Prediction of blood pressure during general anesthesia using machine learning

[Objective]
The purpose of this study is to develop a real-time predictive model capable of forecasting blood pressure changes five minutes ahead during general anesthesia. It is believed that the ability to predict these changes can potentially reduce circulatory fluctuations.

[Methods]
The subjects of this study were cases where general anesthesia was administered at the Kansai Rosai Hospital between August 2011 and December 2021. Blood pressure was measured non-invasively during the anesthesia. The blood pressure data was extracted from the anesthesia record device (ORSYSG4, manufactured by Philips). The average blood pressure obtained through non-invasive measurements at approximately 3-5 minute intervals from entry to exit was linearly interpolated to create continuous data at one-minute intervals. A one-dimensional convolutional neural network was used to create a model that predicts the systolic blood pressure five minutes ahead using approximately 500 data points as training data. The model's accuracy was validated using another set of approximately 500 data points.

[Results]
The mean absolute error of the predicted average blood pressure five minutes after the start of anesthesia was 8.3 mmHg.

[Discussion]
The mean absolute error is a measure of the average absolute difference between the predicted values and the actual values, indicating the magnitude of prediction errors. In a recent study that predicted the average blood pressure three minutes ahead from the start of anesthesia to the start of surgery, the model used blood pressure data along with information such as drug administration data, BIS values, and exhaled carbon dioxide concentration, resulting in mean absolute errors ranging from 8.2 to 11.1 mmHg. In this study, we created the model using only blood pressure data. In the future, we plan to build a multi-modal architecture incorporating data on factors such as the type of surgery, age, drug administration data, start and end times of surgery, and pneumoperitoneum, aiming to improve the prediction accuracy.