STUDY ON COOLING WITH GAS CRYOTHERAPY AFTER HAND SURGERY

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Gas cryotherapy is beginning to be widely used and seems to benefit from a newfound notoriety, whether it is through the increasing number of apparati put on the market or mediatised events (Football World Cup).
Far from dwelling on these mercantile considerations, we thought it would be interesting to begin studies specific to our area.

Let us specify its use:
CO2 gas pulverisation at -78 C at a pressure of 50 bars.
Sublimation on the skin.
Sweeping, and listening to the patient.

The main disadvantage of any study of a physiotherapy technique is that it is impossible to have a control group, because patients are put together for rehabilitation.

We tried to apply the technique according to two methods:
- post-operatively at the Toulon Hand Centre
- a rational method in the treatment of acute and chronic algoneuro-dystrophy.

Hand Centre Study

30 patients benefited from the cryotherapy in either the operating room or in rehabilitation.

PROTOCOL

Application of:

15 seconds: (1green led) ganglion knot at the bend of the elbow
30 seconds: (2 green leds) sweeping movement on the whole of the forearm and both sides of the hand.
15 seconds: (1 green led) distant projection then at 5 cm from the operated finger or the operated area.

Total time: 1 minute max

TYPES OF PATHOLOGIES

- 4 *tenoathrolyses* of long fingers
- 10 fractures of 5th *broached metacarpians*
- 16 fractures of inferior extremities treated by internal fixation

TOLERANCE

All the patients tolerated the application well.
Having observed that the application of cryotherapy at the beginning of a session caused the patient not to apprehend the contact, it was systematic. Taking into account the type of pathology and the precautions used due to the synthetic material,

near-total articulatory amplitudes were obtained between D3 and D5 in 26 out of 30 cases.

RESULTS:

Effect on the pain
In the cases between D0 and D5, the bearable pain always allows mobility.

Effect on the oedema
In all the cases, it remains contained and is never a hindrance to mobility.

Effect on mobility
There is no doubt that it is improved by cryotherapy, however the duration of the effect varies:
- in 11 cases: over 6 hours
- in 8 cases: between 3 and 6 hours
- in 10 cases: between 1 and 3 hours
- in 1 case: less than 1 hour

CONCLUSION

Beyond this restricting study, the use of post-operative cryotherapy has become essential in all cases that do not present circulatory problems.
We must also remember that the weaning off cryotherapy must intervene fairly quickly after the disappearance of physical signs that hinder articular recuperation.

Treatment of Algoneurodystrophy

By definition, AND is a reflex problem which will necessitate a treatment which provokes reflexes.

In what way is cryotherapy a treatment method?

In the hot phase:
We know that the thermoregulatory centre of the sympathetic nervous system controls the blood circulation beneath the skin. AND in the hot phase is characterised by a hot oedema, pain, and cutaneous dysesthesies, the result being that movement is impossible.

Two questions arise:

Is the application of cold useful and why is cold preferable?

The application induces a vasoconstriction of the capillaries by an axonal reflex of parasympathetic fibres.

Perkins et al ( ) have shown that vasoconstriction can be achieved through the direct action of cold on blood vessels. They showed that this reflex action did not occur with a sympathectomy, whereas it did with lesions of peripheral nerves.

Therefore cold provokes a tissular aggression, and the vasomotor response is a normal response to safeguard the member.

- Having caused a reflex reaction, is it enough to answer this question:

Does the application of cold affect the oedema?

Matsen et al ( ), contrarily to what they expected, did not find any difference in the swelling with the application of cold 72 hours after the trauma, or any differences found were not significant.

Marek et al ( ) using a treatment with water at 12 C confirmed the results above.

Jezdinsky et al ( ) found that the application of cold straight after the occurrence of the lesion (2,5,7 and 10 hours) did not inhibit the development of the oedema, and even wondered if it did not have a contributory effect on the formation of the oedema.

Forgsen et al ( ) did not find any difference with treatment carried out at the mandibular level (trismus, swelling, local temperature, postoperative pain).

However, **Schmidt** et al ( ) achieved a reduction of the oedema with the application of ice and frozen packs.

The development of the inflammatory oedema depends on the period and the method of application of the cold. It appears to the authors that the application of cold has an important action if the application is carried out early.

In any case, **Schmidt** et al ( ) showed that heat had different effects, often opposite ones, to cold.

Does the application of cold influence pain?

The latter is indeed linked to the oedema, but does cold have an effect on the nervous transmission of pain?
The experiments show that the effect of the cold depends on the diameter of the nervous fibres and their degree of myelinisation.

Douglas et al ( ) studied the different effects of cold on the diameter of the nervous fibres. They found that small diameter fibres are the first affected, which explains the action on the gamma fibres of the neuromuscular network and the action of cold on tonus and spasticity.
The C fibres that transmit pain have a very small diameter (0.4 to 1.2 microns), like sympathetic postganglionary fibres.
Fibres with a larger diameter, like the motoneuronal and proprioception ones, are less sensitive to cold as they have a wider diameter.

Last but not least, cold allows the discharges in tendinous Golgi corpuscules, which are inhibitory when high temperatures are applied.

The action of cold is the basis of vasoconstriction. The faster the decrease of temperature, the stronger the thermal shock, and the more efficient the return reaction.

Application method

- on the elbow's lymphatic ganglions, or even those of the armpit, in order to stimulate lymphatic circulation.
- On the dorsal or ventral side depending on the patient's sensibility, we apply at a distance or closer without provoking pain. The sensation of cold is found in the secondary activation of proprioceptive fibres.
- Bandaging of the extremity according to the studies of Nilsson, Schaubel.

According to our little experiment, after 5 or 6 days, we almost always obtained the quasi-total reduction of the oedema on the dorsal side of the hand. This disappearance allows us to begin a treatment of «finding» the member, previously excluded due to the pain.

In the cold phase

Capillaries are no longer at fault, there is a circulatory fault in the large vessels, and the hand is cold with well-known trophic disorders.

The action of cold can be compared with the action of heat.

The metabolism of tissues is reduced by cold and increased by heat. Capillary permeability is increased in both cases, articulatory problems can be increased by cold and reduced with heat.

Rather than start a useless comparative study, we should say that the effects of heat and cold depend on the mode of application.

Cryotherapy will no longer have an effect on the now extremely rare nociception, however it will allow dermic thermoregulation, as the 50 bars pressure will stimulate the epidermis.

Conclusion

Gas cryotherapy is a recent technique which deserves all our attention as it uses very low temperatures and high pressure, which causes a «thermal shock» that is totally unheard of in traditional cryotherapy.

The initial results show that the obtained reactions are quicker and more efficient than anything known until now.

This technique is therefore an appreciable element of reflex stimulation which should be used in acute and chronic cases (AND).

The application of cold with ice vessels, badly applied and badly indicated (Collins et al) can modify the axonal transport, which is not the case with gas cryotherapy because of the brevity of its application.

Gas cryotherapy has become an indispensable technique in the post operative care of the hand.