Cooling - Out of the Bag:

Water Jel® - Burn Dressings

Author:
Dr. med. Thomas Castner
AGAN, Institute for Emergency Medicine
Hochwaldstraße 6
88677 Markdorf, Germany
E-mail: info@agan.de

Co-Authors:
Carsten Harz, Paramedic Instructor
Jens Schlör, Paramedic

T. Castner, C. Harz, J. Schlör

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The prehospital cooling therapy is an established measure in the case of burn and scald injuries. With effective cooling management the dimension of the skin and tissue destruction and the pain can be reduced.

However the usage of the classic cold – water – therapy can induce hypothermia. Most commercial burn sets are based on cold water therapy and the principle of heat transfer by evaporation. The Water Jel gel based system is an exception.

Fig. 1
Usage of a Water Jel dressing. The water based sterile dressing is applied directly on the burn or scald wound

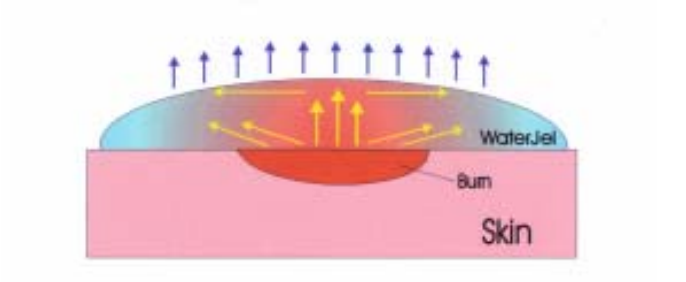


Fig.3:
Water Jel - mode of action (background see laboratory test). The heat gets transferred out of the burn wound directly into the gel

Fig.2:
Cooling therapy with a WaterJel face mask.On a patient with burn injuries to the face and inhalation trauma after a petrol explosion

Cooling of burns and scalds

By rapidly cooling a burn or scald injury, the amount of thermal destruction of the skin can be reduced immensely. One of the main effects is the interruption of the damaging effect of the heat. After the burn the heat is stored in the deeper skin layers. The cooling leads to a heat transfer up to the skin surface and interrupts the after-burn effect. If the thermal injury is not cooled first, a second degree burn can progress to a third degree burn as a result of the after-burn effect.
After only a short time of cooling the pain can be reduced effectively. This analgesic effect is based on the interruption of the release of pain-messenger substances (mediators) out of burned skin (thromboxane, prostaglandine, leukotriene). Additionally these mediators have a key position in the pathogenesis of the burn disease. A massive release leads to a capillary leak syndrome with oedemas, low blood pressure and shock, possible leading to ARDS (Adult Respiratory Distress Syndrome).

Water Jel burn dressings

Water Jel is a special gel which consists of 96% demineralised sterile water combined with selected gelling agents. Additionally WaterJel contains the bacteriostatic tea tree oil, this helps to reduces the infection of the burn wound. Already infected wounds start the disinfected process (**tab. 1**).

The carrier for the gel is a medical grade polyester dressing, this has a special design to allow for the uninterrupted flow of the gel through the dressing (**fig. 1**). The sterile dressings are available in different sizes from 5x15 cm up to 244x183cm. For burns to the face there is a special facemask available. Even with intubated

patients the Water Jel face mask can be used (**fig. 2**). Water Jel dressings are packed sterile and have a 5 years shelf life.

Water Jel system - mode of action

When using Water Jel for cooling burns and scalds the heat is transferred from the burn into the gel (**fig.3**). The temperature in the burn wound decreases rapidly which results in rapid pain relief and reduction of the skin destruction. In the Water Jel layer a heat flow (convection) starts. The heat energy is spread over the whole gel surface. At the outer surface of the gel the heat is released by transfer into the air (**fig. 3**). The buffer effect of the WaterJel layer leads to rapid heat transfer out of the burn wound without losing temperature around the area of usage (**fig.4**). The risk of inducing hypothermia is greatly reduced.

Fig.5:
Usage of a Water Jel Burn Blanket

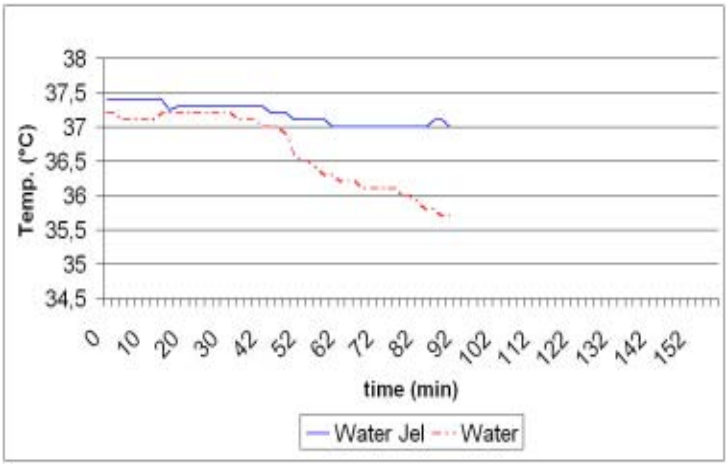


Fig.6:
Comparison of the body core temperature while cooling both legs with 15°C cold water and a Water Jel rescue blanket.

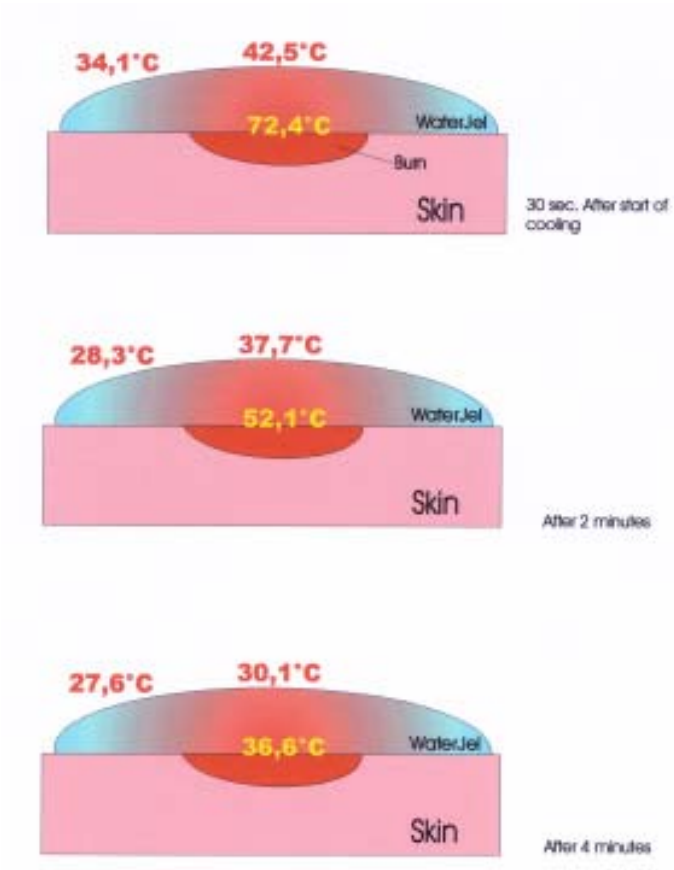


Fig.4:
Temperature displacement using Water Jel

tab.1:
Bacterium growth after contact with Water Jel (modified Torsova 1995)

	Bacterium growth after		
Bacterium	**30 min**	**60 min**	**240 min**
Staphylococcus aureus	+	+	negative
Streptococcus pyogenes	+	+	negative
Streptococcus agalactiae	+	+	negative
Streptococcus faecalis	+	+	negative
Escherichia coli	+	negative	negative
Klebsiella pneumoniae	+	negative	negative
Enterobacter cloacae	+	negative	negative
Serratia marcescens	+	negative	negative
Proteus vulgaris	+	negative	negative
Pseudomonas aeruginosa	+	negative	negative
Acinetobacter calcoaceticus	+	negative	negative
Clostridium perfringens	+	+	negative
Clostridium difficile	+	(+)	mean
Candida albicans	+	+	negative
Candida tropicalis	+	+	negative

Fig. 7:
Water Jel Burn kit with different sizes of gel dressings , a face mask, bandages and a scissor.

Comparison of the cooling therapy Between cold water and Water Jel dressings

The usage of 15-20 °C cold water (where available) for cooling burns and scalds is effective and reduces the temperature of the burn wound rapidly. The most serious disadvantage of the classic cold water therapy is the induction of hypothermia. In Particular babies, infants and elderly patients, these groups are endangered by loosing excessive core temperature while cooling with cold water (**tab.2**). Within these high risk groups cold water therapy should be used very carefully, under strict controls, with frequent checks of the vital signs, especially the body core temperature.

Over and over again burn patients with core temperature down to 30°C or lower (Hypothermia) get hospitalised at the specialised burn intensive care units. This finding had lead some burn specialists to object to the prehospital cooling therapy because hypothermia causes a higher rate of complications and an increasing mortality in burn patients. The importance of maintaining the body core temperature during the therapy management of burn patients is shown by the data from a study at a burn centre. A 1°C reduction in core temperature at arrival at hospital leads to a 43% higher mortality (Lönnecker 2001).

tab.2:
Risk groups for hypothermia in case of a cold water therapy

- Babies and Infants
- Patients with Extensive Burns
- Patients with Burns at the Central Corpus
- Elderly Patients
- Patients with Shock
- Polytrauma Patients

Method

To compare the body core temperature while cooling with cold water and Water Jel dressings we made numerous trials with young healthy volunteers. We monitored the body temperature simultaneously rectally, at the tympanic membrane (core temperature/ Pro 3000 Braun)and at the skin surface.
In the first experiment we cooled both legs of the volunteers with 15°C cold water. After the cold water treatment we could not continue the trials because we had induced numerous cases of hypothermia in the young and healthy volunteers. We had to wait for re-warming, and the trials continued the next day. For the second experiment we used the Water Jel dressings covering both legs up to the hip (**fig. 5**).

Results

By using the cold water treatment on both legs we induced a relevant loss of body temperature to all volunteers (**fig. 6**). We found that the recommended cold water therapy for 20 to 30 minutes induces hypothermia even in the young and healthy .
The rectal temperature reacted very slowly and with a delay of 50 minutes from the beginning of the cold water therapy, the rectal temperature showed a loss of core body temperature. The tympanic temperature monitoring reacted much faster and showed the decreasing body temperature even during the cooling.
The skin temperature can be reduced very effectively by using the Water Jel dressings. We found no clinically relevant loss of body temperature at the trials with the Water Jel dressings.

Water Jel study 2000

The practical testing of the Water Jel system was carried out in an international multicentre study. We started in January 2001 and installed Water Jel burn kits at 56 EMS units and emergency doctor vehicles (**fig. 7**). The data collection was made by the local EMS team and documented on a special form.

The study was coordinated by the Institute for Emergency Medicine, Markdorf, Germany. At present we have 131 cases of burns and scalds treated with Water Jel dressings. The analysis of the data we collected so far shows positive trends for pain relief, reduction of the need for analgesics and the user friendliness of the Water Jel system.

Results Water Jel study

From the 131 documented cases more than half were children younger than 15 years (n=69 / 53%). The group of infants 2 years and younger were the majority with 35% (n=46). Scalds were more frequent than burns (scalds 67% / burns 33%).

Of the EMS teams involved in the study 98% stated that the WaterJel dressings were „very easy" or „easy". Only in three cases was the usage described as „difficult".

These three cases were infants with scalds to the chest. There were no cases where the EMS teams described the usage as „very difficult" or „not usable". The results from the German Emergency Doctors on the usage of analgesics on burn and scold patients proved interesting.

After the application of the Water Jel dressings 73% of the patients had an „appropriate" or „permanent" reduction of pain. Even in 9 cases „total pain relief". In contrast to this the frequent use of analgesics by the doctors was surprising. In numerous cases analgesics were provided even though the pain relief with Water Jel was estimated by the patient as „appropriate" , „permanent" or even „total pain relief".

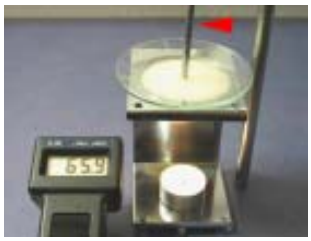
Summary

The prehospital cooling therapy is an established and effective method for the treatment of burn and scald injuries. It reduces pain and should be used routinely. During cooling therapy hypothermia must be avoided because of the increasing mortality and higher rate of complications.

The Water Jel system offers the possibility of an effective cooling management system with a considerably lower risk of inducing hypothermia. Water Jel dressings showed an excellent pain relief and bacteriostatic effect.

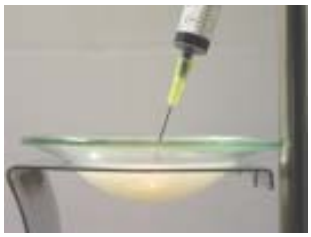
Last but not least the universal availability makes Water Jel the perfect system for prehospital conditions.

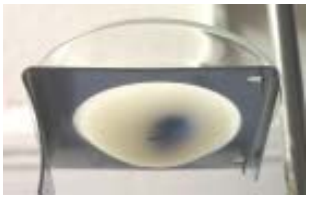
Water Jel laboratory test

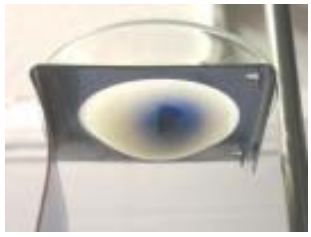


Experimental arrangement for measuring the temperature development during cooling with Water Jel dressings.

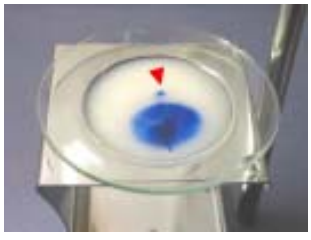
Experimental arrangement for detecting the heat transfer in the gel layer. At the beginning of the heating a we injected a drop of ink in the middle of the gel. The heat transfer by convection makes the ink – molecules moving in the heat stream.

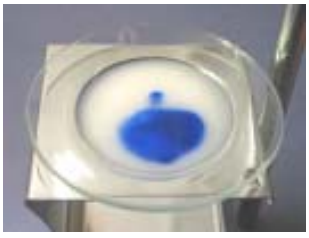


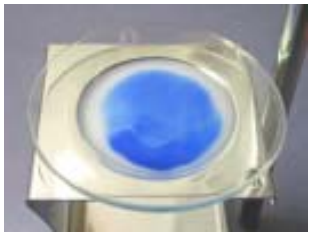




To investigate the mode of action of the Water Jel system we made numerous tests in our laboratory. The tests were made under standardized conditions. The punctual heating at the bottom generates a heat stream to the outside of the gel.







After a short time the heat energy moves up and gets to the surface of the gel. At the surface the heat streams to the edge. (red arrow = channel of ink injection)

Published references are available from the Author.