LOCAL HYPOTHERMIA THERAPY USING A PELTIER ELEMENTS COOLING DEVICE SEVERE TRAUMATIC BRAIN INJURY PATIENTS

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Introduction

1. Severe traumatic brain injury (TBI) is one of the causes contributed to the major source of death and severe disability worldwide. Patients suffering from severe traumatic brain injury usually will end up with disability, as they most often are associated with extensive irreversible damages to the brain. This makes the management of severe TBI to be challenging and very often associate with disappointing outcomes.
2. Hypothermic neuroprotection has been demonstrated in many preclinical models of injury.
3. The humoral and cellular neuroinflammatory response to TBI has been shown to be temperature dependent.
4. Hypothermia has effects on many secondary injury mechanisms including (1) cerebral metabolism, (2) excitotoxicity, (3) oxidative stress, (4) blood–brain barrier (BBB) permeability, (5) gene expression, (6) neurotrophin levels and function, (7) neuroinflammation, (8) cerebral swelling, and (9) axonal injury.

Purpose

The study aims to use a Peltier effect device in severe TBI patients as a method of local hypothermia, because therapeutic hypothermia showed promising results in reducing secondary tissue injury and intracranial pressure after TBI.

Keywords

Traumatic brain injury, TBI, hypothermia. Peltier, local.

Results

As mentioned earlier, targeting Brain temperature (BT) is now possible—making regional or selective hypothermia of the patient’s head an alternative method to achieving hypothermia after TBI, which may have fewer side effects than systemic hypothermia. Preliminary studies suggest that custom cooling devices of the brain were effective at achieving a BT 34°C within a 2–6 h time frame.

Material and methods

Thermoelectric coolers (TECs) based on the Peltier effect are preferred in hypothermia because they have small thickness, low weight, lack of moving mechanisms, high precision, and safe operation. Peltier cooling elements allow elaboration of a small mobile device, complementary to ICP monitoring that can be operated in emergency medical services, as well as neurointensive care units, in this way reducing the risk of secondary tissue injury after TBI.

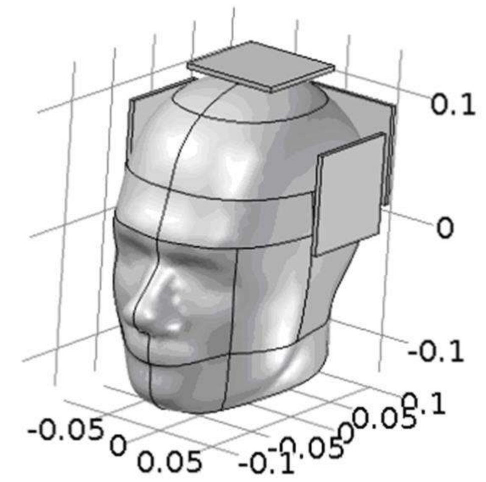

Fig. 1: Early computer models of the device.

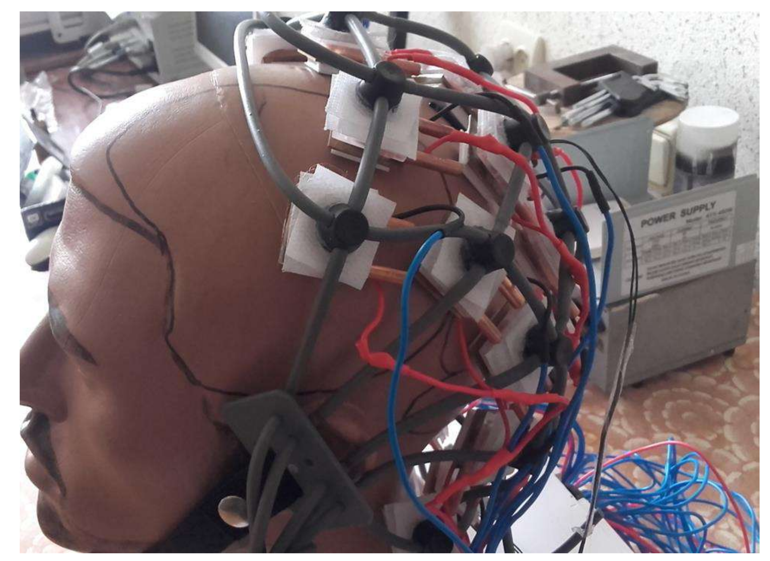

Fig. 2: Assembled device

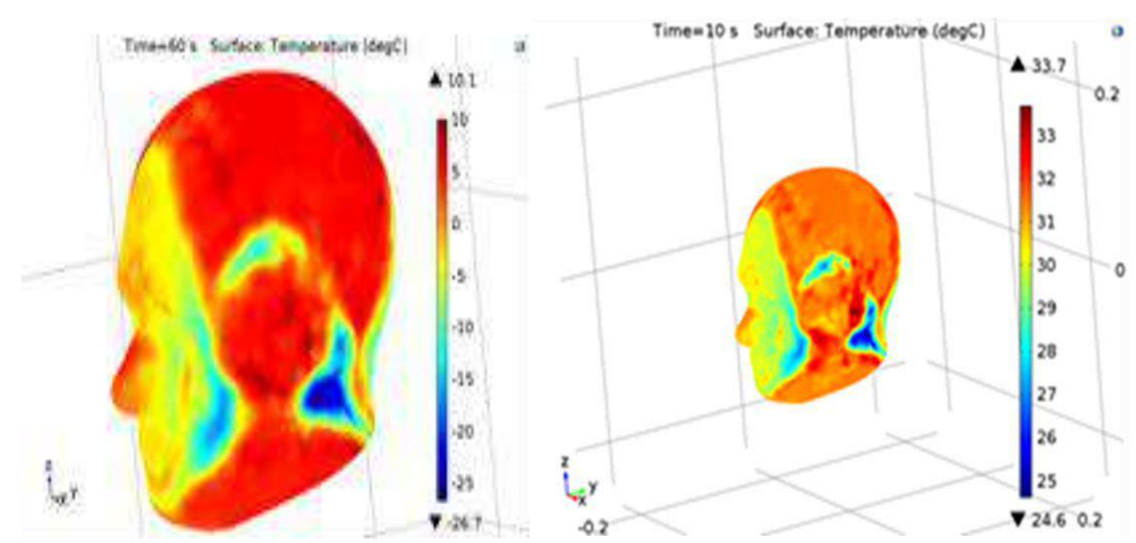

Fig. 3: Heat map of the head, before and after application of the device on the head.

Conclusions

There is a possibility to implement this device for local hypothermia in the clinical settings, for this purpose a RCT is being designed to test the efficacy of the device, and ICP monitoing because there is an ongoing debate about local hypothermia efficacy in TBI in clinical trials compared to laboratory ones.