**Supplementary Table 1. Summary of non-coding RNAs in sarcoma therapeutic resistance.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| First author  Year  [Reference] | Pathological type  (subtype) | Setting | Non-coding RNA investigated | Intervention | Methods | Number of replicates/  subjects | Genes and pathways | Major conclusion | W-MeQS |
| Chemotherapy (OS) | | | | | | | | | |
| Xie  2020  [1] | OS | in vitro | lncRNA NORAD | cisplatin | RT-qPCR | 3 | miR-410-3p/NF-κB | Inhibition of lncRNA NORAD expression can increase sensitivity to cisplatin. | 4 |
| Li  2019  [2] | OS | in vitro | lncRNA ANRIL | cisplatin | RT-qPCR | 3 | miR-125a-5p/STAT3 | ANRIL knockdown sensitizes OS cells to cisplatin. | 3 |
| Lee  2021  [3] | OS | in vitro | lncRNA ANRIL | cisplatin  doxorubicin | RT-qPCR | 3 | - | The over-expression of ANRIL in OS cells led to an increased resistance to both agents. | 5 |
| Wang  2016  [4] | OS | in vitro | LINC00161 | cisplatin | RT-qPCR  microarray | 3 | miR-645/IFIT2 | LINC00161 sensitizes OS cells to cisplatin. | 7 |
| Zhang  2021  [5] | OS | in vitro | lncRNA FOXD2-AS1 | cisplatin | RT-PCR | - | miR-143/ (Bax&Bcl-2) | LncRNA FOXD2-AS1 knockdown inhibits the resistance of human OS cells to cisplatin. | 3 |
| Li  2021  [6] | OS | in vitro | LINC01116 | doxorubicin | RT-qPCR | 3 | miR-424-5p/HMAG2 | LINC01116 promotes doxorubicin resistance in OS. | 5 |
| Cheng  2019  [7] | OS | in vitro | lncRNA NCK-AS1 | cisplatin | RT-qPCR | 3 | miR-137/ (Bax, Bcl-2 &cleaved caspase 3) | NCK-AS1 knockdown enhanced DDP sensitivity of OS cells. | 4 |
| Zhang  2017  [8] | OS | in vitro | LINC00473 | cisplatin | RT-qPCR | 3 | C/EBPβ-IL24 | Elevated ZBTB7A inhibits cisplatin-induced apoptosis by repressing LINC00473 expression in OS cells. | 7 |
| Sun  2022  [9] | OS | in vitro | lncRNA SNHG15 | cisplatin | RT-qPCR | 3 | miR-335-3p/ZNF32 | SNHG15 suppresses cisplatin-induced apoptosis and ROS accumulation through the miR-335-3p/ZNF32 pathway. | 7 |
| Wang  2021  [10] | OS | in vitro | lncRNA DICER1-AS1 | cisplatin  carboplatin  etoposide  methotrexate  doxorubicin | RT-qPCR | 3 | miR-34a-5p/GADD45A | DICER1-AS1 indeed involves in the inhibition of the multi-drugresistance of OS cells. | 9 |
| Song  2019  [11] | OS | in vitro  in vivo | lncRNA OIP5-AS1 | cisplatin | qPCR | 3 | miR-340-5p/ LPAATβ/PI3K/AKT/mTOR | Lnc RNA OIP5AS1 causes cisplatin resistance in OS. | 6 |
| Han  2018  [12] | OS | in vitro  in vivo | lncRNA LUCAT1 | methotrexate | RT-qPCR | 3 | miR-200c/ABCB1 | LUCAT1 knockdown decreased the expression levels drug resistance related genes. | 5 |
| Zhou  2019  [13] | OS | in vitro  in vivo | lncRNA TUG1 | cisplatin | RT-qPCR | - | MET/AKT | Knockdown of TUG1 inhibited the cisplatin resistance. | 4 |
| Hu  2019  [14] | OS | in vitro  in vivo | lncRNA TUG1 | doxorubicin | RT-qPCR | - | AKT | Down-regulating of lncRNA TUG1 promotes apoptosis of doxorubicin resistant OS cells. | 7 |
| Sun  2019  [15] | OS | in vitro  in vivo | lncRNA PVT1 | gemcitabine | RT-qPCR | 3 | miR-152/c-MET/PI3K/AKT | LncRNAPVT1 targets miR-152 to enhance chemoresistance of OS to gemcitabine. | 6 |
| Liu  2021  [16] | OS | in vitro  in vivo | lnc MALAT-1 | doxorubicin | RT-qPCR | 3 | ERK | Downregulating MALAT-1 in the doxorubicin resistance OS cells could reverse the resistance and may improve chemotherapeutic efficiency. | 7 |
| Pu  2021  [17] | OS | in vitro  in vivo | lncRNA LAMTOR5-AS1 | cisplatin | RT-qPCR | 3 | NRF2 | LAMTOR5-AS1 significantly inhibits the proliferation and drug resistance of OS cells. | 9 |
| Shen  2020  [18] | OS | in vitro  in vivo | lnc ARSR | adriamycin  paclitaxel  cisplatin | RT-qPCR  microarray | 3 | MRP1 | The reduction of lnc ARSR overcame the resistance to adriamycin. | 9 |
| Wang  2020  [19] | OS  (N/A) | in vitro  humans | LINC00426 | doxorubicin | RT-qPCR | 3/  OS tissues:50  normal tissues:50 | miR-4319/caspase 3 | LINC00426 contributes to doxorubicin resistance. | 4 |
| Zhu  2019  [20] | OS  (N/A) | in vitro  humans | lncRNA MEG3 | doxorubicin  cisplatin  methotrexate | RT-qPCR | 3/  chemo-sensitive OS tissue:48  chemo-resistance OS tissue:32 | hsa-miR-200b-3p/AKT2 | LncRNA MEG3 could promote the OS doxorubicin resistance through miR-200b-3p/AKT2 axis. | 9 |
| hsa\_circ\_0001258 | hsa-miR-744-3p/GSTM | Hsa\_circ\_0001258 suppressed the doxorubicin resistance of OS cells through hsa-miR-744-3p /GSTM2 axis. |
| Fu  2019  [21] | OS  (N/A) | in vitro  humans | lncRNA TTN-AS1 | cisplatin | qPCR | -/  OS tissues:55  normal tissues:9 | miR-134-5p/MBTD1 | Downregulation of lncRNA TTN-AS1 reduced drug resistance. | 8 |
| Zhang  2020  [22] | OS  (N/A) | in vitro  humans | lncRNA MSC-AS1 | cisplatin | RT-qPCR | 3/  OS tissues:45  normal tissues:45 | miR-142/PI3K/AKT | Slience MSC-AS1 made OS cells more sensitive to cisplatin. | 4 |
| Liu  2020  [23] | OS  (N/A) | in vitro  in vivo  humans | lncRNA OIP5-AS1 | cisplatin | RT-qPCR | 3/  cisplatin-resistant OS tissue: 30  cisplatin-sensitive OS tissue: 17 | miR-377-3p/FOSL2 | LncRNA OIP5-AS1 positively modulated FOSL2 expression to decrease cisplatin sensitivity in OS. | 6 |
| Gu  2020  [24] | OS  (N/A) | in vitro  in vivo  humans | LINC00922 | doxorubicin | RT-qPCR  microarray | -/  OS tissues:40  normal tissues:40 | miR-424-5p/TFAP2C | LINC00922 accelerated OS doxorubicin-resistance. | 4 |
| Sun  2020  [25] | OS  (N/A) | in vitro  in vivo  humans | lncRNA OIP5-AS1 | doxorubicin | RT-qPCR | 3/  OS tissues:56  normal tissues:16 | miR-137-3p/PTN | LncRNA OIP5-AS1 promotes resistance to doxorubicin by regulating miR-137-3p/PTN axis in OS. | 6 |
| Meng  2020  [26] | OS  (osteoblastic/ chondroblastic/ fibroblastic/ mixed OS) | in vitro  in vivo  humans | lncRNA MIR17HG | cisplatin | RT-qPCR | 3/  OS tissues:40  (15 osteoblastic, 10 chondroblastic, 9 fibroblastic and 6 mixed OS)  normal tissues:40 | miR-130a-3p/SP1 | MIR17HG promoted the  proliferation, invasion and cisplatin resistance of OS cells in vitro. | 5 |
| Liang  2018  [27] | OS  (osteoblastoma/other OS) | in vitro  in vivo  humans | lncRNA DNAJC3‐AS1 | cisplatin | RT-qPCR | 3/  tumor tissues: 30  (19 osteoblastoma and 11 other OS)  normal tissues: 30 | DNAJC3 | DNAJC3‐AS1 reduced sensitivity of OS to cisplatin. | 7 |
| Shi  2020  [28] | OS  (N/A) | in vitro  in vivo  humans | lncRNA PWRN1 | cisplatin | RT-qPCR | -/  OS tissues: 54  normal tissues: 54 | miR-214-5p | PWRN1 overexpression inhibited cisplatin chemoresistance in OS cells. | 4 |
| Zhu  2020  [29] | OS  (N/A) | in vitro  in vivo  humans | lncRNA Sox2OT-V7 | doxorubicin | RT-qPCR | 3/  OS tissues: 32  normal tissues: 32 | miR-142/miR-22 | Sox2OT-V7 promotes doxorubicin-induced chemoresistance in OS. | 8 |
| Wen  2020  [30] | OS  (N/A) | in vitro  in vivo  humans | lncRNA-SARCC | cisplatin | RT-qPCR | 3/  cisplatin-sensitive OS tissue:20  cisplatin-resistant OS tissue:20 | miR-143/Hexokinase 2 | LncRNA-SARCC sensitizes OS to cisplatin. | 4 |
| Wang  2017  [31] | OS  (N/A) | in vitro  in vivo  humans | lncRNA CTA | doxorubicin | RT-qPCR | 3/  OS tissues: 30  normal tissues: 30 | miR-210/ (p62, cleaved caspase 3& Bcl-2) | LncRNA CTA sensitizes OS cells to doxorubicin. | 6 |
| Guo  2020  [32] | OS  (N/A) | in vitro  humans | lncRNA HOTAIR | cisplatin | qPCR | 3/  sensitive cases:20 resistant cases:20 | miR-106a-5p/STAT3 | HOTAIR enhanced cisplatin resistance of OS. | 5 |
| Zhou  2018  [33] | OS  (N/A) | in vitro  humans | lncRNA SNHG12 | doxorubicin | RT-qPCR | 3/  sensitive cases:32 resistant cases:32 | miR-320a/MCL1 | Knockdown of SNHG12  improved the sensitivity of doxorubicin. | 5 |
| Zhang  2016  [34] | OS  (N/A) | in vitro  humans | lncRNA ODRUL | doxorubicin | RT-qPCR | -/  sensitive cases:30 resistant cases:30 | ABCB1 | LncRNA ODRUL contributes to doxorubicin resistance of OS. | 5 |
| Cheng  2019  [35] | OS  (N/A) | in vitro  humans | lncRNA ROR | cisplatin | RT-qPCR | 3/  primary OS tissues: 25  relapsed OS tissues: 25 | miR-153-3p/ABCB1 | LncRNA ROR induce cisplatin resistance in OS. | 3 |
| Zhang  2017  [36] | OS  (N/A) | in vitro  in vivo  humans | lncRNA FOXC2-AS1 | doxorubicin | RT-qPCR | -/  chemosensitive OS tissue: 34  chemoresistant OS group: 34 | FOXC2/ABCB1 | LncRNA FOXC2-AS1 promotes doxorubicin resistance in OS | 6 |
| Zhu  2019  [37] | OS  (N/A) | in vitro  in vivo  humans | lncRNA OIP5‐AS1 | doxorubicin | RT-qPCR | -/  chemo‐resistant:32  chemo‐sensitive:48 | miR-200b-3p/Fibronectin‐1 | Lnc RNA OIP5‐AS1 modulates Fibronectin‐1 contributes to doxorubicin resistance of OS cells. | 8 |
| Li  2018  [38] | OS  (N/A) | in vitro  humans | lncRNA B4GALT1-AS1 | adriamycin | RT-qPCR | 3/  tumor sample:39  normal tissue:39 | YAP | Knockdown of B4GALT1-AS1 inhibited OS cells chemotherapeutic sensitivity. | 7 |
| Hu  2018  [39] | OS  (N/A) | in vitro  in vivo  humans | lncRNA NEAT1 | cisplatin | RT–qPCR | -/  OS tissue:40  normal tissue:20 | miR-34c/ (Bcl-2, CCND1) | Knockdown of lncRNA NEAT1 improves the sensitivity to cisplatin in OS. | 6 |
| Li  2016  [40] | OS  (N/A) | in vitro  humans | lnc HOTTIP | cisplatin | RT-qPCR | 3/  OS tissue:21  normal tissue:21 | Wnt/β-catenin | Overexpression of lnc HOTTIP increases chemoresistance of OS. | 3 |
| Chen  2018  [41] | OS  (osteoblastoma/other OS) | in vitro  in vivo  humans | lnc RAB11B-AS1 | cisplatin | RT-qPCR | 3/  OS tissue: 24  (14 osteoblastoma and 10 other OS)  normal tissue:24 | RAB11B | The reduction of RAB11B-AS1 results in lower sensitivity to cisplatin in OS cells. | 7 |
| Zhu  2017  [42] | OS  (N/A) | in vitro  in vivo  humans | lncRNA FENDRR | doxorubicin | RT-qPCR | 3/  chemoresistant group:40  chemosensitive group:40 | ABCB1  ABCC1 | LncRNA FENDRR sensitizes doxorubicin-resistance of OS cells. | 5 |
| Zhang  2020  [43] | OS  (N/A) | in vitro  in vivo  humans | lncRNA SNHG15 | doxorubicin | RT-qPCR | 3/  chemoresistant group:30  chemosensitive group:30 | miR-381-3p/GFRA1 | LncRNA SNHG15 contributes to doxorubicin resistance of OS cells. | 4 |
| Tang  2022  [44] | OS  (N/A) | in vitro  in vivo  humans | LINC00641 | cisplatin | RT-qPCR | OS tissues and paracancerous tissues:58 pairs | miR-320d/MCL1 | Knock-down of LINC00641 gene represses DDP-resistance of DDP-resistant OS cells via modulating miR-320d. | 5 |
| Liu  2020  [45] | OS | in vitro | miR-187 | doxorubicin | RT-qPCR | 3 | MAPK7 | MiR-187 enhanced the chemosensitivity of the OS cells to doxorubicin | 3 |
| Patil  2019  [46] | OS | in vitro | miR-509-3p | cisplatin | RT-qPCR | 3 | AXL  ARHGAP1 | MicroRNA-509-3p sensitizes OS to cisplatin. | 8 |
| Wang  2020  [47] | OS | in vitro | miR-410-3p | cisplatin | RT-qPCR | 3 | HMGB1/NF-κB | Overexpression of miR-410-3p increased cisplatin sensitivity of OS cells via suppressing HMGB1/NF-κB pathway. | 4 |
| Lou  2019  [48] | OS | in vitro | miR-29b | doxorubicin | RT-qPCR | 3 | MMP-9 | MiR-29b sensitizes OS cells to doxorubicin. | 3 |
| Li  2020  [49] | OS | in vitro | miR-29b | doxorubicin | RT-qPCR | 3 | spin1/PI3K/AKT  spin1/STAT3 | Down-regulating of miR-29b promotes OS cell drug resistance. | 8 |
| Vanas  2016  [50] | OS | in vitro | miR-21 | cisplatin | northern blot | 3 | Spry2 | MiRNA-21 increases cisplatin sensitivity of OS-derived cells | 5 |
| Ziyan  2014  [51] | OS | in vitro | miR-21 | cisplatin | RT-qPCR | 3 | Bcl-2 | Suppression of miR-21 in OS cells led to enhanced cisplatin cytotoxicity. | 3 |
| Bazavar  2020  [52] | OS | in vitro | miR-192 | methotrexate | RT-qPCR | 4 | MMP-9  c-Myc  KRAS  CXCR-4  ADAMTS | MiR-192 enhances sensitivity of methotrexate to OS cells. | 3 |
| Xu  2016  [53] | OS | in vitro | miR-30a | doxorubicin | RT-qPCR | 3 | Beclin-1 | MicroRNA-30a downregulation contributes to chemoresistance of OS cell. | 4 |
| Wang  2019  [54] | OS | in vitro | miR-22 | cisplatin | RT-qPCR | 3 | MTDH | MiR-22 sensitized OS cells to cisplatin treatment. | 4 |
| Li  2014  [55] | OS | in vitro | miR-22 | doxorubicin  cisplatin | RT-qPCR | 3 | HMGB1 | Overexpressed miR-22 against chemotherapy resistance in OS. | 4 |
| Zhu  2020  [56] | OS | in vitro | miR-4779 | doxorubicin | - | - | PLK1 | MiR-4779 negatively regulates  the expression of PLK1 and possesses a cancer-inhibiting role in drug-resistant OS cells. | 3 |
| Zhang  2015  [57] | OS | in vitro | miR-217 | cisplatin | RT-qPCR | 3 | KRAS | Overexpression of miR-217 enhanced cisplatin sensitivity of 143B OS cells. | 6 |
| Song  2017  [58] | OS | in vitro | miR-340-5p | cisplatin | RT-qPCR | 2 | LPAATβ | MiR-340-5p enhanced the sensitivity to CDDP. | 3 |
| Song  2017  [59] | OS | in vitro | miR-214 | cisplatin | RT-qPCR | 3 | HK2  PKM2  LDHA | MiR-214 contributes to cisplatin resistance in OS cells. | 3 |
| Fiore  2016  [60] | OS | in vitro | Let-7d microRNA | doxorubicin  cisplatin  paclitaxel  etoposide | RT-qPCR | 4 | Bcl-2  caspase3  E2F2  CCND2 | Let-7d- overexpression reduced cell sensitivity to apoptosis induced by various chemotherapy drugs. | 6 |
| Zhang  2015  [61] | OS | in vitro | miR-301a | doxorubicin | RT-qPCR  northern blot | 3 | AMPKα1 | Up-regulation of miR-301a contributed to chemoresistance of OS cells. | 6 |
| Meng  2020  [62] | OS | in vitro  in vivo | miR-22 | cisplatin | RT-qPCR | 3 | MTDH | MiR-22 promoted cisplatin sensitivity. | 4 |
| Meng  2020  [63] | OS | in vitro  in vivo | miR‑22 | cisplatin | RT‑qPCR | 3 | PI3K/AKT/mTOR | MiR‑22 leads to an improvement in the sensitivity of cisplatin in OS. | 7 |
| Yuan  2018  [64] | OS | in vitro  in vivo | miR-20a | doxorubicin  cisplatin | RT-qPCR | 3 | TAK1 | Overexpression of miR-20a sensitizes the OS cells to chemotherapeutic drugs. | 5 |
| Lin  2016  [65] | OS | in vitro  in vivo | miR-184 | doxorubicin | RT-qPCR | 3 | BCL2L1 | MiR-184 leads to poor response to doxorubicin therapy. | 4 |
| Lei  2018  [66] | OS | in vitro  in vivo | miR-199a-3p | cisplatin  carboplatin  doxorubicin | RT-qPCR | 3 | AK4/NF-кB | MiR-199a-3p promoted multi-drug resistance in OS cells. | 6 |
| Pu  2016  [67] | OS | in vitro  in vivo | miR-34a-5p | doxorubicin  etoposide  methotrexate  cisplatin  carboplatin | RT-qPCR | 3 | MEF2 | MiR-34a-5p promotes multi-drug resistance in OS cells. | 7 |
| Song  2010  [68] | OS | in vitro | miR-215 | methotrexate | RT–qPCR | 2 | DTL | MiR-215 increase in chemoresistance to methotrexate in OS cells. | 7 |
| Li  2017  [69] | OS | in vitro, | miR-34a | cisplatin | RT–qPCR | 3 | c-Myc  Bim | MiR-34a increases cisplatin sensitivity of OS cells in vitro. | 4 |
| Zhou  2016  [70] | OS | in vitro | miR-34b | doxorubicin  gemcitabine  methotrexate | RT-qPCR | 3 | ABCB1  PAK1 | miR-34b overexpression reverses multidrug resistance in human OS cells in vitro. | 6 |
| Chang  2014  [71] | OS | in vitro | miR-101 | doxorubicin | - | 3 | LC3-Ⅰ  LC3-Ⅱ | Blocked autophagy by miR-101 enhances OS cell chemosensitivity. | 3 |
| Gao  2015  [72] | OS | in vitro | miR-199a-3p | doxorubicin | microarray | 3 | CD44 | MiR-199a-3p transfection increased drug sensitivity in OS. | 7 |
| Fiore  2014  [73] | OS | in vitro | miR‐29b-1 | cisplatin  doxorubicin  etoposide | RT-qPCR | 3 | Oct3/4  SOX2  Nanog  CD133  N-Myc | MiR-29b-1 overexpression sensitized OS cells to chemotherapeutic drug-induced apoptosis. | 4 |
| Wei  2016  [74] | OS | in vitro | miR-140-5p | cisplatin  doxorubicin | RT-qPCR | 3 | IP3K2 | The increased miR-140-5p expression levels up-regulated anticancer drug-induced autophagy in OS cells. | 3 |
| Xie  2018  [75] | OS | in vitro | miR-149 | doxorubicin | RT-qPCR | 3/  tumor tissue:41  normal tissue:36 | BMP9 | Overexpression of miR-149 conferred chemoresistance in OS cells. | 4 |
| Novello  2014  [76] | OS | in vitro | miR-34a | etoposide | RT-qPCR | 3 | - | MiR-34a basal levels were lower in p53-deficient OS cells and with a higher sensitivity to etoposide. | 5 |
| Chen  2014  [77] | OS | in vitro | miR-155 | cisplatin | qPCR | 3 | LC3-Ⅰ  LC3-Ⅱ | The increased miR-155 expression levels upregulated anti­cancer drug-induced autophagy in OS cells. | 3 |
| Li  2015  [78] | OS | in vitro | miR-199a-5p | cisplatin | RT-qPCR | 3 | LC3-Ⅰ  LC3-Ⅱ | MicroRNA-199a-5p inhibits cisplatin-induced drug resistance in OS cells. | 3 |
| Huang  2021  [79] | OS | in vitro | miR-203 | cisplatin | RT-qPCR | 3 | RUNX2 | Knockdown of microRNA-203 reduces cisplatin chemosensitivity to OS cell lines. | 4 |
| Zou  2018  [80] | OS | in vitro | miR-133b | cisplatin | RT-qPCR | 3 | - | MiR-133b induces chemoresistance of OS cells to cisplatin treatment. | 3 |
| Zhu  2021  [81] | OS | in vitro | miR-128-3p | cisplatin | RT-qPCR | 3 | ZC3H12D | MiR-128-3p overexpression also improved resistance to cisplatin in OS cells. | 4 |
| Zhang  2019  [82] | OS | in vitro | miR-19a-3p | cisplatin | RT-qPCR | 3 | PTEN | Silencing of miR‑19a‑3p enhances OS cells chemosensitivity. | 5 |
| Jiang  2015  [83] | OS | in vitro | miR-126 | cisplatin  methotrexate | qPCR | - | - | MicroRNA-126 enhances the sensitivity of OS cells to cisplatin and methotrexate. | 5 |
| Chen  2016  [84] | OS | in vitro | miR-34a  miR-203 | cisplatin | RT-qPCR | 3 | survivin | MiR-34a and miR-203 enhanced cell sensitivity to cisplatin. | 7 |
| Yu  2019  [85] | OS | in vitro | miR-26a-5p | paclitaxel | RT-qPCR | 3 | HOXA5 | Knock-down of miR-26a-5p increased OS cell sensitivity to chemotherapeutic drug paclitaxel. | 3 |
| Pu  2017  [86] | OS | in vitro  in vivo | miR-34a-5p | doxorubicin  etoposide  methotrexate  cisplatin | RT-qPCR | 3 | DLL1 | MiR-34a-5p promotes multi-chemoresistance of OS. | 4 |
| Song  2009  [87] | OS | in vitro  in vivo | miR-140 | methotrexate | RT–qPCR | 2 | HDAC4 | Overexpression of miR-140 causes chemoresistance to methotrexate in OS. | 7 |
| Pu  2017  [88] | OS | in vitro  in vivo | miR-34a-5p | doxorubicin cisplatin  carboplatin  etoposide | RT-qPCR | 3 | AGTR1 | The miR-34a-5p promotes the multi-chemoresistance of OS. | 6 |
| Osaki  2016  [89] | OS | in vitro  in vivo | miR‐29 | cisplatin  doxorubicin; | RT-qPCR | 3 | MCL1 | Upregulation of miR-29 enhanced chemotherapy- induced apoptosis in OS cells. | 6 |
| Zhang  2021  [90] | OS | in vitro  in vivo | miR-134 | doxorubicin | RT-qPCR | 3/  resistant group:23  sensitive group:23 | PTBP1 | Downregulation of miR-134 promoted chemoresistance of OS cells to doxorubicin by upregulating PTBP1 expression. | 6 |
| Zhao  2017  [91] | OS | in vitro  in vivo | miR‑20a‑5p | etoposide  methotrexate  cisplatin  doxorubicin | RT-qPCR | 3 | SDC2 | MiR‑20a‑5p represses the multi‑drug resistance of OS. | 5 |
| Wang  2019  [92] | OS | in vitro  in vivo | miR-193a | doxorubicin | RT-qPCR | 3 | IRS2 | MiR-193a-3p suppresses both growth and doxorubicin drug resistance of OS in vivo. | 4 |
| Gao  2017  [93] | OS | in vitro  in vivo | miR-335 | cisplatin | RT-qPCR | 3 | POU5F1 | Pre-miR-335 resulted in tumor enhanced sensitivity to traditional chemotherapy. | 6 |
| Cheng  2020  [94] | OS  (N/A) | in vitro  in vivo  humans | miR‑487b‑3p | doxorubicin | RT-qPCR | -/  patients:40  healthy bone:24 | ALDH1A3 | MiR‑487b‑3p inhibits OS chemoresistance. | 6 |
| Yu  2019  [95] | OS  (N/A) | in vitro  humans | miR-221 | cisplatin | RT-qPCR | 3/  OS tissues:15  normal tissues:15 | PPP2R2A | Overexpression of miR-221 promoted OS cell cisplatin resistance. | 5 |
| Tsai  2018  [96] | OS  (N/A) | in vitro  in vivo  humans | miR‐519d | doxorubicin | RT-qPCR | - | ABCG2 | Downregulation of miR‐519d increases ABCG2 expression and promotes drug resistance. | 6 |
| Meng  2017  [97] | OS  (N/A) | in vitro  in vivo  humans | miR-140-5p | cisplatin  doxorubicin  methotrexate | RT-qPCR  microarray | 3/  OS tissues: 40  normal tissues: 40 | HMGN5 | Knockdown of miR-140-5p enhanced OS cells resistance to multiple chemotherapeutics. | 8 |
| Zhang  2020  [98] | OS  (N/A) | in vitro  humans | miR-129-5p | 5-flurouracil | RT-qPCR | -/  OS tissues: 30  normal tissues: 30 | LARP1 | Down-regulation of miR-129-5p promoted proliferation, invasion, and drug resistance in OS. | 3 |
| Liu  2019  [99] | OS  (N/A) | in vitro  humans | miR-16 | cisplatin | RT-qPCR | 3/  OS tissues: 30  normal tissues: 30 | ATG4B | Down-regulation of miR-16 enhances cisplatin resistance of OS. | 5 |
| Keremu  2019  [100] | OS  (N/A) | in vitro  in vivo  humans | miR-199a | cisplatin | RT-qPCR | 3/  OS tissues: 20  normal tissues: 20 | HIF-1α | Overexpression ofmiR-199a resensitizes cisplatin resistant cells to cisplatin. | 5 |
| Yan  2018  [101] | OS  (N/A) | in vitro  humans | miR-340 | cisplatin | RT-qPCR | -/  tumor tissues: 20  normal tissues: 20 | ZEB1 | Overexpression of miR-340 enhanced sensitivity to DDP in OS cells. | 4 |
| Xiao  2017  [102] | OS  (N/A) | in vitro  humans | miR-100 | doxorubicin | RT-qPCR | 5/  tumor tissues: 28  normal tissues: 28 | ZNRF2 | MiR-100 suppresses OS cell chemoresistance | 3 |
| Wang  2017  [103] | OS  (osteoblastic/ chondroblastic/ fibroblastic/ telangiectatic/ other OS) | in vitro  in vivo  humans | miR-491 | cisplatin | RT-qPCR | -/  OS patients:102  (60 osteoblastic, 13 chondroblastic, 18 fibroblastic, 6 telangiectatic and 5 other OS)  healthy control:20 | CRYAB | MiR-491 inhibits OS lung metastasis and chemoresistance | 8 |
| Zhou  2018  [104] | OS  (parosteal/ conventional/ chondroblastic/osteoblastoma/telangiectatic OS) | in vitro  humans | miR-22 | cisplatin | RT-qPCR | 3/  OS patients:7  (1 parosteal, 3 conventional,1 chondroblastic, 1 osteoblastoma and 1 telangiectatic OS)  healthy control:7 | S100A11 | MiR-22 increase the cisplatin sensitivity of OS cells. | 4 |
| Zhang  2020  [105] | OS  (N/A) | in vitro  in vivo  humans | miR-429 | adriamycin | qPCR | 2/  OS tissues:10  normal tissues:10 | SOX2 | Upregulation of miR-429 increased adriamycin sensitivity through down regulating SOX2 in CD133+ OSCs. | 3 |
| Xu  2014  [106] | OS  (N/A) | in vitro  humans | miR-34c | cisplatin  doxorubicin  methotrexate | RT-qPCR | 3/  metastasis:25  chemosensitive:76  chemoresistance:21 | Notch1  LEF1 | MiR-34c inhibits OS chemoresistance. | 5 |
| Duan  2016  [107] | OS  (N/A) | in vitro  in vivo  humans | miR-15b | doxorubicin | RT-qPCR  microarray | 4/  samples from survivors; 14  samples from nonsurvivors:35 | Wee1 | MDR in OS is associated with downregulation of miR-15b. | 9 |
| Maximov  2019  [108] | OS  (osteoblatic/osteoblatic/chondroblastic/high-grade surface OS) | in vitro  in vivo  humans | miR-16-1-3p  miR-16-2-3p | cisplatin  doxorubicin | RT-qPCR | 3/  OS samples:18  (15 osteoblatic, 2 osteoblatic/chondroblastic and 1 high-grade surface OS ) | FGFR2 | MiR-16-1-3p and miR-16-2-3p overexpression enhances chemosensitivity. | 8 |
| Chen  2017  [109] | OS  (N/A) | in vitro  humans | miR-410 | cisplatin | RT-qPCR | 3/  OS sample:40  normal tissue:40 | ATG16L1 | MiR-410 enhances chemosensitivity in OS. | 5 |
| Lin  2015  [110] | OS  (osteoblastic/ fibroblastic OS) | in vitro  humans | miR‑202 | doxorubicin | RT-qPCR | 3/  OS sample:8  (6 osteoblastic and 2 fibroblastic OS)  normal tissue:8 | TGF-β 1 | MiR-202 promotes chemotherapy resistance in OS cells. | 6 |
| Zhao  2013  [111] | OS  (N/A) | in vitro  humans | miR-221 | cisplatin | RT-qPCR | 3/  OS tissue:60  normal tissue:25 | PI3K/AKT | MicroRNA-221 Induces cisplatin resistance in human OS. | 5 |
| Zhou  2016  [112] | OS  (N/A) | in vitro  humans | miR-488 | doxorubicin | RT-qPCR | 3/  OS tissue:5  normal tissue:5 | Bim | Over-expression of miR-488 decreases the sensitivity to doxorubicin of OS cells. | 6 |
| Wang  2021  [113] | OS  (N/A) | in vitro  humans | miR-376c | cisplatin | RT-qPCR | 3/  tumor tissue:26  normal tissue:26 | TGFA | Cisplatin inhibited the prolif­eration of OS cells by upregulating miR-376c and downregulating *TGFA* expression. | 3 |
| Yang  2020  [114] | OS  (N/A) | in vitro  in vivo  humans | miR-216b | cisplatin | RT-qPCR | 3/  OS tissue:60  normal tissue:60 | JMJD2C//HIF-1α/HES1 | MiR-216b enhances cisplatin-induced apoptosis in OS cells | 9 |
| Xu  2018  [115] | OS  (N/A) | in vitro  humans | miR-29 | methotrexate | RT-qPCR | 3/  poor-response:18  good-response:18 | COL3A1  MCL1 | MiR-29 inhibits resistance to methotrexate in OS. | 6 |
| Zhou  2015  [116] | OS  (N/A) | in vitro  in vivo  humans | miR-143 | doxorubicin | RT–qPCR | -/  OS patients:45  health controls:13 | ATG2B  LC3-I  Bcl-2 | MiR-143 expression significantly reversed chemoresistance in OS resistance cells. | 6 |
| Liu  2015  [117] | OS  (N/A) | in vitro  humans | miR-100 | cisplatin | RT–qPCR | 3/  OS sample:20  normal sample:20 | IGFIR/PI3K/AKT  IGFIR/MAPK/ERK | MiR-100 enhances chemosensitivity in OS cells. | 4 |
| Shao  2015  [118] | OS  (N/A) | in vitro  in vivo  humans | miR-497 | cisplatin | RT–qPCR | 3/  OS tissue:14  normal tissue:14 | PI3K/AKT | The down regulation of miR-497 contributes to cisplatin resistance in OS. | 5 |
| Xu  2016  [119] | OS  (N/A) | in vitro  humans | miR-146b-5p | doxorubicin  cisplatin  methotrexate | RT-qPCR | 3/  OS tissues:35  normal tissue;35 | zinc and ring finger 3 | MiR-146b-5p promotes invasion and metastasis contributing to chemoresistance in OS. | 5 |
| Zhou  2014  [120] | OS  (N/A) | in vitro  humans | miR-33a | cisplatin | RT-qPCR | 2/  poor responder:35  good responder:35; | TWIST | MiR-33a promotes OS cell resistance to cisplatin. | 7 |
| Liu  2019  [121] | OS  (N/A) | in vitro  humans | miR-342-5p | doxorubicin | RT-qPCR | 3/  OS tissues:6  normal tissues:6 | Wnt/β-catenin | MiR-342-5p inhibits OS cell growth, migration, invasion, and sensitivity to doxorubicin. | 6 |
| Liu  2018  [122] | OS  (N/A) | in vitro  in vivo  humans | miR-92a | cisplatin | RT-qPCR | 3/  tumor tissue;25  nontumor tissue:25 | Notch1 | MiR-92a inhibits the progress of OS cells and increases the cisplatin sensitivity. | 4 |
| Li  2021  [123] | OS  (N/A) | in vitro  humans | miR-329-3p | cisplatin | RT-qPCR | 3/  tumor tissue: 30  normal tissue:30 | LDHA | Overexpression of miR-329-3p sensitizes OS cells to cisplatin. | 4 |
| Tang  2018  [124] | OS  (N/A) | in vitro  humans | miR-223 | cisplatin | RT-qPCR | 3/  OS tissue: 20  normal tissue:20 | JNK/JUN | MiR-223 overexpression further promoted CDDP-induced OS cell apoptosis. | 5 |
| Xu  2014  [125] | OS  (osteoblastic/ chondroblastic/ fibroblastic/ telangiectatic/other OS) | in vitro  in vivo  humans | miR-382 | cisplatin  doxorubicin  methotrexate | RT-qPCR | 3/  OS tissues:115  (29 osteoblastic, 6 chondroblastic, 11 fibroblastic, 3 telangiectatic and 2 other OS)  normal bone:107 | KLF12  HIPK3 | MiR-382 inhibits tumor growth and enhance chemosensitivity in OS. | 4 |
| Liu  2018  [126] | OS  (N/A) | in vitro  humans | miR-377 | cisplatin | RT-qPCR | 3/  poor responder:21  good responder:21 | XIAP | Down-regulation of miR-377 contributes to cisplatin resistance in OS. | 4 |
| Liu  2017  [127] | OS  (N/A) | in vitro  in vivo  humans | miR-200c | cisplatin | RT-qPCR | 3/  OS tissue:35  normal tissue:35 | AKT2 | Overexpression of miR-200c increases chemosensitivity of OS cells to cisplatin. | 7 |
| Zhu  2016  [128] | OS  (N/A) | in vitro  humans | miR-138 | cisplatin | RT-qPCR | 3/  OS tissue:20  normal tissue:20 | EZH2 | MiR-138 enhances cisplatin-induced apoptosis in OS cells. | 7 |
| Long  2018  [129] | OS  (N/A) | in vitro  humans | miR‐590 | doxorubicin | qPCR | 3/  OS tissue:18  normal tissue:18 | WIP1/ATM-p53 | MiR‐590 overexpression could enhance the cytotoxicity of doxorubicin. | 5 |
| Li  2016  [130] | OS  (N/A) | in vitro  humans | miR-381 | cisplatin | RT-qPCR | 3/  OS patients: 60  chondroma patients:7 | mTOR | Low expression of miR-381 enhances the chemosensitivity of OS. | 6 |
| Wang  2016  [131] | OS  (N/A) | in vitro  humans | miR-367 | adriamycin | RT-qPCR | 3/  tumor tissue:40  normal tissue:40 | KLF4 | MiR-367 negatively regulates apoptosis induced by adriamycin in OS cells. | 4 |
| Li  2021  [132] | OS  (N/A) | in vitro  in vivo  humans | miR-26a | doxorubicin  methotrexate  cisplatin | RT-qPCR | 5/  chemoresistant group:12  chemosensitive group:9; | MCL1 | MiR-26a reverses resistance  to doxorubicin in OS multidrug resistance cells. | 7 |
| Jin  2017  [133] | OS  (conventional/ non-conventional OS) | in vitro  humans | miR-610 | cisplatin | RT-qPCR | -/  tumor tissue:21  (13 conventional and 17 non-conventional OS)  normal tissue:21; | TWIST1 | Overexpression of miR-610 increased sensitivity of OS cells to cisplatin. | 4 |
| Li  2020  [134] | OS  (osteoblastic/ fibroblastic/ chondroblastic/telangiectatic OS) | in vitro  humans | miR-584 | cisplatin | RT-qPCR | 3/  OS tissue:37  (19 osteoblastic, 8 fibroblastic, 6 chondroblastic and 4 telangiectatic OS)  normal tissue:37; | CCN2/IκBα/NF-κB | MicroRNA-584 sensitizes OS cells to cisplatin. | 8 |
| Chen  2019  [135] | OS  (N/A) | in vitro  humans | miR-504 | cisplatin | RT-qPCR | 3/  OS tissue:10  normal tissue:10; | p53 | MiR-504 contributes to cisplatin resistance in OS cells. | 4 |
| Zhou  2018  [136] | OS  (osteoblastic/ chondroblastic fibroblastic OS) | in vitro  humans | miR‑192‑5p | cisplatin | RT-qPCR | 3/  OS tissue:25  (13 osteoblastic, 9 chondroblastic, and 3 fibroblastic OS)  normal tissue:25; | USP1 | Ectopic expression of miR-192-5p increased the sensitivity of osteosarcoma cells to cisplatin. | 4 |
| Ling  2020  [137] | OS  (N/A) | in vitro  humans | miR-150 | doxorubicin | RT-qPCR | 3/  OS tissue: 26  normal tissue:26; | RUNX2 | MicroRNA-150 functions as a tumor suppressor and sensitizes OS to doxorubicin-induced apoptosis. | 4 |
| Sun  2016  [138] | OS  (N/A) | in vitro  humans | miR-24 | doxorubicin | RT-qPCR | 3/  OS tissue: 45  normal tissue:45; | BIM-Smac/DIABLO | Knockdown of miR-24 reverses the doxorubicin-resistance in OS cells. | 5 |
| Zhi  2022  [139] | OS  (N/A) | in vitro  humans | miR-140 | doxorubicin | RT-qPCR | 3/  OS tissues:50  normal tissues:50 | Wnt1 | Overexpression of miR-140 inhibits OS cell proliferation and enhances drug sensitivity by suppressing Wnt1. | 5 |
| Zhou  2021  [140] | OS  (N/A) | in vitro  humans | miR-141-3p | cisplatin | RT-qPCR | 3/  OS and adjacent normal tissues:31 pairs | glutaminase | MiR-141-3p promotes the cisplatin sensitivity of OS cell through suppressing the glutaminase-mediated glutamine metabolism. | 4 |
| Liang  2019  [141] | OS  (N/A) | in vitro  in vivo  humans | miR-765 | cisplatin | RT-qPCR | 3/  negative: 19  positive: 24 | APE1 | MicroRNA-765 sensitizes OS cells to cisplatin. | 6 |
| Gao  2020  [142] | OS  (N/A) | in vitro  in vivo  humans | miR-375 | cisplatin | RT-qPCR | 3/  chemosensitive group: 35  chemoresistant group: 35 | ATG2B | MiR-375 suppresses autophagy and tumorigenesis in cisplatin-resistant OS cells | 5 |
| Wang  2021  [143] | OS  (N/A) | in vitro  in vivo  humans | miR‐519d‐3p | cisplatin | RT-qPCR | OS and adjacent normal tissues:40 pairs | PD‐L1 | MiR‐519d‐3p antagonizes OS resistance  against cisplatin by targeting PD‐L1. | 8 |
| Wang  2022  [144] | OS  (N/A) | in vitro  in vivo  humans | miR-19a-3p | cisplatin | RT-PCR | OS tissues:85 | PHLDA3/AKT/GSK3β | MiR-19a-3p promotes tumor growth and chemoresistance in OS by downregulating PHLDA3. | 5 |
| Zhan  2022  [145] | OS | in vitro  in vivo | miR-579-3p | cisplatin | RT-qPCR | 3 | MSH6 | Increasing expression  of miR-579 could inhibit the development and cisplatin resistance of OS. | 7 |
| Zhang  2021  [146] | OS | in vitro | circ-CHI3L1.2 | cisplatin | RT-qPCR | 3 | miR-340-5p/LPAATβ | Circ-CHI3L1.2 knockdown sensitized cisplatin-resistant OS cells to cisplatin. | 7 |
| Zhang  2020  [147] | OS | in vitro  in vivo | circTADA2A | cisplatin | RT-qPCR | 3 | miR-129-5p/(TRPS1, YAP1) | CircTADA2A knockdown inhibited cell proliferation and reduced cisplatin resistance in OS cells. | 7 |
| Feng  2021  [148] | OS | in vitro  in vivo | circPRKAR1B | cisplatin | RT-qPCR | 3 | miR-361-3p/FZD4/ Wnt/β-catenin | Overexpression of circPRKAR1B suppresses the sensitivity of OS cells to cisplatin. | 8 |
| Dong  2020  [149] | OS  (N/A) | in vitro  humans | circUBAP2 | cisplatin | RT-qPCR | -/  cisplatin-response:30  cisplatin-resistance:30 | miR-506-3p/SEMA6D/Wnt/β-catenin | CircUBAP2 promotes SEMA6D expression to enhance the cisplatin resistance in OS. | 6 |
| Wei  2021  [150] | OS  (N/A) | in vitro  in vivo  humans | circ\_0081001 | methotrexate | RT-qPCR | 3/  sensitive group:35  resistant group:28 | miR-494-3p/TGM2 | Circ\_0081001 knockdown enhances methotrexate sensitivity in OS cells. | 4 |
| Hu  2019  [151] | OS  (chondroblastic/osteoblastic/ conventional/ telangiectatic OS) | in vitro  humans | circ‐LARP4 | cisplatin  doxorubicin | RT-qPCR | -/  OS tissue:72  (10 chondroblastic, 47 osteoblastic,9 conventional and 6 telangiectatic OS)  normal tissue: 72 | miR-424 | Circ‐LARP4 elevates chemosensitivity to cisplatin and doxorubicin. | 5 |
| Li  2020  [152] | OS  (N/A) | in vitro  in vivo  humans | hsa\_circ\_0000073 | methotrexate | RT-qPCR | -/  tumor tissues: 25  normal tissues: 25; | (miR-145-5P, miR-151-3p)/NRAS | Hsa\_circ\_0000073 contributes to OS methotrexate resistance. | 7 |
| Li  2021  [153] | OS  (N/A) | in vitro  in vivo  humans | circPTV1 | doxorubicin | RT-qPCR | 3/  chemoresistant group:21  chemosensitive group:31 | miR-137/TRIAP1 | CircPVT1 contributes to doxorubicin resistance of OS cells. | 5 |
| Zhu  2018  [154] | OS  (N/A) | in vitro  humans | circPVT1 | doxorubicin  cisplatin | RT–qPCR | 3/  OS patients: 80  benign bone tumor:20  healthy control:20 | ABCB1 | Overexpressed circPVT1 contributes to doxorubicin and cisplatin resistance of OS cells. | 7 |
| Wang  2022  [155] | OS  (N/A) | in vitro  humans | circ PVT1 | cisplatin  doxorubicin  methotrexate | RT-qPCR | OS and adjacent normal tissues:80 pairs | miR‑24‑3p/KLF8 | CircRNA PVT1 promotes proliferation and chemoresistance of OS cells via the miR‑24‑3p/KLF8 axis. | 4 |
| Pan  2021  [156] | OS  (N/A) | in vitro  humans | hsa\_circ\_103801 | cisplatin | RT–qPCR | 3/  OS patients: 43  healthy control:15 | MRP1  P-gp | Hsa\_circ\_103801 increased the resistance of OS cells to cisplatin. | 5 |
| Zhang  2018  [157] | OS  (N/A) | in vitro  humans | circ\_001569 | cisplatin | RT-qPCR | 3/  tumor tissues:36  normal tissues:36 | Wnt/β-catenin | Expression of circ\_001569 is upregulated in OS promotes cisplatin resistance. | 4 |
| Xie  2020  [158] | OS  (N/A) | in vitro  humans | hsa\_circ\_0003496 | doxorubicin | RT-qPCR | -/  primary OS patients: 35  recurrent OS patients:35; | miR-370/KLF12 | Hsa\_circ\_0003496 contributes to chemoresistance in OS. | 8 |
| Lin  2022  [159] | OS  (N/A) | in vitro  humans | has\_circ\_0001982 | paclitaxel  cisplatin  doxorubicin  methotrexate | RT-qPCR | 3/  OS tissue:20  drug sensitive:10  drug resistant:10 | miR-143 | Hsa\_circ\_0001982 improves multidrug resistance of OS cells. | 3 |
| Ma  2021  [160] | OS  (N/A) | in vitro  in vivo  humans | circRNA\_0004674 | doxorubicin | RT-qPCR | 3/  OS tissues and paracancerous tissues:80 pairs | miR-142-5p/MCL1 | circRNA\_0004674 facilitates OS progression and chemoresistance. | 7 |
| Yuan  2021  [161] | OS  (N/A) | in vitro  in vivo  humans | circPRDM2 | doxorubicin | RT-qPCR | -/  OS tissue:43  normal tissue:43 | miR-760/EZH2 | CircPRDM2 contributes to doxorubicin resistance of OS. | 8 |
| Wei  2020  [162] | OS  (N/A) | in vitro  in vivo  humans | circSAMD4A | doxorubicin | RT-qPCR | 3/  chemoresistant group:36  chemosensitive group:24; | miR-218-5p/KLF8 | CircSAMD4A contributes to cell doxorubicin  resistance in OS. | 4 |
| Zhou  2021  [163] | OS  (osteoblastic/  fibroblastic OS) | in vitro  in vivo  humans | circ ITCH | doxorubicin | RT-qPCR | 3/  OS tissue:40  (32 osteoblastic and 8 fibroblastic cancer tissues)  normal tissue:40; | miR-524/RASSF6 | Down-regulation of circ ITCH promotes OS development and resistance to doxorubicin. | 6 |
| Bai  2021  [164] | OS  (N/A) | in vitro  in vivo  humans | hsa\_circ\_0004674 | doxorubicin | RT-qPCR | 3/  OS tissue:41  drug sensitive:23  drug resistant:18 | miR-342-3p/FBN1/Wnt/β-catenin | Hsa\_circ\_0004674 promotes OS doxorubicin resistance by regulating the miR-342-3p/FBN1 axis. | 7 |
| Li  2021  [165] | OS  (N/A) | in vitro  in vivo  humans | circDOCK1 | cisplatin | RT-qPCR | 3/  OS tissues and paracancerous tissues:3 pairs  Blood sample:  OS patients:70  normal control:70 | miR-339-3p/IGF1R | CircDOCK1 promotes cisplatin resistance of OS  via the miR-339-3p/IGF1R axis. | 10 |
| Tang  2022  [166] | OS  (N/A) | in vitro  in vivo  humans | circ\_ANKIB1 | doxorubicin | RT-qPCR | 3/  OS tissues and paracancerous tissues:61 pairs | miR-26b-5p/EZH2 | Circ RNA\_ANKIB1 accelerates chemo-resistance of OS. | 7 |
| Chemotherapy (EWS) | | | | | | | | | |
| Jacques  2016  [167] | sarcoma  (OS/EWS) | in vitro | miR-193a-5p | cisplatin | RT-qPCR | 3 | TAp73β | MiRNA-193a-5p repression of p73 controls cisplatin chemoresistance in primary bone tumors. | 5 |
| Nakatani  2012  [168] | EWS | in vitro  humans | miR-34a | doxorubicin  vincristine | RT–qPCR | 2/  EWS patients:49 | p53 | Restoration of miR-34a activity increase tumour sensitivity to current drugs. | 9 |
| Robin  2012  [169] | EWS | in vitro  humans | miR-708 | doxorubicin  etoposide | RT-qPCR | 3/  EWS sample:23  bone marrow:2 | EYA3 | Downregulation of miR-708 resulted in increased chemoresistance in EWS. | 4 |
| Iida  2013  [170] | EWS | in vitro  humans | miR-125b | doxorubicin  etoposide  vincristine | RT-qPCR | 3/  EWS tissue:5 | p53  Bak | The overexpression of miR-125b in parental EWS cells resulted in enhanced drug resistance. | 4 |
| Chemotherapy (chondrosarcoma) | | | | | | | | | |
| Zhu  2014  [171] | chondrosarcoma  (N/A) | in vitro  humans | miR-100 | cisplatin | RT-qPCR | 3/  chondrosarcoma tissues:6 | mTOR | Overexpression of miR-100 in chondrosarcoma enhances the sensitivity to cisplatin. | 3 |
| Huang  2017  [172] | chondrosarcoma  (N/A) | in vitro  humans | miR-23b | cisplatin | RT-qPCR | 3/  tumor sample:20  nontumor sample:10 | Src-AKT | MiR-23b increases the cisplatin sensitivity of chondrosarcoma cells | 5 |
| Tang  2016  [173] | chondrosarcoma  (N/A) | in vitro  humans | miR-125b | doxorubicin | RT-qPCR | 3/  tumor tissue:20  normal tissue:20 | ErbB2 | MiR-125b acts as a tumor suppressor in chondrosarcoma cells by the sensitization to doxorubicin. | 4 |
| Chemotherapy (RMS, synovial sarcoma, GIST, ULMS, fibrosarcoma and malignant fibrous histiocytoma) | | | | | | | | | |
| Bharathy  2019  [174] | RMS | in vitro  in vivo | miR-27a | vincristine | RT-qPCR | 3 | PAX3:FOXO1 fusion oncogene | Re-expression of miR-27a led to PAX3:FOXO1 mRNA destabilization and chemotherapy sensitization in RMS cells in culture and in vivo. | 8 |
| Minami  2014  [175] | synovial sarcoma  (N/A) | in vitro  in vivo  humans | miR-17 | doxorubicin | RT-PCR | 3/  tumor tissue:7 | p21WAF1⁄CIP1 | MiR-17 induces drug resistance in synovial sarcoma cells. | 7 |
| Xu  2018  [176] | GIST | in vitro | miR‐22-3p | cisplatin | RT-qPCR | 3 | PTEN/PI3K/AKT | MiR-22-3p enhances the chemosensitivity of GIST. | 3 |
| Zhang  2020  [177] | ULMS | in vitro  in vivo  humans | miR-34a | doxorubicin | RT-qPCR | -/  ULMS tissues:27  myometrium:24  uterine leiomyoma:40 | JAK2/STAT3 | Inhibition of miR-34a/JAK2/STAT3 pathway promoted ULMS chemoresistance to doxorubicin. | 9 |
| Jain  2022  [178] | fibrosarcoma | in vitro | miR-197-5p | doxorubicin | RT-qPCR | 3 | ABCC1  MVP  p53 | MiR-197-5p increases doxorubicin-mediated anticancer cytotoxicity of fibrosarcoma cells. | 3 |
| Li  2021  [179] | malignant fibrous histiocytoma | in vitro | miR-206 | docetaxel  gemcitabine | qPCR | 3 | - | Has-miR-206 was lowly expressed in docetaxel-resistant MFH cells and inhibited the growth of MFH cells. | 7 |
| Targeted therapy (OS, GIST and synovial sarcoma) | | | | | | | | | |
| Wang  2021  [180] | OS  (N/A) | in vitro  in vivo  humans | miR-34a | cabozantinib | RT-qPCR | OS samples: N/A  adjacent normal samples: N/A | Notch pathway | MiR-34a enhanced sensitivity of OS cell to cabozantinib by inhibiting Notch signaling pathway. | 7 |
| Wang  2019  [181] | OS  (N/A) | in vitro  in vivo  humans | miR-596 | anlotinib | qPCR | -/  OS tissue:74  normal tissue:74; | Survivin | MiR-596 enhances the sensitivity of OS cells. | 7 |
| Wang  2019  [182] | OS  (N/A) | in vitro  in vivo  humans | miR-499a | erlotinib | RT–qPCR | 3/  OS patients: 10 | SHKBP1 | Down-regukation of miR-499 resulted in upregulation of SHKBP1, and increased erlotinib resistance. | 7 |
| Cao  2018  [183] | GIST | in vitro | lncRNA CCDC26 | imatinib | RT-qPCR | 3 | c-KIT | CCDC26 knockdown enhances resistance of GIST to imatinib. | 4 |
| Yan  2019  [184] | GIST | in vitro | lncRNA CCDC26 | imatinib | RT-qPCR | - | IGF-1R | Downregulation of lncRNA CCDC26 contributes to  imatinib resistance in human GIST | 3 |
| Zhang  2021  [185] | GIST | in vitro  in vivo | lncRNA-HOTAIR | imatinib | RT-qPCR | 3 | miR-130a/ATG2B | LncRNA-HOTAIR promotes the imatinib resistance of GIST cells | 7 |
| Shao  2021  [186] | GIST | in vitro  in vivo  humans | lncRNA RP11-616M22.7 | imatinib | RT-qPCR | GIST samples:20  adjacent normal samples: 20 | RASSF1 | RP11-616M22.7 overexpression induces resistance of GIST cells to imatinib. | 6 |
| Fan  2014  [187] | GIST | in vitro | miR-218 | imatinib | RT–qPCR | - | PI3K/AKT pathway | MicroRNA-218 increase the sensitivity of GIST to imatinib | 4 |
| Chen  2020  [188] | GIST | in vitro  in vivo | miR-30a | imatinib | RT-qPCR | 3 | beclin-1 | MiRNA-30a sensitizes GIST cells to imatinib | 7 |
| Shi  2015  [189] | GIST | in vitro  humans | miR-518a-5p | imatinib | RT-qPCR | -/  tumor tissue:20  normal tissue:20 | PIK3C2A | Low expression of miR-518a-5p is likely to cause resistance to imatinib in GISTs. | 5 |
| Huang  2018  [190] | GIST | in vitro  humans | miR-125a-5p | imatinib | RT–qPCR | 3/  Imatinib- resistant:13  Imatinib sensitivy:15 | pFAK | MiR-125a-5p contributes to imatinib resistance in GIST | 8 |
| Akcakaya  2014  [191] | GIST | in vitro  humans | miR-125a-5p  miR-107 | imatinib | RT–qPCR | 3/  imatinib resistant:10  imatinib sensitive:14 | PTPN18 | Overexpression of miR-125a-5p and miR-107 were associated with imatinib resistance in GIST. | 9 |
| Cao  2016  [192] | GIST | in vitro  humans | miR-21 | imatinib | RT-qPCR | 3/  GIST specimens: 31 | bcl-2 | MiRNA-21 sensitizes GIST cells to imatinib | 8 |
| Shiozawa  2017  [193] | synovial sarcoma | in vitro | miR-761 | pazopanib | RT-qPCR | 6 | TRIP6  LMNA  SIRT3 | MicroRNA-761 enhances pazopanib resistance in synovial sarcoma | 6 |
| Immunotherapy (sarcoma) | | | | | | | | |  |
| Pang  2021  [194] | sarcoma | - | ADAM6  C5orf58  CXCR2P1  FCGR2C  HCP5  HLA-H  NAPSB  NCF1B  NCF1C | immune checkpoint inhibitor | - | - | - | High expression of these lncRNAs reduced sensitivity to immune checkpoint inhibitors in sarcoma. | 6 |
| Radiotherapy (OS, chondrosarcoma and atypical teratoid/rhabdoid tumor) | | | | | | | | | |
| He  2020  [195] | OS  (N/A) | in vitro  humans | LINC00210 | X ray | RT-qPCR | -/  tumor tissues:53  adjacent normal tissues:53 | miR-342-3p/GFRA1 | LINC00210 knockdown improved the radiosensitivity of OS cells. | 3 |
| Yang  2018  [196] | OS | in vitro  in vivo | miR‑328‑3p | X-ray | RT-qPCR | - | H2AX | MiR‑328‑3p enhances the radiosensitivity of OS. | 4 |
| Li  2019  [197] | OS  (N/A) | in vitro,  in vivo  humans | miR-214 | X ray | qPCR | 3/  OS tissue:30  normal tissue:30; | PI3K/AKT | Upregulation of miR-214 induced radioresistance of OS. | 4 |
| Dai  2018  [198] | OS  (N/A) | in vitro  in vivo  humans | miR-513a-5p | X ray | RT-qPCR | -/  OS tissue:30  healthy controls:9 | APE1 | MiR-513a-5p could directly lead to radiosensitization. | 6 |
| Vares  2020  [199] | chondrosarcoma | in vitro  in vivo | miR-34 | carbon ions irradiation | RT-qPCR | 3 | FOXO3/KLF4 | MiR-34 overexpression may overcome treatment resistance of high-grade chondrosarcoma to carbon-ion irradiation. | 7 |
| Lee  2014  [200] | atypicalteratoid/rhabdoid tumor | in vitro  in vivo | miR142-3p | γradiation (IR) | RT-qPCR | 3 | SOX2  ADCY9 | Silencing of endogenous miR142-3p promoted the mesenchymal transitional and radioresistant properties of ATRT cells. | 7 |
| Biomarkers for monitoring treatment response | | | | | | | | | |
| Polvani  2022  [201] | OS  (osteoblastic/  telangiectatic) | humans | lncRNA growth  arrest-specific 5 (GAS5) | - | RT-qPCR | OS tissue:10  osteoblastic OS:8  telangiectatic OS:2 | - | GAS5 is significantly increased in patients with a good prognosis and is expressed differently between chemosensitive and chemoresistant osteosarcoma patients. | 4 |
| Zhu  2015  [202] | OS  (N/A) | in vitro  humans | lncRNA ENST00000563280 | doxorubicin | RT-qPCR | chemosesitive group:30  chemoresistant group:30 | - | LncRNA ENST00000563280 was distinctly increased in specimens of OS patients with a poor chemoresponse compared to those with a good chemoresponse. | 6 |
| Yuan  2012  [203] | OS  (N/A) | humans | miR-21 | methotrexate  cisplatin  adriamycin  bleomycin/  cyclo-phosphamide/  dactinomycin | RT-qPCR | OS patients: 65  healthy controls: 30 | - | High serum miR-21 was significantly correlated with advanced Enneking stage and chemotherapeutic resistance in patients with OS. | 5 |
| Lou  2016  [204] | OS  (N/A) | humans | miR-125b | - | RT-qPCR | resectable OS: 82  unresectable OS: 56 | - | Negative correlation was found between miR-125b expression and response to chemotherapy. | 4 |
| Han  2020  [205] | OS | in vitro | hsa\_circ\_0008336  hsa\_circ\_0004664  hsa\_circ\_0003302 | cisplatin | RNA sequencing  RT-qPCR | - | - | Hsa\_circ\_0008336, hsa\_circ\_0004664, and hsa\_circ\_0003302 were upregulated in cisplatin-resistant cells and may be involved in the pathology of cisplatin resistance in OS. | 3 |
| Zhu  2018  [206] | OS  (N/A) | in vitro  humans | hsa\_circ\_0004674 | cisplatin  doxorubicin | RT-qPCR | OS tissue: 60  normal tissue:40 | - | Hsa\_circ\_0004674 was distinctly increased in OS chemoresistant cells and tissues, related to poor prognosis. | 8 |
| YAMADA  2021  [207] | sarcoma | in vitro  humans | lncRNA HAR1B | pazopanib | RT-qPCR  microarray | -/  responder: 16  non-responder:23 | - | LncRNA HAR1B expression is higher in responder than in non-responder in patients with sarcoma. | 4 |
| Yan  2017  [208] | GIST | humans | lncRNAs | imatinib | RT-qPCR | 3/  normal tissues:3  primaryGIST samples:3  imatinib-resistant samples:3 | - | LncRNAs may serve as potential biomarkers or drug targets for imatinib-resistant GISTs. | 5 |
| Amirnasr  2019  [209] | GIST | humans | miRNAs | imatinib | RT-qPCR | imatinib-naïve (IM-n) tissue:33  imatinib-resistant (IM-r) tissue:20 | - | Differentially expressed of miRNAs identified between IM-n and IM-r GIST and highlighted the key miRNAs might be putative treatment targets. | 7 |
| Kou  2018  [210] | GIST | humans | miR-518e-5p | imatinib | PCR | serum samples:  imatinib resistant GIST patients:39,  imatinib-sensitive GIST patients:37,  healthy controls:28 | - | Serum miR-518e-5p is a potential biomarker for secondary imatinib-resistant GIST. | 4 |
| Gao  2013  [211] | GIST | humans | miR-320a | imatinib | RT-qPCR | 3/  pre-imatinib:3  imatinib-resistant:12 | - | MiR-320a downregulation is associated with imatinib resistance in GIST. | 4 |
| Zhang  2018  [212] | GIST | Gene Expression Omnibus database | miR-28-5p  miR-125a-5p | imatinib | - | - | GnRH | Hsa-miR-28-5p and hsa-miR-125a-5p may be able to serve as prognostic markers for imatinib-response in GIST patients. | 5 |

Histological subtype of sarcomas (OS, chondrosarcoma and synovial sarcoma) among the studies explored human tissues have been identified. Abbreviations:ABCG2: ATP binding cassette subfamily G member 2; ADCY9: adenylate cyclase 9; ALDH1A3: aldehyde dehydrogenase 1 family member A3; ATG2B: autophagy-related 2B; ATG4B: autophagy-related 4B; AGTR1: angiotensin II type 1 receptor; AMPKα1: AMP-activated protein kinase alpha 1; BCL2L1: Bcl-2-like protein 1; BMP9: bone morphogenetic protein 9; CD44: cluster of differentiation 44;circ-CHI3L1.2: circRNA circ-chitinase 3-like 1.2; CRYAB: aB-crystallin; DNMT1:Kcnq1/DNA methyltransferase 1; DTL: denticleless protein homolog; DLL1: Delta-like ligand 1; FBN1: fibrillin-1; ERK: extraneous signal regulated kinase; EWS : Ewing’s sarcoma; FGFR: fibroblast growth factor receptor; FOSL2: FOS like 2;EZH2: zeste homolog 2; FZD4: Frizzled class receptor 4; GADD45A: DNA damage-inducible alpha; GFRA1: GDNF family receptor alpha-1; GIST: gastrointestinal stromal tumor; GFRA1: GDNF receptor alpha 1.HDAC4: histone deacetylase 4; HMGB1:high-mobility group box 1; HIF1: hypoxia‑inducible factor-1; IP3K2: inositol 1,4,5-trisphosphate kinase 2; IRS2: insulin receptor substrate 2;KEAP1: kelch-like ECH-associated protein 1;KLF8: Krüppel-like factor 8; KLF12: Krüppel-like factor 12; KCNQ1OT1:lncRNA KCNQ1 opposite strand/antisense transcript 1; LC3: rabbit anti‑light chain 3; LPAATb: lysophosphatidic acid acyltransferase; LPAATβ: lysophosphatidic acid acyltransferase; MAPK7: mitogen activated protein kinase 7; MCL1: myeloid cell leukemia 1; MRP1: multidrug resistance. associated protein-1; MTDH: metadherin; MCL1: myeloid cell leukemia-1; NRF2: nuclearfactor erythroid 2-related factor 2; OS: osteosarcoma; PD‐L1: programmed cell death receptor‐1; PTN: pleiotrophin; PI3K: phosphatidylinositol 3-kinase; PLK1: Polo-like kinase 1; PPP2R2A: PP2A subunit B;RAB11B-AS1: lncRNA RAB11B antisense RNA; RUNX2: Runt-related transcription factor 2; RASSF6: Ras association (RA) domain family; RMS: Rhabdomyosarcoma; S100A11: S100 calcium‑binding protein A11; SDC2: homo sapiens syndecan 2; SOX2: sex-determiningregion Y Box 2; TRIAP1: TP53-regulated inhibitor of apoptosis 1; TGM2: transglutaminase-2;USP1: ubiquitin‑specific protease 1; ULMS: uterine leiomyosarcoma;XIAP: X-linked inhibitor of apoptosis protein; ZNF32:zinc finger protein 32

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