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Can we predict the risk of falls in elderly patients with instability?

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ABSTRACT

Objective: The aim of this study is to determine whether clinical and instrumental examination of balance can predict the risk of falls in elderly patients with instability.
Methods: Study design: It is a case control study, with cases defined by falls in the last year, developed in a third level university hospital.
Patients: Seventy patients aged 65 years or more who met at least one of the following inclusion criteria: (a) at least one fall in the last year; (b) spend more than 15 s during the timed up and go test (TUG); (c) a score of less than 68% average balance in the sensory organisation test (SOT) of the computerised dynamic posturography (CDP); or (d) at least one fall in the CDP-SOT.
Intervention: TUG test, CDP-SOT, CDP centre of gravity balancing (CG) and limits of stability (LOS), Dizziness Handicap Inventory (DHI) test and short FES-I test.
Main outcome measures: Number of steps and time (TUG), average balance and use of sensorial information (CDP-SOT), speed and directional control (CDP-CG and LOS), DHI score and short FES-I score.
Results: Comparing subjects without falls (non-fallers) vs subjects with at least one fall (fallers) in the last year, fallers obtain worse scores than non-fallers in condition 2 ($p = 0.043$) and use of somatosensory information ($p = 0.039$). Comparing subjects with five falls or less (non-multiple-fallers) vs subjects with more than five falls (multiple-fallers), multiple-fallers obtain worse scores than non-multiple-fallers in overall balance ($p = 0.023$), condition 6 ($p = 0.036$), directional control (swaying ($p = 0.006$) and LOS ($p = 0.023$)) and short FES-I score ($p = 0.007$).
Conclusion: The three most useful parameters for identifying unstable elderly patients at particularly high risk of repeated falls are mean balance in the CDP SOT, directional control of CDP LOS and short FES-I score.

1. Introduction

Accidental falls in the elderly are a very important public health problem from both a clinical and an economic perspective [1]. Their repercussions (fractures, long hospitalisations, rehabilitation sessions, need for caregivers, etc.) represent a significant threat for the quality of life of a growing segment of the population in western societies.

Balance disorders (both vertigo and instability) can be the cause of such falls [2]. The detection and, whenever possible, treatment of different neurological and vestibular disorders that alter the ability to maintain a stable centre of gravity can reduce the risk of falling. However, even without pathological disorders, the physiological decline in balance that occurs with age, due to the ageing of the different body systems involved, is a factor that also favours falls.

There are two fundamental elements in relation to fall prevention. First, equilibriometric examinations enable us to assess patients' balance, detecting even subclinical problems. Secondly, vestibular rehabilitation protocols have been shown to be effective in improving balance affected by different neurological [3,4] and vestibular disorders [5–8]; specifically, therapeutic

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protocols combining vestibular and proprioceptive rehabilitation have improved postural control and confidence in elderly people with instability [9].

In the case of elderly patients with no pathological disorders in whom balance has deteriorated with age, it would be particularly important to determine whether equilibriometric measurements enable us to predict which present a greater risk of accidental falls. If that is the case, we could design rehabilitation and training strategies aimed at improving balance in this population subgroup.

The objective of this study is therefore to determine whether clinical and instrumental examination of balance can predict the risk of falls in the elderly.

2. Materials and methods

This study forms part of a research project financed by the Spanish National R&D Plan (Instituto de Salud Carlos III, dossier–PI11/01328) about reduction of falls in the elderly by improving balance with vestibular rehabilitation. The study is conducted in a third level university hospital.

2.1. Study design

Case control study, with cases defined by falls in the last year.

2.2. Study population: inclusion and exclusion criteria

The study included patients aged 65 years or more who met at least one of the following inclusion criteria:

(a) Have suffered at least one accidental fall in the last 12 months.
(b) Spend more than 15 s, or require support, during the timed up and go test.
(c) Present a score of less than 68% average balance in the sensory organisation test of the computerised dynamic posturography.
(d) Have suffered at least one fall in the sensory organisation test of the computerised dynamic posturography.

The following exclusion criteria were applied:

(a) Cognitive decline preventing the patient from understanding the examinations.
(b) Organic diseases that prevent standing, required for an assessment of balance.
(c) Balance disorders caused by conditions other than age (neurological, vestibular, etc.).
(d) Low cultural level, preventing the patient from understanding the examinations and granting informed consent.

2.3. Sample

The sample comprised 70 people aged 65 years or more, who met the above criteria and were seen because of balance disorders in the Neurotology Department of a third level hospital. Fifteen of the 70 patients were men and 55 were women (male/female ratio of 1/3.67). The mean age of the sample was 77.5 ± 6.06 years and the median was 78 years, with a maximum of 90 years.

2.4. Methodology

In order to rule out a pathological cause for the balance disorder, all the subjects underwent a complete otoneurological clinical examination, including neurological examination, verification of absence of nystagmus (spontaneous or caused by the head-shaking test), absence of saccades in Halmagyi's head thrust test and absence of nystagmus caused by Hallpike and Dix positional manoeuvres. When necessary, they also underwent a videonystagmography with caloric tests, vestibular evoked potentials and/or encephalic magnetic resonance. When one or more of these tests were abnormal, the patient was not included in the study. Taking account the physiological decreasing of vestibular function in older people, we have excluded only those subjects who had an asymmetry higher than 25% or severe bilateral hyporeflexia (the sum of the slow phase velocity of the four stimulations was less than 10) in caloric tests; or when the asymmetry in the amplitude of VEMPs was higher than 45% or VEMPs were absent.

They underwent the following equilibriometric and other tests to assess their balance and determine whether they met the inclusion criteria. These tests also constitute the study's methodology:

(a) Modified timed up and go test: it starts with the patient seated on a chair. The patient stands up (without support), walks 3 m, makes a 180° turn, walks another 3 m, walks around the back of the chair and sits on it again (without support).
(b) Sensory organisation test (SOT) of the computerised dynamic posturography (CDP) (we use the Neurocom® Smart Equitest platform). The SOT includes quantitation of the patient's centre of gravity's movements in six different sensory information conditions:
   - Condition 1: stable surface and visual surround and eyes open.
   - Condition 2: stable surface and eyes closed.
   - Condition 3: stable surface, eyes open and moving visual surround.
   - Condition 4: moving surface, eyes open and fixed visual surround.
   - Condition 5: moving surface and eyes closed.
   - Condition 6: moving surface, eyes open and moving visual surround.

   Each of the six conditions was applied on three consecutive occasions, with the patients completing a total of 18 tests each. The time established for each test was 20 s.
(c) CDP centre of gravity balancing. Following visual feedback (movement of a pictogram representing the subject's centre of gravity on a TV screen), the patient has to voluntarily move his or her centre of gravity, without moving his/her feet, on the posturography platform. He/she has to follow the pictogram's movement by anteroposterior and side-to-side swaying. The duration of each test is 20 s and they are repeated at three different speeds (low, medium and high).
(d) Limits of stability (LOS) of CDP. Again following visual feedback from the pictogram, the patient has to voluntarily move his centre of gravity, without moving his feet, on the posturography platform, to reach eight points around it. These points represent 100% of the subject's centre of gravity's movement limits, according to his height and age.
(e) Questionnaires completed by the patient (alone or with the help of a companion) after an explanation by the investigator:
   - Dizziness Handicap Inventory (DHI), validated in Spain [10]: it evaluates disability perceived by the patient in relation to instability. It comprises 25 questions divided into three groups (9 on the functional, 9 on the emotional and 7 on the physical scale), with three possible answers: "yes" (4 points), "sometimes" (2 points) and "no" (0 points). Highest perception of disability would be 100 points and lowest would be 0.
   - A shortened version of the falls efficacy scale-international to assess fear of falling (Short FES-I) [11]: it evaluates fear of

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