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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 *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒ 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 *Give P values as exact values whenever suitable.*
☒	☐ 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	No software was used to collect the data
Data analysis	GraphPad 8.0, Image J V1.8.0.112

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 affirm that data underpinning the conclusions of this study are accessible within the article and its Supplementary Information files. Additionally, the sequencing results have been uploaded to Figshare, with the link: 10.6084/m9.figshare.27173397.

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	Sex and/or gender factors were not considered.
Reporting on race, ethnicity, or other socially relevant groupings	The study focused on esophageal cancer patients in Henan Province, China. Race, ethnicity, or other socially relevant groupings were not considered as factors influencing the research outcomes.
Population characteristics	All patients included in this study underwent radical resection for ESCC without receiving preoperative radiotherapy or chemotherapy. Postoperative tissue samples were pathologically confirmed as ESCC. Patient selection was conducted in strict accordance with predefined inclusion and exclusion criteria. The inclusion criteria were: 1) patients with significant differences in prognosis who underwent surgery between January 1, 2014, and December 31, 2017, and 2) patients diagnosed at stages I, II, or III of ESCC. The exclusion criteria were: 1) incomplete clinical data, 2) postoperative complications, 3) missing tissue samples, and 4) deaths unrelated to tumor progression.
Recruitment	Participants were recruited via the thoracic surgery department platform of the First Affiliated Hospital of Henan Medical University. Strict inclusion and exclusion criteria were applied to ensure the representativeness of the study population and mitigate potential self-selection bias.
Ethics oversight	Committees for Ethical Review of Research at The First Affiliated Hospital of Henan Medical University.

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

Life sciences study design

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

Sample size	G*Power 3.1.9.7 software was utilized for sample size calculation, with a significance level (α) of 0.05 and statistical power (1-β) set at 0.8. The required sample size was determined based on data from previous studies, along with the standard deviation and effect size derived from long-term ESCC model preparation.
Data exclusions	No data were excluded.
Replication	All attempts at replication were successful.
Randomization	Samples were randomly allocated into experimental groups using a computer-generated random number sequence.
Blinding	Investigators were blinded to group allocation during data collection by using coded labels for experimental groups.

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

In this study, we utilized a variety of antibodies for Western blot, Immunohistochemistry, and Immunofluorescence staining experiments. The specific information is as follows:
Antibodies for Western blot:
anti-ACC1 (1:1000, 4190, CST, Massachusetts, USA)
anti-H3K9ac (1:1000, 9649, CST, Massachusetts, USA)
anti-H3 (1:1000, 4499, CST, Massachusetts, USA)
anti-c-Fos (1:1000, 66590-1-Ig, Proteintech, Wuhan, China)
anti-CXCL8 (1:1000, 94407, CST, Massachusetts, USA)
anti-p-AKT (1:1000, 4060, CST, Massachusetts, USA)
anti-AKT (1:1000, 4691, CST, Massachusetts, USA)
anti-p-ERK1/2 (1:2000, 4370, CST, Massachusetts, USA)
anti-ERK1/2 (1:2000, 4695, CST, Massachusetts, USA)
anti-PAI-1 (1:1000, WL01486, Wanlei, Shenyang, China)
anti-Slug (1:2000, 9585, CST, Massachusetts, USA)
anti-Vimentin (1:1000, WL00742, Wanlei)
anti-E-cadherin (1:2000, 3195, CST, Massachusetts, USA)
anti-β-actin (1:2000, 4967, CST, Massachusetts, USA)
Antibodies for Immunohistochemistry:
anti-Ly6G (1:500, 87048, CST, Massachusetts, USA)
anti-Cit-H3 (1:1000, ab5103, Abcam, Cambridge, UK)
anti-MPO (1:1000, AF3667, R&D, Minnesota, USA)
anti-ACC1 (1:200, 4190S, CST, Massachusetts, USA)
Antibodies for Immunofluorescence staining:
anti-Cit-H3 (1:1000, ab5103, Abcam, Cambridge, UK)
anti-MPO (1:1000, AF3667, R&D, Minnesota, USA)
Alexa Fluor 594 (1:500, 150132, Abcam, Cambridge, UK)
Alexa Fluor 488 conjugated secondary antibodies (1:500, 150073, Abcam, Cambridge, UK)

Validation

Each primary antibody was validated for specificity and applicability in the corresponding species and experimental applications, in accordance with the manufacturer's instructions and established protocols. The specific validation methods are as follows:
Validation of Western blot antibodies:
All antibodies used for Western blot were validated via Western blot experiments to ensure specific recognition of the target protein, confirmed by the appearance of specific bands at the anticipated molecular weight.
Validation of Immunohistochemistry antibodies:
The anti-Ly6G, anti-Cit-H3, anti-MPO, and anti-ACC1 antibodies were validated for immunohistochemistry on paraffin sections, confirming good specificity and staining efficacy in tissue samples.
Validation of Immunofluorescence staining antibodies:
The anti-Cit-H3 and anti-MPO antibodies were validated for immunofluorescence staining on frozen sections, ensuring specific labeling of the target protein under fluorescence microscopy.
The Alexa Fluor 594 and Alexa Fluor 488 - conjugated secondary antibodies were optimized in preliminary experiments to ensure strong fluorescence signals and low background interference in immunofluorescence experiments.
Moreover, validation data for some antibodies can also be referenced from the manufacturer's website and relevant literature, further supporting their effectiveness and reliability in this study.

Eukaryotic cell lines

Policy information about cell lines and Sex and Gender in Research

Cell line source(s)

Human esophageal squamous cell carcinoma (ESCC) cell line KYSE-450 and KYSE-140 were obtained from Cobioer Bioscience (Nanjing, China), while ESCC cell line KYSE-150 and human embryonic renal cell line 293T were obtained from Cell Bank of the Typical Culture Preservation Committee of the Chinese Academy of Sciences (Shanghai, China).

Authentication

No commonly misidentified cell lines were used in this study. To ensure the authenticity and integrity of our cell lines, we conducted short tandem repeat (STR) profiling. The results of the STR profiling can be found in the Supplementary information, Supplementary Table 6.

Mycoplasma contamination	All cell lines used in the study tested negative for mycoplasma contamination using a PCR-based detection kit. Result of test for mycoplasma: Supplementary information, page 26, Supplementary figure 9
Commonly misidentified lines (See ICLAC register)	No commonly misidentified cell lines were used in this 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	This study used 6-week-old female BALB/c nude mice.
Wild animals	This study did not involve wild animals.
Reporting on sex	This information has not been collected due to the study's focus on a specific gender-neutral outcome.
Field-collected samples	The study did not involve samples collected from the field.
Ethics oversight	The experimental procedures were approved by the Institutional Research Ethics Committee of The First Affiliated Hospital of Henan Medical University

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

Plants

Seed stocks	n/a
Novel plant genotypes	n/a
Authentication	n/a