https://doi.org/10.24207/jca.v38i1.3491

CLINICAL ARRHYTHMIA
Original Article

What are the characteristics and results of Tilt Tests in the elderly?

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ABSTRACT

Introduction: The elderly have several causes of syncope or pre-syncope. The importance of the Tilt Test (TT) has been questioned in this population. However, dysautonomic causes are common in these age groups, having an impact on morbidity and mortality. **Objective:** Compare the results of the TT between the age groups of the elderly (>=60 years) and the non-elderly. Methods: Cross-sectional study carried out between 2016-2021. We used the Mann-Whitney and Chi-square tests, with a p-value < 5% considered significant. The protocols used were Westminster or Italian. **Results:** We analyzed 2364 tilt tests, 61.7% female, aged 51.1 (31-71) years. Positivity was 32.6%, 37.2% with sensitization (p<0.0001). In the elderly group (EG), there were 958 tests (40.5%) and 1381 (58.4%) in the non-elderly (NEG). EG positivity was 270 (28.0%), lower than NEG with 524 (37.43%) (p<0.01). Positivity with sensitization in EG was 195 (20.35%)x 403(29.18%) in NEG (p<0.001). In EG, 50 patients (5.22%) had a dysautonomic response and in NEG, there were 10 (0.72%) (p<0.001). Complications were 4.2% EG x2.6% NEG (p=0.03). **Conclusion:** The TT in the elderly showed a lower incidence of positivity in the passive and sensitization phases compared to the non-elderly. Vasovagal causes were the most frequent causes in the elderly, had a higher incidence of dysautonomic responses, fewer prodromes and a higher rate of complications, however without severity.

KEYWORDS: Tilt-Table Test; Vasovagal Syncope; Aged.

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Received: May 06, 2023 | **Accepted:** Apr. 09, 2024

INTRODUCTION

Syncope is a symptomatic manifestation of pathophysiological mechanisms that result in an acute global decrease in cerebral perfusion. A transient and self-limited loss of consciousness characterizes it. Syncope can be caused by several mechanisms, such as orthostatic hypotension, neuromediated, and cardiac mechanisms (including arrhythmias and structural heart disease).

Performing the orthostatic tolerance test or Tilt Table test (TT) in the elderly can be an essential investigation strategy, particularly after excluding cardiac etiologies responsible for sudden death. Assessment with TT can help in the definitive diagnosis, in the institution of appropriate treatment, and in the recognition of susceptibility to early or late orthostatic hypotension in such a way that it can prevent complications arising from syncope and pre-syncope in the elderly[1-4].

The exam is relevant in identifying dysautonomic syndromes and differentiating them from epileptic conditions, as many elderly people present convulsive syncope due to cerebral hypoflow. The test also allows the investigation of hypersensitivity of the carotid sinuses in an upright position, which is associated with up to 20% of cases of syncope in the elderly[3,5].

Although TT has already been shown to provide relevant data in the investigation of syncope, its use has been criticized due to its sensitivity and specificity variability. Its importance has been questioned, especially after the advent of implantable cardiac monitors. The TT results do not have well-defined therapeutic implications and are limited in reproducibility.

Therefore, this study aimed to understand the characteristics, safety and effectiveness of Tilt test exams in elderly people and compare them with the results of non-elderly patients.

METHOD

This is a cross-sectional study, with analyses of consecutive TT exams carried out by 5 specialists in cardiac arrhythmias from 2016 to 2021 in a private specialized unit in the investigation of syncope (Syncope Unit), a reference in the region with experience in the carrying out these tests for 22 years.

The protocols used were the Westminster or Italian protocol, with a sensitization phase of 1.25 mg of sublingual isosorbide, used according to the doctor's assessment during the examination. No equipment was used for hemodynamic measurements in the TT, such as assessment of stroke volume, vascular resistance or cardiac output.

Requests for exams came from several other services and by professionals from different areas, such as clinicians, geriatricians, neurologists and cardiologists. The test was considered positive in the presence of significant hemodynamic changes (bradycardia and/or hypotension), especially if accompanied by symptoms. If symptoms were reproduced, the test was considered true positive, and the information was available in the report. In the presence of initial symptoms, the examination was immediately interrupted, and the table was returned to its normal position at zero degrees or to the Trendelenburg position if the patient presented symptoms and/or critical hemodynamic changes.

International classifications for response types during the exam were followed, divided into vasodepressor, cardioinhibitory, mixed, psychogenic or tachycardiac orthostatic postural syndrome (POTS) responses. Patients over 60 years of age were considered elderly, according to the World Health Organization for developing countries[6-9].

The examination room had cardiac resuscitation material, cardiac defibrillator, material for venous access, and intravenous hydration, and a specialist in cardiac arrhythmia and a nursing technician[6] monitored the examination.

The sensitization was chosen according to the doctor's request; however, it was done with strict judgment from the person carrying out the examination, aiming to minimize complications. Patients with baseline hypotension (systolic pressures less than 100 mmHg), who were very frail or who had recent or relevant clinical comorbidities were not sensitized. Patients with prior suspicion of dysautonomia or neurogenic orthostatic hypotension were also not sensitized in the first examination performed.

The test to investigate carotid sinus hypersensitivity was carried out following medical judgment, but this study did not analyze the results.

The variables concerning the normality test were analyzed using the Kolmogorov-Smirnov method. Normal variables were described as mean and their respective standard deviation, and non-normal variables as medians with their 25-75% interquartile ranges. Categorical variables were expressed as percentages and their standard deviations.

When applicable, comparative analyses were performed using the t-student or Mann-Whitney tests and chi-square for categorical variables, with a p-value less than 5% considered significant. Data were analyzed using Stata/SE version 12.1 (StataCorp LP, College Station, TX, USA).

The data described in the Declaration of Helsinki were strictly observed. The work was approved by the Ethics and Research Committee of the Federal University of Ceará/PROPESQ with opinion number 5.542.323 and CAAE 59920822.6.0000.5054.

RESULTS

2364 Tilt tests were analyzed, with 25 inconclusive data, totaling 2339 tests, 37.5% of the patients being male and 61.7% female, with a median age of 51.1 years (31-71). The overall positivity rate in the global population was 32.6%, 37.24% with pharmacological sensitization (p <0.001). The elderly group (EG), aged 60 years or over, had 958 patients, representing 40.5% of the tested population. Likewise, the non-elderly group (NEG) contained 1381 patients, equivalent to 58.4% of the total. 1619 (68.05%) were selected for pharmacological sensitization (Table 1).

Table 1. Exam results and types of hemodynamic responses from Tilts Tests comparatively between elderly and non-elderly people.

Variable	Total	EG (> 60 years)	NEG (< = 60 years)	*p-value*
Total number	2364*	958 (40,5%)	1381 (58,4%)	
Tilt test positive	789 (32,6%)	270 (28,00%)	524 (37,43%)	<0,0001
Tilt test normal	1550 (66,27%)	689 (71,92%)	861 (63,35%)	<0,0001
Tilt test sensitized	1619 (68,05%)**	612 (63,88%)	1002 (73,09%)	<0,0001
Positive tilt with sensitization	602 (37,24%)	195 (20,35%)	403 (29,18%)	<0.0001
Negative tilt with sensitization	1010 (62,62%)	416 (43,42%)	593 (42,93%)	0,7414
Response types				
Vasovagal	681 (29,12%)	221 (23,06%)	468 (33,89%)	<0.0001
Vasodepressor	380 (16,25%)	147 (15,34%)	233 (16,87%)	0,381
Mixed	275 (11,76%)	57 (5,95%)	218 (16,14%)	<0,0001
Cardioinhibitory	26 (1,11%)	9 (0,94%)	17 (1,23%)	0,5193
Pots	36 (1,54%)	4 (0,42%)	32 (2,32%)	0,0002
Psychogenic	12 (0,51%)	2 (0.21%)	10 (0,72%)	0,0854
Dysautonomic	60 (2,57%)	50 (5,22%)	10 (0,72%)	<0,0001
Complications	78 (3,29%)	41 (4,29%)	37 (2,68%)	0.0340

*Numerical variables expressed as mean ± SD or median (interquartile range); nominal variables expressed as number (%). *25 inconclusive answers or incomplete data. Percentages (%) refer to the proportions of the total number of exams in that age group. **p-value<0.01 for positivity with sensitization concerning non-sensitization.
Source: Elaborated by the authors.

As can be seen in Table 1, evaluating the positivity rate of each group, EG presented a lower percentage than that of NEG (p<0.0001), with 270 (28%) observed in EG with positive TT, in contrast to 524 (37.4%) in NEG. The elderly were subjected to less pharmacological sensitization, EG 612 (63.8%) x 1002 (73.09%) of NEG. When evaluating the results

of patients in each group when subjected to sensitization, the positivity rate in EG was 195 (20.35%), compared to 403 (29.18%) in NEG (p <0.001).

Regarding the type of response evidenced by each stratum, in the EG group, 50 (5.22%) patients had a dysautonomic response, while in the NEG, there were 10 (0.72%) dysautonomic responses (p<0.001). In EG, vasovagal response rates were also the most frequent causes, accounting for 221 (23.06%) cases, distributed as follows: vasodepressor (15.34%), cardioinhibitory (0.94%), mixed (5.95), while in NEG, the rates were 468 (33.89%), being vasodepressant in 16.87%, cardioinhibitory in 1.23%, and mixed in 16.14% (p<0.001).

Concerning the prodromes before the tests were positive, the NEG result that presented some symptoms was 323 (23.39%) patients, being higher than the percentage of EG prodromes 155 (16.17%) (p<0.001).

In the analyzed context, the total number of complications in the EG was 41 (4.29%), while that of the NEG was 37 (2.68%) (p=0.03), but with no record of serious events or the need for hospitalizations. The complications that occurred were nausea and vomiting, prolonged hypotension with or without the need for intravenous hydration, prolonged asystole with or without the need for rapid external massage, short-term convulsive movements, and a short period of confusional symptoms.

DISCUSSION

The work presented demonstrates the importance and safety of using the Tilt Test exam to investigate syncope/pre-syncope or postural dizziness in the elderly population, being a methodology that remains useful in the elderly.

Our main findings were the demonstration of the safety of TT in the elderly, a favorable profile with sensitization in the elderly that was lower than that of non-elderly people, differences in the types of response, with a higher percentage of dysautonomic-type patterns, fewer prodromal symptoms and a higher rate of complications in the elderly than in non-elderly people. Vasovagal responses were also the most common causes, although to a lesser extent than in younger people.

Positivity rates

The literature shows great variability in positivity percentages10; this depends on the chosen method and the target population. Considering the Westminster protocol, the review article by Macedo et al. estimates specificity rates with an average of 95% and sensitivity rates with a median of 31%, corroborating the general positivity rate present in this work[1,6].

To reduce the chances of false-positive results, the Italian protocol, with a sensitization phase, needs to be individualized by the doctor performing the exam and analyzing the patient's condition. Thus, in certain well-selected population groups, the active phase with sensitization can reach sensitivities between 57 and 87% and specificities between 70 and 100%[10,11]. In the present study, the positivity rate for patients undergoing this protocol was 37.24%, which may reflect a low pre-test probability of patients undergoing the exam. Our study had a percentage of females found, and the median age of patients was consistent with other studies using similar methodologies[1].

Among the critical findings of this study, it is essential to highlight that there is a lower passive and active positivity rate for non-elderly people. On the other hand, in the literature, elderly people without pre-existing cardiovascular disease and with recurrent and unexplained episodes of syncope have a higher pre-test probability of the test being positive. This age group is also related to worse long-term prognoses. It is also known that the reproducibility of TT in elderly people is more significant than in non-elderly people[1,12].

The sensitivity percentage of the test in the elderly may be similar to non-elderly patients with a protocol using sublingual nitroglycerin, with positivity in the active phase being higher in the elderly, especially those over 75 years of age[12-14].

Types of Responses

Elderly people have higher rates of dysautonomic responses than younger people, as well as more excellent patterns of hypotensive responses[14], due to the higher incidence of pathologies that can lead to dysfunctions of the autonomic nervous system, such as diabetes mellitus, Parkinson's disease, renal failure, neurodegenerative diseases, in addition to the more significant number of drugs in use. Knowing the mechanisms of syncope is very important for risk-stratifying patients and helping to make therapeutic choices[6-8], with evidence of improvement in care for these patients. In this context, elderly people without a described and established diagnosis presenting recurrent falls may suffer from high morbidity.[12,14].

As previously reported, the vasovagal response rates in EG attract much attention, corresponding to the highest response pattern in elderly patients whose TT was positive. Considering that 23.06% of the elderly presented a vasovagal response, 5, 22% showed a dysautonomic reaction. Cardioinhibitory responses may be less frequent in the elderly, although we did not find significant differences due to the low number in this group[14].

Reflex syncope is the most common diagnosis of syncope patients of all ages, including in the emergency department, although with a lower percentage in elderly people than non-elderly people. Vasovagal response rates in the senile group typically range from 31 to 34%[15].

TT can discriminate between symptomatic and asymptomatic patients, which is very important for diagnostic purposes. With the dissemination of TT as a tool for diagnosing vasovagal syncope, different tilt protocols began to be used, contributing to vital heterogeneity in test results. The sensitivity of TT and its sensitized phases may decrease with increasing age. However, it has been demonstrated that increasing age is associated with changes in maintaining blood pressure homeostasis due to age-related cardiovascular autonomic dysfunction[15].

In the aging process, we observe a compensation phase with increased vascular sympathetic regulation, then a reduction in baroreceptor sensitivity and a decrease in sympathetic and parasympathetic stimulation of the heart and peripheral vasculature. These mechanisms can lead to inadequate compensatory changes in heart rate in response to prolonged upright posture, favoring syncope. These reasons may justify the higher rates of dysautonomic reactions in the elderly than vasovagal responses[5].

No clinically significant complications, strokes, hospitalizations or deaths were recorded. These data confirm the safety of the exam in both the passive and active phases[12]. However, it is necessary to pay attention to possible contraindications before submitting the patient to the test, such as severe aortic stenosis[16,17], left ventricular obstruction, proximal coronary and severe cerebrovascular stenosis. The performance of the tests in the present study by doctors specializing in arrhythmia may have been responsible for the low rate of complications, even in more vulnerable groups such as the elderly.

These positivity rates presented in the study should not discourage the use of the method for diagnosing clinical conditions that are often difficult to diagnose, such as in investigations of syncope and pre-syncope, which may have diagnostic clarification rates of only 50% in the general population, being reduced with the advent of new research methods.

Criticism of performing the Tilt test as identifying only susceptibility to neuro-mediating phenomena does not seem valid to us as long as the guidelines for carrying out and interpreting the method are adequately followed, trying to demonstrate through the clinical history and symptoms during the examination that it deals with a result true positive.

Many elderly people do not present prodromes because they have difficulty perceiving them or, as in the cases of patients with dysautonomia, they are used to chronically low blood pressure in orthostasis, reporting symptoms mainly as fatigue, tiredness, effort intolerance, dizziness and some nausea. Sometimes, they can progress with syncope and do not report prodromes[12,13,16]. Therefore, the specialist's experience can be essential for a better definition.

This absence of symptoms before positivity is also considered a clinical predictor of high-risk syncope[18]. Also, according to guidelines, short prodromes or their absence, especially in the elderly or with heart disease, maybe more associated with cardiac causes of syncope. The reduction in the percentage of prodromes makes it challenging to report the clinical history accurately, and the presence of atypical characteristics establishes the importance of performing TT in the elderly[2,19]. Many of these cases can be diagnosed by TT without looper implantation. Elderly patients without prodromes do not necessarily present syncope/pre-syncope due to cardiac causes, as demonstrated in our study[13,20].

Limitations

This study was a cross-sectional study carried out in a single center, with professionals specialized in the area, in a non-hospital environment, with tests requested for different causes and by several other professionals, it presents a lot of heterogeneity, which may not represent the data from the general population and the population treated in emergencies or cardiology centers. The data, therefore, must be considered within the context of our study population; however, they reinforce that the method is safe and effective for the elderly.

This work did not consider evaluating carotid sinus hypersensitivity responses during the tilt test, and the test positivity may be higher in the general context.

CONCLUSION

TT in the elderly population showed a lower incidence of positivity in the passive and sensitized phases compared to younger people. Elderly people had a higher incidence of dysautonomic responses and complication rates than non-elderly people but without severity. Vasovagal responses were the most common TT results also in the elderly. TT proved safe and effective and should remain a complementary test in this age group's investigation of syncope or pre-syncope.

CONFLICT OF INTERESTS

Not applicable.

AUTHOR CONTRIBUTIONS

Substantial scientific and intellectual contributions to the study: Farias AGP, Filho AD, Holanda MA, Dantas AH, Freitas AA, Paiva RC, Kubrusly MS, Gondim DS, Vidal PBD, Maia FPA, Pinho LGB, Farias AGLP, Rocha EA; **Conception and design:** Dantas AH, Freitas AA, Paiva RC, Kubrusly MS, Rocha EA; **Data analysis and interpretation:** Holanda MA, Dantas AH, Freitas AA, Paiva RC, Kubrusly MS, Gondim DS, Vidal PBD; **Article writing:** Maia FPA, Pinho LGB, Farias AGLP, Rocha EA; **Critical review:** Maia FPA, Pinho LGB, Farias AGLP, Rocha EA; **Final approval:** Farias AGLP, Rocha EA

DATA STATEMENT AVAILABILITY

The data will be made available upon request.

FUNDINGS

Not applicable.

ACKNOWLEDGEMENTS

Not applicable

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