The Value of Peripheral Oxygen Saturation as a Prognostic Tool for Critically Ill Medical Emergency Patients

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ABSTRACT

Background: *Decreased* **o***xygen supply due to acute physiological deterioration may increase mortality risk, particularly in critically ill patients with inadequacy to compensate such changes. The aim of the study was to evaluate peripheral oxygen saturation (SpO_2) at admission in predicting mortality of emergency patients with critical conditions at Cipto Mangunkusumo Hospital (CMH), the national referral hospital in Indonesia.*

Methods: *We performed a retrospective cohort study of emergency patients with critical conditions at Emergency department (ED), CMH from October to November 2012. SpO_2 was meassured within 15 minutes after patients' arrivals. Subjects were divided into two groups: group 1 consisted of subjects with SPO_2 more or equal to 95% and subjects with SpO_2 less than 95% were in group 2. Primary outcome measured was in-hospital mortality. Log-rank test was used to analyze survival between groups. Risk of in-hospital mortality was analyzed with Cox proportional hazard model.*

Results: *In-hospital mortality rate was observed in 69 (40.1%) from 172 patients. Patients with SpO_2 less than 95% had a significantly lower survival rate (mean survival 21.3 vs 28.6 days, log-rank p = 0.011). The hazard ratio of mortality was 1.8 (95% CI 1.13 to 2.90) in patients whose SpO_2 fell below 95%.*

Conclusions: *Peripheral oxygen saturation below 95% at admission was significantly associated with increased risk of in-hospital mortality. Given the ease of its measurement, SpO_2 should be considered as a predictor of mortality in emergency patients with critical conditions.*

Keywords: *Peripheral oxygen saturation, critical conditions, emergency, mortality*

ABSTRAK

Latar Belakang: Gangguan ketersediaan oksigen akibat perburukan kondisi fisiologis akut akan meningkatkan risiko mortalitas, khususnya pada pasien kritis yang memiliki keterbatasan daya kompensasi. Tujuan dari penelitian ini adalah untuk menilai saturasi oksigen perifer (SpO_2) saat pasien masuk dalam memprediksi mortalitas pasien gawat darurat medis dengan kondisi kritis di Rumah Sakit Cipto Mangunkusumo (RSCM) yang merupakan rumah sakit rujukan nasional di Indonesia.

Metode: Kami melakukan penelitian kohort retrospektif pada pasien kritis di Ruang Resusitasi Instalasi Gawat Darurat RSCM pada bulan Oktober sampai November 2012. Pengukuran SpO_2 dilakukan dalam waktu 15 menit setelah pasien masuk. Subjek kemudian dibagi menjadi dua kelompok: Kelompok dengan SpO_2 lebih atau sama dengan 95% (1) dan kurang dari 95% (2). Luaran yang dinilai adalah mortalitas selama perawatan. Uji *log-rank* digunakan untuk membandingkan kesintasan kedua kelompok. Risiko mortalitas selama perawatan dianalisis dengan *Cox proportional hazard model*.

Hasil: Mortalitas selama perawatan terjadi pada 69 (40,1%) dari 172 subjek penelitian. Pasien dengan SpO_2 kurang dari 95% memiliki laju kesintasan yang lebih rendah secara bermakna (rerata kesintasan 21,3 *vs* 28,6 hari, *log-rank* p = 0,011). Rasio hazard terjadinya mortalitas adalah 1,8 (IK 95% 1,13 sampai 2,90) pada pasien dengan SpO_2 di bawah 95%.

Simpulan: Saturasi oksigen perifer di bawah 95% pada saat pasien masuk meningkatkan risiko mortalitas secara bermakna. Karena mudahnya pengukuran nilai saturasi tersebut, maka SpO_2 sebaiknya dipertimbangkan sebagai prediktor mortalitas pada pasien gawat darurat medis dengan kondisi kritis.

Kata Kunci: Saturasi oksigen perifer, penyakit kritis, gawat darurat, mortalitas

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INTRODUCTION

Mortality rate of emergency patients with critical conditions who underwent resuscitation is still quite high, ranging from 15-23%.[1,2] These emergency and critical conditions are associated with tissue hypoxia caused by decreased availability of oxygen. Oxygen availability is determined by three main factors, which are oxygen saturation, hemoglobin concentration, and cardiac output.[3]

Oxygen saturation (SpO_2) is the fifth vital sign suggested to be assessed in patients with shortness of breath as well as in patients with other acute conditions.[4] Nevertheless, the role of SpO_2 role as a predictor of mortality in emergency patients with critical conditions has not been widely studied, especially in Indonesia.

The purpose of this study was to assess patients' SpO_2 values at admission. The values were to predict mortality of emergency patients in critical condition at Cipto Mangunkusumo Hospital (CMH).

MATERIALS AND METHODS

This was a retrospective cohort study. Samples were emergency patients recruited consecutively from medical records during October to November 2012. Data collected included: demographic data (age and sex), chief complaint, vital signs, and SpO_2 value at the time of admission, early diagnosis. Peripheral O_2 saturation was assessed by fingertip pulse oxymeter Contec® CMS-50DLP. Outcomes assessed were patients' conditions when discharge from hospitalization (alive or dead). Causes of death were also assessed from the medical record .

The data were collected then analyzed using SPSS version 16.0. Categorical data are presented in numbers and percentages. Numerical data with normal distributions are presented in mean and standard deviations. Numerical data with not normal distribution are presented as median and range .

Subjects were divided into two groups: group 1 consisted of subjects with SPO_2 more or equal to 95% and subjects with SpO_2 less than 95% were in group 2. Log-rank test was used to compare survival between groups. Risk of mortality during treatment were analyzed using Cox proportional hazards models.

This study has received ethical approval by Health Research Ethics Committee of the Faculty of Medicine, Universitas Indonesia/Cipto Mangunkusumo Hospital.

RESULTS

A total of 172 patients with critical conditions were admitted to resusitation room in ED, CMH during study period. Thirteen subjects (7.6 %) were excluded because they went home at their own requests. Mortality rate during hospitalization was 40.1%. Characteristics of subjects are summarized in Table 1.

Table 1. Characteristics of Subjects

Characteristics	Alive (n=90)	Dead (n=69)
Age (years)	51,6 (SD 14,76)	48,9 (SD 15,73)
Male n (%)	44 (48,9%)	46 (51,1%)
Siystolic (mmHg)	131,2 (SD 40,04)	112,3 (SD 44,05)
Diastolic (mmHg)	79,7 (SD 20,81)	68,0 (SD 27,16)
Heart rate (beats/min)	103,1 (SD 26,03)	109,4 (SD 30,83)
Resp rate (times/min)	27,9 (SD 7,91)	30,4 (SD 8,78)
Temp (°C)	36,7 (SD 0,90)	37,4 (SD 1,67)
Peripheral Sat O_2 (%)	94,7 (SD 6,48)	92,0 (SD 7,35)
Glasgow *coma scale*	14,0 (SD 2,51)	11,5 (SD 4,14)

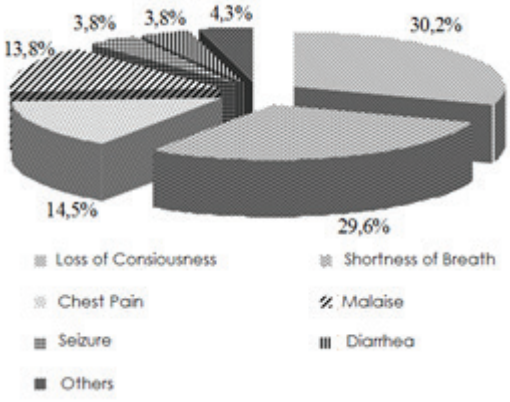

Figure 1. Major Complaints reported in emergency patients with critical conditions at Cipto Mangunkusumo Hospital (n = 159)

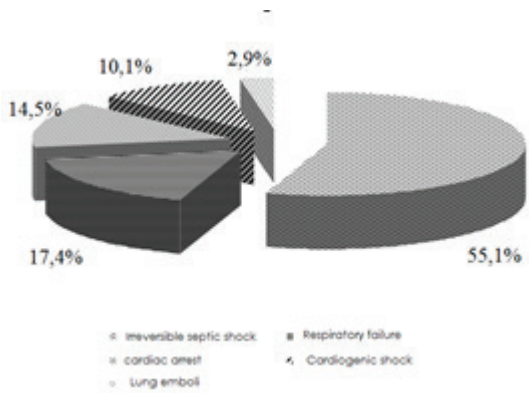

Figure 2. Causes of Death of Emergency Patients (Adult) at CMH (n = 69)

Major complaints (Figure 1) found were loss of consciousness (30.2%), shortness of breath (29.6%), and chest pain (14.5%). The most common initial diagnoses reported were pneumonia (48.4%), renal failure (42.1%), sepsis (38.4%), and hypovolemic shock (25.8%). Irreversible septic shock caused the death of most patients (Figure 2)

Survival Rate

Subjects with SpO_2 less than 95% had significantly lower survival rate compared to subjects with SpO_2 greater than or equal to 95% (21.3 vs. 28.6 days survival rate, log-rank p value = 0.011, Figure 3). Occurrence of mortality hazard ratio was 1.8 (95% CI, 1.13 to 2.90) in patients with SpO_2 below 95%.

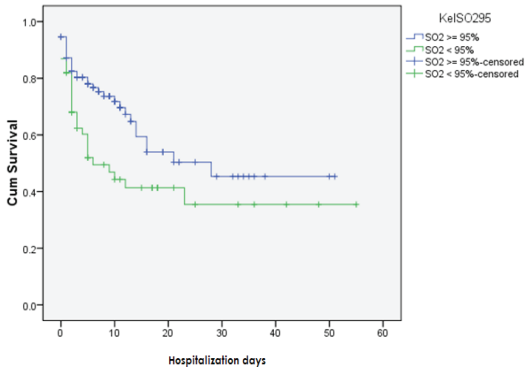

Figure 3. Survival Rate between Groups

DISCUSSION

Characteristics of Subjects

High mortality rate found in this study (40.1 %) may reflect patients' severe conditions at admission. Cipto Mangunkusumo Hospital is the national referral hospital so that most patients being admitted have advanced conditions. Malignancies happened to 13.2 % of subjects (data not shown). However, the care system in resusitation room – ED should be assessed further.

Oxygen saturation

Benefits of peripheral oxygen saturation (SpO_2) as a predictor of mortality can be observed clearly in this study. Subjects with SpO_2 less than 95% had almost 2 times mortality risk during treatment. Previous studies used central venous oxygen saturation as a predictor or a target in the management of critically ill patients, both in emergency room and intensive care unit.[5,6]

Value of SpO_2 does not replace central venous oxygen saturation as SpO_2 can be less accurate especially in patients with poor peripheral perfusion (hypotension or hypovolemia), carbon monoxide and methemoglobin intoxication, skin, fingers or nails pigmentations, as well as error in oxymeter placement.[3] However, low SpO_2 values, either due to artifacts or others, will lead to physicians trying to find the causes, provide optimal managements in oxygen delivery, and do arterial blood gas analysis.[3]

SpO_2 values as the fifth vital sign is now becoming a routine evaluation done in ED. Value of SpO_2 below 95% is a benchmark for physicians to find the cause of decreased oxygen saturation and treat it.

ADVANTAGES AND LIMITATIONS OF RESEARCH

This study is the first to evaluate peripheral oxygen saturation as a predictor of mortality in emergency patients with critical conditions in Indonesia. Consecutively sampling technique is the best non-probability sampling.

Retrospective cohort design can lead to biased results of peripheral oxygen saturation, however, the evaluation has become a routine procedure performed in ED triage and resuscitation room at Cipto Mangunkusumo Hospital and been recorded on medical records. As previously described, less accuracy can be found in various conditions. As this is a pragmatic study, the conditions observed were real conditions that happened so it would not affect the results of the study.

CONCLUSION

Peripheral oxygen saturation value below 95% at admission significantly increased mortality risk of patients. Because the evaluation is easy and applicable, SpO_2 value should be considered as a predictor of mortality in emergency patients with critical conditions.

REFERENCES

1. Lee CK, Rainer TH. Application of APACHE II in the assessment, classification of severity and predictive ability of Chinese patients presenting to an emergency department resuscitation room. Hong Kong j emerg med. 2002;9:188–94. Available from: hkcem.com/html/publications/Journal/ 2002-4/188-194.pdf
2. Cattermole GN, Mak SK, Liow CH, Ho MF, Hung KY, Keung KM, et al. Derivation of a prognostic score for identifying critically ill patients in an emergency department resuscitation room. Resuscit. 2009;80:1000–5.

3. Mansjoer A, George YWH. Pathophysiology of critical ill patients: focus on ciritical oxygen delivery. Acta Med Indones – Indones J Intern Med. 2008;40:161–70.
4. O'Driscoll BR, Howard LS, Davison AG. BTS guideline for emergency oxygen use in adult patients. Thorax 2008;63(Suppl VI):vi1–68.
5. Rady MY, Rivers EP, Nowak RM. Resuscitation of the critically ill in the ED: response of blood pressure, heart rate, shock index, central venous oxygen saturation, and lactate. Am J Emerg Med. 1996;14(2):218–25.
6. Rivers EP, Ander DS, Powell D. Central venous oxygen saturation monitoring in the critically ill patient. Curr Opin Crit Care. 2001;7(3):204–11.