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MILITARY BLOOD BANKING: PLATELET
PACKAGING

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Army Medical Research Laboratory
Fort Knox, Kentucky

8 March 1973

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**US ARMY
MEDICAL RESEARCH LABORATORY
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REPORT NO. 1,024

MILITARY BLOOD BANKING: PLATELET PACKAGING

(Progress Report)

by

Dailey W. McPeak

and

COL Frank R. Camp, Jr., MSC

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Military Blood Banking:
Preservation Methods--Liquid and Frozen--and Logistics
Work Unit No. 155
Combat Surgery
Task No. 00
Combat Surgery
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ABSTRACT

MILITARY BLOOD BANKING: PLATELET PACKAGING

OBJECTIVE

To study the variance in recommended storage temperature for platelets and provide proper protection during transit.

METHODS

Requests to The Blood Bank Center, US Army Medical Research Laboratory, Fort Knox, Kentucky, for blood components, especially platelets, have increased tenfold over the past few years. To supply quality platelets, proper temperature must be maintained during transit. Because of the complex physiological make-up of the platelet, viability following storage is difficult to determine. The fact that numerous criteria have been proposed to evaluate and measure platelet viability is indicative of the inadequacy of the methods (1). Consequently, studies were designed to determine the correct packaging necessary for maintaining platelets at various temperatures.

Tests were conducted in an environmental chamber* designed to provide constant temperature with ± 0.1 F fluctuation. A Yellow Springs Model 47, eleven-channel scanning telethermometer** was used to measure temperature of the 25 ml aliquots of platelet-rich plasma.

RESULTS AND CONCLUSIONS

Platelet aggregation occurs at low temperatures even with agitation (2); however, aggregation is not considered to be a reliable means of measuring viability. Nevertheless, the degree of effectiveness of transfused platelets to improve hemostasis is dependent on their ability to circulate in the recipient. Consequently, investigators recommend different temperatures for processing and preparing platelets for storage, based on a particular phase of the processing procedure. The real need for establishing a standard criterion for determining platelet viability is evidenced by the variance in temperatures recommended. Data are submitted describing packaging techniques which will provide maximum protection for platelets during transit, based on the particular processing procedure used.

* Modern Laboratory Equipment Co., Inc., 4033 Third Avenue, Bronx, NY.

** Yellow Springs Instrument Co., Inc., Yellow Springs, OH.

MILITARY BLOOD BANKING: PLATELET PACKAGING

INTRODUCTION

The scope of the military blood bank program continues to broaden as a result of research and refinement in the methodology for procuring, processing, and preserving whole blood and components. Constant reevaluation, updating, and expansion of the entire blood bank system dictate a progressive approach to a bustling enterprise. Manifestation of the complexity of a well functioning blood bank is acknowledged by the numerous interdependent facets made compatible to form an efficient blood banking system. The objective of the overall system is to provide quality blood and components to the patient when the need arises. Very often the real challenge in accomplishing this objective occurs when the blood or component must be transported. This is the usual rule rather than the exception, because the site of collection is seldom the same as that of transfusion.

Maintaining proper temperature of the blood or blood fraction from donor to patient has been termed a critical aspect of blood banking, dating back to its inception. For example, on 18 August 1941, a subcommittee for blood procurement recommended that bottles of blood be precooled with dry ice prior to shipment, and thermostatically controlled at a temperature well below 10 C during shipment (3). This subcommittee's recommendation was based on studies, by Rous and Turner in 1916, which showed that the rate of hemolysis was much greater when blood was stored at 20 C rather than 5 C. Current data show that the lower temperature is as important as the upper.

In 1943, when movement of blood by air was considered, it was established that useful and safe blood ideally must be maintained at a constant temperature of 4 to 6 C. In 1945, Captain John Elliott, SNC, assistant in the Division of Surgical Physiology, Army Medical School, recommended that blood be maintained between 4 and 10 C during transit. These temperature guidelines are still in use.

To continue the expertise associated with procuring, processing, and preserving whole blood, a vast amount of engineering professionalism has been expended to make available quality blood and components. There is no problem in most hospital units, since electric current is available for refrigeration. The problem arises when the blood and temperature-sensitive components must be transported.

Progress in the shipping phase of blood banking has been slow. For example, in 1943, during the early stages of military blood banking, an attempt was made to fabricate a refrigerator that would hold 40 to 50 bottles of blood and operate on AC or DC current, making it suitable for field use. When the European airlift of blood finally became a reality in 1944, only a prototype existed. However, this box, along with other

transfusion equipment, was later standardized and produced in quantity. Currently, a similar deterrent in blood shipping may be seen in the lack of proper cargo coding. For example, cargo labeled "radioactive" commands better priority and handling procedures than human blood. Attempts to rectify this misalignment of priorities have been less than satisfactory.

Uniform progress in all segments of blood banking is an acute and necessary ingredient of the modern blood bank. All personnel, including the donor recruiter, the phlebotomist, the highly skilled technician who processes the blood, those who transport the blood, the researcher, and, finally, the clinician who administers the transfusion represent separate, independent arms of blood banks. The purpose of this report is to provide data on that special field of blood banking involving platelet inventory logistics.

MATERIALS AND METHODS

Tests were conducted in an environmental chamber with temperature controlled to within ± 0.1 F. Twenty-five milliliter units of platelet concentrates packed in shipping containers (FSN 8115-682-6525) normally used for transporting platelets were used in these tests. Temperature measurements were recorded by a Yellow Springs eleven-channel Model 47 scanning telethermometer.

DISCUSSION

The quantity of whole blood and blood components supplied by The Blood Bank Center at the US Army Medical Research Laboratory during 1972 is shown in Table 1. From the phlebotomy station through the entire processing laboratory, quality control has preeminence over quantity of products. Methods to reduce the time the blood or fractions are subjected to packaged refrigerants are continually being pursued by closely scrutinizing air line schedules, in addition to delivering the products to the air terminals immediately prior to plane departure time.

Destination and time of travel dictate packaging techniques. To better understand how platelets should be handled during shipment, some knowledge of the function of the platelet is required. In the circulating blood, the platelets are normally carried along separately from each other and there seems to be no evidence that they adhere to normal vascular endothelium. When the wall of a vessel is injured, platelets adhere to it immediately, and to each other, to form aggregates on the damaged intima. When the vessel wall is broken, aggregates of platelets tend to seal the opening and thus help to arrest bleeding. According to Born and Cross (4), there is a growing recognition that the economy of the platelets is something largely separable from the behavior of the coagulation system. When diseases damage the intima, platelets again adhere to it and to each other. It is not well understood why damage to the intima should cause platelets to adhere and aggregate.

TABLE 1

WHOLE BLOOD AND BLOOD COMPONENT SHIPMENTS 1972

	Whole Blood	Cryopre- cipitate	Fresh Frozen Plasma	Platelet Preparations	Packed Red Blood Cells
ASMPH	857				
Brooke	446	950	308	306	119
Carlisle Barracks		30			4
Darnall	140	90	63	11	49
Fitzsimons	1,915	202	135	40	183
Fort Benning	136		30		
Fort Bragg	198	155	4		17
Fort Campbell	979	825	12		55
Fort Dix	50				13
Fort Gordon	6		23		
Fort Jackson	52	35			26
Fort Lee	39		2		3
Fort Leonard Wood	5	940	56		
Fort Ord	424	250	161		60
Fort Rucker	278		20	10	17
Fort Seward	834	20	55	32	25
Gettysburg	501	32			
Hamman	842	50	40	80	93
Sanita	4	30			
Tripler		950	2		
USAMRI Research	415	71	54	50	184
WAMC	3,420	4,348	869	5,154	1,322
Andrews	1,490	1,243	34		171
Corumbus	374				15
Dover		30			
Edwards	103	210			32
Goodfellow		24			
Lackland			66		
Maxwell	693	750			20
Moody	254		17		6
Reese		140			
Scott	191				1
Samuel Johnson	614	156	12		42
Tyndall	253	122			3
Wright-Patterson			85		
Detmold		160			
Charleston		460	115		
Chelsea	300				169
Memphis	114	200			
Louisville Red Cross					118
Hardin Memorial	19				2
	16,373	13,080	2,376	5,693	2,756
Whole Blood Collected		19,470			
Total Shipments		10,208			

According to Kattlove and Alexander (2), low temperatures induce platelet aggregation, even with agitation. Murphy and Gardner (5) show that at 4 and 13 C the platelet yield in recipients is moderately reduced with a considerable reduction occurring at 37 C. At 30 C, yield is slightly reduced as compared to 22 C, which they found to be the optimal storage temperature.

A common misconception among those recommending 22 C storage temperature is that it is easily maintained. The fallacy of this kind of reasoning has been shown by McPeak et al (6). Figure 1 shows that platelets may be satisfactorily maintained at 22 C in an ambient temperature of 5 C by inclosing a plastic bag filled with 1,000 ml of water at normal tap temperature of 40 C. The water was placed in the bottom of the box and protected from direct contact with the platelet concentrates by a one-half inch thick styrofoam insulator.

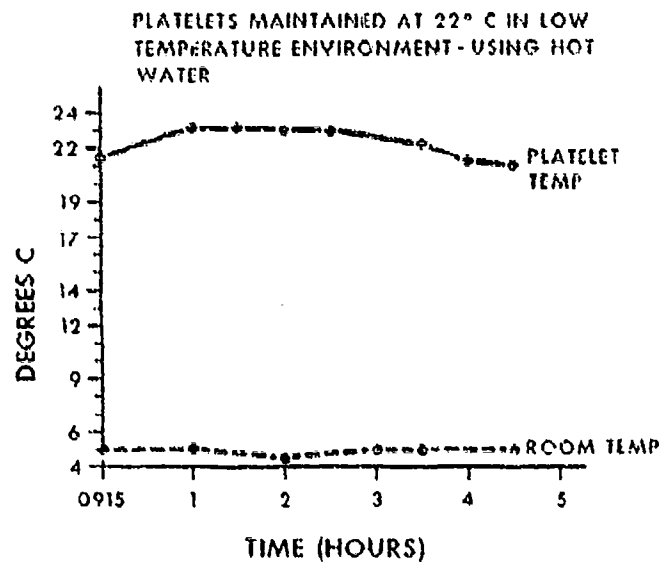


Figure 1

Studies by Becker and Aster (7) show that excellent viability of platelets occurs when they are stored at temperatures approximating 4 C. Figure 2 indicates that platelets may be maintained at a lower temperature, between 4 and 10 C in an environmental temperature of 41 C, for at least 8 hours by inclosing one-half pound of wet ice at the top and one-half pound at the bottom of the shipping container.

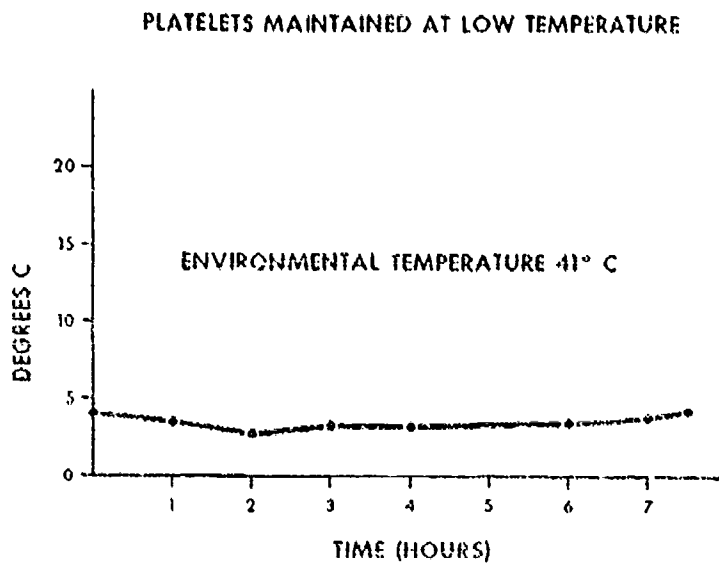


Figure 2

Presently, there are differences among researchers as to the optimum temperature for platelet storage. However, it is generally accepted that a fluctuating temperature is very detrimental to platelet survival. To maintain platelets at a constant temperature during long distance shipping requires a well insulated shipping container. Figure 3 shows the shipping containers used by the Fort Knox Blood Bank Center.



Figure 3

RESULTS AND CONCLUSIONS

Because of the rapidly growing practice of platelet therapy by US Army clinicians, The Blood Bank Center of the US Army Medical Research Laboratory has developed packaging techniques, uniquely and specifically designed to provide proper protection for platelets during shipment to distant hospitals. Studies of the effect various environmental temperatures impose on shipping containers dispel the common idea that the recommended room temperature is easy to maintain.

Results of these studies indicate that the "jiffy bag," a thinly insulated envelope used for intracity transport containers for platelets may be a poor substitute for an insulated box.

Although a common, specific temperature has not been settled on by investigators in the field of platelet storage, all are in agreement that platelet temperature fluctuation costs in terms of viability. These studies show how the currently recommended temperature of 4 and 22 C may be maintained with minimum variations resulting in maximum viability.

SUMMARY

The purpose of this research was to study the variance in recommended storage temperature for platelets and to provide proper protection during transit. The fact that numerous criteria have been proposed to evaluate and measure platelet viability is indicative of the inadequacy of the methods (6).

Tests were conducted in an environmental chamber designed to provide constant temperature with ± 0.1 F fluctuation. An eleven-channel scanning telethermometer was used to measure temperature of the 25 ml aliquots of platelet-rich plasma.

Platelet aggregation occurs at low temperatures even with agitation; however, aggregation is not considered to be a reliable means of measuring viability. Nevertheless, the degree of effectiveness of transfused platelets to improve hemostasis is dependent on their ability to circulate in the recipient. Consequently, investigators recommend different temperatures for processing and preparing platelets for storage based on a particular phase of the processing procedure. The real need for establishing a standard criterion for determining platelet viability is evidenced by the variance in temperatures recommended. Data are submitted describing packaging techniques which will provide maximum protection for platelets during transit based on the particular processing procedure used.

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