Symposium on Neurobiology of Mastication: From Molecular to Systems Approach

November 19–21, 1998
Tokyo, Japan

This international symposium was organized by Dr Y. Nakamura (Tokyo Medical and Dental University, Japan) to provide an international forum for the discussion of recent advances in a variety of fields related to the neurobiology of mastication. The symposium was divided into 5 plenary sessions (Molecular Mechanisms of Signal Transduction, Cellular Mechanisms of Information Processing, Systems Sensory Mechanisms, Systems Motor Mechanisms, and Cortical Mechanisms of Information Processing) comprising 28 presentations; in addition, 44 posters were presented. The symposium also served as a vehicle for the recognition of the many outstanding contributions to the field by Dr Nakamura in view of his retirement in 1999. The proceedings of the symposium will be published by Elsevier Science B.V. The following briefly outlines selected plenary presentations.

Dr L. J. Goldberg (USA) opened the symposium with a presentation that provided an overview of the process of mastication. He noted that electrophysiologic, histologic, and pharmacologic studies continue to provide important insights into the neural and chemical mechanisms underlying mastication, but that new approaches to collecting and interpreting data are required to elucidate these mechanisms and the general principles of organization of the masticatory system.

The properties of craniofacial primary afferents and their influences on brain stem neurons was the subject of several presentations. Dr K. Toda (Japan) described 4 subtypes of oral mucosal nociceptive afferents (A-delta high threshold mechanonociceptor, A-delta mechanoheat nociceptor, A-delta polymodal nociceptor, and C-polymodal nociceptor) found in a rat in vitro preparation. Dr K. Messlinger (Germany) outlined some of the properties of nociceptive afferents in in vivo preparations and the properties of trigeminal brain stem nociceptive neurons that process these afferent inputs and the role especially of substance P in this transmission process. The properties of jaw muscle spindle afferents were described by Dr T. Morimoto (Japan), who provided evidence for their contribution to masticatory control, in particular a possible role as a feedforward mechanism in the control of masticatory force. Dr K. Appenteng (Ghana) reviewed his studies, which indicate that GABAergic premotor neurons form axo-axonic contacts on glutaminergic boutons synapsing on trigeminal motoneurons and may provide a mechanism by which the masticatory pattern generator gates excitatory transmission in these motoneurons. Presentations by Drs R. Donga (England) and J. P. Lund (Canada) also addressed brain stem premotor mechanisms involved in the control and patterning of mastication. Donga noted that the masticatory pattern generator can be subdivided into smaller modules having phasic or tonic outputs, while Lund provided data on how the pattern generator elaborates the different masticatory patterns in response to cerebral cortical and craniofacial afferent inputs. Two related presentations by Drs Y. Shigenaga and A. Yoshida (Japan) outlined the morphologic substrates of some of these craniofacial inputs and their central consequences. The authors reported that the central organization of jaw muscle spindle afferent inputs onto masticatory motoneurons differs between group Ia and II spindle afferents and that different populations of trigeminal principalis and oralis neurons may play distinct roles in sensory discrimination and in the reflex control of trigeminal motoneurons.

Several presentations outlined findings from in vitro as well as in vivo preparations of the properties of masticatory motoneurons. Dr S. Chandler (USA) described their intrinsic membrane properties and excitatory transmission processes exerted through serotonergic and glutaminergic inputs, Dr N. Katakura (Japan) described the reorganization

of corticobulbar projections and the pattern generator itself in the maturational change from suckling to mastication, and Dr A. Berger (USA) outlined the postnatal developmental changes that occur in the modulation of glycinergic synaptic transmission in hypoglossal motoneurons. Dr I. Ono (Japan) also described findings, but from in vivo studies, of the modulation of the inspiratory-related activity of hypoglossal motoneurons during fictive ingestion or rejection.

An overview of the reflex control of masticatory muscles in humans by Dr K. S. Turker (Australia) focused on the development of reliable techniques for studying the synaptic connections of different craniofacial afferent inputs to masticatory motoneurons that control human jaw muscles. Dr A. Takanishi (Japan) described his studies aimed at clarifying mechanisms related to jaw motor control through the development of a robot based on currently known human anatomy and physiology.

The cerebral cortical mechanisms related to somatosensation and masticatory motor control were first addressed by Dr M. Takada (Japan), who described some of the anatomically defined pathways originating from different cortical areas and projecting to other cortical and subcortical regions. Dr T. Yamamoto (Japan) outlined his findings on the properties of neurons in the cortical taste area and their likely roles in taste perception, memory, and ingestive behaviors. Dr K. Iwata (Japan) described the properties of nociceptive neurons in the somatosensory cortex and anterior cingulate cortex in awake monkeys in relation to pain perception and its modulation by attentional factors. Cortical mechanisms in awake animals were also the subject of two other presentations by Drs B. J. Sessle (Canada) and H. Hiraba (Japan), which reported on the input and output properties of neurons in the somatosensory cortex and motor cortex and their functional interrelationships in trained motor behaviors or in semiautomatic movements such as mastication.

The symposium was concluded by Dr Nakamura, who briefly reviewed the many advances in knowledge of the neural mechanisms underlying mastication. He noted that our knowledge base had developed—encompassing engineering as well as many biologic principles—to the extent that the field can now justifiably be called "the neurobiology of mastication."

—Barry J. Sessle