Poor balance, visual field damage and falls in glaucoma

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Purpose: To evaluate the relationship between static balance and falls in a glaucoma population, and to determine if static balance accounts for the association between visual field (VF) damage and falls.

Methods: Balance data were collected on 233 patients with diagnosed or suspect glaucoma using the Opal kinematic system, in which sensors measured root mean squared (RMS) sway (RMS of the acceleration vector length) while standing on a foam surface with eyes opened. Integrated VF (IVF) sensitivities were calculated from merged 24-2 VF data from both eyes while peripheral VF data was obtained from the peripheral 60 screening platform for the better eye. Negative binomial regression was used to determine: (1) if balance predicted fall rates in a population of glaucoma patients, (2) if the impact of balance on fall rates increased with severity of VF damage, and (3) if balance mediated the relationship between VF damage and falls in glaucoma. Models included falls per step as the dependent variable, and age, sex, race, comorbidities and polypharmacy as covariables. Step-normalized fall rates were taken as the total number of falls divided by total steps during the study period, with steps estimated over a one-week accelerometry trial.

Results: Average patient age was 70.5 years (range 57-93) with IVF sensitivity averaging 26.6 (6.1) dB and better-eye mean deviation averaging –4.6 (6.6) dB. Worse balance, as judged by RMS sway, was associated with higher step-normalized fall rates (IRR 1.47 for a 1 z-score unit change in RMS sway, 95% CI 1.21 to 1.80, $p<0.001$); when both balance and IVF sensitivity were incorporated into the same regression model, both were found to independently predict falls per step (VF loss: IRR=1.33 per 5 dB decrement in IVF sensitivity, 95% CI = 1.06 to 1.67, $p=0.01$; RMS sway: IRR=1.33 for a 1 z-score unit change, 95% CI= 1.06 to 1.67, $p=0.001$). Balance was not noted to impact fall rates more strongly at lower IVF sensitivity values ($p=0.32$ when an interaction term was included in regression models).

Conclusions: VF damage and balance are independent contributors to falls, and the association between VF damage and falls does not appear to be significantly mediated by poor balance. Additionally, poor balance does not interact with VF loss with regards to falls. These results suggest that variables other than balance, such as gait or hazard perception, may primarily account for the increased rate of falls in glaucoma patients.