
Okayama University Medical Research Updates (OU-MRU)

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Okayama University research: Ensuring a cool recovery from cardiac arrest

(Okayama, 29 October 2014) **Researchers at Okayama University in collaboration with several medical centres in Japan have demonstrated the safety and efficacy of a hypothermal treatment – pharyngeal cooling – for cardiac arrest patients.**

Cooling the brain is known to prevent neurological problems in patients recovering from cardiac arrest. However the most of current methods for therapeutic hypothermia may not be initiated before return of spontaneous circulation.

Researchers at Okayama University investigated a method for cooling the area at the top of the throat – the pharynx - because the arteries that supply the head with oxygenated blood run nearby. Cooling this area should be a good approach to cooling the brain but so far there have been no complete studies to determine whether pharyngeal cooling could be administered effectively or whether it may lead to other adverse side effects.

The researchers alongside people working in emergency and critical care clinics set up a trial for 108 cardiac arrest patients. The medical staff administered treatments with or without pharyngeal cooling to patients at random, and subsequently recorded success rates of resuscitation and physiological conditions, including temperature both at the body core and in the head near the ear (tympanic temperature), mechanical or temperature damage to the pharynx, inflammation and blood platelet levels.

The results of the trial indicated effective cooling of tympanic temperatures, with no observed adverse side effects. In addition, incidences of inflammation and blood-clotting disorders were reduced in patients receiving pharyngeal cooling. As the researchers report, “In conclusion, it appears that the initiation of pharyngeal cooling is safe and feasible before and shortly after recovery of spontaneous circulation in the emergency room.”

Background

Hypothermia treatments and limitations

Previous clinical data has indicated that quickly achieving therapeutic hypothermia is one of the most important factors for improving neurological outcomes for cardiac arrest patients. Approaches to achieving therapeutic hypothermia include intravenous infusion of cold fluid, which can increase re-arrest rates, and nasal cooling which is prone to cause extreme nosebleeds (epistaxis) and accumulation of air in soft tissues (peri-orbital emphysema).

Pharyngeal cooling method

Pharyngeal cooling was begun during chest compression as soon as patients entered the emergency room or on return of spontaneous circulation (ROSC) if ROSC returned before entering the emergency room.

In the current study pharyngeal cooling was administered using a pharyngeal cuff, a vinyl chloride tubular structure fitted into the upper oesophagus and pharynx. Saline solution at a temperature of 5 °C was perfused into the cuff at a rate of 500 ml min⁻¹ and pressure of 50 cm H₂O.

The temperature was chosen to be above freezing so that ice did not form, and treatment duration was also limited to 2 hours to avoid damage from the cold. The pressure was chosen to be below 60 cm H₂O to avoid neuropathy – nerve damage – which has been reported with the use of equipment similar to the cuff.

Low mechanical damage to the pharynx was thought to be largely due to similarities between the cuff and other medical instruments, as clinicians administering the treatment were familiar with using similar equipment.

Choice of patients

Patients aged 14-89 years old were considered eligible for the study within 15 minutes of collapse if they had suffered cardiogenic cardiac arrest or had been resuscitated from non-cardiogenic arrest by medical personnel. A shortage of human resources meant that not all eligible patients were used in the study. Of the 818 patients that met the criteria, 113 were enrolled on the study. The researchers believe that the relatively small size of the fraction of eligible patients that were enrolled does not affect the quality of the study data because the random selection for treatment with or without pharyngeal cooling was undertaken after enrolment, and exclusion from the study after enrolment was very low.

Inflammation and blood clotting disorders post cardiac arrest

Systemic Inflammatory Response Syndrome (SIRS) has been highlighted as an important factor linked to illnesses following cardiac arrest that include brain and heart injury and restricted blood supplies to tissue. Poor blood clotting (coagulopathy) is observed with whole body cooling and severe brain damage and low levels of platelets (thrombocytopenia) can impair blood clotting.

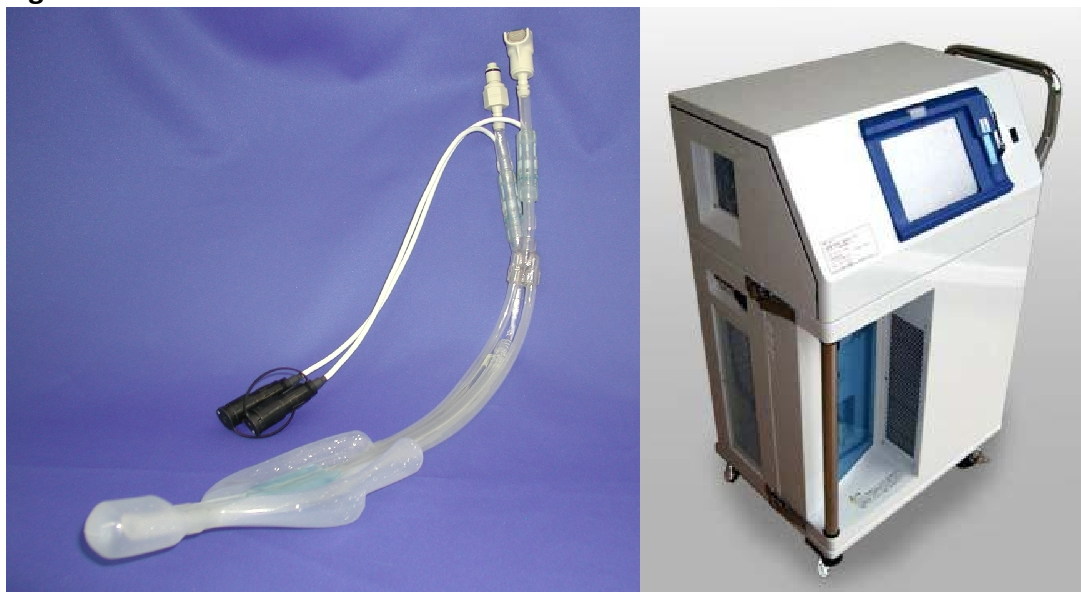
Incidences of all three diseases were diminished in patients treated with pharyngeal cooling: SIRS incidences in the pharyngeal cooling group amounted to 31% of patients compared with 57% in the control, coagulopathy incidences were lower in the first three days and thrombocytopenia incidences dropped to zero compared with 17% of the control group

Reference

Yoshimasa Takeda,* , Takahisa Kawashima, Kazuya Kiyota, Shigeto Oda, Naoki Morimoto, Hitoshi Kobata, Hisashi Isobe, Mitsuru Honda, Satoshi Fujimi, Jun Onda, Seishi I, Tetsuya Sakamoto, Masami Ishikawa, Hiroshi Nakano, Daikai Sadamitsu, Masanobu Kishikawa, Kosaku Kinoshita, Tomoharu Yokoyama, Masahiro Harada, Michio Kitaura, Kiyoshi Ichihara, Hiroshi Hashimoto Beng, Hidekazu Tsuji Beng, Takashi Yorifuji, Osamu Nagano, Hiroshi Katayama, Yoshihito Ujike and Kiyoshi Morita, "Feasibility study of immediate pharyngeal cooling initiation in cardiac arrest patients after arrival at the emergency room" , *Resuscitation*, x, (x), pp.xx-xx, (2014)

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Figure 1



Pharyngeal cooling cuff (left) and circulator (right). Physiological saline (5 °C) is initially supplied to the oesophageal cuff through the inflow tube, where the temperature is continuously monitored, and subsequently fills the pharyngeal cuff before being discharged through bilateral outlets. The bilateral outlets are connected to an outflow tube, where pressure is continuously monitored. According to a pilot study, intra-cuff pressures at the oesophageal and pharyngeal cuffs were 8 cm H₂O and 6 cm H₂O higher than the pressure monitored at the outlet tube, respectively. The intra-cuff pressure at the pharyngeal cuff was controlled at 50 cm H₂O. The cuff is made from vinyl chloride, has passed biological safety tests, and tolerates up to 200 cm H₂O of intra-cuff pressure

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Okayama University is one of the largest comprehensive universities in Japan with roots going back to the Medical Training Place sponsored by the Lord of Okayama and established in 1870. Now with 1,300 faculty and 14,000 students, the University offers courses in specialties ranging from medicine and pharmacy to humanities and physical sciences. Okayama University is located in the heart of Japan approximately 3 hours west of Tokyo by Shinkansen.

