OptiPrep™ Reference List RC08

Hepatic non-parenchymal cells: Kupffer cells, sinusoidal endothelial cells (and other liver cell types)

- **This Reference List** provides a complete list of publications that report the use of OptiPrep™ for the purification of hepatic non-parenchymal cells (NPC) **other than stellate cells**.
- The only NPCs that can be isolated at sufficiently high purity, using solely density gradient centrifugation, are **stellate cells** (see **Application Sheet C27 and Reference List RC07**).
- Very often a total NPC fraction is prepared using an iodixanol barrier or discontinuous gradient (see **Application Sheet C26**) and the NPCs analyzed by flow cytometry alone. Kupffer cells and sinusodial endothelial cells may be analyzed in this manner.
- **Kupffer or sinusoidal endothelial cells** may also be resolved using a secondary technique involving (1) the use of an antibody (usually bound to magnetic beads), (2) elutriation or (3) selective adherence of Kupffer cells cells to a collagen-coated plastic substratum.
- **Kupffer cells** have also been isolated using only an iodixanol density gradient (**see Section 4 and Application Sheet C28**).
- Epithelial cells, leukocytes, macrophages, NK cells and oval (progenitor) cells are also listed
- **RC09** provides a reference list of all **stellate cell** papers

Important notes

- To avoid excessive duplication, references on both **endothelial** and **Kupffer cells** are listed under **Non-parenchymal cells** (Section 7) and are divided alphabetically according to **Research Topic**.
- **Langerhans cells** are included in **Reference List RC05**

1. Dendritic and leukocytic cells

Connolly, M.K., Ayo, D., Malhotra, A., Hackman, M., Bedrosian, A.S., Ibrahim, J., Cieza-Rubio, N.E., Nguyen, A.H., Henning, J.R., et al (2011) *Dendritic cell depletion exacerbates acetaminophen hepatotoxicity* Hepatology, **54**, 959-968

Cremer, I., Dieu-Nosjean, M-C., Maréchal, S., Dezutter-Dambuyant, C., Goddard, S., Adams, D., Winter, N., Menetrier-Caux, C., Sautès-Fridman, C., Fridman, W.H. and Mueller, C.G. (2002) *Long-lived immature dendritic cells mediated by TRANCE-RANK interaction* Blood, **100**, 3646-3655

Eksteen, B., Mora, J.R., Haughton, E.L., Henderson, N.C., Lee–Turner, L., Villablanca E.J., Curbishley, S.M., Aspinall, A.I., Von Andrian, U.H. and Adams, D.H. (2009) *Gut homing receptors on CD8 T cells are retinoic acid dependent and not maintained by liver dendritic or stellate cells* Gastroenterology, **137**, 320–329

Goddard, S., Youster, J., Morgan, E. and Adams, D.H. (2004) *Interleukin-10 secretion differentiates dendritic cells from human liver and skin* Am. J. Pathol., **164**, 511-519

Henning, J.R., Graffeo, C.S., Rehman, A., Fallon, N.C., Zambirinis, C.P., Ochi, A., Barilla, R., Jamal, M., Deutsch, M., et al (2013) *Dendritic cells limit fibroinflammatory injury in nonalcoholic steatohepatitis in mice* Hepatology, **58**, 589-602

Kim, J-W., Roh, Y-S., Jeong, H., Yi, H-K., Lee, M-H., Lim, C-W. and Kim, B. (2018) *Spliceosome-associated protein 130 exacerbates alcohol-induced liver injury by iducing NLRP3 inflammasome-mediated IL-1b in mice* Am. J. Pathol., **188**, 967-980

Kingham, T.P., Chaudhry, U.I., Plitas, G., Katz, S.C., Raab, J. and DeMatteo, R.P. (2007) *Murine liver plasmacytoid dendritic cells become potent immunostimulatory cells after Flt-3 ligand expansion* Hepatology, **45**, 445-454

Lalor, P.F., Curbishley, S.M. and Adams, D.H. (2010) *Identifying homing interactions in T-cell traffic in human disease* In, T-Cell Trafficking (eds. Marelli-Berg, F.M. and Nourshargh, S.), Methods Mol. Biol., **616**, Springer Science+Business Media, pp. 231-252

Oo, Y.H., Weston, C.J., Lalor, P.F., Curbishley, S.M., Withers, D.R., Reynolds, G.M., Shetty, S., Harki, J., Shaw, J.C. et al (2010) *Distinct roles for CCR4 and CXCR3 in the recruitment and positioning of regulatory T cells in the inflamed human liver* J. Immunol., **184**, 2886–2898

Plitas, G., Burt, B.M., Stableford, J.A., Nguyen, H.M., Welles, A.P. and DeMatteo, R.P. (2008) *Dendritic cells are required for effective cross-presentation in the murine liver* Hepatology, **47**, 1343-1351
Rehman, A., Hemmert, K.C., Ochi, A., Jamal, M., Henning, J.R., Barilla, R., Quesada, J.P., Zambirinis, C.P., Tang, K. et al (2013) *Role of fatty-acid synthesis in dendritic cell generation and function* J. Immunol., **190**, 4640–4649
Ueta, H., Shi, C., Miyanari, N., Xu, X-D., Zhou, S., Yamashita, M., Ezaki, T. and Matsuno, K. (2008) *Systemic transmigration of allosensitizing donor dendritic cells to host secondary lymphoid organs after rat liver transplantation* Hepatology, **47**, 1352-1362
Wiegard, C., Wolint, P., Frenzel, C., Cheruti, U., Schmitt, E., Oxenius, A., Lohse, A.W. and Herkel, J. (2007) *Defective T helper response of hepatocyte-stimulated CD4 T cells impairs antiviral CD8 response and viral clearance* Gastroenterology **133**, 2010-2018

2. Epithelial cells

Gerbal-Chaloin, S., Duret, C., Raulet, E., Navarro, F., Blanc, P., Ramos, J., Maurel, P. and Daujat-Chavanieu, M. (2010) *Isolation and culture of adult human liver progenitor cells: in vitro differentiation to hepatocyte-like cells* In, Hepatocytes, (ed. Maurel, P. ed.) Methods Mol. Biol., **640**, Springer Science+Business Media, pp.247-260

3. Hepatocytes

Pepe-Mooney, B.J., Dill, M.T., Alemany, A., Ordovas-Montanes, J., Matsushita, Y., Rao, A., Sen, A., Miyazaki, M., Anakk, S. (2019) *Single-cell analysis of the liver epithelium reveals dynamic heterogeneity and an essential role for YAP in homeostasis and regeneration* Cell Stem Cell, 25, 23–38
Seong, H-A., Manoharan, R. and Ha, H. (2017) *Zinc finger protein ZPR9 functions as an activator of AMPK-related serine/threonine kinase MPK38/MELK involved in ASK1/TGF-β/p53 signaling pathways* Sci. Rep., **7**: 42502

4. Kupffer cells

Mukhopadhyay, P., Horváth, B., Rajesh, M., Varga, .V., Gariani, K., Ryu, D., Cao, Z., E. Holovac et al (2017) *PARP inhibition protects against alcoholic andnon-alcoholic steatohepatitis* J. Hepatol., **66**, 589–600

5. Leukocytes

Kuniyasu, Y., Qamar, A., Sheikh, S.Z., Jhandier, M.N., Hakim, W. and Mehal, W.Z. (2005) *Blocking intrahepatic deletion of activated $CD8^+$ T cells by an altered peptide ligand* Cell. Immunol., **238**, 31-37

6. Macrophages

Docan Dragomir, A-C., Sun, R., Choi, H., Laskin, J.D. and Laskin, D.L. (2012) *Role of galectin-3 in classical and alternative macrophage activation in the liver following acetaminophen intoxication* J. Immunol., **189**, 5934–5941
Eguchi, A., Lazaro, R.G., Wang, J., Kim, J., Povero, D., Willliams, B., Ho, S.B., Stearkel, P., Schnabl, B. et al (2017) *Extracellular vesicles released by hepatocytes from gastric infusion model of alcoholic liver disease contain a microRNA barcode that can be detected in blood* Hepatology, **65**, 475-490
Samaniego, S. and Marcu, K.B. (2013) *IKKβ in myeloid cells controls the host response to lethal and sublethal Francisella tularensis LVS infection* PloS One, **8**: e54124

7. Non-parenchymal cells

Acetaminophen hepatotoxin

Hoque, R., Sohail, M.A., Salhanick, S., Malik, A.F., Ghani, A., Robson, S.C. and Mehal, W.Z (2012) *P2x7 receptor-mediated purinergic signaling promotes liver injury in acetaminophen hepatotoxicity in mice* Am. J. Physiol. Gastrointest. Liver Physiol., **302**, G1171–G1179

Acute liver injury

Chan, C-C., Cheng, L-Y., Lu, J., Huang, Y-H., Chiou, S-H., Tsai, P-H., Huo, T-I., Lin, H-C., Lee, F-Y. (2012) *The role of interferon-c inducible protein-10 in a mouse model of acute liver injury post induced pluripotent stem cells transplantation* PLoS One, **7**: e50577
Deutsch, M., Graffeo, C.S., Rokosh, R., Pansari, M., Ochi, A., Levie, E.M., Van Heerden, E., *Tippens, D.M. et al. (2015) Divergent effects of RIP1 or RIP3 blockade in murine models of acute liver injury* Cell Death Dis., **6**: e1759

Schwinge, D., Carambia, A., Quaas, A., Krech, T., Wegscheid, C., Tiegs, G., Prinz, I., Lohse, A.W., Herkel, J. and Schramm, C. (2015) *Testosterone suppresses hepatic inflammation by the downregulation of IL-17, CXCL-9, and CXCL-10 in a mouse model of experimental acute cholangitis* J. Immunol., **194**, 2522–2530

Adipose tissue lipolysis

Ma, W., Zhao, D., He, F. and Tang, L. (2019) *The role of Kupffer cells as mediators of adipose tissue lipolysis* J. Immunol., **203**, 2689–2700

Alcoholic injury

Banerjee, A., Abdelmegeed, M.A., Jang, S. and Song, B-J. (2015) *Increased sensitivity to binge alcohol-induced gut leakiness and inflammatory liver disease in HIV transgenic rats* PLoS One, **10**: e0140498
Byun, J-S., Suh, Y-G., Yi, H-S., Lee, Y-S. and Jeong, W-I. (2013) *Activation of toll-like receptor 3 attenuates alcoholic liver injury by stimulating Kupffer cells and stellate cells to produce interleukin-10 in mice* J, Hepatol., **58**, 342–349
Choi, W-M., Kim, H-H., Kim, M-H., Cinar, R., Yi, H-S., Eun, H.S., Kim, S-H., Choi, Y.J., Lee, Y-S et al (2019) *Glutamate signaling in hepatic stellate cells drives alcoholic steatosis* Cell Metab., **30**, 877–889
Chung, H.K., Kim, J.T., Kim, H-W., Kwon, M., Kim, S.Y., Shong, M., Kim, K.S. and Yi, H-S. (2017) *GDF15 deficiency exacerbates chronic alcohol- and carbon tetrachloride-induced liver injury* Sci. Rep. **7**: 17238
Hu, S., Yin, S., Jiang, X., Huang, D. and Shen, G. (2009) *Melatonin protects against alcoholic liver injury by attenuating oxidative stress, inflammatory response, and apoptosis* Eur. J. Pharmacol., **616**, 287–292
Hu, S., Shen, G., Zhao, W., Wang, F., Jiang, X. and Huang, D. (2010) *Paeonol, the main active principles of Paeonia moutan, ameliorates alcoholic steatohepatitis in mice* J. Ethnopharmacol., **128**, 100–106
Lv, X., Chen, Z., Li, J., Zhang, L., Liu, H., Huang, C. and Zhu, P. (2010) *Caffeine protects against alcoholic liver injury by attenuating inflammatory response and oxidative stress* Inflamm. Res., **59**, 635–645
Wu, X-q., Yang, y., Li, W-x., Cheng, Y-h., Li, X-f., Huang, C., Meng, X-m. et al (2016) *Telomerase reverse transcriptase acts in a feedback loop with NF-κB pathway to regulate macrophage polarization in alcoholic liver disease* Sci. Rep., **6**: 18685

Antisense oligonucleotides

Prakash, T.P.,. Graham, M.J., Yu, J., Carty, R., Low, A., Chappell, A., Schmidt, K., Zhao, C., Aghajan, M., Murray, H.F., et al (2013) *Targeted delivery of antisense oligonucleotides to hepatocytes using triantennary N-acetylgalactosamine improves potency 10-fold in mice* Nucleic Acids Res., **42**, 8796–8807

Autophagy

Cassidy, L.D., Young, A.R.J., Pérez-Mancera, P.A., Nimmervoll, B., Jaulim, A., Chen, H-C., McIntyre, D.J.O., Brais, R., Ricketts, T. et al (2018) *A novel Atg5-shRNA mouse model enables temporal control of autophagy in vivo* Autophagy, **14**, 1256-1266

Bone loss

Schmidt, T., Schwinge, D., Rolvien, T., Jeschke, A., Schmidt, C., Neven, M., Butscheidt, S., Kriz, M., Kunzmann, L. et al (2019) *Th17 cell frequency is associated with low bone mass in primary sclerosing cholangitis* J. Hepatol., **70**, 941–953

Cannabinoid CB2 receptor

Horváth, B., Magid, L., Mukhopadhyay, P., Bátkai, S., Rajesh, M., Park, O., Tanchian, G., Gao, R.Y., Goodfellow, C.E., Glass, M., Mechoulam, R. and Pacher, P. (2012) *A new cannabinoid CB2 receptor agonist HU-910 attenuates oxidative stress, inflammation and cell death associated with hepatic ischaemia/reperfusion injury* Br. J. Pharmacol., **165**, 2462-2478

Cell adhesion to sinuosoidal cells

Yang, H., Tong, C., Fu, C., Xu, Y., Liu, X., Chen, Q., Zhang, Y., Lü, S., Li, N. and Long, M. (2016) *Analyses of movement and contact of two nucleated cells using a gas-driven micropipette aspiration technique* J. Immunol. Meth., **428**, 20–29

Chemokine production

Valatas, V., Kolios, G., Manousou, P., Notas, G., Xidakis, C., Diamantis, I. and Kouroumalis, E. (2004) *Octreotide regulates CC but not CXC LPS-induced chemokine secretion in rat Kupffer cells* Br. J. Pharm., **141**, 477-487

Xidakis, C., Ljumovic, D., Manousou, P., Notas, G., Valatas, V., Kolios, G., and Kouroumalis, E. (2005) *Production of pro- and anti-fibrotic agents by rat kupffer cells; the effect of octreotide* Digest. Dis. Sci., **50**, 935-941

Dietary fructose

Ferrere, G., Leroux, A., Wrzosek, L., Puchois, V., Gaudin, F., Ciocan, D., Renoud, M-L., Naveauet, S. et al (2016) *Activation of Kupffer cells is associated with a specific dysbiosis induced by fructose or high fat diet in mice* PLoS One, **11**: e0146177

Differentiation

Xie, G., Wang, X., Wang, L., Wang, L., Atkinson, R.D., Kanel, G.C., Gaarde, W.A. and Deleve, L.D. (2012) *Role of differentiation of liver sinusoidal endothelial cells in progression and regression of hepatic fibrosis in rats* Gastroenterology, **142**, 918–927

Drug toxicity

Xie, G., Wang, L., Wang, X., Wang, L. and DeLeve, L.D (2010) *Isolation of periportal, midlobular, and centrilobular rat liver sinusoidal endothelial cells enables study of zonated drug toxicity* Am. J. Physiol. Gastrointest. Liver Physiol., **299**, G1204–G1210

Endocytosis

Kim, S.Y., Jeong, J-M., Kim, S.J., Seo, W., Kim, M-H., Choi, W-M., Yoo, W., Lee, J-H. et al (2017) *Pro-inflammatory hepatic macrophages generate ROS through NADPH oxidase 2 via endocytosis of monomeric TLR4–MD2 complex* Nat. Comm., **8**: 2247

Lao, Y., Li, Y., Hou, Y., Chen, H., Qiu, B., Lin, W. et al (2017) *Proteomic analysis reveals Dab2 mediated receptor endocytosis promotes liver sinusoidal endothelial cell dedifferentiation* Sci. Rep., **7**: 13456

Exosomes

Tamura, R., Uemoto, S. and Tabata, Y. (2017) *Augmented liver targeting of exosomes by surface modification with cationized pullulan* Acta Biomaterialia, **57**, 274–284

Factor VIII Fc fusion protein

Van der Flier, A., Liu, Z., Tan, S., Chen, K., Drager, D., Liu, T., Patarroyo-White, S., Jiang, H. and Light, D.R. (2015) *FcRn rescues recombinant factor VIII Fc fusion protein from a VWF independent FVIII clearance pathway in mouse hepatocytes* PLoS One, **10**: e0124930

Fatty acids

Etienne-Mesmin, L., Vijay-Kumar, M., Gewirtz, A.T. and Chassaing, B. (2016) *Hepatocyte toll-like receptor 5 promotes bacterial clearance and protects mice against high-fat diet–induced liver disease* Cell. Mol. Gastroenterol. Hepatol., **2**, 584–604

McGettigan, B.M., McMahan, R.H., Luo, Y., Wang, X.X., Orlicky, D.J., Porsche, C. Levi, M. and Rosen, H.R. (2016) *Sevelamer improves steatohepatitis, inhibits liver and intestinal farnesoid X receptor (FXR), and reverses innate immune dysregulation in a mouse model of non-alcoholic fatty liver disease* J. Biol. Chem., **291**, 23058–23067

McMahan, R.H., Porsche, C.E., Edwards, M.G. and Rosen, H.R. (2016) *Free fatty acids differentially downregulate chemokines in liver sinusoidal endothelial cells: insights into non-alcoholic fatty liver disease* PLoS One, **11**: e0159217

Mouralidarane, A., Soeda, J., Visconti-Pugmire, C., Samuelsson, A-M., Pombo, J., Maragkoudaki, X., Butt, A., Saraswati, R., et al (2013) *Maternal obesity programs offspring nonalcoholic fatty liver disease by innate immune dysfunction in mice* Hepatology, **58**, 128-138

Fibrosis

Cong, M., Liu, T., Wang, P., Fan, X., Yang, A., Bai, Y., Peng, Z., Wu, P., Tong, X., Chen, J., Li, H., Cong, R., Tang, S., Wang, B., Jia, J. and You, H. (2013) *Antifibrotic effects of a recombinant adeno-associated virus carrying small interfering RNA targeting TIMP-1 in rat liver fibrosis* Am. J. Pathol., **182**, 1607-1616

Duan, J-L., Ruan, B., Yan, C-C., Liang, L., Song, P., Yang, Z-Y., Liu, Y., Dou, K-F., Han, H. and Wang, L. (2018) *Endothelial notch activation reshapes the angiocrine of sinusoidal endothelia to aggravate liver fibrosis and blunt regeneration in mice* Hapatology, **68**, 667-690

Hyun, J., Wang, S., Kim, J., Rao, K.M., Park, S.Y., 2, Chung, I., Ha, C-S., Kim, S-W., Yun, Y.H. and Jung, Y. (2016) *MicroRNA-378 limits activation of hepatic stellate cells and liver fibrosis by suppressing Gli3 expression* Nat. Comm., **7**: 10993

Lao, Y., Li, Y., Zhang, P., Shao, Q., Lin, W., Qiu, B., Lv, Y., Tang, L., Su, S et al (2018) *Targeting endothelial Erk1/2-Akt axis as a regeneration strategy to bypass fibrosis during chronic liver injury in mice* Mol. Ther., **26**, 2779-2797
Li, P., Li, Y., Zhu, L., Yang, Z., He, J., Wang, L., Shang, Q., Pan, H., Wang, H., Ma, X. et al (2018) *Targeting secreted cytokine BMP9 gates the attenuation of hepatic fibrosis* BBA – Mol. Basis Dis., **1864**, 709–720
Luo, X., Zhang, D., Xie, J., Su, Q., He, X., Bai, R., Gao, G. and Pan, W. (2018) *MicroRNA-96 promotes schistosomiasis hepatic fibrosis in mice by suppressing Smad7* Mol. Ther. Meth. Clin. Devel., **11**, 73-82
Maretti-Mira, A.C., Wang, X., Wang, L. and DeLeve, L.D. (2019) *Incomplete differentiation of engrafted bone marrow endothelial progenitor cells imitiates hepatic fibrosis in the rat* Hepatology, **69**, 1259-1272
Mimche, P.N., Lee, C.M., Mimche, S.M., Thapa, M., Grakoui, A., Henkemeyer, M. and Lamb, T.J. (2018) *EphB2 receptor tyrosine kinase promotes hepatic fibrogenesis in mice via activation of hepatic stellate cells* Sci. Rep., **8**: 2532
Torres-Hernandez, A., Wang, W., Nikiforov, Y., Tejada, K., Torres, L., Kalabin, A., Wu, Y., Ul Haq, M.I., Khan, M.Y. et al (2019) *Targeting SYK signaling in myeloid cells protects against liver fibrosis and hepatocarcinogenesis* Oncogene, **38**, 4512–4526

Francisella tularensis LVS infection

Samaniego, S. and Marcu, K.B. (2013) *IKKβ in myeloid cells controls the host response to lethal and sublethal Francisella tularensis LVS infection* PloS One, **8**: e54124

Hedgehog ligands

Hyun, J., Wang, S., Kim, J., Rao, K.M., Park, S.Y., 2, Chung, I., Ha, C-S., Kim, S-W., Yun, Y.H. and Jung, Y. (2016) *MicroRNA-378 limits activation of hepatic stellate cells and liver fibrosis by suppressing Gli3 expression* Nat. Comm., **7**: 10993
Pereira, T.A., Xie, G., Choi, S.S., Syn, W-K., Voieta I., Lu, J., Chan, I.S., Swiderska, M., Amaral, K.B., Antunes, C.M., et al (2013) *Macrophage-derived hedgehog ligands promotes fibrogenic and angiogenic responses in human schistosomiasis mansoni* Liver Int., **33**, 149-161
Xie, G., Choi, S.S., Syn, W-K., Michelotti, G.A., Swiderska, M., Karaca, G., Chan, I.S., Chen, Y. and Diehl, A.M. (2013) *Hedgehog signalling regulates liver sinusoidal endothelial cell capillarisation* Gut, **62**, 299–309

Hepatitis

Faure-Dupuy, S., Delphin, M., Aillot, L., Dimier, L., Lebosse, F., Fresquet, J., Parent, R., Matter, M.S. et al (2019) *Hepatitis B virus-induced modulation of liver macrophage function promotyes hepatocyte infection* J. Hepatol., **71**, 1086-1098
Greco, S.H., Torres-Hernandez, A., Kalabin, A., Whiteman, C., Rokosh, R., Ravirala, S., Ochi, A., Gutierrez, J., Salyana, M.A., Mani, V.R. et al (2016) *Mincle signaling promotes Con A hepatitis* J. Immunol., **197**, 2816-2827
Kozik, J-H., Trautmann, T., Carambia, A., Preti, M., Lütgehetmann, M., Krech, T., Wiegard, C., Heeren, J. and Herkel, J. (2016) *Attenuated viral hepatitis in Trem1$^{-/-}$ mice is associated with reduced inflammatory activity of neutrophils* Sci. Rep., **6**: 28556
Pourhoseini, S., Seth, R.K., Das, S., Dattaroy, D., Kadiiska, M.B., Xie, G., Michelotti, G.A. et al (2015) *Upregulation of miR21 and repression of Grhl3 by leptin mediates sinusoidal endothelial injury in experimental nonalcoholic steatohepatitis* PLoS One, **10**: e0116780

Hepatocarcinogenesis

Torres-Hernandez, A., Wang, W., Nikiforov, Y., Tejada, K., Torres, L., Kalabin, A., Wu, Y., Ul Haq, M.I., Khan, M.Y. et al (2019) *Targeting SYK signaling in myeloid cells protects against liver fibrosis and hepatocarcinogenesis* Oncogene, **38**, 4512–4526

Hepato-pulmonary syndrome

Chen, L., Han, Y., Li, Y., Chen, B., Bai, X., Belguise, K., Wang, X., Chen, Y., Yi, B. and Lu, K. (2019) *Hepatocyte-derived exosomal MiR-194 activates PMVECs and promotes angiogenesis in hepato-pulmonary syndrome* Cell Death Dis., **10**: 853

Hepatotoxicity

Rose, K.A., Holman, N.S., Green, A.M., Andersen, M.E. and LeCluyse, E.L. (2016) *Co-culture of hepatocytes and Kupffer cells as an in vitro model of inflammation and drug-induced hepatotoxicity* J, Pharmaceut. Sci., **105**, 950-964

High-density lipoprotein uptake

Brundert, M., Heeren, J., Merkel, M., Carambia, A., Herkel, J., Groitl, P., Dobner, T., Ramakrishnan, R., Moore, K.J. and Rinninger, F. (2011) *Scavenger receptor CD36 mediates uptake of high density lipoproteins in mice and by cultured cells* J. Lipid Res., **52**, 745–758

Immunity/Immune responses

Carambia, A., Freund, B., Schwinge, D., Heine, M., Laschtowitz, A., Huber, S., Wraith, D.C., Korn, T., Schramm, C., Lohse, A.W., Heeren, J. and Herkel, J. (2014) *TGF-β-dependent induction of $CD4^+CD25^+Foxp3^+$ Tregs by liver sinusoidal endothelial cells* J. Hepatol., **61**, 594–599

Connolly, M.K., Bedrosian, A.S., Malhotra, A., Henning, J.R., Ibrahim, J., Vera, V., Cieza-Rubio, N.E., Hassan, B.U., Pachter, H.L., Cohen, S., Frey, A.B. and Miller, G. (2010) *In hepatic fibrosis, liver sinusoidal endothelial cells acquire enhanced immunogenicity* J. Immunol., **185**, 2200–2208

Hösel, M., Broxtermann, M., Janicki, H., Esser, K., Arzberger, S., Hartmann, P., Gillen, S., Kleeff, J., Stabenow, D. et al (2012) *Toll-like receptor 2–mediated innate immune response in human nonparenchymal liver cells toward adeno-associated viral vectors* Hepatology **55**, 287-297

Murthy, A., Shao, Y.W., Defamie, V., Wedeles, C., Smookler, D. and Khokha, R. (2012) *Stromal TIMP3 regulates liver lymphocyte populations and provides protection against Th1 T cell-driven autoimmune hepatitis* J. Immunol., **188**, 2876–2883

Park, J.K., Cho, K., Johnson, J. and Perez, R.V. (2004) *Induction of MIP-1α in Kupffer cell by portal venous transfusion* Transplant Immunol., **13**, 33-38

Zhu, J., Huang, X. and Yang, Y. (2007) *Innate immune response to adenoviral vectors is mediated by both toll-like receptor-dependent and -independent pathways* J. Virol., **81**, 3170-3180

Inflammasomes/Inflammatory responses

Banerjee, A., Abdelmegeed, M.A., Jang, S. and Song, B-J. (2015) *Increased sensitivity to binge alcohol-induced gut leakiness and inflammatory liver disease in HIV transgenic rats* PLoS One, **10**: e0140498

Baranova, I.N., Bocharov, A.V., Vishnyakova, T.G., Kurlander, R., Chen, Z., Fu, D., Arias, I.M., Csako, G., Patterson, A.P. and Eggerman, T.L. (2010) *CD36 is a novel serum amyloid A (SAA) receptor mediating SAA binding and SAA-induced signaling in human and rodent cells* J. Biol. Chem., **285**, 8492–8506

Charalampopoulos, I., Androulidaki, A., Minas, V., Chatzaki, E., Tsatsanis, C., Nota, G., Xidakis, C., Kolios, G., Kouroumalis, E., Margioris, A.N. and Gravanis, A. (2006) *Neuropeptide urocortin and its receptors are expressed in rat Kupffer cells* Neuroendocrinology, **84**, 49-57

Farooq, A., Hoque, R., Ouyang, X., Farooq, A., Ghani, A., Ahsan, K., Guerra, M. and Mehal, W.Z. (2014) *Activation of N-methyl-D-aspartate receptor downregulates inflammasome activity and liver inflammation via a β-arrestin-2 pathway* Am. J. Physiol. Gastrointest. Liver Physiol., **307**. G732–G740

Fiorotto, R., Scirpo, R., Trauner, M., Fabris, L., Hoque, R., Spirli, C. and Strazzabosco, M. (2011) *Loss of CFTR affects biliary epithelium innate immunity and causes TLR4–NF-κB—mediated inflammatory response in mice* Gastroenterology, **141**, 1498–1508

Guthrie, G., Tackett, B., Stoll, B., Martin, C., Olutoye, O. and Burrin, D. (2018) *Phytosterols synergize with endotoxin to augment inflammation in Kupffer cells but alone have limited direct effect on hepatocytes* J. Parent. Enter. Nutr., **42**, 37-48

Hoque, R., Farooq, A., Ghani, A., Gorelick, F. and Mehal, W.Z. (2014) *Lactate reduces liver and pancreatic injury in Toll-like receptor-and inflammasome-mediated inflammation via GPR81-mediated suppression of innate immunity* Gastroenterology, **146**, 1763–1774

Hu, S., Yin, S., Jiang, X., Huang, D. and Shen, G. (2009) *Melatonin protects against alcoholic liver injury by attenuating oxidative stress, inflammatory response, and apoptosis* Eur. J. Pharmacol., **616**, 287–292

Hu, S., Shen, G., Zhao, W., Wang, F., Jiang, X. and Huang, D. (2010) *Paeonol, the main active principles of Paeonia moutan, ameliorates alcoholic steatohepatitis in mice* J. Ethnopharmacol., **128**, 100–106

Huang, H., Chen, H-W., Evankovich, J., Yan, W., Rosborough, B.R., Nace, G.W., Ding, Q., Loughran, P., Beer-Stolz, D., Billiar, T.R., Esmon, C.T. and Tsung, A. (2013) *Histones activate the NLRP3 inflammasome in Kupffer cells during sterile inflammatory liver injury* J. Immunol., **191**, 2665–2679

Kataoka, H., Kono, H., Patel, Z. and Rock, K.L. (2014) *Evaluation of the contribution of multiple DAMPs and DAMP receptors in cell death-induced sterile inflammatory responses* PLoS One 9(8): e104741

Kataoka, H., Yang, K., Rock, K.L. (2015) *The xanthine oxidase inhibitor Febuxostat reduces tissue uric acid content and inhibits injury-induced inflammation in the liver and lung* Eur. J. Pharmacol., **746**, 174–179

Licata, L.A., Nguyen, C.T., Burga, R.A., Falanga, V., Espat, N.J., Ayala,A., Thorn, M., Junghans, R.P. and Katz, S.C. (2013) *Biliary obstruction results in PD-1-dependent liver T cell dysfunction and acute inflammation mediated by Th17 cells and neutrophils* J. Leukoc. Biol., **94**, 813–823

Lv, X., Chen, Z., Li, J., Zhang, L., Liu, H., Huang, C. and Zhu, P. (2010) *Caffeine protects against alcoholic liver injury by attenuating inflammatory response and oxidative stress* Inflamm. Res., **59**, 635–645

McMahan, R.S., Riehle, K.J., Fausto, N. and Campbell, J.S. 2013) *A disintegrin and metalloproteinase 17 regulates TNF and TNFR1 levels in inflammation and liver regeneration in mice* Am. J. Physiol. Gastrointest. Liver Physiol., **305**, G25–G34
Mukhopadhyay, P., Rajesh, M., Horváth, B., Bátkai, S., Park, O., Tanchian, G., Gao, R.Y., Patel, V., Wink, D.A. et al (2011) *Cannabidiol protects against hepatic ischemia/reperfusion injury by attenuating inflammatory signaling and response, oxidative/nitrative stress, and cell death* Free Radic. Biol. Med., **50**, 1368–1381
Ouyang, X., Ghani, A., Malik, A., Wilder, T., Colegio, O.R., Flavell, R.A., Cronstein, N.N. and Mehal, W.Z. (2013) *Adenosine is required for sustained inflammasome activation via the A2A receptor and the HIF-1a pathway* Nat. Comm., **4**: 2909
Rose, K.A., Holman, N.S., Green, A.M., Andersen, M.E. and LeCluyse, E.L. (2016) *Co-culture of hepatocytes and Kupffer cells as an in vitro model of inflammation and drug-induced hepatotoxicity* J, Pharmaceut. Sci., **105**, 950-964
Shao, B., Lu, M., Katz, S.C., Varley, A.W., Hardwick, J., Rogers, T.E., Ojogun, N., Rockey, D.C., DeMatteo, R.P. and Munford, R.S. (2007) *A host lipase detoxifies bacterial lipopolysaccharides in the liver and spleen* J. Biol. Chem., **282**, 13726-13735
Schwinge, D., Carambia, A., Quaas, A., Krech, T., Wegscheid, C., Tiegs, G., Prinz, I., Lohse, A.W., Herkel, J. and Schramm, C. (2015) *Testosterone suppresses hepatic inflammation by the downregulation of IL-17, CXCL-9, and CXCL-10 in a mouse model of experimental acute cholangitis* J. Immunol., **194**, 2522–2530
Valatas, V., Kolios, G., Manousou, P., Xidakis, C., Notas, G., Ljumovic, D. and Kouroumalis, E.A. (2004) *Secretion of inflammatory mediators by isolated rat Kupffer cells; the effect of octreotide* Regul. Pept., **120**, 215-225
Wallace, K., Cowie, D.E., Konstantinou, D.K., Hill, S.J., Tjelle, T.E., Axon, A., Koruth, M., White, S.A., Carlsen, H., Mann, D.A. and Wright, M.C. (2010) *The PXR is a drug target for chronic inflammatory liver disease* J. Steroid Biochem. Mol, Biol., **120**, 137–148

Intercellular adhesion

Tong, C-F., Zhang, Y., Lü, S-Q., Li, N., Gong, Y-X., Yang, H., Feng, S-L., Du, Y., Huang D-D. and Long, M. (2018) *Binding of intercellular adhesion molecule 1 to β2-integrin regulates distinct cell adhesion processes on hepatic and cerebral endothelium* Am. J. Physiol. Cell. Physiol., **315**, C409–C421

Interleukins

Byun, J-S., Suh, Y-G., Yi, H-S., Lee, Y-S. and Jeong, W-I. (2013) *Activation of toll-like receptor 3 attenuates alcoholic liver injury by stimulating Kupffer cells and stellate cells to produce interleukin-10 in mice* J, Hepatol., **58**, 342–349
Rao, R., Graffeo, C.S., Gulati, R., Jamal, M., Narayan, S., Zambirinis, C.P., Barilla, R., Deutsch, M., Greco, S.H., Ochi, A., et al (2014) *Interleukin 17–producing gdT cells promote hepatic regeneration in mice* Gastroenterology, **147**, 473–484

In vitro model

Du, Y., Li, N. and Long, M. (2018) *Liver sinusoid on a chip* Meth. Cell Biol., **146**, 105-134

Iron metabolism

Rausa, M., Pagani, A., Nai, A., Campanella, A., Gilberti, M.E., Apostoli, P., Camaschella, C. and Silvestri, L. (2015) *Bmp6 expression in murine liver non parenchymal cells: a mechanism to control their high iron exporter activity and protect hepatocytes from iron overload?* PloS One, **10**: e0122696

Ischaemia

Ebrahimkhani, M.R., Daneshmand, A., Mazumder, A., Allocca, M., Calvo, J.A., Abolhassani, N. et al (2014) *Aag-initiated base excision repair promotes ischemia reperfusion injury in liver, brain, and kidney* Proc. Natl. Acad. Sci. USA, **111**, E4878–E4886
Horváth, B., Magid, L., Mukhopadhyay, P., Bátkai, S., Rajesh, M., Park, O., Tanchian, G., Gao, R.Y., Goodfellow, C.E., Glass, M., Mechoulam, R. and Pacher, P. (2012) *A new cannabinoid CB2 receptor agonist HU-910 attenuates oxidative stress, inflammation and cell death associated with hepatic ischaemia/reperfusion injury* Br. J. Pharmacol., **165**, 2462-2478
Ocuin, L.M., Zeng, S., Cavnar, M.J., Sorenson, E.C., Bamboat, Z.M., Greer, J.B., Kim, T.S., Popow, R. and DeMatteo, R.P. (2012) *Nilotinib protects the murine liver from ischemia/reperfusion injury* J. Hepatol., **57**, 766–773
Wang, J., Koh, H-W., Zhou, L., Bae, U-J., Lee, H-S., Bang, I.H., Ka, S-O., Oh, S-H., Bae, E.J. and Park, B-H. (2017) *Sirtuin 2 aggravates postischemic liver injury by deacetylating mitogen-activated protein kinase phosphatase-1* Hepatology, **65**, 225-236

Wang, J., Koh, H-W., Zhou, L., Bae, U-J., Lee, H-S., Bang, I.H., Ka, S-O., Oh, S-H., Bae, E.J. and Park, B-H. (2017) *Sirtuin 2 aggravates postischemic liver injury by deacetylating mitogen-activated protein kinase phosphatase-1* Hepatology,**65**, 225-236
Wang, X., Maretti-Mira, A.C., Wang, L. and DeLeve, L.D. (2019) *Liver-selective MMP-9 inhibition in the rat eliminates ischemia-reperfusion injury and accelerates liver regeneration* Hepatology, **69**, 314-328
Zhang, J., Xu, P., Song, P., Wang, H., Zhang, Y. Hu, Q., Wang, G., Zhang, S., Yu, Q. (2016) *CCL2eCCR2 signaling promotes hepatic ischemia/reperfusion injury* J. Surg. Res., **202**, 352-362

Kupffer cell identity

Sakai, M., Troutman, Ty D., Seidman, J.S., Ouyang, Z., Spann, N.J., Abe, Y., Ego, K.M., Bruni, C.M. et al (2019) *Liver-derived signals sequentially reprogram myeloid enhancers to initiate and maintain Kupffer cell identity* Immunity **51**, 655–670

Kupffer cell suppression

Santamaria-Barria, J.A., Zeng, S., Greer, J.B., Beckman, M.J., Seifert, A.M., Cohen, N.A., Zhang, J.Q., Crawley, M.H., Green, B.L. et al (2019) *Csf1r or Mer inhibition delays liver regeneration via suppression of Kupffer cells* PLoS One, **14**: e0216275

Leukocyte function

Katz, S.C., Ryan, K., Ahmed, N., Plitas, G., Chaudhry, U.I., Kingham, T.P., Naheed, S., Nguyen, C., Somasundar, P., Espat, N.J., Junghans, R.P. and DeMatteo, R.P. (2011) *Obstructive jaundice expands intrahepatic regulatory T cells, which impair liver T lymphocyte function but modulate liver cholestasis and fibrosis* J. Immunol., **187**, 1150–1156
Licata, L.A., Nguyen, C.T., Burga, R.A., Falanga, V., Espat, N.J., Ayala,A., Thorn, M., Junghans, R.P. and Katz, S.C. (2013) *Biliary obstruction results in PD-1-dependent liver T cell dysfunction and acute inflammation mediated by Th17 cells and neutrophils* J. Leukoc. Biol., **94**, 813–823

Lipopolysaccharide, effects of

Kolios, G., Valatas, V., Manousou, P., Xidakis, C., Notas, G. and Kouroumalis, E. (2008) *Nitric oxide and MCP-1 regulation in LPS activated rat Kupffer cells* Mol. Cell. Biochem., **319**, 91-98
Shao, B., Lu, M., Katz, S.C., Varley, A.W., Hardwick, J., Rogers, T.E., Ojogun, N., Rockey, D.C., DeMatteo, R.P. and Munford, R.S. (2007) *A host lipase detoxifies bacterial lipopolysaccharides in the liver and spleen* J. Biol. Chem., **282**, 13726-13735
Valatas, V., Kolios, G., Manousou, P., Notas, G., Xidakis, C., Diamantis, I. and Kouroumalis, E. (2004) *Octreotide regulates CC but not CXC LPS-induced chemokine secretion in rat Kupffer cells* Br. J. Pharm., **141**, 477-487
Xidakis, C., Ljumovic, D., Manousou, P., Notas, G., Valatas, V., Kolios, G., and Kouroumalis, E. (2005) *Production of pro- and anti-fibrotic agents by rat kupffer cells; the effect of octreotide* Digest. Dis. Sci., **50**, 935-941

Lipoprotein-binding protein

Allan, C.M., Heizer, P.J., Tu, Y., Sandoval, N.P., Jung, R.S., Morales, J.E., Sajti, E., Troutman, T.D., Saunders, T.L. et al (2019) *An upstream enhancer regulates Gpihbp1 expression in a tissue-specific manner* J. Lipid Res., 60, 869–879

Liver injury

Otaka, F., Ito, Y., Inoue, T., Ohkubo, H., Nishizawa, N., Kojo, K., Betto, T.,. Yamane, S., Narumiya, S., Koizumi, W. and Majima, M. (2019) *Thromboxane A2 receptor signaling in endothelial cells attenuates monocrotaline-induced liver injury* Toxicol. Appl. Pharmacol., **381**: 114733

Metalloproteinases

Murthy, A., Shao, Y.W., Defamie, V., Wedeles, C., Smookler, D. and Khokha, R. (2012) *Stromal TIMP3 regulates liver lymphocyte populations and provides protection against Th1 T cell-driven autoimmune hepatitis* J. Immunol., **188**, 2876–2883

Metastasis

Banerjee, A., Abdelmegeed, M.A., Jang, S. and Song, B-J. (2015) *Increased sensitivity to binge alcohol-induced gut leakiness and inflammatory liver disease in HIV transgenic rats* PLoS One, **10**: e0140498

Burga, R.A., Thorn, M., Point, G.R., Guha, P., Nguyen, C.T., Licata, L.A., DeMatteo, R.P., Ayala, A. et al (2015) *Liver myeloid-derived suppressor cells expand in response to liver metastases in mice and inhibit the anti-tumor efficacy of anti-CEA CAR-T* Cancer Immunol. Immunother., **64**, 817–829

Methodology

Beckwitt, C.H., Clark, A.M., Wheeler, S., Taylor, D.L., Stolz, D.B., Griffith, L. and Wells, A. (2018) '*Liver 'organ on a chip'* Exp. Cell Res., **363**, 15–25
Donofrio, B., Kasumov, T., Dasarathy, S., McCullough, A.J. (2013) *A specific and facile method for isolating murine liver sinusoidal endothelial cells using a CD32B monoclonal antibody* Hepatology, **58** (Suppl) 455A
Fernández-Iglesias, A., Ortega-Ribera, M., Guixé-Muntet, S. and Gracia-Sancho, J. (2019) *4 in 1: Antibody - free protocol for isolating the main hepatic cells from healthy and cirrhotic single rat livers* J. Cell. Mol. Med., **23**, 877–886
Meyer, J., Lacotte, S., Morel, P., Gonelle-Gispert, C. and Bühler, L. (2016) *An optimized method for mouse liver sinusoidal endothelial cell isolation* Exp. Cell Res., **349**, 291–301
Meyer, J., Gonelle-Gispert, C., Morel, P. and Bühler, L. (2016) *Methods for isolation and purification of murine liver sinusoidal endothelial cells: a systematic review* PLoS One, **11**: e0151945
Valatas, V., Xidakis, C., Roumpaki, H., Kolios, G. and Kouroumalis, E.A. (2003) *Isolation of rat Kupffer cells: a combined methodology for highly purified primary cultures* Cell Biol Int., **27**, 67-73
Werner, M., Driftmann, S., Kleinehr, K., Kaiser, G.M., Mathé, Z., Treckmann, J-W., Paul, A., Skibbe, K., Timm, J. et al (2015) *All-in-one: advanced preparation of human parenchymal and non-parenchymal liver cells* PLoS One, **10**: e0138655
Xuy, F., Zheny, P., Zheng, Y., LIjuan, F., Aiting, Y., Min, C., Hong Y. and Jidong, J. (2013) *Preparation of Kupffer cell enriched non-parenchymal liver cells with high yield and reduced damage of surface markers by a modified method for flow cytometry* Cell Biol., Int., **37**, 284-291
Zeilinger, K., Freyer, N., Damm, G., Seehofer, D. and Knöspel, F. (2016) *Cell sources for in vitro human liver cell culture models* Exp. Biol. Med., **241,** 1684–1698

Mitochondrial function

Fülöp, P., Derdak, Z., Sheets, A., Sabo, E., Berthiaume, E.P., Resnick, M.B., Wands, J.R., Pragh, G. and baffy, G. (2006) *Lack of UCP2 reduces fas-mediated liver injury in ob/ob mice and reveals importance of cell-specific UCP2 expression* Hepatology, **44**, 592-601

Monocyte chemoattractant protein

Kolios, G., Valatas, V., Manousou, P., Xidakis, C., Notas, G. and Kouroumalis, E. (2008) *Nitric oxide and MCP-1 regulation in LPS activated rat Kupffer cells* Mol. Cell. Biochem., **319**, 91-98

Neutrophil adhesion

Yang, H., Li, N., Du, Y., Tong, C., Lü, S., Hu, J., Zhang, Y. and Long, M. (2017) *Neutrophil adhesion and crawling dynamics on liver sinusoidal endothelial cells under shear flow* Exp. Cell Re., **351**, 91–99

NK cells

Erlach, K.C., Böhm, V., Knabe, M., Deegen, P., Reddehase, M.J. and Podlech, J. (2008) *Activation of hepatic natural killer cells and control of liver-adapted lymphoma in the murine model of cytomegalovirus infection* Med. Microbiol. Immunol., **197**, 167-178

Obstructive jaundice

Katz, S.C., Ryan, K., Ahmed, N., Plitas, G., Chaudhry, U.I., Kingham, T.P., Naheed, S., Nguyen, C., Somasundar, P., Espat, N.J., Junghans, R.P. and DeMatteo, R.P. (2011) *Obstructive jaundice expands intrahepatic regulatory T cells, which impair liver T lymphocyte function but modulate liver cholestasis and fibrosis* J. Immunol., **187**, 1150–1156

Oxidative/stress/studies

Hu, S., Yin, S., Jiang, X., Huang, D. and Shen, G. (2009) *Melatonin protects against alcoholic liver injury by attenuating oxidative stress, inflammatory response, and apoptosis* Eur. J. Pharmacol., **616**, 287–292
Kolios, G., Valatas, V., Manousou, P., Xidakis, C., Notas, G. and Kouroumalis, E. (2008) *Nitric oxide and MCP-1 regulation in LPS activated rat Kupffer cells* Mol. Cell. Biochem., **319**, 91-98
Mukhopadhyay, P., Rajesh, M., Horváth, B., Bátkai, S., Park, O., Tanchian, G., Gao, R.Y., Patel, V., Wink, D.A., Liaudet, L., Haskó, G., Mechoulam, R. and Pacher, P. (2011) *Cannabidiol protects against hepatic ischemia/reperfusion injury by attenuating inflammatory signaling and response, oxidative/nitrative stress, and cell death* Free Radic. Biol. Med., **50**, 1368–1381

Zelnickova, P., Matiasovic, J., Pavlova, B., Kudlackove, H., Kovaru, F. and Faldyna, M. (2008) *Quantitative nitric oxide production by rat, bovine and porcine macrophages* Nitric Oxide, **19**, 36-41 (P)

Plasmalemma vesicle associated protein

Auvinen, K., Lokka, E., Mokkala, E., Jäppinen, N., Tyystjärvi, S., Saine, H., Peurla, M., Shetty, S., Elima, K., Rantakari, P. and Salmi, M. (2019) *Fenestral diaphragms and PLVAP associations in liver sinusoidal endothelial cells are developmentally regulated* Sci. Rep., **9**: 15698

Plasmodium infection

Mamedov, M.R., Scholzen, A., Nair, R.V., Cumnock, K., Kenkel, J.A., Oliveira, J.H.M., Trujillo, D.L., Saligrama, N. et al (2018) *A macrophage colony-stimulating-factor-producing γδ T cell subset prevents malarial parasitemic recurrence* Immunity **48**, 350–363

Murray, S.A., Mohar, I., Miller, J.L., Brempelis, K.J., Vaughan, A.M., Kappe, S.H.I. and Crispe, I.N. (2015) *CD40 is required for protective immunity against liver stage Plasmodium infection* J. Immunol., **194**, 2268–2279

Tavares, J., Formaglio, P., Thiberge, S., Mordelet, E., Van Rooijen, N., Medvinsky, A., Ménard, R. and Amino, R. (2013) *Role of host cell traversal by the malaria sporozoite during liver infection* J. Exp. Med., **210**, 905-915

Prostaglandins

Okamoto, T., Saito, T., Tabata, Y. and Uemoto, S. (2011) *Immunological tolerance in a mouse model of immune-mediated liver injury induced by 16,16 dimethyl PGE2 and PGE2-containing nanoscale hydrogels* Biomaterials, **32**, 4925-4935

Proteomics

Liu, W., Hou, Y., Chen, H., Wei, H., Lin, W., Li, J., Zhang, M., He, F. and Jiang, Y. (2011) *Sample preparation method for isolation of single-cell types from mouse liver for proteomic studies* Proteomics **11**, 3556–3564

rAAV vector

Cong, M., Liu, T., Wang, P., Fan, X., Yang, A., Bai, Y., Peng, Z., Wu, P., Tong, X., Chen, J., Li, H., Cong, R., Tang, S., Wang, B., Jia, J. and You, H. (2013) *Antifibrotic effects of a recombinant adeno-associated virus carrying small interfering RNA targeting TIMP-1 in rat liver fibrosis* Am. J. Pathol., **182**, 1607-1616

Hösel, M., Broxtermann, M., Janicki, H., Esser, K., Arzberger, S., Hartmann, P., Gillen, S., Kleeff, J., et al (2012) *Toll-like receptor 2–mediated innate immune response in human nonparenchymal liver cells toward adeno-associated viral vectors* Hepatology **55**, 287-297

Regeneration

Rao, R., Graffeo, C.S., Gulati, R., Jamal, M., Narayan, S., Zambirinis, C.P., Barilla, R., Deutsch, M., Greco, S.H. et al (2014) *Interleukin 17–producing gdT cells promote hepatic regeneration in mice* Gastroenterology, **147**, 473–484

Retinyl ester

Schreiber, R., Taschler, U., Wolinski, H., Seper, A., Tamegger, S.N., Graf, M., Kohlwein, S.D., Haemmerle, G., Zimmermann, R., Zechner, R. and Lass, A. (2009) *Esterase 22 and beta-glucuronidase hydrolyze retinoids in mouse liver* J. Lipid Res., **50**, 2514–2523

Ricin toxin sensitivity

Fernando, BM., Torres-Velez, F.J., Doering, J., Ehrbar, D.J. and Mantis, N.J. (2019) *Sensitivity of Kupffer cells and liver sinusoidal endothelial cells to ricin toxin and ricin toxin–Ab complexes* J. Leukoc. Biol., **106**, 1161–1176

RNA

Cong, M., Liu, T., Wang, P., Fan, X., Yang, A., Bai, Y., Peng, Z., Wu, P., Tong, X., Chen, J., Li, H., Cong, R., Tang, S., Wang, B., Jia, J. and You, H. (2013) *Antifibrotic effects of a recombinant adeno-associated virus carrying small interfering RNA targeting TIMP-1 in rat liver fibrosis* Am. J. Pathol., **182**, 1607-1616

Ebert, G., Poeck, H., Lucifors, J., Baschuk, N., Esser, K., Esposito, I., Hartmann, G. and Protzer, U. (2011) *5' Triphosphorylated small interfering RNAs control replication of hepatitis B virus and induce an interferon response in human liver cells and mice* Gastroenterology, **141**, 696–706 (H)

Meng, Z., Fu, X., Chen, X., Zeng, S., Tian, Y., Jove, R., Xu, R. and Huang, W. (2010) *miR-194 is a marker of hepatic epithelial cells and suppresses metastasis of liver cancer cells in mice* Hepatology, **52**, 2148-2157

Scavenger activity

Baranova, I.N., Bocharov, A.V., Vishnyakova, T.G., Kurlander, R., Chen, Z., Fu, D., Arias, I.M., Csako, G., Patterson, A.P. and Eggerman, T.L. (2010) *CD36 is a novel serum amyloid A (SAA) receptor mediating SAA binding and SAA-induced signaling in human and rodent cells* J. Biol. Chem., **285**, 8492–8506
Elvevold, K.H., Nedredal, G.I., Revhaug, A. and Smedsrød, B. (2004) *Scavenger properties of cultivated pig liver endothelial cells* Comp. Hepatol., **3:**1
Elvevold, K., Nedredal, G.I., Revhaug, A., Bertheussen, K. And Smedsrød, B. (2005) *Long-term preservation of high endocytic activity in primary cultures of pig liver sinusoidal endothelial cells* Eur. J. Cell Biol., **84**, 749-764
Malerød, L., Juvet, L.K., Gjøen, T. and Berg, T. (2002) *The expression of scavenger receptor class B, type I (SR-BI) and caveolin-1 in parenchymal and nonparenchymal liver cells* Cell Tissue Res., 307, 173-180
Nedredal, G.I., Elvevold, K.H., Ytrebø, L.M., Olsen, R., Revhaug, A. and Smedsrød, B. (2003) *Liver sinusoidal endothelial cells represent an important blood clearance system in pigs* Comp. Hepatol., **2:**1

Schistosomes

Pereira, T.A., Xie, G., Choi, S.S., Syn, W-K., Voieta I., Lu, J., Chan, I.S., Swiderska, M., Amaral, K.B., Antunes, C.M., Secor, W.E., Witek, R.P., Lambertucci J.R., Pereira, F.L. and Diehl, A.M. (2013) *Macrophage-derived hedgehog ligands promotes fibrogenic and angiogenic responses in human schistosomiasis mansoni* Liver Int., **33**, 149-161

Senescence

Koudelkova, P., Weber, G. and Mikulits, W. (2015) *Liver sinusoidal endothelial cells escape senescence by loss of p19ARF* PLoS One, **10**, e0142134

Sinusoidal structures

Du, Y., Li, N., Yang, H., Luo, C., Gong, Y., Tong, C., Gao, Y., Lü, S. and Long, M. (2017) *Mimicking liver sinusoidal structures and functions using a 3D-configured microfluidic chip* Lab. Chip, 17, 782-794
Takeuchi, M., Oda, S., Tsuneyama, K. and Yokoi, T. (2018) *Comprehensive analysis of serum microRNAs in hepatic sinusoidal obstruction syndrome (SOS) in rats: implication as early phase biomarkers for SOS* Arch. Toxicol., **92**, 2947–2962

Steatohepatitis/steatosis

Lee, Y-S., Kim, D-Y., Kim, T-J., Kim, S.Y., Jeong, J-M., Jeong, W-I., Jung, J-K., Choi, J-K. et al (2018) *Loss of toll-like receptor 3 aggravates hepatic inflammation but ameliorates steatosis in mice* Biochem. Biophys. Res. Comm., **497**, 957-962
Smedlund, K., Dube, P. amd Vazquez, G. (2016) *Early steatohepatitis in hyperlipidemic mice with endothelial-specific gain of TRPC3 function precedes changes in aortic atherosclerosis* Physiol. Genomics, **48**, 644 – 649
Sun, X., Seidman, J.S., Zhao, P., Troutman, T.D., Spann, N.J., Que, X., Zhou, F., Liao, Z., Pasillas, M., et al (2020) *Neutralization of oxidized phospholipids ameliorates non-alcoholic steatohepatitis* Cell Metab., **31**, 189–206
Zheng, X-L., Wu, J-P., Gong, Y., Hong, J-B., Xiao, H-Y., Zhong, J-W., Xie, B., Li, B-M. et al (2019) *IL-25 protects against high-fat diet-induced hepatic steatosis in mice by inducing IL-25 and M2a macrophage production* Immunol. Cell Biol., **97**, 165–177

Subsets

Klein, I., Cornejo, J.C., Polakos, N.K., Beena, J., Wuensch, S.A., Topham, D.J., Pierce, R.H. and Crispe, N.J. (2007) *Kupffer cell heterogeneity: functional properties of bone marrow-derived and sessile hepatic macrophages* Blood, **110**, 4077-4085
Xidakis, C., Mastrodimou, N., Notas, G., Renieri, E., Kolios, G., Kouroumalis, E. and Thermos, K. (2007) *RT-PCR and immunocytochemistry studies support the presence of somatostatin, cortistatin and somatostatin receptor subtypes in rat Kupffer cells* Regul. Pept., **143**, 76-82

T cell interactions

Carambia, A., Frenzel, C., Bruns, O.T., Schwinge, D., Reimer, R., Hohenberg, H., Huber, S., Tiegs, G., Schramm, C., Lohse, A.W. and Herkel, J. (2013) *Inhibition of inflammatory CD4 T cell activity by murine liver sinusoidal endothelial cells* J. Hepatol., **58**, 112–118

Katz, S.C., Pillarisetty, V.G., Bleier, J.I., Shah, A.B. and DeMatteo, R.P. (2004) *Liver sinusoidal endothelial cells are insufficient to activate T cells* J. Immunol., **173**, 230-235

TNF and TNF receptors

Cubero, F.J., Nieto, N. (2012) *Arachidonic acid stimulates TNFα production in Kupffer cells via a reactive oxygen species-pERK1/2-Egr1-dependent mechanism* Am. J. Physiol. Gastrointest. Liver Physiol., **303**, G228–G239
McMahan, R.S., Riehle, K.J., Fausto, N. and Campbell, J.S. (2013) *A disintegrin and metalloproteinase 17 regulates TNF and TNFR1 levels in inflammation and liver regeneration in mice* Am. J. Physiol. Gastrointest. Liver Physiol., **305**, G25–G34

Toll-like receptors

Byun, J-S., Suh, Y-G., Yi, H-S., Lee, Y-S. and Jeong, W-I. (2013) *Activation of toll-like receptor 3 attenuates alcoholic liver injury by stimulating Kupffer cells and stellate cells to produce interleukin-10 in mice* J, Hepatol., **58**, 342–349
Cavassani, K.A., Moreira, A.P., Habiel, D., Ito, T., Coelho, A.L., Allen, R.M., Hu, B., Raphelson, J., Carson IV, W.F., Schaller, M.A., Lukacs, N.W., Omary, B., Hogaboam, C.M. and Kunkel, S.L. (2013) *Toll like receptor 3 plays a critical role in the progression and severity of acetaminophen-induced hepatotoxicity* PLoS One, **8**: e65899
Etienne-Mesmin, L., Vijay-Kumar, M., Gewirtz, A.T. and Chassaing, B. (2016) *Hepatocyte toll-like receptor 5 promotes bacterial clearance and protects mice against high-fat diet–induced liver disease* Cell. Mol. Gastroenterol. Hepatol., **2**, 584–604
Hoque, R., Farooq, A., hani, A., Gorelick, F. and Mehal, W.Z. (2014) *Lactate reduces liver and pancreatic injury in Toll-like receptor-and inflammasome-mediated inflammation via GPR81-mediated suppression of innate immunity* Gastroenterology, **146**, 1763–1774

Toxic injury

Oda, S., Takeuchi, M., Akai, A., Shirai, Y., Tsuneyama, K. and Yokoi, T. (2018) *miRNA in rat liver sinusoidal endothelial cells and hepatocytes and application to circulating biomarkers that discern pathogenesis of liver injuries* Am. J. Pathol., **188**, 916-928

Transplantation

Alfaro, F.J., Grau, M., Ramírez, E., Cevey, M., Mellado, M., Castro, M.J., Meneu, J.C., Abradelo, M., Camañas, C. et al (2009) *An in vitro model of cell transplantation for evaluation of cell engraftment enhancers* Transplant. Proc., **41**, 2487–2490

Tumour and virus studies

Balsitis, S.J., Williams, K.L., Lachica, R., Flores, D., Kyle, J.L., Mehlhop, E., Johnson, S., Diamond, M.S., Beatty, P.R. and Harris, E. (2010) *Lethal antibody enhancement of dengue disease in mice is prevented by Fc modification* PLoS Pathogens **6**: e1000790
Connolly, M.K., Mallen-St. Clair, J., Bedrosian, A.S., Malhotra, A., Vera, V., Ibrahim, J., Henning, J., Pachter, H.L., Bar-Sagi, D., Frey, A.B. and Miller, G. (2010) *Distinct populations of metastases-enabling myeloid cells expand in the liver of mice harboring invasive and pre-invasive intra-abdominal tumor* J. Leukoc. Biol., **87**, 713–725
Seckert, C.K., Renzaho, A., Tervo, H-M., Krause, C., Deegen, P., Kühnapfel, B., Reddehase, M.J. and Grzimek, N.K.A.(2009) *Liver sinusoidal endothelial cells are a site of murine cytomegalovirus latency and reactivation* J. Virol., **83**, 8869-8884

VEGF

Wang, L., Wang, X., Wang, L., Chiu, J.D., Van de Ven, G., Gaarde, W. and Deleve, L.D. (2012) *Hepatic vascular endothelial growth factor regulates recruitment of rat liver sinusoidal endothelial cell progenitor cells* Gastroenterology, **143**, 1555–1563

Viral hepatitis

Kozik, J-H., Trautmann, T., Carambia, A., Preti, M., Lütgehetmann, M., Krech, T., Wiegard, C., Heeren, J. and Herkel, J. (2016) *Attenuated viral hepatitis in Trem1$^{-/-}$ mice is associated with reduced inflammatory activity of neutrophils* Sci. Rep., **6**: 28556

8. Oval cells (Progenitor cells)

Dollé, L., Best, J., Mei, J., Al Battah, F., Reynaert, H., van Grunsven, L.A. and Geerts, A. (2010) *The quest for liver progenitor cells: A practical point of view* J. Hepatol., **52**, 117–129

Gerbal-Chaloin, S., Duret, C., Raulet, E., Navarro, F., Blanc, P., Ramos, J., Maurel, P. and Daujat-Chavanieu, M. (2010) *Isolation and culture of adult human liver progenitor cells: in vitro differentiation to hepatocyte-like cells* In, Hepatocytes, (ed. Maurel, P.) Methods Mol. Biol., **640**, Springer Science+Business Media, pp.247-260

Grozdanov, P.N., Yovchev, M.I. and Dabeva, M.D. (2006) *The oncofetal protein glypican-3 is a novel marker of hepatic progenitor/oval cells* Lab. Invest., **86**, 1272-1284

Sicklick, J.K., Li, Y-X., Melhem, A., Schmelzer, E., Zdanowicz, M., Huang, J., Caballero, M., Fair, J.H., Ludlow, J.W., McLelland, R.E., Reid, L.M. and Diehl, A.M. (2006) *Hedgehog signaling maintains resident hepatic progenitors throughout life* Am. J. Physiol. Gastrointest. Liver Physiol., **290**, G859-G870

Wang, L., Wang, X., Wang, L., Chiu, J.D., Van de Ven, G., Gaarde, W. and Deleve, L.D. (2012) *Hepatic vascular endothelial growth factor regulates recruitment of rat liver sinusoidal endothelial cell progenitor cells* Gastroenterology, **143**, 1555–1563

Wang, Z., Yang, X., Chen, L., Zhi, X., Lu, H., Ning, Y., Yeong, J., Chen, S. et al (2017) *Upregulation of hydroxysteroid sulfotransferase 2Blb promotes hepatic oval cell proliferation by modulating oxysterol-induced LXR activation in a mouse model of liver injury* Arch. Toxicol., **91**, 271-287

Yovchev, M.I., Grozdanov, P.N., Hoseph, B., Gupta, S.and Daabeva, M.D. (2007) *Novel hepatic progenitor cell surface markers in the adult rat liver* Hepatology, **45**, 139-149

Yovchev, M.I., Grozdanov, P.N., Zhou, H., Racherla, H., Guha, C. and Dabeva, M.D. (2008) *Identification of adult hepatic progenitor cells capable of repopulating injured rat liver* Hepatology, **47**, 636-647

Yovchev, M.I., Zhang, J., Neufeld, D.S., Grozdanov, P.N. and Dabeva, M.D. (2009) *Thymus cell antigen-1-expressing cells in the oval cell compartment* Hepatology, **50**, 601-611

OptiPrep™ Reference List RC08; 4th edition, February 2020