

DAFTAR PUSTAKA

- Abbaszadeh, H., Ghorbani, F., Derakhshani, M., Movassaghpour, A.A., Yousefi, M., Talebi, M., Shamsasenjan, K., 2020. Regenerative potential of Wharton's jelly-derived mesenchymal stem cells: A new horizon of stem cell therapy. *J. Cell. Physiol.* 235, 9230–9240.
- Agarwal, R., Burton, J., Gallieni, M., Kalantar-Zadeh, K., Mayer, G., Pollock, C., Szepietowski, J.C., 2023. Alleviating symptoms in patients undergoing long-term hemodialysis: a focus on chronic kidney disease-associated pruritus. *Clin. Kidney J.* 16, 30–40.
- Alzahrani, F.A., 2019. Melatonin improves therapeutic potential of mesenchymal stem cells-derived exosomes against renal ischemia-reperfusion injury in rats. *Am. J. Transl. Res.* 11, 2887–2907.
- Amador-Martínez, I., Pérez-Villalva, R., Uribe, N., Cortés-González, C., Bobadilla, N.A., Barrera-Chimal, J., 2019. Reduced endothelial nitric oxide synthase activation contributes to cardiovascular injury during chronic kidney disease progression. *Am. J. Physiol. Renal Physiol.* 317, F275–F285.
- Ameer, O.Z., 2022. Hypertension in chronic kidney disease: What lies behind the scene. *Front. Pharmacol.* 13, 949260.
- Ammirati, A.L., 2020. Chronic kidney disease. *Rev. Assoc. Med. Bras.* 66Suppl 1, s03–s09.
- Anderson, R.L., Federer, W.T., 1956. Experimental Design: Theory and Application. *J. Am. Stat. Assoc.* 51, 667.
- Anggorowati, N., Ratna Kurniasari, C., Damayanti, K., Cahyanti, T., Widodo, I., Ghazali, A., Romi, M.M., Sari, D.C.R., Arfian, N., 2017. Histochemical and immunohistochemical study of α -SMA, collagen, and PCNA in epithelial ovarian neoplasm. *Asian Pac. J. Cancer Prev.* 18, 667–671.
- Arfian, Nur, Ats-tsani, H.K., Sayekti, P.I., Lakabela, D.A., Amelia, Febriyanto, T., Antonio, H.R.P., Wibisono, D.P., Sari, D.C.R., 2018. Prolonged kidney ischemia-reperfusion injury associates with inflammation, vascular remodelling, and myofibroblast formation. *Berkala Ilmu Kedokteran* 50, 1–14.
- Arfian, N., Kusuma, M.H.H., Anggorowati, N., Nugroho, D.B., Jeffilano, A., Suzuki, Y., Ikeda, K., Emoto, N., 2018. Vitamin D upregulates endothelin-1, ETBR, eNOS mRNA expression and attenuates vascular remodelling and ischemia in kidney fibrosis model in mice. *Physiol. Res.* S137–S147.
- Arfian, N., Muflikhah, K., Soeyono, S.K., Sari, D.C.R., Tranggono, U., Anggorowati, N., Romi, M.M., 2016. Vitamin D attenuates kidney fibrosis via reducing fibroblast expansion, inflammation, and epithelial cell apoptosis. *Kobe J. Med. Sci.* 62, E38-44.
- Athira, U., Sonia, S., Sharma, A., Sharma, S., 2025. Angiogenesis and vascular repair in acute kidney injury. *J. Res. Appl. Sci. Biotechnol.* 4, 45–54.
- Baer, P.C., Koch, B., Geiger, H., 2021. Kidney inflammation, injury and regeneration 2020. *Int. J. Mol. Sci.* 22, 5589.

- Baines, C.P., 2011. How and when do myocytes die during ischemia and reperfusion: the late phase. *J. Cardiovasc. Pharmacol. Ther.* 16, 239–243.
- Basile, D.P., Anderson, M.D., Sutton, T.A., 2012. Pathophysiology of acute kidney injury. *Compr. Physiol.* 2, 1303–1353.
- Basile, D.P., Fredrich, K., Chelladurai, B., Leonard, E.C., Parrish, A.R., 2008. Renal ischemia reperfusion inhibits VEGF expression and induces ADAMTS-1, a novel VEGF inhibitor. *Am. J. Physiol. Renal Physiol.* 294, F928-36.
- Basile, D.P., Friedrich, J.L., Spahic, J., Knipe, N., Mang, H., Leonard, E.C., Changizi-Ashtiyani, S., Bacallao, R.L., Molitoris, B.A., Sutton, T.A., 2011. Impaired endothelial proliferation and mesenchymal transition contribute to vascular rarefaction following acute kidney injury. *Am. J. Physiol. Renal Physiol.* 300, F721-33.
- Basile, D.P., Yoder, M.C., 2014. Renal endothelial dysfunction in acute kidney ischemia reperfusion injury. *Cardiovasc. Hematol. Disord. Drug Targets* 14, 3–14.
- Beker, B.M., Corleto, M.G., Fieiras, C., Musso, C.G., 2018. Novel acute kidney injury biomarkers: their characteristics, utility and concerns. *Int. Urol. Nephrol.* 50, 705–713.
- Bittel, D.C., Jaiswal, J.K., 2019. Contribution of extracellular vesicles in rebuilding injured muscles. *Front. Physiol.* 10, 828.
- Bonventre, J.V., Yang, L., 2011. Cellular pathophysiology of ischemic acute kidney injury. *J. Clin. Invest.* 121, 4210–4221.
- Briet, M., Schiffrin, E.L., 2013. Vascular actions of aldosterone. *J. Vasc. Res.* 50, 89–99.
- Cao, J.-Y., Wang, B., Tang, T.-T., Wen, Y., Li, Z.-L., Feng, S.-T., Wu, M., Liu, D., Yin, D., Ma, K.-L., Tang, R.-N., Wu, Q.-L., Lan, H.-Y., Lv, L.-L., Liu, B.-C., 2021. Exosomal miR-125b-5p deriving from mesenchymal stem cells promotes tubular repair by suppression of p53 in ischemic acute kidney injury. *Theranostics* 11, 5248–5266.
- Chen, J.-Y., An, R., Liu, Z.-J., Wang, J.-J., Chen, S.-Z., Hong, M.-M., Liu, J.-H., Xiao, M.-Y., Chen, Y.-F., 2014. Therapeutic effects of mesenchymal stem cell-derived microvesicles on pulmonary arterial hypertension in rats. *Acta Pharmacol. Sin.* 35, 1121–1128.
- Chen, J.-Y., Tsai, I.-J., Pan, H.-C., Liao, H.-W., Neyra, J.A., Wu, V.-C., Chueh, J.S., 2021. The impact of angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers on clinical outcomes of acute kidney disease patients: A systematic review and meta-analysis. *Front. Pharmacol.* 12, 665250.
- Chen, L., Wang, Y., Li, S., Zuo, B., Zhang, X., Wang, F., Sun, D., 2020. Exosomes derived from GDNF-modified human adipose mesenchymal stem cells ameliorate peritubular capillary loss in tubulointerstitial fibrosis by activating the SIRT1/eNOS signaling pathway. *Theranostics* 10, 9425–9442.
- Chen, Y.-X., Deng, Z.-H., She, X.-W., Gao, X., Wei, X.-Y., Zhang, G.-X., Qian, J.-X., 2025. Mesenchymal stem cell-derived exosomes improve vascular remodeling by inhibiting EGFR/ErbB2 heterodimerization in hypoxic pulmonary hypertension. *Sci. Rep.* 15, 24303.

- Chirichella, P.S., Jow, S., Iacono, S., Wey, H.E., Malanga, G.A., 2019. Treatment of knee meniscus pathology: Rehabilitation, surgery, and orthobiologics. *PM R* 11, 292–308.
- Cho, M.E., Brunt, V.E., Shiu, Y.-T., Bunsawat, K., 2025. Endothelial dysfunction in chronic kidney disease: a clinical perspective. *Am. J. Physiol. Heart Circ. Physiol.* 329, H135–H153.
- Coca, S.G., Singanamala, S., Parikh, C.R., 2012. Chronic kidney disease after acute kidney injury: a systematic review and meta-analysis. *Kidney Int.* 81, 442–448.
- Cockwell, P., Fisher, L.-A., 2020. The global burden of chronic kidney disease. *Lancet.*
- Coffin, A., Boulay-Coletta, I., Sebbag-Sfez, D., Zins, M., 2015. Radioanatomy of the retroperitoneal space. *Diagn. Interv. Imaging* 96, 171–186.
- Cui, Y., Yu, L., Cong, W., Jiang, S., Qiu, X., Wei, C., Zheng, G., Mao, J., Liu, R., Patzak, A., Persson, P.B., Chen, J., Zhao, L., Lai, E.Y., 2024. Irisin preserves mitochondrial integrity and function in tubular epithelial cells after ischemia-reperfusion-induced acute kidney injury. *Acta Physiol. (Oxf.)* 240, e14211.
- de Bragança, A.C., Volpini, R.A., Mehrotra, P., Andrade, L., Basile, D.P., 2016. Vitamin D deficiency contributes to vascular damage in sustained ischemic acute kidney injury. *Physiol. Rep.* 4, e12829.
- Deinsberger, J., Brugger, J., Tschandl, P., Meier-Schiesser, B., Anzengruber, F., Bossart, S., Tzaneva, S., Petzelbauer, P., Böhrer, K., Beltraminelli, H., Hafner, J., Weber, B., 2021. Differentiating arteriolosclerotic ulcers of Martorell from other types of leg ulcers based on vascular histomorphology. *Acta Derm. Venereol.* 101, adv00449.
- Dellamea, B.S., Leitão, C.B., Friedman, R., Canani, L.H., 2014. Nitric oxide system and diabetic nephropathy. *Diabetol. Metab. Syndr.* 6, 17.
- Deng, Y., Li, Y., Chu, Z., Dai, C., Ge, J., 2023. Exosomes from umbilical cord-derived mesenchymal stem cells combined with gelatin methacryloyl inhibit vein graft restenosis by enhancing endothelial functions. *J. Nanobiotechnology* 21, 380.
- Desita, E.A.N., Arfian, N., Setyaningsih, W.A.W., Sari, D.C.R., 2023. Calcitriol attenuates vascular remodeling in association with alteration of ppET-1/ETBR/eNOS and ETAR expression in acute and chronic phases of kidney ischemia-reperfusion injury in mice. *Can. J. Physiol. Pharmacol.* 101, 8–17.
- Dimas Satrio Wicaksono, Nur Arfian, Ratih Yuniartha, 2024. Pengaruh Pemberian Eksosom Human's Wharton Jelly Umbilical Cord Mesenchymal Stem Cells Terhadap Faktor Neurotropik Pada Tikus Model Iskemia Serebral Global Transien. Universitas Gadjah Mada, Yogyakarta.
- Dimke, H., Sparks, M.A., Thomson, B.R., Frische, S., Coffman, T.M., Quaggin, S.E., 2015. Tubulovascular cross-talk by vascular endothelial growth factor a maintains peritubular microvasculature in kidney. *J. Am. Soc. Nephrol.* 26, 1027–1038.
- Dong, Y., Zhang, Q., Wen, J., Chen, T., He, L., Wang, Y., Yin, J., Wu, R., Xue, R., Li, S., Fan, Y., Wang, N., 2019. Ischemic duration and frequency determines AKI-to-CKD progression monitored by dynamic changes of tubular biomarkers in IRI mice. *Front. Physiol.* 10, 153.
- Du, T., Zhou, J., Chen, W.-X., Zhang, X.-L., Ji, T.-Y., Liu, J., Rong, L., Wang, L.-D., Zhou, R.-J., Ding, D.-G., 2020. Microvesicles derived from human umbilical

- cord mesenchymal stem cells ameliorate renal ischemia-reperfusion injury via delivery of miR-21. *Cell Cycle* 19, 1285–1297.
- El-Reshaid, W., Abdul-Fattah, H., 2014. Sonographic assessment of renal size in healthy adults. *Med. Princ. Pract.* 23, 432–436.
- Fang, Y., Wei, Z., Chen, B., Pan, T., Gu, S., Liu, P., Guo, D., Xu, X., Jiang, J., Yang, J., Shi, Z., Zhu, T., Shi, Y., Liu, Y., Dong, Z., Fu, W., 2018. A five-year study of the efficacy of purified CD34+ cell therapy for angiitis-induced no-option critical limb ischemia. *Stem Cells Transl. Med.* 7, 583–590.
- Foreman, K.J., Marquez, N., Dolgert, A., Fukutaki, K., Fullman, N., McGaughey, M., Pletcher, M.A., Smith, A.E., Tang, K., Yuan, C.-W., Brown, J.C., Friedman, J., He, J., Heuton, K.R., Holmberg, M., Patel, D.J., Reidy, P., Carter, A., Cercy, K., Chapin, A., Douwes-Schultz, D., Frank, T., Goettsch, F., Liu, P.Y., Nandakumar, V., Reitsma, M.B., Reuter, V., Sadat, N., Sorensen, R.J.D., Srinivasan, V., Updike, R.L., York, H., Lopez, A.D., Lozano, R., Lim, S.S., Mokdad, A.H., Vollset, S.E., Murray, C.J.L., 2018. Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016–40 for 195 countries and territories. *Lancet* 392, 2052–2090.
- Francis, A., Harhay, M.N., Ong, A.C.M., Tummalapalli, S.L., Ortiz, A., Fogo, A.B., Fliser, D., Roy-Chaudhury, P., Fontana, M., Nangaku, M., Wanner, C., Malik, C., Hradsky, A., Adu, D., Bavanandan, S., Cusumano, A., Sola, L., Ulasi, I., Jha, V., American Society of Nephrology, European Renal Association, International Society of Nephrology, 2024. Chronic kidney disease and the global public health agenda: an international consensus. *Nat. Rev. Nephrol.* 20, 473–485.
- Freedman, B.I., Cohen, A.H., 2016. Hypertension-attributed nephropathy: what's in a name? *Nat. Rev. Nephrol.* 12, 27–36.
- Fuchs, M.A.A., Broecker, K.A.E., Schrankl, J., Burzlaff, N., Willam, C., Wagner, C., Kurtz, A., 2021. Inhibition of transforming growth factor β 1 signaling in resident interstitial cells attenuates profibrotic gene expression and preserves erythropoietin production during experimental kidney fibrosis in mice. *Kidney Int.* 100, 122–137.
- Gifford, C.C., Tang, J., Costello, A., Khakoo, N.S., Nguyen, T.Q., Goldschmeding, R., Higgins, P.J., Samarakoon, R., 2021. Negative regulators of TGF- β 1 signaling in renal fibrosis; pathological mechanisms and novel therapeutic opportunities. *Clin. Sci. (Lond.)* 135, 275–303.
- Gupta, A., El-Amin, S.F., 3rd, Levy, H.J., Sze-Tu, R., Ibim, S.E., Maffulli, N., 2020. Umbilical cord-derived Wharton's jelly for regenerative medicine applications. *J. Orthop. Surg. Res.* 15, 49.
- Han, X., Zhao, L., Lu, G., Ge, J., Zhao, Y., Zu, S., Yuan, M., Liu, Y., Kong, F., Xiao, Z., Zhao, S., 2013. Improving outcomes of acute kidney injury using mouse renal progenitor cells alone or in combination with erythropoietin or suramin. *Stem Cell Res. Ther.* 4, 74.
- Harlacher, E., Wollenhaupt, J., Baaten, C.C.F.M.J., Noels, H., 2022. Impact of uremic toxins on endothelial dysfunction in chronic kidney disease: A systematic review. *Int. J. Mol. Sci.* 23, 531.

- Hasan, L.M., Shaheen, D.A.H., El Kannishy, G.A.H., Sayed-Ahmed, N.A.H., Abd El Wahab, A.M., 2021. Is health-related quality of life associated with adequacy of hemodialysis in chronic kidney disease patients? *BMC Nephrol.* 22, 334.
- Hassanpour, M., Salybekov, A.A., Kobayashi, S., Asahara, T., 2023. CD34 positive cells as endothelial progenitor cells in biology and medicine. *Front. Cell Dev. Biol.* 11, 1128134.
- Hidayangsih, P.S., Tjandrarini, D.H., Sukoco, N.E.W., Sitorus, N., Dharmayanti, I., Ahmadi, F., 2023. Chronic kidney disease in Indonesia: evidence from a national health survey. *Osong Public Health Res. Perspect.* 14, 23–30.
- Horne, K.L., Packington, R., Monaghan, J., Reilly, T., Selby, N.M., 2017. Three-year outcomes after acute kidney injury: results of a prospective parallel group cohort study. *BMJ Open* 7, e015316.
- Hu, S., Li, Z., Shen, D., Zhu, D., Huang, K., Su, T., Dinh, P.-U., Cores, J., Cheng, K., 2021. Exosome-eluting stents for vascular healing after ischaemic injury. *Nat. Biomed. Eng.* 5, 1174–1188.
- Huang, J., Shi, L., Yang, Y., Zhao, F., Chen, R., Liao, W., Zhu, J., Yang, D., Wu, X., Han, S., 2025. Mesenchymal cell-derived exosomes and miR-29a-3p mitigate renal fibrosis and vascular rarefaction after renal ischemia reperfusion injury. *Stem Cell Res. Ther.* 16, 135.
- Humphreys, B.D., 2018. Mechanisms of renal fibrosis. *Annu. Rev. Physiol.* 80, 309–326.
- Hustrini, N.M., Susalit, E., Rotmans, J.I., 2022. Prevalence and risk factors for chronic kidney disease in Indonesia: An analysis of the National Basic Health Survey 2018. *J. Glob. Health* 12, 04074.
- Inker, L.A., Astor, B.C., Fox, C.H., Isakova, T., Lash, J.P., Peralta, C.A., Kurella Tamura, M., Feldman, H.I., 2014. KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD. *Am. J. Kidney Dis.* 63, 713–735.
- Inker, L.A., Grams, M.E., Levey, A.S., Coresh, J., Cirillo, M., Collins, J.F., Gansevoort, R.T., Gutierrez, O.M., Hamano, T., Heine, G.H., Ishikawa, S., Jee, S.H., Kronenberg, F., Landray, M.J., Miura, K., Nadkarni, G.N., Peralta, C.A., Rothenbacher, D., Schaeffner, E., Sedaghat, S., Shlipak, M.G., Zhang, L., van Zuilen, A.D., Hallan, S.I., Kovesdy, C.P., Woodward, M., Levin, A., CKD Prognosis Consortium, 2019. Relationship of estimated GFR and albuminuria to concurrent laboratory abnormalities: An individual participant data meta-analysis in a global consortium. *Am. J. Kidney Dis.* 73, 206–217.
- Ioannidou, E., 2006. Therapeutic modulation of growth factors and cytokines in regenerative medicine. *Curr. Pharm. Des.* 12, 2397–2408.
- Ismail, M.T., Anggrahini, D.W., Haryana, S.M., Setianto, B.Y., 2024. HUVECs-derived exosomes increase neovascularization and decrease limb necrosis in hindlimb ischemia. *Narra J* 4, e1358.
- Jankauskas, S.S., Andrianova, N.V., Alieva, I.B., Prusov, A.N., Matsievsky, D.D., Zorova, L.D., Pevzner, I.B., Savchenko, E.S., Pirogov, Y.A., Silachev, D.N., Plotnikov, E.Y., Zorov, D.B., 2016. Dysfunction of kidney endothelium after ischemia/reperfusion and its prevention by mitochondria-targeted antioxidant. *Biochemistry (Mosc.)* 81, 1538–1548.

- Jarajapu, Y.P.R., Hazra, S., Segal, M., Li Calzi, S., Jadhao, C., Qian, K., Mitter, S.K., Raizada, M.K., Boulton, M.E., Grant, M.B., 2014. Vasoreparative dysfunction of CD34+ cells in diabetic individuals involves hypoxic desensitization and impaired autocrine/paracrine mechanisms. *PLoS One* 9, e93965.
- Jin, M.-L., Zou, Z.-H., Tao, T., Li, J., Xu, J., Luo, K.-J., Liu, Z., 2020. Effect of the recombinant Adenovirus-mediated HIF-1 alpha on the expression of VEGF in the hypoxic brain microvascular endothelial cells of rats. *Neuropsychiatr. Dis. Treat.* 16, 397–406.
- Kalantar-Zadeh, K., Jafar, T.H., Nitsch, D., Neuen, B.L., Perkovic, V., 2021. Chronic kidney disease. *Lancet* 398, 786–802.
- Kalogeris, T., Baines, C.P., Krenz, M., Korthuis, R.J., 2012. Cell biology of ischemia/reperfusion injury. *Int. Rev. Cell Mol. Biol.* 298, 229–317.
- Kang, D., Kim, T., Choi, G.-E., Park, A., Yoon, J., Yu, J., Suh, N., 2024. miR-29a-3p orchestrates key signaling pathways for enhanced migration of human mesenchymal stem cells. *Cell Commun. Signal.* 22, 365.
- Kapitsinou, P.P., Sano, H., Michael, M., Kobayashi, H., Davidoff, O., Bian, A., Yao, B., Zhang, M.-Z., Harris, R.C., Duffy, K.J., Erickson-Miller, C.L., Sutton, T.A., Haase, V.H., 2014. Endothelial HIF-2 mediates protection and recovery from ischemic kidney injury. *J. Clin. Invest.* 124, 2396–2409.
- Khairoun, M., van der Pol, P., de Vries, D.K., Liewers, E., Schlagwein, N., de Boer, H.C., Bajema, I.M., Rotmans, J.I., van Zonneveld, A.J., Rabelink, T.J., van Kooten, C., Reinders, M.E.J., 2013. Renal ischemia-reperfusion induces a dysbalance of angiopoietins, accompanied by proliferation of pericytes and fibrosis. *Am. J. Physiol. Renal Physiol.* 305, F901-10.
- Kosieradzki, M., Rowiński, W., 2008. Ischemia/reperfusion injury in kidney transplantation: mechanisms and prevention. *Transplant. Proc.* 40, 3279–3288.
- Kostov, K., 2021. The causal relationship between endothelin-1 and hypertension: Focusing on endothelial dysfunction, arterial stiffness, vascular remodeling, and blood pressure regulation. *Life (Basel)* 11, 986.
- Kovesdy, C.P., 2022. Epidemiology of chronic kidney disease: an update 2022. *Kidney Int. Suppl.* (2011) 12, 7–11.
- Lasorsa, F., Rutigliano, M., Milella, M., d’Amati, A., Crocetto, F., Pandolfo, S.D., Barone, B., Ferro, M., Spilotros, M., Battaglia, M., Ditunno, P., Lucarelli, G., 2024. Ischemia-reperfusion injury in kidney transplantation: Mechanisms and potential therapeutic targets. *Int. J. Mol. Sci.* 25. <https://doi.org/10.3390/ijms25084332>
- Leonard, E.C., Friedrich, J.L., Basile, D.P., 2008. VEGF-121 preserves renal microvessel structure and ameliorates secondary renal disease following acute kidney injury. *Am. J. Physiol. Renal Physiol.* 295, F1648-57.
- Li, L., Wang, X., Zheng, L., Li, J., Xu, M., Rong, R., Zhu, T., Jia, Y., 2019. Downregulation of endothelin A receptor (ETA_R) ameliorates renal ischemia reperfusion injury by increasing nitric oxide production. *Life Sci.* 228, 295–304.
- Liang, X., Zhang, L., Wang, S., Han, Q., Zhao, R.C., 2016. Exosomes secreted by mesenchymal stem cells promote endothelial cell angiogenesis by transferring miR-125a. *J. Cell Sci.* 129, 2182–2189.

- Liau, L.L., Ruszymah, B.H.I., Ng, M.H., Law, J.X., 2020. Characteristics and clinical applications of Wharton's jelly-derived mesenchymal stromal cells. *Curr. Res. Transl. Med.* 68, 5–16.
- Lin, Q., Li, S., Jiang, N., Shao, X., Zhang, M., Jin, H., Zhang, Z., Shen, J., Zhou, Y., Zhou, W., Gu, L., Lu, R., Ni, Z., 2019. PINK1-parkin pathway of mitophagy protects against contrast-induced acute kidney injury via decreasing mitochondrial ROS and NLRP3 inflammasome activation. *Redox Biol.* 26, 101254.
- Linkermann, A., Hackl, M.J., Kunzendorf, U., Walczak, H., Krautwald, S., Jevnikar, A.M., 2013. Necroptosis in immunity and ischemia-reperfusion injury. *Am. J. Transplant* 13, 2797–2804.
- Liu, F., Xu, J., Li, F., Ni, W., Chen, Z., Hou, S., Ke, S., Wang, B., 2024. Resveratrol reinforces the therapeutic effect of mesenchymal stem cell (MSC)-derived exosomes against renal ischemia–reperfusion injury (RIRI)-associated fibrosis by suppressing TGF- β -induced epithelial-mesenchymal transition. *Int. J. Cardiol. Cardiovasc. Risk Prev.* 22, 200242.
- Liu, X., Chen, H., Zhan, B., Xing, B., Zhou, J., Zhu, H., Chen, Z., 2007. Attenuation of reperfusion injury by renal ischemic postconditioning: the role of NO. *Biochem. Biophys. Res. Commun.* 359, 628–634.
- Lu, S., Wang, R., Cai, M., Yuan, C., Gao, B., Guo, D., Xu, Y., Fu, W., Yu, X., Si, Y., 2025. Platelet membrane decorated exosomes enhance targeting efficacy and therapeutic index to alleviate arterial restenosis. *Theranostics* 15, 408–427.
- Malek, M., Nematbakhsh, M., 2015. Renal ischemia/reperfusion injury; from pathophysiology to treatment. *J. Renal Inj. Prev.* 4, 20–27.
- Mannon, R.B., 2013. Necroptosis in solid organ transplantation: a missing link to immune activation? *Am. J. Transplant.*
- Masuda, T., Nagata, D., 2020. Recent advances in the management of secondary hypertension: chronic kidney disease. *Hypertens. Res.* 43, 869–875.
- Masum, M.A., Ichii, O., Elewa, Y.H.A., Nakamura, T., Kon, Y., 2017. Local CD34-positive capillaries decrease in mouse models of kidney disease associating with the severity of glomerular and tubulointerstitial lesions. *BMC Nephrol.* 18, 280.
- Mayer, G., 2011. Capillary rarefaction, hypoxia, VEGF and angiogenesis in chronic renal disease. *Nephrol. Dial. Transplant* 26, 1132–1137.
- McGurk, S., 2013. Moore: Clinically Oriented Anatomy – Seventh international edition Moore: Clinically Oriented Anatomy – Seventh international edition. *Nurs. Stand.* 28, 28–28.
- Mescher, A.L., 2023. Junqueira's basic histology: Text and atlas, seventeenth edition, 17th ed. McGraw Hill/Medical.
- Mills, K.T., Xu, Y., Zhang, W., Bundy, J.D., Chen, C.-S., Kelly, T.N., Chen, J., He, J., 2015. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. *Kidney Int.* 88, 950–957.
- Milsom, A.B., Patel, N.S.A., Mazzon, E., Tripatara, P., Storey, A., Mota-Filipe, H., Sepodes, B., Webb, A.J., Cuzzocrea, S., Hobbs, A.J., Thiemermann, C., Ahluwalia, A., 2010. Role for endothelial nitric oxide synthase in nitrite-

- induced protection against renal ischemia-reperfusion injury in mice. *Nitric Oxide* 22, 141–148.
- Moeinabadi-Bidgoli, K., Rezaee, M., Hossein-Khannazer, N., Babajani, A., Aghdaei, H.A., Arki, M.K., Afaghi, S., Niknejad, H., Vosough, M., 2023. Exosomes for angiogenesis induction in ischemic disorders. *J. Cell. Mol. Med.* 27, 763–787.
- Molitoris, B.A., Sutton, T.A., 2004. Endothelial injury and dysfunction: role in the extension phase of acute renal failure. *Kidney Int.* 66, 496–499.
- Mori, K., 2021. Maintenance of skeletal muscle to counteract sarcopenia in patients with advanced chronic kidney disease and especially those undergoing hemodialysis. *Nutrients* 13, 1538.
- Müller, A.M., Hermanns, M.I., Skrzynski, C., Nesslinger, M., Müller, K.-M., Kirkpatrick, C.J., 2002. Expression of the endothelial markers PECAM-1, vWf, and CD34 in vivo and in vitro. *Exp. Mol. Pathol.* 72, 221–229.
- Navar, L.G., Arendshorst, W.J., Pallone, T.L., Inscho, E.W., Imig, J.D., Bell, P.D., 2008. The Renal Microcirculation, in: *Microcirculation*. Elsevier, pp. 550–683.
- Netter, 2018. *Atlas of Human Anatomy*, 7th ed, Netter Basic Science. Elsevier - Health Sciences Division, Philadelphia, PA.
- Nørgård, M.Ø., Svenningsen, P., 2023. Acute kidney injury by ischemia/reperfusion and extracellular vesicles. *Int. J. Mol. Sci.* 24, 15312.
- Palygin, O., Guan, Z., Intapad, S., Sullivan, J.C., 2021. Editorial: Hypertension and chronic kidney injury or failure. *Front. Physiol.* 12, 662737.
- Pan, Q., Kuang, X., Cai, S., Wang, X., Du, D., Wang, J., Wang, Y., Chen, Yanyu, Bihl, J., Chen, Yanfang, Zhao, B., Ma, X., 2020. miR-132-3p priming enhances the effects of mesenchymal stromal cell-derived exosomes on ameliorating brain ischemic injury. *Stem Cell Res. Ther.* 11, 260.
- Patschan, D., Patschan, S., Müller, G.A., 2012. Inflammation and microvasculopathy in renal ischemia reperfusion injury. *J. Transplant.* 2012, 764154.
- Peng, P., Zou, J., Zhong, B., Zhang, G., Zou, X., Xie, T., 2023. Protective effects and mechanisms of flavonoids in renal ischemia-reperfusion injury. *Pharmacology* 108, 27–36.
- Polichnowski, A.J., Griffin, K.A., Licea-Vargas, H., Lan, R., Picken, M.M., Long, J., Williamson, G.A., Rosenberger, C., Mathia, S., Venkatachalam, M.A., Bidani, A.K., 2020. Pathophysiology of unilateral ischemia-reperfusion injury: importance of renal counterbalance and implications for the AKI-CKD transition. *Am. J. Physiol. Renal Physiol.* 318, F1086–F1099.
- Portolés, J., Martín, L., Broseta, J.J., Cases, A., 2021. Anemia in chronic kidney disease: From pathophysiology and current treatments, to future agents. *Front. Med. (Lausanne)* 8, 642296.
- Qin, Z., Li, X., Yang, J., Cao, P., Qin, C., Xue, J., Jia, R., 2017. VEGF and Ang-1 promotes endothelial progenitor cells homing in the rat model of renal ischemia and reperfusion injury. *Int. J. Clin. Exp. Pathol.* 10, 11896–11908.
- Raina, R., Chauvin, A., Chakraborty, R., Nair, N., Shah, H., Krishnappa, V., Kusumi, K., 2020. The role of endothelin and endothelin antagonists in chronic kidney disease. *Kidney Dis. (Basel)* 6, 22–34.

- Rajendran, S., Shen, X., Glawe, J., Kolluru, G.K., Kevil, C.G., 2019. Nitric oxide and hydrogen sulfide regulation of ischemic vascular growth and remodeling. *Compr. Physiol.* 9, 1213–1247.
- Raposo, G., Stoorvogel, W., 2013. Extracellular vesicles: exosomes, microvesicles, and friends. *J. Cell Biol.* 200, 373–383.
- Rezaie, J., Ajezi, S., Avci, Ç.B., Karimipour, M., Geranmayeh, M.H., Nourazarian, A., Sokullu, E., Rezabakhsh, A., Rahbarghazi, R., 2018. Exosomes and their Application in Biomedical Field: Difficulties and Advantages. *Mol. Neurobiol.* 55, 3372–3393.
- Ricard, N., Zhang, J., Zhuang, Z.W., Simons, M., 2019. Isoform-specific roles of ERK1 and ERK2 in arteriogenesis. *Cells* 9, 38.
- Rizzo, P., Perico, N., Gagliardini, E., Novelli, R., Alison, M.R., Remuzzi, G., Benigni, A., 2013. Nature and mediators of parietal epithelial cell activation in glomerulonephritides of human and rat. *Am. J. Pathol.* 183, 1769–1778.
- Roberts, B.N., Christini, D.J., 2011. NHE inhibition does not improve Na(+) or Ca(2+) overload during reperfusion: using modeling to illuminate the mechanisms underlying a therapeutic failure. *PLoS Comput. Biol.* 7, e1002241.
- Romagnani, P., Agarwal, R., Chan, J.C.N., Levin, A., Kalyesubula, R., Karam, S., Nangaku, M., Rodríguez-Iturbe, B., Anders, H.-J., 2025. Chronic kidney disease. *Nat. Rev. Dis. Primers* 11, 8.
- Romagnani, P., Remuzzi, G., Glasscock, R., Levin, A., Jager, K.J., Tonelli, M., Massy, Z., Wanner, C., Anders, H.-J., 2017. Chronic kidney disease. *Nat. Rev. Dis. Primers* 3, 17088.
- Romi, M.M., Arfian, N., Tranggono, U., Setyaningsih, W.A.W., Sari, D.C.R., 2017. Uric acid causes kidney injury through inducing fibroblast expansion, Endothelin-1 expression, and inflammation. *BMC Nephrol.* 18, 326.
- Roumeliotis, S., Mallamaci, F., Zoccali, C., 2020. Endothelial dysfunction in chronic kidney disease, from biology to clinical outcomes: A 2020 update. *J. Clin. Med.* 9, 2359.
- Salvadori, M., Rosso, G., Bertoni, E., 2015. Update on ischemia-reperfusion injury in kidney transplantation: Pathogenesis and treatment. *World J. Transplant.* 5, 52–67.
- Saran, R., Robinson, B., Abbott, K.C., Agodoa, L.Y.C., Albertus, P., Ayanian, J., Balkrishnan, R., Bragg-Gresham, J., Cao, J., Chen, J.L.T., Cope, E., Dharmarajan, S., Dietrich, X., Eckard, A., Eggers, P.W., Gaber, C., Gillen, D., Gipson, D., Gu, H., Hailpern, S.M., Hall, Y.N., Han, Y., He, K., Hebert, P., Helmuth, M., Herman, W., Heung, M., Hutton, D., Jacobsen, S.J., Ji, N., Jin, Y., Kalantar-Zadeh, K., Kapke, A., Katz, R., Kovesdy, C.P., Kurtz, V., Lavalley, D., Li, Y., Lu, Y., McCullough, K., Molnar, M.Z., Montez-Rath, M., Morgenstern, H., Mu, Q., Mukhopadhyay, P., Nallamothu, B., Nguyen, D.V., Norris, K.C., O'Hare, A.M., Obi, Y., Pearson, J., Pisoni, R., Plattner, B., Port, F.K., Potukuchi, P., Rao, P., Ratkowiak, K., Ravel, V., Ray, D., Rhee, C.M., Schaubel, D.E., Selewski, D.T., Shaw, S., Shi, J., Shieu, M., Sim, J.J., Song, P., Soohoo, M., Steffick, D., Streja, E., Tamura, M.K., Tentori, F., Tilea, A., Tong, L., Turf, M., Wang, D., Wang, M., Woodside, K., Wyncott, A., Xin, X., Zeng, W., Zepel, L., Zhang, S., Zho, H., Hirth, R.A., Shahinian, V., 2017. US renal

- data system 2016 annual data report: Epidemiology of kidney disease in the United States. *Am. J. Kidney Dis.* 69, A7–A8.
- Schrauben, S.J., Chen, H.-Y., Lin, E., Jepson, C., Yang, W., Scialla, J.J., Fischer, M.J., Lash, J.P., Fink, J.C., Hamm, L.L., Kanthety, R., Rahman, M., Feldman, H.I., Anderson, A.H., CRIC Study Investigators, 2020. Hospitalizations among adults with chronic kidney disease in the United States: A cohort study. *PLoS Med.* 17, e1003470.
- Scott, R.P., Quaggin, S.E., 2015. Review series: The cell biology of renal filtration. *J. Cell Biol.* 209, 199–210.
- Setyaningsih, W.A.W., Arfian, N., Fitriawan, A.S., Yuniartha, R., Sari, D.C.R., 2021. Ethanolic extract of *Centella asiatica* treatment in the early stage of hyperglycemia condition inhibits glomerular injury and vascular remodeling in diabetic rat model. *Evid. Based. Complement. Alternat. Med.* 2021, 6671130.
- Sharfuddin, A.A., Molitoris, B.A., 2011. Pathophysiology of ischemic acute kidney injury. *Nat. Rev. Nephrol.* 7, 189–200.
- Sharma, P., Maurya, D.K., 2024. Wharton's jelly mesenchymal stem cells: Future regenerative medicine for clinical applications in mitigation of radiation injury. *World J. Stem Cells* 16, 742–759.
- Shaw, I., Rider, S., Mullins, J., Hughes, J., Péault, B., 2018. Pericytes in the renal vasculature: roles in health and disease. *Nat. Rev. Nephrol.* 14, 521–534.
- Shiva, N., Sharma, N., Kulkarni, Y.A., Mulay, S.R., Gaikwad, A.B., 2020. Renal ischemia/reperfusion injury: An insight on in vitro and in vivo models. *Life Sci.* 256, 117860.
- Shoji, K., Tanaka, T., Nangaku, M., 2014. Role of hypoxia in progressive chronic kidney disease and implications for therapy. *Curr. Opin. Nephrol. Hypertens.* 23, 161–168.
- Shu, S., Wang, Y., Zheng, M., Liu, Z., Cai, J., Tang, C., Dong, Z., 2019. Hypoxia and hypoxia-inducible factors in kidney injury and repair. *Cells* 8, 207.
- Sidhom, K., Obi, P.O., Saleem, A., 2020. A review of exosomal isolation methods: Is size exclusion chromatography the best option? *Int. J. Mol. Sci.* 21, 6466.
- Singh, A.P., Singh, N., Pathak, D., Bedi, P.M.S., 2019. Estradiol attenuates ischemia reperfusion-induced acute kidney injury through PPAR- γ stimulated eNOS activation in rats. *Mol. Cell. Biochem.* 453, 1–9.
- Spurgeon-Pechman, K.R., Donohoe, D.L., Mattson, D.L., Lund, H., James, L., Basile, D.P., 2007. Recovery from acute renal failure predisposes hypertension and secondary renal disease in response to elevated sodium. *Am. J. Physiol. Renal Physiol.* 293, F269-78.
- Su, S.-A., Xie, Y., Fu, Z., Wang, Y., Wang, J.-A., Xiang, M., 2017. Emerging role of exosome-mediated intercellular communication in vascular remodeling. *Oncotarget* 8, 25700–25712.
- Tadesse, H., Gutema, H., Wasihun, Y., Dagne, S., Member, Y., Petrucka, P., Fentahun, N., 2021. Lived experiences of patients with chronic kidney disease receiving hemodialysis in Felege Hiwot Comprehensive Specialized Hospital, Northwest Ethiopia. *Int. J. Nephrol.* 2021, 6637272.
- Thomas, B., Matsushita, K., Abate, K.H., Al-Aly, Z., Ärnlov, J., Asayama, K., Atkins, R., Badawi, A., Ballew, S.H., Banerjee, A., Barregård, L., Barrett-Connor, E.,

- Basu, S., Bello, A.K., Bensenor, I., Bergstrom, J., Bikbov, B., Blosser, C., Brenner, H., Carrero, J.-J., Chadban, S., Cirillo, M., Cortinovis, M., Courville, K., Dandona, L., Dandona, R., Estep, K., Fernandes, J., Fischer, F., Fox, C., Gansevoort, R.T., Gona, P.N., Gutierrez, O.M., Hamidi, S., Hanson, S.W., Himmelfarb, J., Jassal, S.K., Jee, S.H., Jha, V., Jimenez-Corona, A., Jonas, J.B., Kengne, A.P., Khader, Y., Khang, Y.-H., Kim, Y.J., Klein, B., Klein, R., Kokubo, Y., Kolte, D., Lee, K., Levey, A.S., Li, Y., Lotufo, P., El Razek, H.M.A., Mendoza, W., Metoki, H., Mok, Y., Muraki, I., Muntner, P.M., Noda, H., Ohkubo, T., Ortiz, A., Perico, N., Polkinghorne, K., Al-Radaddi, R., Remuzzi, G., Roth, G., Rothenbacher, D., Satoh, M., Saum, K.-U., Sawhney, M., Schöttker, B., Shankar, A., Shlipak, M., Silva, D.A.S., Toyoshima, H., Ukwaja, K., Umesawa, M., Vollset, S.E., Warnock, D.G., Werdecker, A., Yamagishi, K., Yano, Y., Yonemoto, N., Zaki, M.E.S., Naghavi, M., Forouzanfar, M.H., Murray, C.J.L., Coresh, J., Vos, T., Global Burden of Disease 2013 GFR Collaborators, CKD Prognosis Consortium, Global Burden of Disease Genitourinary Expert Group, 2017. Global cardiovascular and renal outcomes of reduced GFR. *J. Am. Soc. Nephrol.* 28, 2167–2179.
- Tienda-Vázquez, M.A., Morreeuw, Z.P., Sosa-Hernández, J.E., Cardador-Martínez, A., Sabath, E., Melchor-Martínez, E.M., Iqbal, H.M.N., Parra-Saldívar, R., 2022. Nephroprotective plants: A review on the use in pre-renal and post-renal diseases. *Plants* 11, 818.
- Vaidya, S.R., Aeddula, N.R., 2025. Chronic kidney disease, in: *StatPearls*. StatPearls Publishing, Treasure Island (FL).
- Valenzuela Fuenzalida, J.J., Vera-Tapia, K., Urzúa-Márquez, C., Yáñez-Castillo, J., Trujillo-Riveros, M., Koscina, Z., Orellana-Donoso, M., Nova-Baeza, P., Suazo-Santibañez, A., Sanchis-Gimeno, J., Bruna-Mejias, A., Gutiérrez Espinoza, H., 2024. Anatomical variants of the renal veins and their relationship with morphofunctional alterations of the kidney: A systematic review and meta-analysis of prevalence. *J. Clin. Med.* 13, 3689.
- Vangsness, C.T., Jr, Sternberg, H., Harris, L., 2015. Umbilical cord tissue offers the greatest number of harvestable mesenchymal stem cells for research and clinical application: A literature review of different harvest sites. *Arthroscopy* 31, 1836–1843.
- Venkatakrisna, S.S.B., Onyango, L.C., Serai, S.D., Viteri, B., 2023. Kidney anatomy and physiology, in: *Advanced Clinical MRI of the Kidney*. Springer International Publishing, Cham, pp. 3–12.
- Wahyudi, Y.I., Fitriana, L.A., Ningrum, T.P., Natasya, N., 2023. Hemodialysis therapy compliance in chronic kidney disease patients. *Indonesian Journal of Community Development* 3, 24–36.
- Wang, H.-J., Varner, A., AbouShwareb, T., Atala, A., Yoo, J.J., 2012. Ischemia/reperfusion-induced renal failure in rats as a model for evaluating cell therapies. *Ren. Fail.* 34, 1324–1332.
- Wang, S., Chen, Y., Han, S., Liu, Y., Gao, J., Huang, Y., Sun, W., Wang, J., Wang, C., Zhao, J., 2022. Selenium nanoparticles alleviate ischemia reperfusion injury-induced acute kidney injury by modulating GPx-1/NLRP3/Caspase-1 pathway. *Theranostics* 12, 3882–3895.

- Wang, W., Tai, S., Cheng, X., Yang, L., Chang, Y., Yan, J., Tao, J., Zhou, J., 2025. Protective role of exosomes in renal ischemia-reperfusion injury: a systematic review and meta-analysis. *Front. Pharmacol.* 16, 1653907.
- Wang, Y., Ma, W.-Q., Zhu, Y., Han, X.-Q., Liu, N., 2018. Exosomes derived from mesenchymal stromal cells pretreated with advanced glycation end product-bovine serum albumin inhibit calcification of vascular smooth muscle cells. *Front. Endocrinol. (Lausanne)* 9. <https://doi.org/10.3389/fendo.2018.00524>
- Webster, A.C., Nagler, E.V., Morton, R.L., Masson, P., 2017. Chronic kidney disease. *Lancet* 389, 1238–1252.
- Weir, M.R., Mayo, M.R., Garza, D., Arthur, S.A., Berman, L., Bushinsky, D., Wilson, D.J., Epstein, M., 2017. Effectiveness of patiromer in the treatment of hyperkalemia in chronic kidney disease patients with hypertension on diuretics. *J. Hypertens.* 35 Suppl 1, S57–S63.
- Wilson, S., Mone, P., Jankauskas, S.S., Gambardella, J., Santulli, G., 2021. Chronic kidney disease: Definition, updated epidemiology, staging, and mechanisms of increased cardiovascular risk. *J. Clin. Hypertens. (Greenwich)*.
- Wu, Xiaoqiang, Yan, T., Wang, Z., Wu, Xuan, Cao, G., Zhang, C., Tian, X., Wang, J., 2018. Micro-vesicles derived from human Wharton's Jelly mesenchymal stromal cells mitigate renal ischemia-reperfusion injury in rats after cardiac death renal transplantation. *J. Cell. Biochem.* 119, 1879–1888.
- Xie, J., Hu, D., Niu, L., Qu, S., Wang, S., Liu, S., 2012. Mesenchymal stem cells attenuate vascular remodeling in monocrotaline-induced pulmonary hypertension rats. *J. Huazhong Univ. Sci. Technol. Med. Sci.* 32, 810–817.
- Xu, X., Song, N., Zhang, X., Jiao, X., Hu, J., Liang, M., Teng, J., Ding, X., 2017. Renal protection mediated by hypoxia inducible factor-1 α depends on proangiogenesis function of miR-21 by targeting thrombospondin 1. *Transplantation* 101, 1811–1819.
- Yang, X., Li, X., Luo, M., Guo, Y., Li, C., Lv, D., Cheng, Z., Huang, L., Shang, F.-F., Huang, B., Shen, J., Luo, S., Yan, J., 2021. Tubeimoside I promotes angiogenesis via activation of eNOS-VEGF signaling pathway. *J. Ethnopharmacol.* 267, 113642.
- Yea, J.-H., Yoon, Y.M., Lee, J.H., Yun, C.W., Lee, S.H., 2021. Exosomes isolated from melatonin-stimulated mesenchymal stem cells improve kidney function by regulating inflammation and fibrosis in a chronic kidney disease mouse model. *J. Tissue Eng.* 12, 20417314211059624.
- Zager, R.A., Johnson, A.C.M., Becker, K., 2011. Acute unilateral ischemic renal injury induces progressive renal inflammation, lipid accumulation, histone modification, and “end-stage” kidney disease. *Am. J. Physiol. Renal Physiol.* 301, F1334-45.
- Zhang, T., Widdop, R.E., Ricardo, S.D., 2024. Transition from acute kidney injury to chronic kidney disease: mechanisms, models, and biomarkers. *Am. J. Physiol. Renal Physiol.* 327, F788–F805.
- Zhang, X., Agborbesong, E., Li, X., 2021. The role of mitochondria in acute kidney injury and chronic kidney disease and its therapeutic potential. *Int. J. Mol. Sci.* 22, 11253.

- Zhang, Y., Liu, Y., Liu, H., Tang, W.H., 2019. Exosomes: biogenesis, biologic function and clinical potential. *Cell Biosci.* 9, 19.
- Zhao, X., Li, Y., Wu, S., Wang, Y., Liu, B., Zhou, H., Li, F., 2023. Role of extracellular vesicles in pathogenesis and therapy of renal ischemia-reperfusion injury. *Biomed. Pharmacother.* 165, 115229.
- Zheng, Z., Xu, K., Li, C., Qi, C., Fang, Y., Zhu, N., Bao, J., Zhao, Z., Yu, Q., Wu, H., Liu, J., 2021. NLRP3 associated with chronic kidney disease progression after ischemia/reperfusion-induced acute kidney injury. *Cell Death Discov.* 7, 324.
- Zhong, X., Tang, T.-T., Shen, A.-R., Cao, J.-Y., Jing, J., Wang, C., Zhu, X.-X., Wen, Y., Li, Z.-L., Wang, B., Qin, S.-F., Liu, B.-C., Lv, L.-L., 2022. Tubular epithelial cells-derived small extracellular vesicle-VEGF-A promotes peritubular capillary repair in ischemic kidney injury. *NPJ Regen. Med.* 7, 73.
- Zhu, D., Wang, Y., Thomas, M., McLaughlin, K., Oguljahan, B., Henderson, J., Yang, Q., Chen, Y.E., Liu, D., 2022. Exosomes from adipose-derived stem cells alleviate myocardial infarction via microRNA-31/FIH1/HIF-1 α pathway. *J. Mol. Cell. Cardiol.* 162, 10–19.
- Zhu, Y., Lai, Y., Hu, Y., Fu, Y., Zhang, Z., Lin, N., Huang, W., Zheng, L., 2024. The mechanisms underlying acute myocardial infarction in chronic kidney disease patients undergoing hemodialysis. *Biomed. Pharmacother.* 177, 117050.
- Zou, X., Gu, D., Xing, X., Cheng, Z., Gong, D., Zhang, G., Zhu, Y., 2016. Human mesenchymal stromal cell-derived extracellular vesicles alleviate renal ischemic reperfusion injury and enhance angiogenesis in rats. *Am. J. Transl. Res.* 8, 4289–4299.