

Activities of coagulation factors in fresh frozen plasma at thawing temperatures of 37°C, 45°C and 48°C

¹ K. Wuttig, ² L. Wiens, ¹ M. Heim, ¹ A. Parkner, ² G. Lutze

¹ Institute of Transfusion Medicine and Immunohematology and ² Institute of Clinical Chemistry and

Pathobiochemistry of the medical faculty Otto-von-Guericke-University, Magdeburg

Introduction

Fresh frozen plasma (FFP) is the primary source of coagulation factors for patients with coagulation factor deficiencies, mainly used in emergency treatment of an acquired complex and clinically relevant failure in blood hemostasis.

Therefore there is a need for a method allowing to thaw up the frozen units in a short time. Guidelines for Germany (BÄK 2000+2003) ensure the thawing process preserves all factors at hemostatic levels including the labile factors V and VIII at a maximum temperature of 37°Celsius.

Background

The use of higher temperatures would be a possibility to accelerate the thawing process. This study was done to find out if the use of temperatures of 45°C and 48°C would have a negative effect on the quality of the FFP. Measuring the activity of the coagulation

parameters was used as a quality criteria.

Methods

Thawing device

A new model of the thawing device Barkey plasmatherm was used for the thawing process. This device is operating with water in a sealed system (pictures 1 and 2). The Barkey plasmatherm allows the Thawing of plasma, blood and stem cells and allows the solution of further designed to user specifications questions. The Thawing presents a dry-warming over the complete area with controlled temperature of the units. The capacity is 1 - 4 units, in an emergency till 8 units. For a mobile use the Barkey plasmatherm can be combined with a movable floor unit with and without warming (Barkey warming center) (picture 2).

Tested plasma

During 12 apheresis procedure we collected 600 ml plasma in each case and divided it into three equal subunits of 200 ml. When shock freezing was complete, they were stored at -30°C.

Conditions of thawing

The conditions of thawing for the 3 identical units of plasma were
A. 30 minutes at 37°C (= standard condition of thawing)
B. 20 minutes at 45°C
C. 18 minutes at 48°C.



fig. 1: Barkey plasmatherm with 4 blood bags and opened cover.



fig. 2: Barkey plasmatherm on a movable floor unit

Analysis of clotting

Directly after the thawing measurements of the following parameters of clotting at the analyzer of clotting AMAX 200 (Trinity Biotech, Lemgo) were done:

- Thromboplastin time (TPZ, quickest) with Innovin ® of Dade Behring, Schwalbach
- Activated partial Thromboplastin time (APTT) with PTT-reagent of Roche Diagnostics, Mannheim
- Time of thrombin (TZ) with reagent of thrombin of Roche Diagnostics, Mannheim
- Activities of the factors V, VII and VIII with defective plasmas from Technoclone, Heidelberg

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Temperature pattern

For the measurement of the temperature during the thawing the measuring probe P 500 of Dostmann Electronic was applied, which was placed central or peripheral inside of the bag before deep-freezing the bags.

Results

Globaltests

Table 1: Thromboplastin time (TPZ), APTT and time of thrombin (TZ) (standardised data: A = 100%)

Spender	TPZ		APTT		TZ	
	B	C	B	C	B	C
1	97	99	99	100	101	101
2	97	97	101	100	99	102
3	97	98	101	100	101	100
4	97	99	101	100	101	99
5	100	100	101	99	98	97
6	95	100	100	100	98	96
7	101	102	100	99	99	97
8	98	97	100	100	101	101
9	99	101	99	100	99	95
10	99	99	100	100	96	96
11	98	98	100	100	99	101
12	96	100	100	99	102	101
\bar{x}	97,8	99,2	100,2	99,8	99,5	98,8
s	1,70	1,53	0,72	0,45	1,73	2,48

The results of the global tests differed only marginal at the three conditions of thawing. A significance was nonexistent ($p > 0,05$) except TPZ (A → B).

Single factors

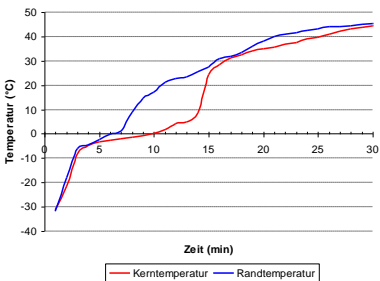
Table 2: Activities of the factors V, VII and VIII (standardised data: A = 100%)

Spender	F V		F VII		F VIII	
	B	C	B	C	B	C
1	101	103	99	101	98	100
2	100	102	100	101	101	102
3	102	98	101	103	100	100
4	96	102	101	101	100	98
5	101	98	102	105	101	101
6	99	99	99	98	100	100
7	102	101	99	99	100	99
8	100	105	97	101	98	98
9	102	101	101	98	102	103
10	105	103	100	102	101	102
11	104	103	102	99	100	99
12	98	96	102	102	99	99
\bar{x}	100,8	100,9	100,3	100,8	100,0	100,1
s	2,48	2,64	1,54	2,08	1,21	1,62

The activities of the factors V, VII and VIII differ only inessential in the three conditions of thawing, without significance ($p > 0,05$).

Temperaturecurve

fig. 3: Graphical presentation of the temperature distribution during the thawing at 48° at central and peripheral placement of the measuring probe (core and peripheral temperature).



The temperature of thawing which was given through the adjustment of the device was achieved delayed inside of the bag. Consequently the capacity of the bag was only shortly exposed to external temperatures of thawing >37°C.

Conclusions

- The thawing device Barkey plasmatherm allows a comfortable and hygienic acceptable thawing of frozen plasma and blood.
- For frozen fresh plasma (GFP) the complete thawing process at 37°C takes a duration of 30 minutes.
- The thawing time can be reduced by the use of higher external temperatures, e.g. to 18 minutes at 48°C.
- A loss of quality by this procedure could be excluded because the tests didn't show clinical relevant changes of activity of the coagulation factors.
- The device does ensure that the higher temperatures of the water are reached into the bags.
- There is no objection against reducing the thawing times by the use of higher temperatures when using the described thawing protocol.