green what should be deleted / add in red / comment in blue

To which CATEGORY does this gene/protein belong? Please, tick the box(es)

- Cell cycle	☐	- Extracellular matrix	☐
- Apoptosis (extrinsic)	☐	- Cytoskeleton / scaffold	☐
- Apoptosis (intrinsic)	☐	- Cell junctions	☐
		- Channels and gap junctions	☐
- DNA replication and recombination	☐	- Exocytosis-endocytosis, vesicle traffic	☐
- DNA repair	☐		
- Nucleole machinery	☐	- Signal: Nuclear receptors	☐
- Transcription-translation (transcription)	☐	- Signal: Secreted factors	☐
- Transcription-translation (spliceosome)	☐	- Signal: Membrane receptors	☐
- Transcription-translation (translation)	☐	- Signal: Intracellular transduction: AMPc signaling	☐
- Micro RNA	☐	- Signal: Intracellular transduction: PLCG signaling	☐
- Chromatin	☐	- Signal: Intracellular transduction: RAS / RAF / MAPK signaling	☐
- Nuclear membrane trafficking	☐	- Signal: Intracellular transduction: PI3K / AKT / mTOR signaling	☐
- Mitosis / centrosome-microtubules-kinetochore	☐	- Signal: Intracellular transduction: JAK / STAT signaling	☐
		- Signal: Intracellular transduction: TGFb signaling	☐
- Mitochondria (oxydative phosphorylation)	☐	- Signal: Intracellular transduction: WNT signaling	☐
- Mitochondria (TOM and TIM)	☐	- Signal: Intracellular transduction: Hedgehog signaling	☐
- Proteasome - ubiquitination	☐	- Signal: Intracellular transduction: NF-kB signaling	☐
		- Signal: Transcription factors	☐ ✔
- Immunity	☐		
- Angiogenesis	☐		

- OTHER: specify	

Author(s)

AUTHORS Franck Viguié
DATE 2009-01
CITATION Viguié F
AUTHORS_AFFILIATIONS / *e-Mail* Laboratoire de Cytogenetique - Service d'Hematologie Biologique, Hopital Hotel-Dieu - 75181 Paris Cedex 04, France

AUTHORS Ritsuko Shimizu, Masayuki Yamamoto
UPDATE 2015-10
CITATION Shimizu R, Yamamoto *M*

AUTHORS_AFFILIATIONS / *e-Mail* Tohoku University Graduate School of Medicine, Sendai, Japan
masiyamamoto@med.tohoku.ac.jp

Abstract

Review on GATA2, with data on DNA, on the protein encoded, and where the gene is implicated.

Keywords

GATA2; Transcription; Hematopoiesis; Stem cell; Mutation; Familial myelodysplastic syndrome; DCML deficiency; Emberger syndrome; 3q21q26 syndrome; Cancer

Identity

GENE NAME **GATA2 (GATA binding protein 2)**
ALIASLOCATION 3q21.3, 128,479,427-128,493,185 reverse strand (reference: http://asia.ensembl.org/Homo_sapiens/Gene/Summary?g=ENSG00000179348;r=3:128479427-128493185;redirect=no)
LOCAL ORDER
IMAGE
IMAGE_LEGEND
IMAGE_FISH
IMAGE_FISH_LEGEND
NOTE

DNA/RNA

NOTE
IMAGE
IMAGE_LEGEND
LINK_IMAGE
LINK_IMAGE_LEGEND
DESCRIPTION Genomic DNA 13,759 bp, 6 exons (two untranslated first exons that utilized differentially and five translated exons ~~one non coding~~).
TRANSCRIPTION ~~mRNA 3383bp,~~ The distal (IS) exon specifically utilized in hematopoietic and neural cells, while the proximal (IG) exon is utilized ubiquitously, producing 3383-bp and 3484-bp transcripts, respectively. These two variant transcripts encode the same protein. T~~t~~rancription is oriented from telomere to centromere. ~~It contains 2 alternative first exons, one distal (IS) specifically transcribed in hematopoietic and neural cells, and a proximal one (IG) transcribed in other cell types~~
PSEUDOGENE

Protein

NOTE
IMAGE
IMAGE_LEGEND
DESCRIPTION Contains 2 zinc finger domains, ZF1 (aa294 to 344) and ZF2 (aa349 to 398).
IMAGE_2
IMAGE_2_LEGEND
EXPRESSION Strictly regulated and tissue specific. Gene activity depends on several trans regulators and cis-acting regulatory elements ~~in the vicinity of the gene~~ scattered in a wide range around the gene. 3.1-kbp upstream of IS exon recapitulates endogenous Gata2 gene expression in yolk sacs and paraaortic splanchnopleura hematopoietic cells in mice. An enhancer in 77-kbp upstream of *GATA2* gene and GATA-box-E-box composite element in the fourth intron are important in adult hematopoiesis and implicated in the leukemogenesis in humans (see below). In non-hematopoietic tissues, the element in the fourth intron works as an endothelial specific enhancer, whereas enhancer(s) located between +75- and +113-kbp to the translational initiation site are responsible to the Gata2 expression in caudal periureteric mesenchyme/

urogenital sinus and rostral metanephric mesenchyme in mice, respectively. It has been considered that currently not-identified enhancer(s) for urogenital organs development are located more distal region of *Gata2* gene.
IMAGE_3
IMAGE_3_LEGEND
LOCALISATION Nuclear.
IMAGE_4
IMAGE_4_LEGEND
FUNCTION Binds to the consensus sequence 5'-(A/T)GATA(A/G)-3' (GATA-box). Transcriptional activator which is expressed very early in hematopoiesis and plays a role in development and regulation of every early pluripotent hematopoietic precursor, but also of eosinophils, basophils and mast cells ~~non hematopoietic embryonic stem cells~~. Early stages of erythroid differentiation depend on GATA2, but during maturation GATA2 expression decreases progressively at the benefit of GATA1. GATA2 suppresses differentiation of bone marrow mesenchyme stem cells to adipocytes and sustains the hematopoietic stem cell environment. GATA2 also plays roles in development of neural system, urogenital organs and vascular system.
IMAGE_5
IMAGE_5_LEGEND
HOMOLOGY Member of the GATA family which contains 6 known members; only GATA1, GATA2 and GATA3 are involved in hematopoiesis.
IMAGE_6
IMAGE_6_LEGEND
IMAGE_7
IMAGE_7_LEGEND

Mutations

NOTE
IMAGE
IMAGE_LEGEND
GERMINAL ~~No known mutation~~ Loss-of-function mutations and dominant-negative mutations have been found as a cause of Familial myelodysplastic syndrome (MDS), DCML deficiency and Emberger syndrome, which are in a group of complex syndromes predisposing to leukemia with overlapping clinical features. Mutation in GATA-box-E-box composite element in the fourth intron, which leads to reduction of *GATA2* gene expression, has been found in a pedigree of MonoMAC syndrome family.
SOMATIC Chromosomal rearrangements involving the 77-kbp upstream region of *GATA2* gene on 3q21 and *EVI1* gene on 3q26 are associated with MDS and acute myeloid leukemia (AML). This type of hematopoietic malignancies is referred to as 3q21q26 syndrome.
Mutations are found as a cause of acute myeloid transformation of chronic myeloid leukemia (CML). ~~In CML acute myeloid transformation (see below).~~
EPIGENETICS

Implicated in (please, develop one paragraph per disease and each cancer) separately)

Entity ------->
ENTITY_NAME DCML deficiency
NOTE
DISEASE Immunodeficiency syndrome associated with loss of dendritic cells, monocytes, B and NK cells, leading to the increasing incidence of mycobacterial, fungal and viral infections. This disease occurs sporadically or in an autosomal dominant inheritance with incomplete penetrance. Patients with DCML deficiency have high incidence of developing hematopoietic malignancies. DCML deficiency with mycobacterium avium complex infection has been described as “monoMAC (monocytopenia with Mycobacterium avium complex) syndrome”.
PROGNOSIS prone to develop MDS and AML
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE

HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Emberger syndrome
NOTE
DISEASE Sporadic or autosomal dominant disease with incomplete penetrance, which has a characteristic feature of primary lymphoedema with myelodysplasia. The lymphedema generally confined to the lower limbs and genitals.
PROGNOSIS prone to develop AML
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME 3q21q26 syndrome
NOTE
DISEASE Hematopoietic malignancies, including MDS and AML, caused by a chromosomal aberration between the regions 3q21 and 3q26. The 77-kbp upstream region of GATA2 gene on 3q21 is rearranged proximal to the Evi1 locus on 3q26 by the translocation or inversion. Aberrant expression of EVI1 gene lead by the activity of GATA2 enhancer is appeared to be involved in the pathogenesis and poor prognosis of this disease.
PROGNOSIS unfavorable prognosis
CYTOGENETICS inv(3)(q21q26), t(3;3)(q21;q26)
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Acute promyelocytic leukaemia
NOTE
DISEASE GATA2 may be involved in APL leukemogenesis by physical interaction with the PML component of PML-RARa fusion or with the variant PLZF-RARa fusion, generated respectively by t(15;17) or t(11;17) translocation.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Myelodysplasic syndrome
NOTE
DISEASE GATA2 is expressed in MDS, but not in normal controls; the frequency of expression increases with the severity of dysplasia (100% in RAEB/RAEB-T).
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Myeloid transformation of chronic myelooid leukemia CML
NOTE
DISEASE Out of 85 unselected cases of CML blast transformation, 9 showed a GATA2 mutation: 8 with a T-->G substitution at aa359 in ZF2 (L359V) and 1 with a 6 aa deletion (aa 341 to 346) in ZF1. All 9 transformations were myeloid, with a myeloblastic or monoblastic morphology. L359V leads to a gain of function of GATA2 protein.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Aplastic anemia
NOTE
DISEASE Hypothetical. In knockout mice, GATA2 haploinsufficiency leads to a decrease of hematopoietic stem cells number and efficiency. In human, GATA2 mRNA expression is largely reduced in patients with AA.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Prostate cancer
NOTE
DISEASE High expression of GATA2 is associated with aggressiveness, high metastasis ratio and resistance for therapy in prostate cancer through, in part, the activation of androgen-receptor target genes in ligand-independent pathway.
PROGNOSIS unfavorable prognosis
CYTOGENETICS

HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->
ENTITY_NAME Non-small cell lung cancer
NOTE
DISEASE GATA2 is required for the survival of Ras-mediated NSCLC by controlling IL-1/NF-κB signaling. Knockdown of GATA2 expression lead to a reduction of tumor burden in mouse model of NSCLC, suggesting that GATA2 is a therapeutic target of Ras mutant cancers.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->
ENTITY_NAME Glioma
NOTE
DISEASE The level of GATA2 expression that might be regulated by EGFR/ERK signaling pathway is correlated with prognosis of glioma patients.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->
ENTITY_NAME Neuroblastoma
NOTE
DISEASE The expression level of GATA2 is reverse-correlated with aggressiveness, as GATA2 may negatively regulate proliferation of neuroblastoma cells.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->

ENTITY_NAME Renal cell carcinoma
NOTE
DISEASE The expression level of GATA2 is reverse-correlated with aggressiveness, possibility of metastasis, and risk of recurrence in clear cell RCC.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->
ENTITY_NAME Hepatocellular carcinoma
NOTE
DISEASE The expression level of GATA2 is reverse-correlated with poor prognosis of hepatocellular carcinoma. Knockdown of GATA2 expression enhances the proliferation of a human liver cancer cell line in vitro.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->
ENTITY_NAME Colorectal cancer
NOTE
DISEASE High level of GATA2 expression is correlated with aggressive feature, high recurrence rate and poor outcome of colorectal cancer.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND
FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Entity ------->
ENTITY_NAME Breast cancer
NOTE
DISEASE Roles of GATA2 in pathogenesis of breast cancer are contraversial. Reports describing that GATA2 level was increased in breast cancer showed that GATA2 might be related to tumor progression by repressing PTEN activity and/or promoting expression of aromatase gene, whereas another report showed that the expression GATA2 gene was silenced by aberrant hyper-methylation of GATA2 promoter region.
PROGNOSIS
CYTOGENETICS
HYBRID_GENE
HYBRID_GENE_IMAGE
HYBRID_GENE_IMAGE_LEGEND

FUSION_PROTEIN
FUSION_PROTEIN_IMAGE
FUSION_PROTEIN_IMAGE_LEGEND
ONCOGENESIS

Breakpoints

IMAGE_PARTNERS
IMAGE_PARTNERS_LEGEND
IMAGE
IMAGE_LEGEND
NOTE

To be noted

NOTE
IMAGE
IMAGE_LEGEND

External links

OTHER_DATABASES
http://asia.ensembl.org/Homo_sapiens/Gene/Summary?db=core;g=ENSG00000179348;r=3:128479427-128493185;t=ENST00000487848

Bibliography

Activity and tissue-specific expression of the transcription factor NF-E1 multigene family.
Yamamoto M, Ko LJ, Leonard MW, Beug H, Orkin SH, Engel JD.
Genes Dev. 1990 Oct;4(10):1650-62.
PMID 2249770

Transcription factor GATA-2 is expressed in erythroid, early myeloid, and CD34+ human leukemia-derived cell lines.
Nagai T, Harigae H, Ishihara H, Motohashi H, Minegishi N, Tsuchiya S, Hayashi N, Gu L, Andres B, Engel JD, Yamamoto M.
Blood. 1994 Aug 15;84(4):1074-84.
PMID 7519472

Potentiation of GATA-2 activity through interactions with the promyelocytic leukemia protein (PML) and the t(15;17)-generated PML-retinoic acid receptor alpha oncoprotein.
Tsuzuki S, Towatari M, Saito H, Enver T.
Mol Cell Biol. 2000 Sep;20(17):6276-86.
PMID 10938104

Decreased expression of transcription factor GATA-2 in haematopoietic stem cells in patients with aplastic anaemia.
Fujimaki S, Harigae H, Sugawara T, Takasawa N, Sasaki T, Kaku M.
Br J Haematol. 2001 Apr;113(1):52-7.
PMID 11328281

GATA-1 and GATA-2 gene expression is related to the severity of dysplasia in myelodysplastic syndrome.
Fadilah SA, Cheong SK, Roslan H, Rozie-Hanisa M, Yen GK.

Leukemia. 2002 Aug;16(8):1563-5.
PMID 12145700

Cloning and characterization of a novel endothelial promoter of the human CYP19 (aromatase P450) gene that is up-regulated in breast cancer tissue.

Sebastian S, Takayama K, Shozu M, Bulun SE.
Mol Endocrinol. 2002 Oct;16(10):2243-54.
PMID: 12351690

GATA transcription factors and hematological diseases.
Harigae H.
Tohoku J Exp Med. 2006 Sep;210(1):1-9. Review
PMID 16960339

A Gata2 intronic enhancer confers its pan-endothelia-specific regulation.
Khandekar M, Brandt W, Zhou Y, Dagenais S, Glover TW, Suzuki N, Shimizu R, Yamamoto M, Lim KC, Engel JD.
Development 2007 May;134(9):1703-12.
PMID: 17395646

GATA-1, -2 and -3 genes expression in bone marrow microenviroment with chronic aplastic anemia.
Wu X, Li Y, Zhu K, Wang Z, Chen S, Yang L.
Hematology. 2007 Aug;12(4):331-5.
PMID 17654061

Gain-of-function mutation of GATA-2 in acute myeloid transformation of chronic myeloid leukemia.
Zhang SJ, Ma LY, Huang QH, Li G, Gu BW, Gao XD, Shi JY, Wang YY, Gao L, Cai X, Ren RB, Zhu J, Chen Z, Chen SJ.
Proc Natl Acad Sci U S A. 2008 Feb 12;105(6):2076-81. Epub 2008 Feb 4.
PMID 18250304

Defining the functional boundaries of the Gata2 locus by rescue with a linked bacterial artificial chromosome transgene.
Brandt W, Khandekar M, Suzuki N, Yamamoto M, Lim KC, Engel JD.
J Biol Chem 2008 Apr 4;283(14):8976-83.
PMID: 18211891

GATA factors in human neuroblastoma: distinctive expression patterns in clinical subtypes.
Hoene V, Fischer M, Ivanova A, Wallach T, Berthold F, Dame C.
Br J Cancer. 2009 Oct 20;101(8):1481-9.
PMID: 19707195

A role for GATA-2 in transition to an aggressive phenotype in prostate cancer through modulation of key androgen-regulated genes.
Böhm M, Locke WJ, Sutherland RL, Kench JG, Henshall SM.
Oncogene. 2009 Oct 29;28(43):3847-56.
PMID: 19684615

DNA methylation changes in murine breast adenocarcinomas allow the identification of candidate genes for human breast carcinogenesis.
Acosta D, Suzuki M, Connolly D, Thompson RF, Fazzari MJ, Greally JM, Montagna C.
Mamm Genome. 2011 Apr;22(3-4):249-59.

PMID: 21373886

Mutations in *GATA2* cause primary lymphedema associated with a predisposition to acute myeloid leukemia (Emberger syndrome).
Ostergaard P, Simpson MA, Connell FC, Steward CG, Brice G, Woollard WJ, Dafou D, Kilo T, Smithson S, Lunt P, Murday VA, Hodgson S, Keenan R, Pilz DT, Martinez-Corral I, Makinen T, Mortimer PS, Jeffery S, Trembath RC, **Mansour** S.
Nat Genet. 2011 Sep 4;43(10):929-31.
PMID: 21892158

GATA2 negatively regulates PTEN by preventing nuclear translocation of androgen receptor and by androgen-independent suppression of PTEN transcription in breast cancer.
Wang Y, He X, Ngeow J, Eng C.
Hum Mol Genet. 2012 Feb 1;21(3):569-76.
PMID: 22021428

The GATA2 transcriptional network is requisite for RAS oncogene-driven non-small cell lung cancer.
Kumar MS, Hancock DC, Molina-Arcas M, Steckel M, East P, Diefenbacher M, Armenteros-Monterroso E, Lassailly F, Matthews N, Nye E, Stamp G, Behrens A, Downward J.
Cell. 2012 Apr 27;149(3):642-55.
PMID: 22541434

***Cis*-element mutated in *GATA2*-dependent immunodeficiency governs hematopoiesis and vascular integrity.**
Johnson KD, Hsu AP, Ryu MJ, Wang J, Gao X, Boyer ME, Liu Y, Lee Y, Calvo KR, Keles S, Zhang J, Holland SM, Bresnick EH.
J Clin Invest. 2012 Oct 1;110(10):3692-704
PMID: 22996659

Decreased expression of GATA2 promoted proliferation, migration and invasion of HepG2 in vitro and correlated with poor prognosis of hepatocellular carcinoma.
Li YW, Wang JX, Yin X, Qiu SJ, Wu H, Liao R, Yi Y, Xiao YS, Zhou J, Zhang BH, Fan J.
PLoS One. 2014 Jan 30;9(1):e87505.
PMID: 24498120

A single oncogenic enhancer rearrangement causes concomitant EVI1 and GATA2 deregulation in leukemia.
Gröschel S, Sanders MA, Hoogenboezem R, de Wit E, Bouwman BA, Erpelinck C, van der Velden VH, Havermans M, Avellino R, van Lom K, Rombouts EJ, van Duin M, Döhner K, Beverloo HB, Bradner JE, Döhner H, Löwenberg B, Valk PJ, Bindels EM, de Laat W, Delwel R.
Cell 2014 Apr 10;157(2):369-81.
PMID: 24703711

A Remote *GATA2* Hematopoietic Enhancer Drives Leukemogenesis in inv(3)(q21;q26) by Activating *EVI1* Expression.
Yamazaki H, Suzuki M, Otsuki A, Shimizu R, Bresnick EH, Engel JD, Yamamoto M.
Cancer Cell 2014 Apr 14;25(4):415-27.
PMID: 24703906

GATA2 regulates differentiation of bone marrow-derived mesenchymal stem cells.
Kamata M, Okitsu Y, Fujiwara T, Kanehira M, Nakajima S, Takahashi T, Inoue A, Fukuhara N, Onishi Y, Ishizawa K, Shimizu R, Yamamoto M, Harigae H.
Haematologica 2014 Nov;99(11):1686-96.
PMID: 25150255

GATA2 promotes glioma progression through EGFR/ERK/Elk-1 pathway.
Wang Z, Yuan H, Sun C, Xu L, Chen Y, Zhu Q, Zhao H, Huang Q, Dong J, Lan Q.
Med Oncol. 2015 Apr;32(4):87.
PMID: 25707769

Decreased mRNA expression of GATA1 and GATA2 is associated with tumor aggressiveness and poor outcome in clear cell renal cell carcinoma.
Peters I, Dubrowinskaja N, Tezval H, Kramer MW, von Klot CA, Hennenlotter J, Stenzl A, Scherer R, Kuczyk MA, Serth J.
Target Oncol. 2015 Jun;10(2):267-75.
PMID: 25230694

TITLE
AUTHORS
REFERENCE
PMID

TITLE
AUTHORS
REFERENCE
PMID