

# Comparison of nine different blood collection tubes for contact activation of coagulation

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## OBJECTIVES

Blood collection induces low grade contact activation of coagulation interfering with tests with low activation triggering.

To evaluate contact activation differences among collection tubes, we collected nine different and one duplicate tube from 10 healthy volunteers.

## METHODS

### Tubes

1. Monovette® vacuum
  2. Monovette aspiration
  3. Monovette vacuum + CTI
  4. Monovette aspiration + CTI
  5. Monovette vacuum
  6. Coated glass tube, Becton Dickinson (BD)
  7. SCAT containing CTI
  8. BD plastic tube
  9. BD plastic tube + CTI
  10. Greiner plastic tube
- Corn trypsin inhibitor (CTI) added immediately after collection (50 µg/ml) or present in the citrate (SCAT), All tubes 4-5 ml; with citrate, blood handling at room temperature and using secondary plastic tubes from Sarstedt.

### Tests:

NAPTT (non-activated partial thromboplastin time),  
NATEM (Thromboelastography with recalcification),  
TGA (Thrombin Generation Assay with low tissue factor (TGA®-RCH)).

## RESULTS

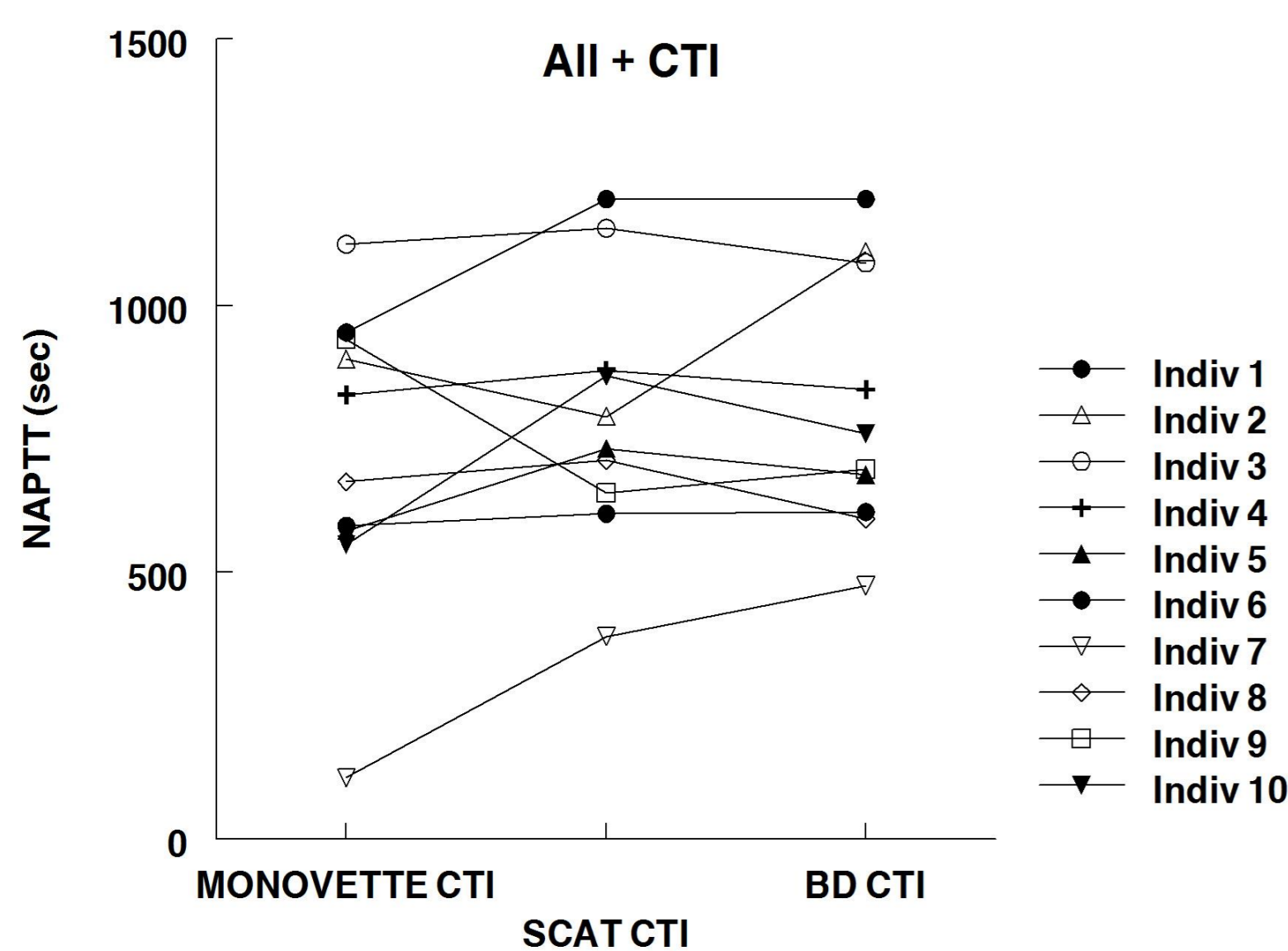


Figure 1: NAPTT lag times in 10 individuals using CTI blood obtained in three different tubes.

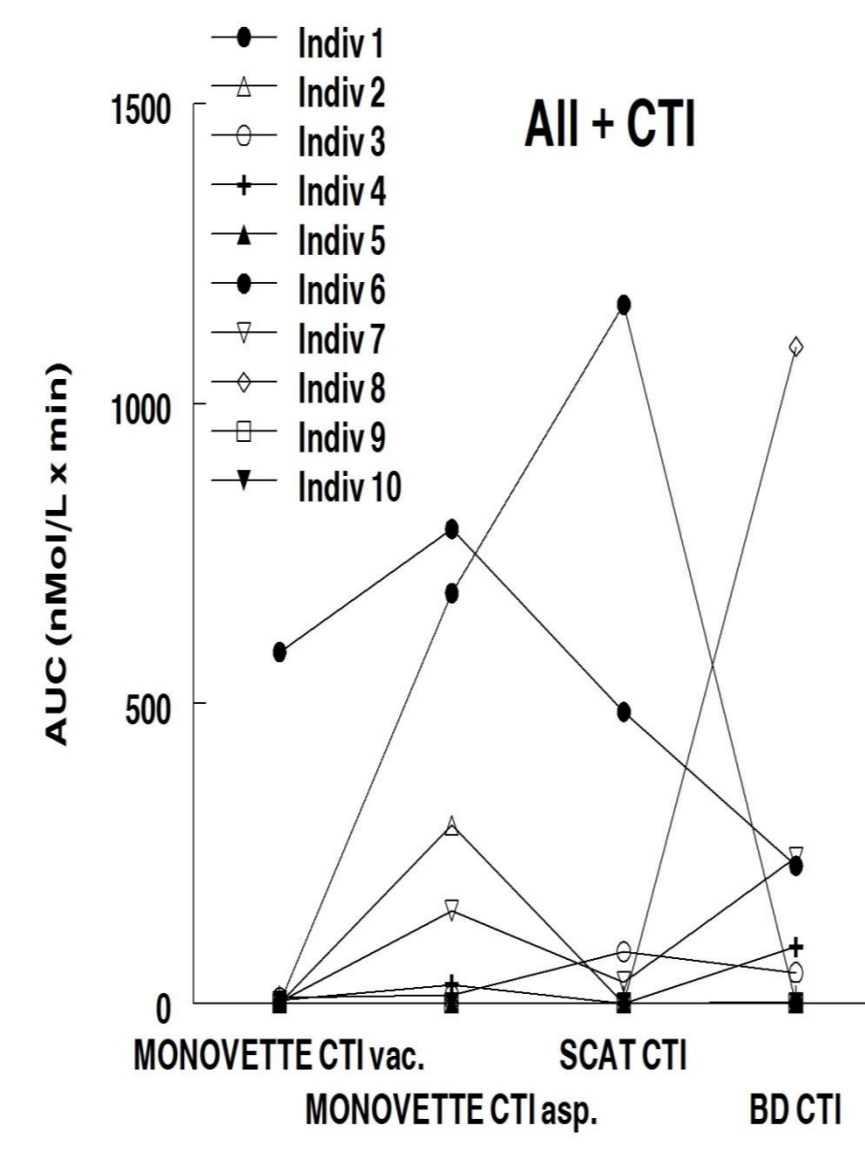


Figure 2: AUC in 10 individuals using CTI-blood obtained in four different tubes.

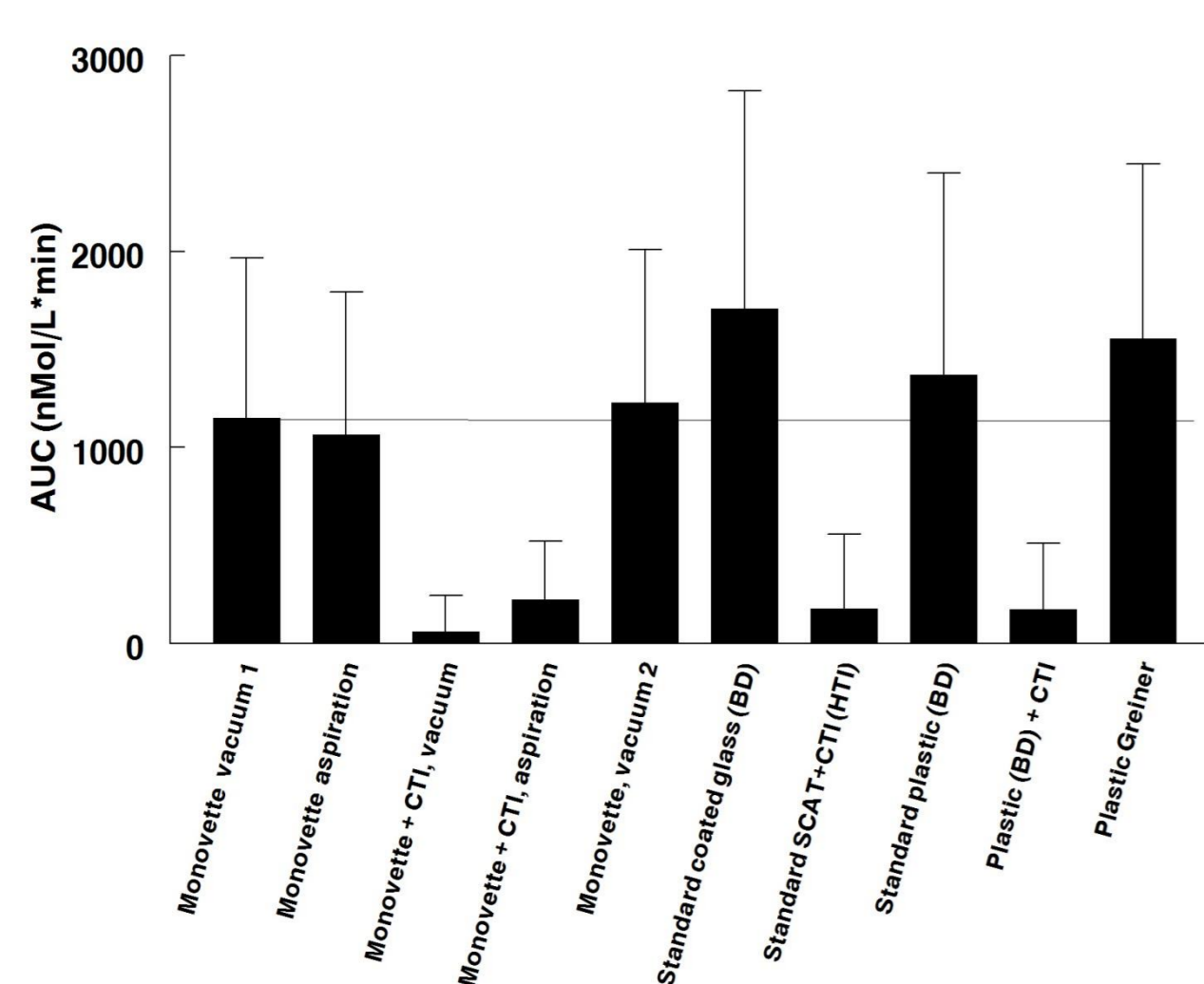


Figure 3: TGA AUC (means/SD, n=10) in 10 tubes (see identity also in M&M). Tubes with CTI have significantly lower; coated glass significantly higher (p=0.015; paired T-test) AUC.

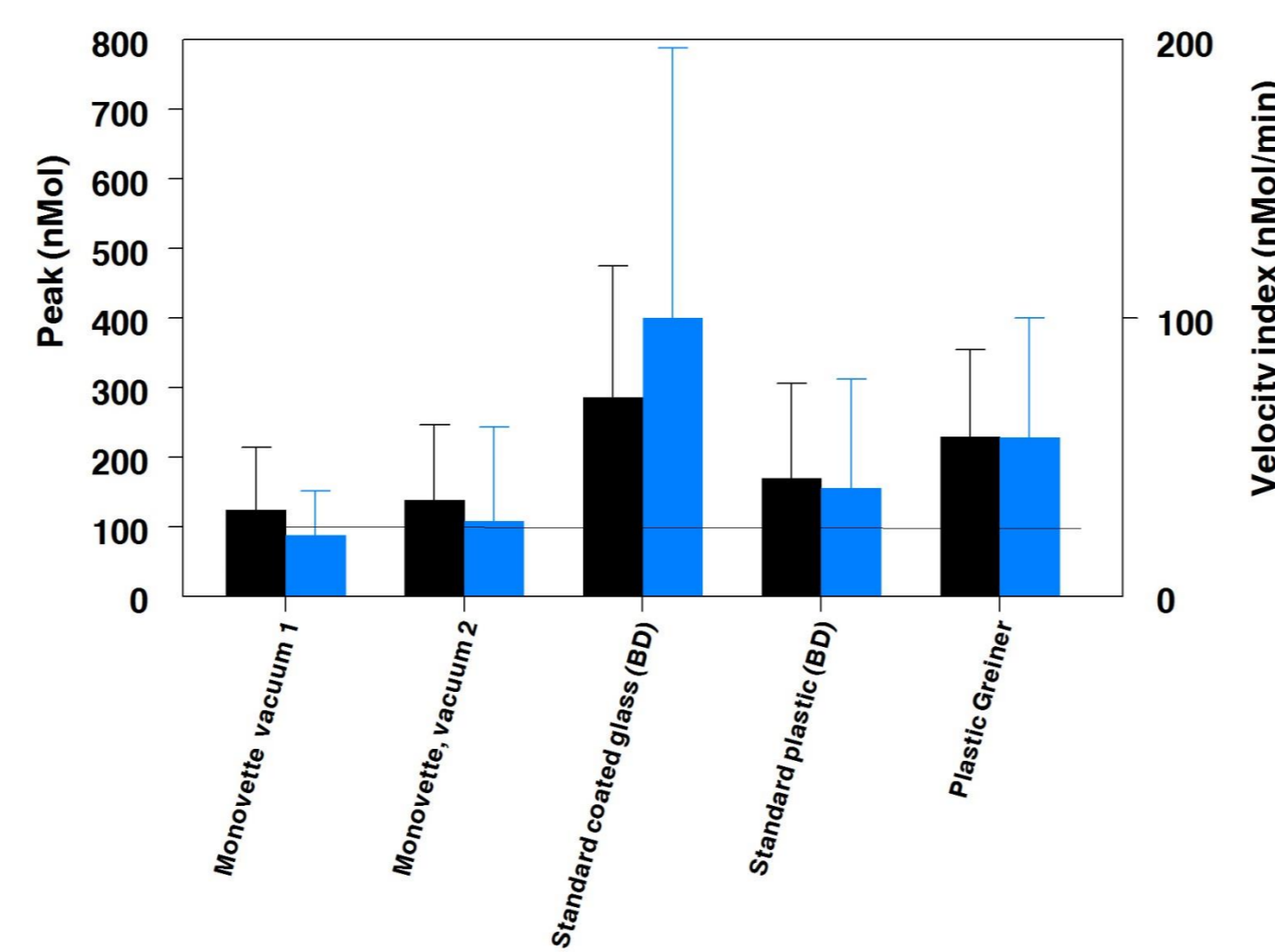


Figure 4: Peak thrombin (black) and velocity index (blue) in TGA in tubes without CTI. Coated glass (p=0.004; 0.012) and Greiner plastic tubes (p=0.020; 0.032) are significantly higher (paired T-test).

### NAPTT

- CTI increased clot time four times
- CTI does not completely block NAPTT
- Rate of clotting (no CTI) showed larger variability between individuals (CV 28%) than between tubes in each individual (CV 10%).
- Rate of clotting (with and without CTI) of individuals correlated ( $r^2: 0.64-0.93$ ) between tubes (see figure 1 for + CTI).

### NATEM /ROTEM

- Addition of CTI increased clotting time and decreased alpha angle, whereas MCF was unaffected.
- MCF was not different in individuals in different tubes

### TGA (low TF)

- CTI is most effective in Monovettes® vacuum and less in BD and SCAT® tubes in reducing signals to nihil (see figure 2 for AUC)
- Monovettes® aspiration tubes with CTI showed higher values than Monovette® vacuum (figure 2 and 3).
- In tubes without CTI, time variables (lag, time-to-peak) were not very different among tubes, but AUC (figure 3) and peak height (figure 4) showed distinct differences.
- Compared to Monovette® tubes, both BD and Greiner tubes showed higher values (AUC, Peak, VCI): notably, coated glass tubes showed the highest TGA-values (figures 3 and 4).

## CONCLUSIONS

- CTI is most effective in inhibition of contact activation in Monovette® tubes (except when aspiration is used)
- Monovette® vacuum tubes showed the lowest contact activation among tubes without CTI
- Time variables of thrombin and clot formation are variably affected by the tubes, but the differences are smaller than the differences between individuals.
- The significance of tube choice depends upon the test system and is most prominent for TGA testing, strongly affecting peak height, AUC and velocity.
- NAPTT shows clear individual differences irrespective of the tubes suggesting that individual differences in potency of the contact system are observed.



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