Atlas of Genetics and Cytogenetics in Oncology and Haematology

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# Gene Section
## Mini Review

# RUVBL1 (RuvB-like 1 (E. coli))

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## Identity

**Other names**: ECP54; INO80H; NMP238; PONTIN; Pontin52; RVB1; TAP54-alpha; TIH1; TIP49; TIP49A

**HGNC (Hugo):** RUVBL1

**Location:** 3q21.3

## DNA/RNA

### Description

11 exons spamming 42840bp, 1371bp open reading frame.

### Transcription

1785bp mRNA.

## Protein

### Description

456 amino acids, 50.2 kDa. RUVBL1 belongs to the AAA+ ATPase superfamily (ATPases associa-ted with diverse cellular activities) sharing conserved Walker A and B motifs, arginine fingers, and sensor domains.
The structure of RuvBL1 has been determined by X-ray crystallography and published in 2006 (Matias et al., 2006).

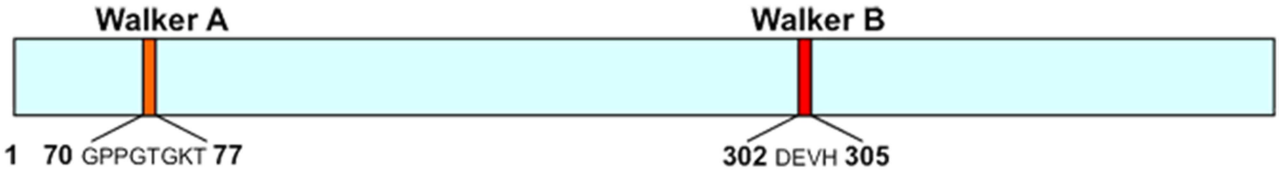
The monomers contain three domains, of which the first and the third are involved in ATP binding and hydrolysis. The second domain is a DNA/RNA-binding domain as demonstrated by structural homology and nucleic acid binding assays. RUVBL1 assembles into an hexameric structure with a central channel. Pure RUVBL1 displays a marginal ATPase activity in vitro and no detectable helicase activity (Matias et al., 2006). RUVBL1 interacts with RUVBL2 to form a dodecamer (Puri et al., 2007). This RUVBL1/ RUVBL2 complex displays a significant ATPase activity and is likely one of the functional forms of the proteins.
Sumoylation of RUVBL1 was reported in metastatic prostate cancer cells (Kim et al., 2007).

### Expression

Expression is ubiquitous but especially abundant in heart, skeletal muscle and testis (Salzer et al., 1999).
RUVBL1 is overexpressed in several tumors : liver (Li et al., 2005), colon (Carlson et al., 2003; Lauscher et al., 2007), lymphoma (Nishiu et al., 2002), non-small cell lung (Dehan et al., 2007). Overexpressions of RUVBL1 in a large number of cancers and its possible role in human cancers have been reported (reviewed in Huber et al., 2008).

### Localisation

Cytoplasm and nucleus.



### Function

RUVBL1 plays roles in essential signaling path-ways such as the c-Myc and beta-catenin pathways. RUVBL1 appears notably required for the trans-forming activity of c-myc (Wood et al., 2000), beta-catenin (Feng et al., 2003) and of the viral oncoprotein E1A (Dugan et al., 2002).
RUVBL1 participates in the remodelling of chromatin as a member of several complexes such as TRRAP, several distinct HAT complexes and BAF53 (Wood et al., 2000; Park et al., 2002; Feng et al., 2003).
It is also involved in transcriptional regulation (reviewed in Gallant, 2007), DNA repair (Gospodinov et al., 2008), snoRNP biogenesis (Watkins et al., 2002), and telomerase activity (Venteicher et al., 2008).
RUVBL1 has a mitosis-specific function in regulating microtubule assembly (Ducat et al., 2008).
RUVBL1 has been found expressed on the cell surface where it participates in the activation of plasminogen (Hawley et al., 2001).

## Implicated in

### Colon cancer

**Disease**

By immunohistochemistry, RUVBL1 expression was found higher in 22 out of 26 cases where information was available (Lauscher et al., 2007). The staining was increased at the invasive margin of the tumors. Increased RUVBL1 transcripts levels were also reported in a smaller series (Carlson et al., 2003).

### Large B cell lymphoma

**Disease**

Microarray analysis has identified an over-expression of RUVBL1 in Advanced lymphomas as compared with localized lymphomas (Nishiu et al., 2002).

### Non Small cell lung cancer

**Disease**

Microarray analysis and subsequent RT-PCR have shown an overexpression of RUVBL1 in NSCLC (Dehan et al., 2007).

**Cytogenetics**

There is a frequent amplification of 3q21 in the same samples (Dehan et al., 2007).

### Hepatocellular carcinoma

**Disease**

Proteomic analysis found an overexpression of RUVBL1 in 4 out of 10 cases (Li et al., 2005).

### Autoimmune diseases

**Disease**

Auto-antibodies to RUVBL1 were found in the serum of patients with polymyositis/dermato-myositis and autoimmune hepatitis (Makino et al., 1998).

## References

Makino Y, Mimori T, Koike C, Kanemaki M, Kurokawa Y, Inoue S, Kishimoto T, Tamura T. TIP49, homologous to the bacterial DNA helicase RuvB, acts as an autoantigen in human. Biochem Biophys Res Commun. 1998 Apr 28;245(3):819-23

Salzer U, Kubicek M, Prohaska R. Isolation, molecular characterization, and tissue-specific expression of ECP-51 and ECP-54 (TIP49), two homologous, interacting erythroid cytosolic proteins. Biochim Biophys Acta. 1999 Sep 3;1446(3):365-70

Wood MA, McMahon SB, Cole MD. An ATPase/helicase complex is an essential cofactor for oncogenic transformation by c-Myc. Mol Cell. 2000 Feb;5(2):321-30

Hawley SB, Tamura T, Miles LA. Purification, cloning, and characterization of a profibrinolytic plasminogen-binding protein, TIP49a. J Biol Chem. 2001 Jan 5;276(1):179-86

Dugan KA, Wood MA, Cole MD. TIP49, but not TRRAP, modulates c-Myc and E2F1 dependent apoptosis. Oncogene. 2002 Aug 29;21(38):5835-43

Nishiu M, Yanagawa R, Nakatsuka S, Yao M, Tsunoda T, Nakamura Y, Aozasa K. Microarray analysis of gene-expression profiles in diffuse large B-cell lymphoma: identification of genes related to disease progression. Jpn J Cancer Res. 2002 Aug;93(8):894-901

Park J, Wood MA, Cole MD. BAF53 forms distinct nuclear complexes and functions as a critical c-Myc-interacting nuclear cofactor for oncogenic transformation. Mol Cell Biol. 2002 Mar;22(5):1307-16

Watkins NJ, Dickmanns A, Lührmann R. Conserved stem II of the box C/D motif is essential for nucleolar localization and is required, along with the 15.5K protein, for the hierarchical assembly of the box C/D snoRNP. Mol Cell Biol. 2002 Dec;22(23):8342-52

Carlson ML, Wilson ET, Prescott SM. Regulation of COX-2 transcription in a colon cancer cell line by Pontin52/TIP49a. Mol Cancer. 2003 Dec 15;2:42

Feng Y, Lee N, Fearon ER. TIP49 regulates beta-catenin-mediated neoplastic transformation and T-cell factor target gene induction via effects on chromatin remodeling. Cancer Res. 2003 Dec 15;63(24):8726-34

Li C, Tan YX, Zhou H, Ding SJ, Li SJ, Ma DJ, Man XB, Hong Y, Zhang L, Li L, Xia QC, Wu JR, Wang HY, Zeng R. Proteomic analysis of hepatitis B virus-associated hepatocellular carcinoma: Identification of potential tumor markers. Proteomics. 2005 Mar;5(4):1125-39

Matias PM, Gorynia S, Donner P, Carrondo MA. Crystal structure of the human AAA+ protein RuvBL1. J Biol Chem. 2006 Dec 15;281(50):38918-29

Dehan E, Ben-Dor A, Liao W, Lipson D, Frimer H, Rienstein S, Simansky D, Krupsky M, Yaron P, Friedman E, Rechavi G, Perlman M, Aviram-Goldring A, Izraeli S, Bittner M, Yakhini Z, Kaminski N. Chromosomal aberrations and gene expression profiles in non-small cell lung cancer. Lung Cancer. 2007 May;56(2):175-84

Gallant P. Control of transcription by Pontin and Reptin. Trends Cell Biol. 2007 Apr;17(4):187-92

Kim JH, Lee JM, Nam HJ, Choi HJ, Yang JW, Lee JS, Kim MH, Kim SI, Chung CH, Kim KI, Baek SH. SUMOylation of pontin chromatin-remodeling complex reveals a signal integration code in prostate cancer cells. Proc Natl Acad Sci U S A. 2007 Dec 26;104(52):20793-8

Lauscher JC, Loddenkemper C, Kosel L, Gröne J, Buhr HJ, Huber O. Increased pontin expression in human colorectal cancer tissue. Hum Pathol. 2007 Jul;38(7):978-85

Puri T, Wendler P, Sigala B, Saibil H, Tsaneva IR. Dodecameric structure and ATPase activity of the human TIP48/TIP49 complex. J Mol Biol. 2007 Feb 9;366(1):179-92

Ducat D, Kawaguchi S, Liu H, Yates JR 3rd, Zheng Y. Regulation of microtubule assembly and organization in mitosis by the AAA+ ATPase Pontin. Mol Biol Cell. 2008 Jul;19(7):3097-110

Huber O, Ménard L, Haurie V, Nicou A, Taras D, Rosenbaum J. Pontin and reptin, two related ATPases with multiple roles in cancer. Cancer Res. 2008 Sep 1;68(17):6873-6

Venteicher AS, Meng Z, Mason PJ, Veenstra TD, Artandi SE. Identification of ATPases pontin and reptin as telomerase components essential for holoenzyme assembly. Cell. 2008 Mar 21;132(6):945-57

Gospodinov A, Tsaneva I, Anachkova B. RAD51 foci formation in response to DNA damage is modulated by TIP49. Int J Biochem Cell Biol. 2009 Apr;41(4):925-33

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