Tissue Resuscitation Using Low Frequency Acoustic Stimulation to Treat Ischemia

Pathological conditions with decreased or low blood flow (ischemia) kill or incapacitate millions of people annually. Examples of such conditions include hemorrhagic shock, cardiogenic shock, congestive heart failure, cardiac arrest, septic shock, intestinal ischemia, myocardial ischemia, stroke, traumatic brain injury, sickle cell vaso-occlusive crisis, burns, compartment syndrome, and acute and chronic wounds, among others. In these cases, ischemia can cause rapid, irreversible damage or death of the affected tissue. In addition, chronic, non-acute low blood flow has been implicated in the development of progressive diseases such as osteoporosis.

Low Frequency Acoustic Stimulation to Increase Tissue Oxygenation

This invention provides methods for preventing or treating low blood flow/ischemia in tissue and equipment (devices) for carrying out the methods. The invention is based on the discovery that a significant increase in blood flow occurs in tissues within the body that are exposed to low frequency sound or vibration. The observed improvements in tissue oxygenation are likely related to the ability of low frequency sound and/or vibration to produce vasodilation of the microvasculature by increasing shear wall stress at the level of the microvascular endothelium, which in turn produces an increase in endothelial nitric oxide (NO) production. NO is known to be a potent vasodilator. Increasing blood flow results in increases in tissue oxygenation, which may be more important in the treatment of low blood flow/ischemia than strict maintenance of systemic blood flow.

The invention may be used in both human and veterinary applications to treat or prevent a wide array of disorders caused by low blood flow and/or ischemia. Such disorders may be the result of acute low blood flow (e.g., caused by trauma or a wound) or due to chronic low blood flow (e.g., osteoporosis). These conditions include but are not limited to those that are related to hemorrhagic shock, cardiogenic shock, congestive heart failure, cardiac arrest, acute and chronic wounds, and osteoporosis. The device would also assist in the treatment of environmental emergencies such as hypothermia or hyperthermia.

As a physical therapy modality, the application of sound or vibration to a patient as performed by this invention can improve function, for example, in the cases of over exertion or recovery from trauma, hypothermia, or surgery.

Applications

- Treatment of low blood flow / ischemia
- Acute low blood flow, such as that caused by trauma
- Chronic low blood flow (e.g., osteoporosis)
- Physical therapy to improve recovery from trauma, hypothermia, or surgery

Advantages

- Rapid improvement in blood flow
· Non-invasive - stimulation is transmitted through the skin
· Can be monitored in real time

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