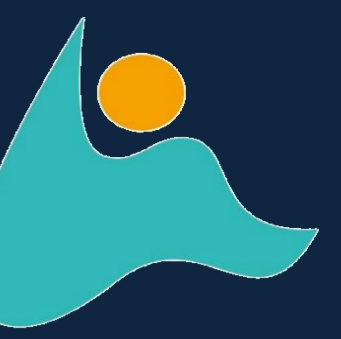


Measurements of Tissue Oxygen and Hemoglobin on a Near Infra-red Spectroscopy in Emergency Patients with Poor General Conditions



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Introduction

- In patients with poor general conditions, conventional pulse oximeters are sometimes unable to determine the oxygen saturation because of peripheral arteriole constriction.
- We developed a miniaturized sensor of near infra-red spectroscopy (NIRS) whose source-detector distance is shorter to detect regional oxygen saturation when examiners mount it on their fingers. ¹⁾
- This system was applied to the transvaginal evaluation of fetal oxygen dynamics during 2nd stage of labor. ²⁾

Reference

- 1) N. Kanayama and M Niwayama. Journal of Biomedical Optics 19(6):067008
- 2) T. Uchida et al. J. Perinat. Med. 2015 [in press]

Methods

- We collected 22 normal control (male/female: 11/11, age: 45±15 y.o.) and 83 patients taken to our ER in an ambulance due to various diseases or injuries including cardio-pulmonary arrest as a pilot study.
- It was investigated whether measurement of arterial oxygen saturation by a conventional pulse oximeter was available.
- We measured total hemoglobin index (T-HbI) and regional tissue oxygenation (rSO₂) on index finger pulp (IF), thenar eminence (TE) and sternocleidomastoid muscle (SM) using NIRS with the miniaturized sensor, "Toccare (Astem Co., Ltd., Kawasaki, Japan)".
- T-HbI and rSO₂ were compared among each part, and between normal control and patients.

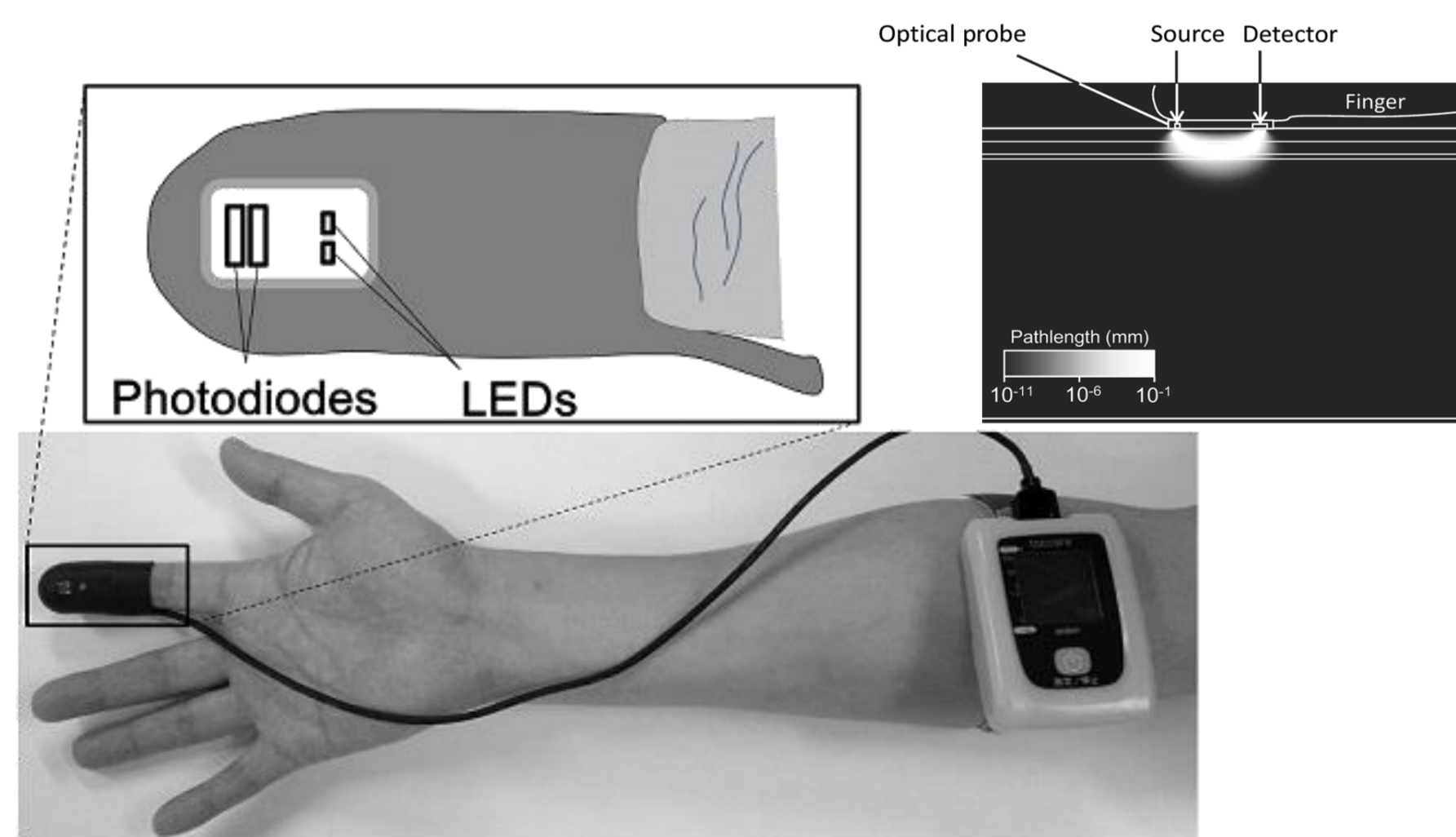
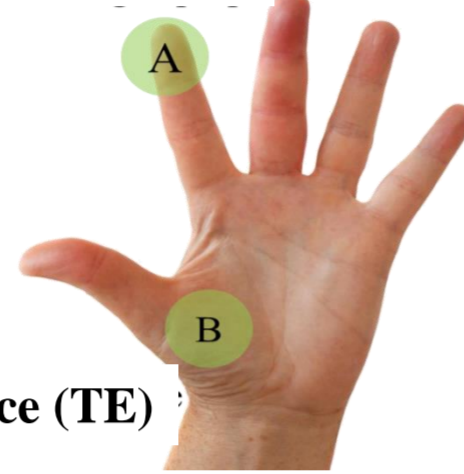
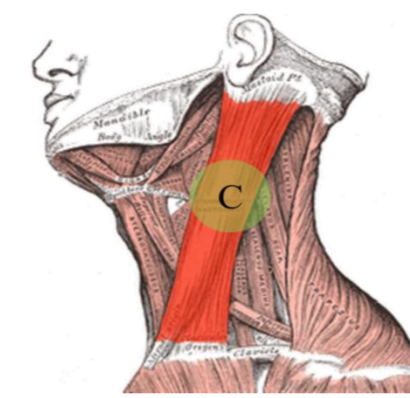


Fig 1. NIRS with a new miniaturized tissue oxygenation sensor
The bare chips of the LEDs and photodiodes were mounted on the substrate with a wire bonding. The detectors were located 6 and 8 mm away from the LEDs in order to determine an absolute value of the hemoglobin concentration using the spatially resolved NIRS. This system can work by batteries.

Index finger pulp (IF)



Sternocleidomastoid muscle (SM)



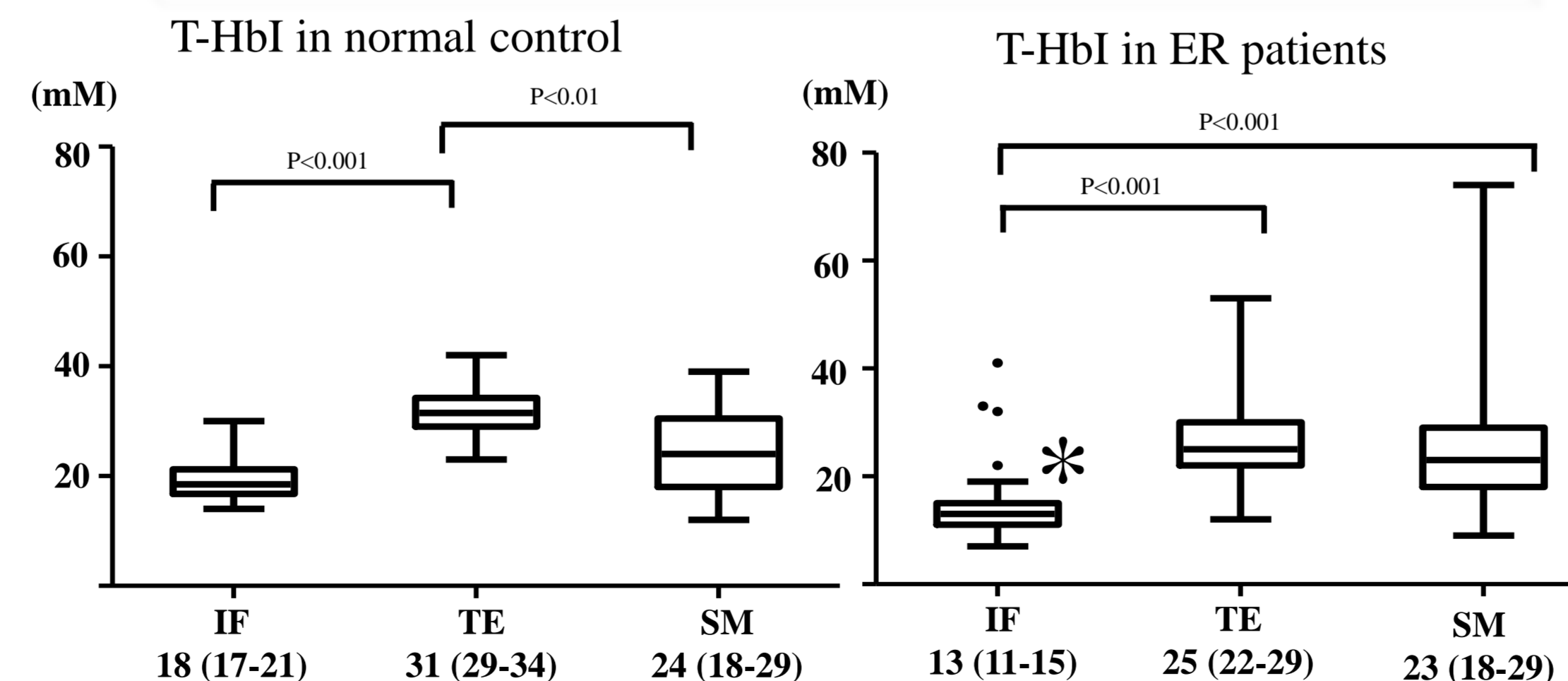
Thenar eminence (TE)

Results

Results 1. Patients characteristics

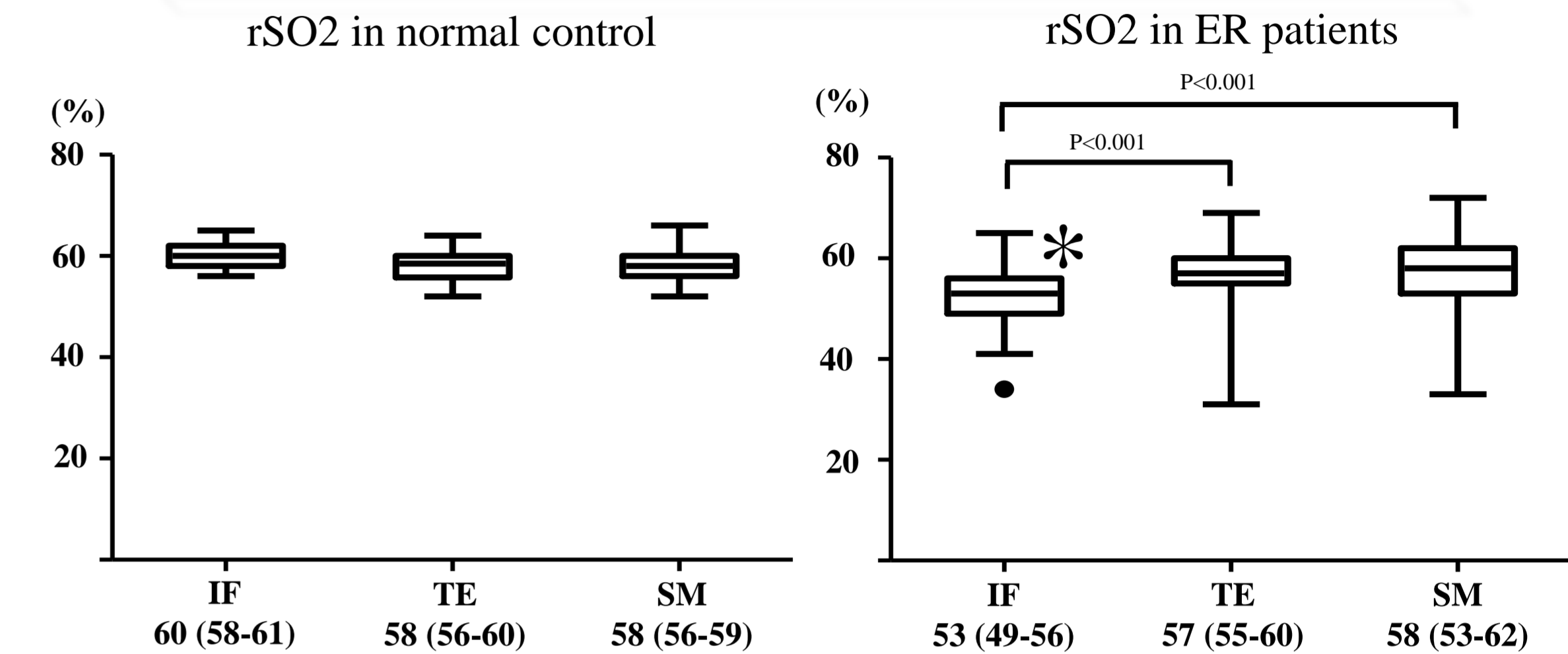
Age (y.o.)	66±20	Baseline diseases	
Male/Female	48/35	Cardiovascular disease	17
Systolic BP (mmHg)	130±48	CNS disease	16
Diastolic BP (mmHg)	74±28	Gastrointestinal disease	12
Pulse (bpm)	78±28	Injury	12
		Infection	10
		Poisoning	6
		Respiratory disease	4
		Endocrine disease	3
		Renal disease	2

Results 2. T-HbI



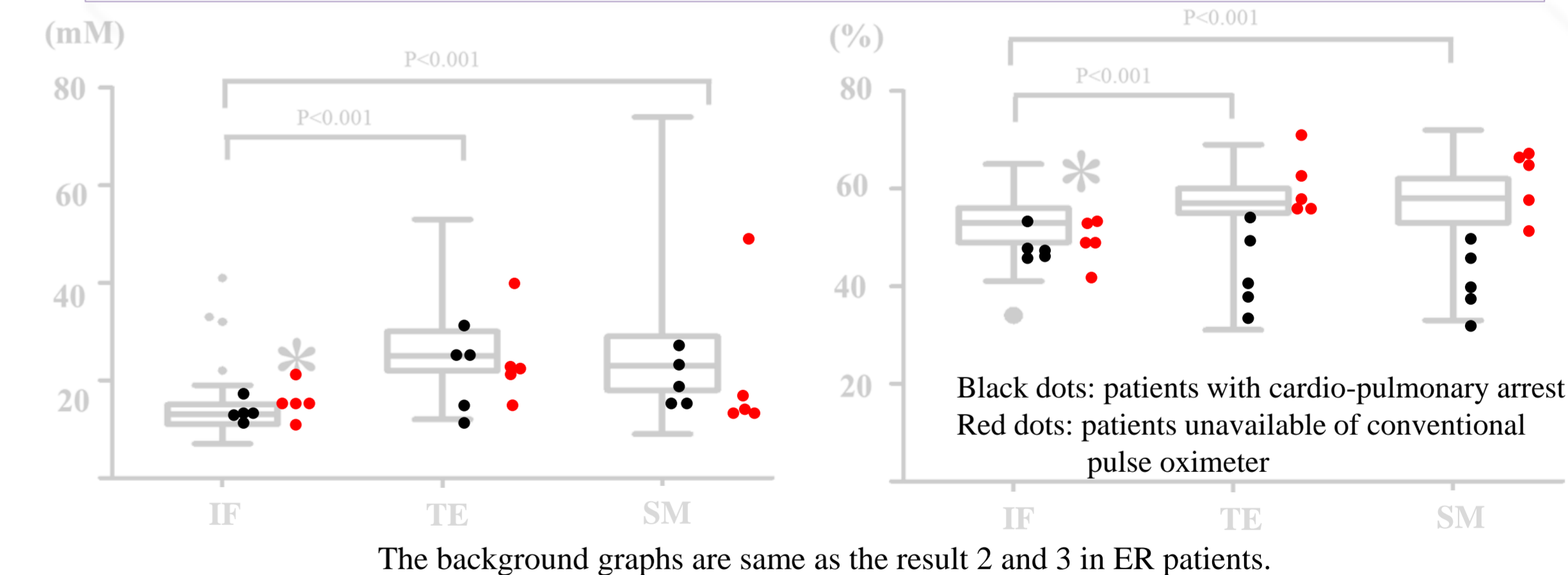
In normal control, the value of T-HbI on thenar eminence is the highest. In ER patients, the value on index finger pulp is the lowest, besides being significantly lower than that in normal control.

Results 3. rSO₂



The value of rSO₂ on index finger pulp in ER patients was significantly lower than that on thenar eminence and sternocleidomastoid muscle, besides being significantly lower than that in normal control (*p<0.001).

Results 4. T-HbI and rSO₂ in patients unavailable of conventional pulse oximeter



The background graphs are same as the result 2 and 3 in ER patients.

T-HbI and rO₂ were obtained stably even in 5 patients who needed CPR and 5 patients who showed no data by conventional pulse oximeter.

Conclusions

NIRS with the new miniaturized tissue oxygenation sensor is available to measure T-HbI and rSO₂ on various places in human body, regardless of whether pulse waves are detected or not. In scenes such as ER or disaster, we could use it for evaluating all patients' condition immediately.