What Is the Probability That External Beam Irradiation Is the Most Effective Modality to Prevent Heterotopic Ossification After Acetabular Surgery? A Bayesian Analysis

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Purpose: Despite the high incidence of heterotopic ossification (HO) after surgical fixation of acetabular fractures, HO prophylaxis treatment pathways remain controversial. Although external beam irradiation (XRT) has been shown to be effective against HO formation in smaller observational studies, there are no adequately powered standalone randomized controlled trials (RCTs) to support its use compared to placebo. We performed a Bayesian network meta-analysis to determine the probability that XRT is the most effective HO prophylaxis treatment strategy.

Methods: In this Bayesian network meta-analysis, RCTs (N = 4) and observational studies (N = 6) were separately analyzed. The primary outcome measure was overall HO formation and significant HO formation (Brooker classification 3 and 4). We compared outcomes between HO prophylaxis type— XRT, indomethacin, or no prophylaxis. For each study outcome, we fit fixed effects and random effects models, and selected the reported model based on optimizing model fit characteristics.

Results: Among RCTs, the average incidence of overall HO formation was 24% for patients who received XRT, compared to 41% in patients who received indomethacin and 60% in patients who received no prophylaxis. Compared to the no prophylaxis control group, patients who received XRT were 45% less likely to develop HO (risk ratio [RR] 0.55, 95% credible interval (CrI) 0.31-0.98) and patients who received indomethacin were 26% less likely to develop HO (RR 0.74, 95% CrI 0.59-0.93). Based on RCT data, the probability that XRT was the most effective treatment strategy to prevent HO formation was 88%. By comparison, indomethacin had a 12% probability of being the most effective strategy but an 87% chance of being the second best strategy. Similarly, among RCT data, the probability that XRT was the most effective treatment strategy to prevent significant HO (Brooker 3 and 4) was 92%. Among observational studies, patients who underwent XRT were 42% less likely develop HO (RR 0.58, 95% CrI 0.30-0.99) compared to the no prophylaxis subgroup. Patients who received indomethacin were 22% less likely to develop HO compared to the control group but this did not reach statistical significance (RR 0.78, 95% CrI 0.31-1.39).

Conclusion: Among the best data available in the literature, we determined that there is ~90% probability that XRT is the most effective treatment strategy to prevent HO after acetabular surgery. Drawbacks to XRT include high cost and resource utilization, risk of radiation-induced sarcoma, and possible increased rates of non-infectious wound healing problems. Given these risks, our data are critical to inform treating surgeons on the relative effectiveness of XRT to better assist discussions and shared treatment decisions with patients.