SHORT COMMUNICATION

ISSN- 0102-9010

AN UNUSUAL COURSE OF THE *Nervus Conarii* IN THE PINEAL GLAND OF THE TINAMID BIRD *Crypturellus parvirostris*. A CASE REPORT

Carlos Alberto Redins and José Carlos Novaes

Department of Morphology, Biomedical Center, Federal University of Espírito Santo (UFES), Vitória, ES, Brazil.

ABSTRACT

The pineal gland is innervated by postganglionic sympathetic nerves from the superior cervical ganglion. As the axons enter the gland, they synapse with the pinealocytes. In this report, we describe a case in which the conarii nerve was observed crossing the distal portion of the ascending branch of the venous sinus, thus penetrating the capsule of the pineal gland. The nerve observed consisted of a bundle of unmyelinated axons and collagen fibers which are surrounded by endothelial cells. This is the first report of a completely engulfed and detached conarii nerve within a venous sinus.

Key words: Conarii nerve, *Crypturellus parvirostris*, innervation, pineal gland

In the tinamid bird *Crypturellus parvirostris* (inhambú-chororó), the pineal gland is located in a triangular space formed by the cerebral hemispheres and the cerebellum, and is partially enclosed by venous sinuses [7]. As described by Beattie and Glenny [1] in *Gallus*, the pineal gland of *C. parvirostris* is surrounded by a complex network of vascular branches with anterior and posterior ascending rami that are connected by a dorsal communicating branch. The gland exhibits a follicular pattern of organization [5] with a well-developed adrenergic innervation, as confirmed by chemical sympathectomy [6].

According to Vollrath [11], the sympathetic nerve fibers of the pineal gland form a distinct nerve known as the pineal nerve or *nervus conarii*. This nerve originates from the left and right superior cervical ganglia [2] and, most frequently, penetrates the dorsal pole of the pineal gland. During investigation of the morphological features of the pineal gland in *C. parvirostris*, we observed an uncommon course of the *nervus conarii* which reached the gland through a venous sinus. In this paper, we describe the ultrastructural organization of this nerve.

An adult male *C. parvirostris* Wagler, 1827 was killed by decapitation under ether anesthesia and the pineal gland was fixed in a 3% solution of glutaraldehyde in 0.1 M phosphate buffer (pH 7.4). Fixation was completed by immersing the gland in the same fixative solution for 3 h at 0-4º C, followed by post-fixation in 1% osmium tetroxide in the same buffer for 2 h. The tissue was then dehydrated, embedded in Epon 812, and sectioned using a MT2-B Porter Blum ultramicrotome. Thin sections of the gland were double-stained with lead citrate and uranyl acetate and observed in a Zeiss EM-10 electron microscope (Center for Electron Microscopy, Institute of Biological Sciences, UFMG, Belo Horizonte, MG, Brazil).

The conarii nerve of *C. parvirostris* normally crosses the distal portion of the anterior ascending branch of the venous sinus and penetrates the pineal capsule. In the specimen examined here, an unusual course of this nerve was found within the venous sinus which meant that the nerve was surrounded by blood (Fig. 1). The nerve was 5 x 7 µm thick and exhibited a Schwann cell with its basal lamina and 29 unmyelinated axons, as well as a bundle of collagen fibers surrounded by fibroblasts processes. The collagen fibers were oriented longitudinally along the long axis of the axons. The nerve was wrapped in a thin endothelial cell layer with its basal lamina. This unusual course for the conarii nerve suggested that had been a protrusion of the endothelial wall into the lumen of a venous sinus (Fig. 2). During this process the conarii nerve, which ran along the sinus (Fig. 2A, B), would have been engulfed by the protruding endothelium thereby becoming confined within its lumen (Fig 2C). This would place the nerve in contact with the circulating blood (Fig. 1). As the bundle of

Correspondence to: Dr. Carlos Alberto Redins
Departamento de Morfologia, Centro Biomédico, Universidade Federal do Espírito Santo (UFES), Rua Cyro Lima 45, Enseada do Suá, CEP 29050-230, Vitória, ES, Brasil. Tel/Fax: (55) (27) 3335-7367, E-mail: redins@npd.ufes.br

axons detached and crossed the endothelial cell wall, the basal lamina of the endothelial cells occupied the innermost layer of the endothelium (Fig. 2C). In addition, at the point where the nerve reached the pineal capsule, we observed a bundle of axons and closely packed collagen fibers surrounded by endothelial cells which were continuous with the endothelium of the venous sinus (Fig. 3).

Experimental studies have shown that the autonomic sympathetic nerve fibers in all animals,

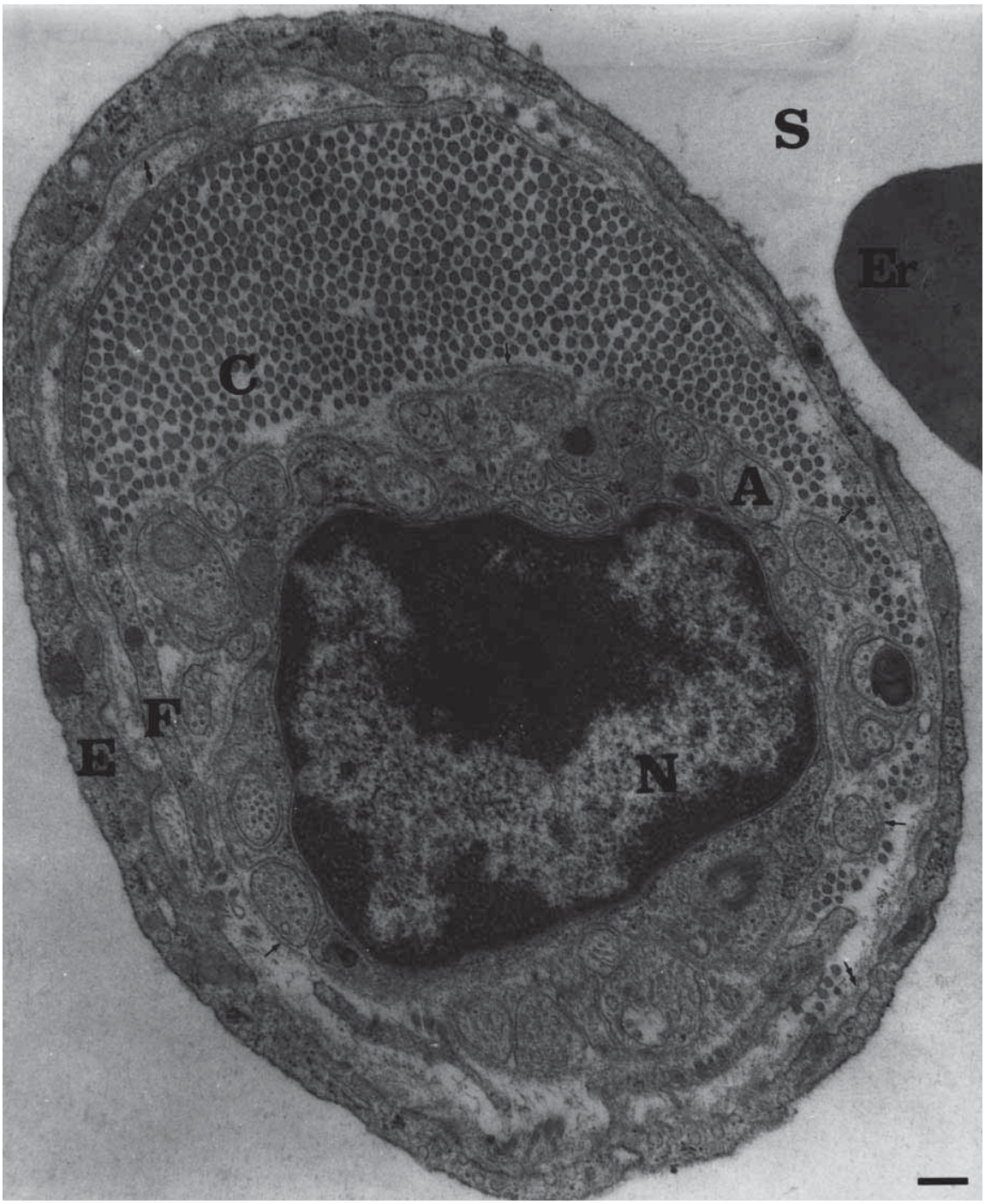

Figure 1. Electron micrograph of a cross-section of conarii nerve within the lumen of the venous sinus (**S**) showing a Schwann cell nucleus (**N**), its basal lamina (**arrows**), axons (**A**), collagen fibers (**C**), fibroblast processes (**F**), endothelial cells (**E**) and the basal lamina of endothelial cell (**double arrows**). **Er** = portion of an erythrocyte in the lumen of the venous sinus. Bar = 0.25 μm.

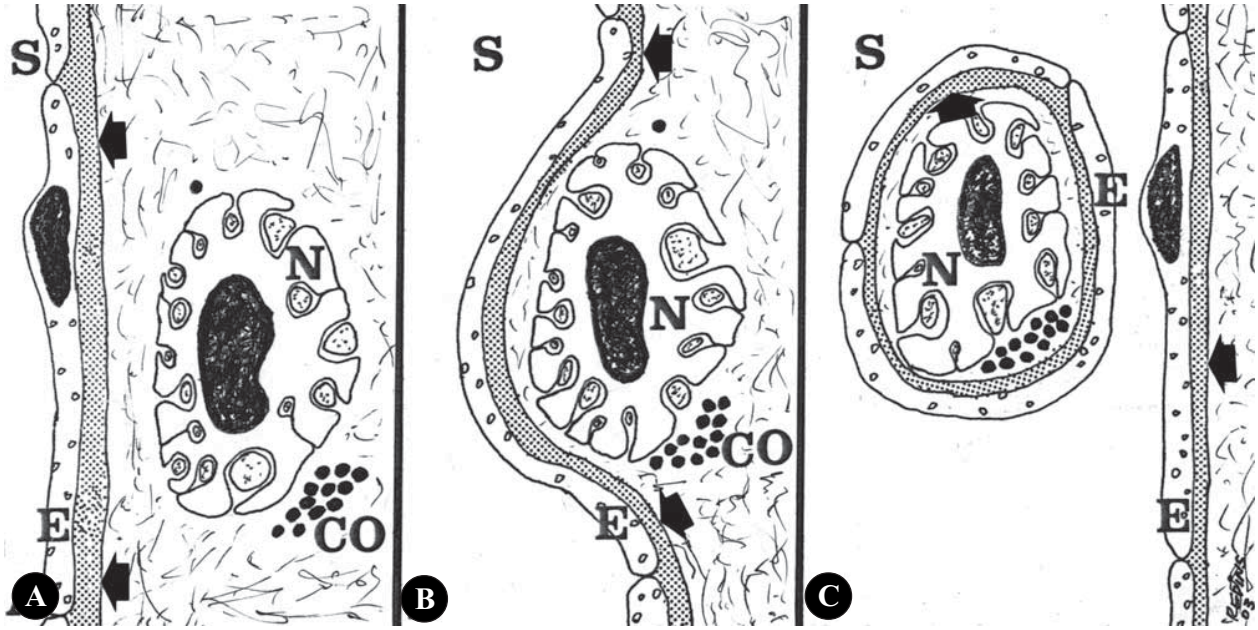

Figure 2. Hypothetical sequence of events to explain the structures seen in Figure 1. Panel **A** shows the nerve (**N**) close to the venous sinus wall followed by it engulfment (panels **B** and **C**) by endothelial cells (**E**) and the basal lamina (**arrows**). Note that the basal lamina is shown proportianally thicker than it would be *in vivo*. **S** = lumen of the venous sinus; **CO** = a cluster of collagen fibers in the subendothelium, near the nerve.

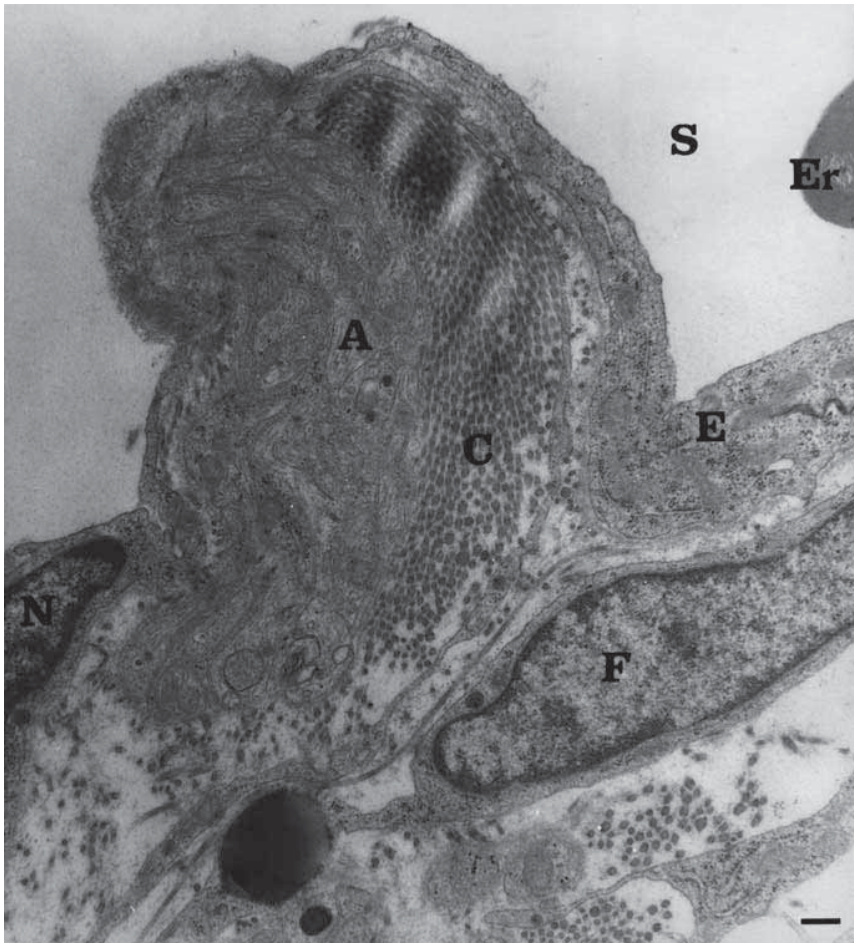

Figure 3. Electron micrograph of an oblique section across the region where the conarii nerve reaches the pineal capsule, showing a bundle of axons (**A**) collagen fibers (**C**), an endothelial cell (**E**) with its nucleus (**N**) and a fibroblast (**F**). **Er** = portion of an erythrocyte in the lumen of the venous sinus (**S**). Bar = 0.25 μm.

including birds, play a crucial role in the regulation of pineal melatonin secretion [3, 4]. In *C. parvirostris*, the sympathetic innervation is abundant and the pineal gland shows a circannual rhythm in its secretory activity, with an increase in secretory vesicles during periods of rest [8].

In humans, the conarii nerve courses along the inferior wall of the *vena magna cerebri*, in a subendothelial position in the floor of the straight sinus [11]. This nerve is about 0.1 mm thick and consists of approximately 150 nerve fibers. Sympathetic unmyelinated nerve fibers, in the form of bundles or single fibers separated from blood vessels, penetrate the external limiting membrane at multiple sites at the dorsal pole of the pineal gland in order to supply the parenchyma of the gland. In the rat, each conarii nerve has about 440 axons [2]. The conarii nerve observed in *C. parvirostris* was thinner than in humans and had fewer nerve fibers than in humans and rats.

Sato and Wake [9,10] observed that most frequently catecholamine-containing nerve fibers were arranged more densely in the anterior wall of the distal portion of the avian pineal gland and were accompained by blood vessels. Within the parenchyma, these sympathetic nerve fibers were closely attached to blood vessels that penetrated the capsule. Similar results were observed in *C. parvirostris*, where the conarii nerve was located in anterior and distal portions of the pineal gland.

The presence of collagen fibers that occupied approximately 30% of the conarii nerve suggested that these fibers provided structural support to the nerve and contributed to its elasticity by allowing the nerve to be stretched during its course within the venous sinus.

The course of the conarii nerve within one of the venous sinuses which enclose the tinamid bird pineal gland is probably not a rare event, in view of this nerve localization, but may be difficult to observe because of the nerve's small diameter.

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Received: May 23, 2003
Accepted: November 25, 2003