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Gene Section

Review

LATS2 (LATS, large tumor suppressor, homolog 2 (Drosophila))

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Identity

Other names: KPM; FLJ13161; EC 2.7.11.1

HGNC (Hugo): LATS2

Location: 13q12.11

Local order: Chromosome 13; orientation: negative.

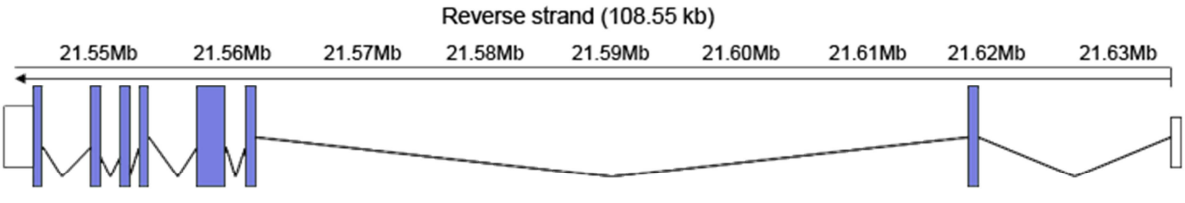
DNA/RNA

Type: functioning gene, 8 exons.

Description

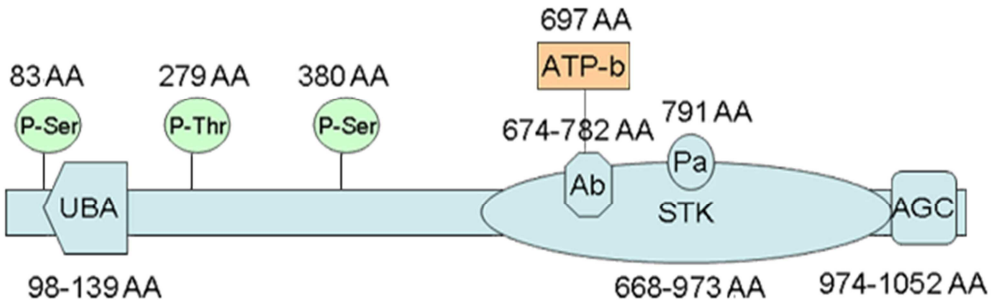
Yabuta et al. (2000) mapped the human LATS2 gene to 13q11-q12 (FISH); gene with protein product.

UBA: ubiquitin-associated domain, PK: protein kinase domain, AGC: AGC-C terminal domain, Nu-B: NB-nucleotide binding domain.



Ex1:	21635485-21635686;	202 bp
In 1-2	21620370-21635484;	15115 bp
Ex 2	21619824-21620369;	546 bp
In 2-3	21565544-21619823;	54280 bp
Ex 3	21565411-21565543;	133 bp
In 3-4	21563444-21565410;	1967 bp
Ex 4	21562020-21563443;	1424 bp
In 4-5	21557946-21562019;	4074 bp
Ex 5	21557363-21557945;	583 bp
In 5-6	21555788-21557362;	1575 bp
Ex 6	21555605-21555787;	183 bp
In 6-7	21553937-21555604;	1668 bp
Ex 7	21553830-21553936;	107 bp
In 7-8	21549504-21553829;	4326 bp
Ex 8	21547171-21549503;	2333 bp

Filled blocks: coding exons, white blocks: non-coding exons, line: intron region, Ex: exon, In: intron, bp: base pair, kb: kilobase.



UBA: ubiquitin-associated domain, STK: serin/threonin kinase domain, AGC: AGC- C terminal domain, Ab: ATP-binding domain, AA: amino acid, P-Ser: phosphorylated serine, P-Thr: phosphorylated threonine, ATP-b: ATP binding site, Pa: proton acceptor.

Gene encodes a serine/threonine protein kinase belonging to the LATS tumor suppressor family.

Pseudogene

Not known; paralogs according to Ensembl: LATS1, ROCK1, ROCK2.

Protein

Note

LATS2 is a nuclear protein of approximately 120 kDa and 1088 AA. The protein localizes to centrosomes during interphase, and early and late metaphase. It interacts with the centrosomal proteins aurora-A and Ajuba and is required for accumulation of gamma-tubulin and spindle formation at the onset of mitosis. It also interacts with a negative regulator of TP53 and may function in a positive feedback loop with TP53 that responds to cytoskeleton damage. Additionally, it can function as a co-repressor of androgen-responsive gene expression.

Description

LATS2 protein is a serine/threonine protein kinase, 1088 AA; 120 kDa; cofactor is magnesium. Subunit interacts and is phosphorylated by STK6. LATS2 binds to AR and interacts to JUB during mitosis. Complex regulates spindle apparatus organisation through gamma-tubulin recruitment to the centrosome. Protein is auto-phosphorylated and phosphorylated during M- and G1/S- phase of cell cycle; phosphorylated and activated by STK3.

Expression

Expressed at high levels in heart and skeletal muscle and at lower levels in all other tissues examined. Gene is found in cDNA libraries from the following tissue types: b-cell, bone, bone marrow, brain, cartilage, cerebrum, colon, ear, embryonic tissue, eye, foetus, gastrointestinal tract, heart, kidney, liver, lung, lymph node, lympho-reticular, mammary gland, muscle, nervous, ovary, pancreas, pancreatic islet, peripheral nervous system, placenta, pooled tissue, prostate, skin, spleen, stem cell, stomach, t-cell, testis, uncharacterized tissue, uterus, vascular.

Localisation

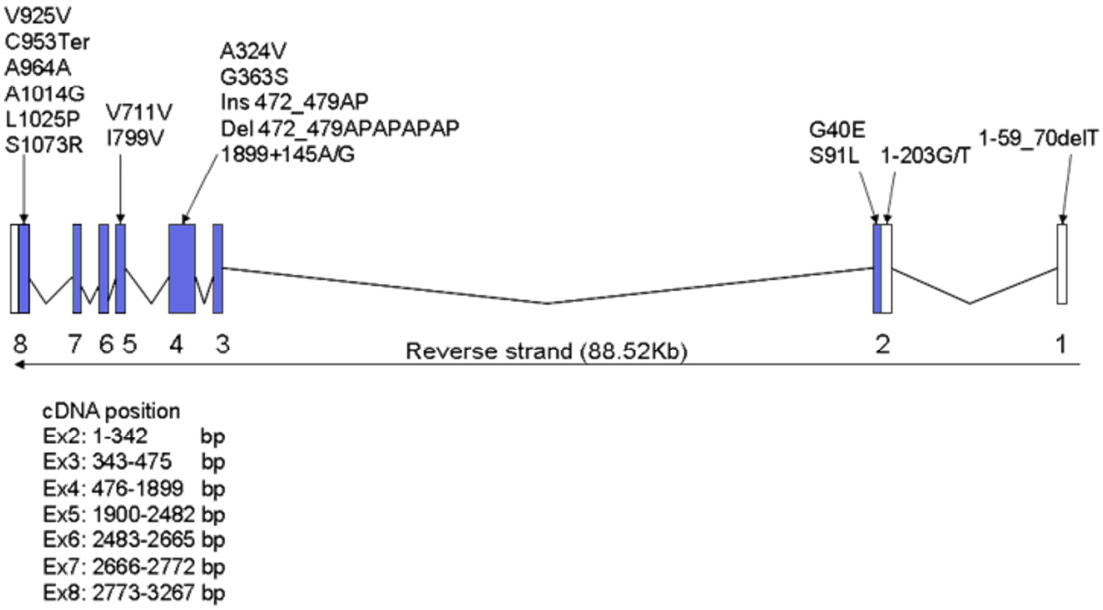
Cytoplasm, nucleus, spindle pole, centrosome; co-localizes with STK6 at the centrosomes during interphase, early pro-phase and cytokinesis. Migrates to spindle poles during mitosis, and to the mid-body during cytokinesis. S83 of Lats2 is a phosphorylation target of Aurora-A and the phosphorylation plays a role of the centrosomal localization of Lats2 (Toji et al., 2004).

Function

Protein product involved in: G1/S transition of mitotic cell cycle, hormone-mediated signalling pathway; negative regulation of Cyclin-dependent protein kinase activity; protein amino acid phosphorylation; protein kinase cascade; centrosome localisation; ATP binding; Mg-ion binding, nucleotide binding, protein serine/threonine kinase activity; protein tyrosine kinase activity; transferase activity; negative regulation of androgen receptor activity. LATS2 is a tumour suppressor that plays critical role in centrosome duplication, maintenance of mitotic fidelity and genomic stability. Negatively regulates G1/S transition by down-regulating cyclin E/CDK2 kinase activity.

LATS2 is involved in conserved Hippo signalling pathway (Zhang et al., 2008; Hergovich et al., 2009). LATS2 has an essential role in the integrity of processes that govern centrosome duplication, mitotic fidelity and genomic stability (McPherson et al., 2004). Components of the pathway bring LATS2 in contact with MST1 and MST2 kinase, which phosphorylates and activates LATS2. Functionally, pathway with LATS2 included is involved in cell proliferation, apoptosis, and cell migration. Involvement in apoptosis has been demonstrated in lung cancer cells where LATS2 has been shown to induce apoptosis through down regulation of BCL-2 and BCL-XL (BCL2L1) anti-apoptotic proteins (Ke et al., 2004).

LATS2 has been reported to inhibit cell growth by causing G1/S and/or G2/M cycle arrest (Li et al., 2003; Kamikubo et al., 2003). LATS2 binds MDM2 and with inhibiting its E3 ligase activity activates TP53.



Position of alterations marked on the exons; length and position of the coding region described according to the exons.

In turn TP53 rapidly and selectively up-regulates LATS2 expression in G2/M cells, defining positive feedback loop. Therefore LATS2-MDM2-TP53 constitutes a novel checkpoint pathway critical for maintenance of proper chromosome number (Aylon et al., 2007). LATS2 is also associated with Ajuba in LATS2-Ajuba complex that regulates organization of the spindle apparatus through recruitment of γ-tubulin to the centrosome (Abe et al., 2006).

In vitro over expression of LATS2 was seen to cause G1/S arrest through the inhibition of CDK2 activity (Li et al., 2003). Complete LATS2 knock-out cells exhibit an acceleration of exit from mitosis and marked down-regulation of critical mitotic regulators, proving its role in coordinating accurate cytokinesis completion, governing the stabilization of other regulators of mitosis (Yabuta at al., 2007). Study of LATS2 knock-out cells and transient co-expression of LATS2, YAP and TP73 showed that LATS2 contributes to the stability of YAP2 (YAP1) and TP73, which is dependant on the kinase function leading to the conclusion that LATS2 is involved in the fate of TP73 through YAP2 (Kawahara et al., 2008).

Mutations

Germinal

No data.

Somatic

Mutations are rare and mostly found in cancerous tissue. More frequently hypermethylation of the LATS2 promoter and or down-regulation of the expression is related to different kind of cancers (lung, breast, hepatocellular, leukaemias, testicular, astrocytomas, retinoblastoma, head and neck).

When polymorphism is noted or when dbSNP entrance number is provided, alterations are listed as polymorphisms; references are those when the alteration was first published.

1-59_70delT	polymorphism	Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009; 64(3): 257-62
119G>A (G40E) in lung adenocarcinoma cell line		Greenman C, Stephens P, Smith R, et al. Patterns of somatic mutation in human cancer genomes. Nature. 2007 Mar 8; 446(7132): 153-8.
1-203G/T	polymorphism	Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009; 64(3): 257-62
272C>T (S91L)	dbSNP rs55842804	Greenman C, Stephens P, Smith R, et al. Patterns of somatic mutation in human cancer genomes. Nature. 2007 Mar 8; 446(7132): 153-8.
ins 472_479 AP	polymorphism	Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell

		carcinoma. Lung Cancer. 2009; 64(3): 257-62
del 472_479 APAPAPAP		Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009; 64(3): 257-62
971C>T (A324V)	dbSNP rs558614	Yabuta N, Fujii T, Copeland NG, et al. Structure, expression, and chromosome mapping of LATS2, a mammalian homologue of the Drosophila tumor suppressor gene lats/warts. Genomics. 2000 Jan 15; 63(2): 263-70.
1087G>A (G363S)	dbSNP rs2770928	
1899+145A/G	polymorphism	Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009; 64(3): 257-62
2133C>T (V711V)		
2395A>G (I799V)	dbSNP rs35368391	Greenman C, Stephens P, Smith R, et al. Patterns of somatic mutation in human cancer genomes. Nature. 2007 Mar 8; 446(7132): 153-8.
2775G>A (V925V) in lung adenocarcinoma cell line		Sanger
2859C>A (C953Ter) in ovary mucinous carcinoma (not specified)		Sanger
2892C>T (A964A)		Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009; 64(3): 257-62
3041C>G (A1014G)	dbSNP rs45523141	Greenman C, Stephens P, Smith R, et al. Patterns of somatic mutation in human cancer genomes. Nature. 2007 Mar 8; 446(7132): 153-8.
3074T>C (L1025P)	dbSNP rs56116059	Greenman C, Stephens P, Smith R, et al. Patterns of somatic mutation in human cancer genomes. Nature. 2007 Mar 8; 446(7132): 153-8.
3219C>A (S1073R)		Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009; 64(3): 257-62

Implicated in

Various cancers

Note

Loss of LATS2 in mice is lethal. Knockout of the gene in mice embryonic fibroblasts induces mitotic defects, genomic instability and loss of contact inhibition (McPherson et al., 2004; Yabuta et al., 2007). Over-expression of LATS2 inhibits tumour formation in mice, or reduces cell growth in human tumour cell lines (Yang et al., 2001; Xia et al., 2002; Li et al., 2003) and on the other hand mutations and/or reduced expression (either methylation or miRNA regulation or unknown) have been observed in variety of human cancers; leukaemia (Jimenez-Velasco et al., 2005), astrocytomas (Jiang et al., 2006), prostate (Powzaniuk et al., 2004), breast (Takahashi et al., 2005), lung (Strazisar et al., 2009), head and neck (Steinmann et al., 2009), retinoblastoma (Chaktaborty et al., 2007), oesophageal (Lee et al., 2009), hepatocellular (Chen et al., 2005) and possibly also colon (Sivarajasingham et al., 2003) cancer. Frequent LOH of the gene has been observed in breast, ovary and liver cancer (Lee et al., 1988; Sato et al., 1991; Wang and Roger, 1988).

Breast cancer

Note

Reduced expression of LATS2 mRNA is associated with biologically aggressive phenotypes of breast cancer, indicating that the reduced function of LATS2 can lead to accelerated cell proliferation and have as a result higher incidence of distant metastases (Takahashi et al., 2005). LATS2 mRNA levels were in 2007 discovered to be clinically useful for the prediction of response to epirubicin plus cyclophosphamide treatment in breast cancer patients (Takahashi et al., 2007).

Acute lymphoblastic leukaemia

Prognosis

Down regulation mainly by aberrant promoter methylation of LATS2 is also associated with poor prognosis in acute lymphoblastic leukaemia (Jimenez-Velasco et al., 2005).

Testicular and prostate tumours

Note

In testicular germ cell tumours miRNAs (miR-372 and miR-373) were implicated in neutralization of TP53-mediated CDK inhibition, through direct inhibition of the expression of LATS2 (Voorhoeve et al., 2006). It has been also shown that LATS2 is down regulated in human testicular cancer cells (Vorhoeve et al., 2006; Duale et al., 2007). LATS2 functions also as negative regulator of AR (androgen receptor), which plays an essential role in the development and maintenance of the male reproductive system and in prostate cancer. It has been shown that expression of LATS2 is lower in human prostate tumours, and suggested to contribute to the development of prostate cancer through regulation AR-mediated transcription (Powzaniuk et al., 2004).

Astrocytomas

Note

Methylation of LATS2 and down regulation was detected in astrocytomas and proposed as a useful target for astrocytomas therapy by Jiang et al. (2006).

Oesophageal squamous cell carcinoma

Note

Frequent polymorphic changes but rare tumour specific mutations of the LATS2 gene were found in oesophageal squamous cell carcinoma, indicating LATS2 is inactivated in only small parts of oesophageal tumours (Ishizaki et al., 2002).

Non-small cell lung cancer

Note

Down regulation of LATS2 have been found in non-small cell lung cancer and mutations discovered have been related mostly to squamous lung cell carcinomas (Strazisar et al., 2009a; Strazisar et al., 2009b).

Breakpoints

Note

Data about all observed breakpoints found at the approximate/distal location of LATS2, but no mentioning of the gene itself:
NCBI CancerChromosomes database: Over 500 investigations on 13q11 and over 1000 on 13q12.
The Cancer genome anatomy project: 209 investigations on 13q11 found.

References

Hori T, Takaori-Kondo A, Kamikubo Y, Uchiyama T. Molecular cloning of a novel human protein kinase, kpm, that is homologous to warts/lats, a Drosophila tumor suppressor. Oncogene. 2000 Jun 22;19(27):3101-9

Yabuta N, Fujii T, Copeland NG, Gilbert DJ, Jenkins NA, Nishiguchi H, Endo Y, Toji S, Tanaka H, Nishimune Y, Nojima H. Structure, expression, and chromosome mapping of LATS2, a mammalian homologue of the Drosophila tumor suppressor gene lats/warts. Genomics. 2000 Jan 15;63(2):263-70

Ishizaki K, Fujimoto J, Kumimoto H, Nishimoto Y, Shimada Y, Shinoda M, Yamamoto T. Frequent polymorphic changes but rare tumor specific mutations of the LATS2 gene on 13q11-12 in esophageal squamous cell carcinoma. Int J Oncol. 2002 Nov;21(5):1053-7

Kamikubo Y, Takaori-Kondo A, Uchiyama T, Hori T. Inhibition of cell growth by conditional expression of kpm, a human homologue of Drosophila warts/lats tumor suppressor. J Biol Chem. 2003 May 16;278(20):17609-14

Li Y, Pei J, Xia H, Ke H, Wang H, Tao W. Lats2, a putative tumor suppressor, inhibits G1/S transition. Oncogene. 2003 Jul 10;22(28):4398-405

Sivarajasingham NS, Baker R, Tilsed JV, Greenman J, Monson JR, Cawkwell L. Identifying a region of interest in site- and stage-specific colon cancer on chromosome 13. Ann Surg Oncol. 2003 Nov;10(9):1095-9

Ke H, Pei J, Ni Z, Xia H, Qi H, Woods T, Kelekar A, Tao W. Putative tumor suppressor Lats2 induces apoptosis through downregulation of Bcl-2 and Bcl-x(L). Exp Cell Res. 2004 Aug 15;298(2):329-38

McPherson JP, Tamblyn L, Elia A, Migon E, Shehabeldin A, Matysiak-Zablocki E, Lemmers B, Salmena L, Hakem A, Fish J, Kassam F, Squire J, Bruneau BG, Hande MP, Hakem R. Lats2/Kpm is required for embryonic development, proliferation control and genomic integrity. EMBO J. 2004 Sep 15;23(18):3677-88

Powzaniuk M, McElwee-Witmer S, Vogel RL, Hayami T, Rutledge SJ, Chen F, Harada S, Schmidt A, Rodan GA, Freedman LP, Bai C. The LATS2/KPM tumor suppressor is a negative regulator of the androgen receptor. Mol Endocrinol. 2004 Aug;18(8):2011-23

Toji S, Yabuta N, Hosomi T, Nishihara S, Kobayashi T, Suzuki S, Tamai K, Nojima H. The centrosomal protein Lats2 is a phosphorylation target of Aurora-A kinase. Genes Cells. 2004 May;9(5):383-97

Chan EH, Nousiainen M, Chalamalasetty RB, Schäfer A, Nigg EA, Silljé HH. The Ste20-like kinase Mst2 activates the human large tumor suppressor kinase Lats1. Oncogene. 2005 Mar 17;24(12):2076-86

Chen CF, Yeh SH, Chen DS, Chen PJ, Jou YS. Molecular genetic evidence supporting a novel human hepatocellular carcinoma tumor suppressor locus at 13q12.11. Genes Chromosomes Cancer. 2005 Nov;44(3):320-8

Jiménez-Velasco A, Román-Gómez J, Agirre X, Barrios M, Navarro G, Vázquez I, Prósper F, Torres A, Heiniger A. Downregulation of the large tumor suppressor 2 (LATS2/KPM) gene is associated with poor prognosis in acute lymphoblastic leukemia. Leukemia. 2005 Dec;19(12):2347-50

Kimura M, Okano Y. [Aurora kinases and cancer]. Gan To Kagaku Ryoho. 2005 Jan;32(1):1-5

Takahashi Y, Miyoshi Y, Takahata C, Irahara N, Taguchi T, Tamaki Y, Noguchi S. Down-regulation of LATS1 and LATS2 mRNA expression by promoter hypermethylation and its association with biologically aggressive phenotype in human breast cancers. Clin Cancer Res. 2005 Feb 15;11(4):1380-5

Abe Y, Ohsugi M, Haraguchi K, Fujimoto J, Yamamoto T. LATS2-Ajuba complex regulates gamma-tubulin recruitment to

centrosomes and spindle organization during mitosis. FEBS Lett. 2006 Feb 6;580(3):782-8

Aylon Y, Michael D, Shmueli A, Yabuta N, Nojima H, Oren M. A positive feedback loop between the p53 and Lats2 tumor suppressors prevents tetraploidization. Genes Dev. 2006 Oct 1;20(19):2687-700

Jiang Z, Li X, Hu J, Zhou W, Jiang Y, Li G, Lu D. Promoter hypermethylation-mediated down-regulation of LATS1 and LATS2 in human astrocytoma. Neurosci Res. 2006 Dec;56(4):450-8

Voorhoeve PM, le Sage C, Schrier M, Gillis AJ, Stoop H, Nagel R, Liu YP, van Duijse J, Drost J, Griekspoor A, Zlotorynski E, Yabuta N, De Vita G, Nojima H, Looijenga LH, Agami R. A genetic screen implicates miRNA-372 and miRNA-373 as oncogenes in testicular germ cell tumors. Cell. 2006 Mar 24;124(6):1169-81

Chakraborty S, Khare S, Dorairaj SK, Prabhakaran VC, Prakash DR, Kumar A. Identification of genes associated with tumorigenesis of retinoblastoma by microarray analysis. Genomics. 2007 Sep;90(3):344-53

Dijkman R, van Doorn R, Szuhai K, Willemze R, Vermeer MH, Tensen CP. Gene-expression profiling and array-based CGH classify CD4+CD56+ hematodermic neoplasm and cutaneous myelomonocytic leukemia as distinct disease entities. Blood. 2007 Feb 15;109(4):1720-7

Duale N, Lindeman B, Komada M, Olsen AK, Andreassen A, Soderlund EJ, Brunborg G. Molecular portrait of cisplatin induced response in human testis cancer cell lines based on gene expression profiles. Mol Cancer. 2007 Aug 21;6:53

Etienne A, Gelsi-Boyer V, Carbuccia N, Adélaïde J, Barba G, La Starza R, Murati A, Eclache V, Birg F, Birnbaum D, Mozziconacci MJ, Mecucci C, Chaffanet M. Combined translocation with ZNF198-FGFR1 gene fusion and deletion of potential tumor suppressors in a myeloproliferative disorder. Cancer Genet Cytogenet. 2007 Mar;173(2):154-8

Greenman C, Stephens P, Smith R, Dalgliesh GL, Hunter C, Bignell G, Davies H, Teague J, Butler A, Stevens C, Edkins S, O'Meara S, Vastrik I, Schmidt EE, Avis T, Barthorpe S, Bhamra G, Buck G, Choudhury B, Clements J, Cole J, Dicks E, Forbes S, Gray K, Halliday K, Harrison R, Hills K, Hinton J, Jenkinson A, Jones D, Menzies A, Mironenko T, Perry J, Raine K, Richardson D, Shepherd R, Small A, Tofts C, Varian J, Webb T, West S, Widaa S, Yates A, Cahill DP, Louis DN, Goldstraw P, Nicholson AG, Brasseur F, Looijenga L, Weber BL, Chiew YE, DeFazio A, Greaves MF, Green AR, Campbell P, Birney E, Easton DF, Chenevix-Trench G, Tan MH, Khoo SK, Teh BT, Yuen ST, Leung SY, Wooster R, Futreal PA, Stratton MR. Patterns of somatic mutation in human cancer genomes. Nature. 2007 Mar 8;446(7132):153-8

Seidel C, Schagdarsurengin U, Blümke K, Würl P, Pfeifer GP, Hauptmann S, Taubert H, Dammann R. Frequent hypermethylation of MST1 and MST2 in soft tissue sarcoma. Mol Carcinog. 2007 Oct;46(10):865-71

Takahashi Y, Miyoshi Y, Morimoto K, Taguchi T, Tamaki Y, Noguchi S. Low LATS2 mRNA level can predict favorable response to epirubicin plus cyclophosphamide, but not to docetaxel, in breast cancers. J Cancer Res Clin Oncol. 2007 Aug;133(8):501-9

Voorhoeve PM, le Sage C, Schrier M, Gillis AJ, Stoop H, Nagel R, Liu YP, van Duijse J, Drost J, Griekspoor A, Zlotorynski E, Yabuta N, De Vita G, Nojima H, Looijenga LH, Agami R. A genetic screen implicates miRNA-372 and miRNA-373 as oncogenes in testicular germ cell tumors. Adv Exp Med Biol. 2007;604:17-46

Yabuta N, Okada N, Ito A, Hosomi T, Nishihara S, Sasayama Y, Fujimori A, Okuzaki D, Zhao H, Ikawa M, Okabe M, Nojima H. Lats2 is an essential mitotic regulator required for the coordination of cell division. J Biol Chem. 2007 Jun 29;282(26):19259-71

Barve A, Khor TO, Nair S, Lin W, Yu S, Jain MR, Chan JY, Kong AN. Pharmacogenomic profile of soy isoflavone concentrate in the prostate of Nrf2 deficient and wild-type mice. J Pharm Sci. 2008 Oct;97(10):4528-45

Finkin S, Aylon Y, Anzi S, Oren M, Shaulian E. Fbw7 regulates the activity of endoreduplication mediators and the p53 pathway to prevent drug-induced polyploidy. Oncogene. 2008 Jul 24;27(32):4411-21

Froment P, Dupont J, Christophe-Marine J. Mdm2 exerts pro-apoptotic activities by antagonizing insulin-like growth factor-I-mediated survival. Cell Cycle. 2008 Oct;7(19):3098-103

Kawahara M, Hori T, Chonabayashi K, Oka T, Sudol M, Uchiyama T. Kpm/Lats2 is linked to chemosensitivity of leukemic cells through the stabilization of p73. Blood. 2008 Nov 1;112(9):3856-66

Matsui Y, Nakano N, Shao D, Gao S, Luo W, Hong C, Zhai P, Holle E, Yu X, Yabuta N, Tao W, Wagner T, Nojima H, Sadoshima J. Lats2 is a negative regulator of myocyte size in the heart. Circ Res. 2008 Nov 21;103(11):1309-18

Ouillette P, Erba H, Kujawski L, Kaminski M, Shedden K, Malek SN. Integrated genomic profiling of chronic lymphocytic leukemia identifies subtypes of deletion 13q14. Cancer Res. 2008 Feb 15;68(4):1012-21

Zhang J, Smolen GA, Haber DA. Negative regulation of YAP by LATS1 underscores evolutionary conservation of the Drosophila Hippo pathway. Cancer Res. 2008 Apr 15;68(8):2789-94

Aylon Y, Yabuta N, Besserglick H, Buganim Y, Rotter V, Nojima H, Oren M. Silencing of the Lats2 tumor suppressor overrides a p53-dependent oncogenic stress checkpoint and enables mutant H-Ras-driven cell transformation. Oncogene. 2009 Dec 17;28(50):4469-79

Chen CH, Sun YH, Pei DS, Zhu ZY. Comparative expression of zebrafish lats1 and lats2 and their implication in gastrulation movements. Dev Dyn. 2009 Nov;238(11):2850-9

Hergovich A, Hemmings BA. Mammalian NDR/LATS protein kinases in hippo tumor suppressor signaling. Biofactors. 2009 Jul-Aug;35(4):338-45

Huang YF, Chang MD, Shieh SY. TTK/hMps1 mediates the p53-dependent postmitotic checkpoint by phosphorylating p53 at Thr18. Mol Cell Biol. 2009 Jun;29(11):2935-44

Lee KH, Goan YG, Hsiao M, Lee CH, Jian SH, Lin JT, Chen YL, Lu PJ. MicroRNA-373 (miR-373) post-transcriptionally regulates large tumor suppressor, homolog 2 (LATS2) and stimulates proliferation in human esophageal cancer. Exp Cell Res. 2009 Sep 10;315(15):2529-38

Steinmann K, Sandner A, Schagdarsurengin U, Dammann RH. Frequent promoter hypermethylation of tumor-related genes in head and neck squamous cell carcinoma. Oncol Rep. 2009 Dec;22(6):1519-26

Strazisar M, Mlakar V, Glavac D. LATS2 tumour specific mutations and down-regulation of the gene in non-small cell carcinoma. Lung Cancer. 2009 Jun;64(3):257-62

Strazisar M, Mlakar V, Glavac D. The expression of COX-2, hTERT, MDM2, LATS2 and S100A2 in different types of non-small cell lung cancer (NSCLC). Cell Mol Biol Lett. 2009;14(3):442-56

Zhang X, Milton CC, Humbert PO, Harvey KF. Transcriptional output of the Salvador/warts/hippo pathway is controlled in distinct fashions in Drosophila melanogaster and mammalian cell lines. Cancer Res. 2009 Aug 1;69(15):6033-41

Zhao B, Lei Q, Guan KL. Mst out and HCC in. Cancer Cell. 2009 Nov 6;16(5):363-4

Chow A, Hao Y, Yang X. Molecular characterization of human homologs of yeast MOB1. Int J Cancer. 2010 May 1;126(9):2079-89

Visser S, Yang X. Identification of LATS transcriptional targets in HeLa cells using whole human genome oligonucleotide microarray. Gene. 2010 Jan 1;449(1-2):22-9

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