Reliability of Oxygen Saturation by Pulse Oximeter to Detect Hypoxemia of Patients in the Intensive Care Unit.
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Introduction
Pulse oximeter is generally used as a noninvasive monitor to alert respiratory dysfunction in the intensive care unit (ICU). SpO2 (oxygen saturation by pulse oximeter / percutaneous oxygen saturation) are expected to be an indirect estimation of arterial oxygen saturation (SaO2). However, there often are gaps between SpO2 and SaO2. In this study, we investigated the dissociation between SpO2 and SaO2 value of patients in the ICU, and examined whether SpO2 can detect hypoxemia of patients in the ICU.

Methods
We retrospectively evaluated 20717 arterial blood gas samples from 3120 patients who stayed in our ICU since January 2008 to December 2010. Data were excluded when SaO2 were less than 85% or PaO2 were higher than 100mmHg. We also excluded data from patients under 20 years of age. First, SpO2 and SaO2 values were compared by paired t-test. Second, we calculated the gaps between SaO2 and SpO2. SaO2 was analyzed by ABL 800 FLEX analyzer (Radiometer), and SpO2 was sampled by Masimo SET LONPTM sensors. SpO2 value was calculated as an average value of SpO2 0, 1,2 and 3 minutes before blood sampling. The gaps between SpO2 and SaO2 were calculated as SpO2 minus SaO2[SpO2 - SaO2]. Third, we investigated serum lactic acid level measured simultaneously with SaO2 level as a marker of hypoxia. Data are expressed as means ± SD.

Results
A total of 8219 arterial blood gas samples from 1834 patients (1108 male and 726 female) were analyzed. SpO2 was significantly higher than SaO2 (97.4±2.4% v.s. 96.2±2.4%, p<0.05). The overall gaps between SpO2- SaO2 [SpO2- SaO2] were 1.2±1.9. In the range of 85≤SaO2<90%, 90≤SaO2<92%, and 92≤SaO2<95%, [SpO2-SaO2] were 3.5±4.2%, 2.7±3.1% and 2.1±2.1% (mean ± SD), respectively. 31% of patients with 90≤SpO2<92% had hypoxemia (SaO2<90%), and 5.6% of patients with 92≤SpO2<95% had hypoxemia. Serum lactic acid levels measured simultaneously at 85≤SaO2<90%, 90≤SaO2<92%, and 92≤SaO2<95% were 2.5±3.4, 2.2±3.3 and 1.9±2.6 mmol/L, respectively.

Discussion
SpO2 tended to show higher value than SaO2. This tendency was more apparent as SaO2 decreased. These results suggest that keeping SpO2 above 90% is not enough to avoid hypoxemia. As SpO2<90% were associated with increased morbidity and mortality among outpatients with pneumonia compared with SpO2<92%1), we suggest to keep SpO2 above 92% to avoid hypoxemia in the ICU.

References