



## Diagnostic utility of the head-up tilt test in syncope and the related complications

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### Abstract

**Background:** Recurrent syncope is a distressing symptom in which the cause may remain undetermined. A definitive diagnosis may help the patients to lead a normal life and avoid the unnecessary risk to their lives.

**Objective:** To evaluate the effectiveness and safety of Head up Tilt Test (HUTT) in patients with undiagnosed syncope and to detect and follow up any complications arising out of the procedure.

**Material and methods:** The head up tilt table test was performed in department of cardiology. 72 patients with a history of syncope or presyncope underwent upright tilt table testing to exclude vasovagal syncope, with baseline tilt and if negative followed by progressively increasing doses of isoprenaline infusion. 70° tilt was used and continuous heart rate and non-invasive BP recordings were made every 2 minutes or earlier when symptomatic.

**Results:** The mean age of the patients was 48±16 years. None of the patients had carotid sinus hypersensitivity. Forty-five patients (62.5%) were positive for syncope. Four (5.55 %) were positive during the baseline tilt and forty-one (56.9%) were positive with the use of isoprenaline during tilt. The majority of positive responses were mixed 23 (51.11%), 17(37.77%) were vasodepressor and 5(11.11%) were cardioinhibitory. The mean time to syncope was 31.84 ± 8.0 minutes. There was a mean drop of 55.65 mmHg in systolic blood pressure and 36.06 mmHg in diastolic blood pressure in the positive group (p = <0.001 for both). No statistical significance was observed as regards the age, sex and type of response. No significant untoward incidents were noted except partial seizures in one patient.

**Conclusion:** The head-up tilt test is a simple, non-invasive, relatively safe test which is useful in documenting objective measures of orthostatic hypotension that cannot be obtained in a clinical setting.

**Keywords:** Head Up Tilt Test, Isoprenaline, Vasovagal syncope, Bezold-jarisch reflex.

### Introduction

Syncope is a distressing symptom characterized by sudden loss of consciousness. However the cause may remain undetermined in 25% to 47% of patients.

<sup>[1]</sup>Current syncope classification as given by the

European Society of Cardiology, is a pathophysiological one and distinguishes three main categories of syncope: reflex/neurally mediated syncope (vasovagal, situational, carotid sinus syncope

and atypical forms), syncope due to orthostatic hypotension (primary or secondary autonomic failure, drug-induced orthostatic hypotension, volume depletion), and cardiac syncope (due to arrhythmia or structural disease).<sup>[2]</sup> Tilt testing for the investigation of syncope was introduced in 1986. Since then, it has propagated worldwide as a routine test to determine the cause of transient loss of consciousness.<sup>[3]</sup> Head-upright tilt table testing has been used by physiologists and physicians to study hemodynamic and neuroendocrine responses in hemorrhage, congestive heart failure, autonomic dysfunction and hypertension; and drug research.<sup>[4]</sup> It allows reproduction of syncope with simultaneous monitoring of physiologic parameters. Hence, it has been possible to learn much about syncope.<sup>[2]</sup>

Tilt-table testing examines the neurocardiovascular orthostatic response in a maximally controlled environment. With passive orthostasis, stress is maximized on the sympathetic system by blocking the influence of inferior limb musculoskeletal contractions that could increase venous return. The table angle, duration of tilting and addition of pharmacologic stimulation are all under the examiner's control.<sup>[5]</sup> Reduced baroreceptor sensitivity during head-up tilt test is valuable in predicting the recurrence of syncope, thus supporting its potential usefulness in the clinical management of patients.<sup>[6]</sup>

The most common indication for tilt table testing is to confirm a diagnosis of reflex syncope in patients in whom this diagnosis has been suspected but not confirmed by the initial evaluation.<sup>[2]</sup> This includes cases with a single unexplained syncope in a high-risk setting or those with multiple recurrent episodes when a cardiovascular cause has been reasonably excluded. Other indications include discrimination between reflex syncope and orthostatic hypotension<sup>[7]</sup> or falls,<sup>[8]</sup> between transient loss of consciousness with jerking movements and epilepsy,<sup>[9]</sup> and in patients with frequent episodes of transient loss of consciousness and suspicion of psychiatric problems.<sup>[10]</sup>

In the present study, we have tried to evaluate our experience on the clinical diagnostic usefulness of the head-up tilt test in relatively unscreened patients with syncope which can save the patients from burden of invasive investigations and to assess any complications related to the test.

## Materials and Methods

The head up tilt table test was performed in the department of cardiology, Batra Hospital, New Delhi. 72 patients aged 14-79 years with a history of syncope or presyncope underwent upright tilt table testing to exclude vasovagal syncope. None of the patients had carotid sinus hypersensitivity. Appropriate clearance from Institutional ethics committee was taken. A written preinformed consent was obtained from all the patients.

Patients were fasted at least 2 hours before the test. Auscultation was done for carotid bruits and carotid sinus massage was carried out on both sides and the electrocardiogram monitored continuously to rule out carotid sinus hypersensitivity. An intravenous indwelling cannula was inserted into one of the hand veins before the procedure and i.v fluids were kept ready should the need arise, and the patient allowed a pre test period of 15 to 20 minutes for equilibration. They were strapped to the tilt table and baseline recordings of the heart rate, blood pressure were made in the supine position and then with the table tilted to an angle of 70° to the horizontal, recordings were made every two minutes for twenty minutes or sooner if the patients became symptomatic. If the test was not positive at the end of 20 minutes, isoprenaline was infused intravenously while the patients remained tilted, starting at one microgram per minute and increasing by one microgram per minute every four minutes for twenty minutes up to a maximum of five micrograms per minute. The patient remained tilted in between each dose increment of isoprenaline. The recordings of the heart rate and blood pressure were made at every two minutes or earlier when the patients became symptomatic during isoprenaline infusion. If the test became positive at any time, it was terminated and the table was tilted down to supine or Trendelenberg position, and the patients given i.v fluids and monitored till symptoms subsided and the blood pressure and heart rate stabilized. The time interval was noted and charted together with the heart rate, blood pressure and the presence of any symptoms.<sup>[11]</sup>

The test was considered positive if the patient experienced syncope or presyncopal symptoms similar to the spontaneous episode of syncope, if there was slowing of the heart rate at the onset of symptoms or there was a drop of systolic pressure to less than or equal to 90 mmHg or by more than 50 mmHg from peak, associated with symptoms.<sup>[12]</sup>

**Statistical analysis**

The statistical analyses was done using Statistical Package for Social Sciences software (SPSS, Inc., Chicago, Illinois). Results are expressed as percentage and mean ± one standard deviation. Statistical significance was determined by using the paired student's t-test for continuous variables and Pearson chi square test with continuity correction. Statistical significance was attributed to  $p < 0.05$ .

**Results**

A total of 73 Head-up tilt tests were done on 72 patients {53 male (73.6%) and 19 (26.38%) female}. One patient with initial test negative underwent repeat test 3 days later and again had negative tilt test. The mean age of the patients was  $48 \pm 16$  years (range 14-79 years). The patients were divided into positive and negative groups. Forty-five patients (62.5%) were positive for syncope. Four (5.55 %) were positive during the baseline tilt and forty-one (56.9%) were positive with the use of isoprenaline during tilt. The mean time to syncope was  $31.84 \pm 8.0$  minutes. No

statistical association was observed in time to syncope with response type ( $p = 2.39$ , Pearson chi – square). The majority of positive responses were mixed 23 (51.11%), 17 (37.77%) were purely vasodepressor and 5 (11.11%) were purely cardioinhibitory. (Table 2)

There was a mean drop of 55.65 mmHg in systolic blood pressure and 36.06 mmHg in diastolic blood pressure in the positive group (paired t-test  $p = <0.001$  for both) (Table 1). There was no significant difference in the frequency of positive responses between the sexes (60.37% of males versus 68.42% of females) ( $p = 0.534$ , Pearson chi - square).

Age had no influence on type of response ( $p = 0.260$ , Pearson chi – square). (Table 2) Two patients were noted to have autonomic dysfunction and seven patients had chronotropic incompetence in the positive group. No significant untoward incidents were noted except one of the patients with positive syncope who had partial seizures on being made supine in post test period. The most common complication observed was palpitations, occurring in 13 (18%) patients. (Table 3)

**Table 1 Results of positive tilt test**

	Before HUTT Mean±SD	After HUTT Mean±SD	Mean Change	P- Value
Heart Rate(bpm)	77.34 ±16	82 ± 33	5.10 ±23	$p > 0.05$
Systolic BP(mmHg)	128 ± 16	73 ± 13	55 ± 3	$P < 0.001$
Diastolic BP(mmHg)	78 ± 9	42 ± 10	36 ± 1	$P < 0.001$

**Table 2 Type of Response during Tilt test:**

Response	Number	Percent (%)	Age (mean) yrs.
Mixed	23	51.11	46.95 ( $p > 0.05$ )
Vasodepressor	17	37.77	50.41 ( $p > 0.05$ )
Cardioinhibitory	5	11.11	35.4 ( $p > 0.05$ )

**Table 3 Complications observed:**

Complication	Number (n)	Percent (%) of total patients
Palpitations	13	18
Nausea	4	5
Headache	2	2.7
Dyspnea	2	2.7
Chest tightness	1	1.3
Cough	1	1.3
Tinnitus	1	1.3
Partial seizures	1	1.3

## Discussion

Tilt table test is a safe and noninvasive tool for the differential diagnosis of syncope and orthostatic intolerance. Any malfunction of the autonomic system is manifested as either hypotension or bradycardia, when an orthostatic challenge is applied. The timing of the response to the orthostatic challenge and the predominant component of the response helps to differentiate between various forms of neurocardiogenic syncope, orthostatic hypotension and non-cardiovascular conditions (e.g., pseudosyncope). Drugs such as isoproterenol and nitrates increase the sensitivity of the test and sublingual nitrates can be used as an alternative.<sup>[13]</sup> Generally North Americans prefer isoprenaline while most Europeans use nitroglycerine. Both protocols when compared randomly in one of the studies showed similar results.<sup>[14, 15]</sup>

Spontaneous syncope and induced syncope in the tilt-table test are associated with similar premonitory signs and symptoms e.g nausea, redness, perspiration, and abdominal discomfort, marked pallor, bilateral mydriasis, and loss of postural tone.<sup>[16, 17]</sup> The temporal sequence of changes in blood pressure and heart rate during tilt induced syncope parallel those seen with spontaneous syncope.<sup>[18]</sup> Single-stage isoproterenol tilt table test has been found to be more effective in inducing a positive vasovagal response in an adult population than the standard (drug free) passive tilt table test, and it significantly reduced the procedural time.<sup>[19]</sup> These observations are in agreement with our study.

Minor side effects include palpitations with the use of isoprenaline. However, using isoprenaline protocols, high doses of the drug are well tolerated in only 62% of patients, must be reduced in 33% and discontinued in 4.2%. Side effects include tachycardia (45%), nausea (35%), chest pain (2.2%), arrhythmias (6%) including life-threatening ventricular arrhythmias, atrial fibrillation, seizures and vasospasm (10.3%).<sup>[20]</sup> Extremely prolonged asystoles have been reported, but are not considered a complication since this is an endpoint of the test.<sup>[21]</sup>

## Conclusion

Vasovagal syncope need no longer be a diagnosis by exclusion. The head-up tilt test is useful in patients with a variety of clinical manifestations induced by orthostatism. It is most useful in documenting objective measures of orthostatic hypotension. Patients considered for tilt test must be carefully selected to

enhance diagnostic value and simple clinical characteristics define the type of patient who is likely to have a positive tilt test and negative tilt test in whom other investigations should receive priority. It is a relatively safe procedure with some complications easy to manage and can save the patients from the burden of further invasive investigations.

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