125. Effect of High Acceleration Forces and Anti-Gravity Maneuver For Cardiac Function in Fighter Pilots

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Body

Background: Environmental factors such as hypoxia and gravity affect to the human cardiovascular system. It's more important for fighter pilots exposed to high altitude, harsh accelerations, and anti-gravity maneuver similar to the Valsalva maneuver. Data evaluating the effect of high acceleration and Valsalva maneuver on the cardiac function has not been established. This study aimed to investigate the echocardiographic changes of fighter pilots exposed to high acceleration forces.

Methods: From 2019 to 2020, fighter pilots underwent regular health check-up and echocardiogram. Data from trainees who did not experience a flight were used for comparison. Echocardiographic data included left ventricle ejection fraction (LVEF), right ventricle systolic pressure (RVSP), inferior vena cava (IVC) diameter, and the tricuspid annular plane systolic excursion (TAPSE). The simple regression analysis was performed with total flight time as an independent variable, and also the multiple linear regression analysis was performed for TAPSE as a dependent variable.

Results: We enrolled 29 fighter pilots (41years; male, 100%; mean flight time 1821 hours) and 16 trainees. There was no significant differences in age, blood pressure, LVEF, RVSP, and the IVC collapsibility between fight pilots and trainees (table 1). In simple regression analysis, the total flight time had no meaningful effect on LVEF, RVSP, and TAPSE ($p=0.087$; 0.440; 0.357). In multiple linear regression analysis, TAPSE was affected by total flight time with positive correlation (table 2).

Conclusion: The experience of fighter pilots exposed to the high acceleration forces and Valsalva maneuver might be associated with right heart function change, but not associated with the risk of echocardiographic abnormality.

Table 1. Comparison of echocardiographic characteristics and clinical demographics between non-flight group and flight group

	Characteristics	All patients (n=45)	Non-flight group (n=16)	Flight-group (n=29)	P value
Clinical characteristic	Male(n(%))	45(100%)	16(100%)	29(100%)	-
	Age (year-old)	39.6±12.8	36.4±16.8	41.3±9.9	0.239
	Total flight time(hr)	-	-	1821.4±1186.4	-
	Height(m)	1.74±0.04	1.74±0.04	1.75±0.04	0.293
	Weight(kg)	74.4±9.5	70.0±8.0	76.9±9.5	0.010
	Alcohol(n(%))	33(73%)	10(63%)	23(79%)	0.296
	Smoke(n(%))	15(33%)	4(25%)	11(38%)	0.514
	Systolic BP(mmHg)	123.2±11.7	122.9±9.3	124.5±12.6	0.991
	Diastolic BP(mmHg)	77.9±7.8	80.5±7.6	76.5±7.7	0.103
Lab	Total cholesterol	182.0±45.9	164.0±33.9	191.9±49.1	0.009
	Fasting glucose	98.3±16.8	95.5±13.6	99.9±18.3	0.235
Echocardiographic findings	Aorta (mm)	27.7±4.0	27.9±4.5	27.5±3.7	0.887
	LA (mm)	35.4±4.9	34.2±3.6	36.0±5.4	0.221
	TR Vmax (m/s)	1.7±0.4	1.7±0.5	1.8±0.4	0.294
	RVSP (mmHg)	18.0±5.0	17.1±6.1	18.5±4.4	0.405
	PV Vmax (m/s)	0.8±0.1	0.8±0.1	0.8±0.1	0.532
	AV Vmax (m/s)	1.2±0.2	1.3±0.2	1.2±0.2	0.255
	IVS diastole (mm)	8.4±1.4	8.4±1.6	9.1±1.3	0.093
	LVPW diastole (mm)	8.8±1.2	8.2±1.3	9.1±1.1	0.053
	IVS systole (mm)	13.2±2.3	12.5±2.3	13.6±2.2	0.126
	LVPW systole (mm)	13.1±2.1	12.5±2.2	13.5±2.0	0.148
	Ejection fraction (%)	65.6±6.4	64.6±6.3	66.1±6.5	0.455
	E velocity (m/s)	0.7±0.2	0.7±0.1	0.7±0.3	0.353
	A velocity (m/s)	0.5±0.1	0.6±0.1	0.5±0.1	0.516
	IVC expiration (cm)	1.5±0.4	1.3±0.5	1.5±0.4	0.095
	IVC Inspiration (cm)	0.9±0.4	0.8±0.2	1.0±0.4	0.105
	IVC collapsibility (%)	38.9±16.0	40.1±19.0	38.3±14.3	0.522

LA, left atrium; TR, tricuspid regurgitation; PV, pulmonary valve; Vmax, max velocity; AV, aortic valve; IVS, interventricular septum; LVPW, left ventricular posterior wall

Table 2. Multiple linear regression analysis for TAPSE

Variable	Coefficient	Standard error	P value
AV Vmax(m/s)	-0.740	0.226	0.004
Total flight time (hr)	8.985E-5	<0.001	0.020

E-5, 10^{-5}

Clinical Implications: My study will help enable cardiovascular clinicians to know about the effect of high acceleration forces and anti-gravity maneuver for cardiac function in fighter pilots.