**Table S1** List of 246 genes associated with breast cancer pathogenesis and the references from which they were collected

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **GENE ID** | **Reference** |
|  | *HIF1A* | [1–3] |
|  | *GLUT1* | [1,4] |
|  | *CAIX* | [1,5] |
|  | *ERO1A* | [6] |
|  | *AR* | [7,8] |
|  | *JUN* | [7–9] |
|  | *STAT1* | [3,7,8] |
|  | *PKC* | [7,8] |
|  | *RelA* | [2,7,8] |
|  | *cABL* | [7,8] |
|  | *SUMO1* | [7] |
|  | *CDK1* | [7,8] |
|  | *HDAC1* | [7,8] |
|  | *IRF1* | [3,7,8] |
|  | *RBAP48* | [7] |
|  | *RGS19* | [7] |
|  | *Top1* | [7] |
|  | *TACC1* | [7,10] |
|  | *RND3* | [10] |
|  | *DTL* | [10,11] |
|  | *ATM* | [2,10,12,13] |
|  | *BUB1* | [10,14] |
|  | *RAD51* | [12,15] |
|  | *MKI67* | [3,16] |
|  | *STK15* | [16] |
|  | *Survivin* | [16] |
|  | *CCNB1* | [16,17] |
|  | *MYBL2* | [16] |
|  | *MMP11* | [16] |
|  | *CTSV* | [16] |
|  | *GRB7* | [16] |
|  | *Her2* | [16] |
|  | *ER* | [16] |
|  | *PGR* | [16] |
|  | *BCL2* | [16] |
|  | *SCUBE2* | [16] |
|  | *GSTM1* | [16] |
|  | *CD68* | [16] |
|  | *BAG1* | [16] |
|  | *NUSAP1* | [11] |
|  | *PRC1* | [11] |
|  | *L2DTL* | [11] |
|  | *cyclin E2* | [14] |
|  | *MCM6* | [14] |
|  | *MMP9* | [14] |
|  | *MP1* | [14] |
|  | *RAB6B* | [14] |
|  | *PK428* | [14] |
|  | *ESM1* | [14] |
|  | *FLT1* | [14] |
|  | *RAD21* | [14] |
|  | *Cyclin B2* | [14] |
|  | *PCTAIRE* | [14] |
|  | *CDC25B* | [14] |
|  | *CENPF* | [14] |
|  | *VEGF* | [14] |
|  | *PGK1* | [14] |
|  | *MAD2* | [14] |
|  | *CKS2* | [14] |
|  | *BUB1* | [14] |
|  | *FGL2* | [18] |
|  | *CYP24A1* | [19] |
|  | *LOXL4* | [19] |
|  | *MGP* | [19] |
|  | *COL5A2* | [19] |
|  | *AREG* | [19] |
|  | *ARHGAP36* | [19] |
|  | *CCDC85A* | [19] |
|  | *SHH* | [19] |
|  | *SERPINE1* | [19] |
|  | *RBM24* | [19] |
|  | *SNAI2* | [19] |
|  | *TMEM40* | [19] |
|  | *RBP7* | [19] |
|  | *COL12A1* | [19] |
|  | *SPOCK1* | [19] |
|  | *PIM1* | [19] |
|  | *GABRP* | [19] |
|  | *MATN3* | [19] |
|  | *FBLN2* | [19] |
|  | *LOXL1* | [19] |
|  | *ATM* | [12] |
|  | *BARD1* | [12] |
|  | *BRCA1* | [12] |
|  | *BRCA2* | [12] |
|  | *FANCA* | [12] |
|  | *MELK* | [20] |
|  | *HDAC1* | [8] |
|  | *RELA* | [8] |
|  | *PKC-beta* | [8] |
|  | *SUMO-1* | [8] |
|  | *ABL1* | [8] |
|  | *STAT1* | [8] |
|  | *IRF1* | [8] |
|  | *TGFB1* | [21] |
|  | *SOD2* | [21] |
|  | *XRCC3* | [21] |
|  | *XRCC1* | [21] |
|  | *APEX* | [21] |
|  | *PIK3CA* | [22] |
|  | *NBN* | [13] |
|  | *MRE11* | [13] |
|  | *RAD50* | [13] |
|  | *RAD51* | [13] |
|  | *ATRX* | [13] |
|  | *XRCC4* | [13] |
|  | *XRCC2* | [13] |
|  | *PRKDC* | [13] |
|  | *LIG4S* | [13] |
|  | *XRCC6* | [13] |
|  | *XRCC5/KU80* | [13] |
|  | *CHEK1* | [13] |
|  | *CHEK2* | [13] |
|  | *DCLRE1C* | [13] |
|  | *ABL* | [13] |
|  | *MDC1* | [12,13] |
|  | *TERT* | [13] |
|  | *CDC25C* | [9] |
|  | *NFKB1* | [9] |
|  | *TGFB2* | [9] |
|  | *ADRB2* | [9] |
|  | *SNAI1* | [9] |
|  | *CAV1* | [9] |
|  | *TNF* | [9] |
|  | *ADRB1* | [9] |
|  | *JUNB* | [9] |
|  | *FOSB* | [9] |
|  | *HIST1H4E* | [9] |
|  | *FOS* | [9] |
|  | *MOAP1* | [9] |
|  | *ITPR1* | [9] |
|  | *ADAMTS9* | [9] |
|  | *LEF1* | [9] |
|  | *NR3C1* | [9] |
|  | *FAM49B* | [9] |
|  | *LMNB1* | [9] |
|  | *FAS* | [9,23] |
|  | *CDKN1A* | [9] |
|  | *NR4A3* | [9] |
|  | *C2CD2* | [9] |
|  | *CACNB2* | [9] |
|  | *PLK1* | [9] |
|  | *HIST1H1B* | [9] |
|  | *HIST1H4B* | [9] |
|  | *HIST2H2AB* | [9] |
|  | *HIST2H2AC* | [9] |
|  | *CDC42* | [9] |
|  | *H2AFX* | [9] |
|  | *MGMT* | [24] |
|  | *CDH1* | [24] |
|  | *p16* | [24] |
|  | *ERp29* | [24] |
|  | *p53* | [25] |
|  | *BAX* | [25] |
|  | *Nrf2* | [26] |
|  | *HO-1* | [26] |
|  | *p21* | [27] |
|  | *Myc* | [27] |
|  | *14-3-3 zeta* | [27] |
|  | *cyclin A* | [27] |
|  | *cyclin B1* | [27] |
|  | *GADD153* | [27] |
|  | *Beclin-1* | [28] |
|  | *Atg5* | [28] |
|  | *Atg7* | [28] |
|  | *Atg12* | [28] |
|  | *FOXC1* | [3,29] |
|  | *TRAPPC9* | [29] |
|  | *AMIGO3* | [29] |
|  | *PDCD2* | [17] |
|  | *MCL1* | [17] |
|  | *CDC10 protein homolog* | [17] |
|  | *TIMP3* | [17] |
|  | *BCGF1* | [17] |
|  | *BMP2A* | [17] |
|  | *endothelin 2* | [17] |
|  | *MSH2* | [12,17] |
|  | *MSH6* | [17] |
|  | *TOP2A* | [17] |
|  | *RPA* | [17] |
|  | *VEGFR1* | [17] |
|  | *IFNG* | [17] |
|  | *CDK4* | [17] |
|  | *TNFRSF12* | [17] |
|  | *ARHGDIA* | [17] |
|  | *RAD52* | [30] |
|  | *HuR* | [31] |
|  | *COX-2* | [31] |
|  | *SIRT1* | [31] |
|  | *p27* | [31] |
|  | *GTSE1* | [32] |
|  | *CDC20* | [32] |
|  | *CDC25C* | [32] |
|  | *KIF2C* | [32] |
|  | *MLL* | [32] |
|  | *CXCR3* | [32] |
|  | *ZDHHC15* | [32] |
|  | *CASP8* | [32] |
|  | *GADD45B* | [32] |
|  | *NOTCH1* | [32] |
|  | *TP53INP1* | [32] |
|  | *CDKN3* | [32] |
|  | *HIST1H4C* | [32] |
|  | *HIST1H4D* | [32] |
|  | *NDC80* | [32] |
|  | *NEK2* | [32] |
|  | *PERK* | [33] |
|  | *ATF4* | [33] |
|  | *LAMP3* | [33] |
|  | *Caspase 3* | [34] |
|  | *ACTB* | [34] |
|  | *ATR* | [2] |
|  | *BCL2L1* | [2] |
|  | *ERCC4* | [2] |
|  | *ERCC6* | [2] |
|  | *ERCC1* | [2] |
|  | *MRE11A* | [2] |
|  | *RAD18* | [2] |
|  | *TIGAR* | [2] |
|  | *TP53* | [2] |
|  | *XIAP* | [2] |
|  | *XPA* | [2] |
|  | *ABCG2* | [2] |
|  | *XRCC5* | [2] |
|  | *AKT1* | [2] |
|  | *OSMR* | [3] |
|  | *RAD54L* | [3] |
|  | *CCL19* | [3] |
|  | *IRF8* | [3] |
|  | *FGR* | [3] |
|  | *TNFRSF1B* | [3] |
|  | *C3* | [3] |
|  | *IRF1* | [3] |
|  | *AURKA* | [3] |
|  | *HIF1* | [3] |
|  | *HIF2A* | [3] |
|  | *WRAP53* | [3] |
|  | *ERBB2* | [3] |
|  | *TACC1* | [10] |
|  | *RND3* | [10] |
|  | *DTL* | [10] |
|  | *Wnt3a* | [35] |
|  | *LRP6* | [35] |
|  | *CTNNB1* | [35] |
|  | *C-myc* | [35] |
|  | *ATF3* | [36] |

**References**

1. Chen CL, Chu JS, Su WC, Huang SC, Lee WY. Hypoxia and metabolic phenotypes during breast carcinogenesis: expression of HIF-1alpha, GLUT1, and CAIX. Virchows Arch 2010;457(1):53-61. doi: 10.1007/s00428-010-0938-0, PMID: 20526721.
2. Pavlopoulou A, Oktay Y, Vougas K, Louka M, Vorgias CE, Georgakilas AG. Determinants of resistance to chemotherapy and ionizing radiation in breast cancer stem cells. Cancer Lett 2016;380(2):485-493. doi: 10.1016/j.canlet.2016.07.018, PMID: 27450721.
3. Sjöström M, Staaf J, Edén P, Wärnberg F, Bergh J, Malmström P, *et al.* Identification and validation of single-sample breast cancer radiosensitivity gene expression predictors. Breast Cancer Res 2018;20(1):64. doi: 10.1186/s13058-018-0978-y, PMID: 29973242.
4. Zhao F, Ming J, Zhou Y, Fan L. Inhibition of Glut1 by WZB117 sensitizes radioresistant breast cancer cells to irradiation. Cancer Chemother Pharmacol 2016;77(5):963-972. doi: 10.1007/s00280-016-3007-9, PMID: 27011212.
5. Tafreshi NK, Lloyd MC, Proemsey JB, Bui MM, Kim J, Gillies RJ, *et al.* Evaluation of CAIX and CAXII expression in breast cancer at varied O2 levels: CAIX is the superior surrogate imaging biomarker of tumor hypoxia. Mol Imaging Biol 2016;18(2):219-231. doi: 10.1007/s11307-015-0885-x, PMID: 26276155.
6. Takei N, Yoneda A, Kosaka M, Sakai-Sawada K, Tamura Y. ERO1α is a novel endogenous marker of hypoxia in human cancer cell lines. BMC Cancer 2019;19(1):510. doi: 10.1186/s12885-019-5727-9, PMID: 31142270.
7. Torres-Roca JF. A molecular assay of tumor radiosensitivity: a roadmap towards biology-based personalized radiation therapy. Per Med 2012;9(5):547-557. doi: 10.2217/pme.12.55, PMID: 23105945.
8. Eschrich S, Zhang H, Zhao H, Boulware D, Lee JH, Bloom G, *et al.* Systems biology modeling of the radiation sensitivity network: a biomarker discovery platform. Int J Radiat Oncol Biol Phys 2009;75(2):497-505. doi: 10.1016/j.ijrobp.2009.05.056, PMID: 19735874.
9. Bravatà V, Minafra L, Russo G, Forte GI, Cammarata FP, Ripamonti M, *et al.* High-dose ionizing radiation regulates gene expression changes in the MCF7 breast cancer cell line. Anticancer Res 2015;35(5):2577-2591, PMID: 25964533.
10. Speers C, Zhao S, Liu M, Bartelink H, Pierce LJ, Feng FY. Development and validation of a novel radiosensitivity signature in human breast cancer. Clin Cancer Res 2015;21(16):3667-3677. doi: 10.1158/1078-0432.CCR-14-2898, PMID: 25904749.
11. Pawitan Y, Bjöhle J, Amler L, Borg AL, Egyhazi S, Hall P, *et al.* Gene expression profiling spares early breast cancer patients from adjuvant therapy: derived and validated in two population-based cohorts. Breast Cancer Res 2005;7(6):R953-R964. doi: 10.1186/bcr1325, PMID: 16280042.
12. Alexander A, Karakas C, Chen X, Carey JP, Yi M, Bondy M, *et al.* Cyclin E overexpression as a biomarker for combination treatment strategies in inflammatory breast cancer. Oncotarget 2017;8(9):14897-14911. doi: 10.18632/oncotarget.14689, PMID: 28107181.
13. Bougen NM, Steiner M, Pertziger M, Banerjee A, Brunet-Dunand SE, Zhu T, *et al.* Autocrine human GH promotes radioresistance in mammary and endometrial carcinoma cells. Endocr Relat Cancer 2012;19(5):625-644. doi: 10.1530/ERC-12-0042, PMID: 22807498.
14. van 't Veer LJ, Dai H, van de Vijver MJ, He YD, Hart AA, Mao M, *et al.* Gene expression profiling predicts clinical outcome of breast cancer. Nature 2002;415(6871):530-536. doi: 10.1038/415530a, PMID: 11823860.
15. Gasparini P, Lovat F, Fassan M, Casadei L, Cascione L, Jacob NK, *et al.* Protective role of miR-155 in breast cancer through RAD51 targeting impairs homologous recombination after irradiation. Proc Natl Acad Sci U S A 2014;111(12):4536-4541. doi: 10.1073/pnas.1402604111, PMID: 24616504.
16. Paik S, Shak S, Tang G, Kim C, Baker J, Cronin M, *et al.* A multigene assay to predict recurrence of tamoxifen-treated, node-negative breast cancer. N Engl J Med 2004;351(27):2817-2826. doi: 10.1056/NEJMoa041588, PMID: 15591335.
17. Li Z, Xia L, Lee LM, Khaletskiy A, Wang J, Wong JY, *et al.* Effector genes altered in MCF-7 human breast cancer cells after exposure to fractionated ionizing radiation. Radiat Res 2001;155(4):543-553. doi: 10.1667/0033-7587(2001)155[0543:egaimh]2.0.co;2, PMID: 11260656.
18. Feng Y, Guo C, Wang H, Zhao L, Wang W, Wang T, *et al.* Fibrinogen-like protein 2 (FGL2) is a novel biomarker for clinical prediction of human breast cancer. Med Sci Monit 2020;26:e923531. doi: 10.12659/MSM.923531, PMID: 32716910.
19. Post AE, Bussink J, Smid M, Sweep FC, Span PN. Downregulation of matrix Gla protein is a biomarker for tamoxifen-resistant and radioresistant breast cancer. Biomark Med 2019;13(10):841-850. doi: 10.2217/bmm-2019-0050, PMID: 31317787.
20. Speers C, Zhao SG, Kothari V, Santola A, Liu M, Wilder-Romans K, *et al.* Maternal embryonic leucine zipper kinase (MELK) as a novel mediator and biomarker of radioresistance in human breast cancer. Clin Cancer Res 2016;22(23):5864-5875. doi: 10.1158/1078-0432.CCR-15-2711, PMID: 27225691.
21. Andreassen CN, Alsner J, Overgaard M, Overgaard J. Prediction of normal tissue radiosensitivity from polymorphisms in candidate genes. Radiother Oncol 2003;69(2):127-135. doi: 10.1016/j.radonc.2003.09.010, PMID: 14643949.
22. Bernichon E, Vallard A, Wang Q, Attignon V, Pissaloux D, Bachelot T, *et al.* Genomic alterations and radioresistance in breast cancer: an analysis of the ProfiLER protocol. Ann Oncol 2017;28(11):2773-2779. doi: 10.1093/annonc/mdx488, PMID: 28945826.
23. Horton JK, Siamakpour-Reihani S, Lee CT, Zhou Y, Chen W, Geradts J, *et al.* FAS death receptor: a breast cancer subtype-specific radiation response biomarker and potential therapeutic target. Radiat Res 2015;184(5):456-469. doi: 10.1667/RR14089.1, PMID: 26488758.
24. Chen S, Zhang Y, Zhang D. Endoplasmic reticulum protein 29 (ERp29) confers radioresistance through the DNA repair gene, O(6)-methylguanine DNA-methyltransferase, in breast cancer cells. Sci Rep 2015;5:14723. doi: 10.1038/srep14723, PMID: 26420420.
25. da Costa Araldi IC, Bordin FPR, Cadoná FC, Barbisan F, Azzolin VF, Teixeira CF, *et al.* The in vitro radiosensitizer potential of resveratrol on MCF-7 breast cancer cells. Chem Biol Interact 2018;282:85-92. doi: 10.1016/j.cbi.2018.01.013, PMID: 29336987.
26. Dong J, Li Y, Xiao H, Luo D, Zhang S, Zhu C, *et al.* Cordycepin sensitizes breast cancer cells toward irradiation through elevating ROS production involving Nrf2. Toxicol Appl Pharmacol 2019;364:12-21. doi: 10.1016/j.taap.2018.12.006, PMID: 30529626.
27. Guo G, Yan-Sanders Y, Lyn-Cook BD, Wang T, Tamae D, Ogi J, *et al.* Manganese superoxide dismutase-mediated gene expression in radiation-induced adaptive responses. Mol Cell Biol 2003;23(7):2362-2378. doi: 10.1128/MCB.23.7.2362-2378.2003, PMID: 12640121.
28. He WS, Dai XF, Jin M, Liu CW, Rent JH. Hypoxia-induced autophagy confers resistance of breast cancer cells to ionizing radiation. Oncol Res 2012;20(5-6):251-258. doi: 10.3727/096504013x13589503483012, PMID: 23581232.
29. Kuhmann C, Weichenhan D, Rehli M, Plass C, Schmezer P, Popanda O. DNA methylation changes in cells regrowing after fractioned ionizing radiation. Radiother Oncol 2011;101(1):116-121. doi: 10.1016/j.radonc.2011.05.048, PMID: 21704414.
30. Liang Z, Ahn J, Guo D, Votaw JR, Shim H. MicroRNA-302 replacement therapy sensitizes breast cancer cells to ionizing radiation. Pharm Res 2013;30(4):1008-1016. doi: 10.1007/s11095-012-0936-9, PMID: 23184229.
31. Mehta M, Basalingappa K, Griffith JN, Andrade D, Babu A, Amreddy N, *et al.* HuR silencing elicits oxidative stress and DNA damage and sensitizes human triple-negative breast cancer cells to radiotherapy. Oncotarget 2016;7(40):64820-64835. doi: 10.18632/oncotarget.11706, PMID: 27588488.
32. Minafra L, Bravatà V, Russo G, Forte GI, Cammarata FP, Ripamonti M, *et al.* Gene expression profiling of MCF10A breast epithelial cells exposed to IOERT. Anticancer Res 2015;35(6):3223-3234, PMID: 26026082.
33. Nagelkerke A, Bussink J, van der Kogel AJ, Sweep FC, Span PN. The PERK/ATF4/LAMP3-arm of the unfolded protein response affects radioresistance by interfering with the DNA damage response. Radiother Oncol 2013;108(3):415-421. doi: 10.1016/j.radonc.2013.06.037, PMID: 23891100.
34. Oladghaffari M, Shabestani Monfared A, Farajollahi A, Baradaran B, Mohammadi M, Shanehbandi D, *et al.* MLN4924 and 2DG combined treatment enhances the efficiency of radiotherapy in breast cancer cells. Int J Radiat Biol 2017;93(6):590-599. doi: 10.1080/09553002.2017.1294272, PMID: 28291374.
35. Yin L, Gao Y, Zhang X, Wang J, Ding D, Zhang Y, *et al.* Niclosamide sensitizes triple-negative breast cancer cells to ionizing radiation in association with the inhibition of Wnt/β-catenin signaling. Oncotarget 2016;7(27):42126-42138. doi: 10.18632/oncotarget.9704, PMID: 27363012.
36. Zhao W, Sun M, Li S, Chen Z, Geng D. Transcription factor ATF3 mediates the radioresistance of breast cancer. J Cell Mol Med 2018;22(10):4664-4675. doi: 10.1111/jcmm.13688, PMID: 30117642.