Three-dimensional Ultrastructure of Synoviocytes in the Horse Joint

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The synovial membrane displays a superficial cellular lining composed of two types of synoviocytes, "absorptive" macrophages (type A synoviocytes) and "secretory" fibroblast-like cells (type B synoviocytes). Type B cells, being proper in the synovial intima, secrete collagen, hyaluronan and other proteoglycans into the interstitium and joint cavity. I report here the three-dimensional ultrastructure and distribution of type B synoviocytes as well as type A cells in the carpal joints of the horse.

Type A synoviocytes faced the joint cavity, and were spherical in shape and densely covered with filo-and lamellipodia, being unique structures to macrophages. The cells tended to gather at the upper region of synovial villi, while they were distributed sparsely at the middle region of the villi, and were few at the basal region of the villi. The rich existence of type A cells in the villous tips is reasonable to contact and uptake substances and cellular elements wandering in the joint cavity.

Type B synoviocytes were mostly embedded in an amorphous or somewhat fibrous matrix. So we observed the synovial intima after removing the intracellular matrix by NaOH maceration method. By using such macerated samples, we first tried here to observe entire shape of type B synoviocytes. In the basal region of the villi, type B synoviocytes, which are situated in close proximity to the synovial cavity, projected thick processes horizontally and intertwined to form a regular network of processes on the synovial surface. In the upper region of the villi, type B cells existed in various depth of the synovial intima. Type B cells, whose cell bodies were near to the synovial surface, issued processes along the surface, forming a meshwork similar to that seen in the basal region of the villi. Type B cells, whose cell bodies were in the deeper layer of the synovial intima, extended a process vertically towards the joint cavity. The vertical processes frequently protruded into the joint cavity like an antenna and their tips exposed to the cavity were covered with a tuft of long microvilli, displaying a unique microvillous crown. Such microvillous crowns appeared as a group at the upper region of villi. TEM observation confirmed the rich existence of granular endoplasmic reticulum throughout the cytoplasm as well as processes.

In addition to thick processes and microvillous crown, type B synoviocytes possessed membranous processes extending from their cell bodies and rod-shaped primary processes. The membranous processes were flat and pleomorphic, having a few filopodia. They formed totally a flat sheet covering the surface of the synovial intima and demarcated it against the joint cavity, but the covering was still fragmental. Since type B synoviocytes are engaged in secretion of hyaluronate, glycoproteins and other components into the synovial cavity, contact with the synovial cav-

ity via totally broad cell surface may be reasonable for effective secretion. Also, this structure may function as cellular elements of the barrier (blood-joint barrier) between blood vessel and joint cavity.

Type B synoviocytes in the horse contain PGP9.5, a marker substance unique to neurons and sensory cells. The microvillous crowns of type B cells are closely similar to receptor sites of gut endocrine cells, sensory cells open to the gut lumen. These findings suggest that type B cells monitor, with their microvillous crowns, certain mechanical and chemical conditions of the joint cavity, such as pressure, viscosity and change of chemical composition.

Effects of streptozotocin on intracellular Ca^{2+} dynamics in rat pancreatic islets.

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1. The present study was carried out to examine the effects of streptozotocin on changes in intracellular Ca^{2+} concentration ($[Ca^{2+}]_i$) and to elucidate a possibility that streptozotocin produces NO in rat pancreatic β cells.

2. A microfluorometric method and a confocal imaging analysis, combined with NO imaging with Diaminofluorescein-2 (DAF-2), were adopted. NO production from streptozotocin in Krebs-Henseleit buffer was also measured with Griess reagent.

3. Stimulation of isolated pancreatic islets with 20 mM glucose caused a biphasic increase in $[Ca^{2+}]_i$, the first transient rise (first phase) followed by a continuous $[Ca^{2+}]_i$ increase (second phase). A confocal imaging suggested that the biphasic $[Ca^{2+}]_i$ changes occured mostly in the β cells. The second phase was inhibited by adding 1 mM or 2 mM streptozotocin to perifusate. This inhibitory effect was persisted even after pretreatment with 10 μM oxyhemoglobin, an extracellular NO scavenger.

4. NO_2^- production was detected in a dose-dependent manner in a solution in which streptozotocin was dissolved. Imaging analysis with DAF-2 also suggested intracellular production of NO in islet cells and NO production lasted even after the withdrawal of streptozotocin from the perifusate.

5. These results indicate that streptozotocin produces NO and the NO thus produced can inhibit glucose-induced $[Ca^{2+}]_i$ dynamics in the pancreatic β cells.