

wound healing perspectives®

A CLINICAL PATHWAY TO SUCCESS

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→ TRANSCUTANEOUS OXYGEN

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Answering questions about hypoxia

Mrs. Jones is a 50-year-old insulin dependent diabetic who is being seen by her primary care physician for a non-healing wound of the foot. Despite reasonable wound care, the patient has not made any discernible progress over the last six weeks. Recognizing that failure to heal may be a result of multiple factors (mechanical, bacterial, physiological), the practitioner wishes to clarify whether there might be a significant degree of **hypoxia**. In the past, this simple question could not be answered at the bedside. Typically it required the use of invasive tests (arteriography) or referral for very expensive tests (magnetic resonance angiography).

Now the answers to questions about **hypoxia** can be answered in a convenient outpatient setting - your local Wound Healing Center.

Recent advances in biotechnology have clarified the utility of bedside diagnostics. In particular, transcutaneous oxygen mapping has emerged as a powerful predictor of wound healing success or failure. In this issue, we will explore the technology, predictability, and utility of this study and how it would provide immediate insight as to why this patient is not healing.

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Why measure tissue oxygen tension?

Tissue oxygen tension measurements were first used to monitor oxygen in neonates and are also used in medical decision-making by several other specialties including wound care and hyperbaric medicine. With the current emphasis on cost savings in the managed care setting, tissue oximetry has gained importance as a tool for predicting potential candidates for HBO therapy. This data aids in vascular assessment to help predict non-responders to treatment and to choose successful amputation sites. It is also used to select candidates for HBO by identifying the presence of tissue hypoxia and the responders to hyperoxia. In some instances tissue O₂ data are used to determine when treatment is complete. (Sheffield, PJ. 1998)

In 1994, LA Matos and AA Nunez reviewed a series of tissue oxygenation studies and concluded that TcPO₂ was clinically useful in



THE RADIOMETER TCM™400 IS USED TO MEASURE TISSUE OXYGEN TENSION.

determining healing potential, selecting amputation level, evaluating revascularization procedures, and assessing severity and progression of peripheral vascular disease. ■



HIGHLIGHTS INSIDE

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Transcutaneous oximetry as a predictor of wound healing

Terms to remember

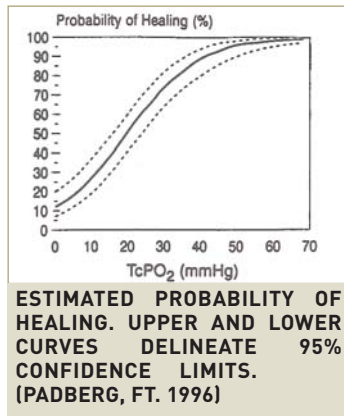
HBO: Hyperbaric oxygen therapy is the administration of 100% oxygen at greater than one atmosphere absolute (ATA). This can only be achieved in an environment of elevated pressure. The entire patient must receive the change in pressure. Topical oxygen is not hyperbaric oxygen.

TCOM: Transcutaneous oxygen monitoring is the test used to determine the oxygen tension in the skin.

TcPO₂: Transcutaneous oxygen tension is the value that a TCOM test returns and is measured in millimeters of Hg. ■

Investigators uniformly agree that TcPO₂ studies have predictive value. However, there is some variation among investigators on precisely which

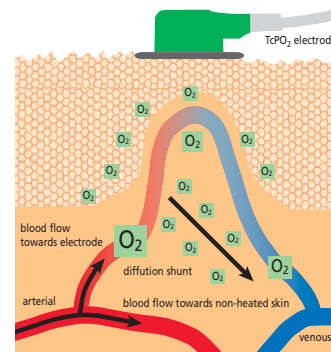
Values > 40 mmHg were associated with good healing, 20-40 mmHg with intermediate healing, and < 20 mmHg with poor healing.



In 1983, PJ Sheffield and WT Workman reported the first known TcPO₂ data recorded under hyperbaric conditions (100% O₂ at 2.4 atm abs, 238 kPa). In 1994, LA Matos and AA Nunez concluded that transcutaneous oxygen measurement was the best presently available method to determine the need for HBO before initiating therapy.

values are used to predict. CR Wyss et al. (1988) measured TcPO₂ at the foot and proximal and distal to the knee in 162 patients who then had 206 amputations. An increasing probability of failure was correlated with decreasing TcPO₂.

Transcutaneous oximetry has become increasingly popular as a tool for vascular assessment of amputation sites and for wound assessment for HBO treatment. Tissue oxygen assessment is



THE SENSOR MEASURES THE AMOUNT OF CURRENT FLOWING AND CONVERTS IT TO THE TISSUE OXYGEN TENSION VALUE.

used to help define those patients within a given diagnosis that will benefit from HBO treatment and, in some cases, to determine when treatment is complete.

Essentially four questions are addressed by measuring tissue oxygen tension:

- Is wound healing complicated by hypoxia?
- When present, is hypoxia reversible?
- Is the patient responding to hyperbaric oxygen therapy?
- Has the patient reached a therapeutic end point? ■

TISSUE OXYGEN TENSION VALUES FOR PROGRESSIVELY INCREASED INSPIRED PO₂

| Ambient pressure (atm abs)/ Breathing media | 1.0 AIR | 1.0 O ₂ | 2.0 O ₂ | 2.4 O ₂ | 3.0 O ₂ |
|----------------------------------------------------------|---------|--------------------|--------------------|--------------------|--------------------|
| REPRESENTATIVE TISSUE OXYGEN TENSION VALUES, MMHG | | | | | |
| Ambient PO ₂ , mmHg | 159 | 760 | 1,520 | 1,824 | 2,280 |
| Transcutaneous PO ₂ (1) | 69 ± 6 | 440 ± 95 | | 1,350 ± 220 | |
| Transcutaneous PO ₂ - chest (2) | 67 ± 12 | 450 ± 54 | | 1,312 ± 112 | |
| Transcutaneous PO ₂ - calf, male (2) | 49 ± 14 | 281 ± 78 | | 1,027 ± 164 | |
| Transcutaneous PO ₂ - calf, female (2) | 59 ± 12 | 367 ± 59 | | 1,174 ± 127 | |
| Transcutaneous PO ₂ - midfoot (2) | 63 ± 13 | 280 ± 82 | | 919 ± 214 | |
| Transcutaneous PO ₂ - limb (3) | 49 | 325 | 696 | | |

1 - TRANSCUTANEOUS O₂ DATA FROM SHEFFIELD (1998)
 2 - TRANSCUTANEOUS O₂ DATA FROM DOOLEY (1997)
 3 - TRANSCUTANEOUS O₂ DATA FROM HART (1990)

[CHART FROM PJ SHEFFIELD, 1998]



How do transcutaneous oxygen monitors work?

JM Bacharach, et al., (1992) described the equipment used to measure TcPO₂ as an oxygen sensor consisting of two parts: (1) a modified Clark-type polarographic sensor, a silver anode, electrolyte, and an oxygen permeable membrane; and (2) a heating section with two precision thermistors for measuring and controlling the sensor temperature. When the sensor is exposed to oxygen, it creates an electrochemical reaction that causes current to flow through the cathode. An amplifier connected to the cathode measures the amount of current flowing and converts it to a value proportional to the oxygen tension at the sensor/membrane interface. This information is displayed as TcPO₂.

Each study takes about 30 minutes and is noninvasive. The process is very similar to an EKG. Since the electrodes will not adhere to a moist surface, TcPO₂ values are collected near the wound at standardized locations. The clinician uses peri-wound TcPO₂ in combination with other assessment methods (e.g. temperature, pulse, presence of hair, general appearance of the tissue) to predict the behavior of the wound.

Factors influencing TcPO₂ values

- Systemic
 - Patient's oxygen content as affected ventilation and hemoglobin oxygen carrying ability.
 - Blood flow as affected by the condition of the cardiac and vascular systems.
- Local
 - Infection
 - Smoking
 - Caffeine
 - Vasoactive drugs (vasoconstrictor or vasodilator)
 - Environmental temperature
 - Increased skin thickness
 - Obesity
 - Edema
 - Cellulitis
 - Bony prominences
 - Underlying vein or artery ■

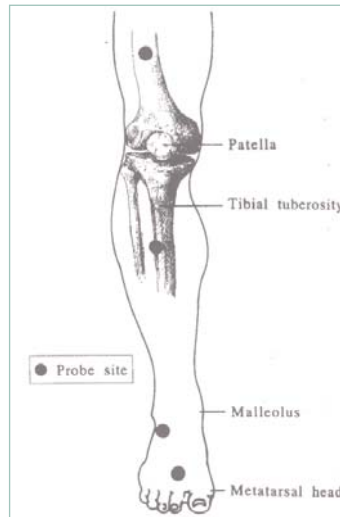


DIAGRAM ILLUSTRATING THE SITES OF MEASUREMENT. SITES WERE CHOSEN TO YIELD THE MOST CLINICALLY USEFUL DATA FOR HEALING OF ISCHEMIC ULCERATION OR PLANNED AMPUTATION. (PADBERG, FT. 1992)

Radiometer's TCM™ 400



The Radiometer TCM400 is available as part of the standard equipment suite at National Healing Corporation Wound Centers. The TCM400 is a portable, noninvasive instrument that measures transcutaneous oxygen tension (TcPO₂) at up to six different points along a limb or around a wound. Results produced by the TCM400 are reliable and reproducible since the instrument houses an internal barometer that automatically calculates the correct calibration value. ■

CONSISTENT TCOM SENSOR PLACEMENT ENSURES REPRODUCIBLE RESULTS AND CLEAR COMPARISONS OVER TIME.

STUDIES DESIGNED TO MEASURE WOUND OXYGENATION DURING A COURSE OF NORMOBARIC OR HYPERBARIC OXYGEN SHOW:

- Problem wounds have low PO₂
- Wounds respond to O₂
- Wound PO₂ has minute-to-minute variability
- Hyperbaric oxygen elevates wound PO₂
- Multiple HBO exposures increase wound response
- Irradiated tissue responds like a wound

(PJ SHEFFIELD, 1998)

Predicting response to HBO: changes in results over time is the key

Indications for HBO



Medicare has approved reimbursement for HBO therapy when the following diagnoses are made:

- Actinomycosis
- Acute carbon monoxide intoxication
- Acute peripheral arterial insufficiency
- Acute traumatic peripheral ischemia
- Chronic refractory osteomyelitis
- Crush injuries and suture (reattachments) of severed limbs
- Cyanide poisoning
- Decompression illness
- Diabetic wounds of the lower extremities
- Gas embolism
- Gas gangrene
- Osteoradionecrosis
- Preparation and preservation of compromised skin grafts
- Progressive necrotizing infections
- Soft tissue radiation injury ■

RE Grolman, et al., (2001) reported a difference in transcutaneous oxygen tension readings measured near the ischemic lesion with the patient breathing room air and while breathing 100% oxygen at ambient pressure is predictive of wound healing with adjunctive hyperbaric oxygen therapy. Patients can be predictably identified who are likely to benefit from this modality using TCOM at the time of initial evaluation. An increase of tissue O₂ tension of ≥10 mmHg when breathing pure O₂ suggests that the patient may benefit from HBO therapy. Those patients with a change of <10 mmHg are unlikely to receive benefit from this treatment modality.

Transcutaneous oxygen measurement (TCOM) has been used to assess the degree of hypoxia present in ischemic tissue and has been proven to be satisfactory for objective risk stratification. Adapting a criterion originally introduced to assess skin flap viability and exploited to successfully predict amputation success, RE Grolman, et al., tested the response of TCOM to 100% oxygen inhalation in an effort to improve the ability to predict the benefit of

HBO therapy. The authors also tested the hypothesis that a change in TCOM value of ≥10 is predictive of healing with HBO therapy and that a change in TCOM of <10 is predictive of failure of healing with HBO therapy.

patient the change in TCOM was calculated as the difference in TCOM values obtained during inhalation with 100% oxygen by mask versus that value obtained at baseline when the patient was breathing room air. The protocol did not call for measuring TCOM

| CHANGES IN TCOM VALUES (MMHG) | | | |
|---------------------------------------------------|--------------------------|-----------------------------------------------|---------------------------|
| | Average TCOM at baseline | TCOM value after inhaling 100% O ₂ | Mean change in TCOM value |
| Group A | 5.8 ± 1.6 | 6.50 ± 2.4 | 0.7 ± 1.5 |
| Group B | 16.0 ± 2.5 | 75.9 ± 11 | 59.9 ± 10 |
| FOR ALL GROUP B MEASUREMENTS, P < 0.05. | | | |

The study evaluated 28 foot or leg ulcers, 18 digit amputation sites, one above-knee amputation, and one transmetatarsal amputation. All patients underwent lower-extremity segmental pressure assessment and waveform analysis - either Doppler and/or pulse volume - before HBO therapy. In all of these patients, noninvasive testing documented some element of distal extremity ischemia.

The site used for the actual TCOM measurement was the healthy skin just proximal to the nonhealing wound. After successful measurement at baseline the patients were administered 100% O₂ via a non-rebreathing mask for 10 minutes until equilibration occurred, and the TCOM values were reassessed. In each

during the actual hyperbaric treatments. Patients were grouped according to the change in their TCOM values: Group A had a change of less than 10 mmHg and Group B had a change of greater than or equal to 10 mmHg.

Only 11% of ischemic wounds healed after HBO therapy in Group A patients. 70% of patients having change in TCOM values = 10 mmHg healed ischemic wounds with HBO. Initial (room air) TCOM values did not predict outcome. Patients who went on to heal did, however, have a higher TCOM after breathing 100% oxygen than those who did not heal (77 vs. 35 mmHg; P < 0.05). The authors could not identify a specific co-morbid factor or race or gender to be



TCOM VALUE MEASURED IN-CHAMBER DURING HBO PROVIDES THE BEST SINGLE PREDICTOR OF SUCCESS AND FAILURE OF HBO THERAPY.

CE Fife, et al., (2002) makes these suggestions for the practical use of TcPO₂ in selecting patients for HBO therapy:

Tips for using TcPO₂ values to select patients for HBO

- Baseline air TcPO₂ should be taken to determine whether tissue hypoxia exists.
- Without in-chamber TcPO₂ data, measuring the absolute TcPO₂ breathing sea-level oxygen may be of value in determining the benefit of subsequent HBO therapy.
- Whenever possible, in-chamber TcPO₂ data should be utilized as a guide to patient selection for HBO therapy.
- A combination of in-chamber TcPO₂ and sea-level air TcPO₂ may increase accuracy slightly. ■

Predicting response to HBO: changes in results over time is the key *(continued)*

associated with a different likelihood of predicting success or failure of wound healing with HBO therapy.

A TcPO₂ value of at least 40 mmHg is required for normal collagen production. In addition, collagen crosslinking, which is crucial to wound tensile strength, is also optimized with TcPO₂ values above 40 mmHg. Finally, infection is promoted within a hypoxic environment where the leukocytes' ability to use oxygen is diminished. These and other observations form the basis of HBO therapy for the healing of difficult ischemic wounds in which all conventional therapy has been exhausted.

Noninvasive TCOM determination is an es-

tablished predictor of the severity of tissue hypoxia associated with peripheral arterial occlusive disease. This objective measure, which was previously used to quantify the healing potential in ischemic extremity wounds, has also been documented to assist in the prediction for likelihood of healing or failure in lower extremity amputation sites. Unlike other noninvasive studies, TCOM assessment uniquely provides a demonstration of the adequacy of local tissue oxygenation.

Specifically using an objective and reproducible measurement (change in TCOM) and a corresponding limit (≥ 10 mmHg) statistical significance regarding healing could be predicted. These

patients should be treated with HBO therapy. Of equal or possibly even greater importance is the fact that those patients with changes in TCOM values of < 10 mmHg are unlikely to benefit and should not undergo this costly and prolonged therapy.

RE Grolman, et al., noted that hyperbaric oxygen should not be used as a replacement to vascular reconstruction. The authors always use vascular reconstruction for limb salvage, with debridement of devitalized tissue as indicated. However, in conclusion, the authors noted where vascular options did not exist or reconstruction was inadequate, hyperbaric therapy proved to be an effective option for many patients. ■

working with Hyperbaric Oxygen

Hyperbaric physicians take no chances with patients in these circumstances:

- Untreated pneumothorax
- History of spontaneous pneumothorax
- Recent use of cisplatin or adriamycin for chemotherapy
- Any use of bleomycin for chemotherapy
- Current use of disulfiram (Antabuse) if your patient needs > 1 treatment

Common side effects from HBO therapy are:

- Idiosyncratic cataract growth
- Transient deterioration of far vision as near vision improves. Effect is commonly noticed after 30 treatments. Vision generally returns to baseline after 2-3 months.
- Paresthesia, tingling of the fingertips, can be noticed after 30 treatments. Effect disappears about one month after completing treatment.

Inherent risks are barotraumas, transient visual changes, and oxygen seizures. The Wound Healing Center has policies and procedures in place to limit these risks while providing the highest quality care. ■

Deciding where to amputate

In 2000, A. Misuri, et al., found transcutaneous oximetry to be the best method for selection of amputation level. As JM Bacharach (1992) from the Mayo Clinic has said, the appropriate level of amputation must achieve two purposes:

- Maximizing the patient's rehabilitation potential
- Avoiding complications with possible surgical revision or new amputation at proximal level

In a study designed to verify the usefulness of this investigation, the authors evaluated 30 consecutive cases requiring amputation.

This study demonstrated usefulness of TcPO₂ for the selection of amputation level. Oxygen tension was higher than 20 mmHg in 88% of the successful group, while lower than 20 mmHg in 85% of the unsuccessful group. Sensitivity of the method was 88%, specificity 85%, and diagnostic accuracy 87%. Considering the value of the 20 mmHg threshold, positive predictive value is

(continued on page 7)

TcPO₂ vs. ABI

GP Hanna, et al., (1997) compared TcPO₂ and ABI measurements in a group of diabetic patients with infrapopliteal trans-catheter interventions. They found that TcPO₂ measurements are valuable in predicting wound healing and success after interventions and that ABI measurements are not.

TcPO₂ and ABI results
Transcutaneous oximetry was measured in all patients before and within two weeks of the procedure. TcPO₂ improved in all but two patients with

significant for either technically or clinically successful procedures (p>0.2 and 0.4, respectively.)

The TcPO₂ values improved to levels beyond tissue viability, from a mean of 28 to 55 mmHg (p<0.0001) in 90% of patients with technical success. In fact, this improvement in TcPO₂ provides direct evidence of improved tissue perfusion and indirect evidence of improved arterial flow. TcPO₂ levels < 40 mmHg are not consistent with wound healing.

| RESULTS OF TRANSCUTANEOUS OXIMETRY | | | |
|------------------------------------|---------------------------------|--------------------------------|---------|
| | BEFORE TcPO ₂ (MMHg) | AFTER TcPO ₂ (MMHg) | p VALUE |
| Technical success (n=26) | 29.27 ± 9.57 | 57.58 ± 10.02 | <0.0001 |
| Clinical success (n=23) | 27.82 ± 9.97 | 54.5 ± 14.73 | <0.0001 |

successful intervention, as well as in all patients who eventually had healed or healing ulcers. In fact, postintervention TcPO₂ was predictive of both procedural and clinical success (p<0.0182). Two patients continued to have low TcPO₂ values despite technically successful interventions. This may have been due to the presence of severe microvascular disease, persistent infection, or restenosis of the angioplasty site. ABI measurements before or after the transcutaneous intervention were not

This finding demonstrates that TcPO₂ is a reliable method for assessing tissue viability because all TcPO₂ values >40 mmHg after the intervention had healing ulcers. In addition, TcPO₂ predicted interventional success; levels improved in all but two patients with technical success. These two patients may

| RESULTS OF ANKLE-BRACHIAL INDEX MEASUREMENT | | | |
|---------------------------------------------|------------------------|-----------------------|---------|
| | BEFORE ABI MEASUREMENT | AFTER ABI MEASUREMENT | p VALUE |
| Technical success (n=26) | 0.68 ± 0.17 | 0.67 ± 0.19 | <0.2 |
| Clinical success (n=23) | 0.70 ± 0.17 | 0.70 ± 0.19 | <0.4 |



DIABETIC PATIENTS ARE FIVE TIMES MORE LIKELY TO DEVELOP CRITICAL LIMB ISCHEMIA THAN NONDIABETIC PATIENTS.

have experienced vascular reocclusion, had severe microvascular disease, or developed persistent infection. Local skin infection drives down TcPO₂ levels in the setting of borderline perfusion. Finally, ABI measurements in the diabetic patients in the study did not improve significantly after angioplasty, which confirms previous reports that diabetic patients may have calcified arteries, providing unreliable ABI measurements.

The findings of this study are consistent with proponents of the "macrovascular disease" theory. This theory emphasizes large-vessel disease as the main culprit in the development of diabetic gangrene, with some investigators

(continued on page 7)

Deciding where to amputate

(continued)

88% and negative predictive value 85%.

Traditional methods in the selection of the amputation level include: evaluation of skin condition at the presumed amputation level, assessment of the cutaneous temperature, evaluation of arterial pulses, arteriographic picture, and bleeding during amputation. Although clinical evaluation is important, difficulty in correctly evaluating tissue perfusion can lead to failure of amputations at the more distal levels



TcPO₂ MEASUREMENTS DIRECTLY EVALUATE SKIN OXYGEN TENSION AND TISSUE METABOLIC STATES, WHICH ARE THE MOST IMPORTANT VARIABLES FOR WOUND HEALING AFTER LIMB AMPUTATION BECAUSE OF CHRONIC ISCHEMIA.

(below-knee, trans-metatarsal, and toe).

In 1996, TJ Bunt and GA Holloway studied TcPO₂ as an accurate predictor of therapy in limb salvage in 147 consecutive patients with limb-threatening acute diabetic pedal sepsis and/or chronic ischemia. TcPO₂ measurements may be used to direct therapy because they have been

shown to accurately predict the presence of significant vascular disease, its appropriate correction by means of revascularization, and the success of major or minor amputations with or without revascularization. ■

METHODS FOR SELECTING AMPUTATION LEVEL

SYSTOLIC ARTERIAL PRESSURE USING DOPPLER TECHNIQUE: Limited use because arteries with calcified walls are not compressible and are common in patients with diabetes.

RADIOISOTOPE EVALUATION: Not widespread because equipment is complex, invasive, expensive, requires specialized technicians, and the use of radioactive material

TRANSCUTANEOUS OXIMETRY: Noninvasive, easily carried out, simple, does not generate radiation, and cost-effective

Selected bibliography

Bacharach JM, Rooke TW, Osmundson PJ, and Gloviczki P. (1992). Predictive value of transcutaneous oxygen pressure and amputation success by use of supine and elevation measurements. *Journal of Vascular Surgery*, 15, 558-63. • Bunt TJ, and Holloway GA. (1996). TcPO₂ as an accurate predictor of therapy in limb salvage. *Annals of Vascular Surgery*, 10(3), 224-227. • Fife CE, Buyukcakil C, Otto GH, Sheffield PJ, Warriner RA, Love TL, et al. (2002). The predictive value of transcutaneous oxygen tension measurement in diabetic lower extremity ulcers treated with hyperbaric oxygen therapy: a retrospective analysis of 1,144 patients. *Wound Repair and Regeneration*, 10, 198-207. • Fronek A. (1997). Transcutaneous monitoring of pO₂ in the assessment of peripheral vascular disease. Denmark: Radiometer Medical A/S. • Grolman RE, Wilkerson DK, Taylor J, Allinson P, and Zatina MA. (2001). Transcutaneous oxygen measurements predict a beneficial response to hyperbaric oxygen therapy in patients with nonhealing wounds and critical limb ischemia. *The American Surgeon*, 67, 1072-1080. • Hanna GP, Fujise K, Kjellgren O, Feld S, Fife C, Schroth G, et al. (1997). Infrapopliteal transcatheter interventions for limb salvage in diabetic patients: importance of aggressive interventional approach and role of transcutaneous oximetry. *Journal of the American College of Cardiology*, 30, 664-9. • Misuri A, Lucertini G, Nanni A, Viacava A, and Belardi P. (2000). Predictive value of transcutaneous oximetry for selection of the amputation level. *Journal of Cardiovascular Surgery*, 41, 83-7. • Padberg FT, Back TL, Hart LC, and Franco CD. (1992). Comparison of heated-probe laser Doppler and transcutaneous oxygen measurements for predicting outcome of ischemic wounds. *Journal of Cardiovascular Surgery*, 33, 715-722. • Padberg FT, Back TL, Thompson PN, and Hobson RW. (1996). Transcutaneous oxygen (TcPO₂) estimates probability of healing in the ischemic extremity. *Journal of Surgical Research*, 60, 365-369. • Sheffield, PJ. (1998). Measuring tissue oxygen tension: a review. *Undersea Hyperbaric Medicine*, 25(3), 179-188.

TcPO₂ vs. ABI

(continued from page 6)

rejecting the concept of "microvascular disease" completely.

TcPO₂ is a more reliable method for predicting tissue viability and technical success of infrapopliteal interventions in this patient group than the simple Doppler-derived ABI, which was unreliable. The present findings suggest that patients with diseased leg arteries and a low TcPO₂ would benefit from PTCA in conjunction with HBO treatments and local wound care before resorting to the much-dreaded BKA. However, if TcPO₂ levels remain below healing levels, lower extremity amputation may unfortunately be the only route left when surgical revascularization is ruled out as an option. ■



QUESTIONS OR COMMENTS?

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TCOM readings: making sense of the numbers Q&A with Dr. Bartlett

Provided you have addressed the other common complications of wound healing like nutrition, glycemic control, infection, dehiscence, offloading, etc., there are some accepted values you can use to help you with your patient's plan of care.

When I do a room-air TCOM, what value am I looking for?

We teach our physicians to look for the value of 40 mmHg as a beginning point for predicting wound failure. Patients with values of greater than 40 mmHg are associated with good healing.

What is the best predictor of success with HBO therapy?

A TCOM value measured in-chamber during HBO provides the best single predictor of success and failure of HBO therapy. A value of 200 mmHg is what you are looking for during therapy.

If I put my patient on 100% oxygen during the TCOM test, will I get better predictive information?

In the absence of in-chamber TcPO₂ data, measuring TcPO₂ while breathing 100% oxygen at sea level will give you additional information. If

your value is greater than 100 mmHg you should consider HBO.

If I know my patient will require an amputation,

can I use TCOMs to assist in determining the level of amputation?

Yes, there are studies that indicate values of 40 mmHg and above are associated with uncomplicated post-operative healing. Although more distal sites are desirable, they may carry a risk of post-operative complications when the values are less than 40 mmHg. Under the condition of marginal hypoxia, hyperbaric oxygen therapy may offer a much-needed solution to gaining critical limb length.

Is there value in comparing TCOMs done at different times during therapy?

Comparing results of your initial test to those of future tests can provide a useful guide to ongoing therapy. Consistent sensor placement is key to the value of this comparison over time. ■

Working with your Wound Healing Center

Transcutaneous oximetry is appropriate to determine the potential for uncomplicated healing when you have:

- Patients with wounds that haven't healed or shown progress within 30 days
- Patients who have had recent revascularization procedures
- Patients with questionable vascular supply
- Patients for whom you are considering surgical procedures



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