Bleeding risk assessment among patients receiving antithrombotics for hip and knee replacement surgery

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**Purpose:** Over one million total hip replacement (THR) and total knee replacement (TKR) surgeries were performed in 2010. National guidelines recommend use of anticoagulation as orthopedic surgery patients are at increased risk for developing venous thromboembolism. Evidence supports various therapeutic options, causing significant variability between surgical centers. This can lead to undesirable adverse effects in patients. The objective of this study was to systematically develop an algorithm that can be used clinically to appropriately select anticoagulation therapy based on patient characteristics and risk factors in those undergoing THR and TKR.

**Methods:** Our institutional review board approved this retrospective chart review of the 11,000 patients aged >18 and <90 who underwent either THR or TKR between July 1, 2012 and August 31, 2013 at any of our hospital systems. By using the electronic medical archival retrieval system, trigger words, ICD-9 codes, and lab values will be collected and used to construct indicators for orthopedic bleeding events. Indicators with the highest specificity and sensitivity will be selected to apply to the entire cohort in order to assess bleeding related to anticoagulation use. Anticoagulation will be stratified according to incidence and severity of bleeding to formulate a proposed algorithm for future anticoagulation order sets in THR and TKR surgeries.

**Results:** There were a total of 9,249 surgeries (3,890 THA and 5,359 TKA) among 8,645 patients between July 1, 2012 and June 30, 2013 with follow-up through August 30, 2013. ICD-9 codes for bleeding complications on or after surgery and up to 90 days post-op was evaluated within the total cohort, resulting in 173 patients (100 THA and 73 TKA). 60 patients were randomly selected for evaluation-30 THA and 30 TKA. De-identified histories and physicals, discharge summaries, and ER notes were annotated using the GIANT\textsuperscript{\textregistered} software tool and evaluated according to the following criteria: is the patient receiving an antithrombotic drug, is there evidence that a bleeding event occurred, is it suggested that the event is drug-related, what is the primary location of the bleed, and is there a history of a bleeding event. Validation was performed separately by three evaluators (RB, LM, and JC) for the first 10 consecutive patients to ensure accuracy and reliability of data collection. Out of the 8,645 patients that underwent surgery, 7,687 received an antithrombotic drug following THA and TKA. There were 3,148 hip patients and 4,539 knee patients. Of the hip patients 286 (9.1\%) received aspirin, 819 (26.0\%) enoxaparin, 430 (13.7\%) fondaparinux, 468 (14.9\%) heparin, 512 (16.3\%) rivaroxaban, and 633 (20.1\%) warfarin. Of the knee patients 455 (10.0\%) received aspirin, 1212 (26.7\%) enoxaparin, 724 (15.9\%) fondaparinux, 229 (5.0\%) heparin, 831 (18.3\%) rivaroxaban, and 1088 (23.9\%) warfarin. Bleeding evaluation results for the 60 patients evaluated based on ICD-9 codes are as follows. There were 58 (96.7\%) patients who received antithrombotic therapy, 2 (3.3\%) that did not, and 0 (0\%) unknown. There were 43 (71.7\%) bleeding events, 8 (13.3\%) determined to not be a bleeding event, and 9 (15.0\%) were unknown. Of these, 5 (8.3\%) were determined to be drug-related, 20 (33.3\%) were not, and 35 (58.4\%) were unknown.

**Conclusion:** Current progress demonstrated the feasibility of evaluating drug-related bleeding based on identified clinical indicators for an orthopedic surgery population. The next steps will be to assess the other clinical indicators for bleeding within the randomly selected cohorts and then apply each to the overall population. Finally, the results from the evaluation of each indicator will be used to construct a bleeding risk assessment to optimize medication use for these patients.