Abstract Title: Recommending Anesthesia Dosages with Neural Networks

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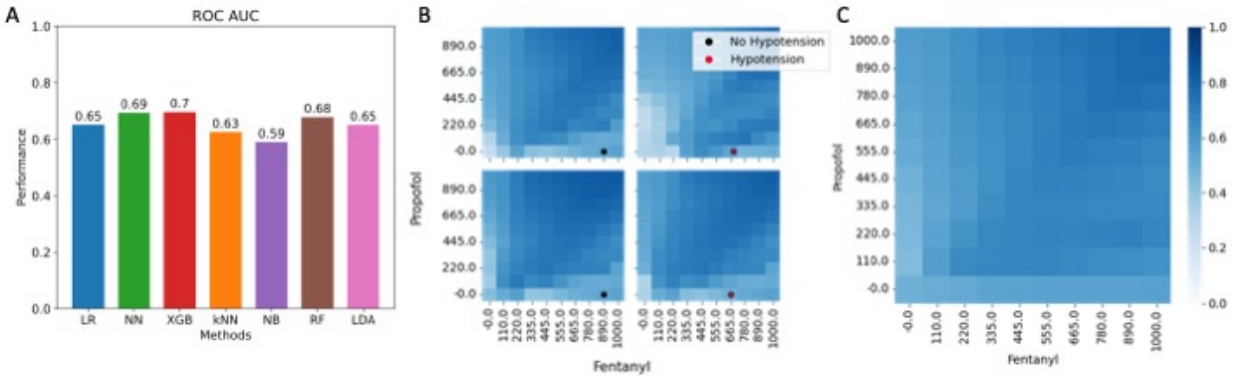
Abstract Content: It has been shown that anesthesia can have adverse effects if administered improperly and that post-induction hypotension is a well-known risk factor for adverse postoperative outcomes (1). For this study, we define post-induction hypotension as mean arterial pressure (<60mmHG) occurring during the first 20 minutes after anesthesia induction. Anesthesiologists estimate anesthetic dosages based on the patient's weight, age, medical history, surgery, and domain knowledge. There is no set method or guideline for recommending anesthetic doses to patients; instead, different clinicians will reach different findings. Machine learning is becoming more widely applicable, trustworthy, and interpretable for use in predicting post-induction hypotension (2,3). Neural networks can model a wide range of data while remaining robust and accurate. Approximately 201,000 patient records totaling 75 features were gathered for this study. This information includes clinical characteristics, medication history, details of the undergone procedures, and anesthetic doses administered, specifically for the medications fentanyl and propofol. The work aims to use machine learning to suggest anesthetic doses that can be generalized to an average patient population or specialized for a specific patient. We implemented several classification algorithms to model post-induction hypotension. These models were implemented with 5-fold cross-validation and were measured in performance by the area under the receiver operating characteristic curve (AUC ROC). Gradient boosting and the neural network had the best performance (AUC ROC = 69.6%, AUC ROC = 69.4%) (Figure 1A). We decided to proceed with the neural network since the interactions between fentanyl and propofol were closer to monotonic than those of the gradient-boosting approach. To recommend doses and assess patient risk, we quantified features' responses and interactions by fixing the values of fentanyl and propofol. In doing so, we can use our trained model to create a heatmap showing the likelihood of post-induction hypotension of these new values. This technique can be used for a single patient (Figure 1B) or we can average results across patients (Figure 1C).

Images:



References:

1. Bijker, Jilles B., et al. "Incidence of Intraoperative Hypotension as a Function of the Chosen Definition." *Anesthesiology*, vol. 107, no. 2, 2007, pp. 213–220.
2. Kendale, S., Kulkarni, P., Rosenberg, A. D., & Wang, J. (2018). Supervised machine-learning predictive analytics for prediction of postinduction hypotension. *Anesthesiology*, *129*(4), 675–688.
3. Lee, J., Woo, J., Kang, A. R., Jeong, Y.-S., Jung, W., Lee, M., & Kim, S. H. (2020). Comparative analysis on machine learning and deep learning to predict post-induction hypotension. *Sensors*, *20*(16), 4575.