

# OptiPrep™ Reference List RS08

## Purification of caveolae in gradients prepared from OptiPrep™

- ◆ The principal aim of this **OptiPrep™ Reference List** is to present a bibliography of all of the current papers reporting the use of an iodixanol gradient to purify and analyse caveolae from vertebrate and non-vertebrate cells/tissues (see Section 2). Section 1 contains a brief survey of the technique; it has its own short reference list distinct from the comprehensive reference list in Section 2.

### 1. Background

Early methods for the purification of lipid-rich plasma membrane domains largely relied on their insolubility in Triton X-110 (or some other non-ionic detergent) relative to that of the bulk plasma membrane or that of all the other subcellular membranes. Sometimes detergent was added to the whole homogenate or more frequently a partially-purified plasma membrane fraction was first isolated before treating with detergent. Smart et al [1] however pointed out that, while use of a non-ionic detergent did permit the isolation of a lipid-rich membrane domain, that some characteristic caveolar proteins can be lost in the procedure. These workers therefore developed a method that avoids the use of Triton X-100. After isolation of a plasma membrane fraction from either human skin fibroblasts or MA104 cells, the caveolae are released by sonication in a standard cell homogenization medium. The first part of the isolation procedure is a flotation through a continuous iodixanol gradient (0-20%); this gradient is essentially a resolving gradient in which the caveolin-rich vesicles are concentrated in the top third of the gradient, while the predominantly caveolin-poor vesicles band in denser regions. A second discontinuous gradient is essentially a concentration gradient to band the caveolin-rich vesicles sharply at an interface.

Smart et al [1] used a Percoll™-based method for the initial purification of the plasma membrane, but there is no obvious requirement that such a method must be used. Kumanogoh et al [2] for example used a sucrose gradient to purify a synaptic plasma membrane before using the method devised by Smart et al [1]. There are many examples in the literature of iodixanol gradients being used to purify plasma membrane from a homogenate. The McDonald and Pike [3] method for the isolation of lipid rafts incorporates elements of both the detergent and the sonicated plasma membrane approaches. It involves performing two rounds of homogenization of CHO cells using multiple passages through a syringe needle. A post-nuclear supernatant is then adjusted to 25% (w/v) iodixanol and loaded under a 0-20% iodixanol gradient for floating the lipid-rich plasma membrane fragments. In effect it resembles a Smart et al [3] method without a plasma membrane purification step. It also omits the final iodixanol caveolae concentration gradient. Occasionally the Percoll™ gradient is omitted, see for example ref 4.

1. Smart, E.J., Mineo, C. and Anderson, R.G.W. (1996) *Clustered folate receptors deliver 5-methyltetrahydrofolate to cytoplasm of MA104 cells* J. Cell Biol., **134**, 1169-1177
2. Kumanogoh, H., Miyata, S., Sokawa, Y. and Maekawa, S. (2001) *Biochemical and morphological analysis on the localization of Rac1 in neurons* Neurosci. Res., **39**, 189-196
3. Macdonald, J.L. and Pike, L.J. (2005) *A simplified method for the preparation of detergent-free lipid rafts* J. Lipid Res., **46**, 1061-1067
4. Tome, M.E., Schaefer, C.P., Jacobs, L.M., Zhang, Y., Hemdon, J.M., Matty, F.O. and Davis, T.P. (2015) *Identification of P- glycoprotein co-fractionating proteins and specific binding partners in rat brain microvessels* J. Neurochem., **134**, 200-210

Detailed descriptions of the OptiPrep™-based techniques for isolation of caveolae and lipid rafts can be found in the following OptiPrep™ Application Sheets:

- ◆ **OptiPrep™ Application Sheet S34: Isolation of caveolae**
- ◆ **OptiPrep™ Application Sheet S32: Isolation of lipid rafts (detergent strategy)**
- ◆ **OptiPrep™ Application Sheet S33: Isolation of lipid rafts (detergent-free strategy)**

These can be found via the relevant OptiPrep™ Application Sheets Index on the following website: [www.Optiprep.com](http://www.Optiprep.com) (click on “Methodology”, then “Organelles and Subcellular Membranes”). Scroll down the Index to “Plasma membrane domains”. There is also a large literature on the fractionation of plasma membrane, endoplasmic reticulum, Golgi and endosomes and several Application Sheets, based on this literature, may be accessed from the Index entry for “Endoplasmic reticulum”.

## 2. Comprehensive bibliographies

Papers have been divided into **cell or tissue type**; and additionally, when required, into **research topic**. Within each group papers are listed alphabetically according to **first author**. To facilitate identification of references of interest **key words in titles are highlighted in light blue**. When a paper reports the study of more than one cell type, reference to that paper will appear under all relevant cell headings.

All publications reporting **brain-derived caveolae** are listed under “**22. Neural tissue and cells**”. Papers reporting on **heart-derived caveolae** are listed under “**3. Cardiac muscle**” but see also “**27. Smooth muscle and smooth muscle cells**” for related cells. Cultured cell and tissue-derived caveolae will generally have been prepared from a partially purified plasma membrane fraction. An exception to this is a paper on “signalosomes”, cytoplasmic organelles, that resemble caveolae and which have been purified from cardiac muscle (see **Quinlan et al in Section 3**). Review articles are listed in **Section 30**. Note also the following:

**OptiPrep™ Reference List RS06:** Lipid rich detergent-resistant membranes from mammalian cells, tissues and organelles

**OptiPrep™ Reference List RS07:** Detergent-free strategy for lipid raft isolation from mammalian cells and tissues

### 1. Caco-2 cells

**Delmas, O.**, Breton, M., Sapin, C., Le Bivic, A., Colard, O. and Trugnan, G. (2007) *Heterogeneity of raft-type membrane microdomains associated with VP4, the rotavirus spike protein, in Caco-2 and MA 104 cells* J. Virol., **81**, 1610-1618

### 2. Carcinoma cells

**Cai, C.**, Zhu, H. and Chen, J. (2004) *Overexpression of caveolin-1 increases plasma membrane fluidity and reduces P-glycoprotein function in Hs578T/Dox* Biochem. Biophys. Res. Commun., **320**, 868-874

**Chaterjee, S.**, Cao, S., Peterson, T.E., Simari, et al (2003) *Inhibition of GTP-dependent vesicle trafficking impairs internalization of plasmalemmal eNOS and cellular nitric oxide production* J. Cell Sci., **116**, 3645-3655

**Grądzka I.**, Sochanowicz, B., Brzóska, K., Wójciuk, G., et al (2013) *Cis-9,trans-11-conjugated linoleic acid affects lipid raft composition and sensitizes human colorectal adenocarcinoma HT-29 cells to X-radiation* Biochim. Biophys. Acta, **1830**, 2233–2242

**Huhtakangas, J.A.**, Olivera, C.J., Bishop, J.E., Zanello, L.P. et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds 1 $\alpha$ ,25(OH) $_2$ -vitamin D $_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671

**McDonald, J.F.**, Zheleznyak, A. and Frazier, W.A. (2004) *Cholesterol-independent interactions with CD47 enhance  $\alpha_v\beta_3$  activity* J. Biol. Chem., **279**, 17301-17311

**Nion, S.**, Briand, O., Lestavel, S., Torpier, G., et al (1997) *High-density-lipoprotein subfraction 3 interaction with glycosylphosphatidylinositol-anchored proteins* Biochem. J., **328**, 415-423

**Piazza, T.M.**, Lu, J.-C., Carver, K.C. and Schuler, L.A. (2009) *Src family kinases accelerate prolactin receptor internalization, modulating trafficking and signaling in breast cancer cells* Mol. Endocrinol., **23**, 202-212

**Pitto, M.**, Parenti, M., Guzzi, F., Magni, F., et al (2002) *Palmitic is the main fatty acid carried by lipids of detergent-resistant membrane fractions from neural and non-neural cells* Neurochem. Res., **27**, 729-734

**Sitaraman, S.V.**, Wang, L., Wong, M., Bruewer, M., et al (2002) *The adenosine 2b receptor is required to the plasma membrane and associates with E3KARP and ezrin upon agonist stimulation* J. Biol. Chem., **277**, 33188-33195

**Sun, J.**, Nanjundan, M., Pike, L.J., Wiedmer, T., et al (2002) *Plasma membrane phospholipid scramblase 1 is enriched in lipid rafts and interacts with the epidermal growth factor receptor* Biochemistry, **41**, 6338-6345

**Thiel, K.W.** and Carpenter, G. (2006) *ErbB-4 and TNF- $\alpha$  converting enzyme localization to membrane microdomains* Biochem. Biophys. Res. Commun., **350**, 629-633

**Turk, H.F.**, Barhoumi, R. and Chapkin, R.S. (2012) *Alteration of EGFR spatiotemporal dynamics suppresses signal transduction* PLoS One, **7**: e39682

**Waugh, M.G.**, Lawson, D., Tan, S.K. and Hsuan, J.J. (1998) *Phosphatidylinositol 4-phosphate synthesis in immunisolated caveolae-like vesicles and low buoyant non-caveolar membranes* J. Biol. Chem., **273**, 17115-17121

**Widatalla, S.E.**, Korolkova, O.Y., Whalen, D.S., Goodwin, J.S., Williams, K.P., Ochieng, J. and Sakwe, A.M. (2019) *Lapatinib-induced annexin A6 upregulation as an adaptive response of triple-negative breast cancer cells to EGFR tyrosine kinase inhibitors* Carcinogenesis, **40**, 998–1009

### 3. Cardiac muscle (see also “Smooth muscle”)

**Huhtakangas, J.A.**, Olivera, C.J., Bishop, J.E., Zanello, L.P., et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds  $1\alpha,25(OH)_2$ -vitamin  $D_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671

**Gabrielová, E.**, Bartošíková, L., Nečas, J. and Modrianský, M. (2019) *Cardioprotective effect of 2,3-dehydrosilybin preconditioning in isolated rat heart* Fitoterapia **132**, 12–21

**Quinlan, C.L.**, Costa, A.D.T., Costa, C.L., Pierre, S.V., et al *Conditioning the heart induces formation of signalosomes that interact with mitochondria to open mitoK<sub>ATP</sub> channels* Am. J. Physiol. Heart Circ. Physiol., **295**, H953-H961

### 4. CHO cells

**Babitt, J.**, Trigatti, B., Rigotti, A., Smart, E.J., et al (1997) *Murine SR-BI, a high density lipoprotein receptor that mediates selective lipid uptake, is N-glycosylated and fatty acylated and colocalizes with plasma membrane caveolae* J. Biol. Chem., **272**, 13242-13249

**Graf, G.G.**, Connell, P.M., van der Westhuyzen, D.R. and Smart, E.J. (1999) *The class B, type I scavenger receptor promotes the selective uptake of high density lipoprotein cholesterol esters into caveolae* J. Biol. Chem., **274**, 12043-12048

**Guo, L.**, Chen, M., Song, Z., Daugherty, A., et al (2011) *C323 of SR-BI is required for SR-BI-mediated HDL binding and cholesteryl ester uptake* J. Lipid Res., **52**, 2272–2278

**Uittenbogaard, A.**, Everson, W.V., Matveev, S.V. and Smart, E.J. (2002) *Cholesteryl ester is transported from caveolae to internal membranes as part of a caveolin-annexin II lipid-protein* J. Biol. Chem., **277**, 4925-4931

**Webb, N.R.**, Connell, P.M., Graf, G.A., Smart, E.J., et al (1998) *SR-BII, an isoform of the scavenger receptor BI containing an alternate cytoplasmic tail, mediates lipid transfer between high density lipoprotein and cells* J. Biol. Chem., **273**, 15241-15248

**Zhang, J.**, Chu, W. and Crandall, I. (2008) *Lipoprotein binding preference of CD36 is altered by filipin treatment* Lipids Health Dis., **7**, 23

### 5. Chondrocytes

**Elbaradie, K.B.Y.**, Wang, Y., Boyan, B.D. and Schwartz, Z. (2013) *Sex-specific response of rat costochondral cartilage growth plate chondrocytes to  $17\beta$ -estradiol involves differential regulation of plasma membrane associated estrogen receptors* Biochim. Biophys. Acta, **1833**, 1165–1172

### 6. COS cells

**Grossmann, S.**, Higashiyama, S., Oksche, A., Schaefer, M., et al (2009) *Localisation of endothelin B receptor variants to plasma membrane microdomains and its effects on downstream signaling* Mol. Memb. Biol., **26**, 279-292

**Heberden, C.**, Reine, F., Grosse, B., Henry, C., et al (2006) *Detection of a raft-located estrogen receptor-like protein distinct from ER $\alpha$*  Int. J. Biochem. Cell Biol., **38**, 376-391

**Hinkovska-Galcheva, V.**, Boxer, L.A., Kindzelski, A., Hiraoka, M., Abe, A., Goparju, S., Spiegel, S., Petty, H.R. and Shayman, J.A. (2005) *Ceramide 1-phosphate, a mediator of phagocytosis* J. Biol. Chem., **280**, 26612-26621

**Hinkovska-Galcheva, V.**, Clark, A., VanWay, S., Huang, J-B., et al (2008) *Ceramide kinase promotes Ca21 signaling near IgG-opsonized targets and enhances phagolysosomal fusion in COS-1 cells* J. Lipid Res., **49**, 531-542

**Ikezu, T.**, Trapp, B.D., Song, K.S., Schlegel, A., et al (1998) *Caveolae, plasma membrane microdomains for  $\alpha$ -secretase-mediated processing of the amyloid precursor protein* J. Biol. Chem., **273**, 10485-10495

**Mansfield, P.J.**, Hinkovska-Galcheva, V., Borofsky, M.S., Shayman, J.A. et al (2005) *Phagocytic signaling molecules in lipid rafts of COS-1 cells transfected with Fc $\gamma$ RIIA* Biochem. Biophys. Res. Commun., **331**, 132-138

**Nishiyama, K.**, Trapp, B.D., Ikezu, T., Ransohoff, et al (1999) *Caveolin-3 upregulation activates  $\beta$ -secretase-mediated cleavage of the amyloid precursor protein in Alzheimer's disease* J. Neurosci., **19**, 6538-6548

**Oh, P.** and Schnitzer, J.E. (1999) *Immunoisolation of caveolae with high affinity antibody binding to the oligomeric caveolin cage* J. Biol. Chem., **274**, 23144-23154

### 7. Embryonic stem cells

**Hernandez, V.J.**, Weng, J., Ly, P., Pompey, S., et al (2013) *Cavin-3 dictates the balance between ERK and Akt signaling* eLife, **2**: e00905

## 8. Endothelial (vascular) cells

### 8-1. Alzheimer's disease

David, M.A., Jones, D.R. and Tayebi, M. (2014) *Potential candidate camelid antibodies for the treatment of protein-misfolding diseases* J. Neuroimmunol., **272**, 76–85

### 8-2. ATP synthase

Yamamoto, K., Shimizu, N., Obi, S., Kumagaya, S., Taketani, Y., Kamiya, A. and Ando, J. (2007) *Involvement of cell surface ATP synthase in flow-induced ATP release by vascular endothelial cells* Am. J. Physiol. Heart Circ. Physiol., **293**, H1646-H1653

### 8-3. Caspase-3

Oxhorn, B.C. and Buxton, I.L.O. (2003) *Caveolar compartmentation of caspase-3 in cardiac endothelial cells* Cell. Signal., **15**, 489-496

### 8-4. Caveolin-2

Boyd, N.L., Park, H., Sun, W-P., Coleman, S.E., et al (2004) *Bovine caveolin-2 cloning and effects of shear stress on its localization in bovine aortic endothelial cells* Endothelium, **11**, 189-198

### 8-5. FC5

Abulrop, A., Sprong, H., Van Bergen en Henegouwen P. and Stanimirovic, D. (2005) *The blood-brain barrier transmigration single domain antibody: mechanism of transport and antigenic epitopes in human brain endothelial cells*. J. Neurochem., **95**, 1201-1214

### 8-6. Glycolipids

Czarny, M., Liu, J., Oh, P. and Schnitzer, J.E. (2003) *Transient mechanoactivation of neutral sphingomyelinase in caveolae to generate ceramide* J. Biol. Chem., **278**, 4424-4430

Shu, L. and Shayman, J.A. (2007) *Caveolin-associated accumulation of globotriaosylceramide in the vascular endothelium of  $\alpha$ -glactosidase A null mice* J. Biol. Chem., **282**, 20960-20967

### 8-7. HDL uptake

Balazs, Z., Panzenboeck, U., Hammer, A., Sovic, A., et al. (2004) *Uptake and transport of high-density lipoprotein (HDL) and HDL-associated  $\alpha$ -tocopherol by an in vitro blood-brain barrier model* J. Neurochem., **89**, 939-950

### 8-8. Ion transport

Wang, X-L., Ye, D., Peterson, T.E., Cao, S., et al (2005) *Caveolae targeting and regulation of large conductance  $Ca^{2+}$ -activated  $K^{+}$  channels in vascular endothelial cells* J. Biol. Chem., **280**, 11656-11664

### 8-9. Lung

Jiang, Y., Sverdlov, M.S., Toth, P.T., Huang, L.S., Du, G., Liu, Y., Natarajan, V. Minshall, R.D, (2016) *Phosphatidic acid produced by *RalA*-activated *PLD2* stimulates caveolae-mediated endocytosis and trafficking in endothelial cells* J. Biol. Chem., **291**, 20729–20738

### 8-10. Nitric oxide synthase

Blair, A., Shaul, P.W., Yuhanna, I.S., Conrad, P.A., et al (1999) *Oxidized low density lipoprotein displaces endothelial nitric-oxide synthase (eNOS) from plasmalemmal caveolae and impairs eNOS activation* J. Biol. Chem., **274**, 32512-32519 (1999)

Joshi, M.S., Mineo, C., Shaul, P.W. and Bauer, J.A. (2007) *Biochemical consequences of the *NOS3 Glu298Asp* variation in human endothelium: altered caveolar localization and impaired response to shear* FASEB J., **21**, 2655-2663

Kincer, J.F., Uittenbogaard, A., Dressman, J., Guerin, T. M., et al (2002) *Hypercholesterolemia promotes a *CD36*-dependent and endothelial nitric oxide synthase mediated vascular dysfunction* J. Biol. Chem., **277**, 23525-23533

Peterson, T.E., Poppa, V., Ueba, H., Wu, A., et al (1999) *Opposing effects of reactive oxygen species and cholesterol on endothelial nitric oxide synthase and endothelial cell caveolae*. Circ. Res., **85**, 29-37

Peterson, T.E., d'Uscio, L.V., Cao, S., Wang, X-L., et al (2009) *Guanosine triphosphate cyclohydrolase I expression and enzymatic activity are present in caveolae of endothelial cells* Hypertension, **53**, 189-195

Shaul, P.W., Smart, E.J., Robinson, L.J., German, Z., et al (1996) *Acylation targets endothelial nitric-oxide synthase to plasmalemmal caveolae* J. Biol. Chem., **271**, 6518-6522 (1996)

Uittenbogaard, A., Shaul, P.W., Yuhanna, I.S., Blair, A. et al (2000) *High density lipoprotein prevents oxidized low density lipoprotein-induced inhibition of endothelial nitric-oxide synthase localization and activation in caveolae* J. Biol. Chem., **275**, 11278-11283

### 8-11. Vascular barrier/integrity

Birukova, A.A., Singleton, P.A., Gawlak, G., Tian, X., et al (2014) *GRP78 is a novel receptor initiating a vascular barrier protective response to oxidized phospholipids* Mol. Biol. Cell, **25**, 2006-2016

David, M.A., Jones, D.R. and Tayebi, M. (2014) *Potential candidate camelid antibodies for the treatment of protein-misfolding diseases* J. Neuroimmunol., **272**, 76–85

Heemskerck, N., Asimuddin, M., Oort, C., van Rijssel, J. and van Buul, J.D. (2016) *Annexin A2 limits neutrophil transendothelial migration by organizing the spatial distribution of ICAM-1* J. Immunol., **196**, 2767–2778

### 8-12. VEGF Receptors

Galvagni, F., Anselmi, F., Salameh, A., Orlandini, M., et al (2007) *Vascular endothelial growth factor receptor-3 activity is modulated by its association with caveolin-1 on endothelial membrane* Biochemistry, **46**, 3998-4005

Ikeda, S., Ushio-Fukai, M., Zuo, L., Tojo, T., et al (2005) *Novel role of ARF6 in vascular endothelial growth factor-induced signaling and angiogenesis* Circ. Res., **96**, 467-475

Labrecque, L., Royal, I., Surprenant, D.S., Patterson, C., et al (2003) *Regulation of vascular endothelial growth factor receptor-2 activity by caveolin-1 and plasma membrane cholesterol* Mol. Biol. Cell, **14**, 334-347

### 9. Endothelial progenitor cells

Chilla, A., Magherini, F., Margheri, F., Laurenzana, A., et al (2013) *Proteomic identification of VEGF-dependent protein enrichment to membrane caveolar-raft microdomains in endothelial progenitor cells*. Mol. Cell. Proteom., **12**, 1926-1938

Margheri, F., Chilla, A., Laurenzana, A., Serrati, S., et al (2011) *Endothelial progenitor cell-dependent angiogenesis requires localization of the full-length form of uPAR in caveolae* Blood, **118**, 3743-3755

### 10. Epithelial cells

Bolander Jr., F.F. (2005) *The compartmentalization of prolactin signaling in the mouse mammary gland* Mol. Cell. Endocrinol., **245**, 105-110

Bradbury, N.A., Clark, J.A., Watkins, S.C., Widnell, C.C., et al (1999) *Characterization of the internalization pathways for the cystic fibrosis transmembrane conductance regulator* Am. J. Physiol. Lung Cell. Mol. Physiol., **276**, L659-L668

Briand, O., Lestavel, S., Pilon, A., Torpier, G., et al (2003) *SR-BI does not require raft/caveola localization for cholesteryl ester selective uptake in the human adrenal cell line NCI-H295R* Biochim. Biophys. Acta, **163**, 42-50

Chen, J., Chen, J-K. and Harris, R.C. (2012) *Angiotensin II induces epithelial-to-mesenchymal transition in renal epithelial cells through reactive oxygen species/Src/caveolin-mediated activation of an epidermal growth factor receptor-extracellular signal-regulated kinase signaling pathway* Mol. Cell. Biol., **32**, 981–991

Delmas, O., Breton, M., Sapin, C., Le Bivic, A., et al (2007) *Heterogeneity of raft-type membrane microdomains associated with VP4, the rotavirus spike protein, in Caco-2 and MA 104 cells* J. Virol., **81**, 1610-1618

Heberden, C., Reine, F., Grosse, B., Henry, C., et al (2006) *Detection of a raft-located estrogen receptor-like protein distinct from ER $\alpha$*  Int. J. Biochem. Cell Biol., **38**, 376-391

Huang, C., Hepler, J.R., Chen, L.T., Gilman, A.G., et al (1997) *Organization of G proteins and adenylyl cyclase at the plasma membrane* Mol. Biol. Cell, **8**, 2365-2378

Kifor, O., Diaz, R., Butters, R., Kifor, I., et al (1998) *The calcium-sensing receptor is localized in caveolin-rich plasma membrane domains of bovine parathyroid cells* J. Biol. Chem., **273**, 1708-21713

Lalor, D., Liu, P. and Hayashi, J. (2004) *Fas ligand is enriched in the caveolae membrane domains of thymic epithelial cells* Cell. Immunol., **230**, 10-16

McMahon, K-A., Zhu, M., Kwon, S.W., Liu, P., et al (2006) *Detergent-free caveolae proteome suggests an interaction with ER and mitochondria* Proteomics, **6**, 143-152

Norman, A.W., Olivera, C.J., Silva, F.R.M.B. and Bishop, J.E. (2002) *A specific binding protein/receptor for 1 $\alpha$ ,25-dihydroxyvitamin D<sub>3</sub> is present in an intestinal caveolae membrane fraction* Biochem. Biophys. Res. Commun., **298**, 414-419

Pike, L.J., Han, X., Chung, K-N and Gross, R.W. (2002) *Lipid rafts are enriched in arachidonic acid and plasmylethanolamine and their composition is independent of caveolin-1 expression: a quantitative electrospray ionization/mass spectrometric analysis* Biochemistry, **41**, 2075-2088

- Smart, E.J.**, Mineo, C. and Anderson, R.G.W. (1996) *Clustered folate receptors deliver 5-methyltetrahydrofolate to cytoplasm of MA104 cells* J. Cell Biol., **134**, 1169-1177
- Subramanian, P.S.** and Johnson, H.M. (2002) *Lipid microdomains are required sites for the selective endocytosis and nuclear translocation of IFN- $\gamma$ , its receptor chain IFN- $\gamma$  receptor-1, and phosphorylation and nuclear translocation of STAT1 $\alpha$*  J. Immunol, **169**, 1959-1969

## 11. Fibroblasts

### 11-1. Cholesterol

- Dufour, D.**, Zhao, W-Q., Ravindranath, L. and Alkon, D.L. (2003) *Abnormal cholesterol processing in Alzheimer's disease patient's fibroblasts* Neurobiol. Lipids., **1**, 34-44
- Furuchi, T.** and Anderson, R.G.W. (1998) *Cholesterol depletion of caveolae causes hyperactivation of extracellular signal-related kinase (ERK)* J. Biol. Chem., **273**, 21009-21104
- Gallegos, A.M.**, McIntosh, A.L., Atshaves, B.P. and Schroeder, F. (2004) *Structure and cholesterol domain dynamics of an enriched caveolae/raft isolate* Biochem. J., **382**, 451-461
- Laitinen, S.**, Lehto, M., Lehtonen, S., Hyvarinen, K., et al (2002) *ORP2, a homolog of oxysterol binding protein, regulates cellular cholesterol metabolism* J. Lipid Res., **43**, 245-255
- Landry, Y.D.**, Denis, M., Nandi, S., Bell, S., et al (2006) *ATP-binding cassette transporter A1 expression disrupts raft membrane microdomains through its ATPase-related functions* J. Biol. Chem., **281**, 36091-36101
- Lu, X.**, Kambe, F., Cao, X., Yoshida, T., et al (2006) *DHCR24-Knockout embryonic fibroblasts are susceptible to serum withdrawal-induced apoptosis because of dysfunction of caveolae and insulin-Akt-Bad signaling* Endocrinology, **147**, 3123-3132
- Matthews, L.C.**, Taggart, M.J. and Westwood, M. (2005) *Effect of cholesterol depletion on mitogenesis and survival: the role of caveolar and noncaveolar domains in insulin-like growth factor-mediated cellular function* Endocrinology, **146**, 5463-5473
- Smart, E.J.**, Ying, Ys., Donzell, W.C. and Anderson, R.G.W. (1996) *A role for caveolin in transport of cholesterol from endoplasmic reticulum to plasma membrane* J. Biol. Chem., **271**, 29427-29435
- Uittenbogaard, A.**, Ying, Y.S. and Smart, E.J. (1998) *Characterization of a cytosolic heat-shock protein-caveolin chaperone complex* J. Biol. Chem., **273**, 6525-6532
- Yin, Y.**, Liu, P., Anderson, R.G.W. and Sampson, N.S. (2002) *Construction of a catalytically inactive cholesterol oxidase mutant: investigation of the interplay between active site-residues glutamate 361 and histidine 447* Arch. Biochem. Biophys., **402**, 235-242

### 11-2. Composition and structure

- Landry, Y.D.**, Denis, M., Nandi, S., Bell, S., et al (2006) *ATP-binding cassette transporter A1 expression disrupts raft membrane microdomains through its ATPase-related functions* J. Biol. Chem., **281**, 36091-36101
- Marks, D.L.**, Bittman, R. and Pagano, R.E. (2008) *Use of Bodipy-labeled sphingolipid and cholesterol analogs to examine membrane microdomains in cells* Histochem. Cell. Biol., **130**, 819-832
- McMahon, K-A.**, Zhu, M., Kwon, S.W., Liu, P., et al (2006) *Detergent-free caveolae proteome suggests an interaction with ER and mitochondria* Proteomics, **6**, 143-152
- Smart, E.J.**, Ying, Y-S, Mineo, C. and Anderson, R.G.W. (1995) *A detergent-free method for purifying caveolae membrane from tissue culture cells* Proc. Natl. Acad. Sci. USA, **92**, 10104-10108
- Westermann, M.**, Leutbecher, H. and Meyer, H.W. (1999) *Membrane structure of caveolae and isolated caveolin-rich vesicles* Histochem. Cell Biol., **111**, 71-81

### 11-3. Glycosphingolipids

- Kim, S-Y.**, Wang, T-k., Singh, R.D., Wheatley, C.L., Marks, D.L. and Pagano, R.E. (2009) *Proteomic identification of proteins translocated to membrane microdomains upon treatment of fibroblasts with the glycosphingolipid, C8- $\beta$ -D-lactosylceramide* Proteomics, **9**, 4321-4328

### 11-4. Growth factor receptors (see also "Protein targeting and activation" and "Signal transduction")

- Boucher, P.**, Liu, P., Gotthardt, M., Hiesberger, T., et al (2002) *Platelet-derived growth factor mediates tyrosine phosphorylation of the cytoplasmic domain of the low density lipoprotein receptor-related protein in caveolae* J. Biol. Chem., **277**, 15507-15513
- Liu, P.**, Ying, Y., Ko, Y.G. and Anderson, R.G.W. (1996) *Localization of platelet-derived growth factor-stimulated phosphorylation cascade to caveolae* J. Biol. Chem., **271**, 10299-10303
- Liu, P.**, Ying, Y-S., and Anderson, R.G.W. (1997) *Platelet-derived growth factor activates mitogen-activated protein kinase in isolated caveolae* Proc. Natl. Acad. Sci., USA, **94**, 13666-13670
- Liu, P.** and Anderson, R.G.W. (1999) *Spatial organization of EGF receptor transmodulation by PDGF* Biochem. Biophys. Res. Commun., **261**, 695-700

- Matthews, L.C.**, Taggart, M.J. and Westwood, M. (2005) *Effect of cholesterol depletion on mitogenesis and survival: the role of caveolar and noncaveolar domains in insulin-like growth factor-mediated cellular function* Endocrinology, **146**, 5463-5473
- Matveev, S.V.** and Smart, E.J. (2002) *Heterologous desensitization of EGF receptors and PDGF receptors by sequestration in caveolae* Am. J. Physiol Cell Physiol, **282**, C935-C946
- Mineo, C.**, James, G.L., Smart, E.J. and Anderson, R.G.W. (1996) *Localization of epidermal growth factor-stimulated Ras/Raf-1 interaction to caveolae membrane* J. Biol. Chem., **271**, 11930-11935
- Mineo, C.**, Gill, G.N. and Anderson, R.G.W. (1999) *Regulated migration of epidermal growth factor receptor from caveolae* J. Biol. Chem., **274**, 30636-30643
- Yamabhai, M.** and Anderson, R.G.W. (2002) *Second cysteine-rich region of epidermal growth factor receptor contains targeting information for caveolae/rafts* J. Biol. Chem., **277**, 24843-24846
- Yang, N.**, Huang, Y., Jiang, J. and Frank, S.J. (2004) *Caveolar and lipid raft localization of the growth hormone receptor and its signaling elements* J. Biol. Chem., **279**, 20898-20905

### 11-5. Lipoproteins

- Boucher, P.**, Liu, P., Gotthardt, M., Hiesberger, T., et al (2002) *Platelet-derived growth factor mediates tyrosine phosphorylation of the cytoplasmic domain of the low density lipoprotein receptor-related protein in caveolae* J. Biol. Chem., **277**, 15507-15513
- Nion, S.**, Briand, O., Lestavel, S., Torpier, G., et al (1997) *High-density-lipoprotein subfraction 3 interaction with glycosylphosphatidyl-inositol-anchored proteins* Biochem. J., **328**, 415-423

### 11-6. Protein targeting and activation

- Li, W-P.**, Liu, P., Pilcher, B.K. and Anderson, R.G.W. (2001) *Cell-specific targeting of caveolin-1 to caveolae, secretory vesicles, cytoplasm or mitochondria* J. Cell Sci., **114**, 1397-1408
- Michaely, P.A.**, Mineo, C. Ying, Y-S. and Anderson, R.G.W. (1999) *Polarized distribution of endogenous Rac1 and RhoA at the cell surface* J. Biol. Chem., **274**, 21430-21436
- Mineo, C.**, James, G.L., Smart, E.J. and Anderson, R.G.W. (1996) *Localization of epidermal growth factor-stimulated Ras/Raf-1 interaction to caveolae membrane* J. Biol. Chem., **271**, 11930-11935
- Mineo, C.**, Anderson, R.G.W. and White, M.A. (1997) *Physical association with Ras enhances activation of membrane-bound Raf (RafCAAX)* J. Biol. Chem., **272**, 10345-10348
- Shu, L.**, Lee, L., Chang, Y., Holzman, L.B., et al (2000) *Caveolar structure and protein sorting are maintained in NIH cells independent of glycosphingolipid depletion* Arch. Biochem. Biophys., **373**, 83-90
- Uittenbogaard, A.**, Ying, Y.S. and Smart, E.J. (1998) *Characterization of a cytosolic heat-shock protein-caveolin chaperone complex* J. Biol. Chem., **273**, 6525-6532

### 11-7. Signal transduction

- Bilderback, T.R.**, Gazula, V-R., Lisanti, M.P. and Dobrowsky, R.T. (1999) *Caveolin interacts with Trk A and p75<sup>NTR</sup> and regulates neurotrophin signaling pathways* J. Biol. Chem., **274**, 257-263
- Chen, J.**, Doroudi, M., Cheung, J., Grozier, A.L., et al (2013) *Plasma membrane Pdia3 and VDR interact to elicit rapid responses to 1 $\alpha$ ,25(OH)<sub>2</sub>D<sub>3</sub>* Cell. Signal., **25**, 2362–2373
- Huang, C.**, Hepler, J.R., Chen, L.T., Gilman, et al (1997) *Organization of G proteins and adenylyl cyclase at the plasma membrane* Mol. Biol. Cell, **8**, 2365-2378
- Liu, P.**, Wang, P-y., Michaely, P., Zhu, M., et al (2000) *Presence of oxidized cholesterol in caveolae uncouples active platelet-derived growth factor receptors from tyrosine kinase substrates* J. Biol. Chem., **275**, 31648-31654
- Lu, X.**, Kambe, F., Cao, X., Yoshida, T., et al (2006) *DHCR24-Knockout embryonic fibroblasts are susceptible to serum withdrawal-induced apoptosis because of dysfunction of caveolae and insulin-Akt-Bad signaling* Endocrinology, **147**, 3123-3132
- Mineo, C.**, Ying, Y-S, Chapline, C., Jaken, S., et al (1998) *Targeting of protein kinase C $\alpha$  to caveolae* J. Cell Biol., **141**, 601-610
- Yin, Y.**, Liu, P., Anderson, R.G.W. and Sampson, N.S. (2002) *Construction of a catalytically inactive cholesterol oxidase mutant: investigation of the interplay between active site-residues glutamate 361 and histidine 447* Arch. Biochem. Biophys., **402**, 235-242

### 12. HEK cells

- Balijepalli, R.C.**, Delisle, B.P., Balijepalli, S.Y., Foell, J.D., et al (2007) *Kv11.1 (ERHI) K<sup>+</sup> channels localize in cholesterol and sphingolipid enriched membranes and are modulated by cholesterol* Channels, **1**, 263-272
- Fortin, J-P.**, Rivard, G.E., Adam, A. and Marceau, F. (2005) *Studies on rabbit natural and recombinant tissue factors: intracellular retention and regulation of surface expression in cultured cells* Am. J. Physiol., **288**, H2192-H2202

- Ikezu, T.,** Trapp, B.D., Song, K.S., Schlegel, A., et al (1998) *Caveolae, plasma membrane microdomains for  $\alpha$ -secretase-mediated processing of the amyloid precursor protein* J. Biol. Chem., **273**, 10485-10495
- Lamb, M.E.,** de Weerd, W.F.C. and Leeb-Lundberg, L.M.F. (2001) *Agonist-promoted trafficking of human bradykinin receptors: arrestin- and dynamin-independent sequestration of the  $B_2$  receptor and bradykinin in HEK293 cells* Biochem. J., **355**, 741-750
- Lamb, M.E.,** Zhang, C., Shea, T., Kyle, D.J., et al (2002) *Human  $B_1$  and  $B_2$  bradykinin receptors and their agonists target caveolae-related lipid rafts to different degrees in HEK293 cells* Biochemistry, **41**, 14340-14347
- Sabourin, T.,** Bastien, L., Bachvarov, D.R., and Marceau, F. (2002) *Agonist-induced translocation of the kinin  $B_1$  receptor to caveolae-related rafts* Mol. Pharmacol., **61**, 546-553
- Sorci-Thomas, M.G.,** Owen, J.S., Fulp, B., Bhat, S., Zhu, X., Parks, J.S., Shah, D., Jerome, W.G., Gerelus, M., Zabalawi, M. and Thomas, M.J. (2012) *Nascent high density lipoproteins formed by ABCA1 resemble lipid rafts and are structurally organized by three apoA-I monomers* J. Lipid Res., **53**, 1890–1909

### 13. Hepatoma cells

- Burger, H-M.,** Abela, S. and Gelderblom, W.C.A. (2018) *Modulation of key lipid raft constituents in primary rat hepatocytes by fumonisin B1 - Implications for cancer promotion in the liver* Food Chem. Toxicol., **115**, 34–41
- Smith, R.M.,** Harada, S., Smith, J.A., Zhang, S., et al (1998) *Insulin-induced protein tyrosine phosphorylation cascade and signalling molecules are localized in a caveolin-enriched cell membrane domain* Cell. Signalling, **10**, 355-362
- Truong, T.Q.,** Aubin, D., Bourgeois, P., Falstraalt, L., et al (2006) *Opposite effect of caveolin-1 in the metabolism of high-density and low-density lipoproteins* Biochim. Biophys. Acta, **1761**, 24-36
- Yanase, K.** and Madaio, M.P. (2005) *Nuclear localization anti-DNA antibodies enter cells via caveoli and modulate expression of caveolin and p53* J. Autoimmun., **24**, 145-151

### 13a. Human mammary epithelial cells

- Zhuo, D.** and Guan, F. (2019) *Ganglioside GM1 promotes contact inhibition of growth by regulating the localization of epidermal growth factor receptor from glycosphingolipid - enriched microdomain to caveolae* Cell Prolif. **52**: e12639

### 14. Intestine

- Huhtakangas, J.A.,** Olivera, C.J., Bishop, J.E., Zanello, L.P., et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds  $1\alpha,25(OH)_2$ -vitamin  $D_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671

### 15. Kidney

- Chen, J.,** Chen, J-K. and Harris, R.C. (2012) *Angiotensin II induces epithelial-to-mesenchymal transition in renal epithelial cells through reactive oxygen species/Src/caveolin-mediated activation of an epidermal growth factor receptor–extracellular signal-regulated kinase signaling pathway* Mol. Cell. Biol., **32**, 981–991
- Hill, W.G.,** Butterworth, M.B., Wang, H. Edinger, R.S., et al (2007) *The epithelial sodium channel (ENaC) traffics to apical membrane in lipid rafts in mouse cortical collecting duct cells* J. Biol. Chem., **282**, 37402-37411
- Huhtakangas, J.A.,** Olivera, C.J., Bishop, J.E., Zanello, L.P. et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds  $1\alpha,25(OH)_2$ -vitamin  $D_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671
- Yosef, E.,** Katz, A., Peleg, Y., Mehlman, T. and Karlsh, S.J.D. (2016) *Do Src kinase and caveolin interact directly with Na,K-ATPase?* J. Biol. Chem., **291**, 11736–11750

### 16. Liver (fish)

- Zehmer, J.K.** and Hazel, J.R. (2004) *Membrane order conservation in raft and non-raft regions of hepatocyte plasma membranes from thermally acclimated rainbow trout* Biochim. Biophys. Acta., **1664**, 108-116
- Zehmer, J.K.** and Hazel, J.R. (2005) *Thermally induced changes in lipid composition of raft and non-raft regions of hepatocyte plasma membranes of rainbow trout* J. Exp. Biol., **208**, 4283-4290

### 17. Liver (rodent)

- Huhtakangas, J.A.,** Olivera, C.J., Bishop, J.E., Zanello, L.P. et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds  $1\alpha,25(OH)_2$ -vitamin  $D_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671



Wang, Y., Posner, B.I. and Balbis, A. (2009) *Compartmentalization of epidermal growth factor receptor in liver plasma membrane* J. Cell. Biochem., **107**, 96-103

### 18. Lung

Hill, W.G., Almasri, E., Ruiz, W.G., Apodaca, G., et al (2005) *Water and solute permeability of rat lung caveolae: high permeabilities explained by acyl chain unsaturation* Am. J. Physiol., **289**, C33-C41

Huhtakangas, J.A., Olivera, C.J., Bishop, J.E., Zanello, L.P., et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds  $1\alpha,25(OH)_2$ -vitamin  $D_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671

Oh, P. and Schnitzer, J.E. (1999) *Immunoisolation of caveolae with high affinity antibody binding to the oligomeric caveolin cage* J. Biol. Chem., **274**, 23144-23154

Oh, P. and Schnitzer, J.E. (2001) *Segregation of heterotrimeric G proteins in cell surface microdomains* Mol. Biol. Cell, **12**, 685-698

### 19. Lymphoid/monocytic cells

Huhtakangas, J.A., Olivera, C.J., Bishop, J.E., Zanello, L.P., et al (2004) *The vitamin D receptor is present in caveolae-enriched plasma membranes and binds  $1\alpha,25(OH)_2$ -vitamin  $D_3$  in vivo and in vitro* Mol. Endocrinol., **18**, 2660-2671

Matveev, S., van der Westhuyzen, D.R. and Smart, E.J. (1999) *Co-expression of scavenger receptor-BI and caveolin-1 is associated with enhanced selective cholesterol ester uptake in THP-1 macrophages* J. Lipid Res., **40**, 1647-1654

McMahon, K-A., Zhu, M., Kwon, S.W., Liu, P., et al (2006) *Detergent-free caveolae proteome suggests an interaction with ER and mitochondria* Proteomics, **6**, 143-152

Poussin, C., Foti, M., Carpentier, J.L. and Pugin, J. (1998) *CD14-dependent endotoxin internalization via a macropinocytic pathway* J. Biol. Chem., **273**, 20285-20291

Uittenbogaard, A. and Smart, E.J. (2000) *Palmitoylation of caveolin-1 is required for cholesterol binding, chaperone complex formation, and rapid transport of cholesterol to caveolae* J. Biol. Chem., **275**, 25595-25599

### 20. Macrophages

Sorci-Thomas, M.G., Owen, J.S., Fulp, B., Bhat, S., et al (2012) *Nascent high density lipoproteins formed by ABCA1 resemble lipid rafts and are structurally organized by three apoA-I monomers* J. Lipid Res., **53**, 1890-1909

Zhu, X., Owen, J.S., Wilson, M.D., Li, H., et al (2010) *Macrophage ABCA1 reduces MyD88-dependent Toll-like receptor trafficking to lipid rafts by reduction of lipid raft cholesterol* J. Lipid Res., **51**, 3196-3206

### 21. MDCK (and other kidney cells)

Gallegos, A.M., Storey, S.M., Kier, A.B., Schroeder, F., et al (2006) *Structure and cholesterol dynamics of caveolae/raft and nonraft plasma membrane domains* Biochemistry, **45**, 12100-12116

Heller, B., Adu-Gyamfi, E., Smith-Kinnaman, W., Babbey, C., et al (2010) *Amot recognizes a juxtannuclear endocytic recycling compartment via a novel lipid binding domain* J. Biol. Chem., **285**, 12308-12320

Huang, C., Hepler, J.R., Chen, L.T., Gilman, A.G., et al (1997) *Organization of G proteins and adenylyl cyclase at the plasma membrane* Mol. Biol. Cell, **8**, 2365-2378

Huang, C., Duncan, J.A., Gilman, A.G. and Mumby, S.M (1999) *Persistent membrane association of activated and depalmitoylated G protein  $\alpha$  subunits* Proc. Natl. Acad. Sci. USA, **96**, 412-417

Ikezu, T., Trapp, B.D., Song, K.S., Schlegel, A., Lisanti, M.P. and Okamoto, T. (1998) *Caveolae, plasma membrane microdomains for  $\alpha$ -secretase-mediated processing of the amyloid precursor protein* J. Biol. Chem., **273**, 10485-10495

McMahon, K-A., Zhu, M., Kwon, S.W., Liu, P., et al (2006) *Detergent-free caveolae proteome suggests an interaction with ER and mitochondria* Proteomics, **6**, 143-152

Nashiki, K., Taketani, Y., Takeichi, T., Sawada, N., et al (2005) *Role of membrane microdomains in PTH-mediated down-regulation of NaPi-IIa in opossum kidney cells* Kidney Int., **68**, 1137-1147

### 22. Neural tissue and cells

Abulrob, A., Giuseppin, S., Andrade, M.F., McDermid, A., et al (2004) *Interactions of EGFR and caveolin-1 in human glioblastoma cells: evidence that tyrosine phosphorylation regulates EGFR association with caveolae* Oncogene, **23**, 6967-6979

Brouillett, E., Trembleau, A., Galanaud, D., Volovitch, M., et al (1999) *The amyloid precursor protein interacts with  $G_o$  heterotrimeric protein within a cell compartment specialized in signal transduction* J. Neurosci., **19**, 1717-1727

- Cameron, P.L.**, Ruffin, J.W., Bollag, R., Rasmussen, H., et al (1997) *Identification of caveolin and caveolin-related proteins in the brain* J. Neurosci., **17**, 9520-9535
- Karouzaki, S.**, Peta, C., Tsirimonaki, E. and Mangoura, D. (2019) *PKC $\epsilon$ -dependent H-Ras activation encompasses the recruitment of the RasGEF SOS1 and of the RasGAP neurofibromin in the lipid rafts of embryonic neurons* Neurochem. Int., **131**: 104582
- Kelly, J.F.**, Storie, K., Skamra, C., Bienias, J., et al (2005) *Relationship between Alzheimer's disease clinical stage and Gq/11 in subcellular fractions of frontal cortex* J. Neural Transm., **112**, 1049-1056
- Kumanogoh, H.**, Miyata, S., Sokawa, Y. and Maekawa, S. (2001) *Biochemical and morphological analysis on the localization of Rac1 in neurons* Neurosci. Res., **39**, 189-196
- Langelier, B.**, Linard, A., Bordat, C., Laviolle, M., et al (2010) *Long chain-polyunsaturated fatty acids modulate membrane phospholipid composition and protein localization in lipid rafts of neural stem cell cultures* J. Cell. Biochem., **110**, 1356–1364
- Nishiyama, K.**, Trapp, B.D., Ikezu, T., Ransohoff, R.M., et al (1999) *Caveolin-3 upregulation activates  $\beta$ -secretase-mediated cleavage of the amyloid precursor protein in Alzheimer's disease* J. Neurosci., **19**, 6538-6548
- Ren, Q.** and Bennett, V. (1998) *Palmitoylation of neurofascin at a site in the membrane-spanning domain highly conserved among the L1 family of cell adhesion molecules* J. Neurochem., **70**, 1839-1849
- Rimmerman, N.**, Hughes, H.V., Bradshaw, H.B., Pazos, M.X., et al (2008) *Compartmentalization of endocannabinoids into lipid rafts in a dorsal root ganglion cell line* Br. J. Pharmacol., **153**, 380–389
- Tome, M.E.**, Schaefer, C.P., Jacobs, L.M., Zhang, Y., Hemdon, J.M., Matty, F.O. and Davis, T.P. (2015) *Identification of P-glycoprotein co-fractionating proteins and specific binding partners in rat brain microvessels* J. Neurochem., **134**, 200-210
- Toran-Allerand, C.D.**, Guan, X., MacLusky, N.J., Horvath, T.L., et al (2002) *ER-X: A novel, plasma membrane-associated, putative estrogen receptor that is regulated during development and after ischemic brain injury* J. Neurosci., **22**, 8391-8401
- Vey, M.**, Pilkuhn, S., Wille, H., Nixon, R., et al (1996) *Subcellular colocalization of the cellular and scrapie prion proteins in caveolae-like membranous domains* Proc. Natl. Acad. Sci. USA, **93**, 14945-14949
- Wu, C.**, Butz, S., Ying, Y-S and Anderson, R.G.W. (1997) *Tyrosine kinase receptors concentrated in caveolae-like domains from neuronal plasma membrane* J. Biol. Chem., **272**, 3554-3559
- Zhai, J.**, Ström, A.L., Kilty, R., Venkatakrisnan, P., et al (2009) *Proteomic characterization of lipid raft proteins in amyotrophic lateral sclerosis mouse spinal cord* FEBS J., **276**, 3308-3323

### 23. Ocular photoreceptor membrane

- McClellan, M.E.** and Elliott, M.H. (2017) *Analysis of fatty acid and cholesterol content from detergent-resistant and detergent-free membrane microdomains* In Lipidomics: Methods and Protocols: Methods Mol. Biol., **1609** (ed. Bhattacharya, S.K.) Springer Science+Business Media, LLC, pp 185-194

### 24. Osteoblasts/osteoclasts

- Chen, J.**, Olivares-Navarrete, R., Wang, Y., Herman, T.R., et al (2010) *Protein-disulfide isomerase-associated 3 (Pdia3) mediates the membrane response to 1,25-dihydroxyvitamin D3 in osteoblasts* J. Biol. Chem., **285**, 37041–37050
- Chen, J.**, Doroudi, M., Cheung, J., Grozier, A.L., et al (2013) *Plasma membrane Pdia3 and VDR interact to elicit rapid responses to 1 $\alpha$ ,25(OH) $_2$ D $_3$*  Cell. Signal., **25**, 2362–2373
- Doroudi, M.**, Schwartz, Z., and Boyan, B.D. (2012) *Phospholipase A2 activating protein is required for 1 $\alpha$ ,25-dihydroxyvitamin D3 dependent rapid activation of protein kinase C via Pdia3* J. Steroid Biochem. Mol. Biol., **132**, 48– 56
- Doroudi, M.**, Olivares-Navarrete, R., Hyzy, S.L., Boyan, B.D. and Schwartz, Z. (2014) *Signaling components of the 1 $\alpha$ ,25(OH) $_2$ D $_3$ -dependent Pdia3 receptor complex are required for Wnt5a calcium-dependent signaling* Biochim. Biophys. Acta, **1843**, 2365–2375
- Doroudi, M.**, Plaisance, M.C., Boyan, B.D. and Schwartz, Z. (2015) *Membrane actions of 1 $\alpha$ ,25(OH) $_2$ D $_3$  are mediated by Ca $^{2+}$ /calmodulin-dependent protein kinase II in bone and cartilage cells* J. Steroid Biochem. Mol. Biol., **145**, 65–74

### 25. Platelets

- Silvagno, F.**, De Vivo, E., Attanasio, A., Gallo, V., et al (2010) *Mitochondrial localization of vitamin D receptor in human platelets and differentiated megakaryocytes* PLoS One **5**: e8760

## 26. Pre-adipocytes

Wang, X., Yang, N., Deng, L., Li, X., et al (2009) *Interruption of growth hormone signaling via SHC and ERK in 3T3-F442A preadipocytes upon knockdown of insulin receptor substrate-1* Mol. Endocrinol., **23**, 486–496

Renal cells/tissue see “15. Kidney”

## 27. Smooth muscle and smooth muscle cells

### 27-1. Airway

Grim, K.J., Abcejo, A.J., Barnes, A., Sathish, V., Smelter, D.F., Ford, G.C., Thompson, M.A., Prakash, Y.S. and Pabelick, C.M. (2012) *Caveolae and propofol effects on airway smooth muscle* Br. J. Anaesth., **109**, 444–53

Prakash, Y.S., Thompson, M.A., Vaa, B., Matabdin, I., et al (2007) *Caveolins and intracellular calcium regulation in human airway smooth muscle* Am. J. Physiol. Lung Cell. Mol. Physiol., **293**, L1118-L1126

Sathish, V., Yang, B., Meuchel, L.W., Van Oosten, S.K., et al (2011) *Caveolin-1 and force regulation in porcine airway smooth muscle* Am. J. Physiol. Lung Cell. Mol. Physiol., **300**, L920–L929

Sathish, V., Abcejo, A.J., VanOosten, S.K., Thompson, M.A., et al (2011) *Caveolin-1 in cytokine-induced enhancement of intracellular  $Ca^{2+}$  in human airway smooth muscle* Am. J. Physiol. Lung Cell. Mol. Physiol., **301**, L607–L614

Sathish, V., Thompson, M.A., Sinha, S., Sieck, G.C., et al (2014) *Inflammation, caveolae and CD38-mediated calcium regulation in human airway smooth muscle* Biochim. Biophys. Acta, **1843**, 346–351

### 27-2. Cardiac myocytes

Doyle, D.D., Goings, G., Upshaw-Earley, J., Ambler, S.K., et al (2000) *Dystrophin associates with a caveolae of rat cardiac myocytes* Circ. Res., **87**, 480-488

Lasley, R.D., Narayan, P., Uittenbogaard, A. and Smart, E.J. (2000) *Activated cardiac adenosine  $A_1$  receptors translocate out of caveolae* J. Biol. Chem., **275**, 4417-4421

Liu, L., Mohammadi, K., Aynafshar, B., Wang, H., et al (2003) *Role of caveolae in signal-transducing function of cardiac  $Na^+/K^+$ -ATPase* Am. J. Physiol. Cell Physiol., **284**, C1550-C1560

Rybin, V.O., Xu, X., Lisanti, M.P. and Steinberg, S.F. (2000) *Differential targeting of  $\beta$ -adrenergic receptor subtypes and adenylyl cyclase to cardiomyocyte caveolae: A mechanism to functionally regulate the cAMP signaling pathway* J. Biol. Chem., **275**, 41447-41457

### 27-3. Gall bladder

Cong, P., Pricolo, V., Biancani, P. and Behar, J. (2010) *Effects of cholesterol on CCK-1 receptors and caveolin-3 proteins recycling in human gallbladder muscle* Am. J. Physiol. Gastrointest. Liver Physiol., **299**, G742–G750

Xiao, Z., Schmitz, F., Pricolo, V.E., Biancani, P., et al (2007) *Role of caveolae in the pathogenesis of cholesterol-induced gall bladder muscle hypomotility* Am. J. Physiol. Gastrointest. Liver Physiol., **292**, G1641–G1649

### 27-4. MF-2 cells

De Weerd, W.F.C. and Leeb-Lundberg, L.M.F. (1997) *Bradykinin sequesters  $B_2$  bradykinin receptors and the receptor-coupled  $G\alpha$  subunits  $G\alpha_q$  and  $G\alpha_i$  in caveolae in  $DDT_1$  MF-2 smooth muscle cells* J. Biol. Chem., **272**, 17858-17866

### 27-5. Vascular (primarily pulmonary artery)

#### Angiotensin receptors

Zuo, L., Ushio-Fukai, M., Hilenski, L.L. and Alexander, R.W. (2004) *Microtubules regulate angiotensin II type 1 receptor and Rac1 localization in caveolae/lipid rafts* Arterioscler. Thromb. Vasc. Biol., **24**, 1223-1228

Zuo, L., Ushio-Fukai, M., Ikeda, S., Hilenski, L., et al (2005) *Caveolin-1 is essential for activation of Rac1 and NAD(P)H oxidase after angiotensin II type 1 receptor stimulation in vascular smooth muscle cells* Arterioscler. Thromb. Vasc. Biol., **25**, 1824-1830

### 27-6. Growth factor receptors

Ashino, T., Sudhakar, V., Urao, N., Oshikawa, J., et al (2010) *Unexpected role of the copper transporter ATP7A in PDGF-induced vascular smooth muscle cell migration* Circ. Res., **107**, 787-799

Bousserouel, S., Raymondjean, M., Brouillet, A., Bereziat, G., et al (2004) *Modulation of cyclin D1 and early growth response factor-1 gene expression in interleukin-1 $\beta$ -treated rat smooth muscle cells by n-6 and n-3 polyunsaturated fatty acids* Eur. J. Biochem., **271**, 4462-4473

### 27-7. Lipoprotein receptor

Von Arnim, C.A.F., Kinoshita, A., Peltan, I.D., Tangredi, M.M., et al (2005) *The low density lipoprotein receptor-related protein (LRP) is a novel  $\beta$ -secretase (BACE1) substrate* J. Biol. Chem., **280**, 17777-17785

### Na<sup>+</sup>/K<sup>+</sup>-ATPase and Ca<sup>2+</sup> regulation

Ghosh, B., Kar, P., Mandal, A., Dey, K., et al (2009) *Ca<sup>2+</sup> influx mechanisms in caveolae vesicles of pulmonary smooth muscle plasma membrane under inhibition of  $\alpha 2\beta 1$  isozyme of Na<sup>+</sup>/K<sup>+</sup>-ATPase by ouabain* Life Sci., **84**, 39–148

Ghosh, B., Chakraborti, T., Kar, P., Dey, K., et al (2009) *Solubilization, purification, and reconstitution of  $\alpha 2\beta 1$  isozyme of Na<sup>+</sup>/K<sup>+</sup>-ATPase from caveolae of pulmonary smooth muscle plasma membrane: comparative studies with DHPC, C12E8, and Triton X-100* Mol. Cell. Biochem., **323**, 169–184

Shaikh, S., Samanta, K., Kar, P., Roy, S., et al (2010) *m-Calpain-mediated cleavage of Na<sup>+</sup>/Ca<sup>2+</sup> exchanger-1 in caveolae vesicles isolated from pulmonary artery smooth muscle* Mol. Cell. Biochem., **341**, 167–180

### 27-8. Signaling pathways (signalosomes)

Gabrielová, E., Bartošíková, L., Nečas, J. and Modrianský, M. (2019) *Cardioprotective effect of 2,3-dehydrosilybin preconditioning in isolated rat heart* Fitoterapia **132**, (2019) 12–21

Hilenski, L.L., Clempus, R.E., Quinn, M.T., Lambeth, J.D. and Griendling, K.K. (2004) *Distinct subcellular localizations of Nox1 and Nox4 in vascular smooth muscle cells* Arterioscler. Thromb. Vasc. Biol., **24**, 1-8

### 27-9. Tissue factors

Fortin, J-P., Rivard, G.E., Adam, A. and Marceau, F. (2005) *Studies on rabbit natural and recombinant tissue factors: intracellular retention and regulation of surface expression in cultured cells* Am. J. Physiol., **288**, H2192-H2202

### 27-10. Uterine

Kiss, A.L., Turi, A., Mullner, N., Kovacs, E., et al (2005) *Oestrogen-mediated tyrosine phosphorylation of caveolin-1 and its effect on the oestrogen receptor localization: an in vivo study* Mol. Cell. Endocrinol., **245**, 128-137

### 28. Thyroid

Lin, C-I., Barletta, J.A., Nehs, M.A., Morris, Z.S., et al (2011) *Thyroid-specific knockout of the tumor suppressor mitogen-inducible gene 6 activates epidermal growth factor receptor signaling pathways and suppresses nuclear factor- $\kappa$ B activity* Surgery, **150**, 1295-302

### 29. Trypanosomes

Sharma, A.I., Olson, C.L., Mamede, J.I., Gazos-Lopes, F., Epting, C.L., Almeida, I.C. and Engman, D.M. (2017) *Sterol targeting drugs reveal life cycle stage-specific differences in trypanosome lipid rafts* Sci. Rep., **7**: 9105

### 30. Review articles

Balbis, A. and Posner, B.I. (2010) *Compartmentalization of EGFR in cellular membranes: role of membrane rafts* J. Cell. Biochem., **109**, 1103–1108

Brown, D.A. and London, E. (1998) *Functions of lipid rafts in biological membranes* Annu. Rev. Cell Dev. Biol., **14**, 111-136

Casem, M.L. (2016) *Cytoskeleton and intracellular motility* In “Case studies in cell biology” Elsevier Inc, pp 127-156

Gimpl, G. and Gehrig-Burger, K. (2012) *Specific and non specific regulation of GPCR function by cholesterol* In Regulation of ion channels and receptors (Ed. Levitan, I. and Barrantes, F.J.) John Wiley & Sons, Inc., pp 205-230

Head, B.P., Patel, H.H. and Insel, P.A. (2014) *Interaction of membrane/lipid rafts with the cytoskeleton: Impact on signaling and function. Membrane/lipid rafts, mediators of cytoskeletal arrangement and cell signaling* Biochim. Biophys. Acta, **1838**, 532–545

Kim, W., Chapkin, R.S., Barhoumi, R. and Ma, D.W.L. (2009) *A novel role for nutrition in the alteration of functional microdomains on the cell surface* In Methods Mol. Biol., **579**, Lipidomics (ed. Armstrong, D) Humana Press, Totowa, NJ, pp 261-270

Landry, A. and Xavier, R. (2006) *Isolation and analysis of lipid rafts in cell-cell interactions* Methods Mol. Biol., **341**, 251-282

Lasley, R.D. (2011) *Adenosine receptors and membrane microdomains* Biochim. Biophys. Acta, **1808**, 1284–1289

Matveev, S., Li, X., Everson, W. and Smart, E.J. (2001) *The role of caveolae and caveolin in vesicle-dependent and vesicle-independent trafficking* Adv. Drug. Deliver. Rev., **49**, 237-240

- Mingpeng, S.** and Zongli, W. (1999) *The protective role of high-density lipoproteins in atherosclerosis* Exp. Gerontol., **34**, 539-548
- Minogue, S.** and Waugh, M.G. (2012) *Lipid rafts, microdomain heterogeneity and inter-organelle contacts: Impacts on membrane preparation for proteomic studies* Biol. Cell, **104**, 618-627
- Pilch, P.F.**, Souto, R.P., Liu, L., Jedrycjowski, M.P., et al (2007) *Cellular spelunking: exploring adipocyte caveolae* J. Lipid Res., **48**, 2103-2111
- Shaul, P.W.** and Anderson, R.G.W. (1998) *Role of plasmalemmal caveolae in signal transduction* Am. J. Physiol., **275**, 843-851
- Stillwell, W.** (2016) *Membrane isolation methods* In "An Introduction to Biological Membranes" Elsevier Inc, pp 247-271
- Svoboda, P.** and Novotny, J. (2002) *Hormone-induced subcellular redistribution of trimeric G proteins* Cell. Mol. Life Sci., **59**, 501-512
- Thomas, C.M.** and Smart, E.J. (2008) *Caveolae structure and function* J. Cell Mol. Med., **12**, 796-809

**OptiPrep™ Reference List RS08; 7<sup>th</sup> edition, January 2020**