

Supplementary Materials and Methods

Antibodies and Reagents: anti-p300 (N-15) (sc-584; Santa Cruz Biotechnology, Dallas, TX), anti-fibronectin (610077; BD Biosciences, San Jose, VA), anti-SMAD2/3 (sc-133098; Santa Cruz Biotechnology), anti-SMAD2/3 (3102; Cell Signaling Technology, Danvers, MA), anti-SMAD2 (86F7) (3122; Cell Signaling Technology), anti-SMAD3 (c67H9) (9523; Cell Signaling Technology), anti- α -SMA (A5228; MilliporeSigma, Burlington, MA), anti- α -SMA (ab5694, Abcam, Cambridge, UK), anti-PDGFR- α (3170; Cell Signaling Technology), anti-HDAC2 (C-19) (sc-6296; Santa Cruz Biotechnology), anti-T β RII (K105) (3713; Cell Signaling Technology), anti-DYKDDDDK (FLAG tag) (2368; Cell Signaling Technology), anti-P-SMAD2 (3101; Cell Signaling Technology), anti-TAZ (560235; BD Biosciences), anti-YAP1 (4912; Cell Signaling Technology), anti- β -actin (A5441; MilliporeSigma), and anti-GAPDH (G8140; US Biological, Salem, MA), anti-tenascin C (sc-20932; Santa Cruz Biotechnology), anti-periostin (sc-67233; Santa Cruz Biotechnology), anti-CTGF (sc-14939; Santa Cruz Biotechnology), anti-E-cadherin (61081; BD Biosciences), anti-FLAG (M2) (F1804; MilliporeSigma), anti-FLAG (M2)-FITC (F4049; MilliporeSigma), anti-fibronectin (ab2413; Abcam), anti-HSC70 (sc-7298; Santa Cruz Biotechnology), anti-FGF-2(C-2) (sc-74412; Santa Cruz Biotechnology), anti-TAZ(D-8)-AF594 (sc-518026; Santa Cruz Biotechnology), and anti-SMAD2/3(C-8)-AF594 (sc-133098; Santa Cruz Biotechnology).

TGF β 1 was from R & D (240-B; R & D Systems, Inc. Minneapolis, MN). C646 was purchased from AdipoGen (AG-CR1-3508; AdipoGen Corporation, San Diego, CA).

FLAG-tagged TGF β receptor I (T β RI-FLAG) cDNA was inserted into the pMMP retroviral vector by standard subcloning procedures and confirmed by sequencing (1, 2). FLAG-tagged p300 wildtype cDNA was a gift from Dr. Makiko Fujii (3). P300 NLS-deletion mutant with amino acids

11-PSAKRPK-17 removed was generated using a Q5 Site-Directed Mutagenesis kit. Deletion of the NLS was confirmed by sequencing.

SiRNA and shRNA: YAP1 siRNA (SI00084567 and SI02662954), TAZ siRNA (SI00111216 and SI001112300) and control siRNA (SI03650318) were from Qiagen (Hilden Germany). P300 shRNA lentiviral constructs were from MISSION shRNA Library (NM_001429.1-7724s1c1, NM_001429.1-3602s1c1, and NM_001429.1-2773s1c1; MilliporeSigma). A construct encoding non-target shRNA (SHC202; MilliporeSigma) was used to package control lentiviruses.

Transfection of plasmid or siRNA and viral transduction of cells. Both FLAG-p300wt and FLAG-p300NLS-Del were transfected into LX2 cells by Effectene Transfection Reagent (301425; Qiagen), according to a manufacture-recommended protocol. Cells were collected 48-72 hours later for analyses. SiRNAs were transfected into HSCs by Oligofectamine Reagent (12252011; Thermo Fisher Scientific, Waltham, MA), and cells were collected at 72-96 hours later for experiments. Retroviruses or lentiviruses were generated by cotransfecting 293T cells with 2-3 plasmids by Effectene Transfection Reagent, as we have described (1, 2, 4, 5). Viral transduction of HSCs was done by incubating cells with viral supernatant (25% - 50%) containing polybrene (8 μ g/ml) overnight and cells were collected for experiments 72 hours later.

Immunofluorescence (IF) and microscopy: Cultured cells were fixed by 4% paraformaldehyde for 10 minutes followed by permeabilization by 0.2% Triton X-100 for 3 minutes before staining. For staining of murine tumor biopsies, tumors were first sectioned at 7 μ m using a Leica cryostat. After sections were dried at room temperature overnight, they were fixed by 4% paraformaldehyde

for 10 minutes. Subsequently, cells or sections were incubated with a primary antibody at 4°C overnight and a secondary antibody conjugated with Alexa Fluor (Thermo Fisher Scientific) was added for detection (1, 4). Cell nuclei were counterstained with DAPI dye. Fluorescence microscopy was performed with a Nikon Eclipse TE2000-E microscope (Nikon, Tokyo, Japan) or Axio observer (Zeiss, Oberkochen, Germany) (6). IF signals were quantitated using the ImageJ software (NIH).

Western blot analysis (WB), nuclear fractionation, and coimmunoprecipitation (coIP): Cultured cells or murine tumor tissues were lysed with RIPA buffer, containing PMSF, Na₂VO₃, NaF, and protease inhibitors (11873580001; Roche, Penzberg, Germany) for WB. After homogenization and incubation for 20 minutes on ice, lysates were collected and cleared by centrifugation. Protein concentrations were quantitated by a DC™ Protein Assay kit (5000111; Bio-Rad, Hercules, CA) and 5-15 µg of total protein was loaded into each well of a PAGE gel for electrophoresis. Blotting and antibody incubation were performed as we previously described (2, 5) and signals were captured by an Amersham imager 600 (GE Healthcare Life Sciences). Densitometry analysis was performed with the ImageJ software (NIH, Bethesda, MA).

Cell nuclei were isolated using CellLytic NuCLEAR Extraction Kit (NXTRACT; MilliporeSigma). In brief, cell pellets were resuspended in Hypotonic Lysis Buffer and IGEPAL CA-630 detergent was added in to lyse the cells. After centrifugation at 10,000 g, supernatant containing cytoplasmic proteins was collected. The cell pellet was then resuspended with Nuclear Extraction buffer and soluble nuclear proteins were collected by centrifugation at 20,000 g. The cytoplasmic fraction was validated by WB for PDGFR- α and the nuclear fraction was validated by WB for HDAC2. For coIP, cell nuclei isolated were resuspended and lysed by IP buffer

containing 1% NP40. After homogenization and centrifugation at 20,000 g, the supernatants, containing equal volumes and equal amounts of proteins, were used for coIP. 1-5 µg of anti-p300 (N-15) and 30 µl slurry of Protein G Sepharose 4 Fast Flow (GE17-0618-01; GE Healthcare, Pittsburgh, PA) were used to pulldown p300. After Sepharose beads were washed for 4 times, coprecipitated SMAD2/3 and TAZ were eluted by Laemmli sample buffer (1610737; Bio-Rad, Hercules, CA) for WB.

Chromatin immunoprecipitation (ChIP)-qPCR: Control, p300 knockdown, and C646-incubated HSCs stimulated with TGFβ1 were collected for ChIP using an EZ-Magna-ChIP HiSens kit (17-10461; MilliporeSigma), as we previously described (7). In brief, HSCs were first fixed with 1% formaldehyde to cross-link protein and DNA. Cell lysates were then subjected to sonication for ChIP. ChIP was done using anti-histone H3-acetyl K27 antibody (H3K27AC) (ab4729; Abcam) or control IgG (sc-2027; Santa Cruz Technology). Precipitated DNA fragments containing gene promoter of POSTN or CTGF were detected by qPCR. Primers for POSTN: forward CAAGGAAGCTGATTGTGGTTACC; reverse GCAATCCCTAGCCAAAGGAATG. Primers for CTGF: forward GCTGAGTGTC AAGGGGTCAGG; reverse GGCTCGCCAATGAGCTGAATG.

HSC/tumor coculture: HSCs were seeded into a 24-well cell culture plate and grew to confluence. L3.6 cancer cells, in a single-cell suspension, were added on the top of HSCs so that L3.6 and HSCs grew together. After 3-day-coculture in serum-free DMEM, cells were collected for IF for E-cadherin to label L3.6 cancer cells. IF signals were quantified using an Odyssey imaging System (LI-COR Biosciences, Lincoln, NE).

HSC/tumor coinjection and in vivo xenogen imaging: Experiments were approved by Institutional Animal Care and Use Committee of Mayo Clinic or University of Minnesota. 8-week-old male nude mice (Charles River; 553) were used as tumor implantation recipients. HT29 cells (0.5×10^6) were mixed with HSCs (0.5×10^6) and they were coinjected into a nude mouse subcutaneously (2, 8). Tumor nodules were measured using a caliper and tumor volumes were calculated: tumor volume = (width)² x length/2. Tumor growth curves were generated with the GraphPad Prism 5 software (GraphPad Software, Inc., La Jolla, CA).

For in vivo xenogen imaging, HT29 expressing firefly luciferase by lentiviral transduction were used for coinjection. Each mouse received 150 μ l D-luciferin (GOLDBIO, online shop) by intraperitoneal injection and anesthetized by isoflurane. HT29 bioluminescence was detected and measured by the Xenogen IVIS 200 machine (Caliper Life Sciences, Waltham, MA) and the Living Image software (Caliper Life Sciences) (2, 8).

Liver metastasis mouse models. Experiments were approved by Institutional Animal Care and Use Committee of University of Minnesota. L3.6 liver metastases were generated by portal vein injection. 8 weeks old male SCID mice (Charles River Frederick Research Model Facility) were used as tumor implantation recipients and 1×10^6 L3.6 cells suspended in 100 μ l PBS were used for each injection. Mice were sacrifice 14 days later for isolation of liver metastases. *p300F/F* mice (9) were bred with collagen1A1-*cre* transgenic mice (provided by Dr. Tatiana Kisseleva at UCSD), and pups were genotyped by a PCR-based approach. PCR primer pairs were: 5'- TGG TTA TCG GTT CAC CAT TTT G-3' and 5'- CAG TAG ATG CTA GAG AAA GCC-3'. Littermate-matched *p300+/+cre* and *p300F/Fcre* mice were used for intrasplenic injection of LLCs. 1×10^6 LLCs suspended in 30 μ l PBS were used for each intrasplenic injection. Mice were sacrificed 10 days later for isolation of liver metastases. Detailed portal vein and intrasplenic

injection procedures are included in our prior publications (6, 7).

References

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Supplemental Figure Legends

Suppl. Fig. 1. P300 knockdown does not influence TGF β 1-induced SMAD phosphorylation and protein levels of T β RII, T β RI and YAP1/TAZ of HSCs. **A.** Control and p300 knockdown HSCs were stimulated with TGF β 1 for different times and collected for WB. P300 knockdown did not influence TGF β 1-induced phosphorylation of SMAD2 and protein levels of YAP1 and TAZ. Data are representative of 3 repeats with similar results. **B.** HSCs expressing T β RI-FLAG by retroviral transduction were transduced with control or p300 shRNA lentiviruses. WB revealed that p300 knockdown did not influence protein levels of T β RII and T β RI of HSCs. Data are representative of 3 repeats with similar results.

Suppl. Fig. 2. Nuclear localization of TAZ-4SA mutant is mediated by p300. **A.** NIH3T3 cells expressing doxycycline-inducible FLAG-TAZ-4SA were treated with DMSO or C646 for 24 hours and collected for IF for FLAG (left) and nuclear fractionation (right). C646 inhibited nuclear targeting of FLAG-TAZ-4SA. *, $P < 0.05$ by *t*-test, $n = 3$ repeats. Bar, 50 μ m. **B.** NIH3T3 cells expressing doxycycline-inducible FLAG-TAZ-4SA were transduced with NT shRNA or p300 shRNA lentiviruses and collected for IF for FLAG (left) and nuclear fractionation (right). P300 shRNA inhibited nuclear targeting of FLAG-TAZ-4SA mutant. *, $P < 0.05$ by *t*-test, $n = 3$ repeats. Bar, 50 μ m.

Suppl. Fig. 3. Nuclear localization of YAP1-5SA mutant is minimally affected by p300. **A.** NIH3T3 cells expressing doxycycline-inducible FLAG-YAP1-5SA were treated with DMSO or C646 for 24 hours and collected for IF for FLAG and nuclear fractionation. C646 minimally affected nuclear targeting of FLAG-YAP1-5SA mutant. $P > 0.05$ by *t*-test, $n = 3$ repeats. Bar, 50 μ m. **B.** NIH3T3 cells expressing doxycycline-inducible FLAG-YAP1-5SA were transduced with NT shRNA or p300 shRNA lentiviruses and collected for IF for FLAG and nuclear fractionation.

P300 shRNA minimally affected nuclear targeting of FLAG-YAP1-5SA. $P>0.05$ by t -test, $n=3$ repeats. Bar, 50 μm .

Suppl. Fig. 4. TGF β 1 induction of tumor-promoting factors was inhibited by knockdown of both TAZ and YAP1. **A.** HSCs transfected by control or TAZ siRNA were treated with TGF β 1 and collected for WB. TGF β 1-induced upregulation of α -SMA and fibronectin was not significantly influenced by TAZ knockdown alone. $P>0.05$ by ANOVA, $n=3$ repeats. **B.** HSCs transfected by both TAZ and YAP1 siRNA and collected for WB. TGF β 1 induction of α -SMA and 4 tumor-promoting factors was significantly reduced by TAZ/YAP1 siRNA. *, $P<0.05$ by ANOVA, $n=3$ repeats.

Suppl. Fig. 5. P300 facilitates gene expression by acetylating histones. **A.** Microarray analysis using Human HT-12 v4 Expression BeadChip identified more than 700 TGF β 1-inducible genes. Representative 22 TGF β 1-inducible genes are shown. **B.** HSC conditioned medium (CM) was used as a stimulant for HT29 cells in MTS proliferation assay. CM of p300 knockdown HSCs was less effective than that of control cells at promoting HT29 proliferation, and the impaired tumor-promoting effect of p300 knockdown HSCs was partially rescued by CTGF. *, $P<0.05$ by ANOVA, $n=5$. **C.** HSCs stimulated with TGF β 1 were collected for ChIP-qPCR to study acetylation of histone 3 on POSTN and CTGF promoter. C646 suppressed H3K27Ac on the promoter of POSTN and CTGF gene in TGF β 1-stimulated HSCs. *, $P<0.05$ by ANOVA, $n=3$.

Suppl. Fig. 6. C646 suppresses tumor growth by inhibiting myofibroblasts. **A.** Cell proliferation assay showed that C646 at 20 μM did not influence HT29 cell proliferation *in vitro*. **B.** and **C.** Tumor nodules were used for double IF for α -SMA and SMAD2/3. Nuclear SMAD2/3 of tumor myofibroblasts were reduced by C646. *, $P<0.05$ by t -test, $n>60$ cells per

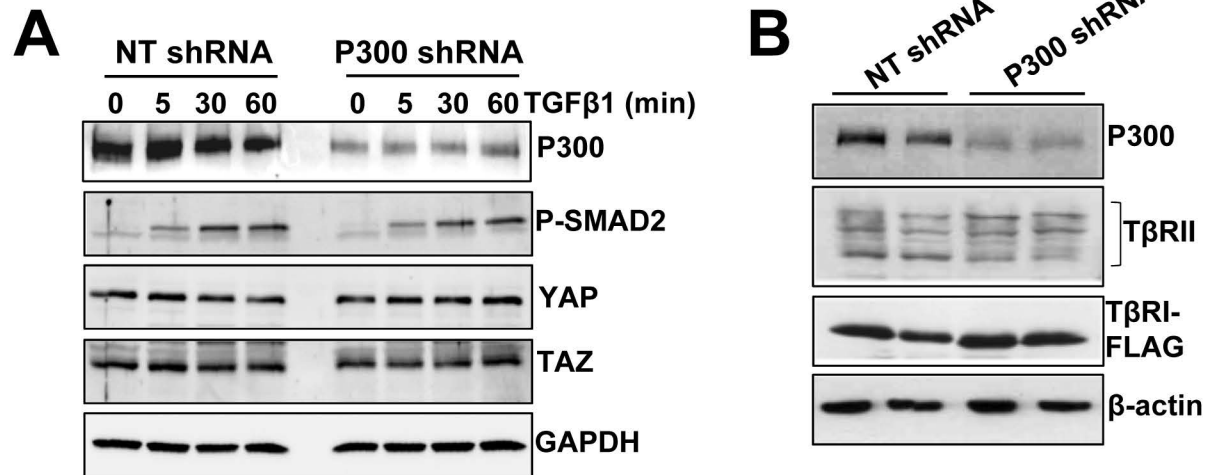
group. Bar, 20 μm . **S**: stroma; **T**: tumor. **D**. Nuclear TAZ in tumor myofibroblasts was also reduced by C646. *, $P < 0.05$ by *t*-test, $n > 60$ cells per group. Bar, 20 μm . **S**: stroma; **T**: tumor.

Suppl. Fig. 7. C646 suppresses tumor growth by inhibiting myofibroblasts. **A**. IF revealed that TGF β transcriptional targets of HSCs, periostin and tenascin C, were reduced by C646 treatment in tumors. *, $P < 0.05$ by *t*-test, $n = 3$ tumors per group. Bar, 100 μm . **B**. α -SMA IF revealed reduced myofibroblast densities in tumors arising from HT29/HSC-p300shRNA coinjections compared to control coinjections. *, $P < 0.05$ by *t*-test, $n = 4$ tumors per group. Bar, 100 μm .

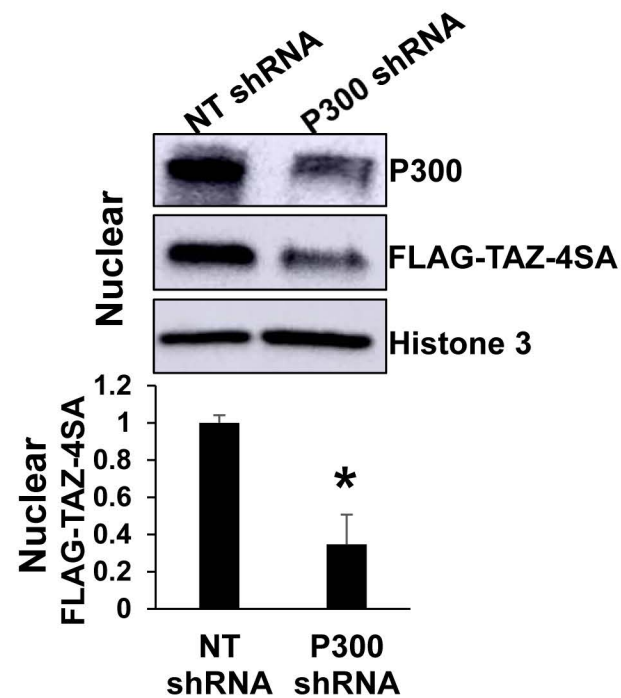
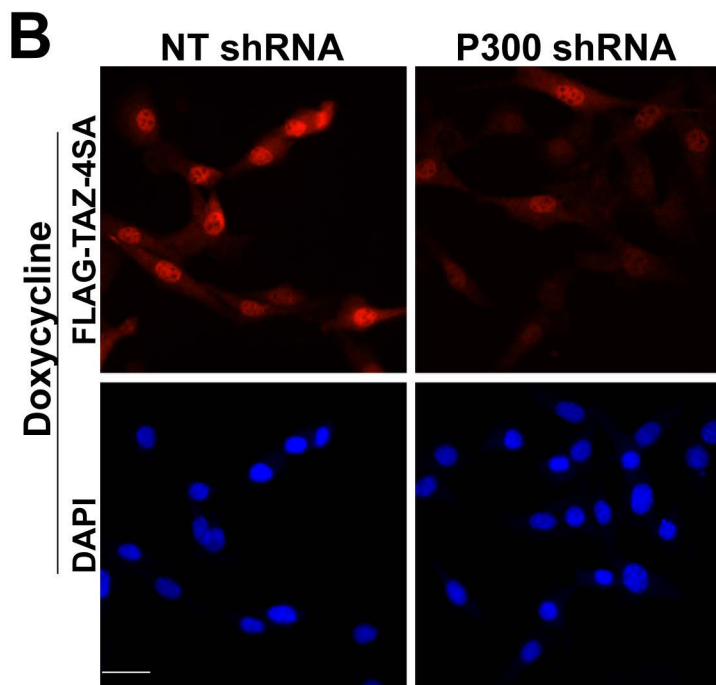
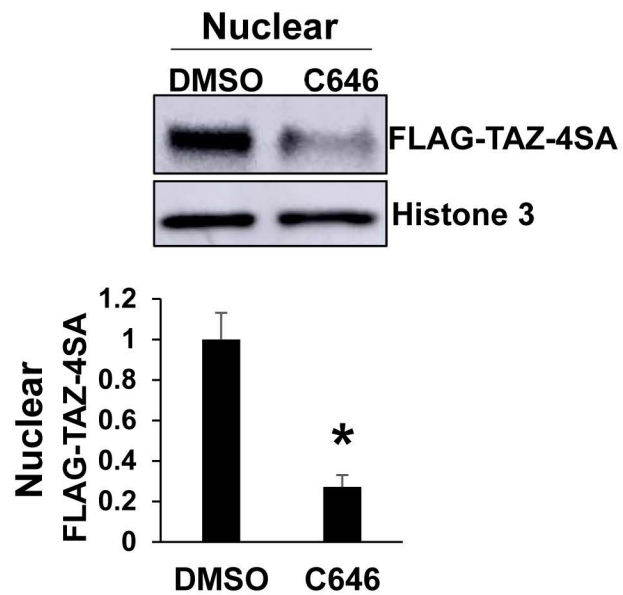
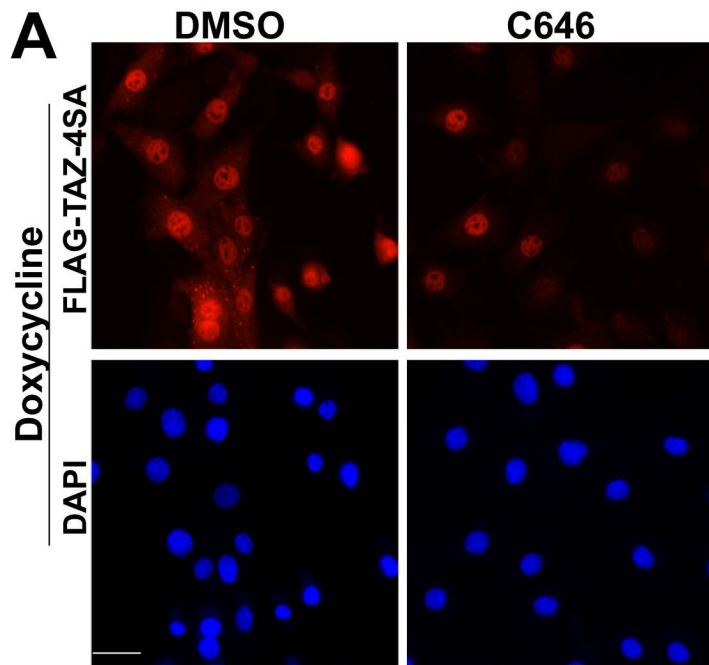
Suppl. Fig. 8. Nuclear TAZ in myofibroblasts of liver metastases is downregulated by *cre*-mediated p300 gene disruption. **A**. Metastases were assessed by IF using antibodies against TAZ in conjunction with either desmin to mark quiescent HSCs or α -SMA to mark activated-HSC/myofibroblasts. TAZ was increased in activated-HSC/myofibroblasts (arrows) of liver metastases than in HSCs (arrowheads). *, $P < 0.05$ by *t*-test, $n > 36$ cells. Bar, 20 μm . **S**: stroma; **T**: tumor. **B**. α -SMA IF was used to label myofibroblasts of liver metastases. TAZ was reduced in *p300F/Fcre* myofibroblasts (arrows) than in *p300+/+cre* myofibroblasts (arrowheads). *, $P < 0.05$ by *t*-test, $n > 45$ cells. Bar, 20 μm . **S**: stroma; **T**: tumor.

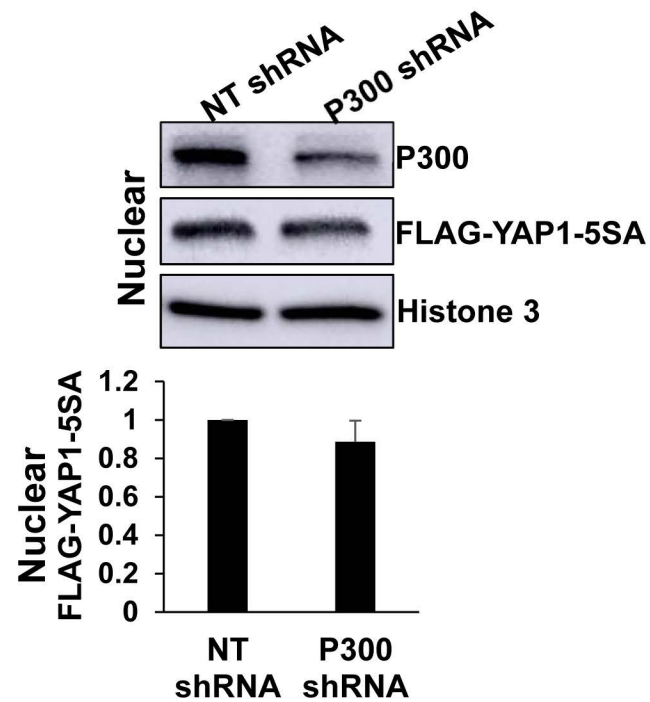
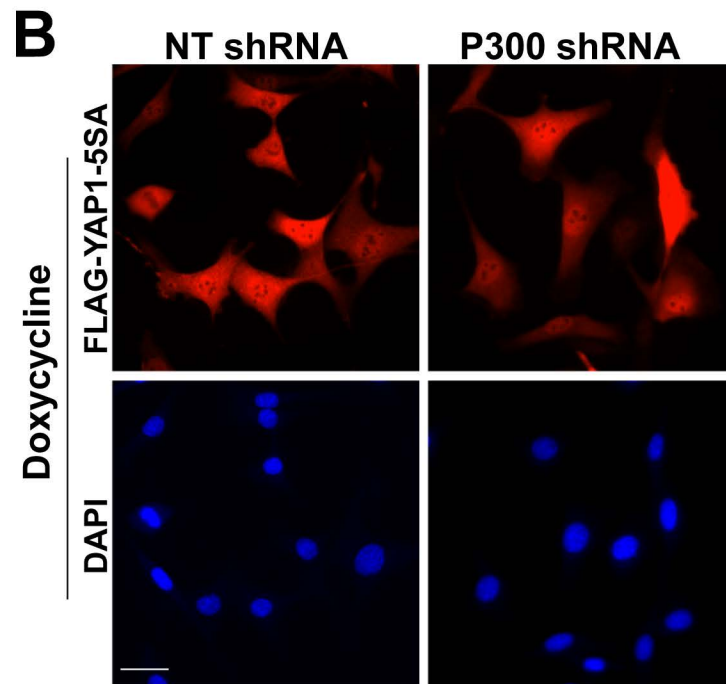
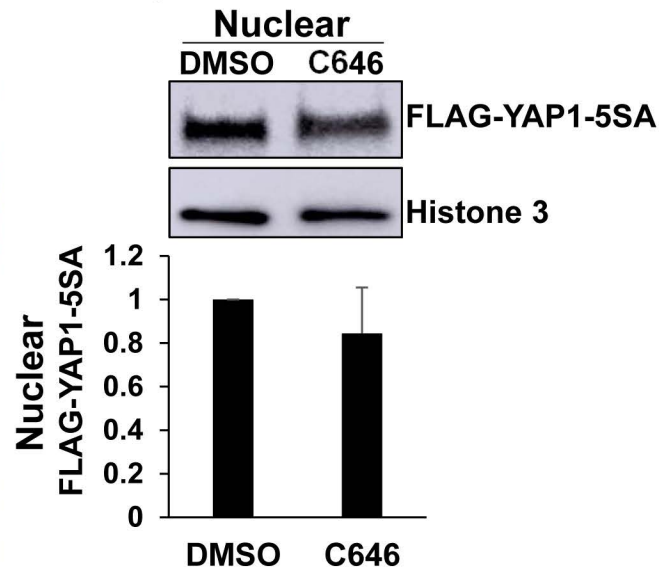
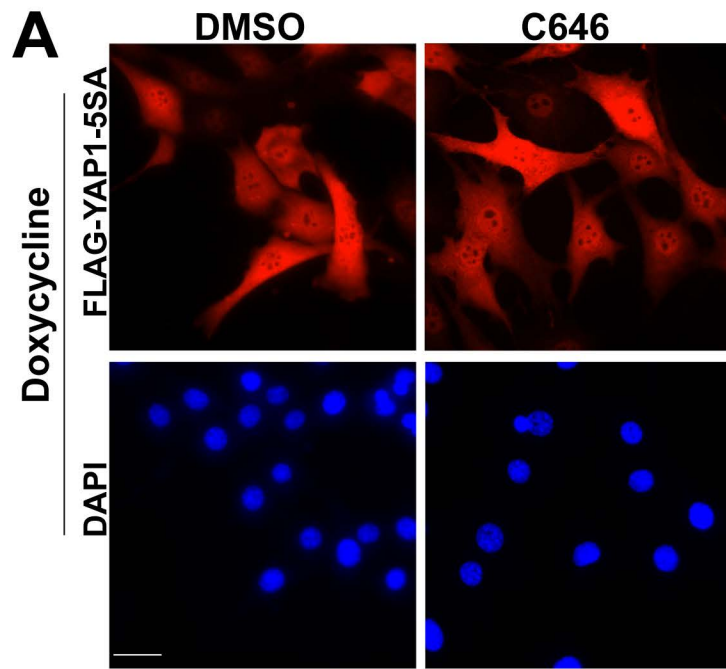
Suppl. Fig. 9. TGF β -inducible and stiffness-inducible targets are distinct but with a small overlap. **A**. Out of 23 tumor-promoting targets of stiffness that we identified by RNA-seq previously, only IL11, THBS1, SERPINE1, FGF2, and CTGF are TGF β 1-inducible genes, as revealed by RNA-seq (GSE127964). **B**. Out of 5 tumor-promoting targets of TGF β 1 identified in this study, only CTGF and FGF2 are upregulated by stiffness, as revealed by RNA-seq (GSE101343). *, $P < 0.05$ by Bonferroni post hoc test.

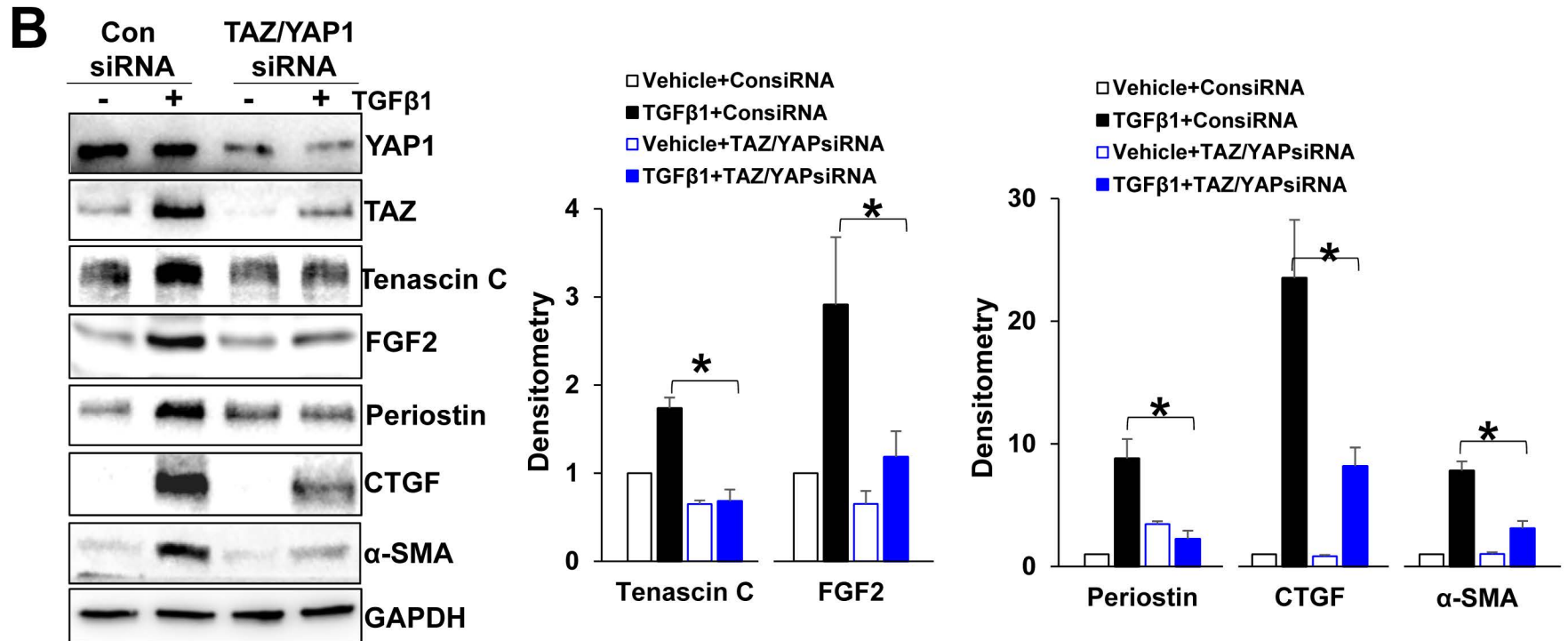
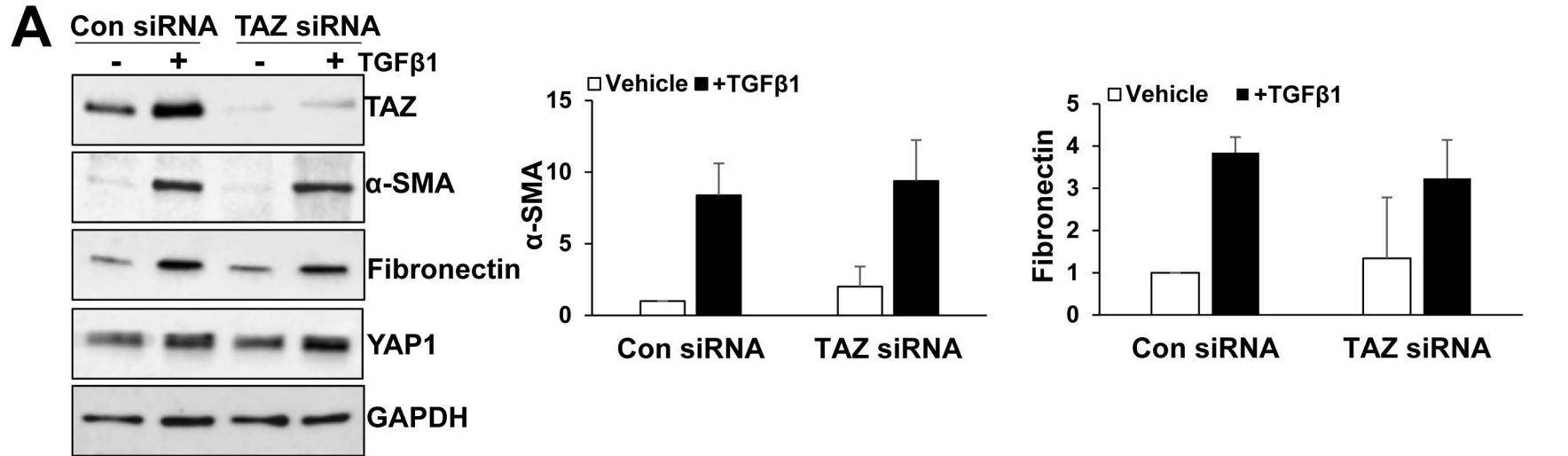
Suppl. Fig. 1



Suppl. Fig. 2







Suppl. Fig. 5

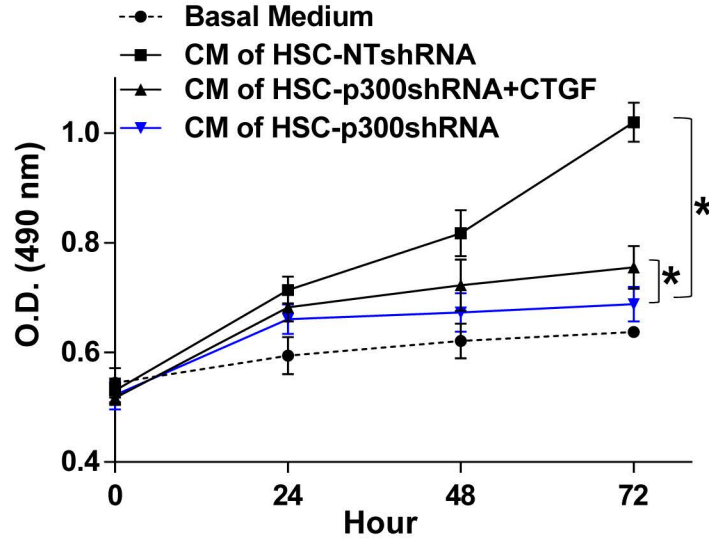
A

Gene	mRNA fold increase by TGFβ1
IGFBP3	11
TAGLN(SM22-α)	4.33
SERPINE1(PAI-1)	5.99
GADD45B	6.5
ACTA2(α-SMA)	6.3
CNN1(Calponin1)	5.3
CTGF	2.3
ITGA1	4.6
TNC	3
MMP3	3
Col7A	2.76
KLF10	1.87
SMAD7	1.82
PDGFC	2.37
Col8A2	2.0
MYL9	2.6
FAP	2.4
ECGF	2.33
MMP10	2.06
FN1	2.01
FGF2	1.98
POSTN	1.6

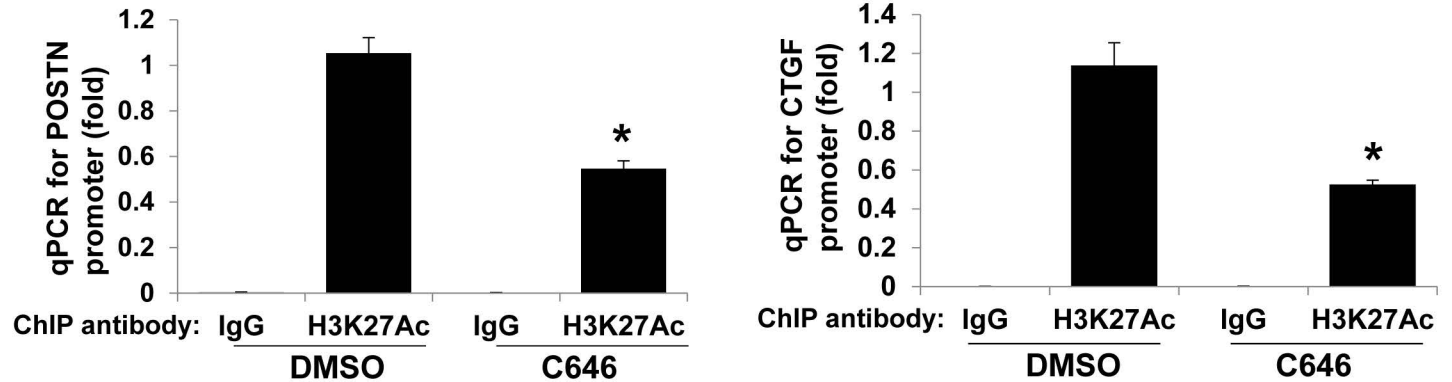
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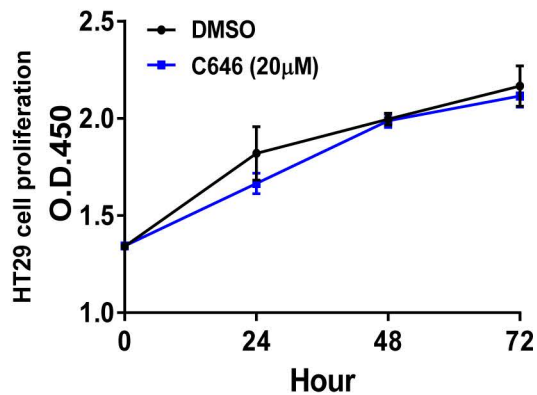
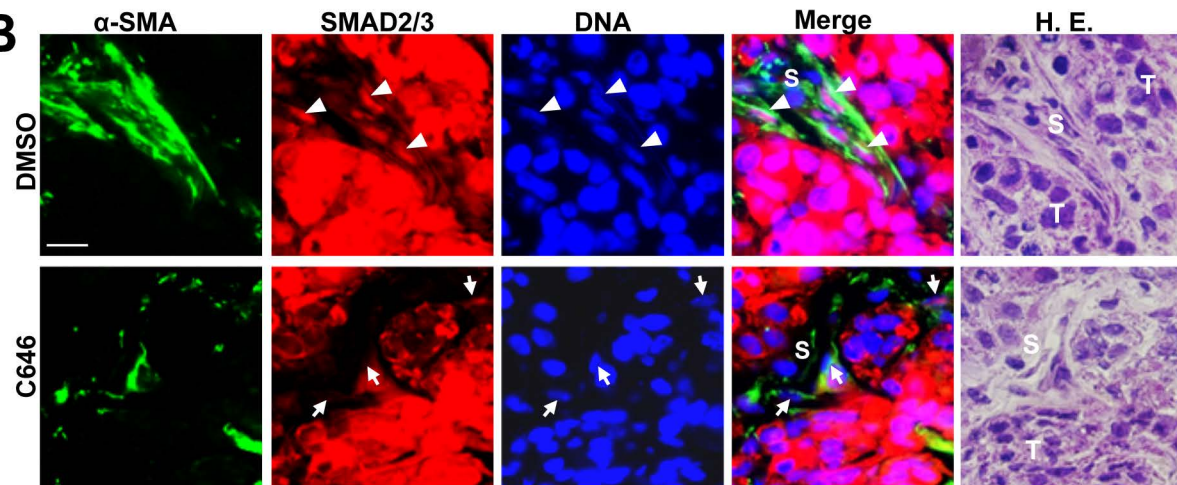
Proliferation of HT29 cells



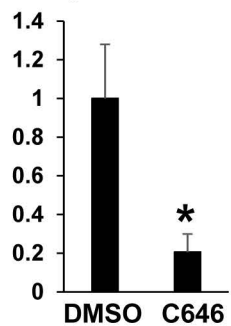
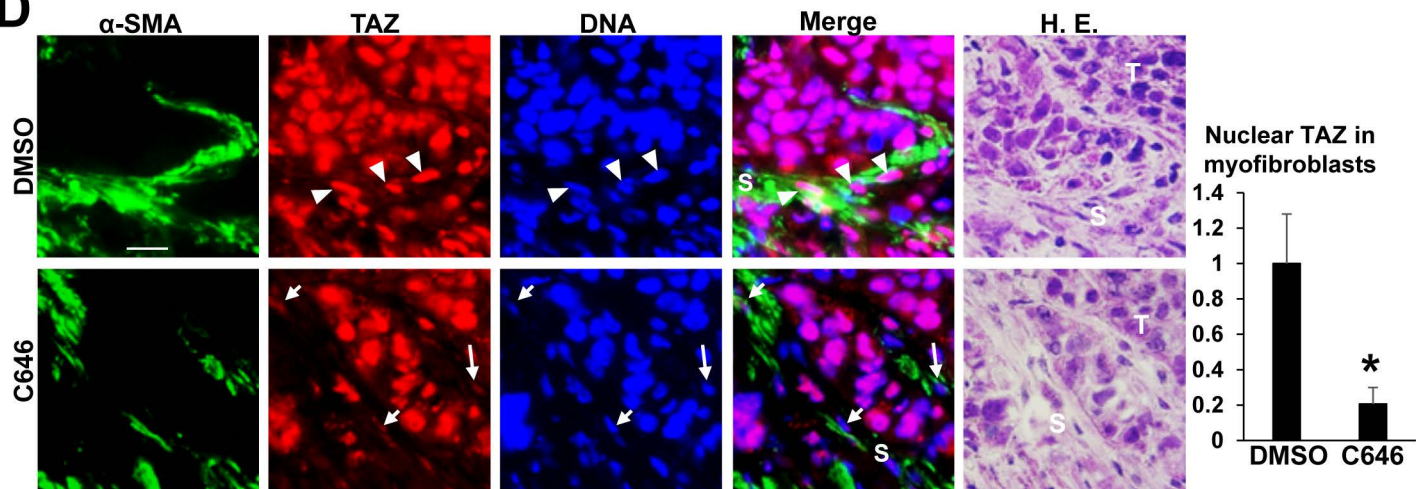
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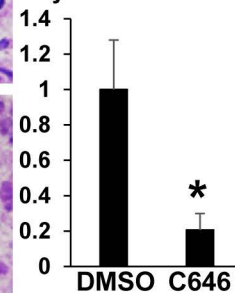
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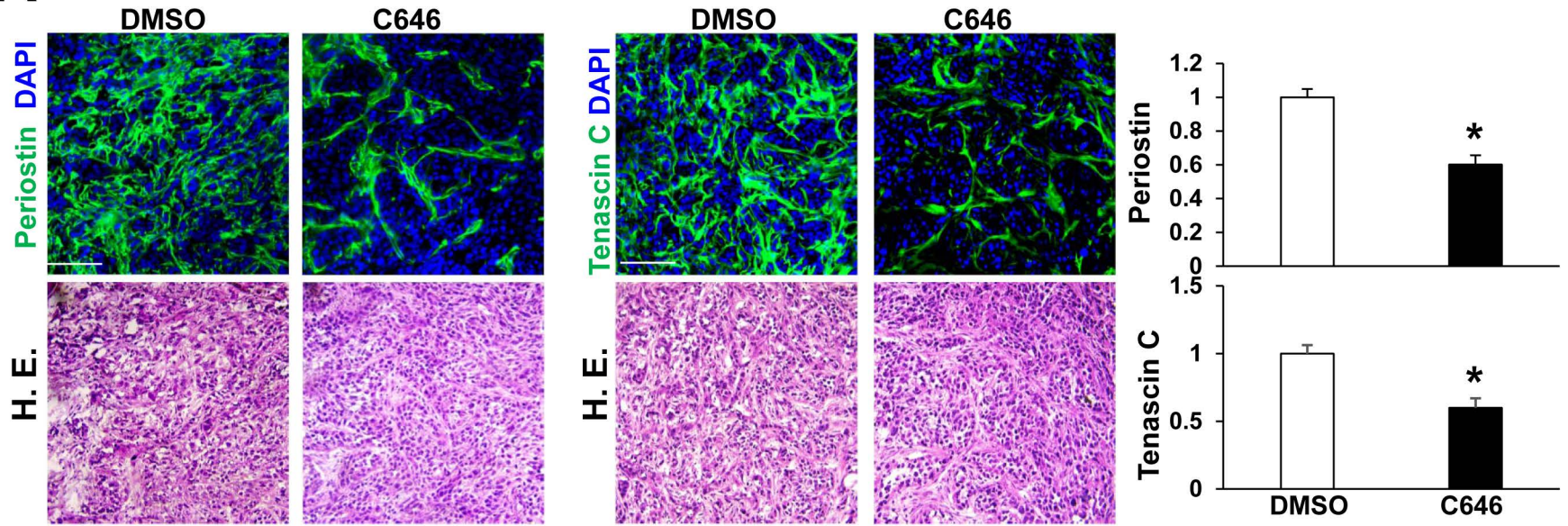
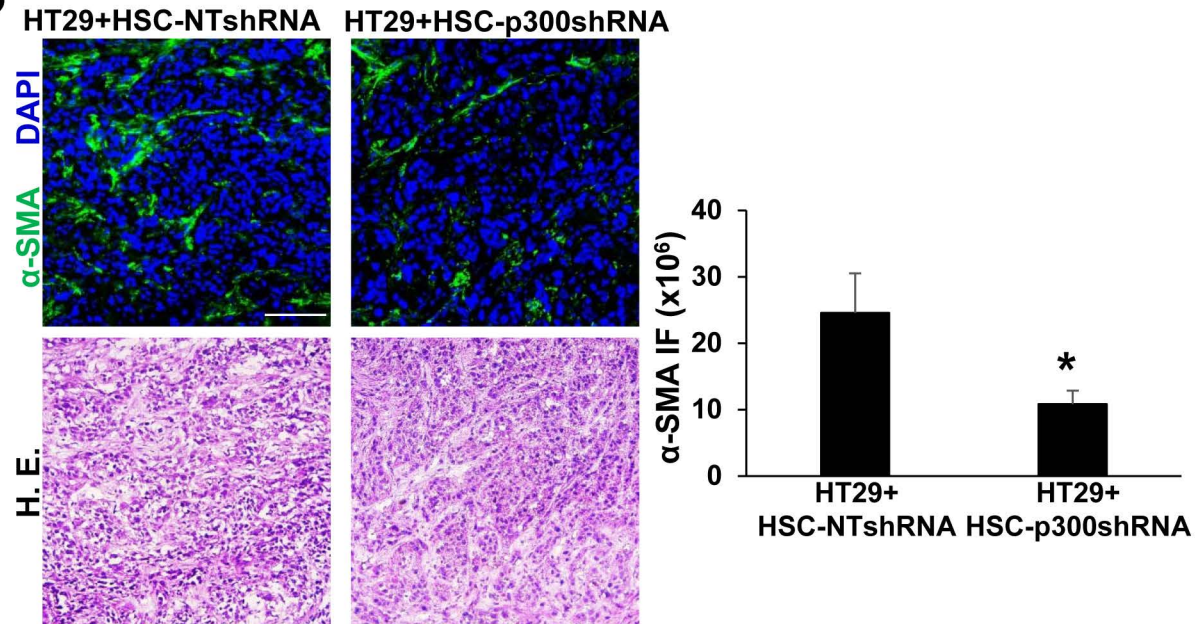
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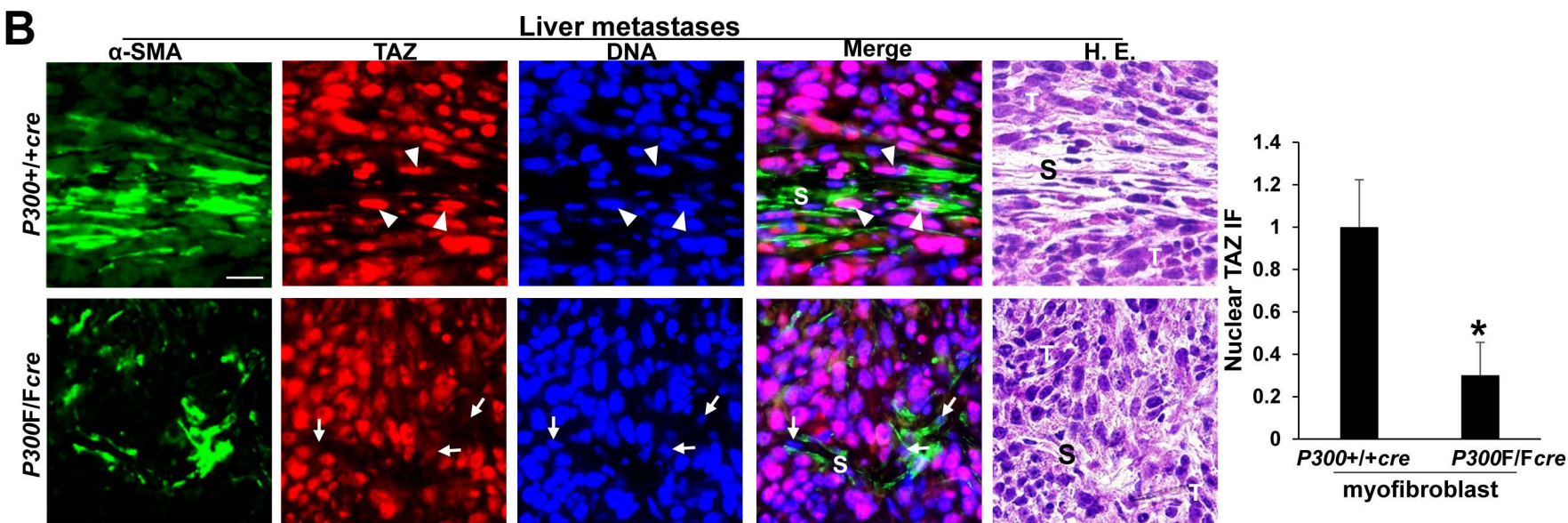
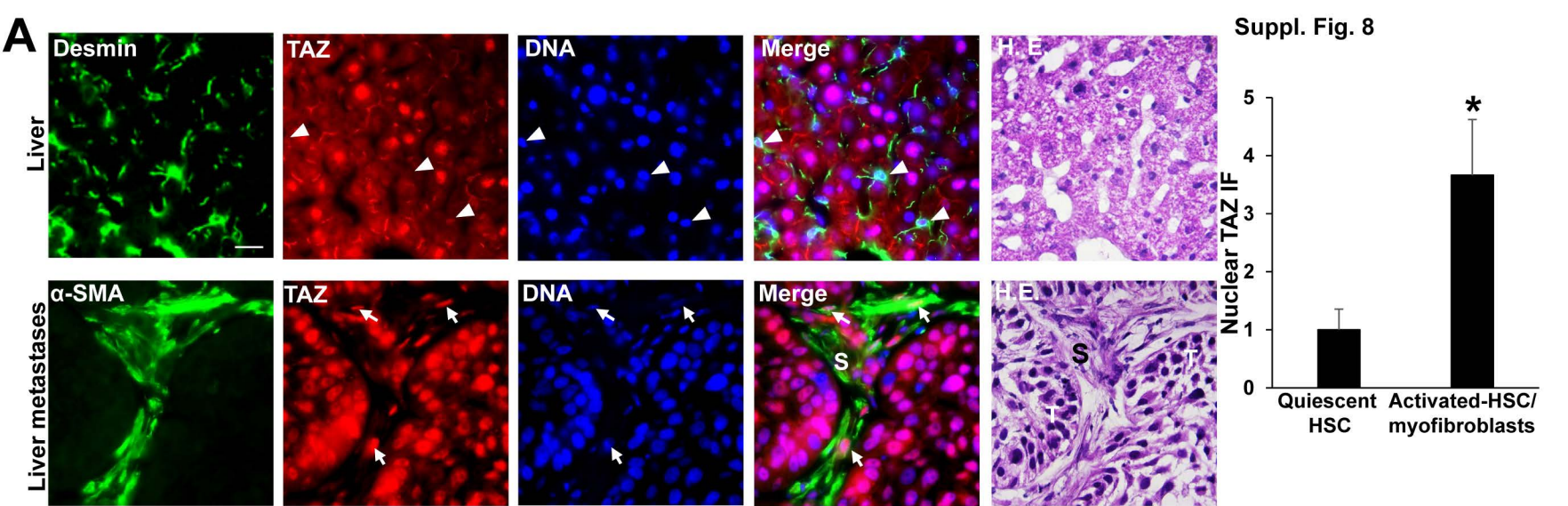
Nuclear SMAD2/3 in myofibroblasts

**D**

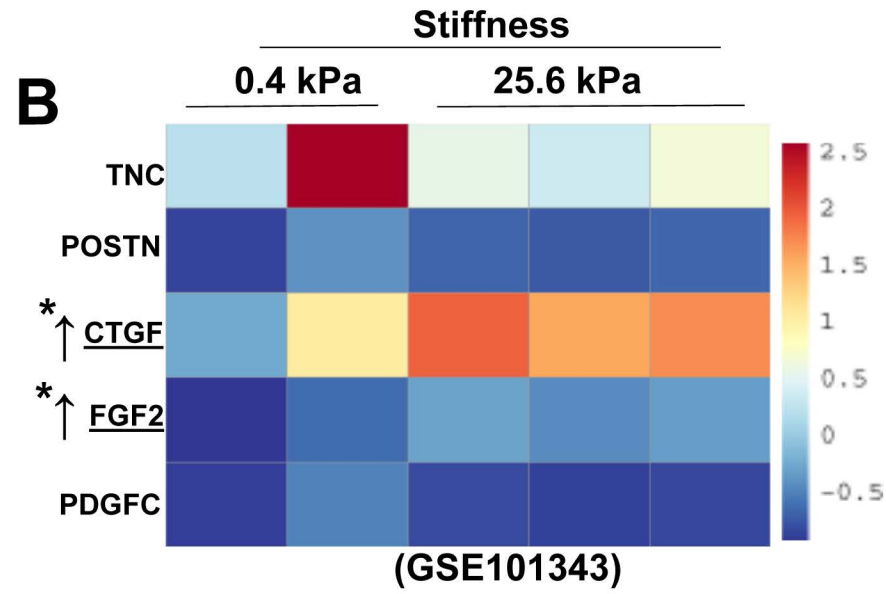
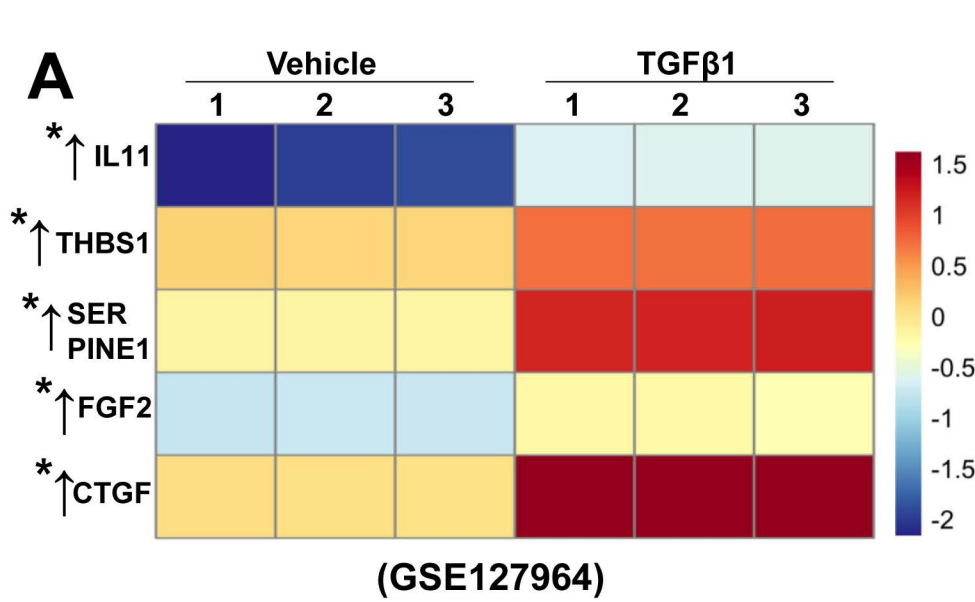
Nuclear TAZ in myofibroblasts



A**B**



Suppl. Fig. 9



*, $P < 0.05$ by Bonferroni post hoc test