BLF22 Technical Note

Considerations for Measurements by Laser Doppler

In preparing to use a BLF Tissue Perfusion Monitor, several factors must be considered. Among these are: motion of the Probe head, tissue or fiber optic cable; pressure on the tissue; temperature of the air or tissue; sterilization of the Probe; method of recording results and time constant switch settings.

MOTION

In order to quantify the flow of blood, care must be taken to eliminate other sources of motion. Doppler devices measure relative motion. A BLF Monitor measures the shift in frequency between the light it emits and that which it receives. This shift is imparted when the light strikes an object which is moving, relative to the Probe head. The shift is described by the Doppler effect. Ideally, wavelength shifts are imparted only by moving blood cells; however, motion between the tissue and Probe head, within the tissue under the Probe head; or bending motion of the Probe's fiber optic cable can also produce a signal (frequency shift). This is an artifact rather than blood flow. Of these motion artifacts, by far the most important is Probe-to-tissue motion. Avoid this type of motion through careful selection of a Probe holder (see LD-106-tn). If the tissue to be studied has moving filaments crossing the path of the laser light (ex. heart tissue), a significant artifact signal can result. Experiments must be performed to determine if the Monitor's signal is meaningful in cases where tissue motion is significant. Finally, Laser Doppler Probes are not designed to allow for large fiber bending motion artifacts. However small, this artifact signal is worth eliminating, so fixing the Probe cable in several points is appropriate.

APPLICATION PRESSURE

Since the laser Doppler is measuring a relatively shallow portion of tissue (about 1 mm deep), a very light application must be used so as not to occlude the small underlying vessels. In order to determine the correct pressure of application, it is best to apply the Probe and take a reading. Then move the Probe back from the tissue slightly and take a second reading after 15 seconds. If the second reading is higher, the first application was likely done with too much pressure. Additionally, it is best to use a chart recorder or computer interface to display the waveform. This very readily shows the difference between tissue occluded by pressure and non-occluded tissue. Additionally, pressure applied to tissue proximal or distal from the Probe can influence the perfusion and, therefore, the instrument readings.

AMBIENT TEMPERATURE

Room temperature has a significant effect on peripheral blood flow. In some studies, the maximal flow in tissue is important (this may be measured by warming the tissue to 42°C). In other studies, the blood flow at room temperature may be most important. In either case, careful control of the temperature is essential. Time should be allocated to allow subjects coming in from other temperature levels to acclimate before measurements are taken.

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Additional Considerations for Measurements

POWERFUL LIGHTING

Strong light applied to the tissue under study can affect the Monitor. While normal room lighting has minimal effects, strong overhead illumination such as operating room lights or microscope lights can flood the tissue with light in the wavelength of interest causing erroneous readings. Switch off bright lights, if possible, before taking readings or drape the area of the Probe.

RECORDING CONSIDERATIONS

You should decide if you will use hand recording of the data from the front display, or an analog or digital recorder connected to the output(s) on the back panel. The time constant switches on the rear panel control the filters for data going to any external recorder (see LD-105-tn).

TO STERILIZE

Prior to using the Probes intraoperatively, they must be sterilized using cold gas (ethylene oxide at 65°C) or STERRAD®. Do not autoclave Laser Doppler Probes. Following use, any blood or tissue adhering to the Probe may be removed in a warm, soapy water bath (do not dip the connectors). See, Sterilization & Care for Transonic® Laser Doppler Probes (LD-115-tn) for more details.

WHEN NOT TO STERILIZE

When using the Probe for cutaneous measurements, an alcohol wipe may be sufficient disinfection between subjects. When making readings on multiple subjects, a disposable clear plastic Probe covering is recommended. For needle type Probes, use an oral thermometer sheath; for larger Probes other types of plastic sleeves will be useful. Always conform to appropriate health and safety regulations regarding Probe cleaning and sterilization.

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Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells "gold standard" transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.

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