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Predicting Sedative Implantation Occasions

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Editorial

Anesthesiologists are medical professionals who are in charge of pain and palliative care, with a focus on the biological management of patients during surgeries. Anesthesiologists must physically stay with patients for a long period of time during operations and provide appropriate treatments before and after the operations in order to provide safe medical care to patients; otherwise, there is a risk that patients will feel pain during surgeries or have residual symptoms. However, due to a severe shortage of anesthesiologists, it has recently become difficult for anesthesiologists to fully participate in all surgeries, and the increasing burden on anesthesiologists has become a major issue.

Aside from workload issues, managing anaesthesia is extremely difficult because the characteristics of patients and the vital signs observed during surgeries are complex; additionally, these characteristics must be considered before performing the appropriate procedure on patients. As a result of these complexities, the possibility of human error in the procedure increases, and it is especially difficult for inexperienced anesthesiologists to perform procedures of sufficient quality.

The widespread use of electronic medical records has recently enabled the collection and storage of large amounts of anaesthesia record data. However, the amount of data continues to grow on an annual basis; because the volume of these data is so large, anesthesiologists have few opportunities to directly use these data. As a result, data analysis using machine learning technology, which has made remarkable progress recently, is becoming increasingly important in order to effectively use the collected data.

Against this backdrop, recent research on machine learning applications in anesthesiology has been conducted. For example, research is being conducted to help anesthesiologists make decisions during surgery, including topics such as risk prediction during surgery and predicting the depth of anaesthesia. Among these techniques, risk prediction during surgery and bispectral index (BIS) prediction have received a lot of attention.

Anesthesiologists can take action at an early stage by predicting risks before a surgery, which benefits patients by reducing sequelae and improving survival rates. Hypotension prediction is one of the most frequently addressed issues in risk prediction. Intraoperative hypotension has been linked to postoperative acute kidney injury and non-cardiac postoperative myocardial infarction, and the risk of these complications is quite high. The classification problem of predicting whether hypotension will occur in some future period of time for a specific patient is a typical problem setting for predicting the risk of hypotension. Many similar studies on predicting the occurrence of hypotension have been conducted. Instead of predicting the occurrence of hypotension, a bidirectional recurrent neural network was used in another study to make real-time predictions of future blood pressure 3 minutes in the future. In addition to hypotension, risk prediction for arrhythmia and hypoxemia has been studied, though there have been fewer studies on these topics. Researchers considered a model to predict tachycardia in terms of arrhythmia. Furthermore, they predicted bradycardia at three time points: the beginning of anaesthesia induction, the beginning of surgery, and 30 minutes after the beginning of surgery, and investigated the relationship between these data and hypotension. They used gradient boosting and Lasso to predict hypoxemia and developed an interpretable model capable of elucidating which features contribute to hypoxemia prediction and under what conditions.

The advantage of predicting BIS in advance is that it aids in predicting the effect of the sedative drug, propofol, allowing the drug's dosage to be adjusted based on the predicted value of BIS. Researchers demonstrated that a lazy learning method outperforms a conventional linear model in predicting BIS, and they contended that machine learning methods can extract useful information from anaesthesia histories. Furthermore, a Recurrent Neural Network (RNN) was used to predict BIS, and experiments were carried out using simulation while considering a system to control anaesthesia. In another study, they used long short-term memory (LSTM) to predict BIS based on the patient's gender, age, height, and weight, as well as a history of propofol and remifentanil use. They also demonstrated that the neural network-based method outperforms the response surface model, which takes into account both pharmacokinetic and pharmacodynamic factors, in predicting BIS.

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