Short Research Article

Changes of pre ejection period and left ventricular ejection time during head up tilt

ABSTRACT

Objective of the study Evaluate changes in Pre ejection period(PEP) and left ventricular ejection time(LVET) during head up tilt (HUT).

Methods Twenty healthy male subjects were involved in this study, with mean age 29.3± 4.7 years, mean body mass index (BMI) 21.3 ± 0.2 Kg/m^2.Measurement of PEP, LVET of Doppler wave form of the aortic flow were done at supine, 30 and 60 degree HUT. Measurement of HR and BP also had been done at these different positions of tilting. Comparison of changes of these variables at different degrees of HUT had been done by paired T-Test.

Results PEP values were significantly higher in 60 degree and 30 degree HUT than PEP values at supine position ($p<0.0001$),and PEP values at 60 degree HUT were significantly higher than PEP values at 30 degree HUT($P=0.05$).

LVET values were statistically lower at 60 degree and 30 degree HUT than values at supine position ($p<0.001$) ,and LVET values were significantly lower at 60 degree HUT than values at 30 degree HUT ($p<0.001$).

Conclusion Key finding of PEP and LVET during HUT are progressive prolongation of PEP and shortening of LVET with increasing head up tilting.

Keywords HUT, LVET,PEP.

Introduction

Tilt table test (TTT) : TTT, over half a century old, has retained a central place in the investigation of syncope of unknown origin[1,2,3,4,5,6,7]. Since the differential diagnosis of syncope of unknown origin is widely spread, there have been many attempts to rationalize and improve the diagnostic procedure[8]. During HUT – or for that matter while standing – a person's cardiovascular system has to adjust itself in order to prevent a significant portion of the blood volume from pooling in the legs.

These adjustments consist of an increase in heart rate, and a constriction of the blood vessels in the legs. These cardiovascular adjustments occur very quickly, and there is no significant drop in the blood pressure [9]. The increase in heart rate of approximately 10-15 beats/min, an elevation of diastolic pressure of about 10mm Hg and little change in systolic pressure[10]. Evaluation the changes that occur in stroke volume, cardiac output, heart rate, and blood pressure during HUT, have been studied and illustrated in details, so the present study focused on the changes that occurred in LVET and PEP during different degree of tilting .

MATERIALS AND METHODS

SUBJECTS Twenty healthy male subjects were involved in this study, after having their signed consent and approval of the ethical committee at Kufa faculty of medicine. with mean age 29.3± 4.7 years, BMI 21.3 ± 0.2 Kg/m^2. The subjects were thoroughly examined clinically to confirm the inclusion criteria. Exclusion criteria included hypertension, diabetes mellitus, coronary heart disease and other cardiac problems, renal disease. None was on any medication.

APPARATUS

Tilting table: A motorized tilt table. All TTT were performed in quite air conditioned room especially equipped for the investigation [11] .

Echocardiography equipment All echocardiographic and Doppler studies were performed using two-dimensional (2D) Philips Sonos 7500 equipment with 2.5 MHZ transducer with tissue harmoni, incorporated ECG, and Doppler facilities for measurement of PEP and LVET .

METHODS

To avoid any possible emotional excitement, reassurance of the subjects were done , of being safe and non invasive procedure .

Participants were examined in a quiet, temperature-controlled room, and were first supine positioned on belt secured tilting table, for at least 10-min. to achieve a steady state. A steady state means that heart rate in consecutive minutes changes by less than 3 beats/min[12] . Pulse oximeter (portable battery oximeter- nonin-USA) was fixed on right index so as to digitally follow up the changes in arterial pulse to gain a steady state, and to record the HR. After reaching the steady state, we placed the transducer on the apex to get apical view and use the continues wave Doppler for aorta . From aortic flow ,PEP were estimated from Q-wave in ECG to the opening of aortic valve ,estimation of LVET time between opening and closure of aortic valve[13]. several measurements for PEP and LVET were made ,then taking the mean for them . After that we raised the subject to 30 degree by tilt table and wait till reach steady state by examining the pulseoximeter, then The same parameters were measured again. After that we return the subject to supine position . Raising the subject to 60 degree HUT and same previous measurements were done. Measurement of blood pressure had been done at supine, 30 and 60 degree HUT.

Statistical analysis: All values were expressed as mean ±SD. Comparison between PEP , LVET HR, SBP, DBP and MBP ,at supine position and different degrees of HUT were done by paired t-test . $p<0.05$ was considered statistically significant and $P<0.001$ was considered statistically highly significant.

Results All hemodynamic parameters were expressed as mean ± SD, at different degrees of tilting, at table-1.

PEP values were significantly higher in 60 degree and 30 degree HUT than PEP values at supine position ($p<0.0001$),and PEP values at 60 degree HUT were significantly higher than PEP values at 30 degree HUT($P=0.05$).

LVET values were statistically lower at 60 degree and 30 degree HUT than values at supine position ($p<0.001$) ,and LVET values were significantly lower at 60 degree HUT than values at 30 degree HUT ($p<0.001$). HR values were significantly higher at 30 degree and 60degree HUT than values at supine position, and HR values at 60 degree HUT were significantly higher than HR values at 30 degree HUT ($P<0.001$).

There were no statistically significant differences between SBP values at supine and 30 and 60 degree HUT($P>0.05$).

DBP and MBP values were significantly higher at 30 degree and 60 degree HUT than values at supine position ($p=0.05$,$p<0.001$) respectively. DBP and MBP values at 60 degree were significantly higher at 60 degree HUT than values at 30 degree HUT($P=0.05$).

Table-1 Hemodynamic parameters at different degrees of HUT (expressed as mean ± SD)

Parameters	Supine	30 degree HUT	60degreeHUT
PEP(ms)	61.35±14.17	82.3±16	90.20±20.5
LVET(ms)	307.5±26.8	267.18±20.11	240.6±19.1
HR(beat/min)	69±8.78	73.11±8.98	83.64±9.14
SBP(mmHg)	126±7.64	127.7±7.8	126.9±10.88

DBP(mmHg)	77.1±5.4	79.47±5.68	83.58±8.17
MBP(mmHg)	93±5.51	96.41±41	98±64±7.59

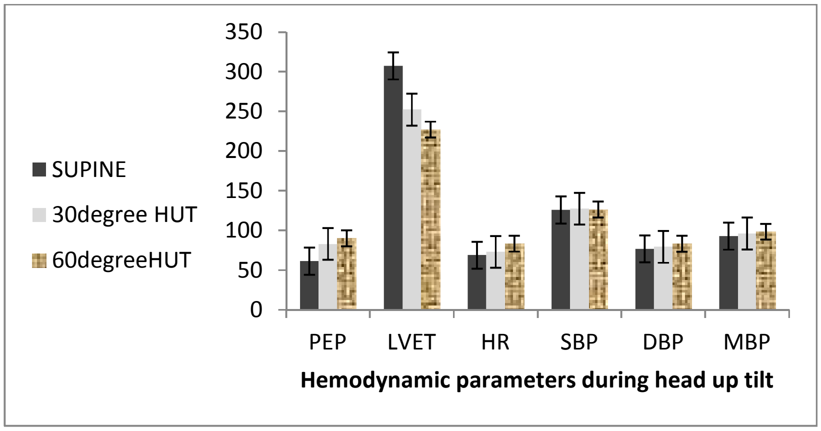

Figure 1 Hemodynamic parameters at supine. 30 and 60 degree HUT.

Discussion

The important findings of this study were the progressive reduction of LVET and prolongation of PEP with increasing tilting, which reflect a decline in central blood volume [14,15,16,17,18]. This reduction of central blood volume are due to pooling about 300-800ml of blood to the lower extremities by effect of gravity during HUT[19,20] . prolongation of PEP and shortening of LVET were more pronounced at 60 degree HUT than 30 degree HUT, this could be explained that are more tilting leads to more pooling of blood to the lower extremities and reduction of cardiac preload .This in agreement with other studies like Chan et al., in 2007 found that there was a significant increase in PEP at (20-30 degrees) HUT[21]. In 2008, Chan et al., found that there was a significant decrease in LVET during HUT[[22].

Pooling of blood during HUT will cause stimulation of baroreceptors and Increase sympathetic activity which will cause increase cardiac contractility, increase HR, and vasoconstriction.[23,24,25,26,27,28] .

A 60^{o} HUT maximize passive orthostatic stress on the sympathetic system by blocking the influence of inferior limb musculoskeletal contractions that could increase venous return [29] . For that reason, maximum sympathetic activity are at 60 degree HUT, so HR and diastolic BP and MBP values were significantly higher at 60 degree HUT than values at supine and 30 degree HUT.

There were no differences in SBP values at different degrees of tilting due to increased sympathetic activity that compensated for reduction of cardiac output.

Conclusion Key finding of PEP and LVET during HUT are progressive prolongation of PEP and shortening of LVET with increasing head up tilting.

ABBREVIATION BMI-body mass index, BP-blood pressure, DBP-diastolic blood pressure, LVET-left ventricular ejection time, PEP-pre ejection period, SBP-systolic blood pressure, TTT-tilt table test.

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