Development of a Risk Calculator for Intensive Care Unit Admission after Hip and Knee Arthroplasty
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INTRODUCTION: In the setting of increased utilization of ambulatory surgery centers and outpatient procedures, it is critical to be able to identify patients at risk for intensive care unit (ICU) admission following total joint arthroplasty (TJA). This study developed calculators to determine the risk of ICU admission following primary and revision, hip and knee arthroplasty.

METHODS: Utilizing a database of 12,342 total hip arthroplasty procedures, with 132 ICU admissions, and 10,976 total knee arthroplasty procedures, with 114 ICU admissions from 2005-2017, we developed a risk stratification calculator based on previously identified preoperative factors which included age, heart disease, neurologic disease, renal disease, unilateral vs. bilateral surgery, preoperative hemoglobin, preoperative blood glucose, and smoking status. Prior to developing the calculator, a set of logistic regressions were analyzed to determine weight and scoring of each variable.

RESULTS:
Four risk calculators were developed. The area under the curve (AUC) for each calculator was Primary Hip AUC 0.837, Revision Hip AUC 0.808, Primary Knee AUC 0.935, and Revision Knee AUC 0.790. As an example, the primary knee risk calculator had a Total Points scale of 200, with 65 points associated with a 0.1% chance of ICU admission, and 193 points associated with a 95% chance of ICU admission (Figure 1). Age (50 years old = 37 points and 80 years old = 65 points), bilateral procedures (31 points), neurologic disease (46 points), and preoperative glucose (150 glucose = 30 points, 300 glucose= 60 points) were important contributors to ICU admission risk. Figure 2 demonstrates an example of a high risk patient who undergoes a bilateral primary total knee procedure with a low hemoglobin, renal failure, and heart disease, with a calculated 34% chance of ICU admission.

DISCUSSION AND CONCLUSION:
The risk calculators developed in this study may serve as critical tools for surgeons to identify at risk patients prior to TJA. Our next goal is to validate this calculator utilizing an external patient cohort.

Figure 1: Points scale for the Primary Knee risk calculator.

Figure 2: Example risk calculator for a high risk patient undergoing a bilateral primary total knee procedure.