located 0.5 mm beneath the epicardium, near the junction between the cranial vena cava and the right atrium at the sulcus...
terminalis (Ghazi and Tadjalli, 1996). Histologically, the authors noted that the sinus node of the camel contained a central artery and a framework of collagen fibres which were distributed around the central artery.

To our knowledge no studies were found concerning the camel foetus. Hence, this study was undertaken. The objective of this research was to investigate the histological structure of SAN of the dromedary camel foetus.

2. Materials and Methods

Twenty hearts of camel foetuses obtained from Tamboul slaughterhouse, Gezeira, Sudan were used in this study. Depending on the age, the foetuses were divided into two groups: second trimester (131-260 days) and third trimester (261-423.5 days). The age of the foetus was determined using the equation of crown vertebral-rump length (CVRL) as described by Elwishy et al. (1981).

Small pieces (about 1cm\(^3\) thick) were taken from the right atrium cranial to the opening of cranial vena cava at the junction between the cranial vena cava and right atrium. Specimens were fixed in 10% buffered formalin. They were then processed by routine histological procedures and stained with H and E. Some special stains including Van Geison’s for collagenous fibres and Verhoeff’s for elastic fibres were applied (Bancroft and Stevens, 2008).

3. Results and Discussion

According to the available literature the present study reports for the first time that the SAN is present at the opening of cranial vena cava during the second and third trimesters of the dromedary camel foetus. It appears that the location of the SAN did not change during development in camels since its position in the foetus (this study) and adult hearts (Ghazi and Tadjalli, 1996; Ghonimi et al., 2015). It also remained the same in human (Titus, 1973), that is to say in the subepicardial region at the opening of the cranial vena cava in the right atrium. However, Walls (1947) stated that SAN can be found in upper part of the bases of both vena cavae in human foetuses.

SAN has been studied in many animals by different histological techniques which revealed a general agreement about its location, shape and cellular structure (Ghazi and Tadjalli, 1996; Nabipour, 2012; Ghonimi et al., 2015).

In the present investigation in the second trimester 131- 260 days SAN appeared as a group of cells connected to each other with a connective tissue (Figures 1 and 2). They had a dark cytoplasm and peripheral nuclei. There were no intercalated discs observed. At the stage of 169 days (Figure 1) and 251 days of gestation (Figure 2) SAN was found beside the ordinary cardiac muscles and embedded in a connective tissue. SAN artery was found beside SAN also (Figure 1). Two cell types were identified: the first type had dark cytoplasm and peripheral nuclei, the second type consisted of small cells with dark and small central nuclei (Figures 1 and 2).
In the early stages of the third trimester (261-423.5 days), SAN appeared as a group of dark stained fibres (Figure 3). It was embedded in fair amounts of connective tissue that contained adipose cells and collagenous fibres. At stages of 268 days and 273 days of gestation the cells were surrounded by a circular and very light area and they had different shapes and sizes (Figures 3 and 4). Their nuclei were large and were peripherally located. The nuclear chromatin was peripherally concentrated (Figures 3 and 4). The connective tissue surrounding SAN was rich in blood capillaries and collagenous fibres. An arteriole and a venule were embedded between ordinary cardiac muscles and SAN connective tissue (Figure 3). Similarly, Ghazi et al. (1998) found that the sinus node of cats contained normally dense collagen framework. However, Ghonimi, et al. (2015) claimed that the SAN of camel consisted of stroma and parenchyma. James (1970) stated that the sinus node was originated in the sinus venosus but subsequently a dense collagen framework developed. He added that partitioning of the sinus node by collagen was important not only to the nature of its cellular development but also to its pacemaking function. This is in confirmation with our findings in camel foetus.
In the late stages of the third trimester (261-423.5 days) SAN became elongated in shape with long peripheral tapering ends (Figures 4 and 5). Similarly, in equine, Bishop and Cole (1967) found that SAN had a body and long acuminate cranial and caudal crura. However, in the domestic cat it was described as triangular in shape (Ghazi et al., 1998).

Two types of cells can be identified; the first type had dark cytoplasm and large spherical light nuclei with peripherally located chromatin (Figure 5, a and b). The other cells were small and spindle in shape with dark small nuclei. Blood capillaries were found in between these cells (Figure 5, a and b). This is in consistency with Ghazi et al. (1998).
A ganglion associated with SAN in the third trimester specimens at (273 – 283 days of gestation) appeared in the subepicardial area near the cardiac muscles embedded in connective tissue rich in adipose tissue, blood vessels and nerves (Figure 6 a and b). The ganglion was surrounded by a thin connective tissue capsule that encloses large scattered irregular neurons characterized by large nucleus and prominent nucleolus. Satellite cells and axons were observed between the neurons (Figure 6, b). According to Nabipour (2012) human, horse, goat, dog and domestic cat SAN ganglia were present at the periphery of the node. Earlier, Nonidez (1943) stated that SAN was supplied by axons of neurons of the intrinsic cardiac ganglia.

4. Conclusion

It is concluded that SAN in camel foetuses in the second and third trimesters had the same location as in the adult and also had two types of cells (P) and (T) as in other animal species. SAN ganglion was first observed in the third trimester of gestation.

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