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(54) BODY CORE THERMO-REGULATION COOLING SLEEVE

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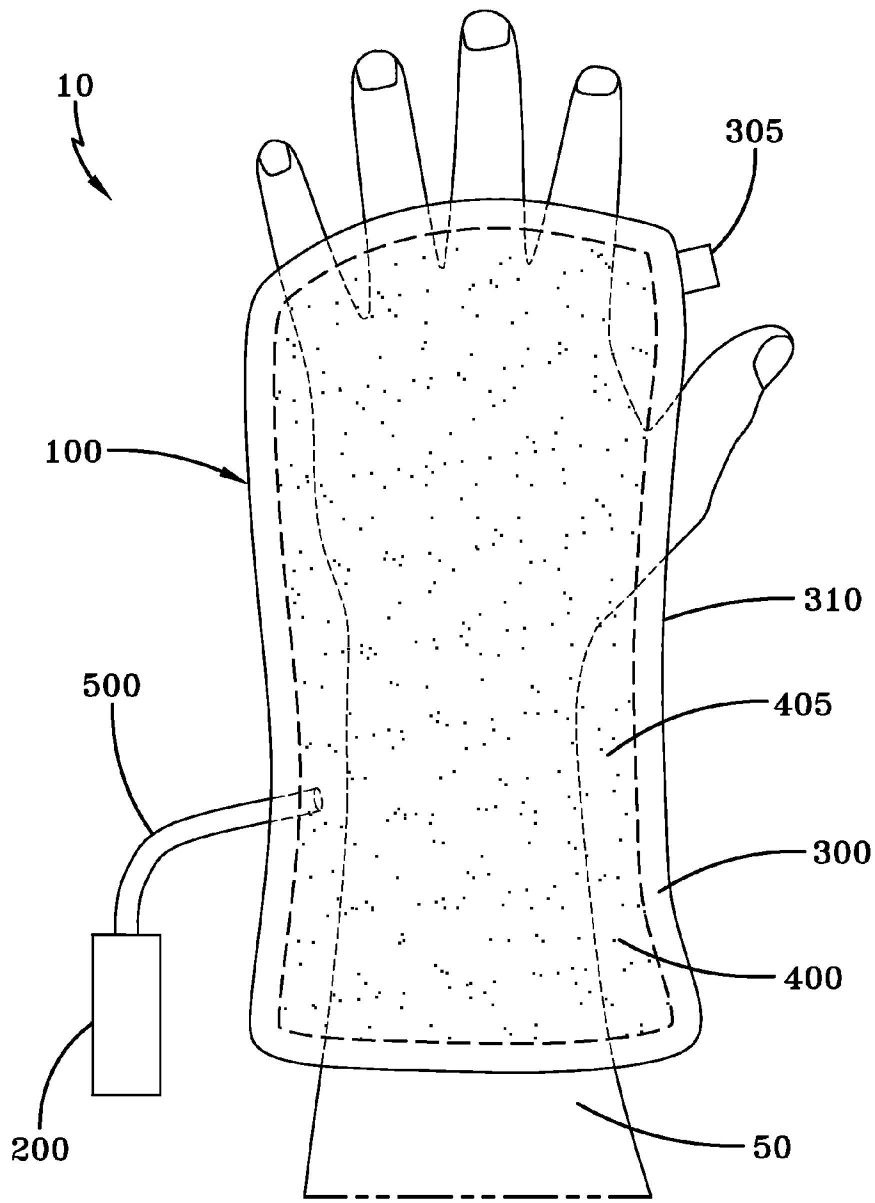
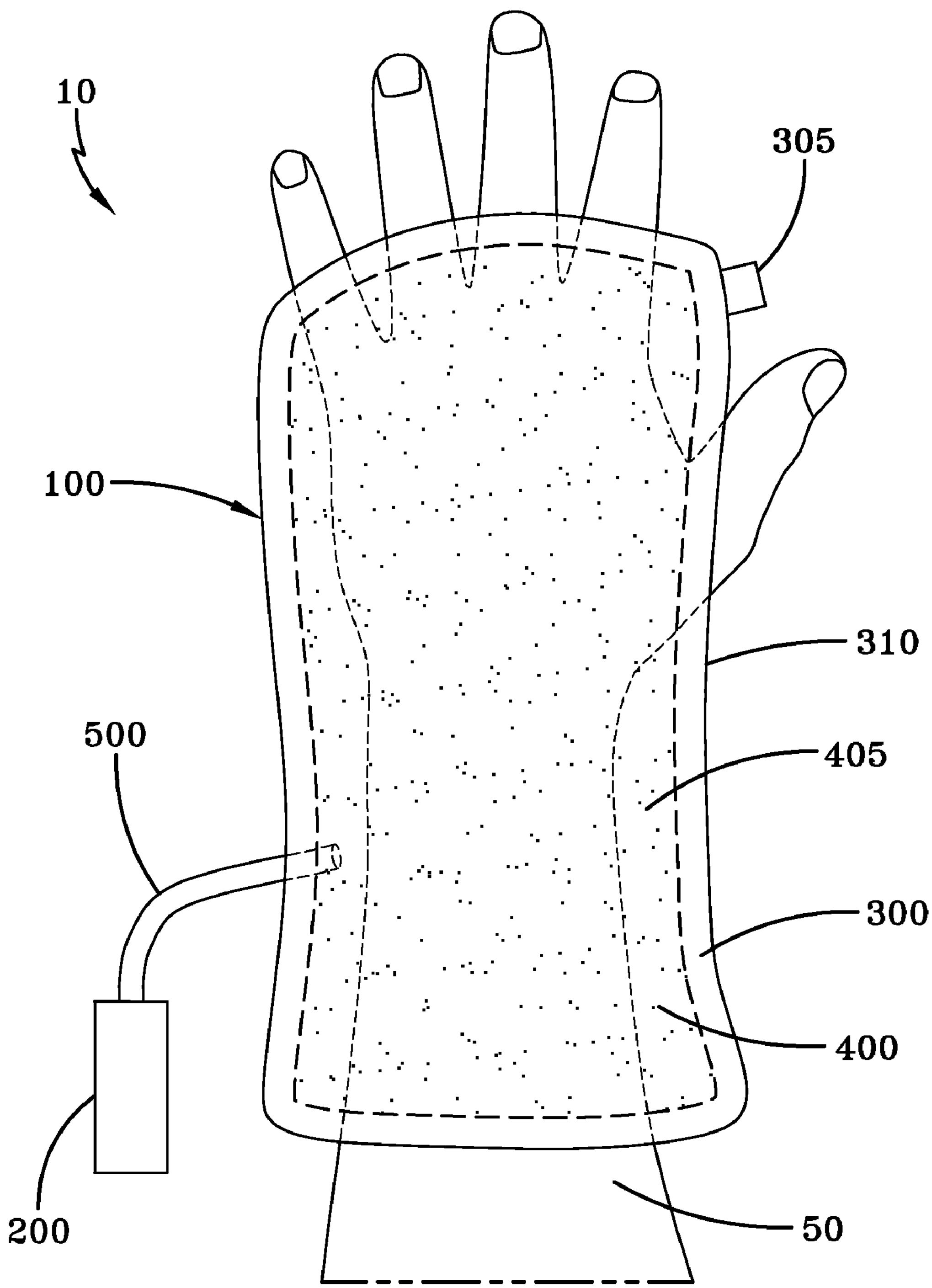
(57) ABSTRACT

The present invention is a cooling sleeve, which has a sheath and a gas cartridge. The sheath is able to slip over a user's clothed arm), and includes a chamber disposed within the sheath. The chamber is able to thermally communicate with the user's arm. The gas cartridge supplies cooling gases to the chamber such that the user's arm is cooled, whereby the user's core temperature is cooled.





FIG—1

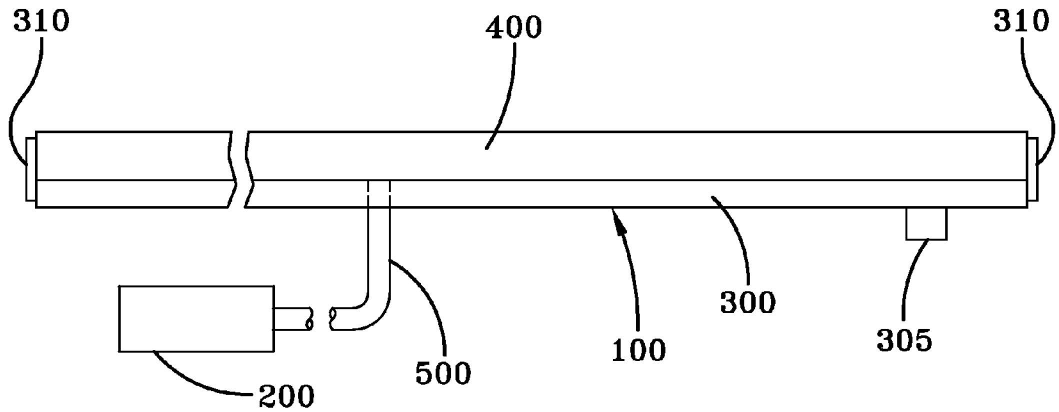


FIG-2

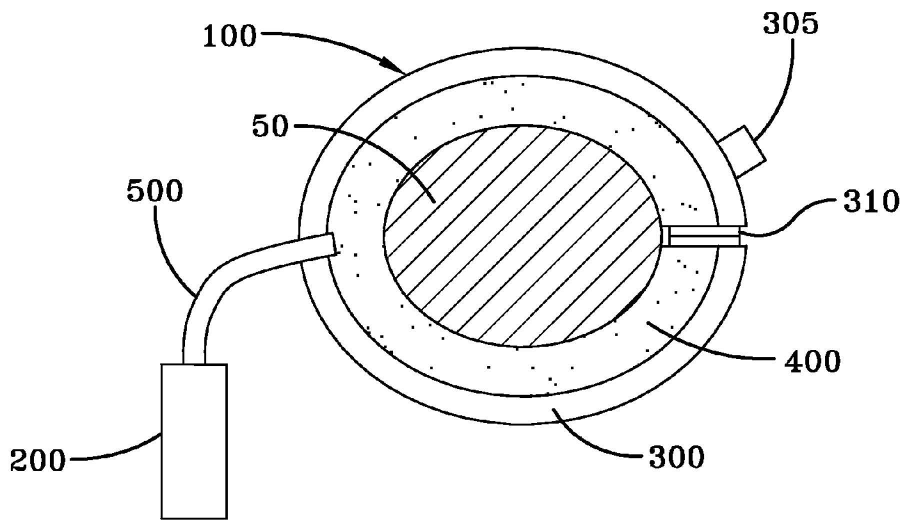
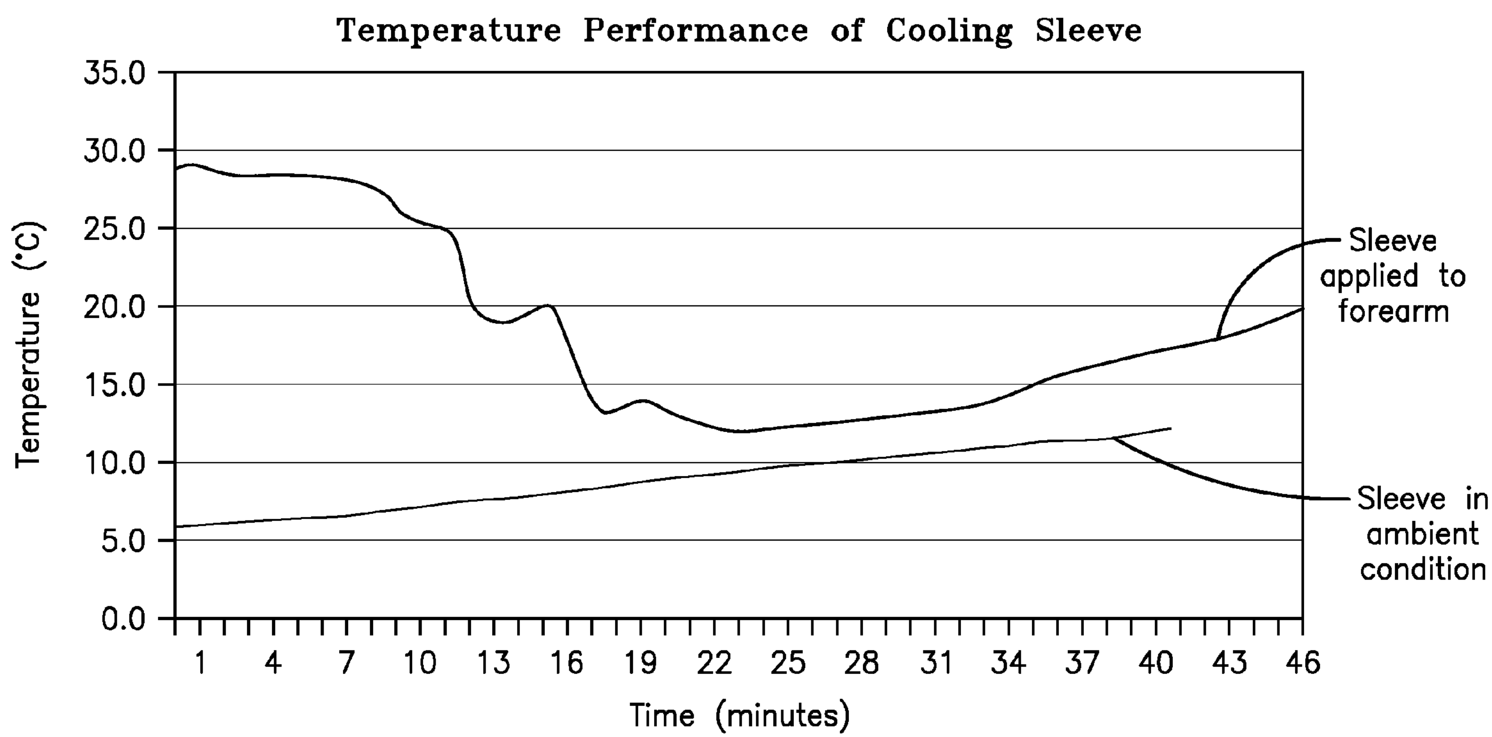
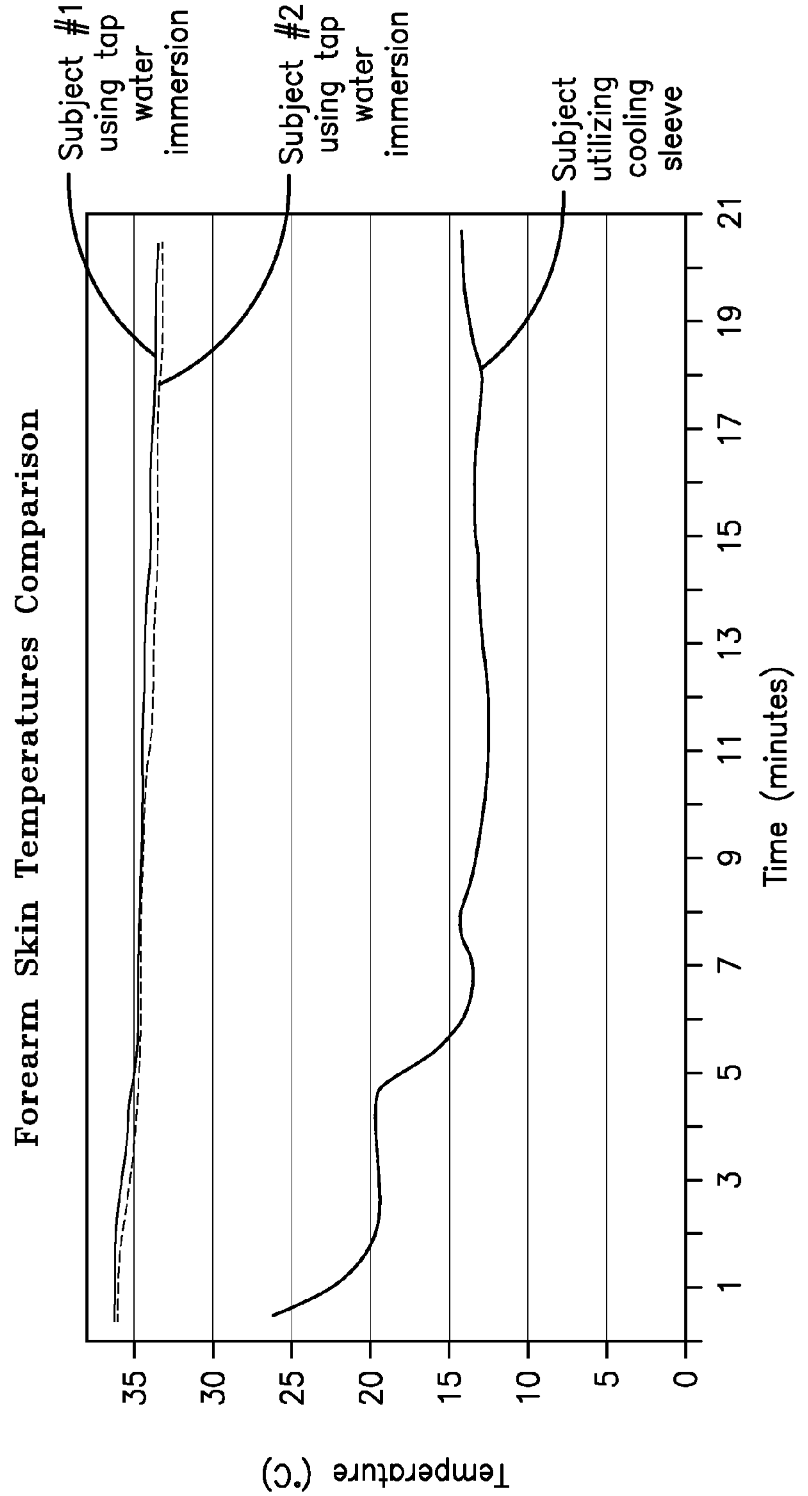


FIG-3



Initial sleeve temperature achieved during charging is 6°C increasing to 12°C over 40 minutes with no thermal load (body heat). Sleeve was charged at the 10 minute mark after donning.

FIG-4



Avergae decrease in skin temperature using water immersion is about 5°C, cooling sleeve provides about 12°C decrease

FIG-5

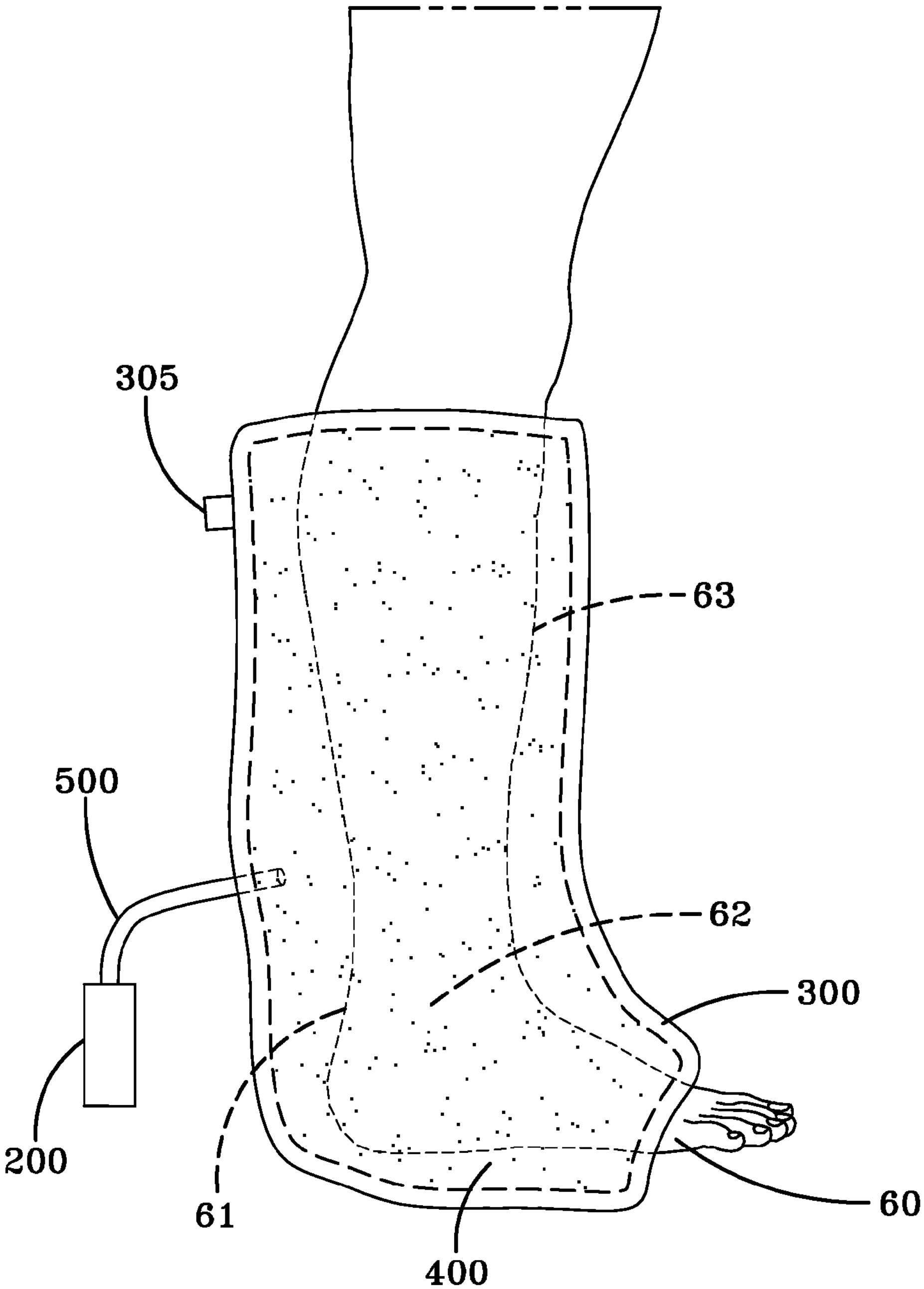


FIG-6

BODY CORE THERMO-REGULATION COOLING SLEEVE

STATEMENT OF GOVERNMENT INTEREST

[0001] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

BACKGROUND

[0002] The present invention relates to a portable, lightweight, individual use heat stress mitigation device. More specifically, but without limitation, the present invention relates to a body core thermo-regulation cooling sleeve.

[0003] The personal clothing and equipment required to protect an individual from biological and chemical hazards and some nuclear effect are typically referred to as individual protective equipment ("IPE"). IPE typically includes headgear, gloves, and protective clothing. Usually this gear is used by emergency and military personnel, and typically a user becomes very hot while wearing the equipment. This creates the danger of a user's body core temperature increasing and puts the user at risk for heat injury and heat exhaustion. Additionally, an increase in core body temperature can lead to decreased strength, decreased endurance and cognitive function, as well as impaired job performance and adverse health effects.

[0004] Misting, passive cooling, and removal of gear are currently used for cooling individuals donned in IPE. These methods are not very effective for decreasing core temperature. One of the more effective methods for decreasing core temperature is immersion, particularly immersion of the hands and forearms. Ice water and cold-water immersion have been used successfully to decrease core temperatures, but this method is not practical in the operating environment. However, research has found that hand and forearm immersion increased work time significantly more that passive cooling during rest periods.

[0005] It is desirable to provide cooling without lowering the individual's protection level (i.e. removing some or all of the protective gear) or requiring the individual to retreat to a clean area when operating in contaminated or dirty environments. Cooling methods currently in use are not practical and/or provide minimal effect in contaminated areas.

[0006] For the foregoing reasons, there is a need for an system that can cool the body core temperature of users of IPE.

[0007] Arteriovenous anastomoses (AVAs) are small blood vessels with thick muscular walls that open and close. AVAs connect the smaller arteries with veins and bypass the capillary bed. When open, a large volume of blood passes through AVAs and heat transfer can occur at the surface of the skin. Immersion in cold water produces a vasoconstriction (when blood vessels constrict, the flow of blood is restricted or decreased, thus, retaining body heat) of the AVAs in order to conserve heat. However, research has shown at high body temperatures (above 37.5 degrees Celsius/99.5 degrees F.) vasoconstriction does not impede blood flow of the AVAs. Blood from AVAs flows directly to the core via superficial veins; therefore AVAs have a beneficial effect on body core temperature. Therefore, the cooling effect of blood in AVAs also cools the body core temperature, as the cooled blood flows to the inner core of the body.

SUMMARY

[0008] The present invention is directed to a cooling sleeve that meets the needs enumerated above and below.

[0009] The present invention is directed to a cooling sleeve, which has a sheath and a gas cartridge. The sheath is able to slip over a user's clothed arm (particularly a user's arm donned in an IPE), and includes a chamber disposed within the sheath. The chamber is able to thermally communicate with the user's arm. The gas cartridge supplies cooling gases to the chamber such that the user's arm is cooled, whereby the user's core temperature is cooled.

[0010] It is a feature of the present invention to provide a body core thermo-regulation cooling sleeve that is lightweight, portable, and cools a user's body core temperature.

[0011] It is a feature of the present invention to provide a body core thermo-regulation cooling sleeve that can be worn over individual protection equipment and is effective without removal of protective gear.

[0012] It is a feature of the present invention to provide a body core thermo-regulation cooling sleeve that does not cause cold damage with extended exposure.

[0013] It is a feature of the present invention to provide a body core thermo-regulation cooling sleeve that cools the arm of a user which in turn cools the core temperature of the user.

DRAWINGS

[0014] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims, and accompanying drawings wherein:

[0015] FIG. **1** is an embodiment of the cooling sleeve in use;

[0016] FIG. **2** is a side view of an embodiment of the cooling sleeve not in use and in the prostrate position;

[0017] FIG. **3** is a cross-sectional view of an embodiment of the cooling sleeve in use;

[0018] FIG. **4** is a graph showing the temperature performance of the cooling sleeve;

[0019] FIG. **5** is a graph showing the forearm skin temperature comparison utilizing the cooling sleeve and tap water; and,

[0020] FIG. **6** is an embodiment of the cooling sleeve in use on a foot/leg.

DESCRIPTION

[0021] The preferred embodiments of the present invention are illustrated by way of example below and in FIGS. **1-6**. As shown in FIGS. **1**, **2** and **3**, the cooling sleeve **10** has a sheath **100** and a gas cartridge **200**. The sheath **100** is able to slip over a user's arm **50** (the arm being clothed or unclothed), and includes a chamber disposed within the sheath **100**. The chamber is able to thermally communicate with the user's arm **50**. The gas cartridge **200** supplies cooling gases to the chamber such that the user's arm **50** is cooled, whereby the user's core temperature is cooled.

[0022] In the description of the present invention, the invention will be discussed in a military and emergency response environment; however, this invention can be utilized for any type of application that requires a user to cool his/her core temperature. Additionally, the invention can be utilized for immediate immobilization and cooling for trauma injuries to reduce tissue swelling, and the like.

[0023] The sheath **100** may be manufactured from plastic, rubber, or any type of flexible material. It may slip over the arm or be able to be opened via a fastener **310** for easy application and removal. The embodiment utilizing the fastener is shown in FIGS. **2** and **3**. FIG. **2** shows the cooling sleeve **10** not in use and in the prostrate or open position. FIG. **3** shows the cooling sleeve **10** with fasteners **310** in use. The fastener **310** used may be, but without limitation, a zipper, a hook and loop configuration, buttons, clasps, laces, snaps, or any type of fastener practicable. The fastener **310** may be located at any convenient location on the sheath, or on opposite ends of the sheath **100**, as shown in FIG. **2**.

[0024] As shown in FIGS. **1-3**, the cooling sleeve **10**, particularly the sheath **100**, may include an outer chamber **300** and an inner chamber **400**. The outer chamber **300** may be filled with insulation, air, or a combination thereof. The inner chamber **400** communicates with the gas cartridge **200** such that the cooling gases enter the inner chamber **400**. The inner chamber **400** is able to thermally communicate with the user's forearm/hand **50**. To thermally communicate may be defined, but without limitation, as the ability to effectively allow heat transfer between the two elements.

[0025] As shown in FIG. **1**, the user's arm **50** may be placed directly in the inner chamber **400** and cooling gases from the gas cartridge directly contact the user's arm **50**. Alternatively, as shown in FIGS. **2** and **3**, the inner chamber **400** may be an enclosed chamber, and the inner chamber **400** envelopes the user's arm. Cooling gases enter the inner chamber **400**, and are not in direct contact with the user's arm **50**. When the inner chamber **400** is an enclosed chamber, the inner chamber **400** of the cooling sleeve **10** may contain additional materials to aid and enhance the period of performance and effectiveness of thermal cooling through the use of silica based crystals, gels or other equivalent materials. A liquid (sodium and water) media may also be introduced in conjunction with the other materials to lower the freezing point of the inner chamber **400** contents to allow for increased heat extraction from the skin.

[0026] The gas cartridge **200** may contain pressurized CO_2 or other comparable gases to achieve and maintain the desired cooling effect. The period of performance can be extended as needed by the ability to repeatedly recharge the sleeve **10** with the use of additional gas cylinders or cartridges **200**.

[0027] The cooling sleeve **10** may also include a charging hose **500**. The charging hose **500** connects the gas cartridge **200** to the inner chamber **400**. The cooling sleeve **10** may also include a pressure relief valve **305**.

[0028] Research has found that hand and forearm immersion increased work time significantly (60%) more that passive cooling during rest periods. It has been shown water misting only increased work time 25% more than passive cooling. Ice water/cold water immersion from shoulder to hips was found to be 38% more effective than passive cooling in reducing core temperature,

[0029] The temperature performance of the cooling sleeve is shown in FIG. **4**. FIG. **5** shows the forearm skin temperature comparison utilizing the cooling sleeve and tap water. Additionally tests have shown that average decrease in skin temperature using water immersion is 5 degrees Celsius, while utilizing the cooling sleeve provides a 12 degree Celsius decrease.

[0030] In another embodiment, as shown in FIG. **6**, the cooling sleeve **10** may used on a foot. The sheath **100** may slip over the back part **61** of the user's foot **60**, the ankle **62** and shin **63**.

[0031] When introducing elements of the present invention or the preferred embodiment(s) thereof, the articles "a," "an," "the," and "said" are intended to mean there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

[0032] Although the present invention has been described in considerable detail with reference to certain preferred embodiments thereof, other embodiments are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred embodiment (s) contained herein.

What is claimed is:

1. A cooling sleeve, comprising:

a sheath, the sheath being able to slip over a user's clothed arm, the sheath including a chamber disposed within the sheath, the chamber being able to thermally communicate with the user's arm; and,

a gas cartridge, the gas cartridge supplying cooling gases to the chamber such that the user's arm is cooled, whereby the user's core temperature is cooled.

2. A cooling sleeve, comprising:

a sheath, the sheath being able to slip over a user's clothed arm, the sheath including an inner chamber and an outer chamber, the inner chamber being able to thermally communicate with the user's arm; and,

a gas cartridge, the gas cartridge supplying cooling gases to the inner chamber such that the user's arm is cooled, whereby the user's core temperature is cooled.

3. The cooling sleeve of claim **2**, wherein the gas cartridge is filled with CO_2.

4. The cooling sleeve of claim **3**, wherein the inner chamber may include silica based crystals.

5. The cooling sleeve of claim **4**, wherein the outer chamber includes a liquid media disposed within the outer chamber.

6. The cooling sleeve of claim **5**, wherein the liquid media is sodium and water.

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