EFFECT OF DILUTION WITH DIFFERENT FLUIDS ON BLOOD COAGULATION

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Perioperative blood dilution may affect increasing risk of perioperative bleeding. Some experimental studies have documented significant increase in APTT, PT, INR following hydroxyethyl starch (HES) and normal saline infusion [1,2]. Unfortunately the effect of blood dilution with balanced crystalloids and gelatin on coagulation times (APTT and PT) has not been thoroughly investigated .

The aim of this study was to analyse an in vitro effect of isovolaemic blood dilution on coagulation variables.

Material and methods: Blood samples from 30 healthy volunteers at the volume of 10 mL were diluted with crystalloid solution (Sterifundin® ISO, Braun), gelatin (Gelaspan®, Braun), and hydroxyethyl starch (Tetraspan®, Braun). According to degree of dilution, samples were randomized using a concealed envelope method into three equal groups: diluted to 25%, 35 and 45% (n = 10). APTT, PT and international normalized ratio INR were assessed in samples just before dilution (baseline) and after dilution.

Conclusions: Blood dilution prolongs coagulation times. In vitro, crystalloids disturb coagulation times more spectacularly than gelatin and hydroxyethyl starch in diluted samples. The greatest changes in PT and INR caused blood dilution to 25%.

Figure 1. Effect of blood dilution with Sterofundin® (S), Gelaspan® (G) and Tetraspan® (T) on active partial thromboplastin time (APTT). 25% blood dilution: baseline vs G: $p < 0.05$, S vs G: $p < 0.05$, S vs T: $p < 0.01$, G vs T: $p < 0.01$. 35% blood dilution: baseline vs S: $p < 0.05$, baseline vs G: $p < 0.01$, S vs G: $p < 0.01$, S vs T: $p < 0.01$, G vs T: $p < 0.01$. 45% blood dilution: baseline vs G: $p < 0.01$, baseline vs T: $p < 0.05$, S vs G: $p < 0.05$, S vs T: $p < 0.01$, G vs T: $p < 0.01$. ††† $p < 0.001$ – differences in prothrombin time between 25% and 45% blood dilutions with Gelaspan®.

Figure 2. Effect of blood dilution with Sterofundin® (S), Gelaspan® (G) and Tetraspan® (T) on international normalized ratio (INR). 25% blood dilution: baseline vs S: $p < 0.01$, S vs G: $p < 0.01$, S vs T: $p < 0.01$. 35% blood dilution: baseline vs S: $p < 0.01$, baseline vs G: $p < 0.01$, baseline vs T: $p < 0.01$, S vs T: $p < 0.01$, G vs T: $p < 0.01$. 45% blood dilution: baseline vs S: $p < 0.01$, baseline vs G: $p < 0.01$, baseline vs T: $p < 0.01$. ** $p < 0.01$ – differences in prothrombin time between 25% and 35% blood dilutions with Sterofundin®, †† $p < 0.01$ – differences in prothrombin time between 25% and 45% blood dilutions with Gelaspan®, ‡ $p < 0.05$ and ‡‡ $p < 0.01$ – differences in prothrombin time between 25% and 45% blood dilutions with Tetraspan®

Figure 3. Effect of blood dilution with Sterofundin® (S), Gelaspan® (G) and Tetraspan® (T) on prothrombin time (PT). 25% blood dilution: baseline vs S: $p < 0.01$, S vs G: $p < 0.01$, S vs T: $p < 0.01$. 35% blood dilution: baseline vs S: $p < 0.01$, baseline vs G: $p < 0.01$, baseline vs T: $p < 0.01$, S vs T: $p < 0.01$, G vs T: $p < 0.01$. 45% blood dilution: baseline vs S: $p < 0.01$, baseline vs G: $p < 0.01$, baseline vs T: $p < 0.01$. ** $p < 0.01$ – differences in prothrombin time between 25% and 35% blood dilutions with Sterofundin®, †† $p < 0.01$ – differences in prothrombin time between 25% and 45% blood dilutions with Gelaspan®, ‡ $p < 0.05$ and ‡‡ $p < 0.01$ – differences in prothrombin time between 25% and 45% blood dilutions with Tetraspan®

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