

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- | | | |
|-------------------------------------|-------------------------------------|--|
| ☐ | ☒ | The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ | A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ | The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☒ | ☐ | A description of all covariates tested |
| ☐ | ☒ | A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ | A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ | For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ | For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☒ | ☐ | For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☐ | ☒ | Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection

Transmission electron microscope (TEM) : JEM-1400 PLUS TEM; Malvern: Zetasizer software 7.01; Microplate reader: SkanIt 2.4.3.37; Confocal laser scanning microscopy: Zeiss LSM 880 with AiryScan ZEN 2.3 SP1 black edition; Flow Cytometer: BD LSR Fortessa analyzers; Photothermal imaging: Fotric 226 thermal imaging system; IVIS® Spectrum In Vivo Imaging System: IVIS Lumina Series III

Data analysis

NUPACK cloud web app; GraphPad prism 9.0; Flowjo_V10;

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

The authors declare that all the data supporting the findings of this study are available within the Article, Supplementary Information or Source Data file. The source data generated in this study have been deposited in the Figshare database at: https://figshare.com/articles/dataset/Source_Data_xlsx/24271477. Source data are provided with this paper.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	not applicable
Reporting on race, ethnicity, or other socially relevant groupings	not applicable
Population characteristics	not applicable
Recruitment	not applicable
Ethics oversight	not applicable

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	No statistical method was used to predetermine sample size. For in vitro experiments, we opted for 3 independent replications to strike a balance between cost-effectiveness and obtaining a distribution closer to the true one. However, when conducting in vivo antitumor studies, each group included 4 individuals to assess statistical significance. The specific 'n' values for each figure are provided in the figure legends. Due to the low variability observed between samples, we considered this to be sufficient.
Data exclusions	No data was excluded from studies.
Replication	We confirmed that all repeated attempts were successful. Experiment repeat numbers are reported in Figure Legends.
Randomization	Samples were randomly allocated into experimental groups.
Blinding	The investigators were blinded to group allocation during data collection and analysis.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☐	☒ Antibodies
☐	☒ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☐	☒ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☐	☒ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	The following antibodies were used for western blot. They are listed as antigen first, followed by supplier, catalog number 1) Anti-mouse PTEN antibody, Abcam, ab267787, 1: 1000 dilution; 2) Anti-mouse HSP70 Antibody, Cell Signaling Technology, #4872, 1: 1000 dilution; 3) Anti-Rabbit GAPDH, Abcam, cat. no. ab210113, 1: 1000 dilution; 4) Anti-mouse Anti-Cytochrome C, Abcam, ab13575, 1: 1000 dilution; 5) Anti-mouse Anti-beta Actin antibody [mAbcam 8226] Abcam ab8226, 1: 1000 dilution; 6) Anti-rabbit Anti-pro Caspase-3, Abcam, ab32150, 1: 1000 dilution; 7) Anti-rabbit Anti-Cleaved Caspase-3 Abcam, ab32042 1: 1000 dilution; 8) ATPase Monoclonal Antibody, thermofisher, (Catalog # MA3-914) 1:5,000 dilution;
Validation	The species and application of the following antibodies used for western blot were validated by the manufacturer. 1) Anti-mouse PTEN antibody https://www.abcam.com/en-fi/search?sorting=relevance&keywords=PTEN&productcode=AB267787&view=quickview 2) Anti-mouse HSP70 Antibody #4872, https://www.cellsignal.com/products/primary-antibodies/hsp70-antibody/4872 3) Anti-Rabbit GAPDH https://www.abcam.com/en-fi/search?sorting=relevance&keywords=GAPDH&productcode=AB210113&view=quickview 4) Anti-mouse Anti-Cytochrome C https://www.abcam.cn/products/primary-antibodies/cytochrome-c-antibody-7h82c12-ab13575.html 5) Anti-mouse Anti-beta Actin antibody https://www.abcam.cn/products/primary-antibodies/beta-actin-antibody-mabcam-8226-loading-control-ab8226.html 6) Anti-rabbit Anti-pro Caspase-3 https://www.abcam.cn/products/primary-antibodies/pro-caspase-3-antibody-e61-ab32150.html 7) Anti-rabbit Anti-Cleaved Caspase-3 https://www.abcam.cn/products/primary-antibodies/cleaved-caspase-3-antibody-e83-77-ab32042.html 8) ATPase Monoclonal Antibody https://www.thermofisher.com/antibody/product/MA3-914.html?gclid=CjwKCAjwyY6pBhA9EiwAMzmfwfFzVQMgBN5-9OrBXP7VLgWMR0dkzgJxYPa44DuP9lahnrnxjKYQnBoCk6UQAvD_BwE&ef_id=CjwKCAjwyY6pBhA9EiwAMzmfwfFzVQMgBN5-9OrBXP7VLgWMR0dkzgJxYPa44DuP9lahnrnxjKYQnBoCk6UQAvD_BwE:G:s&s_kwid=AL3652!31459736943987!!lg!!!10950825775!106531320406&cid=bid_pca_aup_r01_co_cp1359_pjt0000_bid00000_0se_gaw_dy_pur_con

Eukaryotic cell lines

Policy information about [cell lines and Sex and Gender in Research](#)

Cell line source(s)	Human pancreatic cancer cell line PANC-1 cells were purchased from ATCC® and normal human dermal fibroblasts NHDF cells were purchased from PromoCell®.
Authentication	The cell lines used were directly bought from ATCC® and PromoCell®. The cell lines were not authenticated.
Mycoplasma contamination	The cell line tested negative for mycoplasma contamination.
Commonly misidentified lines (See ICLAC register)	No commonly misidentified cell lines were used in the study.

Animals and other research organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research, and [Sex and Gender in Research](#)

Laboratory animals	BALBc-nu(6-8 weeks old) were supplied by the Animal Center of Hangzhou Medical College. The living environment of animals were maintained at a temperature of ~25 °C with a 12 h light/dark cycle, humidity at 50-60%, with free access to standard food and water.
Wild animals	The study did not involve wild animals.
Reporting on sex	To prevent mice from the same group from mating and producing offspring, only one sex (female) was chosen. However, we believe

that the research results were applicable to all sex.

Field-collected samples

The study did not involve samples collected from the field.

Ethics oversight

All the animal experiments were conducted according to the Guidelines for the Care and Use of Laboratory Animals approved by the Institutional Animal Care and Use Committee (IACUC) of Zhejiang Laboratory Animal Center. The animal experiments also follow the PREPARE Guidelines Checklist.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Flow Cytometry

Plots

Confirm that:

- ☒ The axis labels state the marker and fluorochrome used (e.g. CD4-FITC).
- ☒ The axis scales are clearly visible. Include numbers along axes only for bottom left plot of group (a 'group' is an analysis of identical markers).
- ☒ All plots are contour plots with outliers or pseudocolor plots.
- ☒ A numerical value for number of cells or percentage (with statistics) is provided.

Methodology

Sample preparation

The cells were fixed and pipetted evenly.

Instrument

BD LSR Fortessa analyzers

Software

Flowjo_V10

Cell population abundance

No sorting was performed.

Gating strategy

Generally, cells were first gated on FSC/SSC. Singlet cells were usually gated using FSC-H and FSC-A. Surface antigen gating was performed on the live cell population.

☐ Tick this box to confirm that a figure exemplifying the gating strategy is provided in the Supplementary Information.