

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 NAAS Rating (2026): 5.29
 IJABR 2026; 10(6): 221-224
www.biochemjournal.com
 Received: 26-04-2026
 Accepted: 29-05-2026

Arkaprabha Shee
 Dhaanyaganga KVK, RKMA,
 Sargachi, Murshidabad, West
 Bengal, India

Partha Das
 Department of VAN, WB
 University of Animal &
 Fishery Sciences, Kolkata,
 West Bengal, India

Amitava Roy
 Department of LFC, WB
 University of Animal &
 Fishery Sciences, Kolkata,
 West Bengal, India

Cytoarchitectural identification of the suprachiasmatic nucleus in chicken hypothalamus

Arkaprabha Shee, Partha Das and Amitava Roy

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i6c.8590>

Abstract

An evolutionarily ancient brain structure, the avian hippocampus is essential for memory and emotional control. It presents a special difficulty in comparative neurobiology due to its intricate internal organization, which is marked by a variety of subgroups and a functional longitudinal arrangement. The purpose of this research is to clarify the cytomorphological composition of the chicken suprachiasmatic nucleus. Twenty male and twenty female brains were processed for this investigation. An accumulation of nerve cells at the lateral angle of the third ventricle was identified as the medial suprachiasmatic nucleus (mSCN). In terms of morphology, the mSCN was composed of less densely aggregated neurons surrounding a core region that was densely packed with nerve cells. The nucleus increased in size from the rostral to the caudal direction.

Keywords: Chicken, hypothalamus, suprachiasmatic nucleus

Introduction

The suprachiasmatic nucleus, located in the hypothalamus of all vertebrates, receives retinal inputs and is essential for regulating circadian rhythms (Striedter, 2005) ^[9]. It serves as the biological clock that controls circadian rhythms in animals. In birds, two nuclei have been proposed as the avian suprachiasmatic nucleus: the visual SCN (vSCN) and the medial SCN (mSCN). Suprachiasmatic nucleus (SCN) of the hypothalamus is the place for the biological clock in every species. The avian circadian system is a contribution of mutually coupled pacemakers residing in the pineal gland, retina and the avian homologs of the SCN, synchronized to environmental light cycles (LD) by photoreceptors in the eye, pineal gland and multiple sites within the brain (Cassone and Menaker, 1984) ^[2]. Due to the paucity of literature in reference to chicken and keeping in view the importance of SCN in birds the present study has been undertaken to elucidate the cytomorphological structure of suprachiasmatic nucleus in chicken.

Materials and Methods

To undertake the present study 20 male and 20 female skulls were collected from 6-7 weeks old, apparently healthy, freshly slaughtered broiler chicken from the local slaughter house. Brain samples were carefully dissected out and preserved in 10% NBF for further studies. For the histological slide preparation, the standard protocol was followed for tissue processing. All the sections were taken at 10µm thickness and consecutively stained with Haematoxylin and Eosin, Cresyl Violet and Toluidine Blue as described by Suvama *et al.*, (2012) ^[10]. Leica Qwin Images Analyser software in Leica DM 2000 Microscope was used for taking micrometrical data from the stained sections.

Results and Discussion

In the present study, medial suprachiasmatic nucleus (mSCN) was an aggregation of nerve cells observed at the level of lateral angle of third ventricle. Van den Pol (1980) ^[11] documented similar findings in the internal structure of the suprachiasmatic nucleus (SCN) in rat brains. Dorsomedially, the cells were noticed to be smaller and more tightly packed than ventrolaterally located neurons; significantly more somatic appositions occurred in the dorsomedial SCN than in other parts of the nucleus. Moore *et al.*, (2002) ^[5] also stated that the suprachiasmatic nucleus (SCN) of the hypothalamus was a dominant circadian

Corresponding Author:
Amitava Roy
 Department of LFC, WB
 University of Animal &
 Fishery Sciences, Kolkata,
 West Bengal, India

pacemaker in the mammalian brain. It was anatomically and functionally organized into two subdivisions: (1) a core that lied adjacent to the optic chiasma, and (2) a shell that surrounds the core, contained a large population of arginine vasopressin (AVP)-producing neurons in its dorso-medial portion. Similar cellular organization was also noticed in the present investigation.

The rostral hypothalamus in the chicken brain has been investigated in a large number of studies, many of them either focussing on general anatomy, neurosecretory hypothalamo-hypophyseal system, retino-hypothalamic projection or the distribution of the various neurotransmitters and the neuropeptides. This study revealed that SCN of chicken was formed by continuous arrangements of neurons adjacent to the base of third ventricle starting from a region rostral to the preoptic chiasma and ending at the caudal most extension of the preoptic recesses. This is in agreement with the findings of Panzica (1985) ^[6] in case of chicken, Gillette *et al.*, (1999) ^[4] in birds and Brandstätter and Abraham (2003) ^[1] in house sparrow. Similar morpho-physiological observation was also cited by Ebihara & Kawamura (1981) ^[3] in support of bilateral identification of SCN. They examined the roles of the pineal organ and the suprachiasmatic nucleus (SCN) in the control of circadian rhythms of locomotor activity in male Java sparrows (*Padda oryzivora*). Birds with bilateral SCN lesions showed diurnal rhythms with anticipatory activity in LD (Light-Dark) cycles but did not show any circadian rhythms in LL (Constant light). Unilateral lesions of the SCN did not lead to loss of circadian rhythms in LL. Their results suggested that in the Java sparrow the circadian rhythms of locomotor activity were regulated by a pineal-suprachiasmatic complex.

In Nissl stained serial sections, the SCN was consisted of a cluster of small perikarya located bilaterally adjacent to the preoptic recess of the third ventricle. The more dorsal division of the SCN was covered in the form of a cup with the ventral part of the periventricular preoptic nucleus. At this site in coronal sections, the SCN revealed no relation to the optic chiasma. Further caudal to the site this nucleus was septally closely related to the angle of preoptic recess and ventrally found in the juxta position with the fibre of the optic chiasma. More caudally it also covered the dorsal aspect of the preoptic recess (Figs. 1, 4). The average length and breadth of the SCN was 455.3 and 354.2 micron respectively. The SCN was marked by the label of the anterior commissure of lateral ventricle in the coronal sections. The morphological appearance of the mSCN revealed changes throughout its longitudinal extension by increasing in diameter until about half of its total length. On the contrary, the diameter decreased towards its rostrocaudal ends. Thus, together with the preoptic nucleus and the periventricular preoptic nucleus, the mSCN was the most ventral cellular aggregation found in chicken hypothalamus.

Cell type of mSCN

The coronal sections of the hypothalamus were stained with haematoxylin-eosin, cresyl violet and toluidine blue (Sofroniew and Weindl, 1980, Panzica *et al.*, 1987) ^[8, 7] (Figs. 1, 3, 4). Out of these staining procedures the toluidine blue staining revealed the better neuron specific staining to identify the cellular aggregations. Generally the neurons of the mSCN were provided with perikaryon bearing two to four primary dendrites (Figs. 2, 5). In the SCN of the

chicken several parvo and magnocellular neurons were identified in 10-15 μ m. toluidine blue stained sections. The rostro-caudal sections revealed the different cytoarchitecture of SCN. The nucleus increased in size from rostral to caudal and its medial and caudal parts were morphologically characterised by a central part which was composed of densely packed nerve cells, surrounded by less densely aggregated neurons (Figs. 1, 4). This observation was in accordance with the findings of Van den Pol (1980) ^[11] who reported that the nuclei of SCN glia and neurons were often found to invaginate and multiple nucleoli were a prominent feature of a large number of SCN neurons. They stated that at the borders of the nucleus some dendrites might travel into the adjacent anterior hypothalamus; similarly, dendrites from cells outside SCN might enter into the nucleus boundaries in rat's brain. So this study suggested that medial suprachiasmatic nucleus (mSCN) is an aggregation of nerve cell observed at the level of lateral angle of third ventricle of chicken. It was observed that size of the mSCN increased from rostral to caudal and its medial and caudal parts were morphologically characterised by a central part which was composed of densely packed nerve cells, surrounded by less densely aggregated neurons.

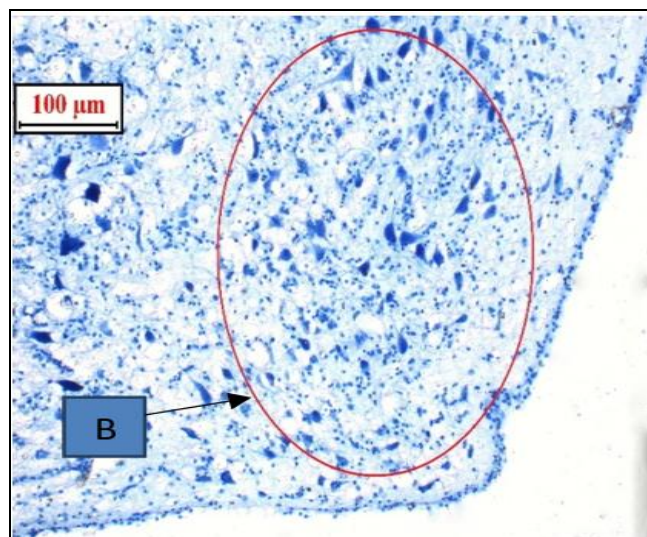


Fig 1: Photomicrograph showing mSCN, Toluidine Blue X 20. (B) mSCN

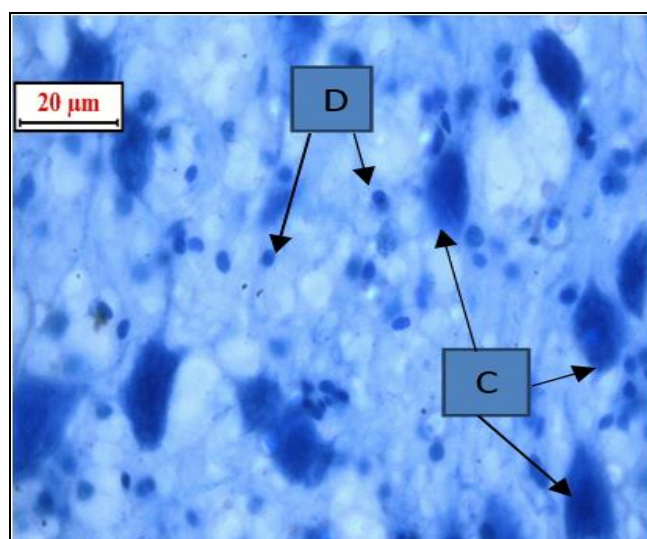


Fig 2: Photomicrograph showing mSCN Toluidine Blue X 100. (C) Cyton, (D) Glial Cell

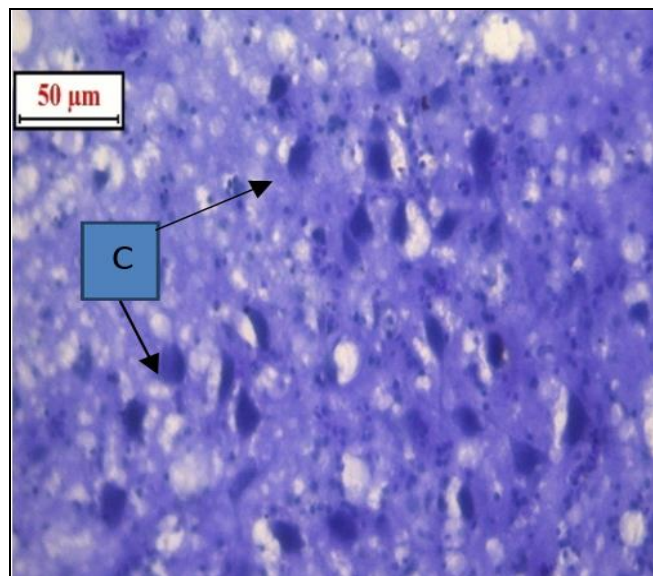


Fig 3: Photomicrograph showing mSCN Cresyl Violet X 40. (C) Cyton

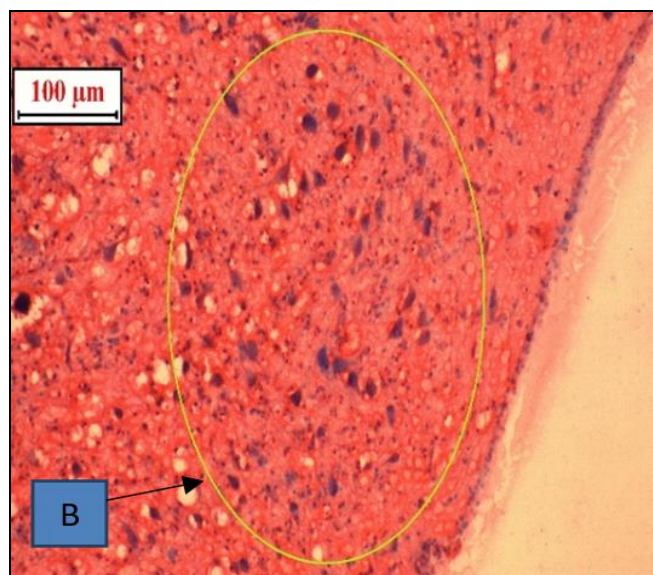


Fig 4: Photomicrograph showing mSCN, H&E X 20. (B) mSCN

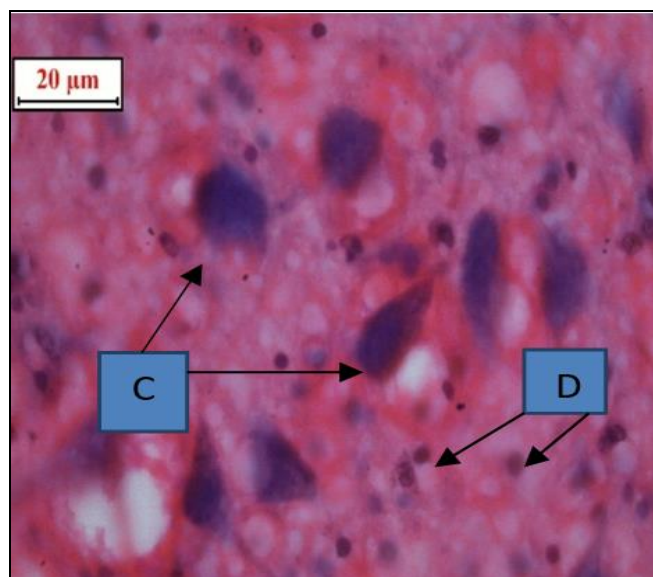


Fig 5: Photomicrograph showing mSCN, H&E X 100. (C) Cyton, (D) Glial Cell

Conclusion

In the present study, the different neuronal aggregations were identified in the preoptic region of the hypothalamus of the chicken. A pair of cell groups adjacent to the base of third ventricle, directly above the optic chiasma were identified. This aggregation of nerve cell was clearly observed at the height of the ventral portion of the periventricular preoptic nucleus at the level of the lateral angle of the third ventricle, interconnected by a small sub-ventricular queue of neurons. These cell groups, according to their positional significance with mammals, revealed the suprachiasmatic nucleus (SCN) in birds. These cell groups at the various levels of the rostro-caudal extension of the hypothalamus may be termed the medial suprachiasmatic nucleus (mSCN). Generally, the neurons of the mSCN were provided with a perikaryon bearing two to four primary dendrites. The nucleus increased in size from rostral to caudal and its medial and caudal parts were morphologically characterised by a central part which was composed of densely packed nerve cells, surrounded by less densely aggregated neurons. An aggregation of neurons was found lateral to the mSCN at the dorsal border of the optic chiasma. In the further rostro-caudal section, these aggregations revealed an extension of the increase of cell group in size and extended into the lateral hypothalamic area. These cellular aggregations may be the lateral hypothalamic nucleus (LHN). This cellular aggregation is again subdivided into two parts, a ventral and a dorsal one. The ventral part represented the lateral hypothalamic rostral nucleus (LHRN) or ventral SCN (vSCN).

Acknowledgements

The authors are very much grateful to Vice-Chancellor, West Bengal University of Animal and Fishery Sciences; Dean, Faculty of Veterinary & Animal Sciences, WBUAFS and Head of the Department of Veterinary Anatomy and Histology, WBUAFS, Kolkata, India for providing necessary facilities.

References

1. Brandstätter R, Abraham U. Hypothalamic circadian organization in birds. I. Anatomy, functional morphology, and terminology of the suprachiasmatic region. *Chronobiol Int.* 2003;20(4):637-655.
2. Cassone VM, Menaker M. Is the avian circadian system a neuroendocrine loop? *J Exp Zool A Ecol Genet Physiol.* 1984;232(3):539-549.
3. Ebihara S, Kawamura H. The role of the pineal organ and the suprachiasmatic nucleus in the control of circadian locomotor rhythms in the Java sparrow, *Padda oryzivora*. *J Comp Physiol A.* 1981;141(2):207-214.
4. Gillette MU, Tischkau SA. Suprachiasmatic nucleus: the brain's circadian clock. *Recent Prog Horm Res.* 1999;54:33-60.
5. Moore RY, Speh JC, Leak RK. Suprachiasmatic nucleus organization. *Cell Tissue Res.* 2002;309(1):89-98.
6. Panzica GC. Vasotocin-immunoreactive elements and neuronal typology in the suprachiasmatic nucleus of the chicken and Japanese quail. *Cell Tissue Res.* 1985;242(2):371-376.
7. Panzica GC, Viglietti-Panzica C, Fiori MG, Calcagni M, Anselmetti G, Balthazart J. Cytoarchitectural

- analysis of the quail preoptic area. Evidence for a sex-related dimorphism in the medial preoptic nucleus. *Ital J Zool.* 1987;54(1):13-17.
8. Sofroniew MV, Weindl A. Identification of parvocellular vasopressin and neurophysin neurons in the suprachiasmatic nucleus of a variety of mammals including primates. *J Comp Neurol.* 1980;193(3):659-675.
 9. Striedter GF. *Principles of Brain Evolution.* Sunderland (MA): Sinauer Associates; 2005.
 10. Suvarna KS, Layton C, Bancroft JD. *Bancroft's Theory and Practice of Histological Techniques.* 7th ed. Philadelphia: Elsevier Health Sciences; 2012.
 11. Van den Pol AN. The hypothalamic suprachiasmatic nucleus of rat: intrinsic anatomy. *J Comp Neurol.* 1980;191(4):661-702.