

***Mapping Of Transcutaneous Oxygen Tension In  
Different Physiological Conditions***

***Thesis***

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# Summary

Transcutaneous measurements of  $O_2$  (  $Tcpo_2$  ) provide continuous and noninvasive estimation of arterial blood gases and indicator of local tissue perfusion by skin surface. In the practical situation of transcutaneous measurements, gases are transferred from the dermis through the epidermis and a layer of contact fluid to the sensor. Heating the sensor affect the permeability of the skin. It has a marked effect on cutaneous blood and gas diffusion through the stratum corneum.

Transcutaneous oxygen tension (  $Tcpo_2$  ) measurement appears to be a useful tool for assessing oxygen tension in the blood of the skin capillaries.

Different methods are used to evaluate the microcirculation of the skin, like capillary microscopy, laser doppler and  $Tcpo_2$ .

The  $Tcpo_2$  measurement is reliable non invasive and simple. But its values are dependent on a lot of different parameters, which must be taken in account when  $Tcpo_2$  measurements are interpreted. These factors include skin thickness, density of sebaceous gland, capillary density and capillary blood flow.

The aim of this work was therefore to map  $Tcpo_2$  of the body in nine locations, at different degrees of temperatures  $37^{\circ}C$ ,  $40^{\circ}C$  and  $45^{\circ}C$ , and to determine the

effect of age, sex, height, weight, body surface area, BMI and haemoglobin on its level.

The subjects included were healthy males and females with different age, sex, height, weight, body surface area, BMI and different levels of haemoglobin.

*All subjects were subjected to the followings:*

1- Tcpo<sub>2</sub> measurements using transcutaneous module of preflux 5040 system measurements were recorded at the following nine areas and at different temperatures ( 37 °c, 40 °c and 45 °c).

- 1- Supraorbital region.
- 2- Submandibular region.
- 3- Subclavicular region.

*Upper limb:*

- 4- Dorsum of hand.
- 5- Anterior aspect of mid forearm.
- 6- Anterior aspect of mid arm.

*Lower limb:*

- 7- Dorsum of foot.
- 8- Anterior of mid leg.
- 9- Anterior of mid thigh.

Our results showed that an increase in temperature from 37 °c, 40 °c to 45 °c, leads to an increase in Tcpo<sub>2</sub> value. The measurements of Tcpo<sub>2</sub> at 37 °c are done under physiological conditions and

used to study the physiological reaction. While measurements of  $T_{cpO_2}$  at  $45^{\circ}C$  lead to maximal dilatation of capillaries so, all the local thermoregulatory physiological mechanisms are abolished and the readings reflect property of skin density of capillaries and arterial  $P_{O_2}$ .

As regard the effect of site on our measurements, the  $T_{cpO_2}$  values can be influenced by the thickness of living part of epidermis, the capillary density, capillary blood flow and the density of sebaceous glands. So our results show a significant difference between different areas at the same degree of temperature.

In the present study, the patient age was found to play no significant role in the over all mean value of  $T_{cpO_2}$ . However, the  $T_{cpO_2}$  at various sites is altered slightly with age. But, for all practical purposes these differences are not important.

Our results also show a significant difference between males and females at  $40^{\circ}C$  and  $45^{\circ}C$ . This difference occurs due to the difference in density of cells in the dermis, as females have a thinner epidermis and a greater permeability of their thinner skin.

Also our data indicate that there is a significant positive correlation between weight, BMI and surface area and over all mean value at  $37^{\circ}C$  only. While at  $40^{\circ}C$  and

45 °c the height, weight, BMI and surface area had no effect on over all mean value of Tcpo<sub>2</sub>. These results demonstrated the thermoregulatory function of skin. Increase body weight lead to increase fat layer which act as insulator, and decrease vasoconstrictor tone of sympathetic. This appear clearly at 37 °c.

Moreover, our results show a negative correlation between Tcpo<sub>2</sub> and haemoglobin level at 40 °c. An increase in the level of haemoglobin mean an increase in number of red blood cells and increase blood viscosity which decrease the flow of microcirculation and decrease Tcpo<sub>2</sub> value.

In conclusion, measuring of Tcpo<sub>2</sub> at 45 °c appears the most reliable method for measurement of Tcpo<sub>2</sub>. The effect of different physiological variables are least affecting at supraorbital, submandibular, foot, leg, and therefore these sites can be used for routine measurements of Tcpo<sub>2</sub> in clinical situation.