預測使用 Propofol 做麻醉誘導時病人的血壓變化：使用對數迴歸和類神經網路模型

Predicting blood pressure change during induction of anesthesia with propofol: using logistic regression and artificial neural network models

中文摘要

propofol 是一種廣泛使用於麻醉誘導的安眠藥物，醫院中其它的加護病房單位也經常使用 propofol 來安眠病人。Propofol 最大的優點在於它在停藥後病人可以在很快的時間恢復意識，另外它的止吐效果也可以讓病人在手術後減少噁心嘔吐的機會。但 propofol 有一個令人詬病的缺點：它很容易導致病人發生低血壓的副作用。Propofol 導致低血壓的原因是來自於對心肌收縮力的抑制以及周邊血管阻力的下降。如果對 propofol 所造成的低血壓沒有作迅速有效的處理，很可能會體內重要的生命器官例如心臟、大腦、腎臟等造成傷害。

我們希望在這研究中建立一個能預測血壓變化的模型，能在使用 propofol 作麻醉誘導時給麻醉醫師一個有用的決策參考指標。我們使用 17 種可以從病人身上(例如年齡、性別，病人過去的病史—如糖尿病、氣喘，血壓及血紅素等)得到的參數值來建立這模型。這訓練資料庫中包含著 200 個以 propofol 作麻醉誘導的病人。另外爲了評估這些模型的預測能力，我們又收集了同樣 100 個以 propofol 作麻醉誘導的病人的資料，用建立的模型實際去預測病人血壓的變化。最後我們以 area under ROC curve 來當作模型預測能力的指標。

我們一共建構了兩組不同結構的模型，第一種模型使用 logistic regression 的方式。最後一共建構了兩個 logistic regression 模型，第一個使用了所有的 17 個參數來預測血壓的變化，第二個則僅使用兩個參數來預測血壓的變化。另一組預測模型其架構是使用類神經網路系統，我們一共建構了五種不同型態的類神經網路。最後爲了評估這些預測模型的能力，我們找了三位經驗豐富的麻醉專科醫師，四位麻醉住院醫師，以及 15 位麻醉技師對同樣的 100 個病人預測其血壓的變化，以便和我們的模型作比較。

最後我們發現兩個 logistic regression models 以及 5 個類神經網路模型和三位麻醉專家比較起來都沒有明顯的統計差異，但我們的預測模型其正確率卻可以明顯的超過四位住院醫師以及 15 位麻醉技師

英文摘要

Propofol is a popular hypnotic agent used in induction or maintain of anesthesia. Other intensive care units in the hospital also use it as a sedative drug. The most attractive feature of propofol is rapid recovery of patient's conscious level while

terminating the infusion of propofol. Moreover, its antiemetic effect seems attractive to many anesthesia staffs to avoid post operative nausea and vomiting.
Unfortunately, propofol can produce hypotension more often than other anesthesia induction agent. The hypotensive effect of propofol comes from direct depress of cardiac muscle and vasodilatation of peripheral vessels. If not treated promptly and properly, hypotension may induce sever damage to vital organs such as kidney, heart and brain.
We want to setup reliable predicting models to forecast the blood pressure change caused by injection of propofol during induction of anesthesia. Seventeen values (including demographic data such as age and gender, patient past histories such as diabetes mellitus and asthma, and laboratory data such as hemoglobin level and blood pressure before induction) from 200 patients who received propofol as their induction agent in a routine operation were collected in about one year. Another data set from 100 patients, for evaluating the performance of the predicting models was collected in the same period by the same induction procedure. Area under ROC (Receiver Operating Characteristic) curve was used as an index tools to evaluate the performance of our predicting models.
Two types of prediction models were built up in our study. The first type is binary logistic regression model. We have make up two logistic regression model using different input variables. The first logistic model contained all the seventeen input variables, and the second logistic regression model had only two input variables. Another type of predicting model used artificial neural network to predict the blood pressure change. We have finally constructed five different neural network models with dissimilar training protocol and network topography. To compare the predicting models with human beings, three anesthesia attending doctors (experts of anesthesia), four anesthesia resident doctors and fifteen anesthesia nurse with different clinical experiences were also enrolled in this study. Their discrimination abilities of blood pressure change caused by injection of propofol in the evaluation group were compared with our models.
Finally we have found that the two logistic regression models and five artificial neural network models had the same predicting abilities and were all superior to the three anesthesia experts, although statistical significance did exist between them. But the abilities of our predicting models surpassed the anesthesia resident doctors and the fifteen anesthesia nurses and the statistic significance was also found. The predicting modes can be easily integrated in the hospital information system and can act as a reliable decision supporting system