

REFERENCES

- Abman SH, Chatfield BA, Hall SL, McMurtry IF. Role of endothelium-derived relaxing factor during transition of pulmonary circulation in birth. **Am J Physiol** 1990;259:H1921-7.
- Adam DJ. Ionic channels in vascular endothelial cells . **Trens Cardiovasc Med** 1994;4:18-26.
- Archer SL, Huang JMC, Hampl V, Nelson DP, Shultz PJ, Weir EK. Nitric oxide and cGMP cause vasorelaxation by activation of a charybdotoxin-sensitive potassium channels by cGMP-dependent protein kinase. **Proc Natl Acad Sci USA** 1994;91:7583-7.
- Armstrong JM, Dusing GJ, Moncada S, Vane JR. Cardiovascular actions of prostacyclin (PGI₂) a metabolites of arachidonic acid which is synthesized by blood vessels. **Circ Res** 1978;43:112-9.
- Ashcroft SJH, Ashcroft FM. Properties and function of ATP-sensitive potassium channels. **Cell Signal** 1990;2:197-214.
- Ashcroft FM, Harrison DE, Ashcroft SJH. Glucose induces closure of single potassium channels in isolated rat pancreatic β -cells. **Nature** 1984;312:446-8.
- Ashcroft FM. Mechanisms of the glycaemic effects of sulfonylureas. **Horm Metab** 1996;28:456-63.
- Ashcroft MLJ, Sturgess NC, Trout NJ, Gardner NJ, Hales CN. Adenosine 5'-triphosphate-sensitive ion channels in neonatal rat cultured central neurones. **Pflugers Arch** 1988;412:297-304.
- Balligand JL, Kobzik L, Han X, Kaye DM, Belhassen L, O'Hara DS, et al. Nitric oxide-dependent parasympathetic signaling is due to activation of constitutive endothelial (typeIII) nitric oxide synthase in cardiac myocytes. **J Biol Chem** 1995;270:14582-6.
- Barber DA, Park YS, Burnett JC Jr, Miller VM. Adrenomedullin- mediated relaxations in veins are endothelium-dependent and distinct from arteries. **J cardiovas Pharmacol** 1997;30:695-701.

- Baskaya MK, Suzuki Y, Anzai M, Seki Y, Saito K, Takayasu M, et al. Effects of adrenomedullin, calcitonin gene-related peptide, and amylin on cerebral circulation in dogs. **J Cereb Blood Flow Metab** 1995;15:827-34.
- Bean BP. Pharmacology and electrophysiology of ATP-activated ion channels. **Trends Pharmacol Sci** 1992;13:87-90.
- Belloni AS, Andreis PG, Rossi GP, Mingrino A, Champion HC, Kadowitz PJ, et al. Inhibitory effect of adrenomedullin on the aldosterone response of human adrenocortical cells to angiotensin-II: role of ADM (22-52)-sensitive receptors. **Life Sci** 1998;63:2313-21.
- Beny JL, Pacicca C. Bidirectional electrical communication between smooth muscle and endothelial cells in the pig coronary artery. **Am J Physiol** 1994;266:H1465-72.
- Bloom SR. Specific adrenomedullin binding sites and hypotension in the rat systemic vascular bed. **Regulatory Peptides** 1996;62:145-51.
- Bolotina VM, Najibi S, Palacino JJ, Pagano PJ, Cohen RA. Nitric oxide directly activates calcium-dependent potassium channels in vascular smooth muscle. **Nature** 1994;368:850-3.
- Brain SD, Williams TJ, Tippins JR, Morris HR, Macintyre I. Calcitonin gene-related peptide is a potent vasodilator. **Nature** 1985;313:54-6.
- Bray K, Quast U. A specific binding site for potassium channel openers in rat aorta. **J Biol Chem** 1992;267:11689-92.
- Brayden JE. Membrane hyperpolarization is a mechanism of endothelium-dependent cerebral vasodilation. **Am J Physiol** 1990;259:H668-73.
- Bunting S, Gryglewski RJ, Moncada S, Vane JR. Arterial walls generate from prostaglandin endoperoxides a substance (prostaglandin X) which relaxes strips of mesenteric and coeliac arteries and inhibits platelet aggregation. **Prostaglandins** 1976;12:897-913.
- Champion HC, Santiago JA, Murphy WA, Coy DH, Kadowitz PJ. Adrenomedullin (22-52) antagonizes vasodilator responses to CGRP but not adrenomedullin in the cat. **Am J Physiol** 1997;272:R234-42.

- Chen G, Cheung DW. Characterization of acetylcholine-induced membrane hyperpolarization in endothelial cells. *Circ Res* 1992;70:257-63.
- Chen G, Suzuki H. Endothelium-dependent hyperpolarization elicited by adenine compounds in rabbit carotid artery. *Am J Physiol* 1991;260:H1037-42.
- Chinni EN, Choi E, Grande JP, Burnett JC, Dousa TP. Adrenomedullin suppresses mitogenesis in rat mesangial cells via cAMP_i pathway. *Biochem Biophys Res Commun* 1995;215:868-73.
- Cohen RA, Vanhoutte PM. Endothelium-dependent hyperpolarization: beyond nitric oxide and cGMP. *Circulation* 1995;92:3337-49.
- Cook DL, Hales CN. Intracellular ATP directly blocks potassium channels in pancreatic β -cells. *Nature* 1984;311:271-3.
- Daut J, Maier-Rudolph W, von Beckerath N, Mehrke G, Gunter K, Goedel-Meinen L. Hypoxic dilation of coronary arteries is mediated by ATP-sensitive potassium channels. *Science* 1990;247:1341-4.
- Davies MG, Hagen PO. The vascular endothelium. *Annals of Surg* 1993;218:593-609.
- Davies NW. Modulation of ATP-sensitive potassium channels in skeletal muscle by intracellular protons. *Nature* 1990;343:375-7.
- De Vroomen M, Takahashi Y, Gournay V, Roman C, Rudolph AM, Heymann MA. Adrenomedullin increases pulmonary blood flow in fetal sheep. *Pediatr Res* 1997;41:493-7.
- De Weille JR, Fosset M, Mourre C, Schmid-Antomarchi H, Bernadi H, Lazdunski M. Pharmacology and regulation of ATP-sensitive potassium channels. *Pflugers Arch* 1989;414:S80-7.
- De Weille JR. Modulation of ATP-sensitive potassium channels. *Cardiovas Res* 1992;26:1017-20.
- Ebara T, Miura K, Okumura M, Matsuura T, Kim S, Yukimura T, et al. Effect of adrenomedullin on renal hemodynamics and functions in dogs. *Eur J Pharmacol* 1994;263:69-73.

- Edwards G, Weston AH. The pharmacology of ATP-sensitive potassium channels. **Annu Rev Pharmacol Toxicol** 1993;33:597-637.
- Edwards RM, Trizna W, Stack E, Aiyar N. Effect of adrenomedullin on cAMP levels along the rat nephron: comparison with CGRP. **Am J Physiol** 1996;271:F895-9.
- Eguchi S, Hirata Y, Iwasaka H, Sato K, Watanabe TX, Inui T, et al. Structure-activity relationship of adrenomedullin, a novel vasodilatory peptide, in cultured rat vascular smooth muscle cells. **Endocrinology** 1994a;135:2454-8.
- Eguchi S, Hirata Y, Kano H, Sato K, Watanabe Y, Watanabe TX, et al. Specific receptors for adrenomedullin cultured rat vascular smooth muscle cells. **FEBS Lett** 1994b;340:226-30.
- Elhawary AM, Poon J, Pang C. Effects of calcitonin gene-related peptide receptor antagonists on renal actions of adrenomedullin. **Br J Pharmacol** 1995;115:1133-40.
- Entzeroth M, Doods HN, Weiland HA, Wienen W. Adrenomedullin mediates vasodilation via CGRP₁ receptors. **Life Sci** 1995;56:PL19-25.
- Faraci FM. Regulation of the cerebral circulation by endothelium. **Pharmacol Ther** 1992;56:P1-22.
- Feng CJ, Kang B, Kaye AD, Kadowitz P, Nossaman B. L-NAME modulates responses to adrenomedullin in the hindquarters a rat vascular bed of the rat. **Life Sci** 1994;55:433-8.
- Fiscus RR, Hao H, Wang X, Arden WA, Dianna JN. Nitroglycerine (exogenous nitric oxide) substitutes for endothelium-derived nitric oxide in potentiating vasorelaxations and cyclic AMP elevation induced by calcitonin gene-related peptide (CGRP) in rat aorta. **Neuropeptides** 1994;26:133-44.
- Fluckiger JP, Sonnay M, Boillat N, Atkinson J. Attenuation of the baroreceptor reflex by general anesthetic agents in the normotensive rat. **Eur J Pharmacol** 1985;109:105-9.
- Furchgott RF, Vanhoutte PM. Endothelium-derived relaxing and contracting factors. **FASEB** 1989;3:2007-18.

- Furchgott RF. Role of endothelium in responses of vascular smooth muscle. **Circ Res** 1983;53:557-73.
- Gardiner SM, Compton AM, Bennet T. Regional hemodynamic effects of calcitonin gene-related peptide. **Am J Physiol** 1989;256:R332-8.
- Garland CJ, Plane F, Kemp BK, Cocks TM. Endothelium-dependent hyperpolarization: a role in the control of vascular tone. **Trends Pharmacol Sci** 1995;16:23-30.
- Goto K, Fujii K, Onaka U, Abe I, Fujishima M. Electrophysiological investigation of the effects of adrenomedullin and PAMP in the rat mesenteric artery. **Abstract of the First International Symposium on Adrenomedullin and PAMP Japan 1997**: P.84.
- Gray DW, Marshall I. Human alpha-calcitonin gene-related peptide stimulates adenylate cyclase and guanylate cyclase and relaxes rat thoracic aorta by releasing nitric oxide. **Br J Pharmacol** 1992c;107:691-6.
- Gray DW, Marshall I. Nitric oxide synthesis inhibitors attenuate calcitonin gene-related peptide endothelium-dependent vasorelaxation in rat aorta. **Eur J Pharmacol** 1992a;212:37-42.
- Gray DW, Marshall I. Novel signal transduction pathway mediating endothelium-dependent beta-adrenoceptor vasorelaxation in rat thoracic aorta. **Br J Pharmacol** 1992b;107:684-90.
- Gryglewski RJ Botting RM, Vane JR. Prostaglandin: from discovery to clinical application. In: Rubanyi GM, ed. **Cardiovascular Significance of Endothelium-Derived Vasoactive Factors** Mount Kisco, NY:Futura Publishing Co. 1991:3-37.
- Guevara M, Gines P, Jimenez W, Sort P, Fernandez-Esparrach G, Escorsell A, et al. Increased adrenomedullin levels in cirrhosis: relationship with hemodynamic abnormalities and vasoconstrictor systems. **Gastroenterology** 1998;114:336-43.
- Gumusel B, Hao Q, Hyman AL, Kadowitz PJ, Champion HC, Chang JK, et al. Analysis of responses to adrenomedullin-(13-52) in the pulmonary vascular bed of rats. **Am J Physiol** 1998;274:H1255-63.

- Hall JM, Siney L, Lippon H, Hyman A, Chang JK, Brain SD. Interaction of human adrenomedullin 13-52 with calcitonin gene-related peptide receptors in the microcirculation of the rat and hamster. *Bri J Pharmacol* 1995;114:592-7.
- Hayakawa H, Hirata Y, Kakoki M, Suzuki Y, Nishimatsu H, Nagata D, et al. Role of nitric oxide-cGMP pathways in adrenomedullin-induced vasodilation in the rat. *Hypertension* 1999;33:689-93.
- Hayashi M, Shimosawa T, Isaka M, Yamada S, Fujita R, Fujita T. Plasma adrenomedullin in diabetes. *The Lancet* 1997;350:1449.
- He H, Bessho H, Fujisawa Y, Horiuchi K, Tomohiro A, Kita T, et al. Effects of synthetic rat adrenomedullin on regional hemodynamics in rat. *Eur J Pharmacol* 1995;273:209-14.
- Heaton J, Lin B, Chang JK, Steinberg S, Hyman A, Lipton H. Pulmonary vasodilation to adrenomedullin: A novel hypotensive peptide in humans. *Am J Physiol* 1995;268:H2211-5.
- Heymann MA, Soifer SJ. Control of fetal and neonatal pulmonary circulation. In: Weir EK, Reeves JT (eds) *Pulmonary Vascular Physiology and Pathophysiology* Dekker, New York. 1989:33-50.
- Heynes JM, Cooper ME. Adrenomedullin and calcitonin gene-related peptide in the rat isolated kidney and in the anesthetized rat: in vitro and in vivo effects. *Eur J Pharmacol* 1995;280:91-4.
- Hirata Y, Hayakawa H, Suzuki Y, Suzuki E, Ikenouchi H, Kohmoto O, et al. Mechanisms of adrenomedullin-induced vasodilation in the rat kidney. *Hypertension* 1995;25:790-5.
- Hutcheson IR, Griffith TM. Heterogeneous populations of K^+ channels mediate EDRF to flow but not agonists in rabbit aorta. *Am J Physiol* 1994;266:H590-6.
- Ichiki Y, Kitamura K, Kangawa K, Kawamoto M, Matsuo H, Eto T. Distribution and characterization of immunoreactive adrenomedullin in human tissue and plasma. *FEBS Lett* 1994;338:6-10.
- Ignarro LJ, Kadowitz PJ. The pharmacological and physiological role of cGMP in vascular smooth muscle relaxation. *Annu Rev Pharmacol Toxicol* 1985;25:171-91.

- Ikeda U, Kanbe T, Kawahara Y, Yokoyama M, Shimada K. Adrenomedullin augments inducible nitric oxide synthase expression in cytokine-stimulated cardiac myocytes. **Circulation** 1996;94:2560-5.
- Ikenouchi H, Barry WH, Bridge JHB, Weinberg EO, Apstein CS, Lorell BH. Effects of angiotensin II on intracellular Ca^{2+} and pH in isolated beating rabbit hearts and myocytes loaded with the indicator indo 1. **J Physiol (Lond)** 1994;480:203-16.
- Ikenouchi H, Kangawa K, Matsuo H, Hirata Y. Negative inotropic effect of adrenomedullin in isolated adult rabbit cardiac ventricular myocytes. **Circulation** 1997;95:2318-24.
- Ishimitsu T, Nishikimi T, Saito Y, Kitamura K, Eto T, kangawa K, et al. Plasma levels of adrenomedullin a newly identified hypotensive peptide in patients with hypertension and renal failure. **J Clin Invest** 1994;94:2158-61.
- Ishiyama Y, Kitamura K, Ichiki Y, Nakamura S, Kida O, Kangawa K, et al. Haemodynamic effect of a novel hypotensive peptide adrenomedullin. **Eur J Pharmacol** 1993;241:271-3.
- Ishizaka Y, Ishizaka Y, Tanaka M, Kitamura K, Kangawa K, Minamoto N, et al. Adrenomedullin stimulates cyclic AMP formation in rat vascular smooth muscle cells. **Biochem Biophys Res Commun** 1994;200:642-6.
- Isumi Y, Shoji H, Sugo S, Tochimoto T, Yoshioka M, Kangawa K, et al. Regulation of adrenomedullin production in rat endothelial cells. **Endocrinology** 1998;139:838-46.
- Iwasaki H, Eguchi S, Shichiri M, Marumo F, Hirata Y. Adrenomedullin as a novel growth-promoting factor for cultured vascular smooth muscle cells: role of tyrosine kinase-mediated mitogen-activated protein kinase activation. **Endocrinology** 1998;139:3432-41.
- Janigro D, West GA, Gordon EL, Winn HR. ATP-sensitive K^+ channels in rat aorta and brain microvascular endothelial cells. **Am J Physiol** 1993;265:C812-21.
- Jougasaki M, Aarhus LL, Heublein DM, Sandberg SM, Burnett Jr JC. Role of prostaglandins and renal nerves in the renal actions of adrenomedullin. **Am J Physiol** 1997;272:F260-6.

- Jougasaki M, Rodeheffer RJ, Redfield MM, Yamamoto K, Wei CM, McKinley LJ, et al. Cardiac secretion of adrenomedullin in human heart failure. **J Clin Invest** 1996;97:2370-6.
- Jougasaki M, Wei C, Aarhus LL, Heublein DM, Sandberg SM, Burnett JC. Renal localization and actions of adrenomedullin: a natriuretic peptide. **Am J Physiol** 1995;268:F657-63.
- Jougasaki M, Wei CM, McKinley LJ, Burnett JC. Elevation of circulating and ventricular adrenomedullin in human congestive heart failure. **Circulation** 1995;92:286-9.
- Kannan H, Hayashida Y, Yamashita H. Increase in sympathetic outflow by paraventricular nucleus stimulation in awake rats **AM J Physiol** 1989;256:R1325-30.
- Kano H, Kohno M, Yasunari K, Yokogawa K, Horio T, Ikeda M, et al. Adrenomedullin as a novel antiproliferative factor of vascular smooth muscle cells. **J Hypertension** 1996;14:209-13.
- Kapas S, Catt K, Clark AJL. Cloning and expression of cDNA encoding in rat ADM receptor. **J Biol Chem** 1995;270:25344-7.
- Karaki H, Ozaki H, Hori M, Mitsui-Saito M, Amano K, Harada K, et al. Calcium movements, distribution and functions in smooth muscle. **Pharmacol Rev** 1997;49:157-230.
- Karaki H. Ca^{2+} localization and sensitivity in vascular smooth muscle. **Trends Pharmacol Sci** 1989;10:320-5.
- Katnik C, Adams DJ. An ATP-sensitive potassium conductance in rabbit endothelial cells. **J Physiol (Lond)** 1995;485:595-606.
- Katnik C, Adams DJ. Characterization of ATP-sensitive potassium channels in freshly dissociated rabbit aortic endothelial cells. **Am J Physiol** 1997;411:H2507-11.
- Kato F, Kitamura K, Niina H, Yamamoto R, Washimine H, kangawa K, et al. Proadrenomedullin N-terminal 20 peptide (PAMP) an endogenous anticholinergic peptide is exocytotic secretion and inhibition of catecholamine secretion in adrenal medulla. **J Neurochem** 1995;64:459-61.

- Kato H, Shichiri M, Marumo F, Hirata Y. Adrenomedullin as an autocrine/paracrine apoptosis survival factor for rat endothelial cells. **Endocrinology** 1997;138:2615-20.
- Kato J, Kitamura K, Kangawa K, Eto T. Receptors for adrenomedullin in human vascular endothelial cells. **Eur J Pharmacol** 1995;289:383-5.
- Kato J, Kobayashi K, Etoh T, Tanaka M, Kitamura K, Imamura T, et al. Plasma adrenomedullin concentration in patients with heart failure. **J Clin Endocrin Metab** 1996;81:180-3.
- Keely SL, Corbin JD. Involvement of cAMP-dependent protein kinase in the regulation of heart contractile force. **Am J Physiol** 1977;232:H269-75.
- Keely SL, Eiring A. Involvement of cAMP-dependent protein kinase in the regulation of heart contractile force II. **Am J Physiol** 1979;236:H84-91.
- Kitamura K, Kangawa K, Kawamoto M, Ichiki Y, Nakamura S, Matsuo H, et al. Adrenomedullin: a novel hypotensive peptide isolate from human pheochromocytoma. **Biochem Biophys Res Commun** 1993a;192:553-60.
- Kitamura K, Ichiki Y, Tanaka M, Kawamoto M, Emura J, Sakakibara S, et al. Immunoreactive adrenomedullin in human plasma. **FEBS Lett** 1994;341:288-90.
- Kitamura K, Sakata J, Kangawa K, Kojima M, Matsuo H, Eto T. Cloning and characterization of cDNA encoding a precursor for human adrenomedullin. **Biochem Biophys Res Commun** 1993b;194:720-5.
- Kitazono T, Faraci FM, Taguchi H. Role of potassium channels in cerebral blood vessels. **Stroke** 1995;26:1713-23.
- Knowles RG, Moncada S. Nitric oxide synthase in mammals. **Biochem J** 1994;298:249-58.
- Kohno M, Hanehira T, Kano T, Horio T, Yokokawa K, Ikeda M, et al. Plasma adrenomedullin concentration in essential hypertension. **Hypertension** 1996;27:102-7.
- Kreisberg JJ, Hassid A. Functional properties of glomerular cells in culture. **Miner Electrolyte Metab** 1986;12:25-31.

- Kubota M, Moseley J, Butera L, Dusting GJ, MacDonald PS, Martin TJ. Calcitonin gene-related peptide stimulates cAMP formation in rat aortic smooth muscle cells. **Biochem Biophys Res Commun** 1985;132:88-94.
- Kureishi Y, Kobayashi S, Nishimura J, Nakano T, Kanaide H. Adrenomedullin decreases both cytosolic Ca^{2+} concentration and Ca^{2+} -sensitivity in pig coronary arterial smooth muscle. **Biochem Biophys Res Commun** 1995;212:572-9.
- Kuriyama H, Kitamura K, Nabata H. Pharmacological and physiological significance of ion channels and factors that modulate them in vascular tissues. **Pharmacol Rev** 1995;47:387-573.
- Lamontagne D, Pohl U, Busse R. N^G -nitro-L-arginine antagonizes endothelium-dependent dilator responses by inhibiting endothelium-derived relaxing factor release in the isolated rabbit heart. **Eur J Physiol** 1991;418:266-70.
- Lang MG, Paterno R, Faraci FM, Heistad DD. Mechanisms of adrenomedullin-induced dilatation of cerebral arterioles. **Stroke** 1997;28:181-5.
- Lefer DJ, Nakanishi K, Vinten-Johansen J. Endothelial and myocardial cell protection by cysteine-containing nitric oxidedonor after myocardial ischemia and reperfusion. **J Cardiovas Pharmacol** 1993;22:s34-43.
- Li K, Rouleau L, Andries J, Brutsaert DL. Effect of dysfunctional vascular endothelium on myocardial performance in isolated papillary muscles. **Circ Res** 1993;72:768-77.
- Lin B, Gao Y, Chang JK, Heaton J, Hyman A, Lippon H. An ADM fragment retains the systemic vasodepressor activity in rat ADM. **Eur J Pharmacol** 1994;260:1-4.
- Luckhoff A, Busse R. Calcium influx into endothelial cells and formation of endothelium-derived relaxing factor is controlled by the membrane potential. **Pflugers Arch** 1990;416:305-11.
- Majid DS, Kadowitz PJ, Coy DH, Navar LG. Renal responses to intraarterial administration of adrenomedullin in dogs. **Am J Physiol** 1996;270:F200-5.

- Martinez A, Weaver C, Lopez J, Bhathena SJ, Elsasser TH, Miller MJ, et al. Regulation of insulin secretion and blood glucose metabolism by adrenomedullin. **Endocrinology** 1996; 137:2626-32.
- Matsunaka K, Iwasaki T, Yonetani Y, Kitamura K, Eto T, Kangawa K, et al. Nitric oxide-dependent hypotensive effect of adrenomedullin in rats. **Drug Devel Res** 1996;37:55-60.
- Mazzocchi G, Rebaffat P, Gottardo G, Nussdorfer GG. Adrenomedullin and calcitonin gene-related peptide inhibit aldosterone secretion in rats, acting via a common receptor. **Life Sciences** 1996;58:839-44.
- McDaniel NL, Chen XL, Singer HA, Murphy RA, Rembold CM. Nitrovasodilators relax arterial smooth muscle by decreasing $[Ca^{2+}]_i$ and coupling stress from myosin phosphorylation. **Am J Physiol** 1992;263:C461-7.
- McPherson GA. Current trends in the study of potassium channel openers. **Gen Pharmacol** 1993;24:275-81.
- Mery PF, Lohmann SM, Walter U, Fischmeister R. Ca^{2+} current is regulated by cyclic GMP-dependent protein kinase in mammalian cardiac myocytes. **Proc Natl Acad Sci USA** 1991;88:1197-201.
- Mery PF, Pavoine C, Belhassen L, Pecker F, Fischmeister R. Nitric oxide regulates cardiac Ca^{2+} current. **J Biol Chem** 1993;268:26286-95.
- Michibata H, Mukoyama M, Tanaka T, Suga S, Nakagawa M, Ishibashi R, et al. Autocrine/paracrine role of adrenomedullin in cultured endothelial and mesangial cells. **Kidney Inter** 1998;53:979-85.
- Minkes MS, Douglas JR, Needleman P. Prostaglandin release by isolated perfused rabbit heart. **Prostaglandins** 1973;3:439-45.
- Miura K, Ebara T, Okumura M, Matsuura T, Kim S, Yukimura T, et al. Attenuation of adrenomedullin-induced renal vasodilatation by N^G -nitro L-arginine but not glibenclamide. **Br J Pharmacol** 1995;115: 917-924.
- Miyao Y, Nishikimi T, Goto Y, Miyazaki S, Daikoku S, Morii I, et al. Increased plasma adrenomedullin levels in patients with acute myocardial infarction in proportion to the clinical severity. **Heart** 1998;79:39-44.

- Moncada S, Palmer RM, Higgs EA. Nitric oxide: physiology, pathophysiology, and pharmacology [Review]. **Pharmacol Rev** 1991;43:109-42.
- Morgan JP. Abnormal intracellular modulation of calcium as a major cause of cardiac contractile dysfunction. **N Engl Med** 1991;325:625-32.
- Mouren S, Souktani R, Beaussier M, Abdenour L, Arthaud M, Duvelleroy M, et al. Mechanisms of coronary vasoconstriction induced by high arterial oxygen tension. **Am J Physiol** 1997;272:H67-75.
- Muff R, Born W, Fischer JA. Calcitonin, calcitonin gene related peptide, adrenomedullin, and amylin: Homologous peptides, separate receptors and overlapping biological actions. **Eur J Endocrinol** 1995;133:17-20.
- Mulder H, Ahren B, Karlsson S, Sandler F. Adrenomedullin: localization in the gastrointestinal tract and effects on insulin secretion. **Regulatory Peptides** 1996;62:107-12.
- Murad F. Cyclic guanosine monophosphate as a mediator of vasodilation. **J Clin Invest** 1986;78:1-5.
- Nagao T, Vanhoutte PM. Hyperpolarization contributes to endothelium-dependent relaxation to acetylcholine in femoral veins of rats. **Am J Physiol** 1991;261:H1034-7.
- Nagaya N, Nishikimi T, Horio T, Yoshihara F, Kanazawa A, Matsuo H, et al. Cardiovascular and renal effects of adrenomedullin in rat with heart failure. **Am J Physiol** 1999;276:R213-8.
- Nakamura J, Honda K, Ishikawa S, Kitamura k, Eto T, Saito T. Plasma adrenomedullin levels in patients with non-insulin dependent diabetes mellitus: close relationships with diabetic complications. **Endocrine J** 1998;45:241-6.
- Nakamura K, Toda H, Terasako K, Kakuyama M, Hatano Y, Mori K, et al. Vasodilative effect of adrenomedullin in isolated arteries of the dog. **Jpn J Pharmacol** 1995;67:259-62.
- Nakashima M, Mombouli JV, Taylor AA, Vanhoutte PM. Endothelium-dependent hyperpolarization caused by bradykinin in human coronary arteries. **J Clin Invest** 1993;92:2867-71.

- Nandha KA, Taylor GM, Smith DM, Owji AA, Byfield PJ, Ghatei MA, et al. Specific adrenomedullin binding sites and hypotension in the rat systemic vascular bed. **Regulatory Peptides** 1996;62:145-51.
- Nelson MT, Huang Y, Brayden JE, Hescheler JK, Standen NB. Arterial dilation in response to calcitonin gene-related peptide involve activation of potassium channels. **Nature Lond** 1990;344:770-3.
- Nelson MT, Quayle JM. Physiological roles and properties of potassium channels in arterial muscle. **Am J Physiol** 1995;268:C799-822.
- Nelson MT. Ca^{2+} - activated potassium channels and ATP-sensitive potassium channels as modulator of vascular tone. **Trends Cardiovas Med** 1993;3:54-60.
- Niimi H, Jariyapongskul A, Minamino N. Vasodilatory response of adrenomedullin on rat cerebral arterioles: an intravital microscopic analysis. In: Messmer K, Kubler WM (eds). **Proceeding of the Sixth World Congress for Microcirculation** Munich: Munduzzi Editore, 1996:709-12.
- Nishikimi T, Horio T, Sasaki T, Yoshihara F, Takishita S, Miyata A, et al. Cardiac production and secretion of adrenomedullin are increased in heart failure. **Hypertension** 1997;30:1369-75.
- Nishikimi T, Horio T, Yoshihara F, Nagaya N, Matsuo H, Kangawa K. Effect of adrenomedullin on cAMP and cGMP levels in rat cardiac myocytes and nonmyocytes. **Eur J Pharmacol** 1998;353:337-44.
- Nishikimi T, Kitamura K, Saito Y, Shimada K, Ishimitsu T, Takamiya M, et al. Clinical studies for the sites of production and clearance of circulating adrenomedullin in human subjects. **Hypertension** 1994;24:600-4.
- Noma A, Shibasaki TJ. Membrane current through adenosine triphosphate-regulated channels in guinea pig ventricular cells. **J Physiol Lond** 1985;363:463-80.
- Noma A. ATP-regulated potassium channels in cardiac muscle. **Nature Lond** 1983;305:147-8.

- Nossaman BD, Feng CJ, Kaye AD, Dewitt B, Coy DH, Murphy WA, et al. Pulmonary vasodilator responses to adrenomedullin are induced by NOS inhibitors in rats but not in cats. *Am J Physiol* 1996;270:L782-9.
- Nuki C, Kawasaki H, Kitamura K, Takenaka m, Kangawa K, Eto T, et al. Vasodilator effect of adrenomedullin and calcitonin gene-related peptide receptor in the rat mesenteric vascular beds. *Biochem Biophys Res Commun* 1993;196:245-51.
- Ohno M, Gibbons GH, Dzau VJ, Cooke JP. Shear stress elevates endothelial cGMP: role of potassium channel and G protein coupling. *Circulation* 1993;88:193-7.
- Okamura T, Ayajiki K, Kangawa K, Toda N. Mechanism of adrenomedullin-induced relaxation in isolated canine retinal arteries. *Invest Ophthalmol & Visual Sc* 1997;38:56-61.
- Okamura T, Zhang JX, Kangawa K, Toda N. Inhibition by adrenomedullin of the adrenergic neurogenic response in canine mesenteric arteries. *Jpn J Pharmacol* 1997;73:259-61.
- Osajima A, Mutoh Y, Uezono Y, Kawamura M, Izumi F, Takasugi M, et al. Adrenomedullin increases cyclic AMP more potently than CGRP and amylin in rat renal tubular basolateral membranes. *Life Sciences* 1995;57:457-62.
- Parkes DG, May CN. Direct cardiac and vascular functions of adrenomedullin in conscious sheep. *Bri J Pharmacol* 1997;120:1179-85.
- Parkes DG. Cardiovascular actions of adrenomedullin in conscious sheep. pathophysiology, and pharmacology. *Pharmacol Rev* 1991;43:109-42.
- Perret M, Broussard H, LeGros T, Burns A, Chang JK, Summer W, et al. The effect of adrenomedullin on the isolated heart. *Life Sciences* 1993;53:377-9.
- Pfrunder D, Anghelescu I, Kreye VAW. Intracellular ADP activates ATP-sensitive potassium channels in vascular smooth muscle cells of the guinea pig portal vein. *Eur J Pharmacol* 1993;423:149-51.

- Pinto A, Sekizawa K, Yamaya M, Ohru T, Jia YX, Sasaki H. Effects of adrenomedullin and calcitonin gene-related peptide on airway and pulmonary vascular smooth muscle in guinea-pigs. **Br J Pharmacol** 1996;119:1477-83.
- Quast U, Bray KM, Andres H, Manley PW, Baumlin Y, Dosogne J. Binding of the potassium channel opener [³H] P1075 in rat isolated aorta: a relationship to functional effects of openers and blockers. **Mol Pharmacol** 1993;43:474-81.
- Quast U. Do the potassium channel openers relax smooth muscle by opening potassium channels?. **Trends Pharmacol Sci** 1993;14:332-7.
- Quast U. Potassium channel openers: pharmacological and clinical aspects. **Fundam Clin Pharmacol** 1992;6:279-93.
- Rademaker MT, Charles CJ, Lewis LK, Yandle TG, Cooper GJS, Coy DH, et al. Beneficial hemodynamic and renal effects of adrenomedullin in an ovine model of heart failure. **Circulation** 1997;96:1983-90.
- Richer C, Pratz J, Mulder P, Mondot S, Giudicelli JF, Cacero I. Cardiovascular and biological effects of potassium channel openers, a class of drugs with vasorelaxant and cardioprotective properties. **Life Sciences** 1990;47:1693-705.
- Robertson BE, Schubert R, Hescheler J, Nelson MT. Cyclic GMP-dependent protein kinase activates calcium-activated potassium channels in cerebral artery smooth muscle cells. **Am J Physiol** 1993;265:C299-303.
- Sabates BL, Pigott JD, Choe EU, Cruz MP, Lippon HL, Hyman AL, et al. Adrenomedullin mediates coronary vasodilation through adenosine receptors and ATP-sensitive potassium channels. **J Surg** 1997;67:163-8.
- Sakai K, Saito K, Ishizaka N. Adrenomedullin synergistically interacts with endogenous vasodilators in rat: a possible role of ATP-sensitive potassium channels. **Eur J Pharmacol** 1998;359:151-9.
- Sakata J, Shimokubo T, Kitamura K, Nakamura S, Kangawa K, Matsuo H, et al. Molecular cloning and biological activities of rat adrenomedullin, a hypotensive peptide. **Biochem Biophys Res Commun** 1993;195:921-7.

- Samson WK, Murphy T, Schell DA. A novel vasoactive peptide adrenomedullin inhibits pituitary adrenocorticotropin release. **Endocrinology** 1995;136:2349-52.
- Sasaki A, Kida O, Kangawa K, Matsuo H, Tanaka K. Involvement of sympathetic nerves in cardiosuppressive effects of α -human atrial natriuretic polypeptide in anesthetized rats. **Eur J Pharmacol** 1986;120:345-9.
- Sato A, Canny BJ, Autelitano DL. Adrenomedullin stimulates cAMP accumulation and inhibits atrial natriuretic peptide gene expression in cardiomyocytes. **Biochem Biophys Res Commun** 1997;230:311-4.
- Segushi H, Nishimura J, Kobayashi S, Kumazawa J, Kanaide H. Autocrine regulation of the renal arterial tone by adrenomedullin. **Biochem Biophys Res Commun** 1995;215:619-25.
- Shiji H, Minamino N, Kangawa K, Matsuo H. Endotoxin markedly elevates plasma concentration and gene transcription of adrenomedullin in rat. **Biochem Biophys Res Commun** 1995;215:531-7.
- Shimekake Y, Nagata K, Ohta S, Kambayashi Y, Teraoka H, Kitamura K, et al. Adrenomedullin stimulates two signal transduction pathways, cAMP accumulation and calcium mobilization, in bovine aortic endothelial cells. **J Biol Chem** 1995;270:4412-7.
- Shimokubo T, Sakata J, Kitamura K, Kangawa K, Matsuo H, Eto T. Adrenomedullin: changes in circulating and cardiac tissue concentration in Dahl salt-sensitive rats on a high-salt diet. **Clin Exp Hypertension** 1996;18:949-61.
- Shoji T, Ishihara H, Ishikawa T, Saito A, Goto K. Vasodilating effects of human and rat calcitonin gene-related peptides in isolated porcine coronary arteries. **Naunyn Schmiedbergs Arch Pharmacol** 1987;336:438-44.
- Spruce AE, Standen NB, Stanfield PR. Voltage-dependent ATP-sensitive potassium channels of skeletal muscle membrane. **Nature** 1985;316:736-8.
- Standen NB, Quayle JM, Davies NW, Brayden JF, Huang Y, Nelson MT. Hyperpolarizing vasodilators activate ATP-sensitive K^+ channels in arterial smooth muscle. **Science Wash DC** 1989;245:177-80.

- Standen NB. Potassium channels, metabolism and muscle. **Exp Physiol** 1992;77:1-25.
- Sugo S, Minamino N, Kangawa K, Miyamoto K, Kitamura K, Sakata J, et al. Endothelial cells actively synthesize and secrete adrenomedullin. **Biochem Biophys Res Commun** 1994a;201:1160-6.
- Sugo S, Minamino N, Shoji H, Kangawa K, Kitamura K, Eto T, et al. Production and secretion of adrenomedullin from vascular smooth muscle cells augmented production by tumor necrosis factor- α . **Biochem Biophys Res Commun** 1994b;203:719-26.
- Sugo S, Minamino N, Shoji H, Kangawa K, Kitamura K, Eto T, et al. Interleukin-1 tumor necrosis factor and lipopolysaccharide additively stimulate production of adrenomedullin in vascular smooth muscle cells. **Biochem Biophys Res Commun** 1995;207:25-32.
- Sumii K, Sperelakis N. cGMP-dependent protein kinase regulation of the L-type Ca^{2+} current in rat ventricular myocytes. **Circ Res** 1995;77:803-12.
- Szodoki I, Kinnunen P, Ruskoaho H. Inotropic effect of adrenomedullin in the isolated perfused rat heart. **Acta Physiol Scand** 1996;156:151-2.
- Szokodi I, Kinnunen P, Tavi P, Weckstrom M, Toth M, Ruskoaho H. Evidence for cAMP-independent mechanisms mediating the effects of adrenomedullin, a new inotropic peptide. **Circulation** 1998;97:1062-70.
- Taguchi H, Heistad DD, Kitazono T, Faraci. ATP-sensitive K^+ channels mediate dilatation of cerebral arterioles during hypoxia. **Circ Res** 1994;74:1005-8.
- Takahashi H, Watanabe T.X, Nishimura M, Nakanishi T, Sakamoto M, Yoshimura M, et al. Centrally induced vasopressor and sympathetic responses to a novel endogenous peptide adrenomedullin in anaesthetized rats. **Am J Hypertens** 1994;7:478-82.
- Takahashi Y, Vroomen MD, Gournay V, Roman C, Rudolph AM, Heymann MA. Mechanisms of adrenomedullin-induced increase of pulmonary blood flow in fetal sheep. **Pediatr Res** 1999;45:276-81.

- Taniyama M, Kitamura K, Ban Y, Eto T, Katagiri T. Elevated plasma adrenomedullin level in hyperthyroidism. **Eur J Clin Invest** 1996;26:454-6.
- Taylor SG, Weston AH. Endothelium-hyperpolarizing factor: a new endogenous inhibitor from vascular endothelium. **Trends Pharmacol Sci** 1988;9:272-4.
- Teitelbaum I. Hormone signaling systems in inner medullary collecting ducts. **Am J Physiol** 1992;263:F985-90.
- Teiyel DF, Iwamoto HS, Rudolph AM. Changes in the pulmonary circulation during birth-related events. **Pediatr Res** 1990;27:372-8.
- Tsuruda T, Kato J, Kitamura K, Kuwasako K, Imamura T, Koiwaya Y, et al. Adrenomedullin: a possible autocrine or paracrine inhibitor of hypertrophy of cardiomyocytes. **Hypertension** 1998;31:505-10.
- Twort CHC, Breeman CV. Cyclic guanosine monophosphate-enhanced sequestration of Ca^{2+} by sarcoplasmic reticulum in vascular smooth muscle. **Circ Res** 1988;62:961-4.
- Vane JR, Anggard EE, Botting RM. Regulatory functions of the vascular endothelium. **N Engl J Med** 1990;323:27-36.
- Vanhoutte PM. The endothelium: modulator of vascular smooth muscle tone. **N Engl J Med** 1988;319:512-3.
- Von Beckerath N, Dittrich M, Klieber HG, Daut J. Inwardly rectifying K^+ channels in freshly dissociated coronary endothelial cells from guinea-pig heart. **J Physiol (Lond)** 1996;491:357-65.
- Wang X, Yue TL, Barone FC, White RF, Clark RK, Willette RN, et al. Discovery of adrenomedullin in rat ischemic cortex and evidence for its role in exacerbating focal brain ischemic damage. **Proc Natl Acad Sci USA** 1995;92:11480-4.
- Williams DL, Katz GM, Roy-Contancin L, Reuben JP. Guanosine 5'-monophosphate modulates gating of high conductance calcium-activated potassium channels in vascular smooth muscle cells. **Proc Natl Acad Sci USA** 1988;85:9360-4.

- Yamaguchi T, Baba K, Doi Y, Yano K. Effect of adrenomedullin on aldosterone secretion by dispersed rat adrenal zona glomerulosa cells. **Life Science** 1995;56: 379-87.
- Yang BC, Lipton H, Gumusel B, Hyman A, Mehta JL. Adrenomedullin dilates rat pulmonary artery rings during hypoxia: role of nitric oxide and vasodilator prostaglandins. **J Cardiovas Pharmacol** 1996;28:458-62.
- Yokoshiki H, Sunakawa M, Seki T, Sperelakis N. ATP-sensitive potassium channels in pancreatic, cardiac, and vascular smooth muscle cells. **Am J Physiol** 1998;274:C25-37.
- Yoshimoto R, Mitsui- Saito M, Ozaki H, Karaki H. Effects of adrenomedullin and calcitonin gene-related peptide on contractions of the rat aorta and porcine coronary artery. **Br J of Pharmacol** 1998;123:1645-54.
- Yoshitomi Y, Nishikimi T, Kojima S, Kuramochi M, Takashita S, Matsuoka H, et al. Plasma levels of adrenomedullin in patients with acute myocardial infarction. **Clin Sci** 1998;94:135-9.

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย



APPENDIX

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

The effect of intravenous injection of AM (1 nmol/kg BW) on mean arterial blood pressure

	MAP (mmHg)									
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	30 min	60 min
No. 1	103	67	73	73	78	83	88	93	93	93
No. 2	95	67	70	75	80	80	85	90	90	95
No. 3	90	67	73	78	83	83	90	90	90	90
No. 4	93	68	70	70	75	75	80	80	93	93
No. 5	120	73	83	88	97	105	120	120	120	120
No. 6	95	68	70	70	73	78	83	83	92	92
No. 7	93	70	73	73	73	73	77	87	90	90

The effect of topical application of AM (10^{-7} M) on the second-order arteriolar diameter of rat skin microcirculation

	Arteriolar diameter (μm)							
	0 min	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	62	64	64	65	64	64	64	63
No. 2	61	65	66	67	67	68	66	66
No. 3	51	52	52	52	52	53	53	52
No. 4	54	54	55	56	55	55	54	54
No. 5	56	59	58	58	57	57	56	56

The effect of topical application of AM (10^{-7} M) on the third-order arteriolar diameter of rat skin microcirculation

	Arteriolar diameter (μm)							
	0 min	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	41	43	44	46	45	45	45	44
No. 2	45	55	56	57	56	54	53	51
No. 3	29	30	30	31	31	30	30	30
No. 4	24	26	26	26	25	25	25	24
No. 5	36	39	40	42	41	39	38	38

The effect of bolus injection of AM (20 μ g) on cardiac contraction in isolated rat heart

	+dP/dT _{max} (mmHg/sec)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	1630	1656	1662	1615	1560	1542	1516	1521	1547
No. 2	1983	1959	1977	1975	1972	1980	1984	1993	1995
No. 3	1862	1828	1829	1822	1809	1794	1775	1760	1770
No. 4	1577	1545	1518	1530	1548	1545	1528	1532	1522
No. 5	1650	1595	1654	1647	1621	1612	1586	1623	1622

The effect of bolus injection of AM (20 μ g) on cardiac relaxation in isolated rat heart

	-dP/dT _{max} (mmHg/sec)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	782	745	748	727	718	710	697	715	743
No. 2	1091	1030	1068	1067	1065	1069	1052	1096	1097
No. 3	1006	973	969	966	977	951	959	950	938
No. 4	852	880	865	862	836	833	825	950	898
No. 5	974	909	943	938	973	955	952	893	892

The effect of bolus injection of AM (20 μ g) on heart rate in isolated rat heart

	HR (beats/min)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	300	294	321	320	324	334	333	321	308
No. 2	284	287	294	300	302	305	314	290	288
No. 3	267	279	291	297	301	300	297	289	280
No. 4	275	286	295	298	301	302	304	303	298
No. 5	266	269	280	279	278	278	277	279	271

The effect of bolus injection of AM (20 μ g) on coronary blood flow in isolated rat heart

	CBF (ml/min)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	6.2	7.2	7.3	7.3	7.4	7.3	7.2	6.7	6.6
No. 2	6.8	8.2	8.2	8.2	8.2	8.2	8.2	8.0	7.9
No. 3	7.8	8.9	9.0	9.0	9.1	9.1	9.2	9.2	8.7
No. 4	7.3	8.5	8.5	8.6	8.7	8.6	8.6	8.5	7.8
No. 5	6.9	8.1	8.2	8.2	8.2	8.2	8.2	7.9	7.4

The effect of bolus injection of AM (20 μ g) on coronary blood flow in isolated rat heart during the continuous infusion of indomethacin

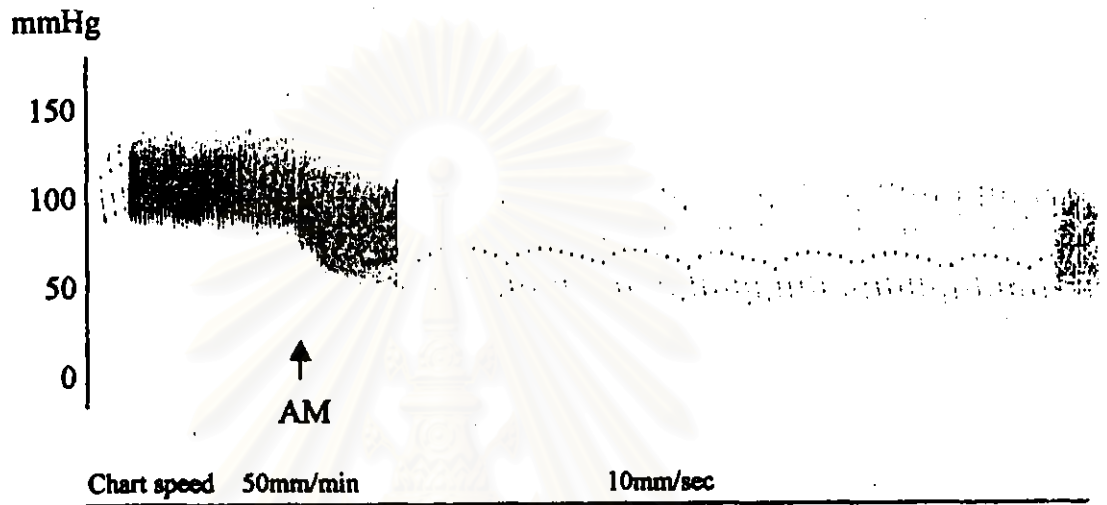
	CBF (ml/min)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	5.7	6.9	6.9	6.9	6.9	6.9	6.9	6.4	6.2
No. 2	6.3	7.7	7.8	7.9	8.0	8.0	8.0	7.7	7.6
No. 3	6.7	7.4	7.3	7.4	7.5	7.5	7.6	7.5	7.3
No. 4	4.6	5.2	5.3	5.3	5.4	5.4	5.5	5.4	5.3
No. 5	5.3	6.1	6.3	6.3	6.4	6.4	6.4	6.2	5.9

The effect of bolus injection of AM (20 μ g) on coronary blood flow in isolated rat heart during the continuous infusion of L-NNA

	CBF (ml/min)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	5.6	6.5	6.5	6.5	6.5	6.5	6.5	6.3	6.2
No. 2	4.6	5.2	5.2	5.2	5.2	5.2	5.2	5.0	4.9
No. 3	6.7	7.5	7.7	7.5	7.5	7.5	7.6	7.5	7.3
No. 4	5.8	6.8	6.8	6.8	6.9	6.8	6.8	6.6	6.3
No. 5	6.2	7.0	7.0	7.0	7.1	7.1	7.2	7.2	7.0

The effect of bolus injection of AM (20 μ g) on coronary blood flow in isolated rat heart during the continuous infusion of glibenclamide

	CBF (ml/min)								
	0 min	30 sec	1 min	2 min	3 min	4 min	5 min	10 min	20 min
No. 1	5.4	5.6	5.8	5.8	5.8	5.7	5.7	5.5	5.5
No. 2	3.9	4.2	4.1	4.1	4.1	4.1	4.1	4.0	3.9
No. 3	5.7	5.8	5.9	5.9	5.9	5.9	5.9	5.8	5.8
No. 4	6.3	6.7	6.6	6.6	6.7	6.7	6.8	6.7	6.5
No. 5	4.1	4.3	4.2	4.2	4.3	4.2	4.2	4.1	4.1



The example of arterial blood pressure tracing recorded from one experiment for hypotensive response in anesthetized rat to intravenous bolus injection of AM (1 nmol/kg BW)

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

PUBLICATIONS

Amatyakul S, Patumraj S, Niimi H. The Effect of Topical Adrenomedullin Application on Striated Muscle Microcirculation. "Proceeding of 3rd Asian Congress for Microcirculation" Bangkok (Thailand). Monduzzi Editore (Italy) 1997:229-31.

Amatyakul S, Patumraj S, Niimi H. Topical Application of Adrenomedullin on the Skin Microcirculation in Rat Dorsal Skinfold Chamber Model. "Abstract of 1st International Symposium on Adrenomedullin and PAMP" Osaka (Japan) 1998:65.

AWARD

Young Investigator Award from 1st International Symposium on Adrenomedullin and PAMP. Osaka, Japan (February 13-14,1998).

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

BIOGRAPHY

NAME	Mrs. Supathra Amatyakul
DATE OF BIRTH	May 11, 1956
PLACE OF BIRTH	Bangkok, Thailand.
INSTITUTION ATTENDED	1975-1978 : Bachelor of Science (General Science), Chulalongkorn University.
	1984-1988 : Master of Science (Physiology), Chulalongkorn University.
	1995-2000 : Ph.D. candidate (Physiology), Chulalongkorn University.
POSITION & OFFICE	(1981 – Present) : Position : Scientist Department of Physiology, Faculty of Dentistry, Chulalongkorn University.



สถาบันวิทยุศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย