Exercise training attenuates aging-induced cell apoptosis in SD rat hearts

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Backgrounds:

Healthy problem is the major concern of aging population in present society. Exercise is considered one of the necessary methods to promote healthy in aged population. The effects and mechanisms against aging and heart protections in long-term exercise training are our main purpose in this research.

Materials and Methods:

We use intraperitioneal injection D-galactose (150mL/kgBW, 8 weeks) as an acute aging model and combined with or without the exercise training. Our exercise training prescription is swimming in warm water 60 min per day and five times per week. H & E staining assay was applied in tissue analysis. DAPI / TUNEL staining assay was used to evaluate the apoptosis cells ratio in tissue slides. Proteins extracts were analyzed by western blotting.

Results:

Table 1. Cardiac characteristics of Control, E group, A group and AE group.

Group	C (n=6)	E (n=5)	A (n=6)	AE (n=6)
BW (g)	527.33±40.67	485.80±66.41	548.67±49.11	484.17±37.32#
Tibia (mm)	46.13±0.34	46.62±0.77	47.57±0.58***	46.78±0.69
HW (g)	1.4916±0.14	1.6291±0.32	1.5852±0.09	1.6419±0.17
LVW (g)	1.0314±0.10	1.1122±0.22	1.1321±0.06	1.1312±0.11
HW/BW	**2.8900±0.21**	**3.3585±0.18***	**3.0276±0.10**	**3.3609±0.33***
LVW/BW	**1.9984±0.16**	**2.2929±0.10***	**2.1631±0.10**	**2.3127±0.18***
HW/Tibia(mg/mm)	32.2063±2.85	34.9121±6.22	33.4974±2.24	34.9964±3.10
LVW/Tibia(mg/mm)	22.2702±2.07	23.8377±4.26	23.9203±1.56	24.1102±2.11

Values are means ± SD among SD rats (Control), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).
*P<0.05, ** P<0.01, ***P<0.001 significant differences between Control and E or A and AE group. , # P<0.05 significant differences between A group and control or E and AE group.

Fig. 1

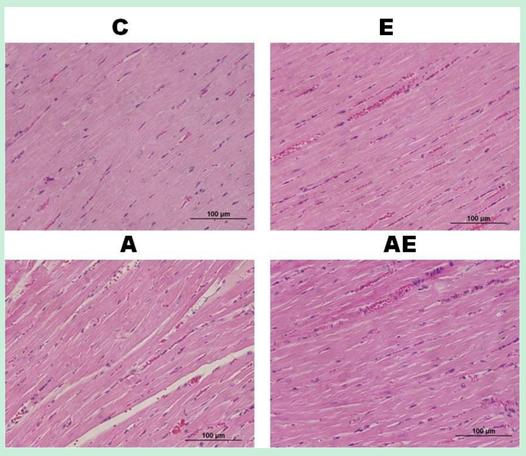

Fig.1 Hematoxylin and eosin stain, It representive histopathological analysis of cardiac sections from left ventricles in SD rat and aging rat with or with out exercise training . The images of myocardial architecture were magnified and ×400. Control (C), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).

Fig. 2

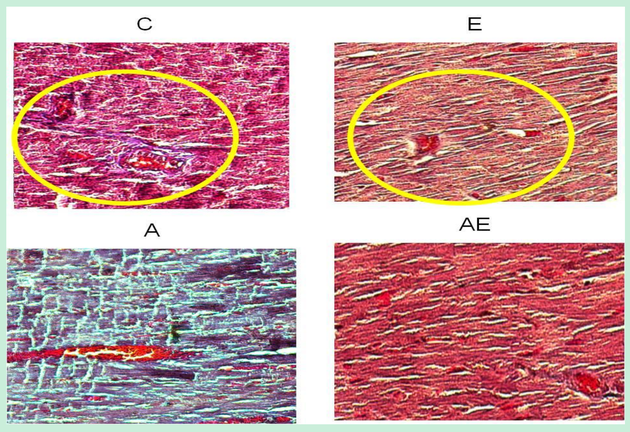

Fig.2 Masson's trichrome stain ,The collagen accumulation will reduce by exercise training compare with control group.
Control (C), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).

Fig. 3

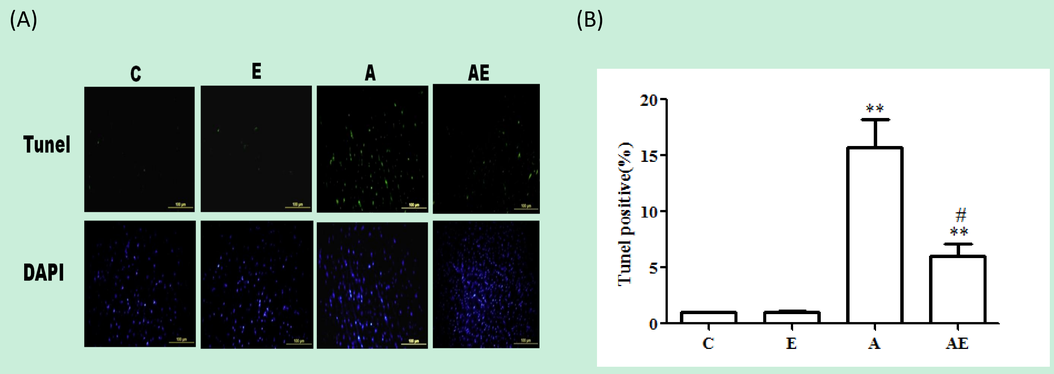

Fig.3 Tunel assay (A)Aging will induce DNA damage, and exercise traininng can attenuates aging-induced DNA damage in AE group. (B)The results were analyzed by one way analysis of variance (ANOVA).
Control(C), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).
*P<0.05, ** P<0.01 VS. control , # P<0.05 VS. aging

Fig. 4

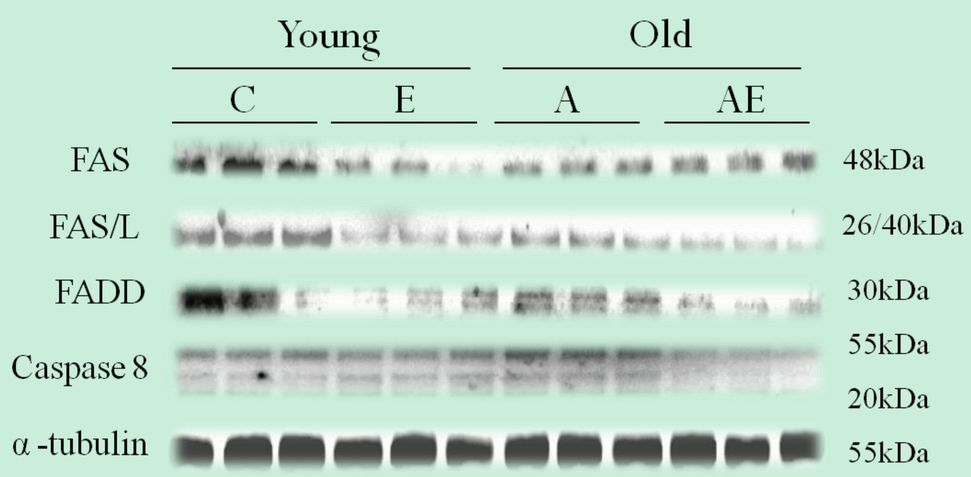

Fig.4. Fas receptor and FADD of Death-receptor dependent apoptotic pathway in heart tissue by western blots assay. Exercise training not only can reduce FAS and FAS/L protein expression in Yong group but also can decrease again-induced FAS/L and caspase 8 expression.

Fig. 5

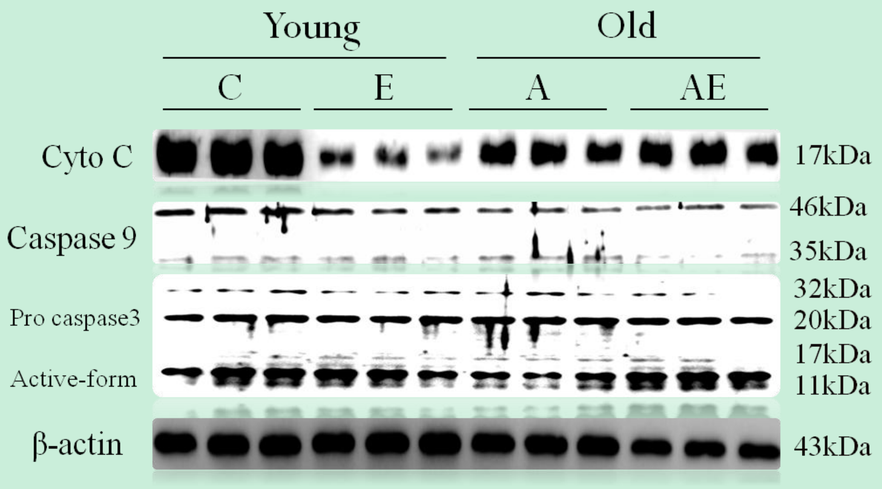

Fig.5. Mitochondrial dependent apoptotic pathway in heart tissue by western blots assay. Exercise training can reduce cytochrome C protein expression in Yong group.
Control (C), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).

Fig. 6

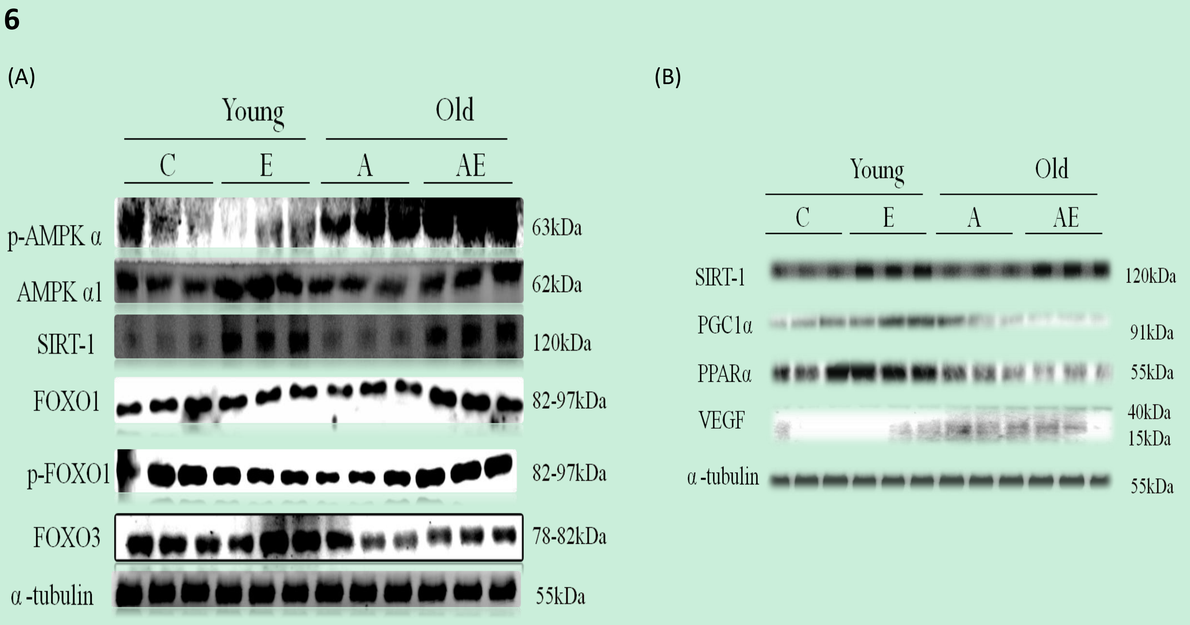

Fig.6 SIRT1 anti-aging signaling pathways in heart tissue by western blots assay. (A) Exercise training can induce AMPKα1, SIRT-1 and FOXOs protein expression. (B) Exercise training will increase PGC1α protein level. .
Control (C), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).

Fig. 7

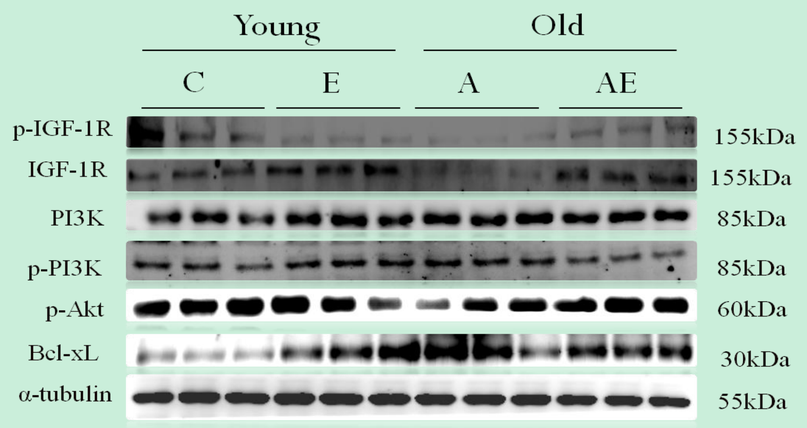

Fig.7 Survival pathway in heart tissue by western blots assay. Exercise training induced IGF-1R and Bcl-xL protein expression.
Control (C), exercise training rats (E) , D-galactose-induced aging rats (A) and aging rats with exercise training (AE).

Conclusion:

Our research results determined the situation of heart tissue senescence was similar between intraperitioneal injection D-galactose as an acute aging model and normal aging model. Long-term exercise training can enhance the SIRT1 anti-aging signaling pathways to protect heart tissue against aging. Our research results suggest that exercise can promote healthy and heart function in this aged population.