Artificial Neural Network Prediction of Readmission Following Primary Total Shoulder Arthroplasty Based on Preoperative and Intraoperative Variables

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INTRODUCTION: The demand for total shoulder arthroplasty (TSA) has increased in recent years. With the increased emphasis on ensuring high quality of care while also decreasing hospital costs and resource utilization, preventing unplanned hospital readmission following surgical procedures should be a major focus for clinicians. However, the patient population that is most at risk for readmission following TSA is still largely unknown. Artificial neural networks (ANNs) are computational models that change based on the input and output of data. The purpose of this study was to develop and utilize an ANN model to determine the most important risk factors which predict unplanned readmission following primary TSA.

METHODS: From 2016-2019, the National Surgical Quality Improvement Program database was utilized to identify patients who underwent primary TSA, including anatomic and reverse arthroplasty. In total, 23 demographic, preoperative, and intraoperative variables were analyzed in this study. Chi-squared and analysis of variance analyses were performed to compare the different variables between the group of patients who required unplanned hospital readmission and those who were not readmitted within thirty days of their procedure. Statistically significant variables were utilized and inputted into the ANN model. The ANN module of Statistical Package for Social Sciences was used for analysis in this study and a p-value < 0.05 was considered statistically significant.

RESULTS: Overall, 10,182 patients were included in the study. The ANN reached a Receiver Operating Characteristic (ROC) Area-Under-the-Curve (AUC) of 0.713, which has been considered to be acceptable accuracy (Figure 1). The ANN identified 15 variables out of the 23 variables analyzed as important factors to predict readmission. The five most important factors predicting readmission following primary TSA were age (older; importance = 0.200), preoperative hematocrit (decreased; importance = 0.161), preoperative albumin (decreased; importance = 0.117), preoperative international normalized ratio (INR) (increased; importance = 0.094), and bleeding disorders (presence of a bleeding disorder; importance = 0.064) (Figure 2).

DISCUSSION AND CONCLUSION: Our study utilized an ANN model to demonstrate several significant factors predictive of unplanned readmission following primary TSA, including age, preoperative hematocrit, albumin, INR, and bleeding disorders. Clinicians should be aware of these important variables when assessing patients for TSA as they may be at increased risk for hospital readmission. Notably, several of these factors, such as hematocrit, albumin, and INR, can be evaluated preoperatively through laboratory tests and improved through medical management. Patients with these risk factors should be counselled appropriately and optimized to prevent adverse outcomes with the goal of improving patient satisfaction and reducing hospital readmission and its associated costs. Overall, our study revealed that ANN modeling represents a novel and unique approach to determine perioperative factors that can predict readmission following primary TSA.

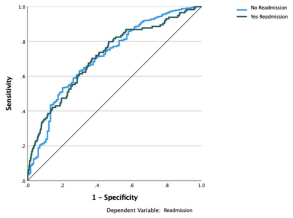

Figure 1. Receiver Operating Characteristic curve of the Artificial Neural Network model in predicting readmission

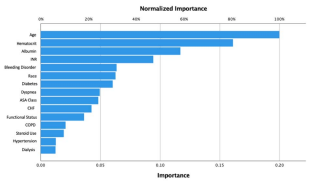

Figure 2. Importance of Variables used by the Neural Network model to predict readmission