Chapter 84
Disorders of the Eccrine Sweat Glands and Sweating

Robert D. Fealey & Adelaide A. Hebert

REFERENCES

1. Sato KT et al: One-step iodine starch method for direct visualization of sweating. *Am J Med Sci* ***295***(6):528-531, 1988
2. Sato K: Normal and abnormal sweat gland function. In: *Clinical Autonomic Disorders*, edited by PA Low. Philadelphia, PA, Lippincott-Raven Publishers, 1997, pp. 97-108
3. Fealey RD: Thermoregulatory sweat test. In: *Clinical Autonomic Disorders*, 3rd edition, edited by PA Low, EE Benarroch. Philadelphia, PA, Lippincott Williams & Wilkins, 2008, pp. 244-263
4. Low PA et al: Quantitative sudomotor axon reflex test in normal and neuropathic subjects. *Ann Neurol* ***14***(5):573-580, 1983
5. Vetrugno R et al: Sympathetic skin response: Basic mechanisms and clinical applications. *Clin Auton Res* ***13***(4):256-270, 2003
6. Kennedy WR: Quantitation of the sweating deficit in diabetes mellitus. *Ann Neurol* ***15***:482-488, 1984
7. Sato K, Sato F: Individual variations in structure and function of human eccrine sweat gland. *Am J Physiol* ***245***(2):R203-R208, 1983
8. Cole DE, Boucher MJ: Use of a new sample-collection device (Macroduct) in anion analysis of human sweat. *Clin Chem* ***32***(7):1375-1378, 1986
9. Tetteh HA et al: Primary palmoplantar hyperhidrosis and thoracoscopic sympathectomy: A new objective assessment method. *Ann Thorac Surg* ***87***(1):267-274, discussion 274-265, 2009
10. Bonde P et al: An objective assessment of the sudomotor response after thoracoscopic sympathectomy. *J Thorac Cardiovasc Surg* ***135***(3):635-641, 2008
11. Fealey RD, Low PA, Thomas JE: Thermoregulatory sweating abnormalities in diabetes mellitus. *Mayo Clin Proc* ***64***(6):617-628, 1989
12. Hsieh C, McNeeley K, Chelimsky TC: The clinical thermoregulatory sweat test induces maximal sweating. *Clin Auton Res* ***11***(4):227-234, 2001
13. Morgan CJ et al: Cutaneous microdialysis as a novel means of continuously stimulating eccrine sweat glands in vivo. *J Invest Dermatol* ***126***(6):1220-1225, 2006
14. Kennedy WR, Wendelschafer-Crabb G, Brelje TC: Innervation and vasculature of human sweat glands: An immunohistochemistry-laser scanning confocal fluorescence microscopy study. *J Neurosci* ***14***(11 Pt 2):6825-6833, 1994
15. Sato F et al: Cystic fibrosis transport regulator and its mRNA are expressed in human epidermis. *J Invest Dermatol* ***119***(6):1224-1230, 2002
16. Eisenach JH, Atkinson JL, Fealey RD: Hyperhidrosis: Evolving therapies for a well-established phenomenon. *Mayo Clin Proc* ***80***(5):657-666, 2005
17. Hornberger J et al: Recognition, diagnosis, and treatment of primary focal hyperhidrosis. *J Am Acad Dermatol* ***51***(2):274-286, 2004
18. Strutton DR et al: US prevalence of hyperhidrosis and impact on individuals with axillary hyperhidrosis: Results from a national survey. *J Am Acad Dermatol* ***51***(2):241-248, 2004
19. Solish N, Benohanian A, Kowalski JW: Prospective open-label study of botulinum toxin type A in patients with axillary hyperhidrosis: Effects on functional impairment and quality of life. *Dermatol Surg* ***31***(4):405-413, 2005
20. Shih CJ, Wu JJ, Lin MT: Autonomic dysfunction in palmar hyperhidrosis. *J Auton Nerv Syst* ***8***(1):33-43, 1983
21. Ma L et al: Topiramate reduced sweat secretion and aquaporin-5 expression in sweat glands of mice. *Life Sci* ***80***(26):2461-2468, 2007
22. Simonetta Moreau M et al: A double-blind, randomized, comparative study of Dysport vs. Botox in primary palmar hyperhidrosis. *Br J Dermatol* ***149***(5):1041-1045, 2003
23. Kim WO et al: Topical glycopyrrolate for patients with facial hyperhidrosis. *Br J Dermatol* ***158***(5):1094-1097, 2008
24. Swartling C et al: Sweat gland morphology and periglandular innervation in essential palmar hyperhidrosis before and after treatment with intradermal botulinum toxin. *J Am Acad Dermatol* ***51***(5):739-745, 2004

25. Schnider P et al: Treatment of focal hyperhidrosis with botulinum toxin type A: Long-term follow-up in 61 patients. *Br J Dermatol* ***145***(2):289-293, 2001

26. Richards RN. Ethyl chloride spray for sensory relief for botulinum toxin injections of the hands and feet. *J Cutan Med Surg* ***13***(5):253-256, 2009

27. Benohanian A: What stands in the way of treating palmar hyperhidrosis as effectively as axillary hyperhidrosis with botulinum toxin type A. *Dermatol Online J* ***15***(4):12, 2009

28. Davarian S et al: Effect and persistency of botulinum toxin iontophoresis in the treatment of palmar hyperhidrosis. *Australas J Dermatol* ***49***(2):75-79, 2008

29. Kavanagh GM, Shams K: Botulinum toxin type A by iontophoresis for primary palmar hyperhidrosis. *J Am Acad Dermatol* ***55***(5 Suppl):S115-S117, 2006

30. Li X et al: Minimizing endoscopic thoracic sympathectomy for primary palmar hyperhidrosis: Guided by palmar skin temperature and laser Doppler blood flow. *Ann Thorac Surg* ***87***(2):427-431, 2009

31. Kim WO et al: Influence of T3 or T4 sympathicotomy for palmar hyperhidrosis. *Am J Surg* ***199***(2):166-169, 2010

32. Sugimura H et al: Thoracoscopic sympathetic clipping for hyperhidrosis: Long-term results and reversibility. *J Thorac Cardiovasc Surg* ***137***(6):1370-1376, discussion 1376-1377, 2009

33. Miller DL et al: Effect of sympathectomy level on the incidence of compensatory hyperhidrosis after sympathectomy for palmar hyperhidrosis. *J Thorac Cardiovasc Surg* ***138***(3):581-585, 2009

34. Miller DL, Force SD: Temporary thoracoscopic sympathetic block for hyperhidrosis. *Ann Thorac Surg* ***85***(4):1211-1214, discussion 1215-1216, 2008

35. Mahdy T et al: T4 sympathectomy for palmar hyperhidrosis: Looking for the right operation. *Surgery* ***143***(6):784-789, 2008

36. Atkinson JL, Fode-Thomas NC, Fealey RD, Eisenach JH, Goerss SJ: Endoscopic transthoracic limited sympathotomy for palmar-plantar hyperhidrosis: Outcomes and complications during a 10-year period. *Mayo Clin Proc* ***86***(8):721-729, 2011

37. Westphal FL et al: Skin depigmentation: Could it be a complication caused by thoracic sympathectomy? *Ann Thorac Surg* ***88***(4):e42-e43, 2009

38. Weksler B et al: Transection of more than one sympathetic chain ganglion for hyperhidrosis increases the severity of compensatory hyperhidrosis and decreases patient satisfaction. *J Surg Res* ***156***(1):110-115, 2009

39. Boni R: Tumescent suction curettage in the treatment of axillary hyperhidrosis: Experience in 63 patients. *Dermatology* ***213***(3):215-217, 2006

40. Korpelainen JT, Sotaniemi KA, Myllyla VV: Autonomic nervous system disorders in stroke. *Clin Auton Res* ***9***(6):325-333, 1999

41. Gris D et al: Comparison of effects of methylprednisolone and anti-CD11d antibody treatments on autonomic dysreflexia after spinal cord injury. *Exp Neurol* ***194***(2):541-549, 2005

42. Krenz NR et al: Neutralizing intraspinal nerve growth factor blocks autonomic dysreflexia caused by spinal cord injury. *J Neurosci* ***19***(17):7405-7414, 1999

43. Ondarza AB, Ye Z, Hulsebosch CE: Direct evidence of primary afferent sprouting in distant segments following spinal cord injury in the rat: Colocalization of GAP-43 and CGRP. *Exp Neurol* ***184***(1):373-380, 2003

44. Rabchevsky AG: Segmental organization of spinal reflexes mediating autonomic dysreflexia after spinal cord injury. *Prog Brain Res* ***152***:265-274, 2006

45. Weaver LC et al: Autonomic dysreflexia after spinal cord injury: Central mechanisms and strategies for prevention. *Prog Brain Res* ***152***:245-263, 2006

46. Hahn AF et al: Cold-induced sweating syndrome: A report of two cases and demonstration of genetic heterogeneity. *J Neurol Sci* ***250***(1-2):62-70, 2006

47. Rousseau F et al: Inactivation of cardiotrophin-like cytokine, a second ligand for ciliary neurotrophic factor receptor, leads to cold-induced sweating syndrome in a patient. *Proc Natl Acad Sci U S A* ***103***(26):10068-10073, 2006

48. Eedy DJ, Corbett JR: Olfactory facial hyperhydrosis responding to amitriptyline. *Clin Exp Dermatol* ***12***(4):298-299, 1987

49. Baskan EB et al: Localized unilateral hyperhidrosis and neurofibromatosis type 1: Case report of a new association. *Dermatology* ***211***(3):286-289, 2005

50. Laskawi R et al: Gustatory sweating: Clinical implications and etiologic aspects. *J Oral Maxillofac Surg* ***57***(6):642-648, discussion 648-649, 1999

51. Sethuraman G, Mancini AJ: Familial auriculotemporal nerve (Frey) syndrome. *Pediatr Dermatol* ***26***(3):302-305, 2009

52. Lai YT et al: Complications in patients with palmar hyperhidrosis treated with transthoracic endoscopic sympathectomy. *Neurosurgery* ***41***(1):110-113, discussion 113-115, 1997

53. Nesathurai S, Harvey DT: Clonidine in the management of asymmetrical gustatory facial sweating: An N-of-1 trial. *Arch Phys Med Rehabil* ***77***(9):906-908, 1996

54. Schick CH, Horbach T: Sequelae of endoscopic sympathetic block. *Clin Auton Res* ***13***(Suppl. 1):I36-I39, 2003

55. Mealey BL: Bilateral gustatory sweating as a sign of diabetic neuropathy. *Oral Surg Oral Med Oral Pathol* ***77***(2):113-115, 1994

56. Shaw JE et al: Gustatory sweating in diabetes mellitus. *Diabet Med* ***13***(12):1033-1037, 1996

57. Sheehy TW: Diabetic gustatory sweating. *Am J Gastroenterol* ***86***(10):1514-1517, 1991

58. Friedman JH: Hemifacial gustatory sweating due to Pancoast's tumor. *Am J Med* ***82***(6):1269-1271, 1987

59. Shaw JE et al: A randomised controlled trial of topical glycopyrrolate, the first specific treatment for diabetic gustatory sweating. *Diabetologia* ***40***(3):299-301, 1997

60. Urman JD, Bobrove AM: Diabetic gustatory sweating successfully treated with topical glycopyrrolate: report of a case and review of the literature. *Arch Intern Med* ***159***(8):877-878, 1999

61. Kreyden OP, Scheidegger EP: Anatomy of the sweat glands, pharmacology of botulinum toxin, and distinctive syndromes associated with hyperhidrosis. *Clin Dermatol* ***22***(1):40-44, 2004

62. Laccourreye O et al: Severe Frey syndrome after parotidectomy: treatment with botulinum neurotoxin type A. *Ann Otolaryngol Chir Cervicofac* ***116***(3):137-142, 1999

63. Drummond PD: Lacrimation induced by thermal stress in patients with a facial nerve lesion. *Neurology* ***45***(6):1112-1114, 1995

64. Drummond PD, Lance JW: Site of autonomic deficit in harlequin syndrome: Local autonomic failure affecting the arm and the face. *Ann Neurol* ***34***(6):814-819, 1993

65. Kalapesi FB, Krishnan AV, Kiernan MC: Segmental facial anhidrosis and tonic pupils with preserved deep tendon reflexes: A novel autonomic neuropathy. *J Neuroophthalmol* ***25***(1):5-8, 2005

66. Moon SY et al: Harlequin syndrome with crossed sympathetic deficit of the face and arm. *J Korean Med Sci* ***20***(2):329-330, 2005

67. Ghali FE, Fine JD: Idiopathic localized unilateral hyperhidrosis in a child. *Pediatr Dermatol* ***17***(1):25-28, 2000

68. Foshee JB et al: Eccrine angiomatous harmartoma in an infant. *Pediatr Dermatol* ***23***(4):365-368, 2006

69. Shapiro WR, Williams GH, Plum F: Spontaneous recurrent hypothermia accompanying agenesis of the corpus callosum. *Brain* ***92***(2):423-436, 1969

70. Sanfield JA et al: Altered norepinephrine metabolism in Shapiro's syndrome. *Arch Neurol* ***46***(1):53-57, 1989

71. Walker BR, Anderson JA, Edwards CR: Clonidine therapy for Shapiro's syndrome. *Q J Med* ***82***(299):235-245, 1992

72. Klein CJ et al: Basal forebrain malformation with hyperhidrosis and hypothermia: Variant of Shapiro's syndrome. *Neurology* ***56***(2):254-256, 2001

73. Benarroch EE, Stotz-Potter EH: Dysautonomia in fatal familial insomnia as an indicator of the potential role of the thalamus in autonomic control. *Brain Pathol* ***8***(3):527-530, 1998

74. Sage JI, Mark MH: Drenching sweats as an off phenomenon in Parkinson's disease: Treatment and relation to plasma levodopa profile. *Ann Neurol* ***37***(1):120-122, 1995

75. Fealey RD: Thermoregulatory failure. In: *The Autonomic Nervous System II*, vol. 75, edited by O Appenzeller. Amsterdam, Elsevier, 2000, pp. 53-84. Chapter 2

76. Jose BO et al: Hodgkin's lymphoma in adults—Clinical features. *J Ky Med Assoc* ***103***(1):15-17, 2005

77. Nadjar A et al: Brain cyclooxygenase-2 mediates interleukin-1-induced cellular activation in preoptic and arcuate hypothalamus, but not sickness symptoms. *Neurobiol Dis* ***39***(3):393-401, 2010

78. Nagel S et al: HLXB9 activates IL6 in Hodgkin lymphoma cell lines and is regulated by PI3K signalling involving E2F3. *Leukemia* ***19***(5):841-846, 2005

79. Ikeda T et al: The effect of opioids on thermoregulatory responses in humans and the special antishivering action of meperidine. *Ann N Y Acad Sci* ***813***:792-798, 1997

80. Al-Adwani A, Basu N: Methadone and excessive sweating. *Addiction* ***99***(2):259, 2004

81. Clemens KE, Klaschik E: Clinical experience with transdermal and orally administered opioids in palliative care patients—A retrospective study. *Jpn J Clin Oncol* ***37***(4):302-309, 2007

82. Hilz MJ et al: Assessing function and pathology in familial dysautonomia: assessment of temperature perception, sweating and cutaneous innervation. *Brain* ***127***(Pt 9):2090-2098, 2004

83. Axelrod FB, Berlin D: Pregabalin: A new approach to treatment of the dysautonomic crisis. *Pediatrics* ***124***(2):743-746, 2009

84. Josephs KA et al: Neurophysiologic studies in Morvan syndrome. *J Clin Neurophysiol* ***21***(6):440-445, 2004

85. Low PA et al: Chronic idiopathic anhidrosis. *Ann Neurol* ***18***(3):344-348, 1985

86. Murakami K et al: Acquired idiopathic generalized anhidrosis: a distinctive clinical syndrome. *J Neurol* ***235***(7):428-431, 1988

87. Chen YC et al: Identification of subgroups of acquired idiopathic generalized anhidrosis. *Neurologist* ***14***(5):318-320, 2008

88. Nakazato Y et al: Idiopathic pure sudomotor failure: Anhidrosis due to deficits in cholinergic transmission. *Neurology* ***63***(8):1476-1480, 2004

89. Faden AI, Chan P, Mendoza E: Progressive isolated segmental anhidrosis. *Arch Neurol* ***39***(3):172-175, 1982

90. Nolano M et al: Ross syndrome: A rare or a misknown disorder of thermoregulation? A skin innervation study on 12 subjects. *Brain* ***129***(Pt 8):2119-2131, 2006

91. Nagane Y, Utsugisawa K: Ross syndrome associated with cytomegalovirus infection. *Muscle Nerve* ***38***(1):924-926, 2008

92. Shishido T et al: Alpha-synuclein accumulation in skin nerve fibers revealed by skin biopsy in pure autonomic failure. *Neurology* ***74***(7):608-610, 2010

93. Iodice V et al: Efficacy of immunotherapy in seropositive and seronegative putative autoimmune autonomic ganglionopathy. *Neurology* ***72***(23):2002-2008, 2009

94. Kimpinski K et al: Sudomotor dysfunction in autoimmune autonomic ganglionopathy. *Neurology* ***73***(18):1501-1506, 2009

95. Lipp A et al: Prospective differentiation of multiple system atrophy from Parkinson disease, with and without autonomic failure. *Arch Neurol* ***66***(6):742-750, 2009

96. Sandroni P et al: Autonomic involvement in extrapyramidal and cerebellar disorders. *Clin Auton Res* ***1***(2):147-155, 1991

97. Orimo S et al: Cardiac sympathetic denervation precedes neuronal loss in the sympathetic ganglia in Lewy body disease. *Acta Neuropathol (Berl)* ***109***(6):583-588, 2005

98. Thaisetthawatkul P et al: Autonomic dysfunction in dementia with Lewy bodies. *Neurology* ***62***(10):1804-1809, 2004

99. Hilz MJ: Assessment and evaluation of hereditary sensory and autonomic neuropathies with autonomic and neurophysiological examinations. *Clin Auton Res* ***12***(Suppl. 1):I33-I43, 2002

100. Wang AK et al: Patterns of neuropathy and autonomic failure in patients with amyloidosis. *Mayo Clin Proc* ***83***(11):1226-1230, 2008

101. van de Vosse E, Hoeve MA, Ottenhoff TH: Human genetics of intracellular infectious diseases: molecular and cellular immunity against mycobacteria and salmonellae. *Lancet Infect Dis* ***4***(12):739-749, 2004

102. Newsom-Davis J: Lambert-Eaton myasthenic syndrome. *Rev Neurol (Paris)* ***160***(2):177-180, 2004

103. Low PA et al: The sympathetic nervous system in alcoholic neuropathy. A clinical and pathological study. *Brain* ***98***(3):357-364, 1975

104. Moller AT et al: Autonomic skin responses in females with Fabry disease. *J Peripher Nerv Syst* ***14***(3):159-164, 2009

105. Schiffmann R et al: Four-year prospective clinical trial of agalsidase alfa in children with Fabry disease. *J Pediatr* ***156***(5):832-837, 837 e831, 2010

106. Lao LM et al: The ultrastructural characteristics of eccrine sweat glands in a Fabry disease patient with hypohidrosis. *J Dermatol Sci* ***18***(2):109-117, 1998

107. European Federation of Neurological Societies/Peripheral Nerve Society Guideline on the use of skin biopsy in the diagnosis of small fiber neuropathy. Report of a joint task force of the European Federation of Neurological Societies and the Peripheral Nerve Society. *J Peripher Nerv Syst* ***15***(2):79-92, 2010

108. Low VA et al: Detection of small-fiber neuropathy by sudomotor testing. *Muscle Nerve* ***34***(1):57-61, 2006

109. Davis MD et al: Erythromelalgia: Vasculopathy, neuropathy, or both? A prospective study of vascular and neurophysiologic studies in erythromelalgia. *Arch Dermatol* ***139***(10):1337-1343, 2003

110. Davis MD et al: Histopathologic findings in primary erythromelalgia are nonspecific: Special studies show a decrease in small nerve fiber density. *J Am Acad Dermatol* ***55***(3):519-522, 2006

111. Davis MD et al: Thermoregulatory sweat testing in patients with erythromelalgia. *Arch Dermatol* ***142***:1-6, 2006

112. Drummond PD, Finch PM: Reflex control of facial flushing during body heating in man. *Brain* ***112***(Pt 5):1351-1358, 1989

113. Umeki S et al: Harlequin syndrome (unilateral flushing and sweating attack) due to a spinal invasion of the left apical lung cancer. *Rinsho Shinkeigaku* ***30***(1):94-99, 1990

114. Donaghy M: Neurologists and the threat of bioterrorism. *J Neurol Sci* ***249***(1):55-62, 2006

115. Ben-Zeev B et al: Oligohydrosis and hyperthermia: Pilot study of a novel topiramate adverse effect. *J Child Neurol* ***18***(4):254-257, 2003

116. de Carolis P et al: Transient hypohidrosis induced by topiramate. *Epilepsia* ***44***(7):974-976, 2003

117. Antonovich DD et al: Infectious eccrine hidradenitis caused by Nocardia. *J Am Acad Dermatol* ***50***(2):315-318, 2004

118. Niyonsaba F et al: The human antimicrobial peptide dermcidin activates normal human keratinocytes. *Br J Dermatol* ***160***(2):243-249, 2009

119. Naimer SA et al: Plantar hidradenitis in children induced by exposure to wet footwear. *Pediatr Emerg Care* ***16***(3):182-183, 2000

120. Bilic M, Mutasim DF: Neutrophilic eccrine hidradenitis in a patient with Behcet's disease. *Cutis* ***68***(2):107-111, 2001

121. Pipitone N et al: New approaches in the treatment of Adamantiades-Behcet's disease. *Curr Opin Rheumatol* ***18***(1):3-9, 2006

122. Sfikakis PP: Behcet's disease: A new target for anti-tumour necrosis factor treatment. *Ann Rheum Dis* ***61***(Suppl 2):ii51-ii53, 2002

123. Mitchell J et al: Anhidrosis (hypohidrosis) in Sjogren's syndrome. *J Am Acad Dermatol* ***16***(1 Pt 2):233-235, 1987

124. Sais G et al: Lymphocytic autoimmune hidradenitis, cutaneous leucocytoclastic vasculitis and primary Sjogren's syndrome. *Br J Dermatol* ***139***(6):1073-1076, 1998

125. Cavill D, Waterman SA, Gordon TP: Antibodies raised against the second extracellular loop of the human muscarinic M3 receptor mimic functional autoantibodies in Sjogren's syndrome. *Scand J Immunol* ***59***(3):261-266, 2004

126. Dawson LJ et al: Antimuscarinic antibodies in primary Sjogren's syndrome reversibly inhibit the mechanism of fluid secretion by human submandibular salivary acinar cells. *Arthritis Rheum* ***54***(4):1165-1173, 2006

127. Li J et al: Inhibitory effects of autoantibodies on the muscarinic receptors in Sjogren's syndrome. *Lab Invest* ***84***(11):1430-1438, 2004

128. Waterman SA, Gordon TP, Rischmueller M: Inhibitory effects of muscarinic receptor autoantibodies on parasympathetic neurotransmission in Sjogren's syndrome. *Arthritis Rheum* ***43***(7):1647-1654, 2000

129. Nakazato Y et al: A case of Sjogren's syndrome with heat intolerance induced by generalized anhidrosis as its principal feature. *Rinsho Shinkeigaku* ***42***(2):171-174, 2002

130. Horsefield R et al: High-resolution x-ray structure of human aquaporin 5. *Proc Natl Acad Sci U S A* ***105***(36):13327-13332, 2008

131. Ma L et al: Postnatal expression and denervation induced up-regulation of aquaporin-5 protein in rat sweat gland. *Cell Tissue Res* ***329***(1):25-33, 2007

132. Paquette DL, Falanga V: Cutaneous concerns of scleroderma patients. *J Dermatol* ***30***(6):438-443, 2003

133. Moss C, Ince P: Anhidrotic and achromians lesions in incontinentia pigmenti. *Br J Dermatol* ***116***(6):839-849, 1987

134. Koga M. Vitiligo: A new classification and therapy. *Br J Dermatol* ***97***(3):255-261, 1977

135. Koga M, Tango T: Clinical features and course of type A and type B vitiligo. *Br J Dermatol* ***118***(2):223-228, 1988

136. Beljan G, Metze D: [Miliaria and follicular atrophodermia as an early sign of Bazex-Dupre-Christol syndrome]. *J Dtsch Dermatol Ges* ***2***(7):602-604, 2004

137. Shuster S: Duct disruption, a new explanation of miliaria. *Acta Derm Venereol* ***77***(1):1-3, 1997

138. Haas N, Henz BM, Weigel H: Congenital miliaria crystallina. *J Am Acad Dermatol* ***47***(5 Suppl.):S270-S272, 2002

139. Haas N, Martens F, Henz BM: Miliaria crystallina in an intensive care setting. *Clin Exp Dermatol* ***29***(1):32-34, 2004

140. Holzle E, Kligman AM: The pathogenesis of miliaria rubra. Role of the resident microflora. *Br J Dermatol* ***99***(2):117-137, 1978

141. Mowad CM et al: The role of extracellular polysaccharide substance produced by Staphylococcus epidermidis in miliaria. *J Am Acad Dermatol* ***33***(5 Pt 1):729-733, 1995

142. Badertscher K et al: Mast cell chymase is increased in chronic atopic dermatitis but not in psoriasis. *Arch Dermatol Res* ***296***(10):503-506, 2005

143. Jarvikallio A, Harvima IT, Naukkarinen A: Mast cells, nerves and neuropeptides in atopic dermatitis and nummular eczema. *Arch Dermatol Res* ***295***(1):2-7, 2003

144. Rippke F et al: Stratum corneum pH in atopic dermatitis: Impact on skin barrier function and colonization with Staphylococcus Aureus. *Am J Clin Dermatol* ***5***(4):217-223, 2004

145. Rieg S et al: Deficiency of dermcidin-derived antimicrobial peptides in sweat of patients with atopic dermatitis correlates with an impaired innate defense of human skin in vivo. *J Immunol* ***174***(12):8003-8010, 2005

146. Schittek B et al: The role of antimicrobial peptides in human skin and in skin infectious diseases. *Infect Disord Drug Targets* ***8***(3):135-143, 2008

147. Hata TR, Gallo RL: Antimicrobial peptides, skin infections, and atopic dermatitis. *Semin Cutan Med Surg* ***27***(2):144-150, 2008

148. Lee H et al: Gene delivery to human sweat glands: A model for cystic fibrosis gene therapy. *Gene Ther* ***12***(24):1752-1760, 2005

149. Berk DR et al: Aquagenic wrinkling of the palms in cystic fibrosis: Comparison with controls and genotype-phenotype correlations. *Arch Dermatol* ***145***(11):1296-1299, 2009

150. Katz KA, Yan AC, Turner ML: Aquagenic wrinkling of the palms in patients with cystic fibrosis homozygous for the delta F508 CFTR mutation. *Arch Dermatol* ***141***(5):621-624, 2005

151. Kabashima K et al: Aberrant aquaporin 5 expression in the sweat gland in aquagenic wrinkling of the palms. *J Am Acad Dermatol* ***59***(2 Suppl. 1):S28-S32, 2008