Patient blood management, seuil transfusionnel

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Performance of far forward blood storage containers in (very) cold environments

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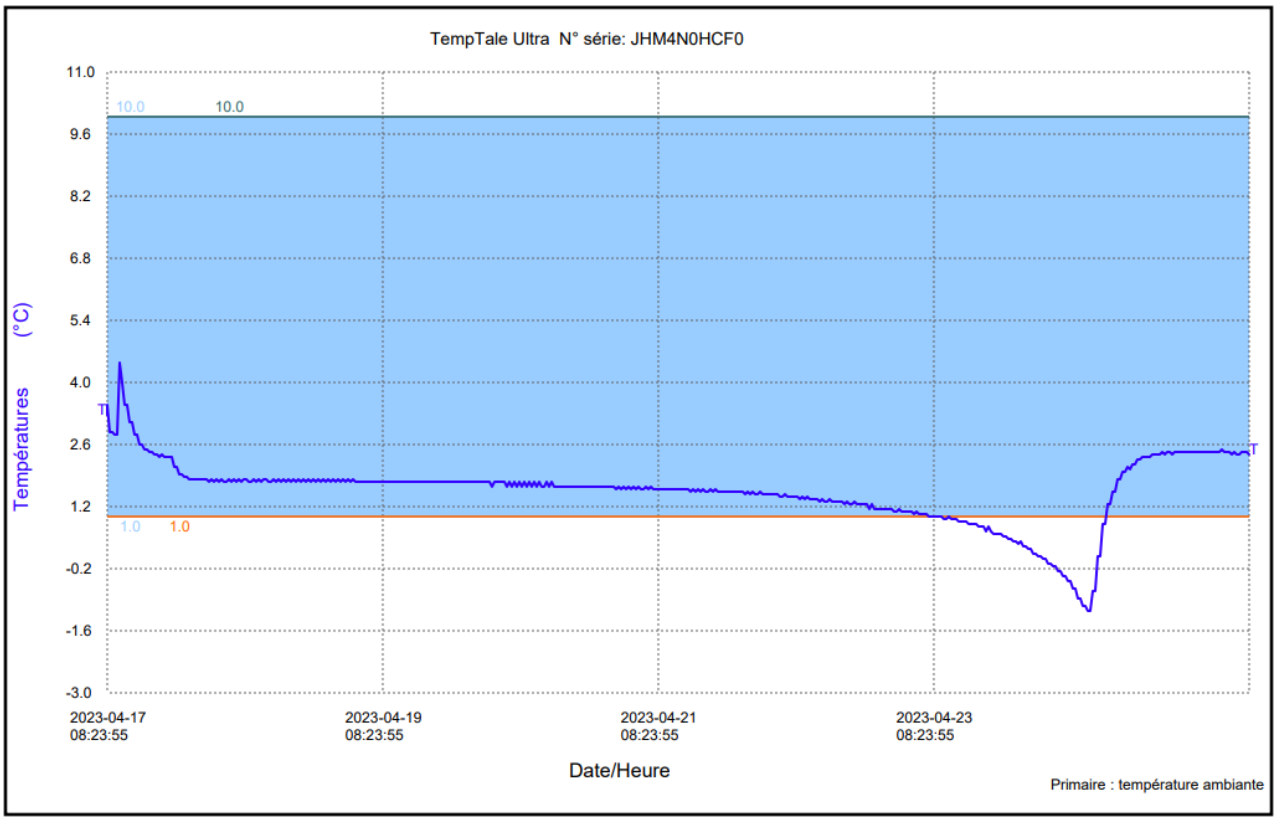
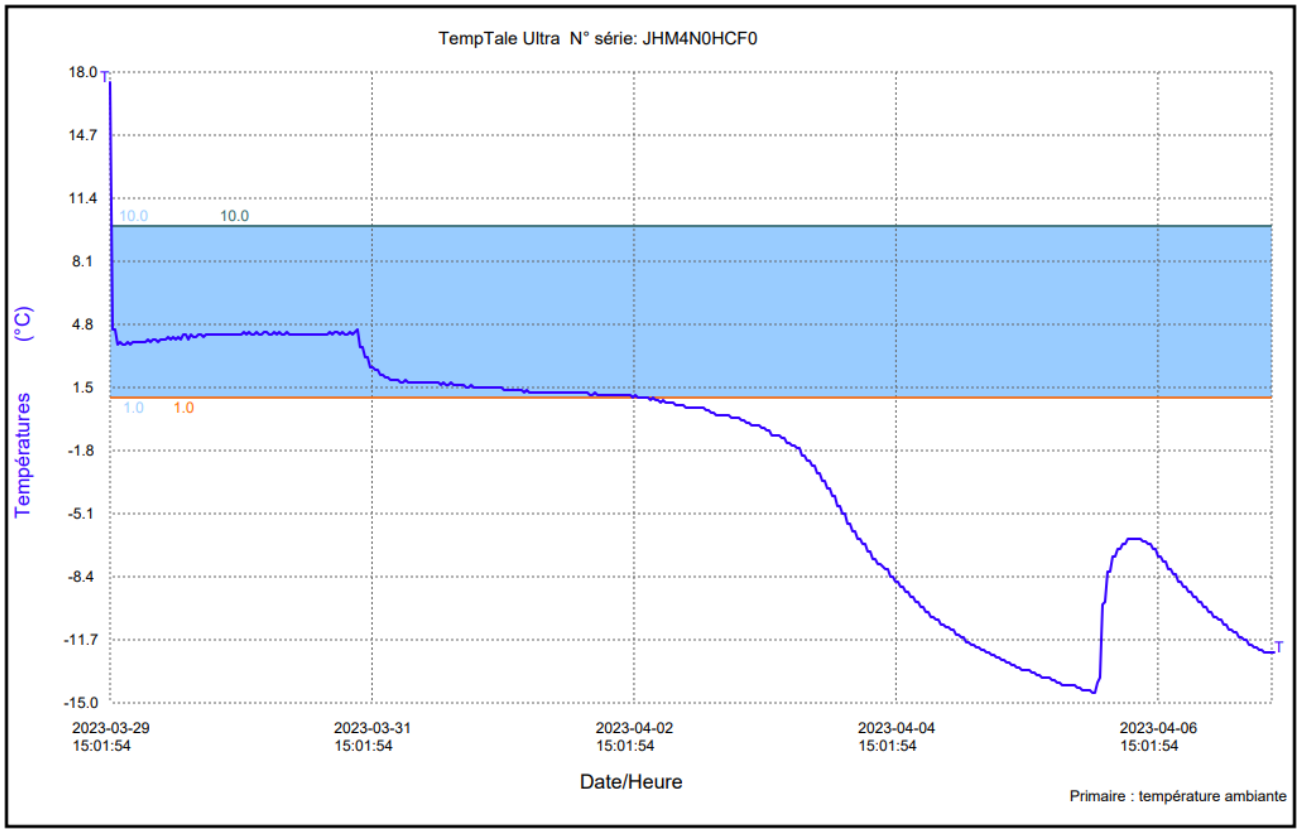
Position du problème et objectif(s) de l'étude:
For the management of massive hemorrhage in remote locations, military medical teams use the Golden Hour Box (GHBs), a far forward blood storage container. Its performance in hot environments is well established and studied. But near future warfare may involve considerably different climatic conditions. The aim of this study was to evaluate the thermal preservation performances of GHBs exposed to (very) cold temperatures, approaching austere military operations conditions in cold environments.

Matériel et méthodes:
GHBs consist of a black cubic cold storage enclosure encased in a larger insulating white box. The manufacturer's recommendations indicate that the black box should be placed in a 4 to 8°C refrigerator for 4 to 8 hours.
We performed a series of tests, using multiple GHBs for each test condition. The black boxes have been preconditioned in a temperature-controlled refrigerator at 4°C for 8h, then placed in the white box to form a complete GHB, and placed in temperature-controlled refrigerators to be exposed at either -5°C, -15°C or -25°C for 120h.
A temperature sensor was placed inside the black box, between the wall and one of two expired 2 RBC units, recording the temperature every minute throughout the experiment. Ambient temperatures were also recorded.
A two-way repeated-measures analysis of variance was performed to determine the effects of temperature on time between 2–6 ◦ C or between 2–10 ◦ C. Results were expressed as mean ± SD. A p-value of <0.05 was considered significant

Résultats & Discussion:
GHBs maintained an internal temperature within the critical zone (1–10 ◦C) for 112 ± 6 hours with an outdoor temperature of -5◦C and 54 ± 3 hours with an outdoor temperature of -15◦C. The tests studying the -25°C exposure are currently in progress.
This is less than the manufacturer's indications, which guarantees that under the recommended preconditionning, the products placed inside the black box will remain between 2 and 6 °C for about 93 hours when the GHB is exposed to -20°C. The performance of the GHB in cold temperatures may be improved if the black box was preconditionned at 8°, but we chose 4°C because that's the standard and safest conservation temperature of red blood cells and whole blood units. Having two separate refigerators in the remote and austere settings of military operations and especially special operation forces, might be impractical or even impossible. Those results are still reassuring, because blood is hardly ever out on the field more than 48h at a time.

Conclusion:
Massive hemorrhage remains the leading cause of preventable death on the battlefield. To improve survivability, remote damage control resuscitation includes early and fast transfusion. GHBs provide a safe way to use blood-products in the pre-hospital, remote and austere setting that is the battlefield. Based on our present data, GHBs can be used for short, less than 48h at a time military missions in cold, eastern Europe countries such as Romania where French armed forces are currently deployed, and where temperatures during winter can reach as low as -20°C. As such, they can be used in the same way that they already are in hot climate countries : temporarily placed in helicopters, forward armored land vehicles, or even carried by men on foot.





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