Table S1. Group characteristics before resuscitation in rats of placebo and H_2 group.

	Placebo (n=9)	H_2 (n=9)
Weight, g	449.6 ± 8.9	462.7 ± 8.4
HR at baseline, bpm	297 ± 8	283 ± 7
MAP at baseline, mmHg	64 ± 4	58 ± 2
Central venous pressure, mmHg	3.4 ± 0.8	1.7 ± 0.3
Teso, ˚C	37.1 ± 0.1	37.2 ± 0.1
$dp/dt_{(max)}$, mmHg/s	2360 ± 347	2486 ± 312
$dp/dt_{(min)}$, mmHg/s	-1142 ± 227	-1074 ± 134
$EtCO_2$ at baseline, mmHg	42.3 ± 1.5	43.1 ± 1.9
Time from vecuronium injection to CA, min	3.1 ± 0.1	2.8 ± 0.2

Values are mean ± SEM. HR, heart rate; MAP, mean arterial pressure; Teso, esophageal temperature; $EtCO_2$, End-Tidal carbon dioxide; CA, cardiac arrest. There was no significant difference in parameters between each group.

Table S2. Physiological and interventional variables during ECPR in rats of placebo and H_2 group.

	Placebo (n=9)	H_2 (n=9)
At 10 min after starting of ECPR		
HR, bpm	304 ± 11	313 ± 11
MAP, mmHg	63 ± 8	58 ± 4
Central venous pressure, mmHg	5.7 ± 0.8	3.1 ± 0.8 *
Pump flow rate, mL/min	61.3 ± 7.3	64.8 ± 3.7
At 30 min after starting of ECPR		
HR, bpm	353 ± 12	361 ± 18
MAP, mmHg	126 ± 8	110 ± 11
Central venous pressure, mmHg	3.6 ± 0.7	2.2 ± 0.8
Pump flow rate, mL/min	14.0 ± 3.4	14.0 ± 2.9
Time from ECPR initiation to ROSC, min	5.2 ± 1.2	3.7 ± 0.7
Duration of PEA, min	3.6 ± 1.1	2.1 ± 0.7

Values are mean ± SEM. HR, heart rate; MAP, mean arterial pressure; CPB, cardiopulmonary bypass; ROSC, return of spontaneous circulation; PEA, pulseless electrical activity. * P=0.036 vs placebo.

Table S3. Detailed information of perturbed metabolites (VIP>1.0) among the groups (Placebo vs. Pre-CA, or H2 vs. Placebo).

Metabolites	VIP	log2(FC) *	p value
Placebo vs Pre-CA			
D-mannitol	1.363	8.667	5.48E-14
myo-inositol	1.328	2.034	8.29E-10
uric acid	1.321	4.143	2.19E-09
citraconic acid	1.315	2.698	4.65E-09
phosphoric acid	1.310	1.699	8.51E-09
succinic acid	1.305	2.018	1.57E-08
allantoin	1.304	8.112	1.84E-08
2-hydroxybutyric acid	1.285	2.528	8.84E-08
glycerol 3-phosphate	1.281	2.651	1.38E-07
glycerol	1.273	1.963	2.30E-07
dehydroascorbic acid	1.262	3.714	4.78E-07
benzoic acid	1.256	-1.529	1.25E-06
hippuric acid	1.233	4.026	2.60E-06
maltose	1.221	3.881	4.21E-06
D-threitol	1.192	3.488	1.29E-05
citrulline	1.191	-1.835	1.50E-05
ethanolamine	1.183	2.593	1.97E-05
gluconic acid	1.139	0.965	7.67E-05
L-ornithine	1.129	1.172	1.15E-04

L-tryptophan	1.125	-0.909	2.29E-04
1-Methylnicotinamide	1.123	2.051	1.08E-04
psicose	1.118	2.496	1.35E-04
lactamide	1.100	1.830	1.89E-04
L-glutamic acid (dehydrated)	1.099	0.980	1.92E-04
3-methyl-2-oxobutanoic acid	1.077	2.129	3.56E-04
phosphoethanolamine	1.074	2.060	3.49E-04
Inosine	1.017	-2.944	1.21E-03
H2 vs Placebo			
myo-inositol	2.162	0.638	3.03E-03
L-histidine	1.964	-0.963	1.82E-02
raffinose	1.827	1.013	1.73E-02
D-mannitol	1.694	0.275	3.06E-02
L-glutamic acid	1.646	-1.035	3.63E-02
n-acetylneuraminic acid	1.633	1.379	4.25E-02

* FC = Placebo/Pre-CA or H2/Placebo.

Table S4. Result from metabolite set enrichment analysis (MSEA).

	total	expected	hits	Raw p	Holm p	FDR
D-Glutamine and D-glutamate metabolism	6	0.02	2	1.93E-04	1.62E-02	1.62E-02
Histidine metabolism	16	0.06	2	1.52E-03	1.26E-01	6.37E-02
Galactose metabolism	27	0.11	2	4.35E-03	3.57E-01	1.22E-01
Aminoacyl-tRNA biosynthesis	48	0.19	2	1.35E-02	1.00E+00	2.83E-01
Nitrogen metabolism	6	0.02	1	2.35E-02	1.00E+00	3.94E-01
Ascorbate and aldarate metabolism	8	0.03	1	3.12E-02	1.00E+00	4.36E-01
Arginine biosynthesis	14	0.06	1	5.40E-02	1.00E+00	6.07E-01
Butanoate metabolism	15	0.06	1	5.78E-02	1.00E+00	6.07E-01
beta-Alanine metabolism	21	0.08	1	8.01E-02	1.00E+00	6.71E-01
Alanine, aspartate and glutamate metabolism	28	0.11	1	1.06E-01	1.00E+00	6.71E-01
Glutathione metabolism	28	0.11	1	1.06E-01	1.00E+00	6.71E-01
Phosphatidylinositol signaling system	28	0.11	1	1.06E-01	1.00E+00	6.71E-01
Inositol phosphate metabolism	30	0.12	1	1.13E-01	1.00E+00	6.71E-01
Porphyrin and chlorophyll metabolism	30	0.12	1	1.13E-01	1.00E+00	6.71E-01
Glyoxylate and dicarboxylate metabolism	32	0.13	1	1.20E-01	1.00E+00	6.71E-01
Amino sugar and nucleotide sugar metabolism	37	0.15	1	1.37E-01	1.00E+00	6.97E-01
Arginine and proline metabolism	38	0.15	1	1.41E-01	1.00E+00	6.97E-01