FoxM1调节网络—抗癌新靶点

《现代肿瘤医学》[ISSN:1672-4992/CN:61-1415/R] 期数: 2019年06期 页码: 1059-1063 栏目: 综述 出版日期: 2019-02-08

Title: FoxM1-regulatory network:Anticancer new target

作者: 时佳琪; 刘 超; 张艳桥
哈尔滨医科大学附属肿瘤医院消化内科二病房,黑龙江 哈尔滨 150081

Author(s): Shi Jiaqi; Liu Chao; Zhang Yanqiao
Department of Digestive Internal Medicine Second Ward,Harbin Medical University Cancer Hospital,Heilongjiang Harbin 150081,China.

关键词: FoxM1; 癌症; 蛋白质相互作用; 抗癌药物

Keywords: FoxM1; cancer; protein interactions; anticancer drugs

分类号: R730.53

DOI: 10.3969/j.issn.1672-4992.2019.06.038

文献标识码: A

摘要: 哺乳动物叉头框蛋白M1（forkhead box protein M1，FoxM1）是叉头框转录因子家族成员之一，它参与正常细胞的增殖。然而研究表明，FoxM1在多种癌症中均呈现过表达的状态，并且与Hanahan和Weinberg所描述的癌症的主要特征有关。据推测，FoxM1的致癌潜力取决于其反式激活的靶基因的能力。此外，FoxM1也可通过与其他蛋白如β-catenin或母亲DPP同源物3（mothers against decapentaplegic homolog 3，SMAD3）相互作用分别诱导Wnt和转化生长因子-β(transforming growth factor-β,TGF-β)信号通路发挥致癌作用。在本文中我们将阐明FoxM1的蛋白质-蛋白质相互作用是癌症发展的关键，这可能成为抗癌药物的新目标。

Abstract: Forkhead box protein M1 (FoxM1) is a transcription factor of the Forkhead family involved in the cell proliferation.However,studies have shown that FoxM1 is overexpressed in a variety of human cancers and associated with the major hallmarks of cancer described by Hanahan and Weinberg.It has been postulated that the oncogenic potential of FoxM1 depends on its capacity to transactivate target genes.In addition,FoxM1 can also play an oncogenic role by inducing Wnt and transforming growth factor-β (TGF-β) signaling pathways,respectively,through interacting with other proteins such as β-catenin or mothers against decapentaplegic homolog 3 (SMAD3).In this review,we will discuss the protein-protein interactions of FoxM1 that are critical for cancer development and may represent novel targets for anticancer drugs.

参考文献/REFERENCES

[1] Laoukili J,Stahl M,Medema RH.FoxM1:at the crossroads of ageing and cancer [J] .Biochimica et Biophysica Acta,2007,1775(1):92-102.
[2] Gu C,Yang Y,Sompallae R,et al.FOXM1 is a therapeutic target for high-risk multiple myeloma [J] .Leukemia,2016,30(4):873-882.
[3] Pilarsky C,Wenzig M,Specht T,et al.Identification and validation of commonly overexpressed genes in solid tumors by comparison of microarray data [J] .Neoplasia,2004,6(6):744-750.
[4] Halasi M,Gartel AL.FOX(M1) news-it is cancer [J] .Molecular Cancer Therapeutics,2013,12(3):245-254.
[5] Hanahan D,Weinberg RA.Hallmarks of cancer:the next generation [J] .Cell,2011,144(5):646-674.
[6] Bhat UG,Jagadeeswaran R,Halasi M,et al.Nucleophosmin interacts with FOXM1 and modulates the level and localization of FOXM1 in human cancer cells [J] .J Biol Chem,2011,286(48):41425-41433.
[7] Pandit B,Halasi M,Gartel AL.p53 negatively regulates expression of FoxM1 [J] .Cell Cycle (Georgetown,Tex),2009,8(20):3425-3427.
[8] Barsotti AM,Prives C.Pro-proliferative FoxM1 is a target of p53-mediated repression [J] .Oncogene,2009,28(48):4295-4305.
[9] Gentles AJ,Newman AM,Liu CL,et al.The prognostic landscape of genes and infiltrating immune cells across human cancers [J] .Nature Medicine,2015,21(8):938-945.
[10] Falini B,Mecucci C,Tiacci E,et al.Cytoplasmic nucleophosmin in acute myelogenous leukemia with a normal karyotype [J] .The New England Journal of Medicine,2005,352(3):254-266.
[11] Quentmeier H,Martelli MP,Dirks WG,et al.Cell line OCI/AML3 bears exon-12 NPM gene mutation-A and cytoplasmic expression of nucleophosmin [J] .Leukemia,2005,19(10):1760-1767.

[12] Khan I,Halasi M,Zia MF,et al.Nuclear FOXM1 drives chemoresistance in AML [J] .Leukemia,2017,31(1):251-255.
[13] Ganguly R,Hong CS,Smith LG,et al.Maternal embryonic leucine zipper kinase:key kinase for stem cell phenotype in glioma and other cancers [J] .Mol Cancer Therapeutics,2014,13(6):1393-1398.
[14] Joshi K,Banasavadi-Siddegowda Y,Mo X,et al.MELK-dependent FOXM1 phosphorylation is essential for proliferation of glioma stem cells [J] .Stem Cells,2013,31(6):1051-1063.
[15] Radhakrishnan SK,Bhat UG,Hughes DE,et al.Identification of a chemical inhibitor of the oncogenic transcription factor forkhead box M1 [J] .Cancer Res,2006,66(19):9731-9735.
[16] Bhat UG,Halasi M,Gartel AL.FoxM1 is a general target for proteasome inhibitors [J] .PloS One,2009,4(8):e6593.
[17] Kruiswijk F,Hasenfuss SC,Sivapatham R,et al.Targeted inhibition of metastatic melanoma through interference with Pin1-FOXM1 signaling [J] .Oncogene,2016,35(17):2166-2177.
[18] Maachani UB,Shankavaram U,Kramp T,et al.FOXM1 and STAT3 interaction confers radioresistance in glioblastoma cells [J] .Oncotarget,2016,7(47):77365-77377.
[19] Jin B,Wang C,Li J,et al.Anthelmintic niclosamide disrupts the interplay of p65 and FOXM1/beta-catenin and eradicates leukemia stem cells in chronic myelogenous leukemia [J] .Clin Cancer Res,2017,23(3):789-803.
[20] Gaponenko V,Arbiser JL,Gartel AL,et al.Anthelmintic niclosamide disrupts the interplay of p65 and FOXM1/beta-catenin and eradicates leukemia stem cells in chronic myelogenous leukemia [J] .Cell Death Dis,2017,23(3):789-803.
[21] Chen Y,Li Y,Xue J,et al.Wnt-induced deubiquitination FoxM1 ensures nucleus beta-catenin transactivation [J] .Embo J,2016,35(6):668-684.
[22] Xu MD,Wang Y,Weng W,et al.A positive feedback loop of lncRNA-PVT1 and FOXM1 facilitates gastric cancer growth and invasion [J] .Clin Cancer Res,2017,23(8):2071-2080.
[23] Clevers H.Wnt/beta-catenin signaling in development and disease [J] .Cell,2006,127(3):469-480.
[24] Ma S,Tang KH,Chan YP,et al.miR-130b promotes CD133(+) liver tumor-initiating cell growth and self-renewal via tumor protein 53-induced nuclear protein 1 [J] .Cell Stem Cell,2010,7(6):694-707.
[25] Zhang N,Wei P,Gong A,et al.FoxM1 promotes beta-catenin nuclear localization and controls Wnt target-gene expression and glioma tumorigenesis [J] .Cancer Cell,2011,20(4):427-442.
[26] Xue J,Lin X,Chiu WT,et al.Sustained activation of SMAD3/SMAD4 by FOXM1 promotes TGF-beta-dependent cancer metastasis [J] .J Clin Invest,2014,124(2):564-579.
[27] Sundqvist A,Ten Dijke P,van Dam H.Key signaling nodes in mammary gland development and cancer:Smad signal integration in epithelial cell plasticity [J] .Breast Cancer Res,2012,14(1):204.
[28] Pan Y,Li J,Zhang Y,et al.Slug-upregulated miR-221 promotes breast cancer progression through suppressing E-cadherin expression [J] .Sci Reports,2016,6:25798.
[29] Chan DW,Hui WW,Wang JJ,et al.DLX1 acts as a crucial target of FOXM1 to promote ovarian cancer aggressiveness by enhancing TGF-beta/SMAD4 signaling [J] .Oncogene,2017,36(10):1404-1416.
[30] Aytes A,Mitrofanova A,Lefebvre C,et al.Cross-species regulatory network analysis identifies a synergistic interaction between FOXM1 and CENPF that drives prostate cancer malignancy [J] .Cancer Cell,2014,25(5):638-651.
[31] Xu M,Qin J,Tsai SY,et al.The role of the orphan nuclear receptor COUP-TFII in tumorigenesis [J] .Acta Pharmacologica Sinica,2015,36(1):32-36.
[32] Lin SC,Kao CY,Lee HJ,et al.Dysregulation of miRNAs-COUP-TFII-FOXM1-CENPF axis contributes to the metastasis of prostate cancer [J] .Nat Commun,2016,7:11418.
[33] Halasi M,Gartel AL.A novel mode of FoxM1 regulation:positive auto-regulatory loop [J] .Cell Cycle (Georgetown,Tex),2009,8(12):1966-1967.
[34] Halasi M,Varaljai R,Benevolenskaya E,et al.A novel function of molecular chaperone HSP70:Suppression of oncogenic FOXM1 after proteotoxic stress [J] .J Biol Chem,2016,291(1):142-148.
[35] Zhang X,Zhang L,Du Y,et al.A novel FOXM1 isoform,FOXM1D,promotes epithelial-mesenchymal transition and metastasis through ROCKs activation in colorectal cancer [J] .Oncogene,2017,36(6):807-819.

备注/Memo: National Natural Science Foundation of China(No.81672428);国家自然科学基金面上项目（编号：81672428）；北京希思科临床肿瘤学研究基金（编号：Y-MX2016-027）

更新日期/Last Update: 1900-01-01