

Bibliografía

7 BIBLIOGRAFÍA

A

Akyurek, L. M., Paul, L. C., Funa, K., Larsson, E. & Fellstrom, B. C. (1996) Smooth muscle cell migration into intima and adventitia during development of transplant vasculopathy. *Transplantation*, **62**, 1526-1529.

Andersson, M., Ostman, A., Westermark, B. & Heldin, C. H. (1994) Characterization of the retention motif in the C-terminal part of the long splice form of platelet-derived growth factor A-chain. *J Biol Chem.*, **269**, 926-930.

Ashikari, S., Habuchi, H. & Kimata, K. (1995) Characterization of heparan sulfate oligosaccharides that bind to hepatocyte growth factor. *J Biol Chem.*, **270**, 29586-29593.

B

Badimon, L., Chesebro, J. H. & Badimon, J. J. (1992) Thrombus formation on ruptured atherosclerotic plaques and rethrombosis on evolving thrombi. *Circulation*, **86**, III74-III85.

Banai, S., Wolf, Y., Golomb, G., Pearle, A., Waltenberger, J., Fishbein, I., Schneider, A., Gazit, A., Perez, L., Huber, R., Lazarovichi, G., Rabinovich, L., Levitzki, A. & Gertz, S. D. (1998) PDGF-receptor tyrosine kinase blocker AG1295 selectively attenuates smooth muscle cell growth in vitro and reduces neointimal formation after balloon angioplasty in swine. *Circulation*, **97**, 1960-1969.

Bar-Shavit, R., Eldor, A. & Vlodavsky, I. (1989) Binding of thrombin to subendothelial extracellular matrix. Protection and expression of functional properties. *J Clin Invest*, **84**, 1096-1104.

Baron, J. H., Moiseeva, E. P., de Bono, D. P., Abrams, K. R. & Gershlick, A. H. (2000) Inhibition of vascular smooth muscle cell adhesion and migration by c7E3 Fab (abciximab): a possible mechanism for influencing restenosis. *Cardiovasc Res*, **48**, 464-472.

Barradas, M. A., Jagroop, I. A. & Mikhailidis, D. P. (1994) Naftidrofuryl inhibits the release of 5-hydroxytryptamine and platelet-derived growth factor from human platelets. *Clin Chim. Acta*, **230**, 157-167.

Bashkin, P., Doctrow, S., Klagsbrun, M., Svahn, C. M., Folkman, J. & Vlodavsky, I. (1989) Basic fibroblast growth factor binds to subendothelial extracellular matrix and is released by heparitinase and heparin-like molecules. *Biochemistry*, **28**, 1737-1743.

Bendeck, M. P., Irvin, C. & Reidy, M. A. (1996) Inhibition of matrix metalloproteinase activity inhibits smooth muscle cell migration but not neointimal thickening after arterial injury. *Circ Res*, **78**, 38-43.

Benezra, M., Ben Sasson, S. A., Regan, J., Chang, M., Bar-Shavit, R. & Vlodavsky, I. (1994) Antiproliferative activity to vascular smooth muscle cells and receptor binding of heparin-mimicking polyaromatic anionic compounds. *Arterioscler. Thromb.*, **14**, 1992-1999.

Bengtsson-Olivecrona, G. & Olivecrona, T. (1991) Phospholipase activity of milk lipoprotein lipase. *Methods Enzymol.*, **197**, 345-356.

Bernfield, M., Kokenyesi, R., Kato, M., Hinkes, M. T., Spring, J., Gallo, R. L. & Lose, E. J. (1992) Biology of the syndecans: a family of transmembrane heparan sulfate proteoglycans. *Annu.Rev.Cell Biol.*, **8**, 365-393.

Bernfield, M., Gotte, M., Park, P. W., Reizes, O., Fitzgerald, M. L., Lincecum, J. & Zako, M. (1999) Functions of cell surface heparan sulfate proteoglycans. *Annu.Rev.Biochem.*, **68**, 729-777.

Betsholtz, C., Rorsman, F., Westermark, B., Ostman, A. & Heldin, C. H. (1990) Analogous alternative splicing. *Nature*, **344**, 299.

Bilder, G., Wentz, T., Leadley, R., Amin, D., Byan, L., O'Conner, B., Needle, S., Galczynski, H., Bostwick, J., Kasiewski, C., Myers, M., Spada, A., Merkel, L., Ly, C., Persons, P., Page, K., Perrone, M. & Dunwiddie, C. (1999) Restenosis following angioplasty in the swine coronary artery is inhibited by an orally active PDGF-receptor tyrosine kinase inhibitor, RPR101511A. *Circulation*, **99**, 3292-3299.

Bingley, J. A., Campbell, J. H., Hayward, I. P. & Campbell, G. R. (1997) Inhibition of neointimal formation by natural heparan sulfate proteoglycans of the arterial wall. *Ann.N.Y.Acad.Sci.*, **811**, 238-242.

Bingley, J. A., Hayward, I. P., Campbell, J. H. & Campbell, G. R. (1998) Arterial heparan sulfate proteoglycans inhibit vascular smooth muscle cell proliferation and phenotype change in vitro and neointimal formation in vivo. *J Vasc.Surg*, **28**, 308-318.

Bingley, J. A., Hayward, I. P., Campbell, G. R. & Campbell, J. H. (2001) Relationship of glycosaminoglycan and matrix changes to vascular smooth muscle cell phenotype modulation in rabbit arteries after acute injury. *J Vasc.Surg*, **33**, 155-164.

Boren, J., Gustafsson, M., Skalen, K., Flood, C. & Innerarity, T. L. (2000) Role of extracellular retention of low density lipoproteins in atherosclerosis. *Curr.Opin.Lipidol.*, **11**, 451-456.

Bornfeldt, K. E., Raines, E. W., Nakano, T., Graves, L. M., Krebs, E. G. & Ross, R. (1994) Insulin-like growth factor-I and platelet-derived growth factor-BB induce directed migration of human arterial smooth muscle cells via signaling pathways that are distinct from those of proliferation. *J Clin Invest*, **93**, 1266-1274.

Bornfeldt, K. E., Raines, E. W., Graves, L. M., Skinner, M. P., Krebs, E. G. & Ross, R. (1995) Platelet-derived growth factor. Distinct signal transduction pathways associated with migration versus proliferation. *Ann.N.Y.Acad.Sci.*, **766**, 416-430.

Bourin, M. C. & Lindahl, U. (1993) Glycosaminoglycans and the regulation of blood coagulation. *Biochem.J*, **289**, 313-330.

Brennand, D. M., Scully, M. F., Kakkar, V. V. & Patel, G. (1997) A cyclic peptide analogue of loop III of PDGF-BB causes apoptosis in human fibroblasts. *FEBS Lett*, **419**, 166-170.

Buchdunger, E., Zimmermann, J., Mett, H., Meyer, T., Muller, M., Regenass, U. & Lydon, N. B. (1995) Selective inhibition of the platelet-derived growth factor signal transduction pathway by a protein-tyrosine kinase inhibitor of the 2-phenylaminopyrimidine class. *Proc.Natl.Acad.Sci.U.S.A*, **92**, 2558-2562.

Buchdunger, E., Zimmermann, J., Mett, H., Meyer, T., Muller, M., Druker, B. J. & Lydon, N. B. (1996) Inhibition of the Abl protein-tyrosine kinase in vitro and in vivo by a 2-phenylaminopyrimidine derivative. *Cancer Res*, **56**, 100-104.

Buton, X., Mamdouh, Z., Ghosh, R., Du, H., Kuriakose, G., Beatini, N., Grabowski, G. A., Maxfield, F. R. & Tabas, I. (1999) Unique cellular events occurring during the initial interaction of macrophages with matrix-retained or methylated aggregated low density lipoprotein (LDL). Prolonged cell-surface contact during which ldl-cholesteryl ester hydrolysis exceeds ldl protein degradation. *J Biol Chem.*, **274**, 32112-32121.

C

Cadroy, Y., Hanson, S. R. & Harker, L. A. (1993) Dermatan sulfate inhibition of fibrin-rich thrombus formation in nonhuman primates. *Arterioscler.Thromb.*, **13**, 1213-1217.

Camejo, G., Fager, G., Rosengren, B., Hurt-Camejo, E. & Bondjers, G. (1993) Binding of low density lipoproteins by proteoglycans synthesized by proliferating and quiescent human arterial smooth muscle cells. *J Biol Chem.*, **268**, 14131-14137.

Cardoso, L. E. & Mourao, P. A. (1994) Glycosaminoglycan fractions from human arteries presenting diverse susceptibilities to atherosclerosis have different binding affinities to plasma LDL. *Arterioscler.Thromb.*, **14**, 115-124.

Carey, D. J. (1997) Syndecans: multifunctional cell-surface co-receptors. *Biochem.J*, **327**, 1-16.

Carragher, N. O., Levkau, B., Ross, R. & Raines, E. W. (1999) Degraded collagen fragments promote rapid disassembly of smooth muscle focal adhesions that correlates with cleavage of pp125(FAK), paxillin, and talin. *J Cell Biol*, **147**, 619-630.

Castellot, J. J., Jr., Favreau, L. V., Karnovsky, M. J. & Rosenberg, R. D. (1982) Inhibition of vascular smooth muscle cell growth by endothelial cell-derived heparin. Possible role of a platelet endoglycosidase. *J Biol Chem.*, **257**, 11256-11260.

Castellot, J. J., Jr., Wong, K., Herman, B., Hoover, R. L., Albertini, D. F., Wright, T. C., Caleb, B. L. & Karnovsky, M. J. (1985) Binding and internalization of heparin by vascular smooth muscle cells. *J Cell Physiol*, **124**, 13-20.

Castellot, J. J., Jr., Choay, J., Lormeau, J. C., Petitou, M., Sache, E. & Karnovsky, M. J. (1986) Structural determinants of the capacity of heparin to inhibit the proliferation of vascular smooth muscle cells. II. Evidence for a pentasaccharide sequence that contains a 3-O-sulfate group. *J Cell Biol*, **102**, 1979-1984.

Casu, B., Petitou, M., Provasoli, M. & Sinay, P. (1988) Conformational flexibility: a new concept for explaining binding and biological properties of iduronic acid-containing glycosaminoglycans. *Trends Biochem.Sci.*, **13**, 221-225.

Chait, A. & Wight, T. N. (2000) Interaction of native and modified low-density lipoproteins with extracellular matrix. *Curr.Opin.Lipidol.*, **11**, 457-463.

Chandrasekar, B. & Tanguay, J. F. (2000) Platelets and restenosis. *J Am.Coll.Cardiol.*, **35**, 555-562.

Chang, M. Y., Potter-Perigo, S., Tsoi, C., Chait, A. & Wight, T. N. (2000) Oxidized low density lipoproteins regulate synthesis of monkey aortic smooth muscle cell proteoglycans that have enhanced native low density lipoprotein binding properties. *J Biol Chem.*, **275**, 4766-4773.

Chappell, D. A., Fry, G. L., Waknitz, M. A., Muhonen, L. E., Pladet, M. W., Iverius, P. H. & Strickland, D. K. (1993) Lipoprotein lipase induces catabolism of normal triglyceride-rich lipoproteins via the low density lipoprotein receptor-related protein/alpha 2-macroglobulin receptor in vitro. A process facilitated by cell-surface proteoglycans. *J Biol Chem.*, **268**, 14168-14175.

Chen, J. K., Hoshi, H. & McKeehan, W. L. (1991) Stimulation of human arterial smooth muscle cell chondroitin sulfate proteoglycan synthesis by transforming growth factor-beta. *In Vitro Cell Dev.Biol.*, **27**, 6-12.

Chon, J. H. & Chaikof, E. L. (2001) Soluble heparin-binding peptides regulate chemokinesis and cell adhesive forces. *Am.J Physiol Cell Physiol*, **280**, C1394-C1402.

Cizmeci-Smith, G., Asundi, V., Stahl, R. C., Teichman, L. J., Chernousov, M., Cowan, K. & Carey, D. J. (1992) Regulated expression of syndecan in vascular smooth muscle cells and cloning of rat syndecan core protein cDNA. *J Biol Chem.*, **267**, 15729-15736.

Cizmeci-Smith, G., Stahl, R. C., Showalter, L. J. & Carey, D. J. (1993) Differential expression of transmembrane proteoglycans in vascular smooth muscle cells. *J Biol Chem.*, **268**, 18740-18747.

Cizmeci-Smith, G., Langan, E., Youkey, J., Showalter, L. J. & Carey, D. J. (1997) Syndecan-4 is a primary-response gene induced by basic fibroblast growth factor and arterial injury in vascular smooth muscle cells. *Arterioscler.Thromb.Vasc.Biol*, **17**, 172-180.

Clowes, A. W., Clowes, M. M. & Reidy, M. A. (1986) Kinetics of cellular proliferation after arterial injury. III. Endothelial and smooth muscle growth in chronically denuded vessels. *Lab Invest*, **54**, 295-303.

Clowes, A. W. & Clowes, M. M. (1986) Kinetics of cellular proliferation after arterial injury. IV. Heparin inhibits rat smooth muscle mitogenesis and migration. *Circ Res*, **58**, 839-845.

Clunn, G. F., Refson, J. S., Lymn, J. S. & Hughes, A. D. (1997) Platelet-derived growth factor beta-receptors can both promote and inhibit chemotaxis in human vascular smooth muscle cells. *Arterioscler.Thromb.Vasc.Biol*, **17**, 2622-2629.

Conrad, H. E. (1998) Antithrombin, the prototypic heparin-binding protein. *Heparin-binding Proteins* 203-238. Academic Press, San Diego, CA.

D

Dangas, G. & Fuster, V. (1996) Management of restenosis after coronary intervention. *Am.Heart J*, **132**, 428-436.

Dangas, G. & Kuepper, F. (2002) Cardiology patient page. Restenosis: repeat narrowing of a coronary artery: prevention and treatment. *Circulation*, **105**, 2586-2587.

Davis, G. E. (1992) Affinity of integrins for damaged extracellular matrix: alpha v beta 3 binds to denatured collagen type I through RGD sites. *Biochem.Biophys.Res Commun.*, **182**, 1025-1031.

Deguchi, J., Namba, T., Hamada, H., Nakaoka, T., Abe, J., Sato, O., Miyata, T., Makuuchi, M., Kurokawa, K. & Takuwa, Y. (1999) Targeting endogenous platelet-derived growth factor B-chain by adenovirus-mediated gene transfer potently inhibits in vivo smooth muscle proliferation after arterial injury. *Gene Ther.*, **6**, 956-965.

DiGabriele, A. D., Lax, I., Chen, D. I., Svahn, C. M., Jaye, M., Schlessinger, J. & Hendrickson, W. A. (1998) Structure of a heparin-linked biologically active dimer of fibroblast growth factor. *Nature*, **393**, 812-817.

Dirks, R. P. H. & Bloemers, H. P. J. (1996) Signals controlling the expression of PDGF. *Mol.Biol.Rep.*, **22**, 1-24.

Duan, D. S., Pazin, M. J., Fretto, L. J. & Williams, L. T. (1991) A functional soluble extracellular region of the platelet-derived growth factor (PDGF) beta-receptor antagonizes PDGF-stimulated responses. *J Biol Chem.*, **266**, 413-418.

E

Edwards, I. J., Xu, H., Wright, M. J. & Wagner, W. D. (1994) Interleukin-1 upregulates decorin production by arterial smooth muscle cells. *Arterioscler.Thromb.*, **14**, 1032-1039.

Edwards, I. J., Xu, H., Obunike, J. C., Goldberg, I. J. & Wagner, W. D. (1995) Differentiated macrophages synthesize a heparan sulfate proteoglycan and an oversulfated chondroitin sulfate proteoglycan that bind lipoprotein lipase. *Arterioscler.Thromb.Vasc.Biol*, **15**, 400-409.

Ellis, S. G., Roubin, G. S., Wilentz, J., Douglas, J. S., Jr. & King, S. B., III (1989) Effect of 18- to 24-hour heparin administration for prevention of restenosis after uncomplicated coronary angioplasty. *Am.Heart J*, **117**, 777-782.

Engstrom, U., Engstrom, A., Ernlund, A., Westermark, B. & Heldin, C. H. (1992) Identification of a peptide antagonist for platelet-derived growth factor. *J Biol Chem.*, **267**, 16581-16587.

Eriksson, A., Siegbahn, A., Westermark, B., Heldin, C. H. & Claesson-Welsh, L. (1992) PDGF alpha- and beta-receptors activate unique and common signal transduction pathways. *EMBO J*, **11**, 543-550.

Esko, J. D., Stewart, T. E. & Taylor, W. H. (1985) Animal cell mutants defective in glycosaminoglycan biosynthesis. *Proc.Natl.Acad.Sci.U.S.A*, **82**, 3197-3201.

Esko, J. D., Weinke, J. L., Taylor, W. H., Ekborg, G., Roden, L., Anantharamaiah, G. & Gawish, A. (1987) Inhibition of chondroitin and heparan sulfate biosynthesis in Chinese hamster ovary cell mutants defective in galactosyltransferase I. *J Biol Chem.*, **262**, 12189-12195.

Esko, J. D., Rostand, K. S. & Weinke, J. L. (1988) Tumor formation dependent on proteoglycan biosynthesis. *Science*, **241**, 1092-1096.

Evanko, S. P., Raines, E. W., Ross, R., Gold, L. I. & Wight, T. N. (1998) Proteoglycan distribution in lesions of atherosclerosis depends on lesion severity, structural characteristics, and the proximity of platelet-derived growth factor and transforming growth factor-beta. *Am.J Pathol.* , **152**, 533-546.

Evanko, S. P., Angello, J. C. & Wight, T. N. (1999) Formation of hyaluronan- and versican-rich pericellular matrix is required for proliferation and migration of vascular smooth muscle cells. *Arterioscler.Thromb.Vasc.Biol*, **19**, 1004-1013.

Evanko, S. P., Johnson, P. Y., Braun, K. R., Underhill, C. B., Dudhia, J. & Wight, T. N. (2001) Platelet-derived growth factor stimulates the formation of versican-hyaluronan aggregates and pericellular matrix expansion in arterial smooth muscle cells. *Arch.Biochem.Biophys.*, **394**, 29-38.

F

Fager, G., Hansson, G. K., Ottosson, P., Dahllof, B. & Bondjers, G. (1988) Human arterial smooth muscle cells in culture. Effects of platelet-derived growth factor and heparin on growth in vitro. *Exp Cell Res*, **176**, 319-335.

Fager, G., Hansson, G. K., Gown, A. M., Larson, D. M., Skalli, O. & Bondjers, G. (1989) Human arterial smooth muscle cells in culture: inverse relationship between proliferation and expression of contractile proteins. *In Vitro Cell Dev.Biol*, **25**, 511-520.

Fager, G., Camejo, G. & Bondjers, G. (1992a) Heparin-like glycosaminoglycans influence growth and phenotype of human arterial smooth muscle cells in vitro. I. Evidence for reversible binding and inactivation of the platelet-derived growth factor by heparin. *In Vitro Cell Dev.Biol*, **28A**, 68-175.

Fager, G., Camejo, G., Olsson, U., Ostergren-Lunden, G. & Bondjers, G. (1992b) Heparin-like glycosaminoglycans influence growth and phenotype of human arterial smooth muscle cells in vitro. II. The platelet-derived growth factor A-chain contains a sequence that specifically binds heparin. *In Vitro Cell Dev.Biol*, **28A**, 176-180.

Fager, G., Camejo, G., Olsson, U., Ostergren-Lunden, G., Lustig, F. & Bondjers, G. (1995) Binding of platelet-derived growth factor and low density lipoproteins to glycosaminoglycan species produced by human arterial smooth muscle cells. *J Cell Physiol*, **163**, 380-392.

Faham, S., Hileman, R. E., Fromm, J. R., Linhardt, R. J. & Rees, D. C. (1996) Heparin structure and interactions with basic fibroblast growth factor. *Science*, **271**, 1116-1120.

Faham, S., Linhardt, R. J. & Rees, D. C. (1998) Diversity does make a difference: fibroblast growth factor-heparin interactions. *Curr. Opin. Struct. Biol.*, **8**, 578-586.

Farquhar, M. G. (1991) The glomerular basement membrane. A selective macromolecular filter. *Cell Biology of Extracellular Matrix* (ed E. D. Hay), pp. 365-418. Plenum Press, New York.

Faxon, D. P., Spiro, T. E., Minor, S., Cote, G., Douglas, J., Gottlieb, R., Califf, R., Dorosti, K., Topol, E., Gordon, J. B. & . (1994) Low molecular weight heparin in prevention of restenosis after angioplasty. Results of Enoxaparin Restenosis (ERA) Trial. *Circulation*, **90**, 908-914.

Ferns, G. A., Sprugel, K. H., Seifert, R. A., Bowen-Pope, D. F., Kelly, J. D., Murray, M., Raines, E. W. & Ross, R. (1990) Relative platelet-derived growth factor receptor subunit expression determines cell migration to different dimeric forms of PDGF. *Growth Factors*, **3**, 315-324.

Ferns, G. A., Raines, E. W., Sprugel, K. H., Motani, A. S., Reidy, M. A. & Ross, R. (1991) Inhibition of neointimal smooth muscle accumulation after angioplasty by an antibody to PDGF. *Science*, **253**, 1129-1132.

Feyzi, E., Lustig, F., Fager, G., Spillmann, D., Lindahl, U. & Salmivirta, M. (1997) Characterization of heparin and heparan sulfate domains binding to the long splice variant of platelet-derived growth factor A chain. *J Biol Chem.*, **272**, 5518-5524.

Feyzi, E., Saldeen, T., Larsson, E., Lindahl, U. & Salmivirta, M. (1998) Age-dependent modulation of heparan sulfate structure and function. *J Biol Chem.*, **273**, 13395-13398.

Field, S. L., Khachigian, L. M., Sleigh, M. J., Yang, G., Vandermark, S. E., Hogg, P. J. & Chesterman, C. N. (1996) Extracellular matrix is a source of mitogenically active platelet-derived growth factor. *J Cell Physiol*, **168**, 322-332.

Fitzgerald, M., Hayward, I. P., Thomas, A. C., Campbell, G. R. & Campbell, J. H. (1999) Matrix metalloproteinase can facilitate the heparanase-induced promotion of phenotype change in vascular smooth muscle cells. *Atherosclerosis*, **145**, 97-106.

Flaumenhaft, R. & Rifkin, D. B. (1992) The extracellular regulation of growth factor action. *Mol. Biol Cell*, **3**, 1057-1065.

Floege, J., Ostendorf, T. & Janjic, N. (1999) Aptamers: novel tools for specific intervention studies. *Nephrol. Dial. Transplant.*, **14**, 1354-1357.

Fritze, L. M., Reilly, C. F. & Rosenberg, R. D. (1985) An antiproliferative heparan sulfate species produced by postconfluent smooth muscle cells. *J Cell Biol*, **100**, 1041-1049.

Fuki, I. V., Iozzo, R. V. & Williams, K. J. (2000) Perlecan heparan sulfate proteoglycan: a novel receptor that mediates a distinct pathway for ligand catabolism. *J Biol Chem.*, **275**, 25742-25750.

G

Galis, Z. S., Alavi, M. Z. & Moore, S. (1992) In situ ultrastructural characterization of chondroitin sulfate proteoglycans in normal rabbit aorta. *J Histochem.Cytochem.*, **40**, 251-263.

Galis, Z. S., Sukhova, G. K., Lark, M. W. & Libby, P. (1994) Increased expression of matrix metalloproteinases and matrix degrading activity in vulnerable regions of human atherosclerotic plaques. *J Clin Invest*, **94**, 2493-2503.

Gallagher, J. T. (1998) The interaction and regulation of basic and acidic fibroblast growth factors by heparan sulfate. *Trends Glycosci. Glycotechnol*, **10**, 137-144.

Gao, G. & Goldfarb, M. (1995) Heparin can activate a receptor tyrosine kinase. *EMBO J*, **14**, 2183-2190.

Garcia-Olivas, R., Hoebeke, J., Castel, S., Reina, M., Fager, G., Lustig, F. & Vilaro, S. (2003) Differential binding of platelet-derived growth factor isoforms to glycosaminoglycans. *Histochem.Cell Biol*, **120**, 371-382.

Garg, H. G., Thompson, B. T. & Hales, C. A. (2000) Structural determinants of antiproliferative activity of heparin on pulmonary artery smooth muscle cells. *Am.J Physiol Lung Cell Mol.Physiol*, **279**, L779-L789.

Garratt, K. N., Edwards, W. D., Kaufmann, U. P., Vlietstra, R. E. & Holmes, D. R., Jr. (1991) Differential histopathology of primary atherosclerotic and restenotic lesions in coronary arteries and saphenous vein bypass grafts: analysis of tissue obtained from 73 patients by directional atherectomy. *J Am.Coll.Cardiol.*, **17**, 442-448.

Geary, R. L., Koyama, N., Wang, T. W., Vergel, S. & Clowes, A. W. (1995) Failure of heparin to inhibit intimal hyperplasia in injured baboon arteries. The role of heparin-sensitive and -insensitive pathways in the stimulation of smooth muscle cell migration and proliferation. *Circulation*, **91**, 2972-2981.

Giese, N. A., Marijjanowski, M. M., McCook, O., Hancock, A., Ramakrishnan, V., Fretto, L. J., Chen, C., Kelly, A. B., Koziol, J. A., Wilcox, J. N. & Hanson, S. R. (1999) The role of alpha and beta platelet-derived growth factor receptor in the vascular response to injury in nonhuman primates. *Arterioscler.Thromb.Vasc.Biol*, **19**, 900-909.

Gimple, L. W., Herrmann, H. C., Winniford, M. & Mammen, E. (1999) Usefulness of subcutaneous low molecular weight heparin (ardeparin) for reduction of restenosis after percutaneous transluminal coronary angioplasty. *Am.J Cardiol.*, **83**, 1524-1529.

Glass, C. K. & Witztum, J. L. (2001) Atherosclerosis. the road ahead. *Cell*, **104**, 503-516.

Godder, K., Vlodavsky, I., Eldor, A., Weksler, B. B., Haimovitz-Freidman, A. & Fuks, Z. (1991) Heparanase activity in cultured endothelial cells. *J Cell Physiol*, **148**, 274-280.

Gohring, W., Sasaki, T., Heldin, C. H. & Timpl, R. (1998) Mapping of the binding of platelet-derived growth factor to distinct domains of the basement membrane proteins BM-40 and perlecan and distinction from the BM-40 collagen-binding epitope. *Eur.J Biochem.*, **255**, 60-66.

Golden, M. A., Au, Y. P., Kirkman, T. R., Wilcox, J. N., Raines, E. W., Ross, R. & Clowes, A. W. (1991) Platelet-derived growth factor activity and mRNA expression in healing vascular grafts in baboons. Association in vivo of platelet-derived growth factor mRNA and protein with cellular proliferation. *J Clin Invest*, **87**, 406-414.

Gonzalez, R. C. & Wintz, P. (1987) Digital Image Processing. Addison Wesley Publication Company, Mass.

Goretzki, L., Burg, M. A., Grako, K. A. & Stallcup, W. B. (1999) High-affinity binding of basic fibroblast growth factor and platelet-derived growth factor-AA to the core protein of the NG2 proteoglycan. *J Biol Chem.*, **274**, 16831-16837.

Green, L. S., Jellinek, D., Jenison, R., Ostman, A., Heldin, C. H. & Janjic, N. (1996) Inhibitory DNA ligands to platelet-derived growth factor B-chain. *Biochemistry*, **35**, 14413-14424.

Guimond, S., Maccarana, M., Olwin, B. B., Lindahl, U. & Rapraeger, A. C. (1993) Activating and inhibitory heparin sequences for FGF-2 (basic FGF). Distinct requirements for FGF-1, FGF-2, and FGF-4. *J Biol Chem.*, **268**, 23906-23914.

H

Halpert, I., Sires, U. I., Roby, J. D., Potter-Perigo, S., Wight, T. N., Shapiro, S. D., Welgus, H. G., Wickline, S. A. & Parks, W. C. (1996) Matrilysin is expressed by lipid-laden macrophages at sites of potential rupture in atherosclerotic lesions and localizes to areas of versican deposition, a proteoglycan substrate for the enzyme. *Proc.Natl.Acad.Sci.U.S.A*, **93**, 9748-9753.

Hardingham, T. E. & Fosang, A. J. (1992) Proteoglycans: many forms and many functions. *FASEB J*, **6**, 861-870.

Hart, C. E., Kraiss, L. W., Vergel, S., Gilbertson, D., Kenagy, R., Kirkman, T., Crandall, D. L., Tickle, S., Finney, H., Yarranton, G. & Clowes, A. W. (1999) PDGFbeta receptor blockade inhibits intimal hyperplasia in the baboon. *Circulation*, **99**, 564-569.

Hayashi, K., Madri, J. A. & Yurchenco, P. D. (1992) Endothelial cells interact with the core protein of basement membrane perlecan through beta 1 and beta 3 integrins: an adhesion modulated by glycosaminoglycan. *J Cell Biol*, **119**, 945-959.

Hedin, U., Bottger, B. A., Forsberg, E., Johansson, S. & Thyberg, J. (1988) Diverse effects of fibronectin and laminin on phenotypic properties of cultured arterial smooth muscle cells. *J Cell Biol*, **107**, 307-319.

Heidaran, M. A., Pierce, J. H., Yu, J. C., Lombardi, D., Artrip, J. E., Fleming, T. P., Thomason, A. & Aaronson, S. A. (1991) Role of alpha beta receptor heterodimer formation in beta platelet-derived growth factor (PDGF) receptor activation by PDGF-AB. *J Biol Chem.*, **266**, 20232-20237.

Heldin, C. H., Backstrom, G., Ostman, A., Hammacher, A., Ronnstrand, L., Rubin, K., Nister, M. & Westermark, B. (1988) Binding of different dimeric forms of PDGF to human fibroblasts: evidence for two separate receptor types. *EMBO J*, **7**, 1387-1393.

Heldin, C. H. (1992) Structural and functional studies on platelet-derived growth factor. *EMBO J*, **11**, 4251-4259.

Heldin, C. H. & Westermark, B. (1996) Role of Platelet-Derived Growth Factor In Vivo. (ed R. A. F. Clark), pp. 249-273. Plenum, New York.

Heldin, C. H. & Westermark, B. (1999) Mechanism of action and in vivo role of platelet-derived growth factor. *Physiol Rev.*, **79**, 1283-1316.

Heldin, C. H., Eriksson, U. & Ostman, A. (2002) New members of the platelet-derived growth factor family of mitogens. *Arch.Biochem.Biophys.*, **398**, 284-290.

Herndon, M. E., Stipp, C. S. & Lander, A. D. (1999) Interactions of neural glycosaminoglycans and proteoglycans with protein ligands: assessment of selectivity, heterogeneity and the participation of core proteins in binding. *Glycobiology*, **9**, 143-155.

Higashiyama, S., Abraham, J. A. & Klagsbrun, M. (1993) Heparin-binding EGF-like growth factor stimulation of smooth muscle cell migration: dependence on interactions with cell surface heparan sulfate. *J Cell Biol*, **122**, 933-940.

Hildebrand, A., Romaris, M., Rasmussen, L. M., Heinegard, D., Twardzik, D. R., Border, W. A. & Ruoslahti, E. (1994) Interaction of the small interstitial proteoglycans biglycan, decorin and fibromodulin with transforming growth factor beta. *Biochem.J*, **302**, 527-534.

Hileman, R. E., Fromm, J. R., Weiler, J. M. & Linhardt, R. J. (1998) Glycosaminoglycan-protein interactions: definition of consensus sites in glycosaminoglycan binding proteins. *Bioessays*, **20**, 156-167.

Hirose, M., Kosugi, H., Nakazato, K. & Hayashi, T. (1999) Restoration to a quiescent and contractile phenotype from a proliferative phenotype of myofibroblast-like human aortic smooth muscle cells by culture on type IV collagen gels. *J Biochem.(Tokyo)*, **125**, 991-1000.

Hosang, M. & Rouge, M. (1989) Human vascular smooth muscle cells have at least two distinct PDGF receptors and can secrete PDGF-AA. *J Cardiovasc Pharmacol.*, **14 Suppl 6**, S22-S26.

Hosang, M., Rouge, M., Wipf, B., Eggimann, B., Kaufmann, F. & Hunziker, W. (1989) Both homodimeric isoforms of PDGF (AA and BB) have mitogenic and chemotactic activity and stimulate phosphoinositol turnover. *J Cell Physiol*, **140**, 558-564.

I

Ikari, Y., Yee, K. O. & Schwartz, S. M. (2000) Role of alpha5beta1 and alphavbeta3 integrins on smooth muscle cell spreading and migration in fibrin gels. *Thromb.Haemost.*, **84**, 701-705.

Inaba, T., Gotoda, T., Shimano, H., Shimada, M., Harada, K., Kozaki, K., Watanabe, Y., Hoh, E., Motoyoshi, K., Yazaki, Y. & . (1992) Platelet-derived growth factor induces c-fms and scavenger receptor genes in vascular smooth muscle cells. *J Biol Chem.*, **267**, 13107-13112.

lozzo, R. V. (1998) Matrix proteoglycans: from molecular design to cellular function. *Annu.Rev.Biochem.*, **67**, 609-652.

Ip, J. H., Fuster, V., Badimon, L., Badimon, J., Taubman, M. B. & Chesebro, J. H. (1990) Syndromes of accelerated atherosclerosis: role of vascular injury and smooth muscle cell proliferation. *J Am.Coll.Cardiol.*, **15**, 1667-1687.

Irvine, C. D., George, S. J., Sheffield, E., Johnson, J. L., Davies, A. H. & Lamont, P. M. (2000) The association of platelet-derived growth factor receptor expression, plaque morphology and histological features with symptoms in carotid atherosclerosis. *Cardiovasc Surg*, **8**, 121-129.

Ismail, N. A., Alavi, M. Z. & Moore, S. (1994) Lipoprotein-proteoglycan complexes from injured rabbit aortas accelerate lipoprotein uptake by arterial smooth muscle cells. *Atherosclerosis*, **105**, 79-87.

J

Jackson, R. L., Busch, S. J. & Cardin, A. D. (1991) Glycosaminoglycans: molecular properties, protein interactions, and role in physiological processes. *Physiol Rev.*, **71**, 481-539.

Jawien, A., Bowen-Pope, D. F., Lindner, V., Schwartz, S. M. & Clowes, A. W. (1992) Platelet-derived growth factor promotes smooth muscle migration and intimal thickening in a rat model of balloon angioplasty. *J Clin Invest*, **89**, 507-511.

Ji, Z. S., Fazio, S., Lee, Y. L. & Mahley, R. W. (1994) Secretion-capture role for apolipoprotein E in remnant lipoprotein metabolism involving cell surface heparan sulfate proteoglycans. *J Biol Chem.*, **269**, 2764-2772.

Jiang, B., Yamamura, S., Nelson, P. R., Mureebe, L. & Kent, K. C. (1996) Differential effects of platelet-derived growth factor isoforms on human smooth muscle cell proliferation and migration are mediated by distinct signaling pathways. *Surgery*, **120**, 427-431.

K

Kahari, V. M., Larjava, H. & Uitto, J. (1991) Differential regulation of extracellular matrix proteoglycan (PG) gene expression. Transforming growth factor-beta 1 up-regulates biglycan (PGI), and versican (large fibroblast PG) but down-regulates decorin (PGII) mRNA levels in human fibroblasts in culture. *J Biol Chem.*, **266**, 10608-10615.

Kakolyris, S., Karakitsos, P., Tzardi, M. & Agapitos, E. (1995) Immunohistochemical detection of fibronectin in early and advanced atherosclerosis. *In Vivo*, **9**, 35-40.

Kan, M., Wang, F., Xu, J., Crabb, J. W., Hou, J. & McKeehan, W. L. (1993) An essential heparin-binding domain in the fibroblast growth factor receptor kinase. *Science*, **259**, 1918-1921.

Kanzaki, T., Shinomiya, M., Ueda, S., Morisaki, N., Saito, Y. & Yoshida, S. (1994) Enhanced arterial intimal thickening after balloon catheter injury in diabetic animals accompanied by PDGF beta-receptor overexpression of aortic media. *Eur.J Clin Invest*, **24**, 377-381.

Kato, M., Saunders, S., Nguyen, H. & Bernfield, M. (1995) Loss of cell surface syndecan-1 causes epithelia to transform into anchorage-independent mesenchyme-like cells. *Mol. Biol Cell*, **6**, 559-576.

Kato, M., Wang, H., Kainulainen, V., Fitzgerald, M. L., Ledbetter, S., Ornitz, D. M. & Bernfield, M. (1998) Physiological degradation converts the soluble syndecan-1 ectodomain from an inhibitor to a potent activator of FGF-2. *Nat. Med*, **4**, 691-697.

Kazi, M., Lundmark, K., Religa, P., Gouda, I., Larm, O., Ray, A., Swedenborg, J. & Hedin, U. (2002) Inhibition of rat smooth muscle cell adhesion and proliferation by non-anticoagulant heparins. *J Cell Physiol*, **193**, 365-372.

Kelly, J. L., Sanchez, A., Brown, G. S., Chesterman, C. N. & Sleight, M. J. (1993) Accumulation of PDGF B and cell-binding forms of PDGF A in the extracellular matrix. *J Cell Biol*, **121**, 1153-1163.

Kenagy, R. D., Hart, C. E., Stetler-Stevenson, W. G. & Clowes, A. W. (1997) Primate smooth muscle cell migration from aortic explants is mediated by endogenous platelet-derived growth factor and basic fibroblast growth factor acting through matrix metalloproteinases 2 and 9. *Circulation*, **96**, 3555-3560.

Kinsella, M. G., Tsoi, C. K., Jarvelainen, H. T. & Wight, T. N. (1997) Selective expression and processing of biglycan during migration of bovine aortic endothelial cells. The role of endogenous basic fibroblast growth factor. *J Biol Chem.*, **272**, 318-325.

Kinsella, M. G., Tran, P. K., Weiser-Evans, M. C., Reidy, M., Majack, R. A. & Wight, T. N. (2003) Changes in perlecan expression during vascular injury: role in the inhibition of smooth muscle cell proliferation in the late lesion. *Arterioscler. Thromb. Vasc. Biol*, **23**, 608-614.

Kjellen, L. & Lindahl, U. (1991) Proteoglycans: structures and interactions. *Annu.Rev.Biochem.*, **60**, 443-475.

Knudson, C. B. & Knudson, W. (2001) Cartilage proteoglycans. *Semin.Cell Dev.Biol*, **12**, 69-78.

Kohno, M., Yokokawa, K., Yasunari, K., Minami, M., Kano, H., Mandal, A. K. & Yoshikawa, J. (1998) Heparin inhibits human coronary artery smooth muscle cell migration. *Metabolism*, **47**, 1065-1069.

Kojima, T., Shworak, N. W. & Rosenberg, R. D. (1992) Molecular cloning and expression of two distinct cDNA-encoding heparan sulfate proteoglycan core proteins from a rat endothelial cell line. *J Biol Chem.*, **267**, 4870-4877.

Kovalenko, M., Gazit, A., Bohmer, A., Rorsman, C., Ronnstrand, L., Heldin, C. H., Waltenberger, J., Bohmer, F. D. & Levitzki, A. (1994) Selective platelet-derived growth factor receptor kinase blockers reverse sis-transformation. *Cancer Res*, **54**, 6106-6114.

Koyama, H., Nishizawa, Y., Hosoi, M., Fukumoto, S., Kogawa, K., Shioi, A. & Morii, H. (1996a) The fumagillin analogue TNP-470 inhibits DNA synthesis of vascular smooth muscle cells stimulated by platelet-derived growth factor and insulin-like growth factor-I. Possible involvement of cyclin-dependent kinase 2. *Circ Res*, **79**, 757-764.

Koyama, H., Raines, E. W., Bornfeldt, K. E., Roberts, J. M. & Ross, R. (1996b) Fibrillar collagen inhibits arterial smooth muscle proliferation through regulation of Cdk2 inhibitors. *Cell*, **87**, 1069-1078.

Koyama, N., Morisaki, N., Saito, Y. & Yoshida, S. (1992) Regulatory effects of platelet-derived growth factor-AA homodimer on migration of vascular smooth muscle cells. *J Biol Chem.*, **267**, 22806-22812.

Koyama, N., Hart, C. E. & Clowes, A. W. (1994) Different functions of the platelet-derived growth factor-alpha and -beta receptors for the migration and proliferation of cultured baboon smooth muscle cells. *Circ Res*, **75**, 682-691.

Koyama, N., Kinsella, M. G., Wight, T. N., Hedin, U. & Clowes, A. W. (1998) Heparan sulfate proteoglycans mediate a potent inhibitory signal for migration of vascular smooth muscle cells. *Circ Res*, **83**, 305-313.

Kraiss, L. W., Geary, R. L., Mattsson, E. J., Vergel, S., Au, Y. P. & Clowes, A. W. (1996) Acute reductions in blood flow and shear stress induce platelet-derived growth factor-A expression in baboon prosthetic grafts. *Circ Res*, **79**, 45-53.

Krettek, A., Fager, G., Jernberg, P., Ostergren-Lunden, G. & Lustig, F. (1997a) Quantitation of platelet-derived growth factor receptors in human arterial smooth muscle cells in vitro. *Arterioscler.Thromb.Vasc.Biol*, **17**, 2395-2404.

Krettek, A., Fager, G., Lindmark, H., Simonson, C. & Lustig, F. (1997b) Effect of phenotype on the transcription of the genes for platelet-derived growth factor (PDGF) isoforms in human smooth muscle cells, monocyte-derived macrophages, and endothelial cells in vitro. *Arterioscler.Thromb.Vasc.Biol*, **17**, 2897-2903.

Krettek, A., Ostergren-Lunden, G., Fager, G., Rosmond, C., Bondjers, G. & Lustig, F. (2001) Expression of PDGF receptors and ligand-induced migration of partially differentiated human monocyte-derived macrophages. Influence of IFN-gamma and TGF-beta. *Atherosclerosis*, **156**, 267-275.

L

LaRochelle, W. J., Jensen, R. A., Heidarani, M. A., May-Siroff, M., Wang, L. M., Aaronson, S. A. & Pierce, J. H. (1993) Inhibition of platelet-derived growth factor autocrine growth stimulation by a monoclonal antibody to the human alpha platelet-derived growth factor receptor. *Cell Growth Differ.*, **4**, 547-553.

Laskey, M. A., Deutsch, E., Hirshfeld, J. W., Jr., Kussmaul, W. G., Barnathan, E. & Laskey, W. K. (1990) Influence of heparin therapy on percutaneous transluminal coronary angioplasty outcome in patients with coronary arterial thrombus. *Am.J Cardiol.*, **65**, 179-182.

Lemstrom, K. B. & Koskinen, P. K. (1997) Expression and localization of platelet-derived growth factor ligand and receptor protein during acute and chronic rejection of rat cardiac allografts. *Circulation*, **96**, 1240-1249.

Leppanen, O., Janjic, N., Carlsson, M. A., Pietras, K., Levin, M., Vargeese, C., Green, L. S., Bergqvist, D., Ostman, A. & Heldin, C. H. (2000) Intimal hyperplasia recurs after removal of

PDGF-AB and -BB inhibition in the rat carotid artery injury model. *Arterioscler.Thromb.Vasc.Biol*, **20**, E89-E95.

Li, X. & Eriksson, U. (2003) Novel PDGF family members: PDGF-C and PDGF-D. *Cytokine Growth Factor Rev.*, **14**, 91-98.

Liaw, L., Skinner, M. P., Raines, E. W., Ross, R., Cheresch, D. A., Schwartz, S. M. & Giachelli, C. M. (1995) The adhesive and migratory effects of osteopontin are mediated via distinct cell surface integrins. Role of alpha v beta 3 in smooth muscle cell migration to osteopontin in vitro. *J Clin Invest*, **95**, 713-724.

Libby, P., Warner, S. J., Salomon, R. N. & Birinyi, L. K. (1988) Production of platelet-derived growth factor-like mitogen by smooth-muscle cells from human atheroma. *N.Engl.J Med*, **318**, 1493-1498.

Libby, P., Salomon, R. N., Payne, D. D., Schoen, F. J. & Pober, J. S. (1989) Functions of vascular wall cells related to development of transplantation-associated coronary arteriosclerosis. *Transplant.Proc.*, **21**, 3677-3684.

Lidholt, K., Weinke, J. L., Kiser, C. S., Lugemwa, F. N., Bame, K. J., Cheifetz, S., Massague, J., Lindahl, U. & Esko, J. D. (1992) A single mutation affects both N-acetylglucosaminyltransferase and glucuronosyltransferase activities in a Chinese hamster ovary cell mutant defective in heparan sulfate biosynthesis. *Proc.Natl.Acad.Sci.U.S.A*, **89**, 2267-2271.

Lindahl, U., Thunberg, L., Backstrom, G., Riesenfeld, J., Nordling, K. & Bjork, I. (1984) Extension and structural variability of the antithrombin-binding sequence in heparin. *J Biol Chem.*, **259**, 12368-12376.

Lindahl, U. & Kjellen, L. (1991) Heparin or heparan sulfate--what is the difference? *Thromb.Haemost.*, **66**, 44-48.

Lindahl, U. (1999) What else can 'Heparin' do? *Haemostasis*, **29 Suppl S1**, 38-47.

Llorente-Cortes, V., Otero-Vinas, M., Hurt-Camejo, E., Martinez-Gonzalez, J. & Badimon, L. (2002) Human coronary smooth muscle cells internalize versican-modified LDL through LDL receptor-related protein and LDL receptors. *Arterioscler.Thromb.Vasc.Biol*, **22**, 387-393.

Lokker, N. A., O'Hare, J. P., Barsoumian, A., Tomlinson, J. E., Ramakrishnan, V., Fretto, L. J. & Giese, N. A. (1997) Functional importance of platelet-derived growth factor (PDGF) receptor extracellular immunoglobulin-like domains. Identification of PDGF binding site and neutralizing monoclonal antibodies. *J Biol Chem.*, **272**, 33037-33044.

Loo, B. M., Kreuger, J., Jalkanen, M., Lindahl, U. & Salmivirta, M. (2001) Binding of heparin/heparan sulfate to fibroblast growth factor receptor 4. *J Biol Chem.*, **276**, 16868-16876.

Lortat-Jacob, H., Turnbull, J. E. & Grimaud, J. A. (1995) Molecular organization of the interferon gamma-binding domain in heparan sulphate. *Biochem.J*, **310**, 497-505.

Lusis, A. J. (2000) Atherosclerosis. *Nature*, **407**, 233-241.

Lustig, F., Hoebeke, J., Ostergren-Lunden, G., Velge-Roussel, F., Bondjers, G., Olsson, U., Ruetschi, U. & Fager, G. (1996) Alternative splicing determines the binding of platelet-derived growth factor (PDGF-AA) to glycosaminoglycans. *Biochemistry*, **35**, 12077-12085.

Lustig, F., Hoebeke, J., Simonson, C., Ostergren-Lunden, G., Bondjers, G., Ruetschi, U. & Fager, G. (1999) Processing of PDGF gene products determines interactions with glycosaminoglycans. *J Mol. Recognit.*, **12**, 112-120.

M

Maglione, D., Guerriero, V., Viglietto, G., Ferraro, M. G., Aprelikova, O., Alitalo, K., Del Vecchio, S., Lei, K. J., Chou, J. Y. & Persico, M. G. (1993) Two alternative mRNAs coding for the angiogenic factor, placenta growth factor (PlGF), are transcribed from a single gene of chromosome 14. *Oncogene*, **8**, 925-931.

Mahadevan, D., Yu, J. C., Saldanha, J. W., Thanki, N., McPhie, P., Uren, A., LaRochelle, W. J. & Heidaran, M. A. (1995) Structural role of extracellular domain 1 of alpha-platelet-derived growth factor (PDGF) receptor for PDGF-AA and PDGF-BB binding. *J Biol Chem.*, **270**, 27595-27600.

Manders, E. M. M., Verbeek, F. J. & Aten, J. A. (1993) Measurement of co-localization of objects in dual-colour confocal images. *Journal of Microscopy*, **169**, 375-382.

Marcum, J. A. & Rosenberg, R. D. (1987) Anticoagulant active heparan sulfate proteoglycan and the vascular endothelium. *Semin. Thromb.Hemost.*, **13**, 464-474.

Maresta, A., Balducelli, M., Cantini, L., Casari, A., Chioin, R., Fabbri, M., Fontanelli, A., Monici Preti, P. A., Repetto, S., De Servi, S. & . (1994) Trepidil (triazolopyrimidine), a platelet-derived growth factor antagonist, reduces restenosis after percutaneous transluminal coronary angioplasty. Results of the randomized, double-blind STARC study. Studio Trepidil versus Aspirin nella Restenosi Coronarica. *Circulation*, **90**, 2710-2715.

Martin, T. F. (1998) Phosphoinositide lipids as signaling molecules: common themes for signal transduction, cytoskeletal regulation, and membrane trafficking. *Annu.Rev.Cell Dev.Biol.*, **14**, 231-264.

Martinez-Gonzalez, J., Llorente-Cortes, V. & Badimon, L. (2001) [Cellular and molecular biology of atherosclerotic lesions]. *Rev.Esp.Cardiol.*, **54**, 218-231.

Mason, D. P., Kenagy, R. D., Hasenstab, D., Bowen-Pope, D. F., Seifert, R. A., Coats, S., Hawkins, S. M. & Clowes, A. W. (1999) Matrix metalloproteinase-9 overexpression enhances vascular smooth muscle cell migration and alters remodeling in the injured rat carotid artery. *Circ Res*, **85**, 1179-1185.

Matoskova, B., Rorsman, F., Svensson, V. & Betsholtz, C. (1989) Alternative splicing of the platelet-derived growth factor A-chain transcript occurs in normal as well as tumor cells and is conserved among mammalian species. *Mol.Cell Biol*, **9**, 3148-3150.

Mercola, M., Deininger, P. L., Shamah, S. M., Porter, J., Wang, C. Y. & Stiles, C. D. (1990) Dominant-negative mutants of a platelet-derived growth factor gene. *Genes Dev.*, **4**, 2333-2341.

Merrilees, M. J. & Beaumont, B. (1993) Structural heterogeneity of the diffuse intimal thickening and correlation with distribution of TGF-beta 1. *J Vasc.Res*, **30**, 293-302.

Mertens, G., Cassiman, J. J., Van den, B. H., Vermylen, J. & David, G. (1992) Cell surface heparan sulfate proteoglycans from human vascular endothelial cells. Core protein characterization and antithrombin III binding properties. *J Biol Chem.*, **267**, 20435-20443.

Miyazawa, K., Backstrom, G., Leppanen, O., Persson, C., Wernstedt, C., Hellman, U., Heldin, C. H. & Ostman, A. (1998) Role of immunoglobulin-like domains 2-4 of the platelet-derived growth factor alpha-receptor in ligand-receptor complex assembly. *J Biol Chem.*, **273**, 25495-25502.

Moiseeva, E. P. (2001) Adhesion receptors of vascular smooth muscle cells and their functions. *Cardiovasc Res*, **52**, 372-386.

Mondy, J. S., Lindner, V., Miyashiro, J. K., Berk, B. C., Dean, R. H. & Geary, R. L. (1997) Platelet-derived growth factor ligand and receptor expression in response to altered blood flow in vivo. *Circ Res*, **81**, 320-327.

Montgomery, A. M., Reisfeld, R. A. & Cheresch, D. A. (1994) Integrin alpha v beta 3 rescues melanoma cells from apoptosis in three-dimensional dermal collagen. *Proc.Natl.Acad.Sci.U.S.A.*, **91**, 8856-8860.

Mulder, M., Lombardi, P., Jansen, H., van Berkel, T. J., Frants, R. R. & Havekes, L. M. (1993) Low density lipoprotein receptor internalizes low density and very low density lipoproteins that are bound to heparan sulfate proteoglycans via lipoprotein lipase. *J Biol Chem.*, **268**, 9369-9375.

Myllarniemi, M., Calderon, L., Lemstrom, K., Buchdunger, E. & Hayry, P. (1997) Inhibition of platelet-derived growth factor receptor tyrosine kinase inhibits vascular smooth muscle cell migration and proliferation. *FASEB J*, **11**, 1119-1126.

Myllarniemi, M., Frosen, J., Calderon Ramirez, L. G., Buchdunger, E., Lemstrom, K. & Hayry, P. (1999) Selective tyrosine kinase inhibitor for the platelet-derived growth factor receptor in vitro inhibits smooth muscle cell proliferation after reinjury of arterial intima in vivo. *Cardiovasc Drugs Ther.*, **13**, 159-168.

N

Nabel, E. G., Yang, Z., Liptay, S., San, H., Gordon, D., Haudenschild, C. C. & Nabel, G. J. (1993) Recombinant platelet-derived growth factor B gene expression in porcine arteries induce intimal hyperplasia in vivo. *J Clin Invest*, **91**, 1822-1829.

Nikkari, S. T. & Clowes, A. W. (1993) Heparin and heparinoids: Control of the intimal hyperplastic response. *Pharmacologic Suppression of Intimal Hyperplasia* (ed W. J. Quinones-Baldrich), pp. 69-79. RG Landes, Austin, TX.

Nikkari, S. T., Jarvelainen, H. T., Wight, T. N., Ferguson, M. & Clowes, A. W. (1994) Smooth muscle cell expression of extracellular matrix genes after arterial injury. *Am.J Pathol.*, **144**, 1348-1356.

Nikkari, S. T., Geary, R. L., Hatsukami, T., Ferguson, M., Forough, R., Alpers, C. E. & Clowes, A. W. (1996) Expression of collagen, interstitial collagenase, and tissue inhibitor of metalloproteinases-1 in restenosis after carotid endarterectomy. *Am.J Pathol.*, **148**, 777-783.

Nister, M., Hammacher, A., Mellstrom, K., Siegbahn, A., Ronnstrand, L., Westermark, B. & Heldin, C. H. (1988) A glioma-derived PDGF A chain homodimer has different functional activities from a PDGF AB heterodimer purified from human platelets. *Cell*, **52**, 791-799.

Noda-Heiny, H. & Sobel, B. E. (1995) Vascular smooth muscle cell migration mediated by thrombin and urokinase receptor. *Am.J Physiol*, **268**, C1195-C1201.

O

O'Brien, K. D., Deeb, S. S., Ferguson, M., McDonald, T. O., Allen, M. D., Alpers, C. E. & Chait, A. (1994) Apolipoprotein E localization in human coronary atherosclerotic plaques by in situ hybridization and immunohistochemistry and comparison with lipoprotein lipase. *Am.J Pathol.*, **144**, 538-548.

O'Brien, K. D., Olin, K. L., Alpers, C. E., Chiu, W., Ferguson, M., Hudkins, K., Wight, T. N. & Chait, A. (1998) Comparison of apolipoprotein and proteoglycan deposits in human coronary atherosclerotic plaques: colocalization of biglycan with apolipoproteins. *Circulation*, **98**, 519-527.

Okamoto, S., Inden, M., Setsuda, M., Konishi, T. & Nakano, T. (1992) Effects of trapidil (triazolopyrimidine), a platelet-derived growth factor antagonist, in preventing restenosis after percutaneous transluminal coronary angioplasty. *Am.Heart J*, **123**, 1439-1444.

Olsson, U., Ostergren-Lunden, G. & Moses, J. (2001) Glycosaminoglycan-lipoprotein interaction. *Glycoconj.J*, **18**, 789-797.

Omura, T., Heldin, C. H. & Ostman, A. (1997) Immunoglobulin-like domain 4-mediated receptor-receptor interactions contribute to platelet-derived growth factor-induced receptor dimerization. *J Biol Chem.*, **272**, 12676-12682.

Osornio-Vargas, A. R., Lindroos, P. M., Coin, P. G., Badgett, A., Hernandez-Rodriguez, N. A. & Bonner, J. C. (1996) Maximal PDGF-induced lung fibroblast chemotaxis requires PDGF receptor-alpha. *Am.J Physiol*, **271**, L93-L99.

Ostman, A., Backstrom, G., Fong, N., Betsholtz, C., Wernstedt, C., Hellman, U., Westermark, B., Valenzuela, P. & Heldin, C. H. (1989) Expression of three recombinant homodimeric isoforms of PDGF in *Saccharomyces cerevisiae*: evidence for difference in receptor binding and functional activities. *Growth Factors*, **1**, 271-281.

Ostman, A., Andersson, M., Betsholtz, C., Westermark, B. & Heldin, C. H. (1991) Identification of a cell retention signal in the B-chain of platelet-derived growth factor and in the long splice version of the A-chain. *Cell Regul.*, **2**, 503-512.

Ostman, A. & Heldin, C. H. (2001) Involvement of platelet-derived growth factor in disease: development of specific antagonists. *Adv.Cancer Res*, **80**, 1-38.

Ostergren-Lunden, G., García-Olivas, R., Eftekhari, P., Krettek, A., Fager, G., Vilaró, S., Lustig, F. & Hoebeke, J. (2003) Characterisation and application of antibodies specific for the long platelet-derived growth factor A and B chains. *Enviado a Int J Biochem Cell Biol*.

P

Parthasarathy, N., Goldberg, I. J., Sivaram, P., Mulloy, B., Flory, D. M. & Wagner, W. D. (1994) Oligosaccharide sequences of endothelial cell surface heparan sulfate proteoglycan with affinity for lipoprotein lipase. *J Biol Chem.*, **269**, 22391-22396.

Pickering, J. G., Uniyal, S., Ford, C. M., Chau, T., Laurin, M. A., Chow, L. H., Ellis, C. G., Fish, J. & Chan, B. M. (1997) Fibroblast growth factor-2 potentiates vascular smooth muscle cell migration to platelet-derived growth factor: upregulation of alpha2beta1 integrin and disassembly of actin filaments. *Circ Res*, **80**, 627-637.

Plotnikov, A. N., Schlessinger, J., Hubbard, S. R. & Mohammadi, M. (1999) Structural basis for FGF receptor dimerization and activation. *Cell*, **98**, 641-650.

Pollock, R. A. & Richardson, W. D. (1992) The alternative-splice isoforms of the PDGF A-chain differ in their ability to associate with the extracellular matrix and to bind heparin in vitro. *Growth Factors*, **7**, 267-277.

Pukac, L., Huangpu, J. & Karnovsky, M. J. (1998) Platelet-derived growth factor-BB, insulin-like growth factor-I, and phorbol ester activate different signaling pathways for stimulation of vascular smooth muscle cell migration. *Exp Cell Res*, **242**, 548-560.

Pukac, L. A., Carter, J. E., Ottlinger, M. E. & Karnovsky, M. J. (1997) Mechanisms of inhibition by heparin of PDGF stimulated MAP kinase activation in vascular smooth muscle cells. *J Cell Physiol*, **172**, 69-78.

R

Radhakrishnamurthy, B., Srinivasan, S. R., Vijayagopal, P. & Berenson, G. S. (1990) Arterial wall proteoglycans--biological properties related to pathogenesis of atherosclerosis. *Eur.Heart J*, **11 Suppl E**, 148-157.

Radhakrishnamurthy, B., Tracy, R. E., Dalferes, E. R., Jr. & Berenson, G. S. (1998) Proteoglycans in human coronary arteriosclerotic lesions. *Exp Mol.Pathol.*, **65**, 1-8.

Raines, E. W., Bowen-Pope, D. F. & Ross, R. (1990) Platelet-Derived Growth Factor. (eds M. B. Sporn & A. B. Roberts), pp. 173-262. Springer-Verlag, Heidelberg.

Raines, E. W. & Ross, R. (1992) Compartmentalization of PDGF on extracellular binding sites dependent on exon-6-encoded sequences. *J Cell Biol*, **116**, 533-543.

Raines, E. W. & Ross, R. (1993) Platelet-derived growth factor in vivo. *Cytokines* (eds B. Westermark & C. Sorg), pp. 74-114. S.Krager AG., Basel, Switzerland.

Raines, E. W. (2000) The extracellular matrix can regulate vascular cell migration, proliferation, and survival: relationships to vascular disease. *Int J Exp Pathol.*, **81**, 173-182.

Raines, E. W., Koyama, H. & Carragher, N. O. (2000) The extracellular matrix dynamically regulates smooth muscle cell responsiveness to PDGF. *Ann.N.Y.Acad.Sci.*, **902**, 39-51.

Ramakrishnan, V., Escobedo, M. A., Fretto, L. J., Seroogy, J. J., Tomlinson, J. E. & Wolf, D. L. (1993) A novel monoclonal antibody dependent on domain 5 of the platelet-derived growth factor beta receptor inhibits ligand binding and receptor activation. *Growth Factors*, **8**, 253-265.

Rapraeger, A. C., Krufka, A. & Olwin, B. B. (1991) Requirement of heparan sulfate for bFGF-mediated fibroblast growth and myoblast differentiation. *Science*, **252**, 1705-1708.

Rapraeger, A. C. & Ott, V. L. (1998) Molecular interactions of the syndecan core proteins. *Curr.Opin.Cell Biol*, **10**, 620-628.

Rapraeger, A. C. (2000) Syndecan-regulated receptor signaling. *J Cell Biol*, **149**, 995-998.

Rapraeger, A. C. (2002) Heparan sulfate-growth factor interactions. *Methods Cell Biol*, **69**, 83-109.

Refson, J. S., Schachter, M., Patel, M. K., Wolfe, J. H. & Sever, P. (1995) Differential mitogenic effects of PDGF isoforms and heparin on human vascular smooth muscle cells. *Biochem.Soc.Trans.*, **23**, 173S.

Reilly, C. F., Kindy, M. S., Brown, K. E., Rosenberg, R. D. & Sonenshein, G. E. (1989) Heparin prevents vascular smooth muscle cell progression through the G1 phase of the cell cycle. *J Biol Chem.*, **264**, 6990-6995.

Rekhter, M. D. & Gordon, D. (1995) Active proliferation of different cell types, including lymphocytes, in human atherosclerotic plaques. *Am.J Pathol.*, **147**, 668-677.

Richardson, M. & Hatton, M. W. (1993) Transient morphological and biochemical alterations of arterial proteoglycan during early wound healing. *Exp Mol.Pathol.*, **58**, 77-95.

Riessen, R., Isner, J. M., Blessing, E., Loushin, C., Nikol, S. & Wight, T. N. (1994) Regional differences in the distribution of the proteoglycans biglycan and decorin in the extracellular matrix of atherosclerotic and restenotic human coronary arteries. *Am.J Pathol.*, **144**, 962-974.

Roghani, M. & Moscatelli, D. (1992) Basic fibroblast growth factor is internalized through both receptor-mediated and heparan sulfate-mediated mechanisms. *J Biol Chem.*, **267**, 22156-22162.

Rolny, C., Spillmann, D., Lindahl, U. & Claesson-Welsh, L. (2002) Heparin amplifies platelet-derived growth factor (PDGF)-BB-induced PDGF alpha-receptor but not PDGF beta-receptor tyrosine phosphorylation in heparan sulfate-deficient cells. Effects on signal transduction and biological responses. *J Biol Chem.*, **277**, 19315-19321.

Ronnstrand, L. & Heldin, C. H. (2001) Mechanisms of platelet-derived growth factor-induced chemotaxis. *Int J Cancer*, **91**, 757-762.

Rooney, B. C., Hosang, M. & Hunziker, W. (1994) Production of platelet-derived growth factor receptor (PDGFR-beta) in *E. coli*. Mapping ligand binding domain. *FEBS Lett*, **339**, 181-184.

Ross, R., Masuda, J., Raines, E. W., Gown, A. M., Katsuda, S., Sasahara, M., Malden, L. T., Masuko, H. & Sato, H. (1990) Localization of PDGF-B protein in macrophages in all phases of atherogenesis. *Science*, **248**, 1009-1012.

Ross, R. (1993) The pathogenesis of atherosclerosis: a perspective for the 1990s. *Nature*, **362**, 801-809.

Ross, R. (1999) Atherosclerosis is an inflammatory disease. *Am.Heart J*, **138**, S419-S420.

Rostand, K. S. & Esko, J. D. (1997) Microbial adherence to and invasion through proteoglycans. *Infect.Immun.*, **65**, 1-8.

Rubin, K., Tingstrom, A., Hansson, G. K., Larsson, E., Ronnstrand, L., Klareskog, L., Claesson-Welsh, L., Heldin, C. H., Fellstrom, B. & Terracio, L. (1988) Induction of B-type receptors for platelet-derived growth factor in vascular inflammation: possible implications for development of vascular proliferative lesions. *Lancet*, **1**, 1353-1356.

Rupp, E., Siegbahn, A., Ronnstrand, L., Wernstedt, C., Claesson-Welsh, L. & Heldin, C. H. (1994) A unique autophosphorylation site in the platelet-derived growth factor alpha receptor from a heterodimeric receptor complex. *Eur.J Biochem.*, **225**, 29-41.

Rutherford, C., Martin, W., Carrier, M., Anggard, E. E. & Ferns, G. A. (1997a) Endogenously elicited antibodies to platelet derived growth factor-BB and platelet cytosolic protein inhibit aortic lesion development in the cholesterol-fed rabbit. *Int J Exp Pathol.*, **78**, 21-32.

Rutherford, C., Martin, W., Salame, M., Carrier, M., Anggard, E. & Ferns, G. (1997b) Substantial inhibition of neo-intimal response to balloon injury in the rat carotid artery using a combination of antibodies to platelet-derived growth factor-BB and basic fibroblast growth factor. *Atherosclerosis.*, **130**, 45-51.

S

Sage, E. H. & Bornstein, P. (1991) Extracellular proteins that modulate cell-matrix interactions. SPARC, tenascin, and thrombospondin. *J Biol Chem.*, **266**, 14831-14834.

Saksela, O. & Rifkin, D. B. (1990) Release of basic fibroblast growth factor-heparan sulfate complexes from endothelial cells by plasminogen activator-mediated proteolytic activity. *J Cell Biol*, **110**, 767-775.

Salmivirta, M., Lidholt, K. & Lindahl, U. (1996) Heparan sulfate: a piece of information. *FASEB J*, **10**, 1270-1279.

Sasisekharan, R., Ernst, S. & Venkataraman, G. (1997) On the regulation of fibroblast growth factor activity by heparin-like glycosaminoglycans. *Angiogenesis.*, **1**, 45-54.

Schilling, D., Reid IV, J. D., Hujer, A., Morgan, D., Demoll, E., Bummer, P., Fenstermaker, R. A. & Kaetzel, D. M. (1998) Loop III region of platelet-derived growth factor (PDGF) B-chain mediates binding to PDGF receptors and heparin. *Biochem.J.*, **333**, 637-644.

Schmidt, A., Yoshida, K. & Buddecke, E. (1992) The antiproliferative activity of arterial heparan sulfate resides in domains enriched with 2-O-sulfated uronic acid residues. *J Biol Chem.*, **267**, 19242-19247.

Schonherr, E., Jarvelainen, H. T., Sandell, L. J. & Wight, T. N. (1991) Effects of platelet-derived growth factor and transforming growth factor-beta 1 on the synthesis of a large versican-like chondroitin sulfate proteoglycan by arterial smooth muscle cells. *J Biol Chem.*, **266**, 17640-17647.

Schonherr, E., Jarvelainen, H. T., Kinsella, M. G., Sandell, L. J. & Wight, T. N. (1993) Platelet-derived growth factor and transforming growth factor-beta 1 differentially affect the synthesis of biglycan and decorin by monkey arterial smooth muscle cells. *Arterioscler.Thromb.*, **13**, 1026-1036.

Sehayek, E., Wang, X. X., Voldavsky, I., Avner, R. & Levkovitz, H. e. a. (1996) *Isr.J.Med.Sci.*, **32**, 449-454.

Shawver, L. K., Schwartz, D. P., Mann, E., Chen, H., Tsai, J., Chu, L., Taylorson, L., Longhi, M., Meredith, S., Germain, L., Jacobs, J. S., Tang, C., Ullrich, A., Berens, M. E., Hersh, E., McMahon, G., Hirth, K. P. & Powell, T. J. (1997) Inhibition of platelet-derived growth factor-mediated signal transduction and tumor growth by N-[4-(trifluoromethyl)-phenyl]5-methylisoxazole-4-carboxamide. *Clin Cancer Res*, **3**, 1167-1177.

Shulman, T., Sauer, F. G., Jackman, R. M., Chang, C. N. & Landolfi, N. F. (1997) An antibody reactive with domain 4 of the platelet-derived growth factor beta receptor allows BB binding while inhibiting proliferation by impairing receptor dimerization. *J Biol Chem.*, **272**, 17400-17404.

Shure, D., Senior, R. M., Griffin, G. L. & Deuel, T. F. (1992) PDGF AA homodimers are potent chemoattractants for fibroblasts and neutrophils, and for monocytes activated by lymphocytes or cytokines. *Biochem.Biophys.Res Commun.*, **186**, 1510-1514.

Sihvola, R., Koskinen, P., Myllarniemi, M., Loubtchenkov, M., Hayry, P., Buchdunger, E. & Lemstrom, K. (1999) Prevention of cardiac allograft arteriosclerosis by protein tyrosine kinase inhibitor selective for platelet-derived growth factor receptor. *Circulation*, **99**, 2295-2301.

Silver, P. J., Moreau, J. P., Denholm, E., Lin, Y. Q., Nguyen, L., Bennett, C., Recktenwald, A., DeBlois, D., Baker, S. & Ranger, S. (1998) Heparinase III limits rat arterial smooth muscle cell proliferation in vitro and in vivo. *Eur.J Pharmacol.*, **351**, 79-83.

Sirois, M. G., Simons, M. & Edelman, E. R. (1997) Antisense oligonucleotide inhibition of PDGFR-beta receptor subunit expression directs suppression of intimal thickening. *Circulation*, **95**, 669-676.

Sjolund, M., Rahm, M., Claesson-Welsh, L., Sejersen, T., Heldin, C. H. & Thyberg, J. (1990) Expression of PDGF alpha- and beta-receptors in rat arterial smooth muscle cells is phenotype and growth state dependent. *Growth Factors*, **3**, 191-203.

Skinner, M. P., Raines, E. W. & Ross, R. (1994) Dynamic expression of alpha 1 beta 1 and alpha 2 beta 1 integrin receptors by human vascular smooth muscle cells. Alpha 2 beta 1 integrin is required for chemotaxis across type I collagen-coated membranes. *Am.J Pathol.*, **145**, 1070-1081.

Slepian, M. J., Massia, S. P., Dehdashti, B., Fritz, A. & Whitesell, L. (1998) Beta3-integrins rather than beta1-integrins dominate integrin-matrix interactions involved in postinjury smooth muscle cell migration. *Circulation*, **97**, 1818-1827.

Sperinde, G. V. & Nugent, M. A. (1998) Heparan sulfate proteoglycans control intracellular processing of bFGF in vascular smooth muscle cells. *Biochemistry*, **37**, 13153-13164.

Spillmann, D., Witt, D. & Lindahl, U. (1998) Defining the interleukin-8-binding domain of heparan sulfate. *J Biol Chem.*, **273**, 15487-15493.

Stary, H. C. (1990) The sequence of cell and matrix changes in atherosclerotic lesions of coronary arteries in the first forty years of life. *Eur.Heart J*, **11 Suppl E**, 3-19.

Steinfeld, R., Van Den, B. H. & David, G. (1996) Stimulation of fibroblast growth factor receptor-1 occupancy and signaling by cell surface-associated syndecans and glypican. *J Cell Biol*, **133**, 405-416.

Stringa, E., Knauper, V., Murphy, G. & Gavrilovic, J. (2000) Collagen degradation and platelet-derived growth factor stimulate the migration of vascular smooth muscle cells. *J Cell Sci.*, **113**, 2055-2064.

Stringa, E., White, D., Tuan, R. S., Knauper, V. & Gavrilovic, J. (2002) Role of newly synthesized fibronectin in vascular smooth muscle cell migration on matrix-metalloproteinase-degraded collagen. *Biochem.Soc.Trans.*, **30**, 102-111.

Stringer, S. E. & Gallagher, J. T. (1997) Specific binding of the chemokine platelet factor 4 to heparan sulphate. *J Biol Chem.*, **272**, 20508-20514.

Sukhova, G. K., Shi, G. P., Simon, D. I., Chapman, H. A. & Libby, P. (1998) Expression of the elastolytic cathepsins S and K in human atheroma and regulation of their production in smooth muscle cells. *J Clin Invest*, **102**, 576-583.

Sukhova, G. K., Schonbeck, U., Rabkin, E., Schoen, F. J., Poole, A. R., Billingham, R. C. & Libby, P. (1999) Evidence for increased collagenolysis by interstitial collagenases-1 and -3 in vulnerable human atheromatous plaques. *Circulation*, **99**, 2503-2509.

Swertfeger, D. K. & Hui, D. Y. (2001) Apolipoprotein E receptor binding versus heparan sulfate proteoglycan binding in its regulation of smooth muscle cell migration and proliferation. *J Biol Chem.*, **276**, 25043-25048.

T

Tabas, I., Li, Y., Brocia, R. W., Xu, S. W., Swenson, T. L. & Williams, K. J. (1993) Lipoprotein lipase and sphingomyelinase synergistically enhance the association of atherogenic lipoproteins with smooth muscle cells and extracellular matrix. A possible mechanism for low

density lipoprotein and lipoprotein(a) retention and macrophage foam cell formation. *J Biol Chem.*, **268**, 20419-20432.

Tanizawa, S., Ueda, M., van der Loos, C. M., van der Wal, A. C. & Becker, A. E. (1996) Expression of platelet derived growth factor B chain and beta receptor in human coronary arteries after percutaneous transluminal coronary angioplasty: an immunohistochemical study. *Heart*, **75**, 549-556.

Tao, Z., Smart, F. W., Figueroa, J. E., Glancy, D. L. & Vijayagopal, P. (1997) Elevated expression of proteoglycans in proliferating vascular smooth muscle cells. *Atherosclerosis*, **135**, 171-179.

Tertov, V. V., Orekhov, A. N., Sobenin, I. A., Gabbasov, Z. A., Popov, E. G., Yaroslavov, A. A. & Smirnov, V. N. (1992) Three types of naturally occurring modified lipoproteins induce intracellular lipid accumulation due to lipoprotein aggregation. *Circ Res*, **71**, 218-228.

Thompson, L. D., Pantoliano, M. W. & Springer, B. A. (1994) Energetic characterization of the basic fibroblast growth factor-heparin interaction: identification of the heparin binding domain. *Biochemistry*, **33**, 3831-3840.

Thyberg, J., Hedin, U., Sjolund, M., Palmberg, L. & Bottger, B. A. (1990) Regulation of differentiated properties and proliferation of arterial smooth muscle cells. *Arteriosclerosis*, **10**, 966-990.

Thyberg, J., Blomgren, K., Roy, J., Tran, P. K. & Hedin, U. (1997) Phenotypic modulation of smooth muscle cells after arterial injury is associated with changes in the distribution of laminin and fibronectin. *J Histochem.Cytochem.*, **45**, 837-846.

Tiesman, J. & Hart, C. E. (1993) Identification of a soluble receptor for platelet-derived growth factor in cell-conditioned medium and human plasma. *J Biol Chem.*, **268**, 9621-9628.

Tumova, S., Woods, A. & Couchman, J. R. (2000) Heparan sulfate proteoglycans on the cell surface: versatile coordinators of cellular functions. *Int J Biochem.Cell Biol*, **32**, 269-288.

U

Uchida, K., Sasahara, M., Morigami, N., Hazama, F. & Kinoshita, M. (1996) Expression of platelet-derived growth factor B-chain in neointimal smooth muscle cells of balloon injured rabbit femoral arteries. *Atherosclerosis*, **124**, 9-23.

Ueda, M., Becker, A. E., Kasayuki, N., Kojima, A., Morita, Y. & Tanaka, S. (1996) In situ detection of platelet-derived growth factor-A and -B chain mRNA in human coronary arteries after percutaneous transluminal coronary angioplasty. *Am.J Pathol.*, **149**, 831-843.

Ueno, H., Colbert, H., Escobedo, J. A. & Williams, L. T. (1991) Inhibition of PDGF beta receptor signal transduction by coexpression of a truncated receptor. *Science*, **252**, 844-848.

Uren, A., Yu, J. C., Gholami, N. S., Pierce, J. H. & Heidaran, M. A. (1994) The alpha PDGFR tyrosine kinase mediates locomotion of two different cell types through chemotaxis and chemokinesis. *Biochem.Biophys.Res Commun.*, **204**, 628-634.

V

Vassbotn, F. S., Langeland, N., Hagen, I. & Holmsen, H. (1990) A monoclonal antibody against PDGF B-chain inhibits PDGF-induced DNA synthesis in C3H fibroblasts and prevents binding of PDGF to its receptor. *Biochim.Biophys.Acta*, **1054**, 246-249.

Vassbotn, F. S., Andersson, M., Westermark, B., Heldin, C. H. & Ostman, A. (1993) Reversion of autocrine transformation by a dominant negative platelet-derived growth factor mutant. *Mol.Cell Biol*, **13**, 4066-4076.

Vlodavsky, I., Bar-Shavit, R., Ishai-Michaeli, R., Bashkin, P. & Fuks, Z. (1991) Extracellular sequestration and release of fibroblast growth factor: a regulatory mechanism? *Trends Biochem Sci.*, **16**, 268-271.

Vlodavsky, I., Miao, H. Q., Medalion, B., Danagher, P. & Ron, D. (1996) Involvement of heparan sulfate and related molecules in sequestration and growth promoting activity of fibroblast growth factor. *Cancer Metastasis Rev.*, **15**, 177-186.

W

Wight, T. N. (1989) Cell biology of arterial proteoglycans. *Arteriosclerosis*, **9**, 1-20.

Wight, T. N., Heinegard, D. K. & Hascall, V. C. (1991) Proteoglycans. Structure and function. *Cell Biology of Extracellular Matrix* (ed E.D.Hay), pp. 45-78. Plenum Press, New York.

Wight, T. N., Kinsella, M. G. & Qwarnstrom, E. E. (1992) The role of proteoglycans in cell adhesion, migration and proliferation. *Curr.Opin.Cell Biol*, **4**, 793-801.

Wight, T. N. (1995) The extracellular matrix and atherosclerosis. *Curr.Opin.Lipidol.*, **6**, 326-334.

Wight, T. N. (1996) The Vascular Extracellular Matrix. *Atherosclerosis and Coronary Artery Disease* (eds V. Fuster, R. Ross & E. J. Topol), pp. 421-440. Lippincott-Raven Publishers, Philadelphia.

Wight, T. N., Lara, S., Riessen, R., Le Baron, R. & Isner, J. (1997) Selective deposits of versican in the extracellular matrix of restenotic lesions from human peripheral arteries. *Am.J Pathol.*, **151**, 963-973.

Wilcox, J. N., Smith, K. M., Williams, L. T., Schwartz, S. M. & Gordon, D. (1988) Platelet-derived growth factor mRNA detection in human atherosclerotic plaques by in situ hybridization. *J Clin Invest*, **82**, 1134-1143.

Williams, K. J. & Tabas, I. (1995) The response-to-retention hypothesis of early atherogenesis. *Arterioscler.Thromb.Vasc.Biol*, **15**, 551-561.

Williams, K. J. & Fuki, I. V. (1997) Cell-surface heparan sulfate proteoglycans: dynamic molecules mediating ligand catabolism. *Curr.Opin.Lipidol.*, **8**, 253-262.

Williams, K. J. (2001) Arterial wall chondroitin sulfate proteoglycans: diverse molecules with distinct roles in lipoprotein retention and atherogenesis. *Curr.Opin.Lipidol.*, **12**, 477-487.

Wilson, T. (1990) Confocal Microscopy. Academic Press Ltd., London.

Wissler, R. W., Vesselinovitch, D. & Komatsu, A. (1990) The contribution of studies of atherosclerotic lesions in young people to future research. *Ann.N.Y.Acad.Sci.*, **598**, 418-434.

Woodard, A. S., Garcia-Cardena, G., Leong, M., Madri, J. A., Sessa, W. C. & Languino, L. R. (1998) The synergistic activity of alphavbeta3 integrin and PDGF receptor increases cell migration. *J Cell Sci.*, **111**, 469-478.

Woods, A. & Couchman, J. R. (1998) Syndecans: synergistic activators of cell adhesion. *Trends Cell Biol*, **8**, 189-192.

Wright, T. C., Castellot, J. J. & Karnovsky, M. J. (1989a) Regulation of cellular proliferation by heparin and heparan sulphate. *Heparin* (eds D. A. Lane & U. Lindahl), pp. 295-316. Edward Arnold, London.

Wright, T. C., Jr., Castellot, J. J., Jr., Petitou, M., Lormeau, J. C., Choay, J. & Karnovsky, M. J. (1989b) Structural determinants of heparin's growth inhibitory activity. Interdependence of oligosaccharide size and charge. *J Biol Chem.*, **264**, 1534-1542.

Y

Yagi, M., Kato, S., Kobayashi, Y., Kobayashi, N., Iinuma, N., Nakamura, K., Kubo, K., Ohyama, S. I., Murooka, H., Shimizu, T., Nishitoba, T., Osawa, T. & Nagano, N. (1998) Beneficial effects of a novel inhibitor of platelet-derived growth factor receptor autophosphorylation in the rat with mesangial proliferative glomerulonephritis. *Gen.Pharmacol.*, **31**, 765-773.

Yanagishita, M. (1998) Cellular Catabolism of Heparan Sulphate Proteoglycans. *Trends Glycosci.Glycotechnol.*, **10**, 57-63.

Yao, C. C., Breuss, J., Pytela, R. & Kramer, R. H. (1997) Functional expression of the alpha 7 integrin receptor in differentiated smooth muscle cells. *J Cell Sci.*, **110**, 1477-1487.

Yao, L. Y., Moody, C., Schonherr, E., Wight, T. N. & Sandell, L. J. (1994) Identification of the proteoglycan versican in aorta and smooth muscle cells by DNA sequence analysis, in situ hybridization and immunohistochemistry. *Matrix Biol*, **14**, 213-225.

Young, R. M., Mendoza, A. E., Collins, T. & Orkin, S. H. (1990) Alternatively spliced platelet-derived growth factor A-chain transcripts are not tumor specific but encode normal cellular proteins. *Mol.Cell Biol*, **10**, 6051-6054.

Yu, J., Moon, A. & Kim, H. R. (2001) Both platelet-derived growth factor receptor (PDGFR)-alpha and PDGFR-beta promote murine fibroblast cell migration. *Biochem.Biophys.Res Commun.*, **282**, 697-700.

Yu, J., Ustach, C. & Kim, H. R. (2003) Platelet-derived growth factor signaling and human cancer. *J Biochem.Mol.Biol*, **36**, 49-59.

Z

Zioncheck, T. F., Richardson, L., Liu, J., Chang, L., King, K. L., Bennett, G. L., Fugedi, P., Chamow, S. M., Schwall, R. H. & Stack, R. J. (1995) Sulfated oligosaccharides promote hepatocyte growth factor association and govern its mitogenic activity. *J Biol Chem.*, **270**, 16871-16878.