Oxidative Stress and Inflammation in Cardiovascular Diseases and Cancer: Role of Non-coding RNAs

Pieterjan Ginckels\textsuperscript{a} and Paul Holvoet\textsuperscript{b,*}

\textsuperscript{a}Department of Architecture, Brussels and Gent, KU Leuven, Leuven, Belgium; \textsuperscript{b}Experimental Cardiology, KU Leuven, Leuven, Belgium

High oxidative stress, Th1/Th17 immune response, M1 macrophage inflammation, and cell death are associated with cardiovascular diseases. Controlled oxidative stress, Th2/Treg anti-tumor immune response, M2 macrophage inflammation, and survival are associated with cancer. MiR-21 protects against cardiovascular diseases but may induce tumor growth by retaining the anti-inflammatory M2 macrophage and Treg phenotypes and inhibiting apoptosis. Down-regulation of let-7, miR-1, miR-9, miR-20a, miR-22a, miR-23a, miR-24a, miR-26a, miR-29, miR-30a, miR-34a, miR-124, miR-128, miR-130a, miR-133, miR-140, miR-143-145, miR-150, miR-153, miR-181a, miR-378, and miR-383 may aid cancer cells to escape from stresses. Up-regulation of miR-146 and miR-223 may reduce anti-tumor immune response together with miR-21 that also protects against apoptosis. MiR-155 and silencing of let-7e, miR-125, and miR-126 increase anti-tumor immune response. MiR expression depends on oxidative stress, cytokines, MYC, and TGF-β, and expression of silencing lncRNAs and circ-RNAs. However, one lncRNA or circ-RNA may have opposite effects by targeting several miRs. For example, PVT1 induces apoptosis by targeting miR-16a and miR-30a but inhibits apoptosis by silencing miR-17. In addition, levels of a non-coding RNA in a cell type depend not only on expression in that cell type but also on an exchange of microvesicles between cell types and tumors. Although we got more insight into the function of a growing number of individual non-coding RNAs, overall, we do not know enough how several of them interact in functional networks and how their expression changes at different stages of disease progression.

INTRODUCTION

Mitochondrial reactive oxygen (ROS), immune response, inflammation, and apoptosis are associated with cardiovascular diseases and cancer [1-7]. Non-coding RNAs regulate these stress conditions [8-10]. They compass small non-coding RNAs or microRNAs or miRs, circular (circ-) RNAs, and long non-coding (lnc)RNAs [11-14]. We recently gave an overview of the relationship between non-coding RNAs, which are deregulated in association with metabolic diseases, and are related to cardiovascular diseases and cancer [15]. Here, we review non-coding RNAs related to cardiovascular diseases and cancer without taking into account a prior relationship with metabolic diseases, focusing on stress conditions mentioned above. Interestingly, we identified a cluster of miRs related to high oxidative stress, Th1/Th17 immune response, M1 macrophage inflammation, and apoptosis in cardiovascular diseases. Importantly, differential expression of this cluster in tumors allowed cancer cells to
escape from oxidative stress, anti-tumor immunity and inflammation, and apoptosis. Their expression depends on oxidative stress, cytokines, MYC, and TGF-β. Differences in miR expressions may be due to differential expression of mainly silencing lncRNAs and circ-RNAs. In addition, we show that many of these lncRNAs and circ-RNAs target several miRs, causing even opposite effects on stress conditions.

**OXIDATIVE STRESS AND INFLAMMATION WITHIN ATHEROSCLEROSIS**

Figure 1 illustrates the mechanisms in atherosclerosis and the involvement of non-coding RNAs in regulating oxidative stress, inflammation, and apoptosis in atherosclerosis. High glucose, ANGII, ox-LDL, and shear stress cause endothelial dysfunction with mitochondrial oxidative stress, releasing ROS. Thus, oxidative stress is due to a shift to more oxidative and less antioxidative factors. Injured endothelium induces adhesion and infiltration of monocytes which differentiate to macrophages. ROS induce M2 to M1 macrophage polarization. In addition, M1 macrophages release proinflammatory cytokines, which induce ROS release and apoptosis in vascular cells. Furthermore, a shift from Th2 and Treg cells to Th1 and Th7 cells occurs, all associated with the activation of DCs. Upregulated regulators are in yellow circles, downregulated ones in blue circles. Upregulated non-coding RNAs are in brown, down-regulated ones in blue.
ECs involves C-C motif chemokine ligand 5 (CCL5) and platelet factor-4 (PF4 or CXCL4) [20].

Usually, infiltrated monocytes differentiate into anti-inflammatory M2 macrophages. They secrete transforming growth factor (TGF)-β and IL10, which counteract vascular inflammation and immune cell activation. However, injured endothelium releases high amounts of ROS, polarizing M2 towards inflammatory M1 macrophages. This polarization involves the activation of toll-like receptors (TLRs) and downstream NFkB and the release of inflammatory cytokines, such as interleukin (IL)-6 and TNF-α [21]. In addition, activated macrophages secrete myeloperoxidase (MPO) and NADPH oxidase (NOX), oxidizing LDL. The disruption of antioxidant defense systems consisting of superoxide dismutases (SODs) [22,23], NRF2 - heme oxygenase (HO)-1 [24], glutathione peroxidase-1 (GPX1) [25], and peroxiredoxin 1 (PRDX1) and PRDX2 [26,27] augment oxidative stress.

The activation of monocytes/macrophages in the vessel wall initiates the innate immune response [28]. Th1 cells exceed the number of Th2 cells in atherosclerotic plaques. Dendritic cells (DCs), activated by cytokines released by M1 macrophages, induce secretion of interferon (IFN)-γ by Th1 cells, no longer counteracted by IL4 produced by Th2 cells. The number of Treg cells secreting IL4, IL5, IL10, and IL13, is also lower. Activated DCs release IFN-γ that induces M2 to M1 polarization and secretion of inflammatory cytokines, inducing apoptosis of vascular cells, associated with ROS release.

NON-CODING RNAs REGULATING OXIDATIVE STRESS AND INFLAMMATION WITHIN ATHEROSCLEROSIS

Oxidative Stress

MiR-19b-3p, miR-221-3p, and miR-222-3p repress the proliferator-activated receptor gamma coactivator (PGC)-1α protein expression leading to mitochondrial oxidative stress [29]. MiR-34a and miR-383 mitochondrial biogenesis increase oxidative stress by repressing sirtuin (SIRT)-1, preventing deacetylation of PGC-1α [30,31].

Advanced glycation end products (AGEs) and ox-LDL induce miR-92a, silencing HO-1 [32]. In contrast, miR-126 induces SIRT1 and SOD2 expression, protecting ECs against ROS production and senescence [33]. MiR-140-5p decreased oxidative stress and ROS levels by increasing the protein expression of NRF2 and SIRT2, and HO1 [34]. However, miR-24 may hamper this NRF2 activation [35] (Figure 1).

Inflammation

MiR-17a and miR-20a induce hypoxia-induced infiltration of monocytes and activation of M1 macrophages [36]. In addition, repression of nexilin F-actin binding protein antisense RNA 1 (NEXN-AS1) increases NFkB, monocyte-specific adhesion molecules, and inflammatory cytokines [37]. In contrast, lncRNA LINC00341 and MANTIS repress adhesion molecules [38,39], the latter by targeting KL2 and KLF4.

MiR-155, miR-222, miR-424, and miR-503 induce M1 macrophage polarization [40]. In contrast, miR-21 and miR-125b retain macrophages in the M2 phenotype [41,42].

Ox-LDL significantly upregulates let-7e that activates NFkB and inflammation. The long intergenic non-protein coding RNA 1826 (LINC01826 or Lnc-MK167IP3) may sponge let-7e, suppressing its proinflammatory effects [43]. Ox-LDL-induced miR-155 and the lncRNA Opa-interacting protein five antisense RNA 1 (OIP5-AS1) accelerate ox-LDL-induced EC injury and inflammation via the TLR4/NFkB signaling pathway [44,45]. Furthermore, the silencing of let-7d by lin-28 homolog (LIN28)-b and the decrease of miR-10a, miR-20a, miR-124, miR-126, miR-132, miR-146a, miR-150, miR-182-5p, miR-221-3p, miR-223, and miR-370, and the metastasis-associated lung adenocarcinoma transcript 1 (MALAT) induce inflammation [46-55]. In contrast, lncRNA HOX transcript antisense RNA (lncRNA HOTAIR), the bromodomain PHD finger transcription circular RNA (CircBPTF; or hsa_circ_0000799) targeting miR-384 [56], and the circRNA circ_0068087 silencing miR-197 protect against inflammation [56-58].

MiR-21 promotes Treg differentiation [59]. In contrast, miR-155 increased Treg cells and decreased Th2 and Treg cells [60,61] (Figure 1).

Apoptosis

High miR-9, due to low hepatocellular carcinoma up-regulated long non-coding RNA (HULC) [62], miR-34a [63], and miR-155 [64] induce apoptosis. H19 increases apoptosis by silencing let-7b [65]. In contrast, miR-17, miR-21, and MIAT sponging miR-150 and miR-181 protect against apoptosis [66-69] (Figure 1).

OXIDATIVE STRESS AND INFLAMMATION WITHIN CARDIOMYOPATHY

Figure 2 illustrates the mechanisms and the involvement of non-coding RNAs in regulating oxidative stress, inflammation, and apoptosis in the development of cardiomyopathy. Endothelial dysfunction is a hallmark of cardiomyopathy. As in atherosclerotic plaques, mitochondrial dysfunction, due to impaired SIRT1 /
Nototypic change to induce cardiac injury and remodeling [83]. Th1 and Th17 cells increase, while Th2 and Treg cells decrease. This shift increases inflammatory cytokines and ROS, inducing cardiac apoptosis. Upregulated regulators are in yellow circles, downregulated ones in blue circles. Upregulated non-coding RNAs are in brown, down-regulated ones in blue.

**Figure 2. Oxidative stress, immune response, inflammation, and apoptosis in cardiomyopathy.** Endothelial dysfunction is a hallmark of cardiomyopathy. As in atherosclerotic plaques, mitochondrial dysfunction induces ROS to release. Thus, oxidative stress is due to a shift to more oxidative and less antioxidative factors. Again, the initial inflammatory response associated with increased oxidative stress consists of the infiltration of monocytes which differentiate to M1 macrophages secreting inflammatory cytokines. This inflammatory response also augments damage-associated molecular patterns (DAMPs), which trigger inflammation and mitochondrial ROS, inducing cell death. During the later phase of the immune response, T lymphocytes infiltrate. Cardiac T cells undergo a phenotypic change. Th2 and Treg cells decrease whereas Th1 and Th17 cells increase. This shift increases inflammatory cytokines and ROS, inducing cardiac apoptosis. Upregulated regulators are in yellow circles, downregulated ones in blue circles. Upregulated non-coding RNAs are in brown, down-regulated ones in blue.

**NON-CODING RNAS REGULATING OXIDATIVE STRESS AND INFLAMMATION WITHIN CARDIOMYOPATHY**

**Oxidative Stress**

MiR-22, miR-23a, miR-26a, and miR-34a increase mitochondrial ROS and cell death, the latter by targeting SIRT1 / PGC-1α [89-92]. MiR-181c disturbed the mitochondrial complex IV increasing ROS production [93].
Down-regulation of miR-145 is associated with mitochondrial dysfunction due to lower SIRT1 [94] (Figure 2).

MiR-153 [95] and miR-320 [96], silencing NRF2, and miR-181a [97], silencing GPX1, increased ROS production, disrupted the mitochondrial structure, and activated the mitochondrial apoptotic pathway. The CD-KN2B antisense RNA 1 (ANRIL) and downregulation of miR-448-3p increases NOX expression and ROS level [98,99]. The decrease of miR-323-3p and miR-708 is associated with decreased SOD [100,101]. In the oxidative stress-challenged heart, TUG1 sponges miR-132-3p, epigenetically inhibiting antioxidative PRDX2 and heat shock protein Hsp70 [102].

In contrast, miR-106b, miR-130a, miR-148b, and miR-204 may decrease oxidative stress and improve heart function [103,104] (Figure 2).

Inflammation

Silencing miR-150 by myocardial infarction-associated transcript (MIAT) may increase monocytes’ infiltration [105]. ANG II decreases miR-30a inducing ICAM-1 and VCAM by ECs [106]. Down-regulation of maternally expressed three IncRNA (MEG3) decreased M1 and increased M2 macrophage polarization by upregulating miR-223 [107].

MiR-155 induces Th17 cells [108]. PVT1 was associated with higher autophagy in Treg cells by targeting miR-146a [109]. Conversely, deletion of NEAT1 reduces Treg cells [110].

Let-7 induces inflammation. H19 represses let-7, but miR-146a and long intergenic non-protein coding RNA, a regulator of reprogramming (LINC-ROR), compete out this repression [111,112]. MiR-155 and miR-375 induce inflammation and apoptosis [113,114]. In contrast, miR-21 [115], miR-24 [116], miR-126 [117], and miR-144 [118] protect against inflammation [115-118] (Figure 2).

Apoptosis

MiR-16-5p [119], miR-29a [120], miR-30a-5p [121], miR-143-145 [122], miR-150 [123], and miR-155 [124] increase apoptosis. Down-regulation of miR-26a and miR-146a is associated with increased apoptosis [125,126]. In addition, ROS increases the circular RNA derived from solute carrier family eight-member A1 (SLC8A1 or NCX1; CircNCX1) that promotes cardiomyocyte apoptosis by acting as an endogenous miR-133a-3p sponge [127].

In contrast, miR-21 [128], the hypoxia-induced exosomal homeodomain interacting protein kinase three circular RNA (circHIPK3), sponging miR-29a [129], and miR-130a [104] inhibit apoptosis. Urothelial cancer-associated one IncRNA (UCA1) protected from mitochondrial and endoplasmatic reticulum oxidative stress [130] (Figure 2).

Overview of non-coding RNAs related to oxidative stress and inflammation within cardiovascular diseases also related to cancer

Oxidative Stress

Notably, ROS is increased in cancer cells. However, there is a strict balance of ROS levels in the growing tumor to allow cancer cell proliferation and avoid tumor cell apoptosis. NRF2 regulates the cellular redox status in cancer cells. Besides inducing antioxidant and detoxification genes, NRF2 induces metabolic reprogramming during stress. Increased fumarate inactivates Keap1 and activates NRF2. NRF2 induces antioxidant response genes; for example, HO-1 is essential for retaining colony-forming capacity [131]. In addition, GPX1 is a gatekeeper restraining the oncogenic power of mitochondrial ROS generated by SOD2 [132]. PRDX family is essential in regulating oxidative stress avoiding apoptosis in cancer cells [133,134] (Figure 3).

Compared to cardiovascular tissues, silencing of miR-22a, miR-23a, miR-24a, miR-29, miR-34a, miR-140, miR-153, miR-181, and miR-383 reduces oxidative stress by de-repressing NRF2, increasing HO-1, SOD, and PDRX [135-146]. Table 1 summarizes candidate silencing IncRNAs and circ-RNAs.

Inflammation and anti-tumor immunity

Hypoxia, one of the hallmarks of cancer, is caused by an insufficient oxygen supply due to a deficient tumor microcirculation. Hypoxia by activating Wnt/β-catenin reduces the anti-cancer immune responses by (a) reducing survival, the cytolytic and migratory activity of effector cells such as CD4+ cells, CD8+ cytotoxic T cells, natural killer-like T cells, and natural killer (NK) cells, (b) reducing the production and release of effector cytokines, (c) supporting immunosuppressive Treg cells, myeloid-derived suppressor cells and M2 macrophages, (d) increasing the production and release of immunosuppressive cytokines, and (e) inducing the expression of immune checkpoint inhibitors [147]. Wnt ligands stimulate tumor-associated macrophages to produce IL-1β, thus driving systemic inflammation [148]. TAMs are mainly alternatively activated M2 macrophages with immunosuppressive and tumor-promoting capabilities. Hypoxic environment and hypoxia-treated glioma cell supernatants can polarize macrophages toward an M2 phenotype through TGF-β [148,149]. TNF-α derived from M2 tumor-associated macrophages promotes EMT.
Table 1. Potential Silencing IncRNAs and Circular RNAs

| MiR  | LncRNA | Circular RNA |
|------|--------|--------------|
| Let-7e | NEAT1 [237], SNHG4 [238] | FOXO3 [244], MTO1 (hsa_circRNA_0007874, or hsa_circRNA_104135) [245] |
| MiR-9 | CASC2 [239], HULC [240], KCNQ1OT1 [241], NEAT1 [242], TUG1 [243] | PVT1 [246,247] |
| MiR-16a | | ITCH [258], LONP2 [259], MTO1 [260], cSMARCA5 (hsa_circ_0001445) [261], PVT1 [262] |
| MiR-17a | MIR17HG [248], BLACAT1 [249], HNF1A-AS1 [250], HOTAIR [251], H19 [252], IncRNAp21 [253], MALAT1 [254], NEAT1 [255], NR2F1-AS1 [256], XIST [257] | ITCH [258] |
| MiR-20a | HNF1A-AS1 [263], HOTAIR [264], SNHG16 [265] | PVT1 [266] |
| MiR-22 | MIR22HG [267], HOTAIR [268], H19 [269], LINCO0968 [270], MALAT1 [271], MEG3 [272], MIAT [273], NCK1-AS1 [274], PART1 [275] | ITCH [276] |
| MiR-23a | GAS5 [277], MALAT1 [278], MEG3 [279], NEAT1 [280], SNHG5 and SNHG7 [281,282], XIST [283], ZEB1-AS1 [284] | |
| MiR-24 | CASC2 [285], CCAT1 [286], HOXA11-AS [287], NEAT1 [288], SOX21-AS1 [289] | |
| MiR-26a | DLGAP1-AS1 [290], GAN1 [291], GAS5 [292], HCG11 [293], MALAT1 [294], MEG3 [295], MINCR [296], NEAT1 [297], NORAD [298], OIP5-AS1 [299], SNHG5 and SNHG6 [300,301], TUG1 [302], ZNF561-A51 [303] | Circ-0001146 (derived from miR-26a) [304] |
| MiR-29 | DANCR, GAS5, and SNHG5 [305], H19 [306], MEG3 [307] | |
| MiR-30a | LEF1-AS1 [308,309], NORAD [309] | PVT1 [310] |
| MiR-34a | ARSR [311], CCAT1 [312], FEZF1-AS1 [313], GAS5 [314], HNF1A-AS1 [315], HOTAIR [316], KCNQ1OT1 [317], LINCO-ROR [318], MACC1-AS [319], MALAT1 [320], MIAT [321], NEAT1 [322], OIP5-AS1 [323], TUG1 [324], XIST [325] | ANRIL [326, MYLK [327] |
| MiR-128 | MIR4435-2HG [328], HULC [329], MEG3 [330], MIAT [331], OIP5-AS1 [332], SNHG3 [333], SNHG16 [334], SNHG22 [335], TUG1 [336], ZNF561-A51 [303] | PVT1 [337] |
| MiR-140 | CCAT1 [338], H19 [339], MALAT1 [340], MIAT [341], NR2F1-AS1 [342], OIP5-AS1 [343], SNHG16 [344], TUG1 [345] | PVT1 [346] |
| MiR-143 | MIR143HG [347], BLACAT1 [348], CCAT1 [349], HOTAIR [350], H19 [351], MALAT1 [352], NCK1-AS1 [353], OIP5-AS1 [354], SNHG1 [355], SOX2-OT [356], TMPO-AS1 [357], TUG1 [358], UCA1[359], ZEB2-AS1 [360] | FOXM1 [361, FOXO3 [362], PVT1 [363] |
| MiR-150 | BLACAT1 [364], FOXD3-AS1 [365], HULC [366], MIAT [367], NEAT1 [368], PART1 [368], SNHG10 [369], ZFAS1 [370] | PVT1 [371] |
| MiR-153 | FGD5-AS1 [372], HIF1A-AS2 [373], KCNQ1OT1 [374], NEAT1 [375], OIP5-AS1 [376], TTN-AS1 [377], TUG1 [378], XIST [379] | CircPCNXL2 [380] |
| MiR-155 | MIR155HG [381], CCAT1 [382], HOXA11-AS [383], MEG3 [384], MIAT [385], NORAD [386], UCA1 [387], XIST [388] | Circ-CHST15 [389] |
| MiR-181 | CCAT1 [390], MEG3 [391], SNHG6 [183], SNHG7 [392] | |
| MiR-222 | MIR222HG [393], CASC2 [394], DANCR [395], GAS5 [396] | |
| MiR-383 | HOXC13-AS [397], TMPO-AS1 [398] | |
| MiR-424 | MYLK-AS1 [399] | |
| MiR-615 | | Circ-ZNF609 [400] |
and cancer stemness through the Wnt/β-catenin pathway. Reprogramming TAMs towards classically activated M1 macrophages may thwart tumor-associated immunosuppression and unleash anti-tumor immunity [150].

Suppression of let-7 increased M2 macrophages and abated recruitment of activated cytotoxic T lymphocytes [151]. MiR-21, miR-146a-5p, and miR-223 may promote M2-polarization, but the down-regulation of let-7e and miR-126 increases M1 macrophages [152-158]. MiR-21 decreases, whereas miR-155 stimulates cytotoxic T cells [159-161]. MiR-146a and miR-146b may induce differentiation of monocytes to MDSCs, suppressing the anti-tumor immune response, whereas down-regulation of let-7e and miR-125 increases this response [162].

Effective CD8+ T cells appear to target predominantly tumor-specific neoantigens. To elicit an effective antitumor response, these antigens have to be taken up by dendritic cells (DCs) and cross-presented for CD8+ T cell priming. Then, the antigen must be directly presented for recognition by primed CD8+ T cells and killing [163]. MiR-155 may CD8+ T cell fitness and improve the anti-tumor activity of adoptively transferred low-affinity tumor-infiltrating lymphocytes, in particular, by rendering them more resistant to the glucose-deprived environment of solid tumors [164].

Downregulation of miR-17 [165], miR-20a [166], miR-23a [167], miR-24 [168], miR-29 [169], miR-34a [170], miR-128 [171], miR-130a [172], miR-140-3p [173], miR-153 [174], miR-181 [175], and miR-378 [176] may suppress NK cytotoxicity. MiR-155 activates

---

**Figure 3. Oxidative stress, immune response, inflammation, and apoptosis in cancer.** Hypoxia, one of the hallmarks of cancer, reduces the anti-cancer immune responses by activating Wnt/β-catenin. As a result, cytotoxic T cells and NK cells decrease, and immunosuppressive Th2 and Treg cells, myeloid-derived suppressor cells and M2 macrophages increase. This shift augments immunosuppressive cytokines and decreases inflammatory cytokines. Notably, ROS is increased in cancer cells. However, there is a strict balance of ROS levels in the growing tumor to allow cancer cell proliferation and avoid tumor cell apoptosis. This protection is due to a shift from oxidative to antioxidative factors. Upregulated regulators are in yellow circles, downregulated ones in blue circles. Upregulated non-coding RNAs are in brown, down-regulated ones in blue.
NK cells [177].

**Apoptosis**

Down-regulation of miR-9, miR-16-5p, miR-26a, miR-29, miR-30a, miR-34a, miR-124, miR-133, miR-143-145, miR-150, and miR-181a/b protect tumor cells against apoptosis, whereas upregulation of miR-155 induce apoptosis [178-191]. Specifically, miR-19-3p and miR-200c sensitize cancer cells to apoptosis induced by CD95 (or FAS) [192-194]. However, they are often reduced in tumor cells. The decrease of miR-206, miR-1-3p, and miR-133b upregulates the Fas Apoptotic Inhibitory Molecule (FAIM), which counteracts oxidative stress-induced loss of cell viability [195,196]. As in cardiovascular tissues, high miR-21 [197] and miR-107/miR-130a impede apoptosis in tumors [198]. MiR-21 enriched in exosomes from M2 polarized TAMS can be directly transferred from macrophages to cancer cells to protect them against apoptosis [199]. In contrast, silencing of miR-17 [200] induces apoptosis (Figure 3). Table 1 summarizes potential silencing lncRNAs and circular RNAs.

AGEs stimulate oxidative stress generation through the interaction with a receptor for AGE (RAGE), while oxidative stress promotes AGE’s formation and increases RAGE expression. This crosstalk between the AGE-RAGE system and oxidative stress generation may form a positive feedback loop, thus further increasing the risk for cancers, particularly in patients with diabetes [201,202]. The high-mobility group box 1 protein (HMGB1), a late inflammatory cytokine that signals danger to the immune system through RAGE and TLR, induces the expression of miR-221 and miR-222, associated with higher malignancy scores [203]. MiR-185-5p binds to RAGE, reversing the EMT and migration and invasion of cancer [204,205]. Furthermore, blockage of RAGE with an anti-RAGE antibody suppressed induction of miR-21 [206].

Figure 4 illustrates the main differences in miR expression in tumors compared to cardiovascular tissues explaining the shift from high oxidative stress to low oxidative stress, from Th1/Th2 to Th2/Treg with less activated NK cells, and from M1 macrophage to M2 macrophage inflammation. The downregulation of miRs is possibly due to the overexpression of lncRNAs and circ-RNAs summarized in Table 1. Upregulated non-coding RNAs are in brown, down-regulated ones in blue.

**DISCUSSION**

This review focused on miRs related to oxidative stress, immune response related to T cell and MDSC differentiation, inflammation related to M2 or M1 macrophages, and apoptosis. In addition, we identified a cluster of miRs involved in the pathogenesis of cardiometabolic diseases and cancer. This cluster contains: members of let-7 family, miR-1, miR-9, miR-16, miR-17, miR-20a, miR-21, miR-22a, miR-23a, miR-24a, miR-26a, miR-29, miR-30a, miR-34a, miR-128, miR-130a, miR-140, miR-143-145, miR-146a, miR-150, miR-153, miR-155, miR-181 family, miR-221-222, miR-223, miR-378, and miR-383.

MiR-21 protects against cardiovascular diseases by retaining the anti-inflammatory M2 macrophage and Treg phenotypes and inhibiting apoptosis. However, the same effects may induce tumor growth. Transfer of exosomal miR-21 from M2 macrophages to cancer cells may even increase protection against apoptosis. Upregulation of miR-146 and miR-223 may reduce anti-tumor immune response by activating MDSCs and retaining the M2.
macrophage phenotype. As in cardiovascular tissues, miR-155 levels are high in tumors. MiR-155 and silencing of let-7e, miR-125, and miR-126 increase anti-tumor immune response.

Most other miRs are downregulated in tumors but upregulated in cardiovascular tissues. Inflammation, oxidative stress, MYC oncogene, and TGF-β regulate miR expression. IL6 increases miR-17, but IFN-γ suppresses miR-17, thereby reverting anti-inflammatory and anti-oxidative action in breast tumors [207-209]. CXCL12 / CXCR4 up-regulate XIST that silences miR-133a-3p, protecting against apoptosis [210]. Mitochondrially encoded COX2 induces methylation of the promoter of let-7, down-regulating let-7 and up-regulating SOX2 [211].

The expression of non-coding RNAs in tumors depends on MYC. MYC induces miR-155 [212] but may silence other miRs by upregulating ANRIL [213], H19, [214-216], and PVT1, enhancing cancer cells’ proliferation. However, PVT1 may induce or inhibit MYC expression [217-220]. MYC directly down-regulates let-7a, let-7d, and let-7g [221], miR-29 [222-226], and miR-34a 4a indirectly by inducing IncRNA-SNHG7 [227,228]. TGF-β reduces miR-29a [229] and miR-34a, thereby up-regulating VEGF and retaining the M2 macrophage phenotype [230,231] or miR-124 [232]. TGF-β1 also decreases miR-133a/b, protecting against apoptosis [233].

These opposite changes in miR expression profiles may be due to differential expression of lncRNAs and circ-RNAs, as discussed above for ANRIL and PVT1. Table 1 shows that other miRs are prone to silencing by lncRNA and circ-RNAs. The same lncRNA and circ-RNAs may obtain the same effect by targeting several miRs. For example, MALAT1 and NEAT1 may reduce oxidative stress and anti-tumor response by targeting miR-23a, miR-24a, miR-26a, and miR-34a. MALAT1 also protects by targeting miR-22 and miR-140, NEAT1 by targeting miR-150 and miR-153.

On the other hand, they may obtain a similar effect by targeting a different miR. For example, NEAT1 may protect against apoptosis by targeting miR-9, MALAT1 by targeting miR-143. In addition, the effects of TUG1 overlap partially with these of MALAT1 and NEAT1 by targeting miR-9, miR-26a, miR-34a, miR-128, miR-140, miR-143, and miR-153. However, the same non-coding RNA may have opposite effects by targeting several miRs. For example, PVT1 may protect against apoptosis by targeting miR-16a and miR-30a but induce apoptosis by targeting miR-17. This non-specificity in targets and function obscures their mechanistic and clinical value. This lack of knowledge is cumbersome because papers identifying a new non-coding RNA are published each month claiming a new function.

Previously, we showed that most of the identified are regulated by adipokines, glucose, insulin, blood pressure, inflammatory cytokines, and ox-LDL related to metabolic diseases, like obesity, type 2 diabetes, and non-alcoholic fatty liver disease. These metabolic diseases increase the overall risk for cardiovascular diseases and cancer [15]. Thus, the identified cluster of miRs will most probably not be specific markers of cardiovascular diseases or cancer. They may, however, be essential to understanding disease mechanisms.

In addition, we have to be aware that levels of non-coding RNAs in a cell type are not only determined by the expression in that cell type but also by extracellular exchange of non-coding RNAs between cells in a tissue or between tissues [9,15,234,235].

Unfortunately, information about the sequence of changes in expression profiles of non-coding RNAs at different stages of disease progression is lacking. We do not even know which non-coding RNAs are expressed together at the same stages. Indeed, we lack algorithms to determine if non-coding RNAs have any clinical value in addition to phenotypic, therapeutic, behavioral, and social data in a predicting model. Artificial intelligence (AI) or machine-learning methods may be applied to fit vast amounts of expression data combined with phenotypic, therapeutic, behavioral, and social data [236].

Abbreviations: AGES, advanced glycation end products; Akt, Akt serine/threonine kinase 1; AMPK, AMP-activated protein kinase; ANG, angiotensin; ANRIL, CDKN2B anisense RNA 1; ARSR, DNA-binding transcriptional repressor ArsR; ATP, adenosine triphosphate; BLACAT1, bladder cancer-associated transcript 1; BMP, bone morphogenetic proteins; BPTF, bromodomain PHD finger transcription factor; CASC2, cancer susceptibility 2; CCAT1, colon cancer-associated transcript 1; CCL5, C-C motif chemokine ligand 5; CCL2 (or MCP-1), C-C motif chemokine ligand 2; CCR2 (or MCP-1 receptor), C-C motif chemokine receptor 2; CHST15, carbohydrate sulfotransferase 15; circ, circular; CM, cardiomyocyte; DAME, damage-associated molecular patterns; DANC, differentiation antagonizing non-protein coding RNA; DC, dendritic cell, DLGAP1, DLG associated protein 1; ECs, endothelial cells; ERK, extracellular-signal-regulated kinase; FEZF1, FEZ family zinc finger 1; FGDF5, FVYE, RhoGEF and PH domain containing 5; FOXD3, forkhead box D3; FOXM1, forkhead box M1; FOXO, forkhead box O; GAN1, gigaxonin; GAS5, growth arrest specific 5; GPX, glutathione peroxidase; HCG11, HLA complex group 11; HIF, hypoxia-inducible factor; HIPK3, homeodomain interacting protein kinase 3; HMGB1, high-mobility group box 1 protein; HNF1A, HNF1 homeobox A; HO, heme oxygenase; HOTAIR, homeobox transcript antisense IncRNA; HOXA11, homeobox 11; HULC, hepatocellular carcinoma upregulated-long non-coding RNA; H19, H19 imprint maternally expressed transcript; ICAM-1, intercellular adhesion molecule 1; IFN, interferon; IL, interleukin; IRS, insulin substrate receptor; ITCH, Itchy E3 ubiquitin protein ligase; KCNQ1OT1, KCNQ1 opposite strand antisense transcript 1; KLF, Krüppel-like factor; LEF1, lymphoid enhancer-binding factor 1; LIN-28, lin-28 homolog; IncRNA, long non-coding RNA; LncRNA-ATB, long non-coding RNA activated by TGF-β; LINC-ROR, long intergenic non-protein coding RNA, regulator of reprogramming; LONP2, lon peptidase 2; MACC1, MACC1MET transcriptional regulator; MALAT1, metastasis-associated lung adenocarcinoma transcript 1; MAPK, mitogen-ac-
tivated protein kinase; MDSC, myeloid-derived suppressor cell; MEG3, maternally expressed 3 IncRNA; MIAT, myocardial infarction-associated transcript; MINCR, MYC-induced long non-coding RNA; MIRT1, myocardial infarction associated with transcript 1; MIR22HG, MIR22 host gene; MTO1, mitochondrial translation optimization 1 homologue; MPO, myeloperoxidase; MYLK, myosin light chain kinase; NCK1, noncatalytic region of tyrosine kinase adaptor protein 1; NEAT1, nuclear paraspeckle assembly transcript 1; NEXN-AS1, nexin-actin binding protein antisense RNA 1; NFκB, nuclear factor kappa B; NK, natural killer; NLRP3, NLR family pyrin domain containing 3; NORAD, noncoding RNA activated by DNA damage; NOS, nitric oxide synthase; NOX, NADPH oxidase; NRF2, NF-E2-related factor 2; NR2F1, nuclear receptor subfamily 2 group F member 1; OIP5-AS1, Opa-interacting protein five antisense RNA 1; Ox-LDL, oxidized LDL; OXPHOS, oxidative phosphorylation; PART1, prostate androgen regulated transcript 1; PCNXL2, pecanx 2; PF4 (or CXCL4), platelet factor-4; PPARy, peroxisome proliferator activated receptor gamma; PQC-1α, proliferator-activated receptor gamma coactivator-1α; PISK, phosphatidylinositol 3-kinase; PIGF, placental growth factor; PRDX, peroxiredoxin; PTEN, phosphatase and tensin homolog; PVTL1, Ptvl 1 oncogene circular RNA; ROS, reactive oxygen species; SIRT, sirtuin; SLC2A4 (or GLUT4), glucose transporter solute carrier family two-member four; SLC8A1 (or NCX1), solute carrier family eight-member A1; SMARCA5, SWI/SNF related, matrix family two-member four; SLC8A1 (or NCX1), solute carrier family eight-member A1; SMARCA5, SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfamily a, member 5; SNHG, small nucleolar RNA host gene host gene; SOCS, suppressor of cytokine signaling; SOD, Superoxide dismutases; SOX, SRY-box transcription factor; SOX2-OT, SOX2 overlapping transcript; SPRY4-IT1, Sprouty4-Intron 1; STAT, signal transducers and activators of transcription; TF, tissue factor; TGF, transforming growth factor; TLR, toll-like receptor; TMPo, thymopoietin; TNIfr, tumor necrosis factor α; Treg, regulatory T cell; TTN, titin; TUG1, taurine upregulated 1; UCA1, urothelial cancer-associated one lnc-RNA; VCAM-1, vascular cell adhesion molecule 1; VEGF, vascular endothelial growth factor; XIST, X inactive specific transcript; ZEB, zinc finger E-box binding homeobox; ZNF, zinc finger protein; ZFAS1, ZNFX1 antisense RNA 1.

REFERENCES

1. Kattoor AJ, Pothineni NV, Palagiri D, Mehta JL. Oxidative Stress in Atherosclerosis.Curr Atheroscler Rep. 2017 Sep;19(11):42.
2. Bugger H, Pfeil K. Mitochondrial ROS in myocardial ischemia reperfusion and remodeling. Biochim Biophys Acta Mol Basis Dis. 2020 Jul;1866(7):165769.
3. Hayes JD, Dinkova-Kostova AT, Tew KD. Oxidative Stress in Cancer. Cancer Cell. 2020 Aug;38(2):167–97.
4. Chen DS, Mellman I. Elements of cancer immuni-
ty and the cancer-immune set point. Nature. 2017 Jan;541(7637):321–30.
5. Rahman MS, Woollard K. Atherosclerosis. Adv Exp Med Biol. 2017;1003:121–44.
6. El Assar M, Angulo J, Rodriguez-Mañas L. Oxidative stress and vascular inflammation in aging. Free Radic Biol Med. 2013 Dec;65:380–401.
7. Greten FR, Grivennikov SI. Inflammation and Cancer: Triggers, Mechanisms, and Consequences. Immunity. 2019 Jul;51(1):27–41.
8. Anastasiadou E, Jacob LS, Slack FJ. Non-coding RNA networks in cancer. Nat Rev Cancer. 2018 Jan;18(1):5–18.
9. Hulsmans M, Holvoet P. MicroRNA-containing microvesicles regulating inflammation in association with atherosclerotic disease. Cardiovasc Res. 2013 Oct;100(1):7–18.
10. Bei Y, Yang T, Wang L, Holvoet P, Das S, Sluijter JP, et al. Circular RNAs as Potential Theranostics in the Cardiovascular System. Mol Ther Nucleic Acids. 2018 Dec;13:407–18.
11. Bartel DP. MicroRNAs: genomics, biogenesis, mechanism, and function. Cell. 2004 Jan;116(2):281–97.
12. Memczak S, Jens M, Elefimenioti A, Torti F, Krueger J, Rybak A, et al. Circular RNAs are a large class of animal RNAs with regulatory potency. Nature. 2013 Mar;495(7441):333–8.
13. Kowalczyk MS, Higgs DR, Gingeras TR. Molecular biology: RNA discrimination. Nature. 2012 Feb;482(7385):310–1.
14. Navickas R, Gal D, Lausevicius A, Tapauskaite A, Zdanyte M, Holvoet P. Identifying circulating microRNAs as biomarkers of cardiovascular disease: a systematic review. Cardiovasc Res. 2016 Sep;111(4):322–37.
15. Holvoet P. Non-coding RNAs at the Cross-Road of Cardiometabolic Diseases and Cancer. Springer International Publishing; 2021. 265 pp. https://doi.org/10.1007/978-3-030-68488-4.
16. Franco CA, Jones ML, Bernabeu MO, Vion AC, Barbacena P, Fan J, et al. Non-canonical Wnt signalling modulates the endothelial shear stress flow sensor in vascular remodeling. elife. 2016 Feb;5:e07727.
17. Soulilhol C, Serbanovic-Canic J, Fragiadaki M, Chico TJ, Ridger V, Roddie H, et al. Endothelial responses to shear stress in atherosclerosis: a novel role for developmental genes. Nat Rev Cardiol. 2020 Jan;17(1):52–63.
18. Gimbrone MA Jr, Garcia-Cardena G. Endothelial Cell Dysfunction and the Pathobiology of Atherosclerosis. Circ Res. 2016 Feb;118(4):620–36.
19. Li X, Tang Y, Chen C, Qiu D, Cao Y. PEGylated gold nanorods are not cytotoxic to human endothelial cells but affect kruppel-like factor signaling pathway. Toxicol Appl Pharmacol. 2019 Nov;382:114758.
20. Domschke G, Greissner CA. CXCL4-induced macrophages in human atherosclerosis. Cytokine. 2019 Oct;122:154141.
21. Hulsmans M, Geeraert B, De Keyzer D, Mertens A, Rybak A, et al. Circular RNAs are a large class of animal RNAs with regulatory potency. Nature. 2013 Mar;495(7441):333–8.
22. Fukai T, Ushio-Fukai M. Superoxide dismutases: role in redox signaling, vascular function, and diseases. Antioxid Redox Signal. 2011 Sep;15(6):1583–606.
23. Zhang X, Li X, Jia H, An G, Ni J. The microRNA METTL3 modifies PGC-1α mRNA promoting mitochondrial dysfunction and oxLDL-induced inflammation in monocytes. J Biol Chem. 2021 Sep;297(3):101058.
24. Landis RC, Quimby KR, Greenidge AR. M1/M2 Macrophages in Diabetic Nephropathy: Nrf2/HO-1 as Therapeu-
tic Targets. Curr Pharm Des. 2018;24(20):2241–9.
25. Cheng F, Torzewski M, Degreif A, Rossmann H, Canisius K. Impact of glutathione peroxidase-1 deficiency on macrophage foam cell formation and prolifera-
tion: implications for atherogenesis. PLoS One. 2013 Nov;8(11):e78341.
26. Jin X, Cheng F, Torzewski M, Degreif A, Rossmann H, Canisius K. Impact of glutathione peroxidase-1 deficiency on macrophage foam cell formation and proliferation: implications for atherogenesis. PLoS One. 2013 Nov;8(11):e78341.
26. Kisucka J, Chauhan AK, Pattan IS, Yesilaltay A, Neumann C, Van Etten RA, et al. Peroxiredoxin1 prevents excessive endothelial activation and early atherosclerosis. Circ Res. 2008 Sep;103(6):598–605.
27. Park JG, Yoo YJ, Jeong SJ, Choi JH, Lee MR, Lee MN, et al. Peroxiredoxin 2 deficiency exacerbates atherosclerosis in apolipoprotein E-deficient mice. Circ Res. 2011 Sep;109(7):739–49.
28. Wolf D, Ley K. Immunity and Inflammation in Atherosclerosis. Circ Res. 2019 Jan;124(2):315–27.
29. Xue Y, Wei Z, Ding H, Wang Q, Zhou Z, Zheng S, et al. MicroRNA-19b/221/222 induces endothelial cell dysfunction via suppression of PGC-1α in the progression of atherosclerosis. Atherosclerosis. 2015 Aug;241(2):671–81.
30. Wu J, Liang W, Tian Y, Ma F, Huang W, Jia Y, et al. Inhibition of P53/miR-34a improves diabetic endothelial dysfunction via activation of SIRT1. J Cell Mol Med. 2019 May;23(5):3538–48.
31. Hu B, Gong Z, Bi Z. Inhibition of miR-383 suppresses oxidative stress and improves endothelial function by increasing sirtuin 1. Braz J Med Biol Res. 2020 Jan;53(2):e8616.
32. Gou L, Zhao L, Song W, Wang L, Liu J, Zhang H, et al. Inhibition of miR-92a Suppresses Oxidative Stress and Improves Endothelial Function by Upregulating Heme Oxygenase-1 in db/db Mice. Antioxid Redox Signal. 2018 Feb;28(5):358–70.
33. Togliatto G, Trombetta A, Dentelli P, Gallo S, Rosso A, boa-Geffen A, et al. MicroRNA-132 potentiates cholinergic anti-inflammatory signaling by targeting acetylcholinesterase. Immunity. 2009 Dec;31(6):965–73.
34. Leisegang MS, Bibli SI, Günther S, Pflüger-Müller B, Oo JA, Höper C, et al. Pleiotropic effects of laminar flow and statins depend on the Krüppel-like factor-induced lncRNA OIP5-AS1. Mol Med. 2019 Feb;25(2):443–55.
35. Liu QQ, Ren K, Liu SH, Li WM, Huang CJ, Yang XH. micro-RNA 17 and 20a - role during monocyte-to-macrophage differentiation. Mol Immunol. 2013 Dec;56(4):442–49.
36. Harris TA, Yamakuchi M, Ferlito M, Mendell JT, Lowenstein CJ. MicroRNA-126 regulates endothelial expression of vascular cell adhesion molecule 1. Proc Natl Acad Sci USA. 2008 Feb;105(5):1516–21.
37. Chauhan AK, Patel N, Mahabeleshwar GH. Kruppel-like factor 6 and miR-223 signaling axis regulates TLR-triggered IL-6 and IL-1β production in macrophages by targeting STAT3. PLoS One. 2012;7(12):e51140.
38. Shen Y, Xu H, Pan X, Wu W, Wang H, Yan L, et al. miR-34a and miR-125b are upregulated in peripheral blood mononuclear cells from patients with type 2 diabetes mellitus. Exp Ther Med. 2017 Dec;14(6):5589–96.
39. Lin Z, Ge J, Wang Z, Ren J, Wang X, Xiong H, et al. Let-7e regulates the inflammatory response in vascular endothelial cells through ceRNA crosstalk. Sci Rep. 2017 Feb;7(1):42498.
40. Wang N, Zhou Y, Jiang L, Li D, Yang J, Zhang CY, et al. Urinary microRNA-10a and microRNA-30d serve as novel, sensitive and specific biomarkers for kidney injury. PLoS One. 2012;7(12):e11540.
41. Liu QQ, Ren K, Liu SH, Li WM, Huang CJ, Yang XH. MicroRNA-140-5p aggravates hypertension and oxidative stress of atherosclerosis via targeting Nrf2 and Sirt2. Int J Mol Sci. 2019 Feb;20(5):358–70.
42. Wang N, Zhou Y, Jiang L, Li D, Yang J, Zhang CY, et al. Urinary microRNA-10a and microRNA-30d serve as novel, sensitive and specific biomarkers for kidney injury. PLoS One. 2012;7(12):e11540.
43. Qin SB, Peng DY, Lu JM, Ke ZP. MiR-182-5p inhibited oxidative stress and apoptosis triggered by oxidized low-density lipoprotein via targeting toll-like receptor 4. J Cell Physiol. 2018 Oct;233(10):10902–15.
44. Chen Q, Wang H, Liu Y, Song Y, Lai L, Han Q, et al. Inducible micrRNA-223 down-regulation promotes TLR-triggered IL-6 and IL-1β production in macrophages by targeting STAT3. PLoS One. 2012;7(8):e42971.
45. Chen Q, Wang H, Liu Y, Song Y, Lai L, Han Q, et al. Inducible micrRNA-223 down-regulation promotes TLR-triggered IL-6 and IL-1β production in macrophages by targeting STAT3. PLoS One. 2012;7(8):e42971.
46. Kim GD, Ng HP, Patel N, Mahabeleshwar GH. MicroRNA-19b/221/222 induces endothelial cell dysfunction via suppression of PGC-1α in the progression of atherosclerosis. Atherosclerosis. 2015 Aug;241(2):671–81.
47. Shaked I, Meerson A, Avni R, Greenberg D, Gilboa-Geffen A, et al. MicroRNA-132 potentiates cholinergic anti-inflammatory signaling by targeting acetylcholinesterase. Immunity. 2009 Dec;31(6):965–73.
48. Poitz DM, Augstein A, Gradehand C, Ende G, Schmeisser A, Strasser RH. Regulation of the Hif-system by microRNA-17 and 20a - role during monocyte-to-macrophage differentiation. Mol Immunol. 2013 Dec;56(4):442–51.
49. Poitz DM, Augstein A, Gradehand C, Ende G, Schmeisser A, Strasser RH. Regulation of the Hif-system by microRNA-17 and 20a - role during monocyte-to-macrophage differentiation. Mol Immunol. 2013 Dec;56(4):442–51.
50. Hu YW, Guo FX, Xu YJ, Li P, Lu ZF, McVey DG, et al. Long noncoding RNA NEXN-AS1 mitigates atherosclerosis by regulating the actin-binding protein NEXN. J Clin Invest. 2019 Mar;129(3):1115–28.
51. Huang TS, Wang KC, Quon S, Nguyen P, Chang TY, Chen Z, et al. LINC00341 exerts an anti-inflammatory effect on endothelial cells by repressing VCAM1. Physiol Genomics. 2017 Jul;49(7):339–45.
52. Leisegang MS, Bibli SI, Günther S, Pflüger-Müller B, Oo JA, Höper C, et al. Pleiotropic effects of laminar flow and statins depend on the Krüppel-like factor-induced lncRNA MANTIS. Eur Heart J. 2019 Aug;40(30):2523–33.
53. Muñoz-Pacheco P, Ortega-Hernández A, Miana M, Cachofeiro V, Fernández-Cruz A, Gómez-Garre D. Ezetimibe inhibits PMA-induced monocyte/macrophage differentiation by altering microRNA expression: a novel anti-atherosclerotic mechanism. Pharmacol Res. 2012 Dec;66(6):536–43.
54. Wu Y, Ye J, Guo R, Liang X, Yang L, TRIF Regulates BIC/miR-155 via the ERK Signaling Pathway to Control the ox-LDL-Induced Macrophage Inflammatory Response. J Immunol Res. 2018 Jun;2018:6294085.
55. Muñoz-Pacheco P, Ortega-Hernández A, Miana M, Cacho
atherosclerosis. Circ Res. 2015 Jun;117(1):e1–11.

55. Gast M, Rauch BH, Nakagawa S, Haghikia A, Jasina A, Haas J, et al. Immune system-mediated atherosclerosis caused by deficiency of long non-coding RNA MALAT1 in ApoE-/-mice. Cardiovasc Res. 2019 Feb;115(2):302–14.

56. Zhang W, Sui Y. CircBPTF knockdown ameliorates high glucose-induced inflammatory injuries and oxidative stress by targeting the miR-384-5p/LIN28B axis in human umbilical vein endothelial cells. Mol Cell Biochem. 2020 Aug;471(1-2):101–11.

57. Cheng J, Liu Q, Hu N, Zheng F, Zhang X, Ni Y, et al. Downregulation of hsa_circ_0068087 ameliorates TLR4/NF-κB/LIN28B inflammasome-mediated inflammation and endothelial cell dysfunction in high glucose condition by sponging miR-197. Gene. 2019 Aug;709:1–7.

58. Pang JL, Wang JW, Hu PY, Jiang JS, Yu C. HOTAIR alleviates ox-LDL-induced inflammatory response in Raw264.7 cells via inhibiting NF-κB pathway. Eur Rev Med Pharmacol Sci. 2018 Oct;22(20):6991–8.

59. Rouas R, Fayyad-Kazan H, El Zein N, Lewalle P, Rothé F, et al. Human natural Treg microRNA signature: role of microRNA-31 and microRNA-21 in FoxP3 expression. Eur J Immunol. 2009 Jun;39(6):1608–18.

60. Zheng J, Wang W, Hong T, Yang S, Shen J, Liu C. Suppression of microRNA-155 exerts an anti-inflammatory effect on CD4+ T cell-mediated inflammatory response in the pathogenesis of atherosclerosis. Acta Biochim Biophys Sin (Shanghai). 2020 Jun;52(6):654–64.

61. Yao R, Ma Y, Du Y, Liao M, Li H, Liang W, et al. The altered expression of inflammation-related microRNAs with microRNA-155 expression correlates with Th17 differentiation in patients with acute coronary syndrome. Cell Mol Immunol. 2011 Nov;8(6):486–95.

62. Ma Y, Huang D, Yang F, Tian M, Wang Y, Shen D, et al. Long Noncoding RNA Highly Upregulated in Liver Cancer Regulates the Tumor Necrosis Factor-α-Induced Apoptosis in Human Vascular Endothelial Cells. DNA Cell Biol. 2016 Jun;35(6):296–300.

63. Su G, Sun G, Liu H, Shu L, Liang Z. Downregulation of miR-34a promotes endothelial cell growth and suppresses apoptosis in atherosclerosis by regulating Bcl-2. Heart Vessels. 2018 Oct;33(10):1185–94.

64. Zheng B, Yin WN, Suzuki T, Zhang XH, Zhang Y, Song LL, et al. Exosome-Mediated miR-155 Transfer from Smooth Muscle Cells to Endothelial Cells Induces Endothelial Injury and Promotes Atherosclerosis. Mol Ther. 2017 Jun;25(6):1279–94.

65. Pan JX. LncRNA-H19 promotes atherosclerosis by regulating MAPK and NF-κB signaling pathway. Eur Rev Med Pharmacol Sci. 2017 Jan;21(2):322–8.

66. Weber M, Baker MB, Moore JP, Searles CD. MiR-21 is induced in endothelial cells by shear stress and modulates apoptosis and eNOS activity. Biochem Biophys Res Commun. 2010 Mar;389(4):643–8.

67. Sheedy FJ, Palsson-McDermott E, Hennessy EJ, Martin C, O’Leary JJ, Ruan Q, et al. Negative regulation of TLR4 via targeting of the proinflammatory tumor suppressor PDCD4 by the microRNA miR-21. Nat Immunol. 2010 Feb;11(2):141–7.

68. Yan B, Yao J, Liu JY, Li XM, Wang XQ, Li YJ, et al. LncRNA-MIAT regulates microvascular dysfunction by functioning as a competing endogenous RNA. Circ Res. 2015 Mar;116(7):1143–56.

69. Yu X, Ruan Y, Shen T, Qiu Q, Yan M, Sun S, et al. Dexamethasone Protects Cardiomyocyte from Doxorubicin-Induced Apoptosis by Modulating miR-17-5p. BioMed Res Int. 2020 Mar;2020:5107193.

70. Cadenas S. ROS and redox signaling in myocardial ischemia-reperfusion injury and cardioprotection. Free Radic Biol Med. 2018 Mar;117:76–89.

71. Koyama H, Nojiri H, Kawakami S, Sunagawa T, Shiraishi T, Shimizu T. Antioxidants improve the phenotypes of dilated cardiomyopathy and muscle fatigue in mitochondrial superoxide dismutase-deficient mice. Molecules. 2013 Jan;18(2):1383–93.

72. Benhar R. Roles of mammalian glutathione peroxidase and thioredoxin reductase enzymes in the cellular response to nitrosative stress. Free Radic Biol Med. 2018 Nov;127:160–4.

73. Lee YJ. Knockout Mouse Models for Peroxiredoxins. Antioxidants. 2020 Feb;9(2):E182.

74. Waldman M, Arad M, Abraham NG, Hochhauser E. The Peroxisome Proliferator-Activated Receptor-Gamma Coactivator-1α-Heme Oxygenase 1 Axis, a Powerful Antioxidative Pathway with Potential to Attenuate Diabetic Cardiomyopathy. Antioxid Redox Signal. 2020 Jun;32(17):1273–90.

75. Barančík M, Grešová L, Barteková M, Dovinová I. Nrf2 as a key player of redox regulation in cardiovascular diseases. Physiol Res. 2016 Sep;65 Suppl 1:S1–10.

76. Dewald O, Zymek P, Winkelmann K, Koerting A, Ren G, Graf F, et al. Immune system-mediated atherosclerosis. Circ Res. 2015 Jun;117(2):e1–11.

77. Nian M, Lee P, Kaper N, Liu P. Immunological cytokines and postmyocardial infarction remodeling. Circ Res. 2004 Jun;94(12):1543–53.

78. Timmers L, Pasterkamp G, de Hoog VC, Arslan F, Appelman Y, de Kleijn DP. The innate immune response in reperfused myocardium. Cardiovasc Res. 2012 May;94(2):276–83.

79. Ghigo A, Franco I, Morell F, Hirsch E. Myocyte signaling in leucocyte recruitment to the heart. Cardiovasc Res. 2014 May;102(2):270–80.

80. Andrassy M, Volz HC, Igwe JC, Funke B, Eichberger SN, Kaya Z, et al. High-mobility group box-1 in ischemia-reperfusion injury of the heart. Circulation. 2008 Jun;117(25):3216–26.

81. Yamauchi-Takihara K, Ihara Y, Ogata A, Yoshizaki K, Azuma J, Kishimoto T. Hypoxic stress induces cardiac myocyte-derived interleukin-6. Circulation. 1995 Mar;91(5):1520–4.

82. Arslan F, de Kleijn DP, Pasterkamp G. Innate immune signaling in cardiac ischemia. Nat Rev Cardiol. 2011 May;8(5):292–300.

83. Laroumanie F, Douin-Echinard V, Pozzo J, Lairéz O, Tortosa F, Vinel C, et al. CD4+ T cells promote the transition from hypertrophy to heart failure during chronic pressure overload. Circulation. 2014 May;129(21):2111–24.

84. Cheng X, Liao YH, Zhang J, Li B, Ge H, Yuan J, et al.
Effects of Atorvastatin on Th polarization in patients with acute myocardial infarction. Eur J Heart Fail. 2005 Dec;7(7):1099–104.

85. Cheng X, Liao YH, Ge H, Li B, Zhang J, Yuan J, et al. TH1/TH2 functional imbalance after acute myocardial infarction: coronary arterial inflammation or myocardial inflammation. J Clin Immunol. 2005 May;25(3):246–53.

86. Zhang J, Liao Y, Cheng X, Chen J, Chen P, Gao X, et al. Myosin specific-T lymphocytes mediated myocardial inflammation in adoptive transferred rats. Cell Mol Immunol. 2006 Dec;3(6):445–51.

87. Cheng X, Yu X, Ding YJ, Fu QQ, Xie JJ, Tang TT, et al. The Th17/Treg imbalance in patients with acute coronary syndrome. Clin Immunol. 2008 Apr;127(1):89–97.

88. Tang TT, Yuan J, Zhu ZF, Zhang WC, Xiao H, Xia N, et al. Regulatory T cells ameliorate cardiac remodeling after myocardial infarction. Basic Res Cardiol. 2012 Jan;107(1):123.

89. Du J, Hang P, Pan Y, Feng B, Zheng Y, Chen T, et al. Inhibition of miR-23a attenuates doxorubicin-induced mitochondrial-dependent cardiomyocyte apoptosis by targeting the PGC-1α/Drp1 pathway. Toxicol Appl Pharmacol. 2019 Apr;369:73–81.

90. Suh JH, Choi E, Cha MJ, Song BW, Ham O, Lee SY, et al. Up-regulation of miR-26a promotes apoptosis of hypoxic rat neonatal cardiomyocytes by repressing GSK-3β protein expression. Biochem Biophys Res Commun. 2012 Jun;432(2):404–10.

91. Yang B, Ma S, Wang YB, Xu B, Zhao H, He YY, et al. Resveratrol exerts protective effects on anoxia/reoxygenation injury in cardiomyocytes via miR-34a/Sirt1 signaling pathway. Eur Rev Med Pharmacol Sci. 2016 Oct;20(12):2734–41.

92. Du JK, Cong BH, Yu Q, Wang H, Wang L, Wang CN, et al. Upregulation of microRNA-22 contributes to myocardial ischemia-reperfusion injury by interfering with the mitochondrial function. Free Radic Biol Med. 2016 Jul;96:406–17.

93. Das S, Bedja D, Campbell N, Dunkerly B, Chenna V, Maiitra A, et al. miR-181c regulates the mitochondrial genome, bioenergetics, and propensity for heart failure in vivo. PLoS One. 2014 May;9(5):e96820.

94. Lin KH, Kumar VB, Shanmugam T, Shibu MA, Chen RJ, Kuo CH, et al. miR-145-5p targets paxillin to attenuate angiotensin II-induced pathological cardiac hypertrophy via downregulation of Rac1, pJNK, p-c-Jun, NFATc3, ANP and by Sirt1 upregulation. Mol Cell Biochem. 2021 Sep;476(1-2):3253–60.

95. Zhu X, Zhao Y, Hou W, Guo L. MiR-153 regulates cardiomyocyte apoptosis by targeting Nrf2/HO-1 signaling. Chromosome Res. 2019 Sep;27(3):167–78.

96. Zhu XA, Gao LF, Zhang ZG, Xiang DK. Down-regulation of miR-320 exerts protective effects on myocardial I/R injury via facilitating Nrf2 expression. Eur Rev Med Pharmacol Sci. 2019 Feb;23(4):1730–41.

97. Wang L, Huang H, Fan Y, Kong B, Hu H, Hu K, et al. Effects of downregulation of microRNA-181a on H2O2-induced H9c2 cell apoptosis via the mitochondrial apoptotic pathway. Oxid Med Cell Longev. 2014;2014:960362.

98. Kyrychenko S, Kyrychenko V, Badr MA, Ikeda Y, Sadoshima J, Shirokova N. Pivotal role of miR-448 in the development of ROS-induced cardiomyopathy. Cardiovasc Res. 2015 Dec;108(3):324–34.

99. Zhang C, Ge S, Gong W, Xu J, Guo Z, Liu Z, et al. LncRNA ANRIL acts as a modular scaffold of WDR5 and HDAC3 complexes and promotes alteration of the vascular smooth muscle cell phenotype. Cell Death Dis. 2020 Jun;11(6):435.

100. Shi CC, Pan LY, Zhao YQ, Li Q, Li JG. MicroRNA-323-3p inhibits oxidative stress and apoptosis after myocardial infarction by targeting TGF-β2/JNK pathway. Eur Rev Med Pharmacol Sci. 2020 Jun;24(12):6961–70.

101. Zhang S, Wang Y, Wang P, Xuan J. miR-708 affords protective efficacy in anoxia/reoxygenation-stimulated cardiomyocytes by blocking the TLR4 signaling via targeting HMGB1. Mol Cell Probes. 2020 Dec;54:101653.

102. Su Q, Liu Y, Lv XW, Dai RX, Yang XH, Kong BH. LncRNA TUG1 mediates ischemic myocardial injury by targeting miR-132-3p/HDAC3 axis. Am J Physiol Heart Circ Physiol. 2020 Feb;318(2):H332–44.

103. Yang J, Brown ME, Zhang H, Martinez M, Zhao Z, Bhutani S, et al. High-throughput screening identifies microRNAs that target Nox2 and improve function after acute myocardial infarction. Am J Physiol Heart Circ Physiol. 2017 May;312(5):H1002–12.

104. Li Y, Zhang H, Li Z, Yan X, Li Y, Liu S. microRNA-130a-5p suppresses myocardial ischemia-reperfusion injury by downregulating the HMGBl2/NF-kB axis. BMC Cardiovasc Disord. 2021 Mar;21(1):121.

105. Liu W, Liu Y, Zhang Y, Zhu X, Zhang R, Guan L, et al. MicroRNA-150 Protects Against Pressure Overload-Induced Cardiac Hypertrophy. J Cell Biochem. 2015 Oct;116(10):2166–76.

106. Demolli S, Doebele C, Doddballapur A, Lang V, Fisslthaler B, Chavakis E, et al. MicroRNA-30 mediates anti-inflammatory effects of shear stress and KLF2 via repression of angiotopoietin 2. J Mol Cell Cardiol. 2015 Nov;88:111–9.

107. Xue YL, Zhang SX, Zheng CF, Li YF, Zhang LH, Su QY, et al. Long non-coding RNA MEG3 inhibits M2 macrophage polarization by activating TRAF6 via microRNA-NA-223 down-regulation in viral myocarditis. J Cell Mol Med. 2020 Nov;24(21):12341–54.

108. Escobar TM, Kanellopoulou C, Kugler DG, Kilaru G, Nguyen CK, Nagarajan V, et al. miR-155 activates cytokine gene expression in Th17 cells by regulating the DNA-binding protein Jarid2 to relieve polycomb-mediated repression. Immunity. 2014 Jun;40(6):865–79.

109. Lu J, Wang X, Zhang B, Li P, Du X, Qi F. The IncRNA PVT1 regulates autophagy in regulatory T cells to suppress heart transplant rejection in mice by targeting miR-146a. Cell Immunol. 2021 Sep;367:104400.

110. Gast M, Rauch BH, Haghiakia A, Nakagawa S, Haas J, Stroux A, et al. Long noncoding RNA NEAT1 modulates immune cell functions and is suppressed in early onset myocardial infarction patients. Cardiovasc Res. 2019 Nov;115(13):1886–906.

111. Fu Z, Li G, Li Z, Wang Y, Zhao Y, Zheng S, et al. Endogenous miRNA Sponge LincRNA-ROR promotes proliferation, invasion and stem cell-like phenotype of pancreatic
cancer cells. Cell Death Discov. 2017 May;3(1):17004.

112. Peng F, Li TT, Wang KL, Xiao GQ, Wang JH, Zhao HD, et al. H19/let-7/LIN28 reciprocal negative regulatory circuit promotes breast cancer stem cell maintenance. Cell Death Dis. 2017 Jan;8(1):e2569.

113. Girakipati VN, Verma SK, Jolardarashi D, Cheng Z, Ibbeti J, Cimini M, et al. Therapeutic inhibition of miR-375 attenuates post-myocardial infarction inflammatory response and left ventricular dysfunction via PDK-1-AKT signalling axis. Cardiovasc Res. 2017 Jul;113(8):938–49.

114. Wang C, Zhang C, Liu L, A X, Chen B, Li Y, et al. Macrophage-Derived mir-155-Containing Exosomes Suppress Fibroblast Proliferation and Promote Fibroblast Inflammation during Cardiac Injury. Mol Ther. 2017 Jan;25(1):192–204.

115. Yang L, Wang B, Zhou Q, Wang Y, Liu X, Liu Z, et al. MicroRNA-21 prevents excessive inflammation and cardiac dysfunction after myocardial infarction through targeting KBTBD7. Cell Death Dis. 2018 Jul;9(7):769.

116. Maegdefessel L, Spin JM, Raaz U, Eken SM, Toh R, Azuma J, et al. miR-24 limits aortic vascular inflammation and murine abdominal aneurysm development. Nat Commun. 2014 Oct;5(1):3214.

117. Chen J, Cui C, Yang X, Xu J, Venkat P, Zacharek A, et al. MiR-126 Affects Brain-Heart Interaction after Cerebral Ischemic Stroke. Transl Stroke Res. 2017 Aug;8(4):374–85.

118. Li J, Cai SX, He Q, Zhang H, Friedberg D, Wang F, et al. Intravenous miR-144 reduces left ventricular remodeling after myocardial infarction. Basic Res Cardiol. 2018 Aug;113(5):36.

119. Wang X, Shang Y, Dai S, Wu W, Yi F, Cheng L. MicroRNA-16-5p Aggravates Myocardial Infarction Injury by Targeting the Expression of Insulin Receptor Substrates 1 and Mediating Myocardial Apoptosis and Angiogenesis. Curr Neurovasc Res. 2020;17(1):11–7.

120. Ye Y, Hu Z, Lin Y, Zhang C, Perez-Polo JR. Down-regulation of microRNA-29 by antisense inhibitors and a PPAR-gamma agonist protect against myocardial ischaemia-reperfusion injury. Cardiovasc Res. 2010 Aug;87(3):535–44.

121. Wang JJ, Bie ZD, Sun CF. Long noncoding RNA AK088388 regulates autophagy through mir-30a to affect cardiomyocyte injury. J Cell Biochem. 2019 Jun;120(6):10155–63.

122. Li QX, Liu YK, Yi J, Dong JS, Zhang PP, Wan L, et al. MicroRNA-143 Increases Oxidative Stress and Myocardial Cell Apoptosis in a Mouse Model of Doxorubicin-Induced Cardiac Toxicity. Med Sci Monit. 2020 Mar;26:e920394.

123. Li X, Kong M, Jiang D, Qian J, Duan Q, Dong A. MicroRNA-150 aggravates H2O2-induced cardiac myocyte injury by down-regulating c-myc gene. Acta Biochim Biophys Sin (Shanghai). 2013 Sep;45(9):734–41.

124. Li XQ, Liu YK, Yi J, Dong JS, Zhang PP, Wan L, et al. Therapeutic inhibition of miR-375 attenuates post-myocardial infarction inflammatory response and left ventricular dysfunction via PDK-1-AKT signalling axis. Cardiovasc Res. 2017 Jul;113(8):938–49.

125. Pan JA, Tang Y, Yu JY, Zhang H, Zhang JF, Wang CQ, et al. miR-146a attenuates apoptosis and modulates autophagy by targeting TAF9b/P53 pathway in doxorubicin-induced cardiotoxicity. Cell Death Dis. 2019 Sep;10(9):668.

126. Pan JA, Tang Y, Yu JY, Zhang H, Zhang JF, Wang CQ, et al. MicroRNA-146a regulates autophagy and cardiomyocyte apoptosis. Mol Med Rep. 2020 Nov;22(5):4003–16.
Oxygen species (ROS) Production. EBioMedicine. 2015 Nov;3:43–53.

140. Pant K, Yadav AK, Gupta P, Islam R, Saraya A, Venugopal SK. Butyrate induces ROS-mediated apoptosis by modulating miR-22/SIRT-1 pathway in hepatic cancer cells. Redox Biol. 2017 Aug;12:340–9.

141. Wallace L, Aikhionbare K, Banerjee S, Peagner K, Pitts M, Yao X, et al. Differential Expression Profiles of Mitogenome Associated MicroRNAs Among Colorectal Adenomatous Polyps. Cancer Res J (N Y N Y). 2021 Mar;9(1):23–33.

142. Qiu L, Wang M, Hu S, Ru X, Ren Y, Zhang Z, et al. Oncogenic Activation of Nrf2, Though as a Master Antioxidant Transcription Factor, Liberated by Specific Knockout of the Full-Length Nrf1α that Acts as a Dominant Tumor Repressor. Cancers (Basel). 2018 Dec;10(12):E520.

143. Li Q, Wang N, Wei H, Li C, Wu J, Yang G. miR-24-3p regulates progression of gastric mucosal lesions and suppresses proliferation and invasiveness of N87 via peroxiredoxin 6. Dig Dis Sci. 2016 Dec;61(12):3486–97.

144. Xu Z, Chen Q, Zeng X, Li M, Liao J. Inc-NLC1-C inhibits migration, invasion and apoptosis of glioma cells by targeting miR-383 and regulating PRDX-3 expression. Oncol Lett. 2021 Sep;22(3):640.

145. He HW, Wang NN, Yi XM, Tang CP, Wang D. Low-level serum miR-24-2-3p is associated with the progression of colorectal cancer. Cancer Biomark. 2018 Feb;21(2):261–7.

146. Zhu H, Vishwamitra D, Curry CV, Manshouri R, Diao L, Xu Z, Chen Q, Zeng X, Li M, Liao J. lnc-NLC1-C inhibits migration, invasion and apoptosis of glioma cells by targeting miR-383 and regulating PRDX-3 expression. Oncol Lett. 2021 Sep;22(3):640.

147. Nair S, Dhodapkar MV. Natural Killer T Cells in Cancer Immunotherapy. Front Immunol. 2017 Sep;8:1178.

148. Wellenstein MD, Coffelt SB, Duits DE, van Miltenburg MH, Slagter M, de Rink I, et al. Loss of p53 triggers WNT-dependent systemic inflammation to drive breast cancer metastasis. Nature. 2019 Aug;572(7770):538–42.

149. Guo X, Xue H, Shao Q, Wang J, Guo X, Chen X, et al. Hypoxia promotes glioma-associated macrophage infiltration via peristin and subsequent M2 polarization by upregulating TGF-β2 and M-CSFR. Oncotarget. 2016 Dec;7(49):80521–2.

150. Chen Y, Wen H, Zhou C, Su Q, Lin Y, Xie Y, et al. TNF-α derived from M2 tumor-associated macrophages promotes epithelial-mesenchymal transition and cancer stemness through the Wnt/β-catenin pathway in SMMC-7721 hepatocellular carcinoma cells. Exp Cell Res. 2019 May;378(1):41–50.

151. Baer C, Squadrito ML, Laoui D, Thompson D, Hansen SK, Kiialainen A, et al. Suppression of microRNA activity amplifies IFN-γ-induced macrophage activation and promotes anti-tumour immunity. Nat Cell Biol. 2016 Jul;18(7):790–802.

152. Yin C, Han Q, Xu D, Zheng B, Zhao X, Zhang J. SALL4-mediated upregulation of exosomal miR-146a-5p drives T-cell exhaustion by M2 tumor-associated macrophages in HCC. OncolImmunology. 2019 Apr;8(7):1601479.

153. Xue Y, Tong L, Liu Anwei Liu F, Liu A, Zeng S, Xiong Q, et al. Tumor-infiltrating M2 macrophages driven by specific genomic alterations are associated with prognosis in bladder cancer. Oncol Rep. 2019 Aug;42(2):581–94.

154. Yang M, Chen J, Su F, Yu B, Su F, Lin L, et al. Microvesicles secreted by macrophages shuttle invasion-potentiating microRNAs into breast cancer cells. Mol Cancer. 2011 Sep;10(1):117.

155. Pontis F, Roz L, Mensah M, Segale M, Moro M, Bertolini G, et al. Circulating extracellular vesicles from individuals at high-risk of lung cancer induce pro-tumorigenic conversion of stromal cells through transfer of miR-126 and miR-320. J Exp Clin Cancer Res. 2021 Jul;40(1):237.

156. Androulidaki A, Iliopoulos D, Lanitis E, Lopes SF, Huber V, Vallacchi V, Fleming V, Hu X, Cova A, Dugo M, et al. Tumor-derived microRNAs induce myeloid suppressor cells and predict immunotherapy resistance in melanoma. J Clin Invest. 2018 Dec;128(12):5505–16.

157. Tominaga T, Akiyoshi T, Yamamoto N, Taguchi S, Mori S, Nagasaki T, et al. Clinical significance of soluble programmed cell death-1 and soluble programmed cell death-ligand 1 in patients with locally advanced rectal cancer treated with neoadjuvant chemoradiotherapy. PLoS One. 2019 Feb;14(2):e0212978.

158. Yang Z, Liao B, Xiang X, Ke S. miR-21-5p promotes cell proliferation and G1/S transition in melanoma by targeting CDKN2C. FEBS Open Bio. 2020 May;10(5):752–60.

159. Rossi M, Altomare E, Botta C, Gallo Cantafio ME, Sarvide S, Caracciolo D, et al. miR-21 antagonism abrogates Th17 tumor promoting functions in multiple myeloma. Leukemia. 2021 Mar;35(3):823–34.

160. Qiu C, Ma J, Wang ML, Zhang Q, Li YB. MicroRNA-155 deficiency in CD8+ T cells inhibits its anti-glioma immunity by regulating FoxO3a. Eur Rev Med Pharmacol Sci. 2019 Mar;23(6):2486–96.

161. Ji Y, Fioravanti J, Zhu W, Wang H, Wu T, Hu J, et al. miR-155 harnesses Phf19 to potentiate cancer immunotherapy through epigenetic reprogramming of CD8+ T cell fate. Nat Commun. 2019 May;10(1):2157.

162. Huber V, Vallacchi V, Fleming V, Hu X, Cova A, Dugo M, et al. Tumor-derived microRNAs induce myeloid suppressor cells and predict immunotherapy resistance in melanoma. J Clin Invest. 2018 Dec;128(12):5505–16.

163. Jhumjunnwala S, Hammer C, Delamarre L. Antigen presentation in cancer: insights into tumour immunogenicity and immune evasion. Nat Rev Cancer. 2021 May;21(5):298–312.

164. Monnot GC, Martinez-Usoarre A, Lanitis E, Lopes SF, Cheng WC, Ho PC, et al. miR-155 Overexpression in OT-1 CD8+ T Cells Improves Anti-Tumor Activity against Low-Affinity Tumor Antigen. Mol Ther Oncolytics. 2019 Dec;16:111–23.

165. Yang B, Yu D, Liu J, Yang K, Wu G, Liu H. Antitumor activity of SAHA, a novel histone deacetylase inhibitor, against murine B cell lymphoma A20 cells in vitro and in vivo. Tumour Biol. 2015 Jul;36(7):5051–61.

166. Zhu SY, Wu QY, Zhang CX, Wang Q, Ling J, Huang XT, et al. miR-20a inhibits the killing effect of natural killer cells to cervical cancer cells by downregulating RUNX1. Biochem Biophys Res Commun. 2018 Oct;505(1):309–16.

167. Sanchez-Martinez D, Krzywinska E, Rathore MG, Saument A, Cornillon A, Lopez-Royuela N, et al. All-trans retinoic acid (ATRA) induces miR-23a expression, de-
ceases CTSC expression and granzyme B activity leading to impaired NK cell cytotoxicity. Int J Biochem Cell Biol. 2014 Apr;46:42–52.

168. Zhang LL, Zhang LF, Shi YB. miR-24 inhibited the killing effect of natural killer cells to colorectal cancer cells by downregulating Paxillin. Biomed Pharmacother. 2018 May;101:257–63.

169. Lee CC, Ho KH, Huang TW, Shih CM, Hsu SY, Liu AJ, et al. A regulatory loop among CD276, miR-29c-3p, and Myc exists in cancer cells against natural killer cell cytotoxicity. Life Sci. 2021 Jul;277:119438.

170. Heinemann A, Zhao F, Pechlivanis S, Eberle J, Steinle A, Diederichs S, et al. Tumor suppressive microRNAs miR-34a/c control cancer cell expression of UB2P2, a stress-induced ligand of the natural killer cell receptor NK2G2D. Cancer Res. 2012 Jan;72(2):460–71.

171. Xi Q, Chen Y, Yang GZ, Zhang JY, Zhang LJ, Guo XD, et al. Long noncoding RNA H19 overexpression induces bortezomib resistance in multiple myeloma by targeting MCL-1 via miR-20b-3p. Cell Death Dis. 2019 Feb;10(2):106.

172. Zhou X, Liu S, Liu J, Zhang Z, Mao X, Zhou H. MicroRNA-130a enhances the killing ability of natural killer cells against non-small cell lung cancer cells by targeting signal transducers and activators of transcription 3. Biochem Biophys Res Commun. 2020 Mar;523(2):481–6.

173. Wang J, Zhu M, Zhou X, Wang T, Xi Y, Jing Z, et al. MiR-140-3p inhibits natural killer cytotoxicity to human ovarian cancer via targeting MAPK1. J Biosci. 2020;45(1):66.

174. Ou ZL, Luo Z, Wei W, Liang S, Gao TL, Lu YB. Hypoxia-induced shedding of MICA and HIF1A-mediated immune escape of pancreatic cancer cells from NK cells: role of circ_0000977/miR-153 axis. RNA Biol. 2019 Nov;16(11):1592–603.

175. Cichocki F, Felices M, McCullar V, Presnell SR, Al-Attar A, Lutz CT, et al. Cutting edge: microRNA-181 promotes anti-tumor immunity in Pancreatic Cancer. Front Immunol. 2020 May;11:890.

176. Briand J, Garnier D, Nadaradjane A, Clément-Colmou K, Cichocki F, Felices M, McCullar V, Presnell SR, Al-Attar A, Lutz CT, et al. Cutting edge: microRNA-181 promotes anti-tumor immunity in Pancreatic Cancer. Front Immunol. 2020 May;11:890.

177. Trotta R, Chen L, Costinean S, Josyula S, Mundy-Bosse BL, Ciarlarelli D, et al. Overexpression of miR-155 causes expansion, arrest in terminal differentiation and functional activation of mouse natural killer cells. Blood. 2013 Apr;121(16):3126–34.

178. Li J, Xu X, Wei C, Liu L, Wang T. Long noncoding RNA NORAD regulates lung cancer cell proliferation, apoptosis, migration, and invasion by the miR-30a-5p/ADAM19 axis. Int J Cell Exp Pathol. 2020 Jan;13(1):1–13.

179. Zhang X, Wu N, Wang J, Li Z. LncRNA MEG3 inhibits cell proliferation and induces apoptosis in laryngeal cancer via miR-23a/APAF-1 axis. J Cell Mol Med. 2019 Oct;23(10):6708–19.

180. Feng K, Liu Y, Xu LJ, Zhao LF, Jia CW, Xu MY. Long noncoding RNA PVT1 enhances the viability and invasion of papillary thyroid carcinoma cells by functioning as ceRNA of microRNA-30a through mediating expression of insulin like growth factor 1 receptor. Biomed Pharmacother. 2018 Aug;104:686–98.

181. Li J, Xu X, Wei C, Liu L, Wang T. Long noncoding RNA NORAD regulates lung cancer cell proliferation, apoptosis, migration, and invasion by the miR-30a-5p/ADAM19 axis. Int J Cell Exp Pathol. 2020 Jan;13(1):1–13.

182. Pan Y, Zhang Y, Liu W, Huang Y, Shen X, Jing R, et al. LncRNA H19 overexpression induces bortezomib resistance in multiple myeloma by targeting MCL-1 via miR-20b-3p. Cell Death Dis. 2019 Feb;10(2):106.

183. Coccia E, Masanas M, López-Soriano J, Segura MF, Cornella JX, Pérez-Garcia MJ. FAIM Is Regulated by Stress and Interferes With Accumulation of Stress-Induced Protein Aggregates. Front Mol Biosci. 2020 Feb;7:32.

184. Schickel R, Park SM, Murmann AE, Peter ME. miR-200c regulates induction of apoptosis through TCF4 down-regulation. J Gastrointest Oncol. 2021 Jun;12(3):1007–19.

185. Yuan L, Li S, Zhou Q, Wang D, Zou D, Shu J, et al. MiR-124 inhibits invasion and induces apoptosis of ovarian cancer cells by targeting programmed cell death 6. Oncol Lett. 2017 Dec;14(6):7311–7.

186. Ceppi P, Hadji A, Kohlhapp FJ, Pattanayak A, Hau A, Liu X, et al. CD95 and CD95L promote and protect cancer stem cells. Nat Commun. 2014 Nov;5(1):5238.

187. Schickel R, Park SM, Murmann AE, Peter ME. miR-200c regulates induction of apoptosis through TCF4 down-regulation. J Gastrointest Oncol. 2021 Jun;12(3):1007–19.

188. Yuan L, Li S, Zhou Q, Wang D, Zou D, Shu J, et al. MiR-124 inhibits invasion and induces apoptosis of ovarian cancer cells by targeting programmed cell death 6. Oncol Lett. 2017 Dec;14(6):7311–7.

189. Ceppi P, Hadji A, Kohlhapp FJ, Pattanayak A, Hau A, Liu X, et al. CD95 and CD95L promote and protect cancer stem cells. Nat Commun. 2014 Nov;5(1):5238.

190. Schickel R, Park SM, Murmann AE, Peter ME. miR-200c regulates induction of apoptosis through TCF4 down-regulation. J Gastrointest Oncol. 2021 Jun;12(3):1007–19.

191. Yuan L, Li S, Zhou Q, Wang D, Zou D, Shu J, et al. MiR-124 inhibits invasion and induces apoptosis of ovarian cancer cells by targeting programmed cell death 6. Oncol Lett. 2017 Dec;14(6):7311–7.
MiR-206, MiR-1-3p and MiR-133b. Front Cell Dev Biol. 2020 Dec;8:584606.

197. Zhou B, Wang D, Sun G, Mei F, Cui Y, Xu H. Effect of miR-21 on Apoptosis in Lung Cancer Cell Through Inhibiting the PI3K/Akt/NF-xB Signaling Pathway in Vivo and in Vivo. Cell Physiol Biochem. 2018;46(3):999–1008.

198. Liu T, Liu S, Xu Y, Shu R, Wang F, Chen C, et al. Circular RNA-ZFR Inhibited Cell Proliferation and Promoted Apoptosis in Gastric Cancer by Sponging miR-130a/miR-107 and Modulating PTEN. Cancer Res Treat. 2018 Oct;50(4):1396–417.

199. Zheng P, Chen L, Yuan X, Luo Q, Liu Y, Xie G, et al. Exosomal transfer of tumor-associated macrophage-derived miR-21 confers cisplatin resistance in gastric cancer cells. J Exp Clin Cancer Res. 2017 Apr;36(1):53.

200. Shi YP, Liu GL, Li S, Liu XL. miR-17-5p knockdown inhibits proliferation, autophagy and promotes apoptosis in thyroid cancer via targeting PTEN. Neoplasma. 2020 Mar;67(2):249–58.

201. Abe R, Yamagishi S. AGE-RAGE system and carcinogenesis. Curr Pharm Des. 2008;14(10):940–5.

202. Haque E, Kamil M, Hasan A, Irfan S, Sheikh S, Khatoon A, et al. Microenvironmental interleukin-6 suppresses toll-like receptor 4/MyD88/NF-κB/PI3K/Akt pathway in breast cancer. Cell Physiol Biochem. 2019 Sep;50(4):1396–417.

203. Dey S, Kwon JJ, Liu S, Hodge GA, Taleb S, Zimmers TA. MiR-206, MiR-1-3p and MiR-133b. Front Cell Dev Biol. 2020 Dec;8:584606.
and Its Restoration Drives Tumor-Suppressive Effects via Downregulation of LOXL2. Mol Cancer Res. 2020 Feb;18(2):311–23.

226. Peta E, Sinigaglia A, Masi G, Di Camillo B, Grassi A, Trevisan M, et al. HPV16 E6 and E7 upregulate the histone lysine demethylase KDM2B through the c-MYC/miR-146a-5p axis. Oncogene. 2018 Mar;37(12):1654–68.

227. Chen PY, Gu CC, Huang WY, Huang WH, Chuang YM, Lin RI, et al. c-Myc Acts as a Competing Endogenous RNA to Sponge miR-34a, in the Upregulation of CD44, in Urothelial Carcinoma. Cancers (Basel). 2019 Sep;11(10):E1457.

228. Zhang L, Fu Y, Guo H. c-Myc-Induced Long Non-Coding RNA Small Nucleolar RNA Host Gene 7 Regulates Glycolysis in Breast Cancer. J Breast Cancer. 2019 Nov;22(4):533–47.

229. Wang H, Li C, Jian Z, Ou Y, Ou J. TGF-β1 Reduces miR-29a Expression to Promote Tumorigenicity and Metastasis of Cholangiocarcinoma by Targeting HDAC4. PLoS One. 2015 Oct;10(10):e0136703.

230. Zhang D, Qiu X, Li J, Zheng S, Li L, Zhao H. TGF-β secreted by tumor-associated macrophages promotes proliferation and invasion of colorectal cancer via miR-34a-VEGF axis. Cell Cycle. 2018;17(24):2766–78.

231. Pan Y, Hui X, Hoo RL, Ye D, Chan CY, Feng T, et al. Adipocyte-secreted exosomal microRNA-34a inhibits M2 macrophage polarization to promote obesity-induced adipose inflammation. J Clin Invest. 2019 Feb;129(2):834–49.

232. Veremeiko T, Siddiqui S, Sotnikov I, Yung A, Ponomerov ED. IL-4/IL-13-dependent and independent expression of miR-124 and its contribution to M2 phenotype of monocyteic cells in normal conditions and during allergic inflammation. PLoS One. 2013 Dec;8(12):e81774.

233. Duan LJ, Qi J, Kong XJ, Huang T, Qian XQ, Xu D, et al. MiR-133 modulates TGF-β1-induced bladder smooth muscle cell hypertrophic and fibrotic response: implication for a role of microRNA in bladder wall remodeling caused by bladder outlet obstruction. Cell Signal. 2015 Feb;27(2):215–27.

234. Vanhaverbeke M, Gal D, Holvoet P. Functional Role of Cardiovascular Exosomes in Myocardial Injury and Atherosclerosis. Adv Exp Med Biol. 2017;998:45–58.

235. Huber HJ, Holvoet P. Exosomes: emerging roles in communication between blood cells and vascular tissues during atherosclerosis. Curr Opin Lipidol. 2015 Oct;26(5):412–9.

236. Magrabi F, Ammenwerth E, McNair JB, De Keizer NF, Hyppönen H, Nykänen P, et al. Artificial Intelligence in Clinical Decision Support: Challenges for Evaluating AI and Practical Implications. JAMIA Open 2019 Aug;28(1):128–34.

237. Gong W, Zheng J, Liu X, Ma J, Liu Y, Xue Y. Knockdown of NEAT1 restrained the malignant progression of glioma stem cells by activating microRNA let-7e. Oncotarget. 2016 Sep;7(38):62208–23.

238. Fang F, Quan Q. The long non-coding RNA SNHG4/microRNA-let-7e/KDM3A/p21 pathway is involved in the development of non-small cell lung cancer. Mol Ther Oncolytics. 2020 Dec;20:634–45.

239. Li F, Dai B, Ni X. Long non-coding RNA cancer susceptibility candidate 2 (CASC2) alleviates the high glucose-induced injury of CIHI-P1 cells via regulating miR-9-5p/PPARγ axis in diabetes nephropathy. Diabetol Metab Syndr. 2020 Aug;12(1):68.

240. Cui M, Xiao Z, Wang Y, Zheng M, Song T, Cai X, et al. Long noncoding RNA HULC modulates abnormal lipid metabolism in hepatoma cells through an miR-9-mediated RXRA signaling pathway. Cancer Res. 2015 Mar;75(5):846–57.

241. Feng L, Li H, Li F, Bei S, Zhang X. LncRNA KCNQ1OT1 regulates microRNA-9-LMX1A expression and inhibits gastric cancer cell progression. Aging (Albany NY). 2020 Jan;12(1):707–17.

242. Xie Q, Lin S, Zheng M, Cai Q, Tu Y. Long noncoding RNA NEAT1 promotes the growth of cervical cancer cells via sponging miR-9-5p. Biochem Cell Biol. 2019 Apr;97(2):100–8.

243. Zhang S, Cheng M, Zheng X, Zheng L, Liu H, Lu J, et al. Interactions Between lncRNA TUG1 and miR-9-5p Modulate the Resistance of Breast Cancer Cells to Doxorubicin by Regulating elF5A2. OncoTargets Ther. 2020 Dec;13:13159–70.

244. Li Y, Qiao L, Zang Y, Ni W, Xu Z. Circular RNA FOXO3 Suppresses Bladder Cancer Progression and Metastasis by Regulating MiR-9-5p/TGFBR2. Cancer Manag Res. 2020 Jun;12:5049–56.

245. Han D, Li J, Wang H, Su X, Hou J, Gu Y, et al. Circular RNA circMTO1 acts as the sponge of microRNA-9 to suppress hepatocellular carcinoma progression. Hepatology. 2017 Oct;66(4):1151–64.

246. Pidikova P, Reis R, Herichova I. miRNA Clusters with Down-Regulated Expression in Human Colorectal Cancer and Their Regulation. Int J Mol Sci. 2020 Jun;21(13):E4633.

247. Wu H, Wei M, Jiang X, Tan J, Xu W, Fan X, et al. Long Noncoding RNA MIR17HG Promotes Colorectal Cancer by Stabilizing miR-16-5p and Interacting with the VEGFA/VEGFR1/AKT Axis. Mol Ther Nucleic Acids. 2020 Jun;20:438–50.

248. Xu J, Meng Q, Li X, Yang H, Xu J, Gao N, et al. Long Noncoding RNA MIR17HG Promotes Colorectal Cancer Progression via miR-17-5p. Cancer Res. 2019 Oct;79(19):4882–95.

249. Huang FX, Chen HJ, Zheng FX, Gao ZY, Sun PF, Peng Q, et al. LncRNA BLACAT1 is involved in chemoresistance of non-small cell lung cancer cells by regulating autophagy. Int J Oncol. 2019 Jan;54(1):339–47.

250. Zhang G, An X, Zhao H, Zhang Q, Zhao H. Long non-coding RNA HIF1A-AS1 promotes cell proliferation and invasion via regulating miR-17-5p in non-small cell lung cancer. Biomed Pharmacother. 2018 Feb;98:594–9.

251. Liu X, Liu G, Lu Y, Shi Y. Long non-coding RNA HOX B19 interacts with miR-130a-3p and miR-17-5p to regulate microRNA-130a-3p and miR-17-5p in thyroid cancer cells by sponging miR-17-5p. Neoplasma. 2020 Jun;75(5):846–57.

252. Jia J, Zhang X, Zhan D, Li J, Li Z, Li H, et al. LncRNA PVT1 Promotes Tumorigenesis of Colorectal Cancer by Stabilizing miR-16-5p and Interacting with the VEGFA/VEGFR1/AKT Axis. Mol Ther Nucleic Acids. 2020 Jun;20:438–50.

253. Ao X, Jiang M, Zhou J, Liang H, Xia H, Chen G. LncRNA-p21 inhibits the progression of non-small cell
254. Wei S, Wang K, Huang X, Tang W, Zhao Z, Zhao Z. Knockdown of the lncRNA MALAT1 alleviates lipo polysaccharide-induced A549 cell injury by targeting the miR-17-5p/FOX1 axis. Mol Med Rep. 2019 Aug;20(2):2021–9.

255. Wang CL, Wang D, Yan BZ, Fu JW, Qin L. Long non-coding RNA NEAT1 promotes viability and migration of gastric cancer cell lines through up-regulation of microRNA-17. Eur Rev Med Pharmacol Sci. 2018 Jul;22(13):4128–37.

256. Peng J, Hou F, Zhu W, Li J, Teng Z. lncRNA NR2F1-AS1 regulates miR-17-5p expression in prostate cancer. J Clin Lab Anal. 2020 Mar;54(6):2157–68.

257. Sun W, Zu Y, Fu X, Deng Y. Knockdown of lncRNA-XIST enhances the chemosensitivity of NSCLC cells via suppression of autophagy. Oncol Rep. 2017 Dec;38(6):3347–54.

258. Yang BY, Meng Q, Sun Y, Gao L, Yang JX. Long non-coding RNA MALAT1 promotes cell proliferation and apoptosis via the miR-22-3p/Snail1 axis in gastric cancer. Int J Oncol. 2019 Jun;54(6):2157–68.

259. Han K, Wang FW, Cao CH, Ling H, Chen JW, Chen RX, et al. Circular RNA cSMARCA5 inhibits growth and metastasis through modulating the maturation and exosomal dissemination of microRNA-17. Mol Cancer. 2020 Mar;19(1):60.

260. Hu Y, Guo B. Circ-MTO1 correlates with favorable prognosis and inhibits cell proliferation, invasion as well as miR-17-5p expression in prostate cancer. J Clin Lab Anal. 2020 Mar;34(3):e23086.

261. Yu J, Xu QG, Wang ZG, Yang Z, Zhang L, Ma JZ, et al. Circular RNA cSMARCA5 inhibits growth and metastasis in hepatocellular carcinoma. J Hepatol. 2018 Jun;68(6):1214–27.

262. Wang Z, Zhang Q, Sun Y, Shao F. Long Non-Coding RNA PVT1 Regulates BAMBI To Promote Tumor Progression In Non-Small Cell Lung Cancer By Sponging miR-22-3p. OncoTargets Ther. 2020 Feb;13:1343–54.

263. Zhao C, Wang S, Zhao Y, Du F, Wang W, Lv P, et al. Long non-coding RNA H19 regulates cell growth and apoptosis via miR-22-3p/Snail1 axis in gastric cancer. Cell Oncol (Dordr). 2016 Dec;39(6):559–72.

264. Gan L, Lv L, Liao S. Long non-coding RNA H19 regulates cell growth and migration via the miR-22-3p/Smad7 axis in gastric cancer. Cell Oncol. 2019 Jun;54(6):2157–68.

265. Li DY, Chen WJ, Luo L, Wang YK, Jiang G, Zhang Y, et al. Prospective lncRNA-miRNA-mRNA regulatory network of long non-coding RNA LINC00968 in non-small cell lung cancer A549 cells: A miRNA microarray and bioinformatics investigation. Int J Mol Med. 2017 Dec;40(6):1895–906.

266. Zhang Z, Li M, Zhang Z. lncRNA MALAT1 modulates oxaliplatin resistance of gastric cancer via sponging miR-22-3p. Oncotargets Ther. 2020 Feb;13:1343–54.

267. Yao H, Duan M, Lin L, Wu C, Fu X, Wang H, et al. TET2 and MEG3 promoter methylation is associated with acute myeloid leukemia in a Hainan population. Oncotarget. 2017 Mar;8(11):18337–47.

268. Zhao L, Hu K, Cao J, Wang P, Li J, Zeng K, et al. LncRNA miAT functions as a ceRNA to upregulate sirt1 by sponging miR-22-3p in HCC cellular senescence. Aging (Albany NY). 2019 Sep;11(17):7098–122.

269. Guan B, Ma J, Yang Z, Yu F, Yao J. LncRNA NCK1-AS1 exerts oncogenic property in gastric cancer by targeting the miR-22-3p/BCL9 axis to activate the Wnt/β-catenin signaling. Environ Toxicol. 2021 Aug;36(8):1640–53.

270. Cruickshank BM, Wasson MD, Brown JM, Fernando D, Venkatesh J, Walker OL, et al. LncRNA PART1 Promotes Proliferation and Migration, Is Associated with Cancer Stem Cells, and Alters the miRNA Landscape in Triple-Negative Breast Cancers. Cancer Basel. 2021 May;13(11):2644.

271. Ren C, Liu J, Zheng B, Yan P, Sun Y, Yue B. The circular RNA circ-ITCH acts as a tumour suppressor in osteosarcoma via regulating miR-22. Artif Cells Nanomed Biotechnol. 2019 Dec;47(1):3359–67.

272. Liu J, Chen M, Ma L, Dang X, Du G. LncRNA GASS Suppresses the Proliferation and Invasion of Osteosarcoma Cells via the miR-23a-3p/PTEN/P13K/akt Pathway. Cell Transplant. 2020 Jan-Dec;29:963689720953093.

273. Wang P, Hu L, Fu G, Lu J, Zheng Y, Li Y, et al. LncRNA MALAT1 Promotes the Proliferation, Migration, and Invasion of Melanoma Cells by Downregulating miR-23a. Cancer Manag Res. 2020 Jul;12:6553–62.

274. Zhang X, Wu N, Wang J, Li Z. LncRNA MEG3 inhibits cell proliferation and induces apoptosis in laryngeal cancer via miR-23a/APA1 axis. J Cell Biochem. 2019 Oct;23(10):6708–19.

275. Zhao C, Wang S, Zhao Y, Du F, Wang W, Lv P, et al. Long non-coding RNA NEAT1 modulates cell proliferation and apoptosis by regulating miR-23-3p/SMC1A in acute myeloid leukemia. J Cell Physiol. 2019 May;234(5):6161–72.
281. Lin H, Lin Q, Dong C, Maswela B, Illahi GS, et al. SNHG5 enhances Paclitaxel sensitivity of ovarian cancer cells through sponging miR-23a. Biomed Pharmacother. 2020 Mar;123:109711.

282. Liu Y, Li Q, Tang D, Li M, Zhao P, Yang W, et al. SNHG17 promotes the proliferation and migration of colorectal adenocarcinoma cells by modulating CXCL12-mediated angiogenesis. Cancer Cell Int. 2020 Nov;20(1):566.

283. Hao YQ, Liu KW, Zhang X, Kang SX, Zhang K, Han W, et al. GINS2 was regulated by lncRNA XIST/miR-23a-3p to mediate proliferation and apoptosis in A375 cells. Mol Cell Biochem. 2021 Mar;476(3):1455–65.

284. Wang X, Guo Y, Wang C, Wang Q, Yan G. Long Noncoding RNA ZEB1-AS1 Downregulates miR-23a, Promotes Tumor Progression, and Predicts the Survival of Oral Squamous Cell Carcinoma Patients. OncoTargets Ther. 2021 Apr;14:2699–710.

285. Li X, Sun J, Lou L, Fan X, Zhang W, Li Q. Overexpression of lncRNA H19 regulates epithelial-mesenchymal transition in hepatocellular carcinoma via the miR-26a/b-5p-mediated STAT3/YKL-40 signaling pathway. Neoplasia. 2021 Jul;23(7):692–703.

286. Hu W, Zhao Z, Su L, Wu Z, Jiang W, Jiang X, et al. Silencing the lncRNA NORAD inhibits EMT of head and neck squamous cell carcinoma stem cells via miR-26a-5p. Mol Med Rep. 2021 Nov;24(5):743.

287. Ma YS, Chu KJ, Ling CC, Wu TM, Zhu XC, Liu JB, et al. Long Noncoding RNA OIP5-AS1 Promotes the Progression of Liver Hepatocellular Carcinoma via Regulating the hsa-miR-26a-3p/EPHA2 Axis. Mol Ther Nucleic Acids. 2020 Sep;21:229–41.

288. Wang RQ, Long XR, Zhou NN, Chen DN, Zhang MY, et al. Long Noncoding RNA LEF1-AS1 Promotes Migration, Invasion and Metastasis of Colon Cancer Cells Through miR-29b-3p as Competing Endogenous RNA. Biochim Biophys Acta Mol Cell Res. 2020 Apr;1864(10):1887–99.

289. Wang SH, Yang Y, Wu XC, Zhang MD, Weng MZ, Zhou D, et al. Long non-coding RNA MINCR promotes gallbladder cancer progression through stimulating EZH2 expression. Cancer Lett. 2016 Sep;380(1):122–33.

290. Fan JT, Zhou ZY, Luo YL, Luo Q, Chen SB, Zhao JC, et al. Exosomal IncRNA NEAT1 from cancer-associated fibroblasts facilitates endometrial cancer progression via miR-26a/b-5p-mediated ST33/YKL-40 signaling pathway. Int J Oncol. 2021 Jan;1;12(1):3.

291. Gao J, Zeng K, Liu Y, Gao L, Liu L. LncRNA SNHG6 regulates EZH2 expression by sponging miR-26a/b and miR-214 in colorectal cancer. J Hematol Oncol. 2019 Jan;12(1):3.

292. Tian L, Zhao ZF, Xie L, Zhu JP. Taurine up-regulated lncRNA ZEB1-AS1 accelerates tumorigenesis of colon cancer by regulating miR-26a-5p/MMP14/p38 MAPK/Erk2 pathway. Life Sci. 2019 Dec;239:117035.

293. Si Z, Yu L, Jing H, Wu L, Wang X. Oncogenic IncRNA ZNF561-AS1 is essential for colorectal cancer proliferation and survival through regulation of miR-26a-3p/miR-128-5p/SRSF6 axis. J Exp Clin Cancer Res. 2021 Feb;40(1):78.

294. Wang J, Ni J, Song D, Ding M, Huang J, Li W, et al. The regulatory effect of has-circ-0001146/miR-26a-5p/MNAT1 network on the proliferation and invasion of osteosarcoma. Bioci Rep. 2020 Jun;40(6):BSR20201232. https://doi.org/10.1042/BSR20201232.

295. Muluhngwi P, Klinge CM. Identification and Roles of miR-29b-1-3p and miR29a-3p-Regulated and Non-Regulated IncRNAs in Endocrine-Sensitive and Resistant Breast Cancer Cells. Cancers (Basel). 2021 Jul;13(14):3530.

296. Lv M, Zhong Z, Huang M, Tian Q, Jiang R, Chen J. IncRNA H19 regulates epithelial-mesenchymal transition and metastasis of bladder cancer by miR-29b-3p as competing endogenous RNA. Biochim Biophys Acta Mol Cell Res. 2017 Oct;1864(10):1887–99.

297. Bracconi C, Kogure T, Valeri N, Huang N, Nuovo G, Costinean S, et al. microRNA-29 can regulate expression of the long non-coding RNA gene MEG3 in hepatocellular cancer. Oncogene. 2011 Nov;30(47):4756–50.

298. Sun T, Liu Z, Zhang R, Ma S, Lin T, Li Y, et al. Long Non-Coding RNA LEMF1-AS1 Promotes Migration, Invasion and Metastasis of Colon Cancer Cells Through miR-30-5p/SOX9 Axis. OncoTargets Ther. 2020 Apr;13:2957–
72.
309. Zhang Y, Li Y. Long non-coding RNA NORAD contributes to the proliferation, invasion and EMT progression of prostate cancer via the miR-30a-5p/RAB11A/WNT/beta-catenin pathway. Cancer Cell Int. 2020 Nov;20(1):571.
310. Shi J, Lv X, Zeng L, Li W, Zhong Y, Yuan J, et al. CircPVT1 promotes proliferation of lung squamous cell carcinoma by binding to miR-30d/e. J Exp Clin Cancer Res. 2021 Jun;40(1):193.
311. Li S, Zhu K, Liu L, Gu J, Niu H, Guo J. lncARSR sponges miR-34a-5p to promote colorectal cancer invasion and metastasis via hexokinase-1-mediated glycolysis. Cancer Sci. 2020 Oct;111(10):3938–52.
312. Hu F, Jiang C, Bu G, Fu Y, Yu Y. Silencing long noncoding RNA colon cancer-associated transcript-1 upregulates microRNA-34a-5p to promote proliferation and differentiation of osteoblasts in osteoporosis. Cancer Gene Ther. 2021 Nov;28(10-11):1150–61.
313. Huang S, Li C, Huang J, Luo P, Mo D, Wang H. LncRNA FEZF1-AS1 promotes non-small lung cancer cell migration and invasion through the up-regulation of NOTCH1 by serving as a sponge of miR-34a. BMC Pulm Med. 2020 Apr;20(1):110.
314. Li Y, Li C, Liu L, Gu J, Niu H, Guo J. lncRNA MEG3 prevents vascular endothelial growth factor-mediated vascular proliferation and migration in human lung cancer. J Cell Mol Med. 2020 May;24(10):5578–92.
315. Zhang Y, Li Y. Long non-coding RNA HNF1A-AS1 mediated repression of miR-34a/SIRT1/p53 axis exerts function in cell senescence by impairing miR-128-dependent G1/S phase transition. Onco Targets Ther. 2019 Jan;12:451–62.
316. Ye J, Fu Y, Yuan J, Li X, Jia Y, et al. Novel role of IncRNA HULC/miR-128-3p/RAC1 axis in the inflammatory response during LPS-induced sepsis in HMEC-1 cells. Mol Med Rep. 2020 Dec;22(6):5095–104.
317. Li Y, Li C, Li D, Yang L, Jin J, Zhang B. IncRNA KCNQ10T1 enhances the chemoresistance of oxaliplatin in colon cancer by targeting the miR-34a/ATG4B pathway. OncoTargets Ther. 2019 Apr;12:2649–60.
318. Wang W, Li Y, Zhi S, Li J, Miao J, Ding Z, et al. LncRNA-ROR/microRNA-185-3p/YAP1 axis exerts function in biological characteristics of osteosarcoma cells. Genomics. 2021 Jan;113(1 Pt 2):450–61.
319. Jin J, Chen X, Chen J, Geng X. Long noncoding RNA MACC1-AS1 is a potential sponge of miR-34a-3p in cervical squamous cell carcinoma and up-regulates cyclin-dependent kinase 6. Oncol Lett. 2020 Mar;19(3):2339–45.
320. Sun Z, Zhang T, Chen B. Long Non-Coding RNA Metastasis-Associated Lung Adenocarcinoma Transcript 1 (MALAT1) Promotes Proliferation and Metastasis of Osteosarcoma Cells by Targeting e-Met and SOX4 via miR-34a-5p and miR-449a/b. Med Sci Monit. 2019 Feb;25:1410–22.
321. Fu Y, Li C, Luo Y, Li L, Liu J, Gui R. Silencing of Long Non-coding RNA MIAT Sensitizes Lung Cancer Cells to Gefitinib by Epigenetically Regulating miR-34a. Front Pharmacol. 2018 Feb;9:82.
322. Jiang X, Guo S, Zhang Y, Zhao Y, Li X, Jia Y, et al. LncRNA NEAT1 promotes docetaxel resistance in prostate cancer by regulating ACSL4 via sponging miR-34a-5p and miR-204-5p. Cell Signal. 2020 Jan;65:109422.
323. Jiang X, Ye Z, Jiang Y, Yu W, Fang Q. LncRNA OIP5-AS1 upregulates snail expression by sponging miR-34a to promote ovarian carcinoma cell invasion and migration. Biol Res. 2020 Oct;53(1):49.
324. Liu L, Chen X, Zhang Y, Hu Y, Shen X, Zhu W. Long non-coding RNA TUG1 promotes endometrial cancer development via inhibiting miR-299 and miR-34a-5p. Oncotarget. 2017 May;8(19):31386–94.
325. Liu H, Deng H, Zhao Y, Li C, Liang Y. LncRNA XIST/miR-34a axis modulates the cell proliferation and tumor growth of thyroid cancer through MET-Pi3K-AKT signaling. J Exp Clin Cancer Res. 2018 Nov;37(1):279.
326. Wang CH, Li QY, Nie L, Ma J, Yao CJ, Chen FP. LncRNA ANRIL promotes cell proliferation, migration and invasion during acute myeloid leukemia pathogenesis via negatively regulating miR-34a. Int J Biochem Cell Biol. 2020 Feb;119:105666.
327. Ye W, Chen L, Feng C, Liang T. CircMYLK promotes the growth, migration, invasion, and survival of bladder cancer cells by upregulating CCND3 level via competitively binding to miR-34a. Drug Dev Res. 2021 Dec;82(8):1206–16.
328. Zhu L, Wang A, Gao M, Duan X, Li Z. LncRNA MIR4435-2HG triggers ovarian cancer progression by regulating miR-128-3p/CKD14 axis. Cancer Cell Int. 2020 May;20(1):145.
329. Yang W, Luo X, Liu Y, Xiong J, Xia H, Liu Y. Potential role of IncRNA HULC/miR-128-3p/RAC1 axis in the inflammatory response during LPS-induced sepsis in HMEC-1 cells. Mol Med Rep. 2020 Dec;22(6):5095–104.
330. Lan Y, Li YJ, Li DJ, Li P, Wang YJ, Diao YP, et al. Long noncoding RNA MEG3 prevents vascular endothelial cell senescence by impairing miR-128-dependent Girdin downregulation. Am J Physiol Cell Physiol. 2019 Jun;316(6):C830–43.
331. Zhang C, Xie L, Liang H, Cui Y. LncRNA MIAT facilitates osteosarcoma progression by regulating miR-128-3p/VEGFC axis. IUBMB Life. 2019 Jul;71(7):845–53.
332. Liu Y, Fu X, Wang X, Liu Y, Song X. Long non-coding RNA OIP5-AS1 facilitates the progression of ovarian cancer via the miR-128-3p/CCNG1 axis. Mol Med Rep. 2021 May;23(5):388.
333. Zhang PF, Wang F, Wu J, Wu Y, Huang W, Liu D, et al. LncRNA SNHG3 induces EMT and sorafenib resistance by modulating the miR-128/CD151 pathway in hepatocellular carcinoma. J Cell Physiol. 2019 Mar;234(3):2788–94.
334. Yang L, Zhang L, Lu L, Wang Y. Long Noncoding RNA SNHG16 Sponges miR-182-5p And miR-128-3p To Promote Retinoblastoma Cell Migration And Invasion By Targeting LASP1. OncoTargets Ther. 2019 Oct;12:8653–62.
335. Yao J, Wang C, Dong X, Zhang Y, Li Y, Zhou H, et al. IncRNA SNHG22 sponges miR-128-3p to promote the progression of colorectal cancer by upregulating E2F3. Int J Oncol. 2021 Sep;59(3):71.
ulating miR-128-3p/YES1 axis. Eur Rev Med Pharmacol Sci. 2020 Jan;24(2):619–32.

337. Yu C, Longfei L, Long W, Feng Z, Chen J, Chao L, et al. LncRNA PVT1 regulates VEGFC through inhibiting miR-128 in bladder cancer cells. J Cell Physiol. 2019 Feb;234(2):1346–53.

338. Yang F, Peng ZX, Ji WD, Yu JD, Qian C, Liu JD, et al. LncRNA CCAT1 Upregulates ATG5 to Enhance Autophagy and Promote Gastric Cancer Development by Absorbing miR-140-3p. Dig Dis Sci. 2021 Aug;***. https://doi.org/10.1007/s10620-021-07187-9.

339. Li J, Su T, Zou C, Luo W, Shi G, Chen L, et al. Long non-coding RNA H19 Regulates Porcine Satellite Cell Differentiation Through miR-140-5p/SOX4 and DBN1. Front Cell Dev Biol. 2020 Nov;8:518724.

340. Hou ZH, Xu XW, Fu XY, Zhou LD, Liu SP, Tan DM. Long non-coding RNA MALAT1 promotes angiogenesis and immunosuppressive properties of HCC cells by sponging miR-140. Am J Cell Physiol. 2020 Mar;318(3):C649–63.

341. He J, Xue Y, Wang Q, Zhou X, Liu L, Zhang T, et al. NR2F1-AS1/FOXM1 axis regulates miR-143-3p expression and cell proliferation of SOX2-OT Prevents Hepatocellular Carcinoma Progression Through miR-143-3p/MSI2. Front Oncol. 2021 Jul;11:685912.

342. Li X, Li Y, Bai S, Zhang J, Liu Z, Yang J. LncRNA CCAT1 promotes angiogenesis and metastasis by miR-143-3p and EZH2. J Cell Mol Med. 2020 Oct;24(20):11858–73.

343. Zhao H, Bi M, Lou M, Yang X, Sun L. Downregulation of SOX2-OT Prevents Hepatocellular Carcinoma Progression Through miR-143-3p/MSI2. Front Oncol. 2021 Jun;11:685912.

344. Zhang K, Chen J, Song H, Chen LB. SNHG16/miR-143-3p. Cancer Biol Ther. 2018 May;19(5):391–9.

345. Yuan JB, Gu L, Chen L, Yin Y, Fan BY. Annexin A8 promotes proliferation and inhibits apoptosis of colon cancer cells via the miR-143/MYO6 Axis. Cancer Manag Res. 2020 Mar;12:1587–99.

346. Xue YN, Yan Y, Chen ZZ, Chen J, Tang FJ, Xie HQ, et al. LncRNA TUG1 regulates FGF1 to enhance endothelial differentiation of adipose-derived stem cells by sponging miR-143. J Cell Biochem. 2019 Nov;120(11):19087–97.

347. Luan Y, Li X, Luan Y, Zhao R, Li Y, Liu L, et al. Circulating LncRNA UCA1 promotes Malignancy of Colorectal Cancer via the miR-143/MY06 Axis. Mol Ther Nucleic Acids. 2020 Mar;19:790–803.

348. Yuan JB, Gu L, Chen L, Yin Y, Fan BY. Annexin A8 regulated by LncRNA-TUG1/miR-140-3p axis promotes bladder cancer progression and metastasis. Mol Ther Oncolytics. 2021 Apr;22:36–51.

349. Ding Y, Fang Q, Li Y, Wang Y. Amplification of LncRNA PVT1 promotes ovarian cancer proliferation by binding to miR-140. Mamm Genome. 2019 Aug;30(7-8):217–25.

350. Wang P, Bao W, Liu X, Xi W. LncRNA miR143HG inhibits the proliferation of glioblastoma cells by sponging miR-504. Int J Neurosci. 2021 Feb;***:1–9.

351. Cheng H, Tian J, Wang C, Ren L, Wang N. LncRNA BLACAT1 Is Upregulated in Cervical Squamous Cell Carcinoma (CSCC) and Predicts Poor Survival. Reprod Sci. 2020 Feb;27(2):585–91.

352. Hu M, Zhang Q, Tian XH, Wang JL, Niu YX, Li G. IncRNA CCAT1 is a biomarker for the proliferation and drug resistance of esophageal cancer via the miR-143/PLK1/BUBR1 axis. Mol Carcinog. 2019 Dec;58(12):2207–17.

353. Liao M, Jia J, Wang X, Liu Y, Wang C, Fan R. Long non-coding RNA HOTAIR promotes cervical cancer progression through regulating BCL2 via targeting miR-143-3p. Cancer Biol Ther. 2018 May;19(5):391–9.

354. Qi D, Wang M, Yu F. Knockdown of LncRNA-H19 inhibits cell viability, migration and invasion while promotes apoptosis via microRNA-143/RUNX2 axis in retinoblastoma. Biomed Pharmacother. 2019 Jan;109:798–805.

355. Fatollahi Dolatabadi N, Dehghani A, Shahand E, Yazdanshenas M, Tabatabaeian H, Zamani A, et al. The interaction between MALAT1 target, miR-143-3p, and RALGAP2 is affected by functional SNP rs3827693 in breast cancer. Hum Cell. 2020 Oct;33(4):1229–39.

356. Qiao Z, Dai H, Zhang Y, Li Q, Zhao M, Yue T. LncRNA NCKI-AS1 Promotes Cancer Cell Proliferation and Increase Cell Stemness in Urinary Bladder Cancer Patients by Downregulating miR-143. Cancer Manag Res. 2020 Mar;12:1661–8.

357. Li J, Zhang H, Luo H. Long Non-Coding RNA OIP5-AS1 Contributes to Gallbladder Cancer Cell Invasion and Migration by miR-143-3p Suppression. Cancer Manag Res. 2020 Dec;12:12983–92.

358. Xiang W, Lyu L, Huang T, Zheng F, Yuan J, Zhang C, et al. The long non-coding RNA SNHG1 promotes bladder cancer progression by interacting with miR-143-3p and EZH2. J Cell Mol Med. 2020 Oct;24(20):11858–73.

359. Zhao H, Bi M, Lou M, Yang X, Sun L. Downregulation of SOX2-OT Prevents Hepatocellular Carcinoma Progression Through miR-143-3p/MSI2. Front Oncol. 2021 Jul;11:685912.

360. Jiang T, Li J, Yang D, Yu JD, Qian C, Liu JD, et al. TMPO-AS1 Promotes Cervical Cancer Cell Proliferation, Migration, and Invasion by Regulating miR-143-3p/ZEB1 Axis. Cancer Manag Res. 2020 Mar;12:1587–99.

361. Xue YN, Yan Y, Chen ZZ, Chen J, Tang FJ, Xie HQ, et al. LncRNA TUG1 regulates FGF1 to enhance endothelial differentiation of adipose-derived stem cells by sponging miR-143. J Cell Biochem. 2019 Nov;120(11):19087–97.

362. Luan Y, Li X, Luan Y, Zhao R, Li Y, Liu L, et al. Circulating LncRNA UCA1 promotes Malignancy of Colorectal Cancer via the miR-143/MY06 Axis. Mol Ther Nucleic Acids. 2020 Mar;19:790–803.

363. Liu A, Liu L. Long non-coding RNA ZEB2-AS1 promotes proliferation and inhibits apoptosis of colon cancer cells via miR-143/bcl-2 axis. Am J Transl Res. 2019 Aug;11(8):5240–8.

364. Tian S, Han G, Lu L, Meng X. Circ-FOXMI1 contributes to cell proliferation, invasion, and glycolysis and represses apoptosis in melanoma by regulating miR-143-3p/FLOT2 axis. World J Surg Oncol. 2020 Mar;18(1):56.

365. Xiang T, Jiang HS, Zhang BT, Liu G. CircFOXO3 functions as a molecular sponge for miR-143-3p to promote the progression of gastric carcinoma via upregulating USP44. Gene. 2020 Aug;753:144798.

366. Shen J, Yu Y, Li H, Hu Q, Chen X, He Y, et al. Long non-coding RNA PVT1 promotes tumor progression by regulating the miR-143/HK2 axis in gallbladder cancer. Mol Cancer. 2019 Mar;18(1):33.

367. Hu X, Liu Y, Du Y, Cheng T, Xia W. Long non-coding RNA BLACAT1 promotes breast cancer cell proliferation and metastasis by miR-150-5p/CCR2. Cell Biosci. 2019 Jan;9(1):14.

368. Zhang D, Lee H, Haspel JA, Jin Y. Long noncoding RNA FOXD3-AS1 regulates oxidative stress-induced apoptosis via sponging microRNA-150. FASEB J. 2017 Oct;31(10):4472–81.
366. Han Y, Ma Z. LncRNA highly upregulated in liver cancer regulates imatinib resistance in chronic myeloid leukemia via the miR-150-5p/MCL1 axis. Anticancer Drugs. 2021 Apr;32(4):427–36.

367. Wang X, Jiang G, Ren W, Wang B, Yang C, Li M. LncRNA NEAT1 Regulates 5-Fu Sensitivity, Apoptosis and Invasion in Colorectal Cancer Through the MiR-150-5p/CPSF4 Axis. Oncotargets Ther. 2020 Jul;13:6373–83.

368. Lou T, Ke K, Zhang L, Miao C, Liu Y. LncRNA PART1 facilitates the malignant progression of colorectal cancer via miR-150-5p/LRG1 axis. J Cell Biochem. 2020 Oct;121(10):4271–81.

369. Lan T, Yuan K, Yan X, Xu L, Liao H, Hao X, et al. LncRNA SNHG10 Facilitates Hepatocarcinogenesis and Metastasis by Modulating Its Homolog SCARNA13 via a Positive Feedback Loop. Cancer Res. 2019 Jul;79(13):3220–34.

370. Chen X, Zeng K, Xu M, Hu X, Liu X, Xu T, et al. Sp1-induced LncRNA-ZFAS1 contributes to colorectal cancer progression via the miR-150-5p/VEGFA axis. Cell Death Dis. 2018 Sep;9(10):982.

371. Li X, Ren H. Long noncoding RNA PVT1 promotes tumor cell proliferation, invasion, migration and inhibitors apoptosis in oral squamous cell carcinoma by regulating miR-150-5p/GLUT1. Oncol Rep. 2020 Oct;44(4):1524–38.

372. Ge C, Dong J, Chu Y, Cao S, Zhang J, Wei J. LncRNA FGDS5-AS1 promotes tumor growth by regulating MCL1 via sponging miR-153-3p in oral cancer. Aging (Albany NY). 2020 Jul;12(4):14355–64.

373. Zhang W, Liu K, Pei Y, Tan J, Ma J, Zhao J. Long noncoding RNA HIF1A-AS2 Promotes Non-Small Cell Lung Cancer Progression by the miR-153-5p/S100A14 Axis. Oncotargets Ther. 2020 Aug;13:8715–22.

374. Wang Y, Wang J, Hao H, Luo X. LncRNA KCNN1OT1 promotes the proliferation, migration and invasion of retinoblastoma cells by upregulating HIF-1α via sponging miR-153-3p. J Investig Med. 2020 Dec;68(8):1349–56.

375. Zhao L, Bi M, Zhang H, Shi M. Downregulation of NEAT1 suppresses cell proliferation, migration, and invasion in NSCLC via sponging miR-153-3p. Cancer Biother Radiopharm. 2020 Jun;35(5):362–70.

376. Zhi XH, Jiang K, Ma YY, Zhou LQ. OIP5-AS1 promotes the progression of gastric cancer cells via the miR-153-3p/ZBTB2 axis. Eur Rev Med Pharmacol Sci. 2020 Mar;24(5):2428–41.

377. Cui Z, Luo Z, Lin Z, Shi L, Hong Y, Yan C. Long non-coding RNA TTN-AS1 facilitates tumorigenesis of papillary thyroid cancer through modulating the miR-153-3p/ZNFRF2 axis. J Gene Med. 2019 May;21(5):e3083.

378. Shao H, Dong D, Shao F. Long non-coding RNA TUG1-mediated down-regulation of KLF4 contributes to metastasis and the epithelial-to-mesenchymal transition of colorectal cancer by miR-153-1. Cancer Manag Res. 2019 Sep;11:8699–710.

379. Wen JF, Jiang YQ, Li C, Dai XK, Wu T, Yin WZ. LncRNA-XIST promotes the oxidative stress-induced migration, invasion, and epithelial-to-mesenchymal transition of osteosarcoma cancer cells through miR-153-SNAIN1 axis. Cell Biol Int. 2020 Oct;44(10):1991–2001.

380. Zhou B, Zheng P, Li Z, Li H, Wang X, Shi Z, et al. CircPCNXL2 sponges miR-153 to promote the proliferation and invasion of renal cancer cells through upregulating ZEB2. Cell Cycle. 2018;17(23):2644–54.

381. Wu X, Wang Y, Yu T, Nie E, Hu Q, Wu W, et al. Blocking MIR155HG/miR-155 axis inhibits mesenchymal transition in glioma. Neuro-oncol. 2017 Sep;19(9):1195–205.

382. Lu S, Dong L, Jing X, Gen-Yang C, Zhan-Zheng Z. Abnormal LncRNA CCAT1/microRNA-155/SIRT1 axis promoted inflammatory response and apoptosis of tubular epithelial cells in LPS caused acute kidney injury. Mitochondrion. 2020 Jul;53:76–90.

383. Xu J, Bo Q, Zhang X, Lei D, Wang J, Pan X. LncRNA HOXA11-AS Promotes Proliferation and Migration via Sponging miR-155 in Hypopharyngeal Squamous Cell Carcinoma. Oncol Res. 2020 May;28(3):311–9.

384. Yu Y, Kou D, Liu B, Huang Y, Li S, Qi Y, et al. LncRNA MEG3 contributes to drug resistance in acute myeloid leukemia by positively regulating ALG9 through sponging miR-155. Int J Lab Hematol. 2020 Aug;42(4):464–72.

385. Luan T, Zhang X, Wang S, Song Y, Zhou S, Lin J, et al. Long non-coding RNA MIAT promotes breast cancer progression and functions as ceRNA to regulate DUSP7 expression by sponging miR-155-5p. Oncotarget. 2017 Jul;8(44):76153–64.

386. Tong L, Ao Y, Zhang H, Wang K, Wang Y, Ma Q. Long noncoding RNA NORAD is upregulated in epithelial ovarian cancer and its downregulation suppressed cancer cell functions by competing with miR-155-5p. Cancer Med. 2019 Aug;8(10):4782–91.

387. Yang TJ, Wang L, Zhang Y, Zheng JD, Liu L. LncRNA UCA1 regulates cervical cancer survival and EMT occurrence by targeting miR-155. Eur Rev Med Pharmacol Sci. 2020 Oct;24(19):9869–79.

388. Zheng R, Lin S, Guan L, Yuan H, Liu K, Liu C, et al. Long non-coding RNA XIST inhibited breast cancer cell growth, migration, and invasion via miR-155-CDX1 axis. Biochem Biophys Res Commun. 2018 Apr;498(4):1002–8.

389. Yang J, Jia Y, Wang B, Yang S, Du K, Luo Y, et al. Circular RNA CHST15 Sponges miR-155-5p and miR-194-5p to Promote the Immune Escape of Lung Cancer Cells Mediated by PD-L1. Front Oncol. 2021 Mar;11:595609.

390. Guo J, Ma Y, Peng X, Jin H, Liu J. LncRNA CCAT1 promotes autophagy via regulating ATG7 by sponging miR-181 in hepatocellular carcinoma. J Cell Biochem. 2019 Oct;120(10):17975–83.

391. Peng W, Si S, Zhang Q, Li C, Zhao F, Wang F, et al. Long non-coding RNA MEG3 functions as a competing endogenous RNA to regulate gastric cancer progression. J Exp Clin Cancer Res. 2015 Aug;34(1):79.

392. Yang J, Jia Y, Wang B, Yang S, Du K, Luo Y, et al. Circular RNA CHST15 Sponges miR-155-5p and miR-194-5p to Promote the Immune Escape of Lung Cancer Cells Mediated by PD-L1. Front Oncol. 2021 Mar;11:595609.

393. Sun Q, Hao Q, Lin YC, Song YJ, Bangru S, Arif W, et al. Long non-coding RNA NORAD is upregulated in epithelial ovarian cancer and its downregulation suppressed cancer cell functions by competing with miR-155-5p. Cancer Med. 2019 Aug;8(10):4782–91.

394. Yang TJ, Wang L, Zhang Y, Zheng JD, Liu L. LncRNA UCA1 regulates cervical cancer survival and EMT occurrence by targeting miR-155. Eur Rev Med Pharmacol Sci. 2020 Oct;24(19):9869–79.

395. Zheng R, Lin S, Guan L, Yuan H, Liu K, Liu C, et al. Long non-coding RNA XIST inhibited breast cancer cell growth, migration, and invasion via miR-155-CDX1 axis. Biochem Biophys Res Commun. 2018 Apr;498(4):1002–8.

396. Yang J, Jia Y, Wang B, Yang S, Du K, Luo Y, et al. Circular RNA CHST15 Sponges miR-155-5p and miR-194-5p to Promote the Immune Escape of Lung Cancer Cells Mediated by PD-L1. Front Oncol. 2021 Mar;11:595609.

397. Guo J, Ma Y, Peng X, Jin H, Liu J. LncRNA CCAT1 promotes autophagy via regulating ATG7 by sponging miR-181 in hepatocellular carcinoma. J Cell Biochem. 2019 Oct;120(10):17975–83.
CASC2 inhibits hypoxia-induced pulmonary artery smooth muscle cell proliferation and migration by regulating the miR-222/ING5 axis. Cell Mol Biol Lett. 2020 Mar;25(1):21.

395. Wang X, Cheng ML, Gong Y, Ma WJ, Li B, Jiang YZ. LncRNA DANCR promotes ATG7 expression to accelerate hepatocellular carcinoma cell proliferation and autophagy by sponging miR-222-3p. Eur Rev Med Pharmacol Sci. 2020 Sep;24(17):8778–87.

396. Liu L, Wang HJ, Meng T, Lei C, Yang XH, Wang QS, et al. LncRNA GAS5 Inhibits Cell Migration and Invasion and Promotes Autophagy by Targeting miR-222-3p via the GAS5/PTEN-Signaling Pathway in CRC. Mol Ther Nucleic Acids. 2019 Sep;17:644–56.

397. Gao C, Lu W, Lou W, Wang L, Xu Q. Long noncoding RNA HOXC13-AS positively affects cell proliferation and invasion in nasopharyngeal carcinoma via modulating miR-383-3p/HMGA2 axis. J Cell Physiol. 2019 Aug;234(8):12809–20.

398. Liu G, Yang H, Cao L, Han K, Li G. LncRNA TMPO-AS1 Promotes Proliferation and Invasion by Sponging miR-383-5p in Glioma Cells. Cancer Manag Res. 2020 Nov;12:12001–9.

399. Teng F, Zhang JX, Chang QM, Wu XB, Tang WG, Wang JF, et al. LncRNA MYLK-AS1 facilitates tumor progression and angiogenesis by targeting miR-424-5p/E2F7 axis and activating VEGFR-2 signaling pathway in hepatocellular carcinoma. J Exp Clin Cancer Res. 2020 Nov;39(1):235.

400. Liu C, Yao MD, Li CP, Shan K, Yang H, Wang JJ, et al. Silencing Of Circular RNA-ZNF609 Ameliorates Vascular Endothelial Dysfunction. Theranostics. 2017 Jul;7(11):2863–77.