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Reporting Summary

Nature Research 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 Research policies, see Authors & Referees 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	The data that was used for analysis has been deposited to publicly accessible databases EGA and GEO. The plasma IL8 data for IMvigor210, IMvigor211 and IMmotion150 is included as the Supplementary Tables associated with this manuscript.
Data analysis	All computational software used for analysis in this manuscript as open source software. It is included in the Software versions section in Methods.

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/reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research 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 list of figures that have associated raw data
- A description of any restrictions on data availability

Raw data analyzed in this study has been submitted to the European Genome-Phenome Archive (EGA) with accession numbers EGAS00001004008, EGAS00001004229 and EGAS00001004230. Raw and processed count matrix of single cell RNAseq data has been submitted to Gene Expression Omnibus (GEO) with accession number GSE145281.

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	No sample size calculation was conducted. We just reported data available for patients from three trials. These patients all had with defined ORR (CR/PR/SD/PD), along with overall survival and progression free survival data. Not all patients have baseline and on-treatment plasma and TMB data, so numbers vary based on the biomarker evaluable populations. Our analyses were performed on samples from participants of a clinical trial with predetermined in- and exclusion criteria. We show in Extended Data Figure 1 that the biomarker evaluable population was equivalent in important covariates to the original intent-to-treat population. Grouping of samples in our analyses were based on objective phenotypes, such as response. We have analyzed over 1000 patients from two randomized clinical trials in mUC and mRCC and the analysis of biomarkers from such a large number of patients being analyzed provides a strong statistical basis of our results.
Data exclusions	Patients with undefined ORR or ORR defined as NE were excluded from analysis.
Replication	We replicated our findings in an independent cohort of mUC patients.
Randomization	In IMvigor210 Phase II trial, patients were treated with atezolizumab monotherapy. For IMvigor211 and IMmotion150,in which other arms were available, patients were randomized 1:1 to atezoizumab vs. alternative treatments.
Blinding	Patients/investigators were blinded to PD-L1 status of the patients in the trials.

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
☒	☐ Animals and other organisms
☐	☒ Human research participants
☐	☒ Clinical data

Methods

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

Human research participants

Policy information about studies involving human research participants

Population characteristics	Full description of the human research participants and the covariate-relevant population characteristics is detailed in the following publications: IMvigor210 trial cohorts: Rosenberg JE, et al. Lancet, 2016;387(10031):1909-1920. Balar AV, et al. Lancet, 2017;389(10064):67-76. IMvigor211 trial cohort: Powles T, et al, Lancet, 2017;392(10122): 748-757. IMmotion150 trial cohort: McDermott, D.F., et al. Nat Med, 2018;24(6), 749-757.
Recruitment	The recruitment of participants of the clinical trials was based on predetermined in- and exclusion criteria. Full description of the recruitment of participants of the clinical trials is detailed in the https://clinicaltrials.gov/ website and the corresponding publications.

IMvigor210 trial cohorts (NCT02951767, NCT02108652):

Rosenberg JE, et al. Lancet, 2016;387(10031):1909-1920.
Balar AV, et al. Lancet, 2017;389(10064):67-76.

IMvigor211 trial cohort (NCT02302807):
Powles T, et al, Lancet, 2017;392(10122): 748-757.

IMmotion150 trial cohort (NCT01984242):
McDermott, D.F., et al. Nat Med, 2018;24(6), 749-757.

Ethics oversight

The study was conducted with approval from appropriate research ethics committees, regulatory committees and host institutions of Hoffmann-La Roche/Genentech.

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

Clinical data

Policy information about clinical studies

All manuscripts should comply with the ICMJE guidelines for publication of clinical research and a completed CONSORT checklist must be included with all submissions.

Clinical trial registration

Data from three trials are presented in this manuscript. IMvigor210: NCT02108652; IMvigor211: NCT02302807; IMmotion150: NCT01984242

Study protocol

The studies have reported and the full protocols are available on clinicaltrials.gov

Data collection

The full description of the data collection is detailed in the https://clinicaltrials.gov/ website and the corresponding publications.

IMvigor210 trial cohorts (NCT02951767, NCT02108652):

Rosenberg JE, et al. Lancet, 2016;387(10031):1909-1920.
Balar AV, et al. Lancet, 2017;389(10064):67-76.

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IMmotion150 trial cohort (NCT01984242):
McDermott, D.F., et al. Nat Med, 2018;24(6), 749-757.

Outcomes

The full description of outcomes is detailed in the https://clinicaltrials.gov/ website. IMvigor210 trial cohorts (NCT02951767, NCT02108652), IMvigor211 trial cohort (NCT02302807) and IMmotion150 trial cohort (NCT01984242)