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Invasiveness and anchorage independent growth ability augmented by PTEN inactivation through the PI3K/AKT/NFkB pathway in lung cancer cells

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Abstract

PTEN is inactivated in a subset of lung cancer; therefore, we investigated the involvement of PTEN inactivation in invasiveness of lung cancer cells. AKT at Ser473 was phosphorylated in several lung cancer cell lines with loss of PTEN expression. Therefore, we created a tetracycline inducible expression system of wild-type PTEN (PTEN-WT) as well as catalytically (PTEN-G129R) and lipid phosphatase (PTEN-G129E) inactive PTEN mutants using the PC14, PC9 and PC3 lung adenocarcinoma cell lines, in which endogenous PTEN expression was not detected and AKT at Ser473 was phosphorylated by Western blot analysis. Induction of PTEN-WT reduced phosphorylation of AKT and inhibited the transcriptional activity of NFkB, whereas PTEN mutants did not, suggesting that PTEN inactivation results in the activation of the AKT/NFkB pathway in PC14, PC9 and PC3 cells. Furthermore, overexpression of PTEN-WT suppressed anchorage independent growth in soft agar and reduced invasiveness in a trans-well chamber assay of PC14 cells. Neither PTEN-G129R nor PTEN-G129E had suppressive effects on anchorage independent growth and invasiveness. Augmentation of invasiveness by constitutively active AKT was also shown in mouse NIH3T3 cells. Therefore, it was strongly indicated that activation of the PI3K/AKT/NFkB pathway by PTEN inactivation results in augmented invasiveness in lung cancer cells and lipid phosphatase activity of PTEN plays a key role in this process.

Keywords

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References

1.
 - Wang S.I.
 - Puc J.
 - Li J.
 - Bruce J.N.
 - Cairns P.
 - Sidransky D.

Somatic mutations of PTEN in glioblastoma multiforme.
Cancer Res. 1997; 19: 4183-4186
[View in Article](#)
 - [Google Scholar](#)
2.
 - Guldberg P.
 - Thor Straten P.
 - Birck A.
 - Ahrenkiel V.
 - Kirklin A.F.
 - Zeuthen J.

Disruption of the MMAC1/PTEN gene by deletion or mutation is a frequent event in malignant melanoma.
Cancer Res. 1997; 17: 3660-3663
[View in Article](#)
 - [Google Scholar](#)
3.
 - Cairns P.
 - Okami K.
 - Halachmi S.
 - Halachmi N.
 - Esteller M.
 - Herman J.G.

Frequent inactivation of PTEN/MMAC1 in primary prostate cancer.
Cancer Res. 1997; 22: 4997-5000
[View in Article](#)

- [Google Scholar](#)
- 4. ○ Rhei E.
- Kang L.
- Bogomolniy F.
- Federici M.G.
- Borgen P.I.
- Boyd J.

Mutation analysis of the putative tumor suppressor gene PTEN/MMAC1 in primary breast carcinomas.

Cancer Res. 1997; 17: 3657-3659

[View in Article](#)

- [Google Scholar](#)

- 5. ○ Kohno T.
- Takahashi M.
- Manda R.
- Yokota J.

Inactivation of the PTEN/MMAC1/TEP1 gene in human lung cancers.

Genes Chromosome Cancer. 1998; 22: 152-156

[View in Article](#)

- [Scopus \(143\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

- 6. ○ Tashiro H.
- Blazes M.S.
- Wu R.
- Cho K.R.
- Bose S.
- Wang S.I.
- et al.

Mutations in PTEN are frequent in endometrial carcinoma but rare in other common gynecological malignancies.

Cancer Res. 1997; 18: 3935-3940

[View in Article](#)

- [Google Scholar](#)

- 7. ○ Liaw D.
- Marsh D.J.
- Li J.
- Dahia P.L.
- Wang S.I.
- Zheng Z.
- et al.

Germline mutations of the PTEN gene in Cowden disease, an inherited breast and thyroid cancer syndrome.

Nat Genet. 1997; 11: 64-67

[View in Article](#)

- [Scopus \(1645\)](#)
- [Crossref](#)
- [Google Scholar](#)

- 8. ○ Marsh D.J.
- Dahia P.L.
- Zheng Z.
- Liaw D.
- Parsons R.
- Gorlin R.J.
- et al.

Germline mutations in PTEN are present in Bannayan-Zonana syndrome.

Nat Genet. 1997; 4: 333-334

[View in Article](#)

- [Scopus \(566\)](#)
- [Crossref](#)
- [Google Scholar](#)

9. ○ Pilarski R.
○ Eng C.

will the real Cowden syndrome please stand up (again?) expanding mutational and clinical spectra of the PTEN hemartoma tumor syndrome.

J Med Genet. 2004; 41: 323-326

[View in Article](#)

- [Scopus \(250\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

10. ○ Di Cristofano A.
○ Pesce B.
○ Cordon-Cardo C.
○ Pandolfi P.P.

Pten is essential for embryonic development and tumour suppression.

Nat Genet. 1998; 19: 348-355

[View in Article](#)

- [Scopus \(1270\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

11. ○ Suzuki A.
○ de la Pompa J.L.
○ Stambolic V.
○ Elia A.J.
○ Sasaki T.
○ del Barco Barrantes I.
○ et al.

High cancer susceptibility and embryonic lethality associated with mutation of the PTEN tumor suppressor gene in mice.

Curr Biol. 1998; 22: 1169-1178

[View in Article](#)

- [Scopus \(686\)](#)
- [Abstract](#)
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12. ○ Li J.
○ Yen C.
○ Liaw D.
○ Podsypanina K.
○ Bose S.
○ Wang S.I.
○ et al.

PTEN a putative protein tyrosine phosphatase gene mutated in human brain, breast and prostate cancer.

Science. 1997; 275: 1943-1947

[View in Article](#)

- [Scopus \(4141\)](#)
- [PubMed](#)
- [Crossref](#)
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13.
 - Steck P.A.
 - Pershouse M.A.
 - Jasser S.A.
 - Yung W.K.
 - Lin H.
 - Ligon A.H.
 - et al.
- Identification of a candidate tumor suppressor gene MMAC1, at chromosome 10q23.3 that is mutated in multiple advanced cancers.
- Natl Genet.* 1997; 15: 356-362
- [View in Article](#)
- [Scopus \(2469\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
14.
 - Li D.M.
 - Sun H.
- TEP1, encoded by a candidate tumor suppressor locus, is a novel protein tyrosine phosphatase regulated by transforming growth factor beta.
- Cancer Res.* 1997; 11: 2124-2129
- [View in Article](#)
- [Google Scholar](#)
15.
 - Maehama T.
 - Dixon J.E.
- The tumor suppressor PTEN/MMAC1 dephosphorylates the lipid secondary messenger, phosphatidylinositol 3,4,5-triphosphate.
- J Biol Chem.* 1998; 273: 13375-13378
- [View in Article](#)
- [Scopus \(2517\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
16.
 - Auger K.R.
 - Serunian L.A.
 - Soltoff S.P.
 - Libby P.
 - Cantley L.C.
- PDGF dependent tyrosine phosphorylation stimulates production of novel polyphosphoinositides in intact cells.
- Cell.* 1989; 57: 167-175
- [View in Article](#)
- [Scopus \(664\)](#)
 - [PubMed](#)
 - [Abstract](#)
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17.
 - Myers M.P.
 - Pass I.
 - Batty I.H.
 - Van der Kaay J.
 - Stolarov J.P.
 - Hemmings B.A.
 - et al.
- The lipid phosphatase activity of PTEN is critical for its tumor suppressor function.
- Proc Natl Acad Sci U S A.* 1998; 95: 13513-13518
- [View in Article](#)
- [Scopus \(976\)](#)

- [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
- 18. ○ Haas-Kogan D.
 - Shalev N.
 - Wong M.
 - Mills G.
 - Yount G.
 - Stokoe D.

Protein kinase B (PKB/Akt) activity is elevated in glioblastoma cells due to mutation of the tumor suppressor PTEN.

Curr Biol. 1998; 8: 1195-1198

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 - [PubMed](#)
 - [Abstract](#)
 - [Full Text](#)
 - [Full Text PDF](#)
 - [Google Scholar](#)
- 19. ○ Dudek H.
 - Datta S.R.
 - Franke T.F.
 - Birnbaum M.J.
 - Yao R.
 - Cooper G.M.
 - et al.

Regulation of neuronal survival by the serine-threonine protein kinase Akt.

Science. 1997; 275: 661-665

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 - [Scopus \(2195\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
- 20. ○ Datta S.R.
 - Dudek H.
 - Tao H.
 - Masters S.
 - Fu H.
 - Gotoh Y.
 - et al.

Akt phosphorylation of BAD couples survival signals to the cell-intrinsic death machinery.

Cell. 1997; 2: 231-241

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 - [Scopus \(4864\)](#)
 - [Abstract](#)
 - [Full Text](#)
 - [Full Text PDF](#)
 - [Google Scholar](#)
- 21. ○ Dan H.C.
 - Baldwin A.S.

Differential involvement of IkappaB kinases alpha and beta in cytokine- and insulin-induced mammalian target of rapamycin activation determined by Akt.

J Immunol. 2008; 11: 7582-7589

[View in Article](#)

 - [Scopus \(60\)](#)
 - [Crossref](#)
 - [Google Scholar](#)
- 22. ○ Downward J.

Ras signaling and apoptosis.

Curr Opin Genet Dev. 1998; 8: 49-54

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- [Scopus \(501\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

23. ○ Ahmed N.N.
○ Grimes H.L.
○ Bellacosa A.
○ Chan T.O.
○ Tsichlis P.N.

Transduction of interleukin-2 antiapoptotic and proliferative signals via AKT protein kinase.

Proc Natl Acad Sci U S A. 1997; 94: 3627-3632

[View in Article](#)

- [Scopus \(486\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

24. ○ Datta K.
○ Franke T.F.
○ Chan T.O.
○ Makris A.
○ Yang S.I.
○ Kaplan D.R.
○ et al.

AH/PH domain mediated interaction between AKT molecules and its potential role in AKT regulation.

Mol Cell Biol. 1995; 15: 2304-2310

[View in Article](#)

- [Scopus \(156\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

25. ○ Brunet A.
○ Bonni A.
○ Zigmond M.J.
○ Lin M.Z.
○ Juo P.
○ Hu L.S.

AKT promotes cell survival by phosphorylating and inhibiting a forkhead transcription factor.

Cell. 1999; 98: 857-868

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- [Scopus \(5236\)](#)
- [Abstract](#)
- [Full Text](#)
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26. ○ Kennedy S.G.
○ Kandel E.S.
○ Cross T.K.
○ Hay N.

Akt/Protein kinase B inhibits cell death by preventing the release of cytochrome c from mitochondria.

Mol Cell Biol. 1999; 19: 5800-5810

[View in Article](#)

- [Scopus \(576\)](#)

- [PubMed](#)
 - [Crossref](#)
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27. ○ Brodt P.
○ Samani A.
○ Navab R.
Inhibition of the type I insulin-like growth factor receptor expression and signaling: novel strategies for antimetastatic therapy.
Biochem Pharmacol. 2000; 60: 1101-1107
[View in Article](#)
 - [Scopus \(93\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
28. ○ Vivanco I.
○ Sawyers C.L.
The phosphatidylinositol 3-kinase AKT pathway in human cancer.
Nat Rev Cancer. 2002; 2: 489-501
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 - [Scopus \(4974\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
29. ○ Jiang B.H.
○ Jiang G.
○ Zheng J.Z.
○ Lu Z.
○ Hunter T.
○ Vogt P.K.
Phosphatidylinositol 3-kinase signaling controls levels of hypoxia-inducible factor 1.
Cell Growth Differ. 2001; 12: 363-369
[View in Article](#)
 - [PubMed](#)
 - [Google Scholar](#)
30. ○ Ferlay J.
○ Shin H.R.
○ Bray F.
○ Forman D.
○ Mathers C.
○ Parkin D.M.
Estimates of worldwide burden of cancer in 2008. GLOBOCAN 2008.
Int J Cancer. June 17, 2010; (17 [Epub ahead of print])
[View in Article](#)
 - [Google Scholar](#)
31. ○ Nalate R.B.
○ Zaretsky S.L.
ZD1839 (Iressa): what's in it for the patients.
Oncologist. 2002; 7: 25-30
[View in Article](#)
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 - [Google Scholar](#)
32. ○ Woodhouse E.C.
○ Chuaqui R.F.
○ Liotta L.A.
General mechanisms of metastasis.
Cancer. 1997; 80: 1529-1537
[View in Article](#)

- [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
- 33. ○ Myers M.P.
○ Stolarov J.P.
○ Eng C.
○ Li J.
○ Wang S.I.
○ Wigler M.H.
○ et al.
PTEN, the tumor suppressor from human chromosome 10q23, is a dual-specificity phosphatase.
Proc Natl Acad Sci U S A. 1997; 94: 9052-9057
[View in Article](#)
 - [Scopus \(716\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
- 34. ○ Blaskovich M.A.
○ Lin Q.
○ Delarue F.L.
○ Sun J.
○ Park H.S.
○ Coppola D.
○ et al.
A platelet-derived growth factor binding molecule with antiangiogenic and anticancer activity against human tumors in mice.
Nat Biotechnol. 2000; 18: 1065-1070
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 - [Scopus \(129\)](#)
 - [PubMed](#)
 - [Crossref](#)
 - [Google Scholar](#)
- 35. ○ Roy B.C.
○ Kohno T.
○ Iwakawa R.
○ Moriguchi T.
○ Kiyono T.
○ Morishita K.
○ et al.
Involvement of LKB1 in epithelial-mesenchymal transition (EMT) of human lung cancer cells.
Lung Cancer. 2010; 70: 136-145
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 - [PubMed](#)
 - [Abstract](#)
 - [Full Text](#)
 - [Full Text PDF](#)
 - [Google Scholar](#)
- 36. ○ Soria J.C.
○ Lee H.Y.
○ Lee J.I.
○ Wang L.
○ Issa J.P.
○ Kemp B.L.
○ et al.
Lack of PTEN expression in non-small cell lung cancer could be related to promoter methylation.
Clin Cancer Res. 2002 May; 8: 1178-1184

[View in Article](#)

- [PubMed](#)
- [Google Scholar](#)

37. ○ Noro R.
○ Gemma A.
○ Miyanaga A.
○ Kosaihira S.
○ Minegishi Y.
○ Nara M.

PTEN inactivation in lung cancer cells and the effect of its recovery on treatment with epidermal growth factor receptor tyrosine kinase inhibitors.

Int J Oncol. 2007; 31: 1157-1163

[View in Article](#)

- [PubMed](#)
- [Google Scholar](#)

38. ○ Ozes O.N.
○ Akca H.
○ Mayo L.D.
○ Gustin J.A.
○ Maehama T.
○ Dixon J.E.
○ et al.

Phosphatidylinositol 3-kinase/AKT/mTOR pathway mediates and PTEN antagonizes tumor necrosis factor inhibition of insulin signaling through insulin receptor substrate-1.

Proc Natl Acad Sci U S A. 2001; 98: 4640-4645

[View in Article](#)

- [Scopus \(318\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

39. ○ Greenlee R.T.
○ Hill-Harmon M.B.
○ Murray T.
○ Thun M.

Cancer statistics.

CA Cancer J Clin. 2001; 51: 16-36

[View in Article](#)

- [Scopus \(3287\)](#)
- [Crossref](#)
- [Google Scholar](#)

40. ○ Tang J.M.
○ He Q.Y.
○ Guo R.X.
○ Chang X.J.

Phosphorylated AKT overexpression and loss of PTEN expression in non-small lung cancer confers poor prognosis.

Lung Cancer. 2006; 51: 181-191

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- [Scopus \(312\)](#)
- [PubMed](#)
- [Abstract](#)
- [Full Text](#)
- [Full Text PDF](#)
- [Google Scholar](#)

41. ○ Marsit C.J.
○ Zheng S.
○ Aldape K.

- Hinds P.W.
- Nelson H.H.
- Wiencke J.K.
- et al.

PTEN expression in non-small-cell lung cancer: evaluating its relation to tumor characteristics allelic loss, and epigenetic alteration.

Human Pathol. 2005; 36: 768-776

[View in Article](#)

- [Scopus \(212\)](#)
- [PubMed](#)
- [Abstract](#)
- [Full Text](#)
- [Full Text PDF](#)
- [Google Scholar](#)

42. ○ Akca H.
○ Tani M.
○ Hishida T.
○ Matsumoto S.
○ Yokota J.

Activation of the AKT and STAT3 pathways and prolonged survival by a mutant EGFR in human lung cancer cells.

Lung Cancer. 2006; 54: 25-33

[View in Article](#)

- [Scopus \(41\)](#)
- [PubMed](#)
- [Abstract](#)
- [Full Text](#)
- [Full Text PDF](#)
- [Google Scholar](#)

43. ○ Furnari F.B.
○ Lin H.
○ Huang H.S.
○ Cavenee W.K.

Growth suppression of glioma cells by PTEN requires a functional phosphatase catalytic domain.

Proc Natl Acad Sci U S A. 1997; 94: 12479-12484

[View in Article](#)

- [Scopus \(379\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

44. ○ Nakanishi K.
○ Sakamoto M.
○ Yasuda J.
○ Takamura M.
○ Fujita N.
○ Tsuruo T.
○ et al.

Critical involvement of the phosphatidylinositol 3-kinase/Akt pathway in anchorage-independent growth and hematogeneous intrahepatic metastasis of liver cancer.

Cancer Res. 2002; 10: 2971-2975

[View in Article](#)

- [Google Scholar](#)
- Lobo G.P.
○ Waite K.A.
○ Planchon S.M.
○ Romigh T.
○ Nassif N.T.

- Eng C.

Germline and somatic cancer-associated mutations in the ATP-binding motifs of PTEN influence its subcellular localization and tumor suppressive function.

Hum Mol Genet. 2009; 15: 2851-2862

[View in Article](#)

- [Scopus \(36\)](#)
- [Crossref](#)
- [Google Scholar](#)

46. ◦ Heering J.

◦ Erlmann P.

◦ Olayioye M.A.

Simultaneous loss of the DLC1 and PTEN tumor suppressors enhances breast cancer cell migration.

Exp Cell Res. 2009; 315: 2505-2514

[View in Article](#)

- [Scopus \(34\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

47. ◦ Maier D.

◦ Jones G.

◦ Li X.

◦ Schönthal A.H.

◦ Gratzl O.

◦ Van Meir E.G.

◦ et al.

The PTEN lipid phosphatase domain is not required to inhibit invasion of glioma cells.

Cancer Res. 1999; 59: 5479-5482

[View in Article](#)

- [PubMed](#)
- [Google Scholar](#)

48. ◦ Bowen K.A.

◦ Doan H.Q.

◦ Zhou B.P.

◦ Wang Q.

◦ Zhou Y.

◦ Rychahou P.G.

◦ et al.

PTEN loss induces epithelial–mesenchymal transition in human colon cancer cells.

Anticancer Res. 2009; 11: 4439-4449

[View in Article](#)

- [Google Scholar](#)

49. ◦ Shukla S.

◦ MacLennan G.T.

◦ Hartman D.J.

◦ Fu P.

◦ Resnick M.I.

◦ Gupta S.

Activation of PI3K-Akt signaling pathway promotes prostate cancer cell invasion.

Int J Cancer. 2007; 121: 1424-1432

[View in Article](#)

- [Scopus \(252\)](#)
- [PubMed](#)
- [Crossref](#)
- [Google Scholar](#)

50. ◦ Zhang J.G.

◦ Wang J.J.

◦ Zhao F.

- Liu Q.
- Jiang K.
- Yang G.H.

MicroRNA-21 represses tumor suppressor PTEN and promotes growth and invasion in non-small cell lung cancer (NSCLC).

Clin Chim Acta. 2010; 411: 846-852

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- [Scopus \(452\)](#)
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