

University of Groningen

The role of the nucleus retroambiguus in the neural control of respiration, vocalization and mating behavior

Boers, José

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2005

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Boers, J. (2005). *The role of the nucleus retroambiguus in the neural control of respiration, vocalization and mating behavior*. s.n.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

References

- Abrahams VC, Keane J. 1984. Contralateral, midline, and commissural motoneurons of neck muscles: a retrograde HRP study in the cat. *J Comp Neurol* 223:448-456.
- Adametz J, O'Leary JL. 1959. Experimental mutism resulting from periaqueductal lesions in cats. *Neurology* 9:636-642.
- Alstermark B, Kimmel H, Tantisira B. 1987. Monosynaptic raphespinal and reticulospinal projection to forelimb motoneurons in cats. *Neurosci Lett* 74:286-290.
- Altschuler SM, Bao XM, Miselis RR. 1991. Dendritic architecture of nucleus ambiguus motoneurons projecting to the upper alimentary tract in the rat. *J Comp Neurol* 309:402-414.
- Alves SE, Weiland NG, Hayashi S, McEwen BS. 1998. Immunocytochemical localization of nuclear estrogen receptors and progesterin receptors within the rat dorsal raphe nucleus. *J Comp Neurol* 391:322-334.
- Amandusson A, Hermanson O, Blomqvist A. 1995. Estrogen receptor-like immunoreactivity in the medullary and spinal dorsal horn of the female rat. *Neurosci Lett* 196:25-28.
- Annisimova NP, Saywell SA, Ford TW, Kirkwood PA. 2001. Distributions of EPSPs from individual expiratory bulbospinal neurons in the normal and chronically lesioned thoracic spinal cord. *XXXIV Int Congress Physiol Sci*: Abstract 1029.
- Axelson JF, Shannon W, van Leeuwen FW. 1992. Immunocytochemical localization of estrogen receptors within neurotensin cells in the rostral preoptic area of the rat hypothalamus. *Neurosci Lett* 136:5-9.
- Bainton CR, Kirkwood PA. 1979. The effect of carbon dioxide on the tonic and the rhythmic discharges of expiratory bulbospinal neurones. *J Physiol* 296:291-314.
- Ballantyne D, Richter DW. 1986. The non-uniform character of expiratory synaptic activity in expiratory bulbospinal neurones of the cat. *J Physiol* 370:433-456.
- Bandler R, Carrive P, Zhang SP. 1991. Integration of somatic and autonomic reactions within the midbrain periaqueductal grey: viscerotopic, somatopic and functional organization. *Brain Res* 87:269-305.
- Bandler R, Depaulis A. 1991. Midbrain periaqueductal gray control of defensive behavior in the cat and rat. In: Depaulis A, Bandler R (eds). *The midbrain periaqueductal gray matter*. New York: Plenum Press, p175-198.
- Barbarelli P, Minelli A, Gazzanelli G, Malatesta M. 1994. Commissural connections of the cat periaqueductal gray matter studied with anterograde and retrograde tract-tracing techniques. *Neurosci* 60:781-799.
- Barillot JC, Bianchi AL. 1979. Temporal patterns of antidromic potential latency of respiratory neurones in the medulla oblongata (author's transl). *J Physiol (Paris)* 75:783-803.
- Bergmans J. 1970. *The Physiology of Single Human Nerve Fibres*. Louvain: Vander.
- Berman AL. 1968. *The brain stem of the cat: A cytoarchitectonic atlas with stereotaxic coordinates*. Madison: The University of Wisconsin Press.
- Bieger D, Hopkins DA. 1987. Viscerotopic representation of the upper alimentary tract in the medulla oblongata in the rat: the nucleus ambiguus. *J Comp Neurol* 262:546-562.
- Blaustein JD. 1992. Cytoplasmic estrogen receptors in rat brain: immunocytochemical evidence using three antibodies with distinct epitopes. *Endocrinol* 131:1336-1342.
- Blurton-Jones MM, Roberts JA, Tuszynski MH. 1999. Estrogen receptor immunoreactivity in the adult primate brain: neuronal distribution and association with p75, trkA, and choline acetyltransferase. *J Comp Neurol* 405:529-542.
- Boers J, Holstege G. 1998. Estrogen receptor immunoreactive neurons in the nucleus retroambiguus project to the lumbar cord in the female hamster. *Neurosci Abstr* 24 950.
- Boers J, Holstege G. 1999. Evidence for direct projections from the nucleus retroambiguus to the motoneurons of the external oblique abdominal muscle in the female cat. *Neur-*

References

- osci Abstr* 25 (2).
- Boers J, Gerrits PO, Meijer E, Holstege G. 1999. Estrogen receptor-alpha-immunoreactive neurons in the mesencephalon, pons and medulla oblongata of the female golden hamster. *Neurosci Lett* 267:17-20.
- Boers J, Klop EM, Hulshoff AC, de Weerd H, Holstege G. 2002. Direct projections from the nucleus retroambiguus to cricothyroid motoneurons in the cat. *Neurosci Lett* 319:5-8.
- Boers J, Kirkwood PA, Holstege G. 2003. Functional heterogeneity of neurons in the nucleus retroambiguus with sacral projections in female cats. *Neurosci Abstr* 499.4.
- Boers J, Hulshoff AC, de Weerd H, Mouton LJ, Kuipers R and Holstege G. 2005a. Afferent projections to pharynx and soft palate motoneurons: a light and electron microscopical tracing study in cat. *J Comp Neurol* 486:18-38.
- Boers J, Ford TW, Holstege G and Kirkwood PA. 2005b. Functional heterogeneity among neurons in the nucleus retroambiguus with lumbosacral projections in female cats. *J Neurophysiol* (article in press 10.1152/jn.00370.2005).
- Cameron WE, Averill DB, Berger AJ. 1983. Morphology of cat phrenic motoneurons as revealed by intracellular injection of horseradish peroxidase. *J Comp Neurol* 219:70-80.
- Carrive P, Bandler R, Dampney RA. 1989. Viscerotopic control of regional vascular beds by discrete groups of neurons within the midbrain periaqueductal gray. *Brain Res* 493:385-390.
- Ciriello J, Caverson MM, Polosa C. 1986. Function of the ventrolateral medulla in the control of the circulation. *Brain Res* 396:359-391.
- Cohen MI, Feldman JL, Sommer D. 1985. Caudal medullary expiratory neurone and internal intercostal nerve discharges in the cat: effects of lung inflation. *J Physiol* 368:147-178.
- Corodimas KP, Morrell JI. 1990. Estradiol-concentrating forebrain and midbrain neurons project directly to the medulla. *J Comp Neurol* 291:609-620.
- Cowan WM, Gottlieb DI, Hendrickson AE, Price JL, Woolsey TA. 1972. The autoradiographic demonstration of axonal connections in the central nervous system. *Brain Res* 37:21-51.
- Cowie RJ, Holstege G. 1992. Dorsal mesencephalic projections to pons, medulla, and spinal cord in the cat: limbic and non-limbic components. *J Comp Neurol* 319:536-559.
- Davies RO, Kubin L. 1986. Projection of pulmonary rapidly adapting receptors to the medulla of the cat: an antidromic mapping study. *J Physiol* 373:63-86.
- Davis PJ, Nail BS. 1984. On the location and size of laryngeal motoneurons in the cat and rabbit. *J Comp Neurol* 230:13-32.
- Dellovade TL, Blaustein JD, Rissman EF. 1992. Neural distribution of estrogen receptor immunoreactive cells in the female musk shrew. *Brain Res* 595:189-194.
- De Troye A, Kirkwood PA, Wilson TA. 2005. respiratory action of the intercostal muscles. *Physiol Rev* 85:717-756.
- Doty RW, Bosma JF. 1956. An electromyographic analysis of reflex deglutition. *J Neurophysiol* 19:44-60.
- Ellenberger HH, Feldman JL. 1988. Monosynaptic transmission of respiratory drive to phrenic motoneurons from brainstem bulbospinal neurons in rats. *J Comp Neurol* 269:47-57.
- Ellenberger HH, Feldman JL, Goshgarian HG. 1990. Ventral respiratory group projections to phrenic motoneurons: electron microscopic evidence for monosynaptic connections. *J Comp Neurol* 302:707-14.
- Ennis M, Xu SJ, Rizvi TA. 1997. Discrete subregions of the rat midbrain periaqueductal gray project to nucleus ambiguus and the periambigular region. *Neurosci* 80:829-845.
- Feldman JL, Loewy AD, Speck DF. 1985. Projections from the ventral respiratory group to phrenic and intercostal motoneurons in cat: an autoradiographic study. *J Neurosci* 5:1993-2000.

- Ford TW, Meehan CF, and Kirkwood PA. 2001. Functional roles for nucleus retroambiguus neurones projecting to the lumbosacral spinal cord of the cat. *XXXIV Int Congress Physiol Sci*: Abstr 983.
- Fox CA, Ross LR, Handa RJ, Jacobson CD. 1991. Localization of cells containing estrogen receptor-like immunoreactivity in the Brazilian opossum brain. *Brain Res* 546:96-105.
- Fritz N, Illert M, Saggau P. 1981. Location of dorsal interosseus motor nuclei in the cat. *Neurosci Lett* 21:243-248.
- Fritz N, Illert M, Saggau P. 1986a. Location of motoneurons projecting to the cat distal forelimb. I. Deep radial motornuclei. *J Comp Neurol* 244:286-301.
- Fritz N, Illert M, Reeh P. 1986b. Location of motoneurons projecting to the cat distal forelimb. II. Median and ulnar motornuclei. *J Comp Neurol* 244:302-312.
- Fukuda H, Fukai K. 1988. Discharges of bulbar respiratory neurons during rhythmic straining evoked by activation of pelvic afferent fibers in dogs. *Brain Res* 449:157-166.
- Gacek RR. 1975. Localization of laryngeal motor neurons in the kitten. *Laryngoscope* 85:1841-1861.
- Gerrits PO, Holstege G. 1996. Pontine and medullary projections to the nucleus retroambiguus: a wheat germ agglutinin-horseradish peroxidase and autoradiographic tracing study in the cat. *J Comp Neurol* 373:173-185.
- Gerrits PO, Holstege G. 1999. Descending projections from the nucleus retroambiguus to the iliopsoas motoneuronal cell groups in the female golden hamster: possible role in reproductive behavior. *J Comp Neurol* 403:219-228.
- Gerrits PO, Vodde C, Holstege G. 2000a. Retroambiguus projections to the cutaneous trunci motoneurons may form a pathway in the central control of mating. *J Neurophysiol* 83:3076-3083.
- Gerrits PO, Krukerink M, Meijer E, Holstege G. 2000b. Estrogen receptor-alpha immunoreactive neurons in the periaqueductal gray project to the nucleus retroambiguus in the female hamster. *Neurosci Abstr* 30:212.
- Gerrits PO, Mouton LJ, de Weerd H, Georgiadis JR, Krukerink M, Holstege G. 2004. Ultrastructural evidence for a direct excitatory pathway from the nucleus retroambiguus to lateral longissimus and quadratus lumborum motoneurons in the female golden hamster. *J Comp Neurol* 480:352-363.
- Giovanelli Barilari MS, Kuypers HGJM. 1969. Propriospinal fibers interconnecting the spinal enlargements in the cat. *Brain Res* 14:321-330.
- Gobel S, Falls WM, Hockfield S. 1977. The division of the dorsal and ventral horns of the mammalian caudal medulla into eight layers using anatomical criteria. In: Anderson, Matthews (eds). *Pain in the trigeminal region*. Elsevier/North-Holland Press, p443-453.
- Gordon DC, Richmond FJ. 1991. Distribution of motoneurons supplying dorsal suboccipital and intervertebral muscles in the cat neck. *J Comp Neurol* 304:343-356.
- Greene GL, Sobel NB, King WJ, Jensen EV. 1984. Immunochemical studies of estrogen receptors. *J Steroid Biochem* 20:51-56.
- Grélot L, Milano S, Gestreau C, Bianchi AL. 1996. Are medullary respiratory neurones multipurpose neurones? In: Bostock H, Kirkwood PA, Pullen AH (eds). *The Neurobiology of Disease: Contributions from Neurosci to Clinical Neurology*. Cambridge: Cambridge University Press, p.229-308.
- Grélot L, AD Miller. 1997. Neural control of respiratory muscle activation during vomiting. In: Miller AD, Bianchi AL, Bishop BP (eds). *Neural control of the respiratory muscles*. Boca Raton (FL): CRC Press, p239-248.
- Hayakawa T, Zheng JQ, Seki M, Yajima Y. 1998. Synaptology of the direct projections from the nucleus of the solitary tract to pharyngeal motoneurons in the nucleus ambiguus of the rat. *J Comp Neurol* 393:391-401.
- Hayakawa T, Zheng JQ, Seki M. 1999. Direct parabrachial nuclear projections to the pha-

References

- ryngeal motoneurons in the rat: an anterograde and retrograde double-labeling study. *Brain Res* 816:364-374.
- Haywood SA, Simonian SX, van der Beek EM, Bicknell RJ, Herbison AE. 1999. Fluctuating estrogen and progesterone receptor expression in brainstem norepinephrine neurons through the rat estrous cycle. *Endocrinol* 140:3255-3263.
- Heimer L. 1995. *The human brain and spinal cord: functional neuroanatomy and dissection guide*. Second edition. New York: Springer Verlag, p415-421.
- Holstege G. 1987. Some anatomical observations on the projections from the hypothalamus to brainstem and spinal cord: an HRP and autoradiographic tracing study in the cat. *J Comp Neurol* 260:98-126.
- Holstege G. 1989. Anatomical study of the final common pathway for vocalization in the cat. *J Comp Neurol* 284:242-52.
- Holstege G. 1991. Descending motor pathways and the spinal motor system: limbic and non-limbic components. *Prog Brain Res* 87:307-412.
- Holstege G. 1996. The somatic motor system. *Prog Brain Res* 107:9-26.
- Holstege G, Kuypers HGJM, Dekker JJ. 1977. The organization of the bulbar fibre connections to the trigeminal facial and hypoglossal motor nuclei. II. An autoradiographic tracing study in the cat. *Brain* 100:265-286.
- Holstege G, Kuypers HG, Boer RC. 1979. Anatomical evidence for direct brain stem projections to the somatic motoneuronal cell groups and autonomic preganglionic cell groups in cat spinal cord. *Brain Res* 171:329-333.
- Holstege G, Kuypers HG. 1982. The anatomy of brain stem pathways to the spinal cord in cat. A labeled amino acid tracing study. *Prog Brain Res* 57:145-175.
- Holstege G, Graveland G, Bijker-Biemoed C, Schuddeboom I. 1983. Location of motoneurons innervating soft palate, pharynx and upper esophagus. Anatomical evidence for a possible swallowing center in the pontine reticular formation. An HRP and autoradiographical tracing study. *Brain Behav Evol* 23:47-62.
- Holstege G, Meiners L, Tan K. 1985. Projections of the bed nucleus of the stria terminalis to the mesencephalon, pons, and medulla oblongata in the cat. *Exp Brain Res* 58:379-391.
- Holstege G, Griffiths D, de Wall H, Dalm E. 1986. Anatomical and physiological observations on supraspinal control of bladder and urethral sphincter muscles in the cat. *J Comp Neurol* 250:449-461.
- Holstege G, Tan J. 1987. Supraspinal control of motoneurons innervating the striated muscles of the pelvic floor including urethral and anal sphincters in the cat. *Brain* 110:1323-44.
- Holstege G, Van Neerven J, Evertse F. 1987. Spinal cord location of the motoneurons innervating the abdominal, cutaneous maximus, latissimus dorsi and longissimus dorsi muscles in the cat. *Exp Brain Res* 67:179-194.
- Holstege G, Blok B. 1989. Descending pathways to the cutaneous trunci muscle motoneuronal cell group in the cat. *J Neurophysiol* 62:1260-1269.
- Holstege G, Kerstens L, Moes MC, Vanderhorst VG. 1997. Evidence for a periaqueductal gray-nucleus retroambiguus-spinal cord pathway in the rat. *Neurosci* 80:587-598.
- Hopkins DA, Holstege G. 1978. Amygdaloid projections to the mesencephalon, pons and medulla oblongata in the cat. *Exp Brain Res* 32:529-547.
- Hopkins DA, Bieger D, deVente J, Steinbusch WM. 1996. Vagal efferent projections: viscerotopy, neurochemistry and effects of vagotomy. *Prog Brain Res* 107:79-96.
- Hörner M, Kümmel H. 1993. Topographical representation of shoulder motor nuclei in the cat spinal cord as revealed by retrograde fluorochrome tracers. *J Comp Neurol* 335:309-19.
- Iscoe S. 1998. Control of abdominal muscles. *Prog Neurobiol* 56:433-506.

- Jakuš J, Tomori Z, and Stránský A. 1985. Activity of bulbar respiratory neurones during cough and other respiratory tract reflexes in cats. *Physiol Bohemoslov* 34:127-136.
- Jankowska E. 2001. Spinal interneuronal systems: identification, multifunctional character and reconfigurations in mammals. *J Physiol* 533:31-40.
- Jansen ASP, Farkas E, Mac Sams J, Loewy AD. 1998. Local connections between the columns of the periaqueductal gray matter: a case for intrinsic neuromodulation. *Brain Res* 784:329-336.
- Jones BE, Friedman L. 1983. Atlas of catecholamine perikarya, varicosities and pathways in the brainstem of the cat. *J Comp Neurol* 215:382-396.
- Jürgens U, Pratt R. 1979. Role of the periaqueductal grey in vocal expression of emotion. *Brain Res* 167:367-378.
- Katada A, Sugimoto T, Utsumi K, Nonaka S, Sakamoto T. 1996. Functional role of ventral respiratory group expiratory neurons during vocalization. *Neurosci-Res* 26:225-33.
- Kiley-Worthington M. 1976. The tail movements of ungulates, canids and felids with particular reference to their causation and function as displays. *Behaviour* 56:69-115.
- Kirkwood PA. 1995. Synaptic excitation in the thoracic spinal cord from expiratory bulbospinal neurones in the cat. *J Physiol* 484:201-225.
- Kirkwood PA, Munson JB, Sears TA, Westgaard RH. 1988. Respiratory Interneurons in the thoracic spinal cord of the cat. *J Physiol* 395:161-192.
- Kirkwood PA, Schmid K, Sears TA. 1993. Functional identities of thoracic respiratory interneurons in the cat. *J Physiol* 461:667-87.
- Kirkwood PA, Road JD. 1995. On the functional significance of long monosynaptic descending pathway to spinal motoneurons. In Taylor A, Gladden MH, Durbada R (eds). *Alpha and gamma motor systems*. New York: Plenum Press, p589-592.
- Kirkwood PA, Ford TW, Donga R, Saywell SA, Holstege G. 1999. Assessing the strengths of motoneuron inputs: different anatomical and physiological approaches compared. *Prog Brain Res* 123:67-82.
- Kirkwood PA, Lawton M, Ford TW. 2002. Plateau potentials in hindlimb motoneurons of female cats under anaesthesia. *Exp Brain Res* 146:399-403.
- Kirkwood PA, Ford TW. 2004. Do respiratory neurons control female receptive behavior: a suggested role for a medullary central pattern generator? *Prog Brain Res* 143:105-114.
- Kitamura S, Richmond FJ. 1994. Distribution of motoneurons supplying dorsal and ventral suboccipital muscles in the feline neck. *J Comp Neurol* 347:25-35.
- Krieger MS, Morrell JI, Pfaff DW. 1976. Autoradiographic localization of estradiol-concentrating cells in the female hamster brain. *Neuroendocrinol* 22:193-205.
- Krieger MS, Conrad LC, Pfaff DW. 1979. An autoradiographic study of the efferent connections of the ventromedial nucleus of the hypothalamus. *J Comp Neurol* 183:785-815.
- Krogh JE, Denslow JS. 1979. The cutaneous trunci muscle in spinal reflexes. *Electromyogr Clin Neurophysiol* 19:157-164.
- Krogh JE, Towns LC. 1984. Location of the cutaneous trunci motor nucleus in the dog. *Brain Res* 295:217-225.
- Kuypers HGJM. 1981. Anatomy of the descending pathways. In: Burke RE (ed). *Handbook of Physiology, The nervous system II*. p597-666.
- Laflamme N, Nappi RE, Drolet G, Labrie C, Rivest S. 1998. Expression and neuropeptidergic characterization of estrogen receptors (ERalpha and ERbeta) throughout the rat brain: anatomical evidence of distinct roles of each subtype. *J Neurobiol* 36:357-378.
- Larnicol N, Rose D, Marlot D, Duron B. 1982. Spinal localization of the intercostal motoneurons innervating the upper thoracic spaces. *Neurosci Lett* 31:13-18.
- Larson CR, Kistler MK. 1984. Periaqueductal gray neuronal activity associated with laryngeal

References

- EMG and vocalization in the awake monkey. *Neurosci Lett* 46:261-266.
- Lawn AM. 1966. The localization, in the nucleus ambiguus of the rabbit, of the cells of origin of motor nerve fibers in the glossopharyngeal nerve and various branches of the vagus nerve by means of retrograde degeneration. *J Comp Neurol* 127:293-306.
- Leedy MG, Hart BL. 1985. Female and male sexual responses in female cats with ventromedial hypothalamic lesions. *Behav Neurosci* 99:936-941.
- Lehman MN, Ebling FJ, Moenter SM, Karsch FJ. 1993. Distribution of estrogen receptor-immunoreactive cells in the sheep brain. *Endocrinol* 133:876-886.
- Li HY, Blaustein JD, De Vries GJ, Wade GN. 1993. Estrogen-receptor immunoreactivity in hamster brain: preoptic area, hypothalamus and amygdala. *Brain Res* 631:304-312.
- Liinamaa TL, Keane J, Richmond FJ. 1997. Distribution of motoneurons supplying feline neck muscles taking origin from the shoulder girdle. *J Comp Neurol* 377:298-312.
- Lipski J. 1981. Antidromic activation of neurones as an analytic tool in the study of the central nervous system. *J Neurosci Meth* 4:1-32.
- Lipski J, Martin-Body RL. 1987. Morphological properties of respiratory intercostal motoneurons in cats as revealed by intracellular injection of horseradish peroxidase. *J Comp Neurol* 260:423-434.
- Loewy AD, Burton H. 1978. Nuclei of the solitary tract: efferent projections to the lower brain stem and spinal cord of the cat. *J Comp Neurol* 181:421-450.
- Lovick TA. 1993. Integrated activity of cardiovascular and pain regulatory systems: role in adaptive behavioural responses. *Prog Neurobiol* 40:631-44.
- Lovick TA. 1996. Midbrain and medullary regulation of defensive cardiovascular functions. *Prog Brain Res* 107:301-313.
- Lunteren E van, Dick TE. 1997. Muscles of upper airway and accessory respiratory muscles. In: Miller AD, Bianchi AL, Bishop BP (eds). *Neural control of the respiratory muscles*. Boca Raton (FL): CRC Press. p 47-58.
- Matsushita M, Ueyama T. 1973. Ventral motor nucleus of the cervical enlargement in some mammals; its specific afferents from the lower cord levels and cytoarchitecture. *J Comp Neurol* 150:33-52.
- Merrill EG. 1970. The lateral respiratory neurones of the medulla: their associations with nucleus ambiguus, nucleus retroambiguus, the spinal accessory nucleus and the spinal cord. *Brain Res* 24:11-28.
- Merrill EG. 1974. Finding a respiratory function for the medullary respiratory neurons. In: Bellairs R, Gray EG (eds). *Essays on the nervous system*. Oxford: Clarendon Press, 451-486.
- Merrill EG, Lipski J. 1987. Inputs to intercostal motoneurons from ventrolateral medullary respiratory neurons in the cat. *J Neurophysiol* 57:1837-1853.
- Mesulam M-M. 1982. Principles of horseradish peroxidase neurohistochemistry and their applications for tracing neural pathways-axonal transport, enzyme histochemistry and light microscopic analysis. In: Mesulam M-M (ed). *Tracing Neural Connections With Horseradish Peroxidase*. Chichester: John Wiley, p1-151.
- Michael RP. 1961. Observations upon the sexual behaviour of the domestic cat (*Felis catus* L.) under laboratory conditions. *Behaviour* 18:1-24.
- Miller AD. 1987. Localization of motoneurons innervating individual abdominal muscles of the cat. *J Comp Neurol* 256:600-606.
- Miller AD, Tan LK, Suzuki I. 1987. Control of abdominal and expiratory intercostal muscle activity during vomiting: role of ventral respiratory group expiratory neurons. *J Neurophysiol* 57:1854-1866.
- Miller AD, Nonaka S, Sinišaia MS, Jakuš J. 1995. Multifunctional ventral respiratory group: bulbospinal expiratory neurons play a role in pudendal discharge during vomiting. *J Auton Nerv Syst* 54:253-260.

- Miller AD, Nonaka S, Jakus J, Yates BJ. 1996. Modulation of vomiting by the medullary midline. *Brain Res* 737:51-58.
- Miller AD, Grélot L. 1997. Neural control of respiratory muscle activation during vomiting. In: Miller AD, Bianchi AL, Bishop BP (eds). *Neural control of the respiratory muscles*. Boca Raton (FL): CRC Press. p 239-248.
- Miller AJ. 1972. Characteristics of the swallowing reflex induced by peripheral nerve and brain stem stimulation. *Exp Neurol* 34:210-222.
- Miyazaki T, Yoshida Y, Hirano M, Shin T, Kanaseki T. 1981. Central location of the motoneurons supplying the thyrohyoid and the geniohyoid muscles as demonstrated by horseradish peroxidase method. *Brain Res* 219:423-427.
- Mizuno N, Konishi A, Sato M. 1975. Localization of masticatory motoneurons in the cat and rat by means of retrograde axonal transport of horseradish peroxidase. *J Comp Neurol* 164:105-115.
- Molenaar I. 1978. The distribution of propriospinal neurons projecting to different motoneuronal cell groups in the cat's brachial cord. *Brain Res* 158:203-206.
- Mouton LJ, Holstege G. 1994. The periaqueductal gray in the cat projects to lamina VIII and the medial part of lamina VII throughout the length of the spinal cord. *Exp Brain Res* 101:253-264.
- Mouton LJ, Holstege G. 2000. Segmental and laminar organization of the spinal neurons projecting to the periaqueductal gray (PAG) in the cat suggests the existence of at least five separate clusters of spino-PAG neurons. *J Comp Neurol* 428:389-410.
- Nashold BS, Wilson WP, Slaughter DG. 1969. Sensations evoked by stimulation in the mid-brain of man. *J Neurosurg* 30:14-24.
- Okubo J, Kitamura S, Ogata K, Sakai A. 1987. Localization of rabbit laryngeal motoneurons in the nucleus ambiguus. *Exp Neurol* 96:528-539.
- Olucha F, Martinez-Garcia F, Lopez-Garcia C. 1985. A new stabilizing agent for the tetramethyl benzidine (TMB) reaction product in the histochemical detection of horseradish peroxidase (HRP). *J Neurosci Methods* 13:131-8.
- Osterlund M, Kuiper GG, Gustafsson JA, Hurd YL. 1998. Differential distribution and regulation of estrogen receptor-alpha and -beta mRNA within the female rat brain. *Mol Brain Res* 54:175-180.
- Patrickson JW, Smith TE, Zhou SS. 1991. Motor neurons of the laryngeal nerves. *Anat Rec* 230:551-556.
- Peterson BW, Pitts NG, Fukushima K. 1979. Reticulospinal connections with limb and axial motoneurons. *Exp Brain Res* 36:1-20.
- Pfaff DW, Sakuma Y. 1979. Facilitation of the lordosis reflex of female rats from the ventromedial nucleus of the hypothalamus. *J Physiol* 288:189-202.
- Pfaff D, Schwartz-Giblin S, McCarthy M, Kow L. 1994. Cellular and molecular mechanisms of female reproductive behaviors. In Knobil E, Neill JD (eds). *The physiology of reproduction* (2). New York: Raven Press, p107-220.
- Price WM, and Batsel HL. 1970. Respiratory neurons participating in sneeze and in response to resistance to expiration. *Exp Neurol* 29:554-570.
- Rapoport S, Susswein A, Uchino Y, Wilson VJ. 1977. Synaptic actions of individual vestibular neurones on cat neck motoneurons. *J Physiol* 272:367-382.
- Rees HD, Switz GM, Michael RP. 1980. The estrogen-sensitive neural system in the brain of female cats. *J Comp Neurol* 193:789-804.
- Richmond FJ, Scott DA, Abrahams VC. 1978. Distribution of motoneurons to the neck muscles, biventer cervicis, splenius and complexus in the cat. *J Comp Neurol* 181:451-463.
- Richter DW. 1982. Generation and maintenance of the respiratory rhythm. *J Exp Biol* 100:93-107.

References

- Ritz LA, Bailey SM, Murray CR, and Sparkes ML. 1992. Organization and morphological features of cat sacrocaudal motoneurons. *J Comp Neurol* 318:209-221.
- Robinson BW. 1962. Vocalization evoked from forebrain in macaca mulatta. *Physiol Behav* 2:345-354.
- Rye DB, Saper CB, Wainer BH. 1984. Stabilization of the tetramethylbenzidine (TMB) reaction product: application for retrograde and anterograde tracing, and combination with immunohistochemistry. *J Histochem Cytochem* 32:1145-1153.
- Sakamoto T, Nonaka S, Katada A. 1996. Control of respiratory muscles during speech and vocalization. In: Miller AD, Bianchi AL, Bishop BP (eds). *Neural control of the respiratory muscles*. Boca Raton (FL): CRC Press. p249-258.
- Sakuma Y, Pfaff DW. 1979a. Facilitation of female reproductive behavior from mesencephalic central gray in the rat. *Am J Physiol* 237:R278-R284.
- Sakuma Y, Pfaff DW. 1979b. Mesencephalic mechanisms for integration of female reproductive behavior in the rat. *Am J Physiol* 237:R285-R290.
- Saper CB, Loewy AD. 1980. Efferent connections of the parabrachial nucleus in the rat. *Brain Res* 197:291-317.
- Sasaki S, Uchino H, Imagawa M, Miyake T, Uchino Y. 1991. Lower lumbar branching of caudal medullary expiratory neurons of the cat. *Brain Res* 553:159-162.
- Sasaki SI, Uchino H, Uchino Y. 1994. Axon branching of medullary expiratory neurons in the lumbar and the sacral spinal cord of the cat. *Brain Res* 648:229-238.
- Sato M, Mizuno N, Konishi A. 1978. Localization of motoneurons innervating perineal muscles: a HRP study in cat. *Brain Res* 140:149-154.
- Schmid K, Kirkwood PA, Munson JB, Shen E, Sears TA. 1993. Contralateral projections of thoracic respiratory interneurons in the cat. *J Physiol* 461:647-665.
- Scott CJ, Rawson JA, Pereira AM, Clarke IJ. 1998. The distribution of estrogen receptors in the brainstem of female sheep. *Neurosci Lett* 241:29-32.
- Shughrue PJ, Lane MV, Merchenthaler I. 1997. Comparative distribution of estrogen receptor-alpha and -beta mRNA in the rat central nervous system. *J Comp Neurol* 388:507-525.
- Sterling P, Kuypers HG. 1968. Anatomical organization of the brachial spinal cord of the cat. 3. The propriospinal connections. *Brain Res* 7:419-443.
- Tani M, Kida MY, Akita K. 1994. Relationship between the arrangement of motoneuron pools in the ventral horn and ramification pattern of the spinal nerve innervating trunk muscles in the cat (*Felis domestica*). *Exp Neurol* 128:290-300.
- Ter Horst GJ, Luiten PG, Kuipers F. 1984. Descending pathways from hypothalamus to dorsal motor vagus and ambiguous nuclei in the rat. *J Auton Nerv Syst* 11:59-75.
- Theriault E, Diamond J. 1988. Nociceptive cutaneous stimuli evoke localized contractions in a skeletal muscle. *J Neurophysiol* 60:446-462.
- Thoms G, Jürgens U. 1987. Common input of the cranial motor nuclei involved in phonation in squirrel monkey. *Exp Neurol* 95:85-99.
- Turcotte JC, Blaustein JD. 1993. Immunocytochemical localization of midbrain estrogen receptor- and progesterin receptor-containing cells in female guinea pigs. *J Comp Neurol* 328:76-87.
- Turcotte JC, Blaustein JD. 1997. Convergence of substance P and estrogen receptor immunoreactivity in the midbrain central gray of female guinea pigs. *Neuroendocrinol* 66:28-37.
- VanderHorst VG, Holstege G. 1995. Caudal medullary pathways to lumbosacral motoneuronal cell groups in the cat: evidence for direct projections possibly representing the final common pathway for lordosis. *J Comp Neurol* 359:457-475.
- VanderHorst VG, Holstege G. 1996. A concept for the final common pathway of vocalization and lordosis behavior in the cat. *Prog Brain Res* 107:327-342.

- VanderHorst VG, Holstege G. 1997a. Organization of lumbosacral motoneuronal cell groups innervating hindlimb, pelvic floor, and axial muscles in the cat. *J Comp Neurol* 382:46-76.
- VanderHorst VG, Holstege G. 1997b. Estrogen induces axonal outgrowth in the nucleus retroambiguus-lumbosacral motoneuronal pathway in the adult female cat. *J Neurosci* 17:1122-1136.
- VanderHorst VG, Meijer E, Schasfoort FC, van Leeuwen FW, Holstege G. 1997a. Estrogen receptor-immunoreactive neurons in the lumbosacral cord projecting to the periaqueductal gray in the ovariectomized female cat. *Neurosci Lett* 236:25-28.
- VanderHorst VG, de Weerd H, Holstege G. 1997b. Evidence for monosynaptic projections from the nucleus retroambiguus to hindlimb motoneurons in the cat. *Neurosci Lett* 224:33-36.
- VanderHorst VG, Holstege G. 1998. Sensory and motor components of reproductive behavior: pathways and plasticity. *Behav Brain Res* 92:157-167.
- VanderHorst VG, Schasfoort FC, Meijer E, van Leeuwen FW, Holstege G. 1998. Estrogen receptor-alpha-immunoreactive neurons in the periaqueductal gray of the adult ovariectomized female cat. *Neurosci Lett* 240:13-16.
- VanderHorst VG, Terasawa E, Ralston HJ, III, Holstege G. 2000a. Monosynaptic projections from the lateral periaqueductal gray to the nucleus retroambiguus in the rhesus monkey: implications for vocalization and reproductive behavior. *J Comp Neurol* 424:251-268.
- VanderHorst VG, Terasawa E, Ralston HJ, III, Holstege G. 2000b. Monosynaptic projections from the nucleus retroambiguus to motoneurons supplying the abdominal wall, axial, hindlimb, and pelvic floor muscles in the female rhesus monkey. *J Comp Neurol* 424:233-250.
- VanderHorst VG, Terasawa E, Ralston HJ, III. 2001. Monosynaptic projections from the nucleus retroambiguus region to laryngeal motoneurons in the rhesus monkey. *Neurosci* 107:117-125.
- VanderHorst VG, Terasawa E, Ralston HJ, III. 2002a. Estrogen receptor-alpha immunoreactive neurons in the ventrolateral periaqueductal gray receive monosynaptic input from the lumbosacral cord in the rhesus monkey. *J Comp Neurol* 443:27-42.
- VanderHorst VG, Terasawa E, Ralston HJ, III. 2002b. Axonal sprouting of a brainstem-spinal pathway after estrogen administration in the adult female rhesus monkey. *J Comp Neurol* 454:82-103.
- VanderHorst VG, Terasawa E, Ralston HJ, III. 2004. Projections from estrogen receptor-alpha immunoreactive neurons in the periaqueductal gray to the lateral medulla oblongata in the rhesus monkey. *Neurosci* 125:243-253.
- Vanner SJ, Rose PK. 1984. Dendritic distribution of motoneurons innervating the three heads of the trapezius muscle in the cat. *J Comp Neurol* 226:96-110.
- Wada N, Sugita S, and Kolblinger G. 1990. Spinal cord location of the motoneurons innervating the tail muscles of the cat. *J Anat* 173:101-107.
- Williams SJ, Papka RE. 1996. Estrogen receptor-immunoreactive neurons are present in the female rat lumbosacral spinal cord. *J Neurosci Res* 46:492-501.
- Yajima Y, Hayashi Y, Yoshii N. 1980. The midbrain central gray substance as a highly sensitive neural structure for the production of ultrasonic vocalization in the rat. *Brain Res* 198:446-452.
- Yoshida Y, Miyazaki T, Hirano M, Shin T, Totoki T, Kanaseki T. 1981. Localization of efferent neurons innervating the pharyngeal constrictor muscles and the cervical esophagus muscle in the cat by means of the horseradish peroxidase method. *Neurosci Lett* 22:91-95.
- Zhan WE, Mantilla CB, Zhan P, Bitton A, Prakash YS, De Troyes A, Sieck GC. 2000. Regional differences in serotonergic input to canine parasternal intercostal motoneurons. *Physiol Rev* 88:1581-1589.

References

- Zhang SP, Davis PJ, Bandler R, Carrive P. 1994. Brain stem integration of vocalization: role of the midbrain periaqueductal gray. *J Neurophysiol* 72:1337-1356.
- Zhang SP, Bandler R, Davis PJ. 1995. Brain stem integration of vocalization: role of the nucleus retroambigualis. *J Neurophysiol* 74:2500-2512.