

# Anatomy of the Sinu - Atrial Node in the heart of Goat (*Capra hircus*)

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**Anatomy of the sinu - atrial node was studied in 5 female goats In the goat's heart, the sinu - atrial node lied 0.18 mm - 0.25 mm beneath the epicardium, at terminal sulcus, near the junction between the cranial vena cava to, lateral wall of the right atrium and the right auricle, its shape was elongated and relatively cone shaped. Its cranial end was near the myocardium of the right auricle and caudal end was near the myocardium of atrial wall. The caudal end was narrower than the cranial end. Average of dimensions of the sinu - atrial node were 12.75 mm × 1.5 mm × 1.7 mm. Histologically, the sinu - atrial node of goats contained normally a dense collagen frame and the cells with perinuclear clear zone (P) and transitional cells (T) were the principal cells of paranchyma. since these cells contained less myofibrils than working myocardium , therefore , they were distinctively paler. The "p" cells were bigger than "T" cells and smaller than the ordinary myocardial cells. At the junction between "T" cells and "P" cells intercalated discs were not seen. The sinu - atrial node of goats lacked the central artery, but near the central section and toward the cranial margin there is a distinct arteriole that supplies the node.**

**Key words :** Anatomy, Sinu - Atrial Node, Goats, "P" cells, "T" cells.

The anatomy and histology of the sinu - atrial node was studied in humans (James, 1961), dogs (James, 1962) , cattle (James, 1965), horses and mules (Bishop and Cole, 1967), rabbits (James, 1967), camels (Ghazi and Tadjalli, 1996) and domestic cats (Ghazi and Nabipur, 1998). However, no information is yet available on the anatomy and histology of the sinu - atrial node of goats. The present study was therefore, undertaken to deal with the anatomy and histology of the sinu - atrial node in the heart of goats.

## Materials and Methods

The animals checked for healthy and then slaughtered, the heart with its pericardium was dissected free and it was flushed with warm (40 C) normal saline. The heart was perfused with 10 % buffered formalin. The upper part of the right atrium along with the cranial vena cava and a part of right auricle was separated and kept

submerged in the same fixative for 72 h. The mentioned piece was trimmed and processed. Serial sections at 7  $\mu$ m thickness were cut transversely from the cranial vena cava toward the atrium. The sections were mounted and preserved. The sections were selected by the interval of 10 and stained with the methods of green and blue Masson tircrome, Van Giesson and Best carmine. Then the sections were examined. The length and the width of the sinu - atrial node were measured by micrometry and its thickness was measured by multiplying the number of sections to 7  $\mu$ m.

## Result and Discussion

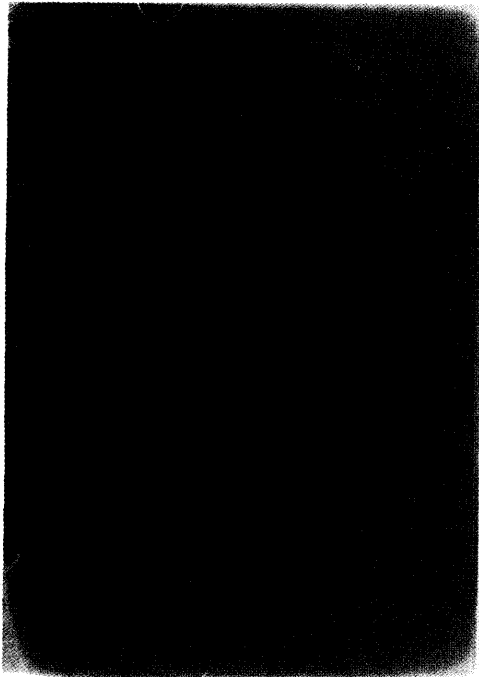
In the goat's heart, the sinu - atrial node lied 0.18 mm-0.25mm beneath the epicardium at terminal sulcus near the junction between the cranial vena cava, lateral wall of the right atrium and the right auricle (Fig. 1). Its shape was elongated and relatively cone shape. Its cranial end was near the myocardium of the right auricle and caudal end was near the myocardium of atrial wall. The caudal end was narrower than cranial end (Fig. 2,3). In the goat's heart, while the sinu - atrial node was normally beneath the epicardium along its length, at its apposite surface the sinu - atrial node usually did not lie close to the endocardium except at one crucial location.

within the collagen frame of the goat's sinu - atrial node there were two principle kinds of nodal cell one of these nodal cells was small and round or ovoid, with an empty appearing cytoplasm with what appeared to be a disproportionatly large central nucleus, contained only sparse myofibrils These cells have been named "P" cells (Fig 4). The second nodal cells were slender and elongated but much smaller than ordinary myocardial cells. These cells contain more myofibrils and formed the slender interweaving fibers as the major component of the goat's sinu - atrial node. These cells have been named transitional "T" cells (Fig 4). In the interstitium between the "P" cells and "T" cells there were some fibroblasts and arterioles (Fig 5). The nerves within the goat's sinu - atrial node was very little In the heart of goats "P" cells lied principally within the central protion of sinu - atrail node, while "T" cells were not exclusively at the anatomic margins of the sinu - atrial node because they were also visible in varying numbers throughout the node. In the heart of

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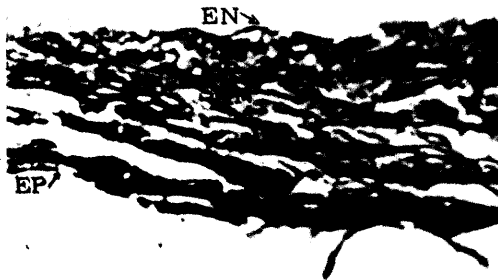




**Fig 1.** Macroscopic location of the SAN in goat's heart.

SAN : sinu - atrail node

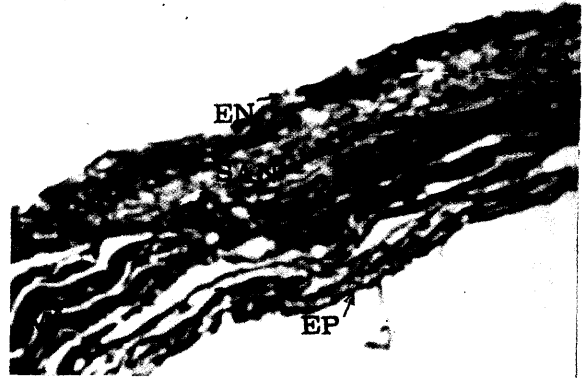
1 : cranial vena cava , 2 : caudal vena cava, 3 : right auricle  
4 : left ventricle    5 : right ventricle



**Fig 3 :** Anatomical location of the SAN in the terminal crest of the goat's heart (caudal end); endocardium (EN), epicardium (EP), sinu - atrial node (SAN); collagen fibers (CF), (green masson trichrome staining,  $\times 64$ )

goat's , average of diameter's length "P" cells ( $11.25 \mu\text{m}$ ) was bigger than the "T" cells ( $7.5 \mu\text{m}$ ) and smaller than the ordinary myocardial cells ( $12.5 \mu\text{m}$ ).

The sinu - atrial node in goats had no central artery, but near the central section and toward the cranial margin there was a distinct arteriole that the nodal cells didnot organized around it (Fig 6). At the junction between "T" cells and "P" cells intercalated discs were not seen. The glycogen content of the "P" cells was very little. The glycogen content of the "T" cells was almost at the same,



**Fig 2 :** Anatomical location of the SAN in the terminal crest of the goat's heart (cranial end) ; endocardium (EN); epicardium (EP) ; sinu - atrial node (SAN); collagen fibers (CF);  $\times$  myocardium of right auricle (M\*)(green masson trichrome staining, 64)

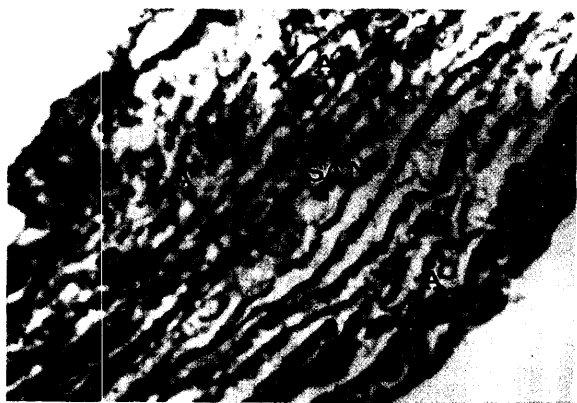


**Fig 4 :** Microphotograph of the SAN in the heart of goats showing perinuclear clear zone cells (P), transitional cells (T), fibroblasts (F), collagen fibers (CF), (green masson trichrome staining,  $\times 640$ )

Level as ordinary myocardial cells. At the caudal vicinity of the goats sinu - atrail node there were some parasympathetic ganglions and each of them enveloped in the capsule of connective tissue and contained numerous perikaryons (Fig 7). The amphicyte cells present around the perikaryons.

The sinu - atrial node in the heart of goats lied beneath the pericardium, at terminal sulcus, near the junction between the cranial vena cava, lateral wall of the right atrium, and the right auricle. Its location in this species of animal was similar as that in haumans (James , 1961), dogs (Jams , 1962), cattle (Jams, 1965), horses (Bishop and cole, 1967) , camels (Ghazi and Tadjalli, 1996) and domestic cats (Ghazi and Nabipur, 1998), while in rabbits it is located at the junction of the midportion o fsinus intercavarum and terminal crest (James, 1967). Our study reveal that goat's sinu - atrial node was elongated and relatively cone shape, however it was subjected to considerable individual variations. Its caudal end was narrower than cranial end. While in humans it resembled and extended like a snail with its shell and also was subjected to considerable variation (James , 1961). In dogs, the shape was

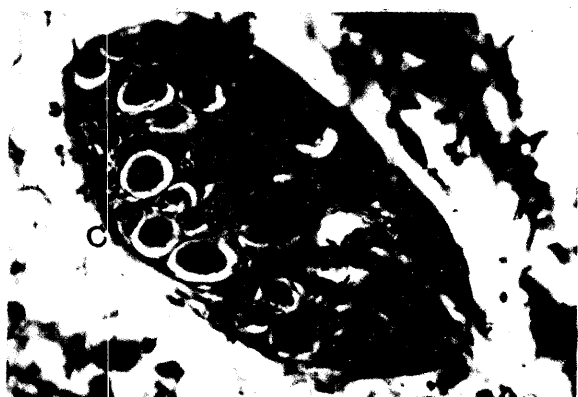




**Fig 5 :** Presence of some arterioles in the SAN of goat's heart, sinu-atrial node (SAN); arterioles (A)(green masson trichrome staining  $\times 160$ )



**Fig 6 :** Shows a distinct arteriole near the central section of the SAN of goat's ; collagen fibers (CF) ; arteriole (A)(green masson trichrome staining  $\times 640$ )



**Fig 7 :** Microphotograph of the SAN ganglion of goat's heart; capsule (C); arrows : nucleus and nucleolus in the perikaryon (green masson trichrome staining  $\times 320$ )

oblong or spindle - like and its variations were even greater than in humans (James , 1962). In horses tapering cranial and caudal crura of the node encircled the lateral half of the junction of the cranial vena cava with the right atrium (Bishop and cole, 1967). In rabbits the shape was oblong with its long axis parallel to the terminal crest (James , 1967). In camels it was elongated in shape and bent oblong (Ghazi and Tadjalli, 1996). In the cats the shape was almost triangular (Ghazi and Nabipur, 1998).

In the goats sinu - atrial node as in the other species which have been studied, the upper side of the sinu - atrial node is in close contact with the epicardium. In this species, the sinu - atrial node is extended to the vicinity of endocardium only in a small region and in the majority of the areas, the sinu - atrial node is separated from endocardium by a thick layer of right atrial myocardium. In goat's the right atrial myocardium separating the sinu - atrial node from endocardium is thicker and in a longer distance than in domestic cats.

The average of dimensions of the sinu - atrial node in goats was approximately 12.75 mm 1.5 mm  $\times$  1.7 mm. In humans the sinu - atrial node measured 15 mm  $\times$  5 mm  $\times$  1.5 mm (James, 1961). In rabbits, the total length varied from 0.5 mm to 0.8 mm (James , 1967). In dogs the total substance of the sinu - atrial node was approximately 5 mm (James, 1962). In adult horses, it measured approximately 3 mm  $\times$  4.4 mm in cross section (Bishop and cole 2.80  $\times$  1967). In camels , it was 28.25 mm  $\times$  5 mm  $\times$  5.38 mm. In domestic cats the sinu - atrial node measured 2.78 mm 0.45  $\times$  mm 0.54 mm in males and 2.75 mm (Ghazi  $\times$  2.64 mm  $\times$  mm in females and Nabipur, 1998).

Histologically, the sinu - atrial node of goats lacked the central artery, but near the central section and toward the cranial margin there is a distinct arteriole that supply the node and nodal cells did not organize around it. In this respect, it was similar to that of sheep (Capenhaver and Truex 1952).

The sinu - atrial node of cattle (James, 1965), rabbits (James, 1967) and domestic cats. (Ghazi and Nabipur, 1998) also lacked the central artery. While, the sinu - atrial node of humans (James, 1961), dogs (James, 1962), horses (Bishop and Cole, 1967) and camels (Ghazi and Tadjalli, 1996) consisted of a central artery and a general framework of collagen fibers, which distributed around the sinu - atrial node artery and the sinu - atrial nodal cells while interlacing the collagen and elastic fibers were regularly or irregularly organized around the central artery. sinu - atrial node of goats contained a large amount of dense collagen frame, which was similar to that of horses (Bishop and Cole, 1967), dogs (James, 1962), humans (James , 1961), camels (Ghazi and Tadjalli, 1996) and domestic cats (Ghazi and Nabipur, 1998). While in cattle (James, 1965) and rabbits (James, 1967) there were relatively less collagen fibers.

The "P" cells of the sinu - atrial node of goats had a relatively



large perinuclear zone, Which was similar to that of cattle. The "P" cells in cattle had greater perinuclear zone than in dogs and humans (James, 1965). The proportion of "P" cells to "T" cells in the sinu - atrial node of rabbits was exceptionally high (James, 1967). The intercalated disc were not found in the sinu - atrial node of goats which was similar to humans (James, 1961). dogs (James, 1962). cattle (James, 1965), horses (Bishop and Cole, 1967), camels (Ghazi and Tadjalli, 1996) and domestic cats (Ghazi and Nabipur, 1998).

In the goat's heart, the glycogen content of the "P" cells was very little. The glycogen content of the "T" cells was almost as high as the ordinary atrial myocardial cells and in this respect, it was similar to that of domestic cats (Ghazi and Nabipur, 1998). No such information in literature is yet available for glycogen content in "P" cells of goats' however, in horses, the glycogen content of ordinary myocardial cells was seven times higher than that of the sinu - atrial nodal cells (Buaze and Werthimer, 1928; cited by Field, 1951). In contrast, in humans (James, 1961) dogs (James, 1962), cattle (James, 1965), rabbits (James, 1967) and camels (Ghazi and Tadjalli, 1996) the glycogen content of the sinu - atrial nodal cells was higher than that of the atrial myocardial cells.

In the heart of goats the nerve fibers and also ganglions was only present at the periphery of the sinu - atrial node and in this respect, was similar to that of cattle (James, 1965) and camels (Ghazi and Tadjalli, 1996). In contrast, in domestic cats (Ghazi and Nabipur, 1998) horses (Bishop and Cole, 1967), humans (James, 1961) and dogs (James, 1962) the nerve fibers were abundant within the substance of the sinu - atrial node. Similarly, in mentioned animals ganglions were also present at the periphery of the sinu - atrial node.

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### آناتومی گره سینوسی - دهلیزی در قلب بز

دکتر ابوالقاسم نبی پور<sup>۱</sup> دکتر سعید خانزادی<sup>۱</sup> دکتر غلامرضا مرادی<sup>۱</sup>

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آناتومی گره سینوسی - دهلیزی قلب در ۵ رأس بز ماده بالغ مطالعه شد. در قلب بز گره سینوسی - دهلیزی ۰/۱۸ تا ۰/۲۵ میلیمتر زیر اپیکارد شیار انتهایی و نزدیک محل اتصال سیاهرگ اجوف قدامی به دیواره جانبی دهلیز راست و گوشک راست قرار داشت. شکل گره بصورت کشیده و تا حدودی مخروطی شکل بود. انتهای قدامی آن نزدیک میوکارد گوشک راست و انتهای خلفی نزدیک میوکارد دهلیز قرار داشت و انتهای خلفی باریکتر از انتهای قدامی بود. میانگین ابعاد گره سینوسی - دهلیزی ۱۲/۷۵ میلیمتر طول، ۱/۵ میلیمتر عرض و ۱/۷ میلیمتر ضخامت بود. از لحاظ بافت‌شناسی گره سینوسی - دهلیزی قلب بز دارای داربست متراکمی از ایاف کلاژن می‌باشد و سلولهای «پی» و انتقالی سلولهای اصلی پارانشیم هستند. چون این سلولها دارای میزان کمتری میوفیبریل نسبت به میوکارد معمولی هستند، بطور مشخصی کمرنگتر بودند. سلولهای «پی» بزرگتر از سلولهای انتقالی و کوچکتر از سلولهای معمولی میوکارد بودند. در محل اتصال سلولهای انتقالی و سلولهای «پی» صفحات پلکانی مشاهده نشد. گره سینوسی - دهلیزی بز فاقد سرخرگ مرکزی است ولی در نزدیک ناحیه مرکزی و بطرف حاشیه قدامی یک آرتریول مشخص وجود دارد که گره را خونرسانی می‌نماید.

واژه‌های کلیدی: آناتومی، گره سینوسی - دهلیزی، بز، سلولهای «پی»، سلولهای انتقالی

