Risk of Hip and Femoral Neck Fractures Following Proton Therapy for Prostate Cancer

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Purpose/Objective(s)

Compared with IMRT, proton therapy (PT) for prostate cancer reduces the dose to the rectum and bladder at the expense of higher doses to the femoral neck. There is concern that this could lead to higher hip-fracture rates. In the present study, we assessed the risk of hip fracture and hip pain in men treated with PT for prostate cancer.

Materials/Methods

The medical records of 400 men treated with PT for prostate cancer on an IRB-approved protocol (UFJ 2006-153) between September 2006 and April 2008 were retrospectively reviewed. At 6-month intervals after PT, patients were evaluated by a nurse and physician who assessed CTCAE v3.0 toxicities, including genitourinary (GU), gastrointestinal (GI), erectile, and pain symptoms, and recorded interim events and interventions. Factors potentially associated with hip fracture or pain were recorded, including androgen deprivation (AD), steroid use, testosterone level, body mass index (BMI), previous fracture, smoking, excessive alcohol consumption, arthritis, osteoporosis, renal/liver disease, hyperparathyroidism, diabetes, and dosimetry factors. The observed median follow-up was 2.2 years (range, 0.1 to 3.6 years). The World Health Organization (WHO) Fracture Risk Assessment Tool was applied to each patient to generate an individual annual hip-fracture risk, with a mean of 0.2% (range, 0 to 1.5%) and an expected 1.5 patient fractures in the study population based on individual follow-up. National Health and Nutrition Examination Survey (NHANES) III was reviewed to generate an expected 12.4% rate of hip pain in an untreated population of similarly aged men.

Results

Two patients developed fractures after PT for an observed-expected ratio (OER) of 1.31 (confidence interval, 0.2 to 4.7; $p = 0.9043$). One patient (79 years old), with a fracture (mean femoral neck dose, 33 CGE) at 10 months had a history of osteoporosis, AD use, arthritis, steroid use, and had the highest WHO annual fracture risk of 1.5%. A second

patient (77 years old), developed bilateral femoral neck fractures (mean doses, 32 CGE and 33.5 CGE) at 19 and 29 months, had a history of prior bone fracture (jaw), AD for 6 months, and a WHO annual fracture risk of 0.6%. Nine (2.2%) patients reported pain at day 0 of PT and an additional 44 (11%) reported hip pain during or after PT at a median time of 13.3 months (range, 1 to 39 months), including 28 (7%) with Grade 1, 12 (3%) with Grade 2, and 4 (1%) with Grade 3 hip pain. Only arthritis was found to be associated with Grade 1+ hip pain (p = 0.0049).

Conclusions

Proton therapy does not appear to increase either the risk of hip fracture or hip pain in the first 2 years of follow-up compared to expected rates in an untreated, similarly aged population of men. Longer follow-up is needed to confirm these findings.