SUPPLEMENTAL INFORMATION

SUMO1-dependent modulation of SERCA2a in heart failure

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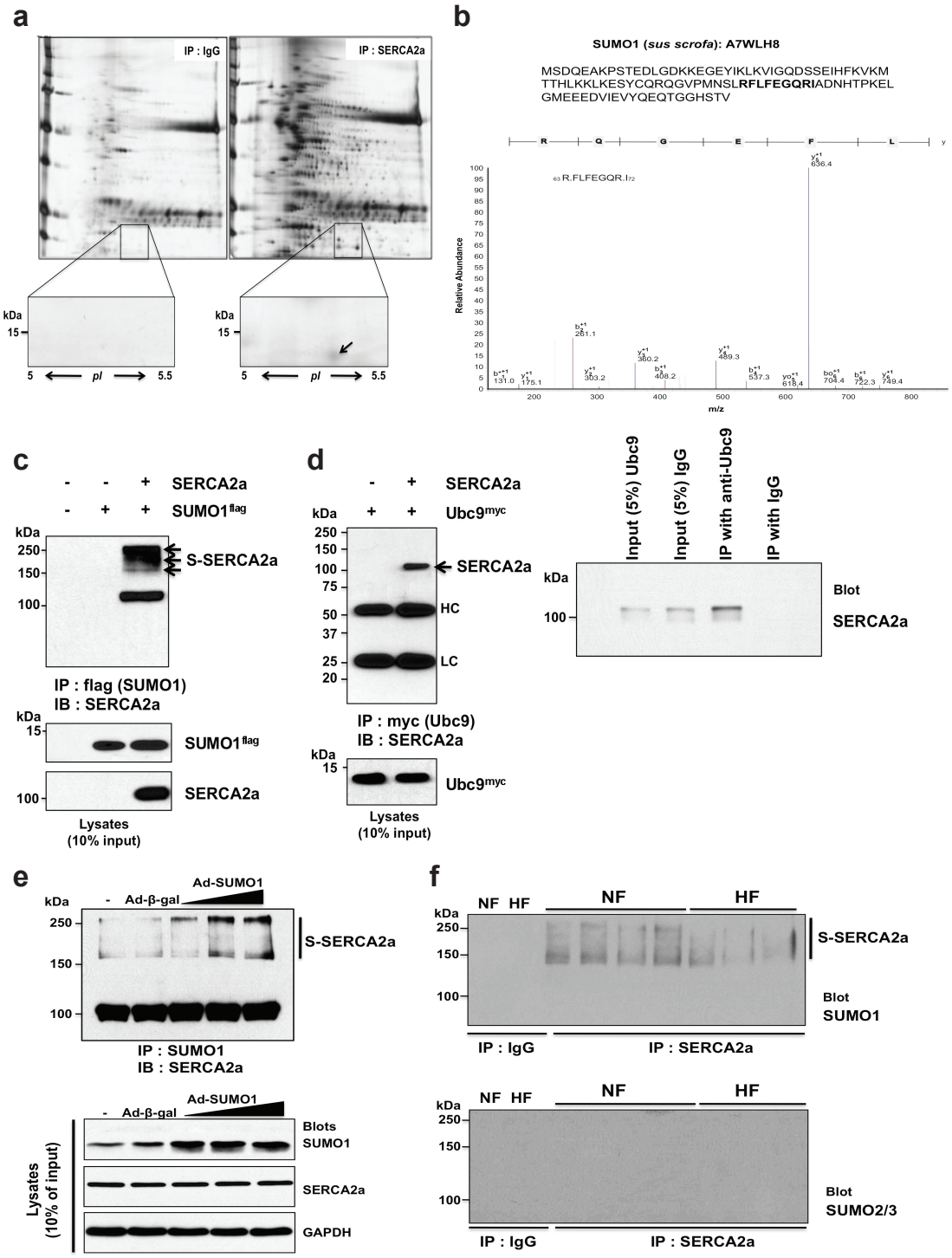
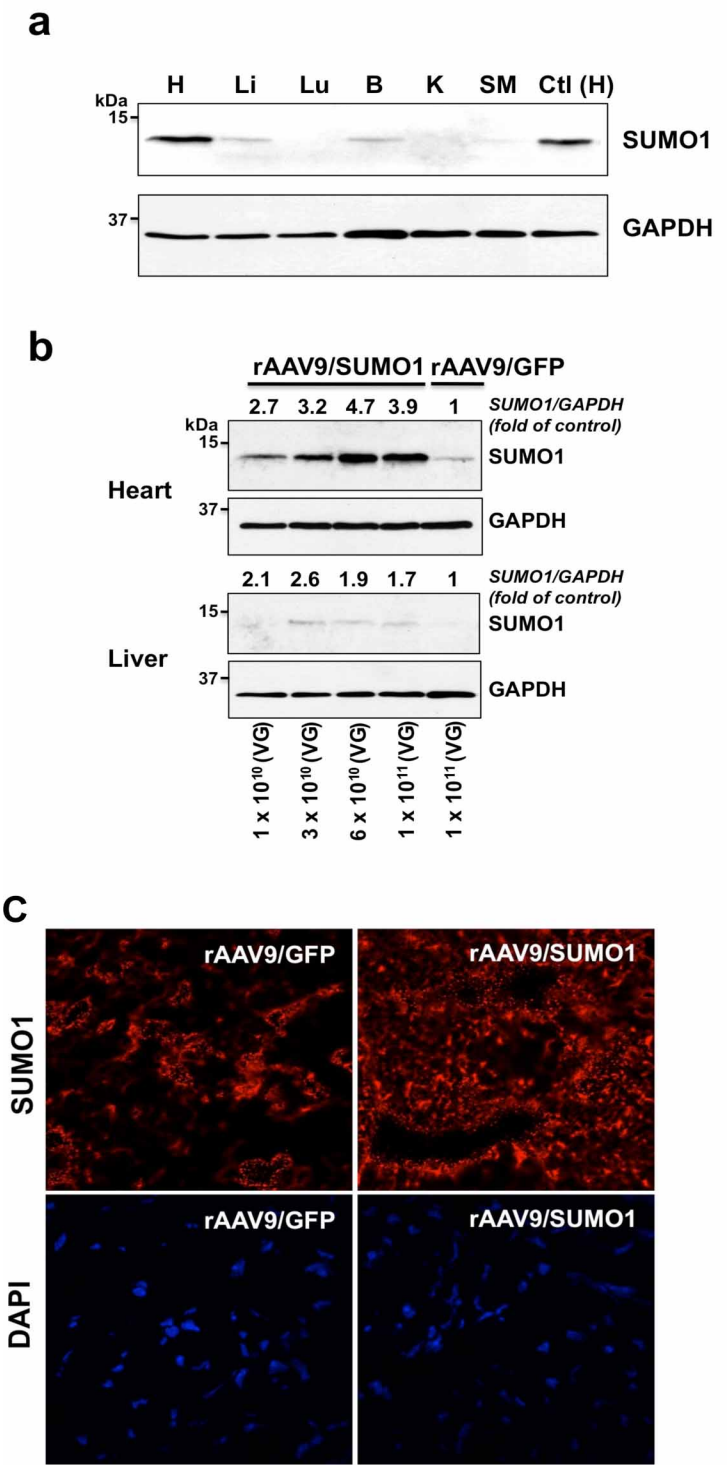
[Supplemental information included Eleven figures and Nine tables.]



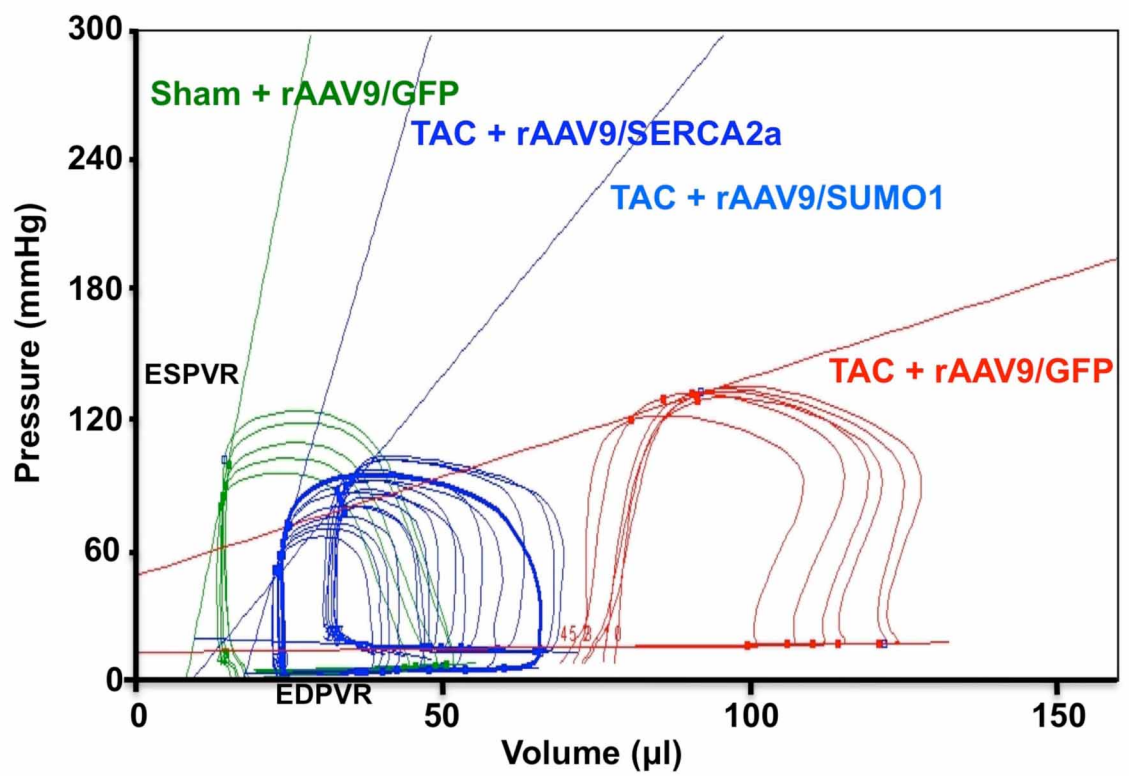
Supplementary Figure 1. SERCA2a complex analysis.
(**a**) Two-dimensional SDS-PAGE gels of SERCA2a complexes. A silver-stained SDS-PAGE gel is shown, which reveals a 12 kDa spot (arrow) that immunoprecipitated with SERCA2a. SERCA2a enrichment was confirmed by blotting the immunoprecipitated

SERCA2a complexes with a rabbit anti-SERCA2a antibody (anti-S2a). Rabbit IgG (anti-IgG) was used as a negative control.
(**b**) The representative peptide fingerprint for SUMO1 was identified by tandem mass spectrometric analysis. The protein sequence of SUMO1 is shown with the matched peptide highlighted in bold.
(**c**) *in vivo* SERCA2a SUMOylation in HEK293 cells expressing flag-tagged SUMO1. Precipitated flag-tagged SUMO1 conjugates were analyzed using an anti-SERCA2a antibody.
(**d**) Direct interaction between SERCA2a and Ubc9 (left panel). HEK293 cells were transfected with expression vectors for myc-tagged Ubc9 and SERCA2a or a pcDNA vector (negative control). Cell lysates were subjected to immunoprecipitation (IP) with an anti-myc antibody, and the resulting precipitates were immunoblotted with anti-SERCA2a. HC, heavy chain; LC, light chain. Endogenous interaction between SERCA2a and Ubc9 in isolated adult mouse cardiomyocytes (right). Immunoprecipitation using cardiomyocyte lysates showing Ubc9 and SERCA2a interact *in vivo*.
(e) *in vivo* SERCA2a SUMOylation in isolated adult mouse cardiomyocytes infected with adenovirus expressing SUMO1. Immunoblot analysis showed that SUMO1 has a dose-dependent affect on SERCA2a SUMOylation in cardiomyocytes.
(f) SUMOylated SERCA2a in human patient. Reverse IP experiments on SERCA2a SUMOylation *in vivo* was performed on same human patient as shown in Figure 1. IP was performed with anti-SERCA2a antibody and the SUMO1 conjugations were revealed by anti-SUMO1 (top panel). The same blot was stripped and re-probed with anti-SUMO2/3 (bottom panel).

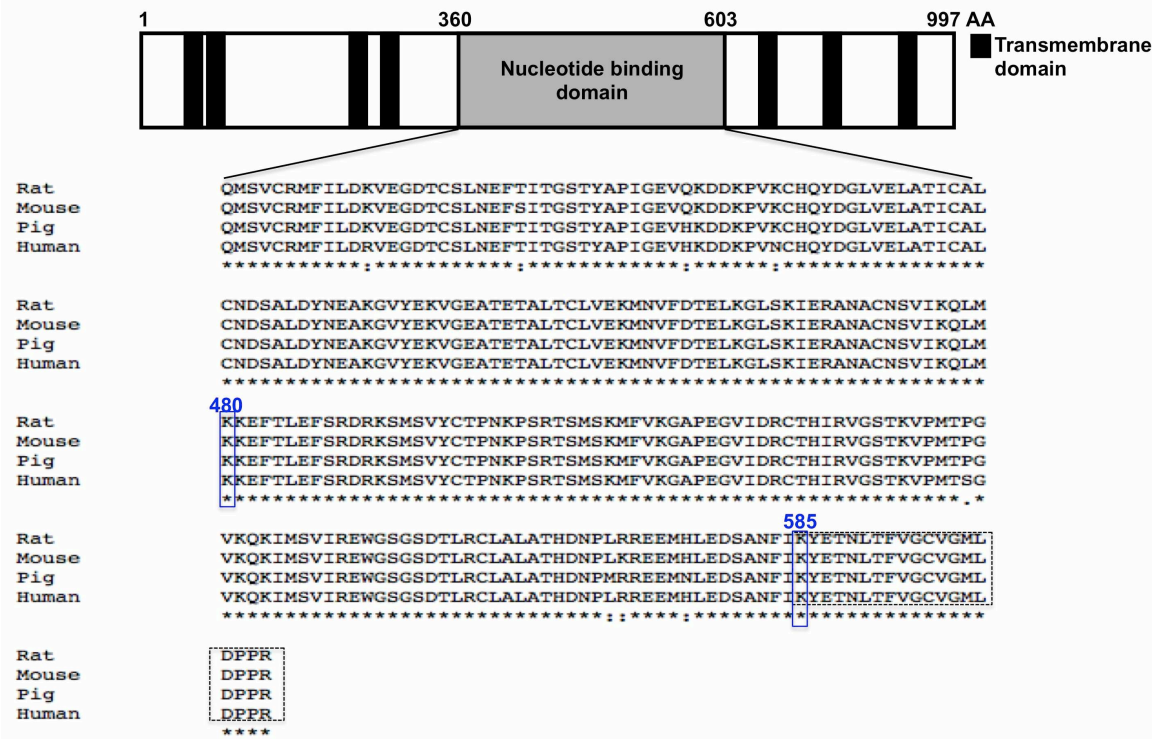


Supplementary Figure 2. Distribution of SUMO1 expression after tail-vein injection. (**a**) Immunoblotting for SUMO1 expression. 4 weeks after tail-vain injection of either rAAV9/SUMO1 or rAAV9/GFP, indicated mice tissues were harvested and subjected to immunoblotting to detect SUMO1 expression. H: Heart; Li: Liver; Lu: Lung; B: Brain; K: Kidney; SM: Smooth muscle; Ctl: heart of rAAV9/GFP injected mice.

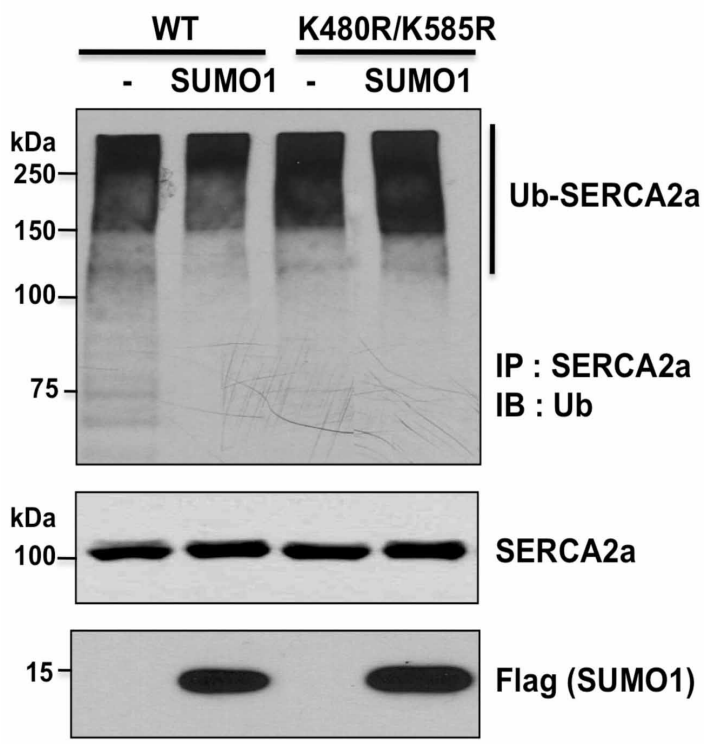
(**b**) Animals were injected by rAAV9/SUMO1 in a different amount of viral genomes (VG). Heart and liver tissues were then analyzed by immunoblotting to detect expression of SUMO1 transduction. GAPDH expression was examined for normalization purposes. (**c**) At 4 weeks after SUMO1 gene delivery, optical section images collected from cardiac tissues were double stained for SUMO1 (red) and DAPI (DNA, blue). rAAV9/GFP injected heart used as a control.



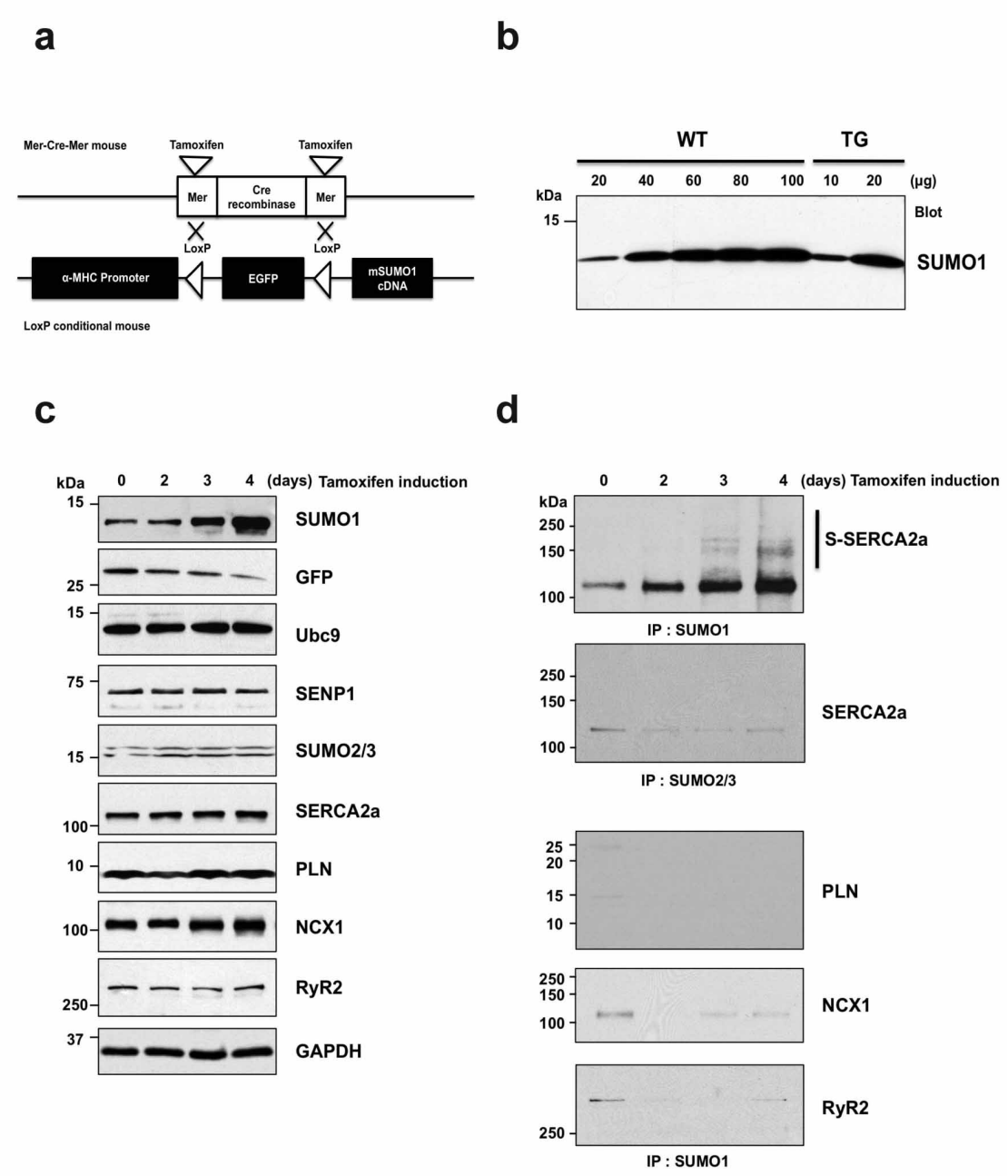
Supplementary Figure 3. Hemodynamic analyses of SUMO1 gene delivered mouse. Representative pressure volume loops at 2 months after adeno-associated virus encoding SUMO1 (rAAV9/SUMO1) delivery (4 months after TAC operation). After induction of HF, the loops shifted rightward. The end-systolic pressure-volume relationship (ESPVR) in the LV was slightly steeper in rAAV9/SUMO1 treated animals than in rAAV9/GFP treated controls, suggesting increased cardiac contractility. Sham + rAAV9/GFP: green; TAC + rAAV9/SUMO1: light blue; TAC + rAAV9/SERCA2a: blue; TAC + rAAV9/GFP: red.



Supplementary Figure 4. N-terminal domain of SERCA2a.
The protein sequences of human (AC# P16615-2), pig (AC# P11607-2), rat (AC# P11507-2) and mouse (AC# O55143-2) SERCA2a were aligned. Putative SUMO consensus motifs (ψKXE, where ψ is a hydrophobic amino acid) were detected at lysine 480 and lysine 585. The SUMO modification sites of SERCA2a are outlined in black. Hydrolase domains are outlined by a dotted line.



Supplementary Figure 5. Ubiquitination of SERCA2a.
HEK cells transfected with SERCA2a (WT or K480R/K585R) alone or together with flag-tagged SUMO1. 48 hours after transfection, cells were treated with 20 μM MG132 (proteasome inhibitor) for 3 hours. Cells were lysed in with lysis buffer (10 mM Tris–HCl, pH 7.5, 10 mM NaCl, 0.5% NP-40, 5 mM EDTA, 5 mM EGTA plus 20 mM NEM, 200 μM iodoacetamide, 1 mM sodium orthovanadate and 1 complete EDTA-free cocktail tablet (Roche Molecular Biochemicals). After centrifugation at 13,000 g for 10 minutes, supernatants were subjected to immunoprecipitation with anti-SERCA2a antibody. The ubiquitin conjugated SERCA2a were analyzed by anti-Ubiquitin antibody.

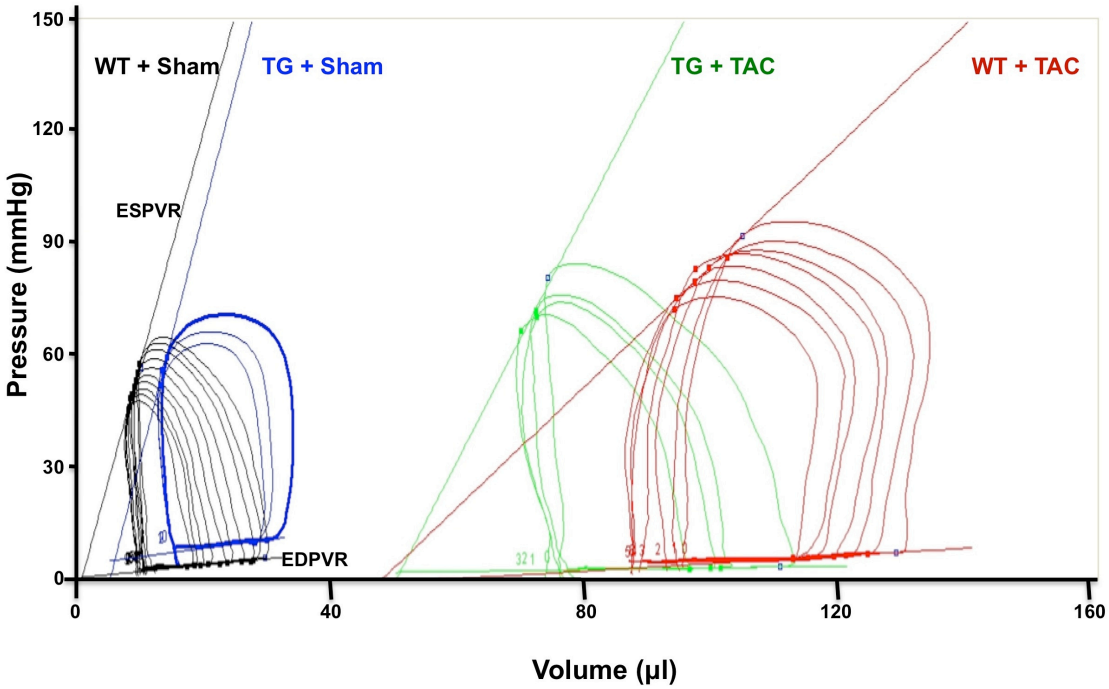


Supplementary Figure 6. Effects of tamoxifen-induced SUMO1 overexpression on Ca^{2+} regulatory proteins in transgenic mice.

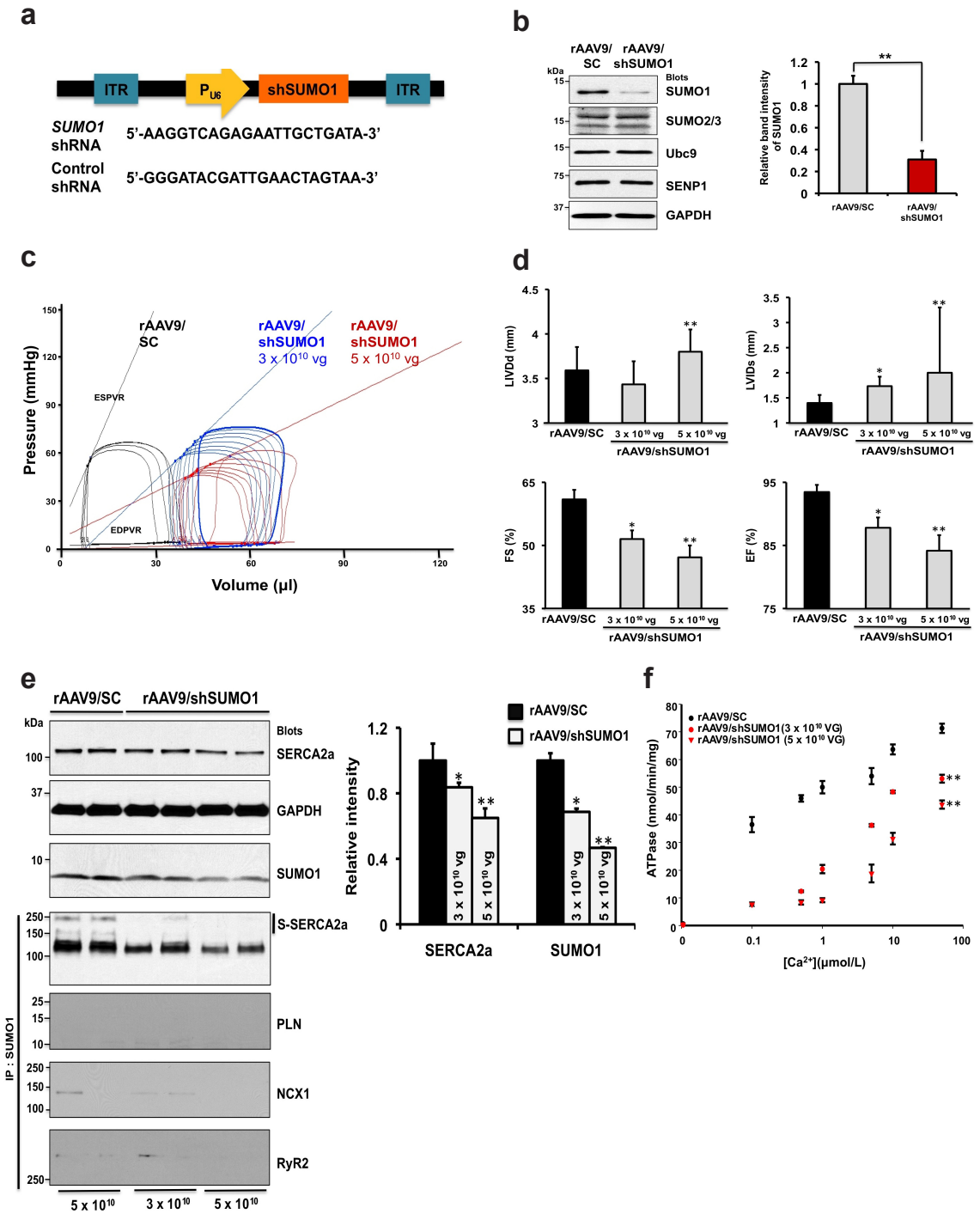
(**a**) Generation of conditional SUMO1 transgenic mice. Cre/loxP conditional expression system was utilized in which administration of tamoxifen induced heart-specific SUMO1 overexpression and concomitantly inhibited EGFP expression. Cardiac SUMO1 is expressed under the control of the α-MHC promoter.

(**b**) Immunoblot analysis revealed that the levels of tamoxifen-induced SUMO1 expression in the transgenic mice were approximately 5-fold higher than that of wild-type littermates. WT: wild-type littermates; TG: SUMO1 transgenic mice.

(**c**) Representative immunoblots show alternations of cardiac protein expressions in SUMO1 transgenic mice treated with tamoxifen received in a different duration as indicated.
(**d**) Effect of tamoxifen-induced SUMO1 overexpression on SUMOylations of SERCA2a. Cardiac tissues were immunoprecipitated with anti-SUMO antibodies. SUMOylated forms of SERCA2a were detected by immunoblot analysis using an anti-SERCA2a antibody. S-SERCA2a: SUMOylated SERCA2a.



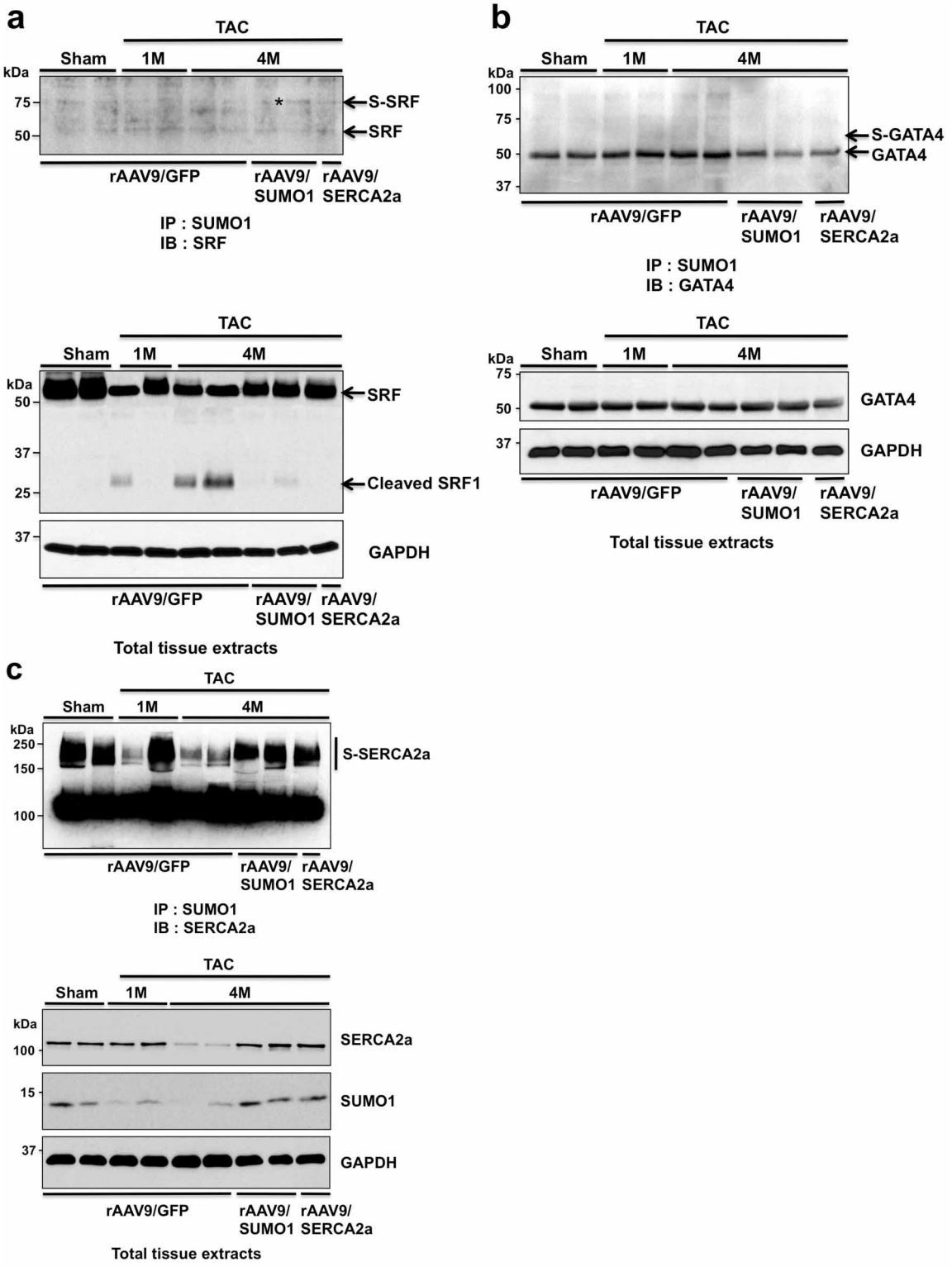
Supplementary Figure 7. Hemodynamic analyses of SUMO1 transgenic mice both in sham and TAC operation groups. Systolic and diastolic function was determined in SUMO1 transgenic mice by pressure-volume analysis. At 3 month of TAC, the loops shifted rightward. The end-systolic pressure-volume relationship (ESPVR) in the LV was slightly steeper in TG animals than in WT, suggesting increased cardiac contractility. By contrast, the slope of the LV end-diastolic pressure-volume relationship (EDPVR) was decreased in TG mice, indicating a decreased end-diastolic LV chamber stiffness. WT [wild type littermate]-sham: black; TG [SUMO1 transgenic mice]-sham: blue; WT-TAC: red; TG-TAC, green.



Supplementary Figure 8. Dose-dependent effects of rAAV vectors containing shRNA against *SUMO1*.

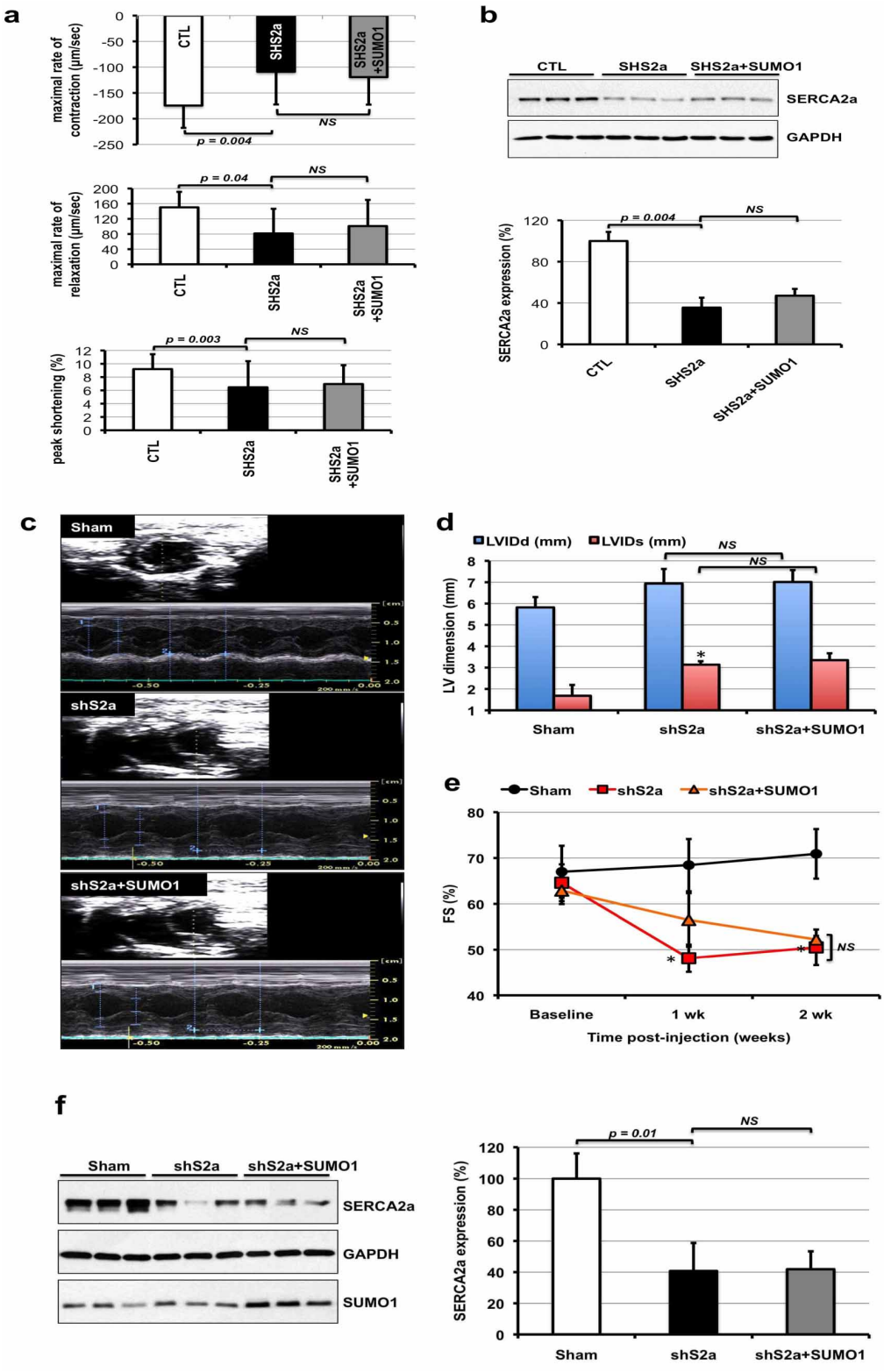
(**a**) SUMO1 shRNA construct design. A recombinant AAV was designed to express a SUMO1 shRNA under control of the U6 promoter. As a control, a scramble expression cassette was cloned into the same viral vectors.

(**b**) Representative immunoblot analysis of cardiac tissue extracts from mice infected with rAAV9 expressing scrambled control shRNA (rAAV9/SC) or shRNA against *SUMO1* (rAAV9/shSUMO1) 3 weeks after injection (left panel). Total extracts were probed with the indicated antibodies, and the level of inhibition of cardiac SUMO1 expression was measured (5 x 10^{10} vg/mice per each group, *n*=5 per each group, right panel).
(**c**) Representative pressure-volume loops from a rAAV9/shSC and rAAV9/shSUMO1 injected mice. Pressure-volume loops are measured before and during transient inferior vena cava occlusion. SUMO1 down-regulation by rAAV9/shSUMO1 injection induced a rightward shift and decreased the slope of the linear fit line of the ESPVR. More severe effects were occurred when we injected an increased dose of rAAV9/shSUMO1.
(**d**) Quantitative analysis of echocardiographic assessments including internal diameters in end-diastole (LVIDd), end-systole (LVIDs), fractional shortening (FS), and ejection fraction (EF). rAAV9/shSC (5 x 10^{10} vg/mice, *n*=14); lower dose of rAAV9/shSUMO1 (3 x 10^{10} vg/mice, *n*=14); higher dose of rAAV9/shSUMO1 (5 x 10^{10} vg/mice, *n*=12).
(**e**) SUMOylation of SERCA2a. Cardiac tissues were immunoprecipitated with anti-SUMO1 antibody. SUMOylated forms of SERCA2a were detected by immunoblot analysis using an anti-SERCA2a antibody. Representative immunoblots and protein quantification results are shown (*n*=6 per each group).
(**f**) ATPase activity of SERCA2a. Ca^{2+}-dependence of SERCA2a's ATPase activity is measured in preparations from scramble injected (●) and shRNA against SUMO1 injected hearts with 3 x 10^{10} vg/mice (●) and 5 x 10^{10} vg/mice (▾) (*n*=3 per each group).
All data represent means ± SD. * $p < 0.05$; ** $p < 0.001$ vs. respective control using Student *t*-test.



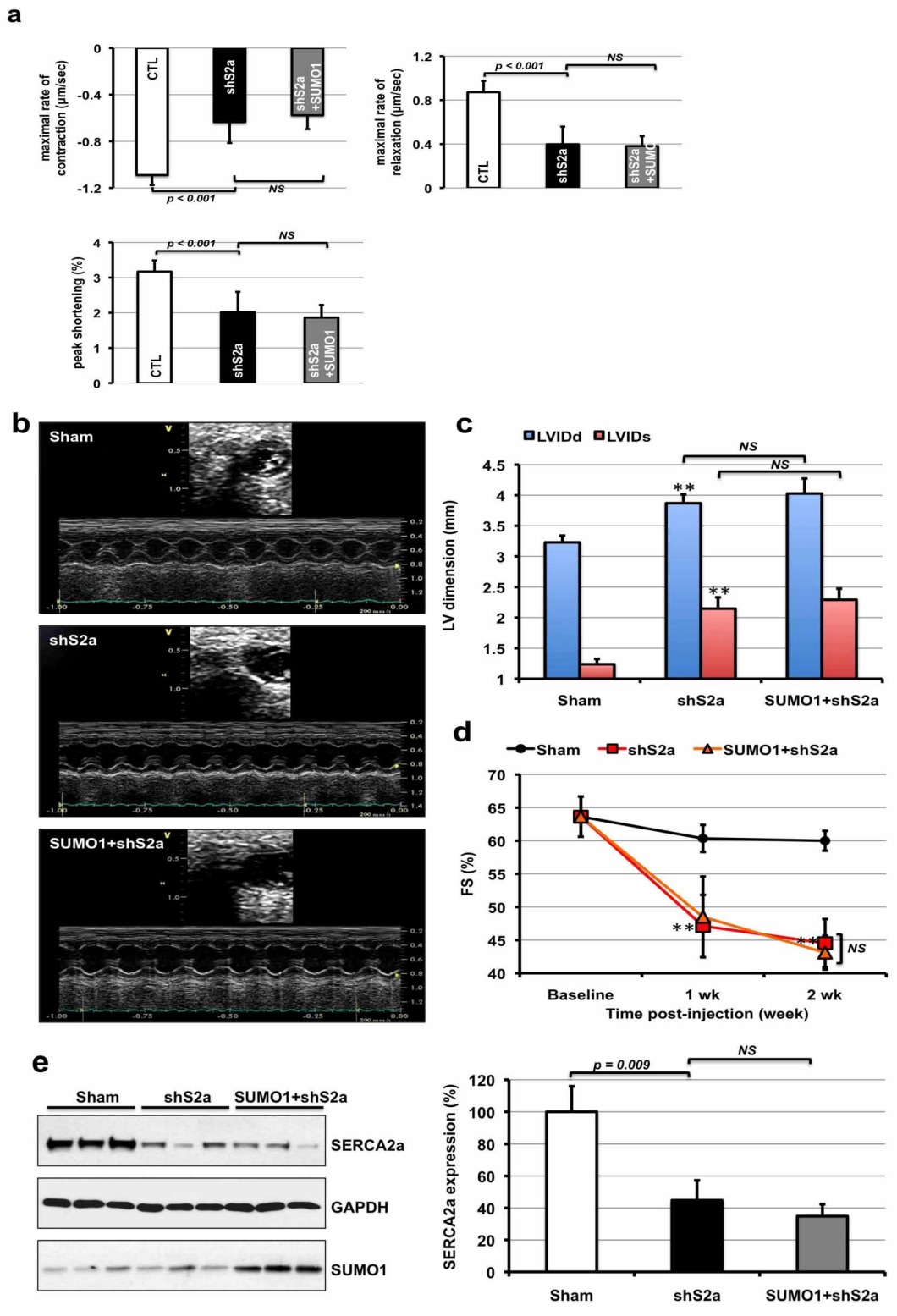
Supplementray Figure 9. Effects of AAV-mediated SUMO1 gene delivery on SUMOylations of known cardiac transcriptional factors such as SRF (**a**), GATA4 (**b**), and SERCA2a (**c**). Cardiac tissues were immunoprecipitated with anti-SUMO1 agarose.

SUMOylated forms of SRF, GATA4, and SERCA2a were detected by immunoblotting using its primary antibodies.



Supplementary Figure 10. shRNA-mediated loss of SERCA2a impairs rodent cardiac function.

(**a**) Contractile properties of isolated rat cardiomyocytes. Maximal rate of contraction, relaxation and cell shortening were measured by IonOptix system. Values are means ± SD; *n* = 20 cells per group.
(**b**) Immunoblotting for SERCA2a was performed with total lysates from the isolated rat cardiomyocytes at 5 days after viral infection. Lower right hand panel shows quantification of SERCA2a in the three different groups of cells.
(**c**) Representative M-mode echocardiography showing dilated left ventricle end diastole and systole in SERCA2a shRNA injected hearts, without or with SUMO1 overexpression compared with sham control.
(**d**) Evaluation of cardiac parameters: LVIDd in mm and LVIDs in mm (n=3 rats per each group).
(**e**) Fractional shortening measured at two different time points.
(**f**) Immunoblots of SERCA2a expression. Values are mean ± SD; * $p < 0.05$ versus sham control; NS, no significant.



Supplementary Figure 11. shRNA-mediated loss of SERCA2a impairs murine cardiac function.

(**a**) Contractile properties of isolated mouse cardiomyocytes. Maximal rate of contraction, relaxation and cell shortening were measured by IonOptix system. Values are means ± SD; $n = 20$ cells per group.
(**b**) Representative M-mode echocardiography showing dilated left ventricle at end-diastole and end-systole in SERCA2a shRNA injected heart, without or with SUMO1 overexpression in comparison with sham control at 2 weeks after SERCA2a shRNA injection.
(**c**) Evaluation of cardiac function in six SERCA2a shRNA injected mice, four SERCA2a shRNA with SUMO1 co-injected mice and six age-matched sham control mice, showing left ventricular dimensions such as LVIDd in mm and LVIDs in mm.
(**d**) Fractional shortening measured at two different time points.
(**e**) Immunoblots of SERCA2a expression. Values are mean ± SD; ** $p < 0.001$ versus sham control; NS, no significant.

Supplementary Table 1. Echocardiographic parameters for SUMO1 gene transfer mice. Data represent the mean value ± SD of cardiac functional parameters after 4 month TAC operation. LVIDd, left ventricular internal dimension-diastole; LVIDs, left ventricular internal dimension-systole; FS, fractional shortening; EF, ejection fraction; HR, heart rate. * $p < 0.05$; ** $p < 0.001$vs. rAAV9/GFP in TAC.

	Sham	**TAC**		
	rAAV9/GFP (*n*=12)	**rAAV9/GFP** (*n*=10)	**rAAV9/SUMO1** (*n*=14)	**rAAV9/SERCA2a** (*n*=12)
LVIDd (mm)	3.40 ± 0.10	5.13 ± 0.57	3.33 ± 0.38*	3.46 ± 0.58**
LIVDs (mm)	1.50 ± 0.30	4.08 ± 0.71	1.55 ± 0.31**	1.53 ± 0.30**
FS (%)	55.13 ± 1.50	21.11 ± 1.71	53.50 ± 5.03**	55.42 ± 2.05**
EF (%)	90.28 ± 1.02	48.50 ± 9.74	88.94 ±3.70**	90.44 ± 1.35**
HR (BPM)	618.18 ± 41.70	589.16 ± 40.33	658.51 ± 32.35	629.34 ± 48.36

Supplementary Table 2. Hemodynamic parameters for SUMO1 gene transfer mice. All values represent mean ± SD. ESPVR slope; relationship between end-systolic pressure and volume; EDPVR slope; end-diastolic pressure-volume relationship; Pmax, maximum pressure point, Pmin, minimum pressure point, Pmax, maximum dP/dt; Pmin, minimum dP/dt; EDV, left ventricular end-diastolic volume; ESV, left ventricular end-systolic volume; SV, stroke volume; HR, heart rate (beats/min). Heart weight (HW) to Body weight (BW) ratio in mice was measured. * $p < 0.05$ vs. rAAV9/GFP in TAC.

	Sham	**TAC**		
	rAAV9/GFP (*n*=3)	**rAAV9/GFP** (*n*=3)	**rAAV9/SUMO1** (*n* =3)	**rAAV9/SERCA2a** (*n* =3)
ESPVR slope (mmHg/µl)	4.48 ± 0.63	1.15 ± 0.58	4.33 ± 0.90*	4.56 ± 0.68*
EDPVR slope (mmHg/µl)	0.03 ± 0.02	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.02
Pmax (mmHg)	69.50 ± 2.51	102.50 ± 46.66	100.11 ± 31.22	115.66 ± 20.20
Pmin (mmHg)	4.00 ± 1.41	13.50 ± 1.41	8.27 ± 6.72	17.70 ± 5.33*
dPmax	4195.75 ± 2526.84	5761.83 ± 2439.28	4912.50 ± 1183.56	5560.48 ± 161.82
dPmin	-3825.25 ± 2807.56	-4995.83 ±1849.55	-4240.00 ± 1331.69	-4729.75 ± 529.59
EDV (µl)	58.75 ± 10.96	124.00 ± 6.36	54.24 ± 12.12*	50.80 ± 22.09*
ESV (µl)	20.91 ± 9.31	98.25 ± 26.51	21.91 ± 12.93*	27.94 ±12.53*
SV (µl)	39.00 ± 2.82	42.50 ± 16.97	37.76 ± 1.74*	37.33 ± 9.01*
HR (bpm)	522.50 ± 40.30	440.25 ± 20.15	528.12 ± 33.44	567.71 ± 76.17
HW/BW (mg/g) (*n*=10)	3.97 ± 0.24	8.57 ± 2.77	4.15 ± 0.66*	4.15 ± 1.24*

Supplementary Table 3. Echocardiographic parameters for SUMO1 transgenic mice with or without tamoxifen administration. Data represent the mean value ± SD of cardiac functional parameters after 1 month of tamoxifen treatment. WT, wild type littermate; TG, SUMO1 transgenic mice; TAM, tamoxifen; LVIDd, left ventricular internal dimension-diastole; LVIDs, left ventricular internal dimension-systole; FS, fractional shortening; EF, ejection fraction; HR, heart rate.

	WT		**TG**	
	TAM (-) (*n*=3)	**TAM (+)** (*n*=3)	**TAM (-)** (*n*=3)	**TAM (+)** (*n*=3)
LVIDd (mm)	3.26 ± 0.11	3.13 ± 0.05	3.33 ± 0.11	2.90 ± 0.34
LIVDs (mm)	1.26 ± 0.05	1.30 ± 0.20	1.30 ± 0.10	1.02 ± 0.22
FS (%)	61.46 ± 1.46	58.87 ± 5.00	61.40 ± 1.55	65.5 ± 3.74
EF (%)	93.80 ± 0.69	92.32 ± 2.79	93.76 ± 0.74	95.46 ± 1.44
HR (BPM)	630.43 ± 44.48	601.69 ± 22.35	562.45 ± 48.66	521.28 ± 35.65

Supplementary Table 4. Echocardiographic parameters for SUMO1 transgenic mice after TAM-induced SUMO1 overexpression at 3 month post-TAC. Data represent the mean value ± SD of cardiac functional parameters. WT, wild type littermate; TG, SUMO1 transgenic mice; TAM, tamoxifen; LVIDd, left ventricular internal dimension-diastole; LVIDs, left ventricular internal dimension-systole; FS, fractional shortening; EF, ejection fraction; HR, heart rate. ** $p < 0.001$ vs. WT in TAC.

	2M post-TAC		**3M post-TAC (+TAM)**	
	WT (*n*=12)	**TG** (*n*=10)	**WT** (*n*=14)	**TG** (*n*=12)
LVIDd (mm)	4.20 ± 0.56	3.76 ± 0.47	4.40 ± 0.57	3.24 ± 0.33**
LIVDs (mm)	2.60 ± 0.70	2.33 ± 0.61	2.93 ± 0.54	1.44 ± 0.30**
FS (%)	41.23 ± 7.35	37.40 ± 8.54	34.30 ± 5.56	55.91 ± 6.70**
EF (%)	77.84 ± 8.06	73.27 ± 1.53	69.57 ± 7.28	90.26 ± 4.27**
HR (BPM)	620.14 ± 30.65	593.60 ± 65.17	620.72 ± 42.60	550.18 ± 68.48

Supplementary Table 5. Hemodynamic parameters based on *in vivo* pressure-volume relationships for SUMO1 transgenic mice. All values represent mean ± SD. ESPVR slope; relationship between end-systolic pressure and volume; EDPVR slope; end-diastolic pressure-volume relationship; Pmax, maximum pressure point, Pmin, minimum pressure point, Pmax, maximum dP/dt; Pmin, minimum dP/dt; EDV, left ventricular end-diastolic volume; ESV, left ventricular end-systolic volume; SV, stroke volume; HR, heart rate (beats/min). Heart weight (HW) to Body weight (BW) ratio in mice was measured. * $p < 0.05$ vs. WT in TAC.

	Sham		**TAC**	
	WT (*n*=5)	**TG** (*n*=5)	**WT** (*n*=5)	**TG** (*n*=3)
ESPVR slope (mmHg/µl)	4.42 ± 1.07	6.12 ± 1.74	2.56 ± 0.71	4.33 ± 1.49*
EDPVR slope (mmHg/µl)	0.07 ± 0.05	0.12 ± 0.07	0.08 ± 0.04	0.03 ± 0.01
Pmax (mmHg)	56.37 ± 3.90	65.3 ± 9.68	98.90 ±15.06	102.66 ± 8.95*
Pmin (mmHg)	3.89 ±1.93	6.50 ± 2.01	4.30 ± 3.30	12.30 ± 1.50
dPmax	2708.73 ± 765.78	3730.10 ± 920.805	3751.80 ± 741.41	4745.33 ± 475.31
dPmin	-2035.03 ± 749.19	-3004.20 ± 918.61	-3535.80 ± 718.18	-2853.50 ± 351.98
EDV (µl)	50.08 ± 4.17	53.40 ± 14.34	120.90 ± 13.35	62.09 ± 22.76
ESV (µl)	27.89 ± 6.44	27.10 ± 9.94	85.40 ± 23.27	37.45 ± 26.87
SV (µl)	27.71 ± 6.97	33.60 ± 12.13	46.10 ± 11.40	26.90 ± 9.33*
HR (bpm)	437.34 ± 97.16	448.90 ± 72.55	441.00 ± 70.59	384.90 ± 38.66
HW/BW (mg/g) (*n*=10)	4.61 ± 0.45	4.20 ± 0.99	8.89 ± 0.36	7.34 ± 0.13*

Supplementary Table 6. Echocardiographic parameters for AAV9-mediated cardiac SUMO1 silencing mice. All values represent mean ± SD. LVIDd, left ventricular internal dimension-diastole; LVIDs, left ventricular internal dimension-systole; FS, fractional shortening; EF, ejection fraction; HR, heart rate. ** $p < 0.001$ vs. rAAV9/SC.

	rAAV9/SC	**rAAV9/shSUMO1**
	5×10^{10}	5×10^{10}
	(*n*=14)	(*n*=14)
LVIDd (mm)	1.30 ± 0.12	2.02 ± 0.17**
LIVDs (mm)	3.42 ± 0.19	3.85 ± 0.17**
FS (%)	61.77 ± 4.77	47.63 ± 3.07**
EF (%)	93.85 ± 1.23	84.51 ± 2.63**
HR (BPM)	569.88 ± 71.35	639.61 ± 50.38

Supplementary Table 7. Hemodynamic parameters for AAV9-mediated cardiac SUMO1 silencing mice. Summary of hemodynamic parameters in each group, measured using Scisense pressure–volume catheter. The data are expressed as mean values ± S.D. ESPVR slope; relationship between end-systolic pressure and volume; EDPVR slope; end-diastolic pressure-volume relationship; Pmax, maximum pressure point, Pmin, minimum pressure point, Pmax, maximum dP/dt; Pmin, minimum dP/dt; EDV, left ventricular end-diastolic volume; ESV, left ventricular end-systolic volume; CO, cardiac output; Ea, arterial elastance; HR, heart rate (beats/min). Heart weight (HW) to Body weight (BW) ratio in mice was measured. * $p < 0.05$; ** $p < 0.001$ vs. rAAV9/SC control group.

	rAAV9/SC 5×10^{10} (*n*=7)	**rAAV9/shSUMO1** 5×10^{10} (*n*=8)
ESPVR slope (mmHg/μl)	4.57 ± 0.74	0.96 ± 0.76**
EDPVR slope (mmHg/μl)	0.06 ± 0.05	0.06 ± 0.02
Pmax (mmHg)	73.22 ± 10.22	54.00 ± 9.53*
Pmin (mmHg)	7.55 ± 3.20	4.33 ± 2.08
dPmax (mmHg)	3797.02 ± 469.32	2554.6667 ± 471.28*
dPmin (mmHg)	-3264.56 ± 633.37	-2093.67 ± 553.37
EDV (μl)	48.36 ± 4.81	47.33 ± 2.51
ESV (μl)	24.33 ± 9.01	18.83 ± 9.46
SV (μl)	29.13 ± 2.23	30.66 ± 4.16
HR (bpm)	523.91 ± 101.88	492.00 ± 42.33
HW/BW (mg/g) (*n*=7)	4.19 ± 0.01	4.80 ± 0.10*

Supplementary Table 8. Echocardiographic parameters for shRNA-mediated SERCA2a silencing rat. Summary of cardiac function in lentiviral SERCA2a shRNA injected rats, with either adenoviral β-gal (shS2a) or adenoviral SUMO1 (shS2a+SUMO1). Age-matched sham-operated rat served as controls (n=3 per group). The data are expressed as mean values ± S.D. * $p < 0.05$; ** $p < 0.001$ versus sham control.

	Sham (*n*=3)	**shSERCA2a** (*n*=3)	**shSERCA2a + SUMO1** (*n*=3)
LVIDd (mm)	5.82 ± 0.48	6.94 ± 0.68	7.01 ± 0.55
LVIDs (mm)	1.68 ± 0.50	3.13 ± 0.16*	3.35 ± 0.32*
FS (%)	70.91 ± 5.7	51.56 ± 3.89*	52.22 ± 0.79*
EF (%)	86.52 ± 0.45	67.31 ± 2.67**	67.99 ± 0.63**
HR (BPM)	400.33 ± 27.53	437.40 ± 20.14	447.25 ± 42.83

Supplementary Table 9. Echocardiographic parameters for shRNA-mediated SERCA2a silencing mice. Evaluation of cardiac function in lentiviral SERCA2a shRNA injected mice, with either rAAV9/GFP (shS2a, n=6) or rAAV9/SUMO1 (SUMO1+shS2a, n=4). Age-matched sham-operated mice served as controls (n=4). The data are expressed as mean values ± S.D. ** $p < 0.001$ versus sham control.

	Sham (*n*=4)	**shSERCA2a** (*n*=6)	**SUMO1 +shSERCA2a** (*n*=4)
LVIDd (mm)	3.22 ± 0.11	3.87 ± 0.14**	4.02 ± 0.24**
LIVDs (mm)	1.23 ± 0.08	2.14 ± 0.18**	2.29 ± 0.18**
FS (%)	61.74 ± 1.53	44.54 ± 3.63**	43.11 ± 2.55**
EF (%)	93.94 ± 0.74	81.64 ± 3.62**	80.30 ± 2.66**
HR (BPM)	608.75 ± 26.57	640.80 ± 19.05	615.00 ± 41.18