Lyophilized plasma, an alternative to 4℃ stored th awed plasma for the early treatment of trauma patients with (massive) blood loss in military theatre.

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Background
The Netherlands military use -80℃ plasma (DFP0) si nce Nov'01 and a low stock of maximally 7 days 4℃ stored thawed plasma (DFP7) for the treatm ent of trauma patients since Apr'09 (Apr'09-Feb'12; 880 DFP0 and 773 DFP7 (3±2 days at 4℃) transfused, no transfusion reactions). Lyophilized plasma (LN) can be stored for 1.5 years at 2-25℃, prepared without equipment and is in use with the UK and GER military. The quality of LN was compared to DFP and fresh frozen plasma (FFP) to evaluate if it can be implemented complementary to the -80℃ NLD military blood supply system.

Methods
FFP(-30℃ male apheresis AB leukodepleted plasma, S anquin) was thawed, repacked and frozen to -80℃ (DFP0). DFP0 was thawed and stored for 7 days at 4℃(DFP7). Lyophilized AB plasma (LyoplasN, German Red Cross) was reconstituted with 200ml water. Plasma coagulation factor activities were measured with Destiny Max, onset of clotting (R), clot development (Angle) and clot strength (MA) with TEG (calcium and Kaolin) and pH with ISTAT at 37℃.

Results
Both DFP7 and LN are comparable in coagulation factor activities but contain less activity compared to DFP0 and FFP (table1). Compared to DFP7, DFP0 and FFP, LN has less volume (213±4 vs 314±9 mL), and shows a weaker clotting profile in TEG. If slowly dissolved (35min N=16), fibrinogen conc. (3.1±0.6) and MA (23±5) of LN are higher compared to the 4 min shaking method (N=13; Fib 2.5±0.3; MA 18±4) which is comparable to the 15 min swirling method (N=20; Fib 2.6±0.5; MA 19±4) but has a lower pH (4min 6.8±0.1 vs 15&35min pH 7.1±0.1).

Conclusions
The logistical advantage, short production time (4 min) and acceptable quality makes LyoplasN suitable for early treatment of trauma patients in the (military) pre-hospital phase, in hospitals without a -80℃ capacity, or complementary to/as an alternative for DFP7. If time is available, the slow dissolution (35 min) method of LN is preferable. If available, fresh thawed plasma (FFP, DFP0) is preferred for the (further) treatment of trauma patients with (massive) blood loss.

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Table1 Coagulation profile of plasma and lyophilized plasma (LN)

parameter	FFP	DFP0	DFP7	LN
FVIII:C(U/mL)	1.0±0.3 N=50 c	0.9±0.2 N=30 c	0.7±0.2 N=30 abd	0.9±0.2 N=49 c
FVII(U/mL)	1.0±0.3 N=62 bcd	0.9±0.2 N=30 ad	0.9±0.3 N=30 ad	0.7±0.1 N=47 abc
FV(U/mL)	1.0±0.2 N=64 cd	1.0±0.2 N=31 cd	0.7±0.1 N=31 ab	0.7±0.2 N=49 ab
FXIII(U/mL)	-	-	1.0±0.2 N=6	0.9±0.2 N=15
INR	0.9±0.1 N=62 cd	0.9±0.1 N=32 cd	1.0±0.1 N=31 abd	1.1±0.2 N=47 abc
APTT(sec)	33±3 N=62 bcd	35±3 N=34 acd	37±3 N=31 abd	39±4 N=49 abc
FIB(g/L)	3.0±0.5 N=64 d	2.9±0.5 N=34	2.9±0.5 N=31	2.7±0.5 N=49 a
ATIII (ATIIa U/mL)	1.0±0.1 N=18 cd	1.0±0.1 N=18 cd	1.2±0.1 N=12 abd	0.9±0.1 N=39 abc
ProtC(U/mL)	1.2±0.2 N=17 d	1.1±0.2 N=17 cd	1.2±0.2 N=18 bd	0.9±0.2 N=33 abc
ProtS(U/mL)	1.0±0.2 N=18 cd	0.9±0.2 N=18 cd	0.5±0.2 N=24 ab	0.6±0.2 N=38 ab
R(min)	9±1 N=56 cd	9±1 N=39 cd	11±2 N=39 abd	14±4 N=49 abc
Angle(°)	57±9 N=56 d	58±7 N=39 d	58±7 N=39 d	48±13 N=49 abc
MA(cm)	27±4 N=56 bcd	29±5 N=39 ad	29±4 N=39 ad	20±5 N=49 abc
pH	7.6±0.0 N=18 bcd	7.6±0.0 N=18 ad	7.7±0.1 N=24 ad	7.0±0.2 N=45 abc
abcd: P<0.05 students Ttest compared to resp. FFP (a), DFP0 (b), DFP7(c),LN(d)				

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