A SMALL AMOUNT CAN MAKE A DIFFERENCE: A PROSPECTIVE HUMAN STUDY OF THE PARADOXICAL COAGULATION CHARACTERISTICS OF HEMOTHORAX

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Based on our previous data, traumatic hemothorax chest tube effluent (HTX) at 4 hours post evacuation contains decreased platelets, absent fibrinogen, and is incoagulable; however when mixed with normal pooled (NPP) plasma coagulation is enhanced. Conditions at earlier time-points when auto transfusion may occur are not clear. Moreover, it is unclear how much HTX would need to be mixed with normal plasma to replicate this in vitro observation. We evaluated HTX from 1 hr to 4 hrs after evacuation, hypothesizing that clot formation would be absent at all time-points in HTX and we further hypothesized that coagulation would be enhanced when even small volumes of HTX were mixed with normal plasma, representing real-volume autotransfusion (i.e., 1250cc HTX: 5L circulating blood volume=1:4).

Adult trauma patients from whom >130mL of HTX was evacuated within 1 hr of tube thoracostomy were prospectively included. HTX was sampled at 1, 2, 3, 4 hrs after evacuation. A portion of each sample was centrifuged and the cell free portion (CFHTX) was collected and frozen. Experiment 1: Each fresh sample was analyzed (coagulation, hematology, electrolytes). Concurrent peripheral venous plasma (PV) values were compared to HTX values. Experiment 2: Coagulation was further evaluated by mixing serial dilutions of previously frozen CFHTX with normal pooled plasma (NPP). As a control, coagulation of NPP alone was simultaneously measured. Data was non-normal, and analyzed via a Kruskal-Wallis one-way ANOVA, and is reported as mean with interquartile range (IQR).

Subjects (n=34) were enrolled with HTX ranging from 130mL to >2000mL. Experiment 1: At no time-point (1, 2, 3, or 4 hours post-evacuation) was thrombus observed in any HTX collection chamber nor in any coagulation test. Mean HTX INR was >9, compared to a mean PV INR of 1.15 (P<0.001). Mean HTX aPTT was >180 (sec), compared to a mean PV aPTT of 28.69 (sec) (P<0.001).

Experiment 2: 1 hr specimens of CFHTX at clinically relevant dilutions were mixed with NPP: Mean mixed INR was 0.90 at a 1:4 dilution CFHTX:NPP (IQR 0.86-0.93); mixed INR was 0.91 at 1:8 (IQR 0.87-0.94); mixed INR 0.92 at 1:16 (IQR 0.88-0.96) vs NPP INR control of 1.00 (IQR 0.97-1.04) (all p<0.05 vs controls). The mean mixed aPTT was: 25.3 (sec) at 1:4 (IQR 24.4-26.5); mixed aPTT 26.7 (sec) at 1:8 (IQR 26.0-27.6); mixed aPTT 28.3 (sec) at 1:16 (27.6-29.3) vs NPP aPTT control of 32.5 (sec) (IQR 31.1 – 33.5) (all p<0.05 vs controls). The 4 hour specimens were also shown to be no different than the 1 hour specimens (p<0.05).

HTX specimens from 1-4 hours are all incoaguable. In vitro mixing of HTX with normal plasma was shown to consistently accelerate coagulation. Even a small amount of HTX autotransfusion, on the order of 300cc (1:16), would produce blood that could potentially clot faster than normal plasma. Although these data are preliminary, we conclude that caution should be used when considering autotransfusion of HTX.