Computed Tomography for Preoperative Shoulder Arthroplasty Planning: Lifetime Malignancy Risk

Westin Mace, Amritpal S. Randhawa, Shannon Tse, Cassandra A Lee, Christopher Bayne, Ryan Freshman, Mariano E Menendez Furrer

INTRODUCTION: Computed Tomography (CT) has become invaluable in shoulder arthroplasty due to the detailed information provided on bone quality, glenoid morphology, and joint alignment, allowing for improved implant selection, placement, and overall surgical planning. The increasing number of shoulder arthroplasties being performed in younger patients leads to concerns about exposure to ionizing radiation. Emerging evidence in orthopaedic literature suggests that low-dose CT protocols represent a viable and reliable alternative for preoperative planning. This study evaluates the potential lifetime cancer risks of conventional and low-dose shoulder CT protocols.

METHODS: Effective dose (ED), a metric accounting for absorbed radiation, organ sensitivity, and radiation type, was used to evaluate conventional (8.0 mSv) and low-dose (1.4 mSv) shoulder CT protocols. ED was determined using institutional records and literature. The Biological Effects of Ionizing Radiation VII report was used to calculate lifetime attributable risk (LAR) of cancer and number needed to harm (NNH) based on age and sex.

RESULTS: The LAR of malignancy for a shoulder CT of a 50-year-old man was 0.0405% (NNH = 2,472) and 0.0071% (NNH = 14,124) for conventional and low-dose protocols, respectively. By age 80 in men, the NNH was 5,640 and 32,237 for conventional and low-dose protocols, respectively. The LAR of malignancy for a shoulder CT of a 50-year-old woman was 0.0541% (NNH = 1,849) and 0.0095% (NNH = 10567) for conventional and low-dose protocols, respectively. By age 80 in women, NNH was 5,128 and 29,308 for conventional and low-dose protocols, respectively. There was a positive relationship between patient age and NNH.

DISCUSSION AND CONCLUSION: This study found that conventional dose CT scans for shoulder arthroplasty impart a small but notable LAR of malignancy, with risk increasing in younger patients and women. A 50-year-old female undergoing a conventional dose shoulder CT has a 32% greater LAR than a male of the same age, and a LAR 2.8 times higher than an 80-year-old female. Low-dose CT was associated with a greater than 80% relative risk reduction of malignancy across ages and sexes. The current reliance on preoperative shoulder CT for arthroplasty planning needs to be weighed against the potential lifetime cancer risks, especially among younger women. Risk-reduction strategies such as the widespread adoption of low-dose CT protocols should be considered.