TRANSCUTANEOUS OXYMETRY AS A PREDICTOR OF STUMP HEALING IN DIABETIC FOOT

SUMMARY:
The diabetic foot syndrome is a major medical, social and economic problem, especially at patients undergoing amputation. We investigated 22 patients with serious neuroischemic affection with gangrene of lower limbs, they underwent amputation after estimation of TcPO$_2$ values. As minimal TcPO$_2$ value predicting successful outcome and stump healing after an amputation we determined 30 mmHg.

Key Words: Transcutaneous oxymetry, diabetic foot, stump healing after amputation

INTRODUCTION

Transcutaneous oxymetry can be helpful for indication and determination of amputation level and enables to estimate the postoperative course of stump healing. In the issues of diabetic foot syndrome are associated four main complications:

1. diabetic angiopathy (macro- and microangiopathy),
2. diabetic neuropathy,
3. diabetic osteoarthropathy and
4. infectious (inflammatory) complications.

AIM OF THE STUDY

To determine the reliability of transcutaneous oxymetry for prediction of stump healing in patients with lower limb amputation because of diabetic foot with severe ischemia and gangrene.

PATIENTS AND METHODS

We investigated 22 patients with diabetes mellitus type 2, (9 men and 13 women), mean age 70,5 years (range 64 – 75), mean diabetes duration 10,6 years.
Mediacalcinosis was presented in 4 patients (18 %), distal sensory polyneuropathy in 18 patients (82 %). 9 patients (41 %) underwent in the past revascularisation, 5 patients (23 %) minor amputation on toes. This data refer to serious neuroischemic affection of lower limbs. Transcutaneous oxymetry was performed with an Oxykapnomonitor SMK 365 Hellige, Germany device. The sensor electrode was attached to the dorsum of the foot and superiorly on crus. As far as maintenance value of TcPO2 for determination of amputation level has been reached. As maintenance value of TcPO2 we choose and estimated 25 mmHg. According to our results 9 patients underwent low and 13 high level amputation.

The age characteristic of the patients are illustrated at figure 1 and TcPO2 values in dependence of DM duration and amputation height are illustrated at figure 2.

RESULTS

The postoperative course of stump healing was as following: in 15 patients (68 %) the stump healed per primam, in 4 patients (18 %) the surgical wound healed per secundam, whereas at 3 patients (14 %) the wound healing failed and reamputation was necessary.

The reamputation was needed just at patients with the smallest TcPO2 values (less than 29 mmHg). The mean level of glycosylated haemoglobin (HbA1c) was 7,1 % (6,0 – 8,5).

DISCUSSION

Similar to other authors (Pecoraro et al., 1991, Kalani et al., 1999) we choose as maintenance TcPO2 value for determination of amputation level 25 mmHg. This minimum value we ascertained at two patients, one has a TcPO2 value of 28 mmHg and the rest, in accordance with graph 2, has 30 mmHg or more.

We didn´t find any correlation between diabetes mellitus duration and TcPO2 values at the dorsum of the leg. We also didn´t find any influence of haemoglobin or serum albumin values on stump healing or reamputation.

Our results in conformity with results of other authors (Bunt and Holloway, 1996, Niinikoski, 2004). Of course, as higher value of TcPO2, as higher success of healing (Hanna et al., 1997).

Healing process is with the exception of TcPO2 unfavourable influenced also by other factors, e. g. presence of infection (Weaver, 2007). TcPO2 value of 30 mmHg and more as positive predictive factor of ulceration healing and on the contrary value of 10 mmHg and less, as negative predictive factor, was determinated also by Got, 1998. Also pulse oximetry is a potential screening tool for lower extremity arterial disease at

AGE CHARACTERISTIC OF PATIENTS

Figure 1.
patients with diabetes mellitus. (Parameswaran et al., 2005)

Unfavourable prognostic factors of ulceration healing were ankle pressure less than 50 mmHg, toe pressure less than 30 mmHg and TcPO2 values less than 20 mmHg (Diamantopoulos et al., 1998). Hyperglycaemia cause at patients with diabetes mellitus change of rheological characteristic of the blood with significant decrease of TcPO2 (Khodabandehlou et al., 1998; Domingo et al., 2006).

Most of the authors agree that forefoot stump will primary heal at 90 % of cases with TcPO2 values more as 30 - 35 mmHg measured 10 cm under the knee. Pinzur et al., 1992, measured TcPO2 values at the dorsum of the foot and in the middle of the forefoot. If TcPO2 was more than 30 mmHg the stump healed at 92,3 % per primam. At TcPO2 values less than 30 mmHg the stump healed per primam at 66 % of the patients. At 7 – 10 % of patients with diabetes mellitus will develop chronic foot ulcerations and at 10 – 15 % of them are small or large amputation are inevitable (Dillingham et al., 2005). The aim of the surgeons is to amputate the extremity as low as possible and stump healing per primam intentionem. The elementary assumption of healing is a good blood – supply.

Two third of patients with amputation of ischaemic lower extremity, as last intervention, when revascularization is impossible, create patients with diabetes mellitus and smokers. Smoking has a negative influence at healing process (Faglia et al., 1996). Our 3 patients required reamputation, confirmed smoking before hospitalisation. On the contrary (Pecoraro et al., 1991) didn´t find correlation between healing success and smoking. They didn´t find not even significant connection between stump healing and age, type of diabetes or glycosylated haemoglobin value. Strong correlation was discovered only with the TcPO2 values near to the wound. At the TcPO2 values the probability of healing failure was less than 20 mmHg, 39 times higher at values overtopping this limit.

Very important factors of wound mishealing are with the exception of tissue ischemic hypoxia, also presence of infection, necrotic covering, unsuitable local attendance and general bad condition with fever and underfeeding. Healing process come true only at optimal tissue perfusion and oxygenation.

CONCLUSIONS

Transcutaneous oxymetry with TcPO2 determination is a clinical important tool for evaluation of stump healing after an amputation for diabetic foot. As minimal TcPO2 values predicted successful outcome after an amputation we consider 30 mmHg. TcPO2 of 30 mmHg has a specificity of 79 % and sensitivity of 100 %. Transcutaneous oxymetry can be used also at patients with mediacalcinosis and so artificial elevated ankle – brachial pressure index.
REFERENCES