Fresh Whole Blood – a possible role in civilian preparedness

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Back to the future

Whole blood -> Blood components ->
Whole blood?

Blood component therapy

- Designed for the haemato-oncology patients
- Designed for the anaemic patients
- Designed for plasma fractionation
- What about the acute severely bleeding patient ?
- Who are the patients needing transfusion in (civilian) disasters?

Blood component therapy

- The blood bank facility may be damaged
- The blood bank capacity may be too limited for the supply needed
- May be dependent on “import” of blood components

Back to the future?

- NO!
- Fresh whole blood/whole blood – what is what?

Disposition

- When the helicopter can not fly
- Regulatory issues
- Extreme situations
- How Fresh Whole Blood/Whole Blood must be improved


0 50 100 Kilometers
0 50 100 Miles
Lambert Conformal Conic Projection, SP 47N/62N
LOFOTEN
Narvik
Kiruna
Kolari
Bodø
Malmberget
Kemijärvi
Arctic Circle
NORDLAND
Jokkmokk
Rovaniemi
Mo
FINLAND
Sandnessjøen
Kemi
Mosjøen
Norwegian Sea
Luleå
Storuman
Skellefteå
Lycksele
Namsos
NORD-TRØNDELAG
SWEDEN
Kajaani
Steinkjer
Umeå
Iisalmi
Kokkola
Trondheim
Örnsköldsvik
Kuopio
Storsjön
Östersund
Vaasa
Molde
SØR-TRØNDELAG
Seinäjoki
Ålesund
Åndalsnes
Äänekoski
MØRE OG ROMSDAL
Jyväskylä
Härnösand
Sundsvall
Gulf of Bothnia
Mikkeli
Flora
SOGN OG FJORDANE
Hudiksvall
Jämsä
Pori
Tampere
Hermansverk
OPPLAND
Lahti
Lillehammer
Rauma
Hämeenlinna
Kouvola
Gudvangen
HEDMARK
Hamar
Mora
Bergen
Gävle

2.2 REGULATORY CONCERNS

The availability of blood may be the primary concern in a disaster, but the safety of the blood supply is also paramount. Adherence to Food and Drug Administration (FDA) regulations is crucial.

Regulatory issues

- Register Fresh Whole Blood as a “Blood component” (EU Blood Directive)

What is Fresh Whole Blood

- Storage of red cells
- Storage of platelets
- Storage of plasma
- Removal of leukocytes?

Fresh Whole Blood

Experiences from the past:

Blood stored less than 24h

Blood stored less than 48 h

Storage solution

- Reduce activation during blood donation
- Reduce storage lesion

- Combined additive solution for red cells and platelets is possible (Heaton, 1990)
- Reducing citrate concentration may stabilize coagulation factors

Storage temperature

- Reduce metabolism
- Reduce risk of bacterial contamination (growth)
- Simple in theory, difficult in real life

Red cell storage lesion

- Temperature 0 -> - 2°C (Strumia, 1954)
- Or 1-2°C (Strumia, 1954-2)
- Or 4-25°C (Strauss, 1974)
- 22°C is good for short-term (Avoy, 1978)
- 37°C is bad! (Jandl, 1958)
- Improving red cell storage solution (Sparrow, 2011)

Platelet storage lesion

Recovery dependent on storage temperature

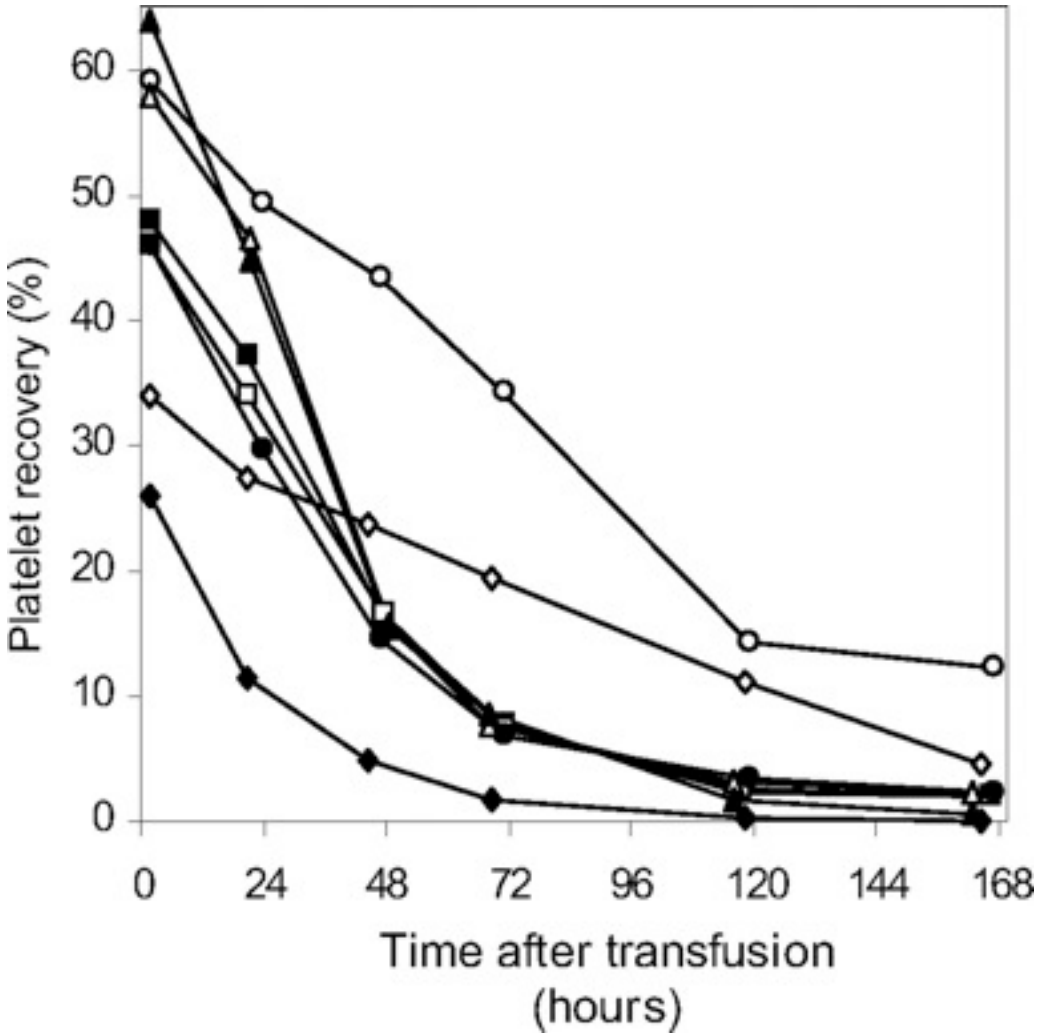
- 4°C recovery 45%, 2d 15%
- 22°C recovery 63% (Becker, 1973)
- Slichter et Harker, 1973

	4°C	22°C
Recovery	63%	51%
Survival	1.3d	8.2d

The GP Ib alpha effect

blood
JOURNAL OF THE AMERICAN SOCIETY OF HEMATOLOGY

In vivo autologous radiolabeled human platelet recoveries and survivals.



Wandall H H et al. Blood 2008;111:3249-3256

Stability of plasma proteins and coagulation factors

- F VIII is reduced to 40% after 24h storage (Slichter, 1976)
- F VIII is reduced by 23% after 24 h storage temperature. Only minor reduction of other factors, including protein S and protein C (Cardigan, 2011)

Leukocyte depletion of Fresh Whole Blood

- Leukocytes perform phagocytosis
- But, then….

Fresh Whole Blood and Graft-versus-Host Disease

- Data from cardiac surgery in Japan
- T-lymphocytes from the donor attack the host's immune system

Prevention

- Gamma irradiation
- Removal of leukocytes (filtration)
- Keep the platelets alive

HLA-immunization

- Children receiving whole blood in connection with cardiac surgery form HLA-antibodies (Opheim, submitted 2011)
- Primary immunization can be prevented by filtration

Conclusions

Fresh Whole Blood will not replace blood components

The component must be improved and better defined

If this will be successful, the clinical usage may be increased – and during disasters it may be THE blood component of choice