

# Efficacy of Two Novel Hemostatic Agents (XStat and Hydrogel) in a Coagulopathic Model of Severe Hemorrhage

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## Rationale

- Exsanguination: #1 cause of preventable battlefield death<sup>1</sup>
  - 20% are junctional wounds not amenable to tourniquet<sup>1</sup>
- TCCC has approved 3 hemostatic products
  - Combat Gauze, ChitoGauze, and Celox Rapid Gauze
- Newer products with novel mechanisms of action include XStat (rapidly expanding sponges) and Hydrogel (hydrophilic polymer)
- However, no previous studies have contrasted XStat and Hydrogel with traditional products in Survival, Blood Loss, Hemostasis, and Rebleeding in a swine model of severe hemorrhagic shock<sup>2</sup>

## Methods

### Subjects

- 35 Female swine (sus scrofa), 35-45kg

### Groups / Hemostatic Agents (Randomly Assigned)

#### Combat Gauze® (n=8)



Embedded w/ Kaolin (white clay)  
 Activates Factors XI & XII

#### ChitoGauze™ (n=5)



Embedded w/ Chitosan (polysaccharide from shellfish)  
 Crosslinks RBCs

#### Celox Rapid™ (n=7)



#### Combat Gauze® (n=8)



Hydrophilic Polymer Gel Forms a Bio-Adhesive Plug

#### XStat® (n=7)



Rapidly Expanding Sponges Impregnated with Chitosan Injected into Wound

## Methods

### Procedures

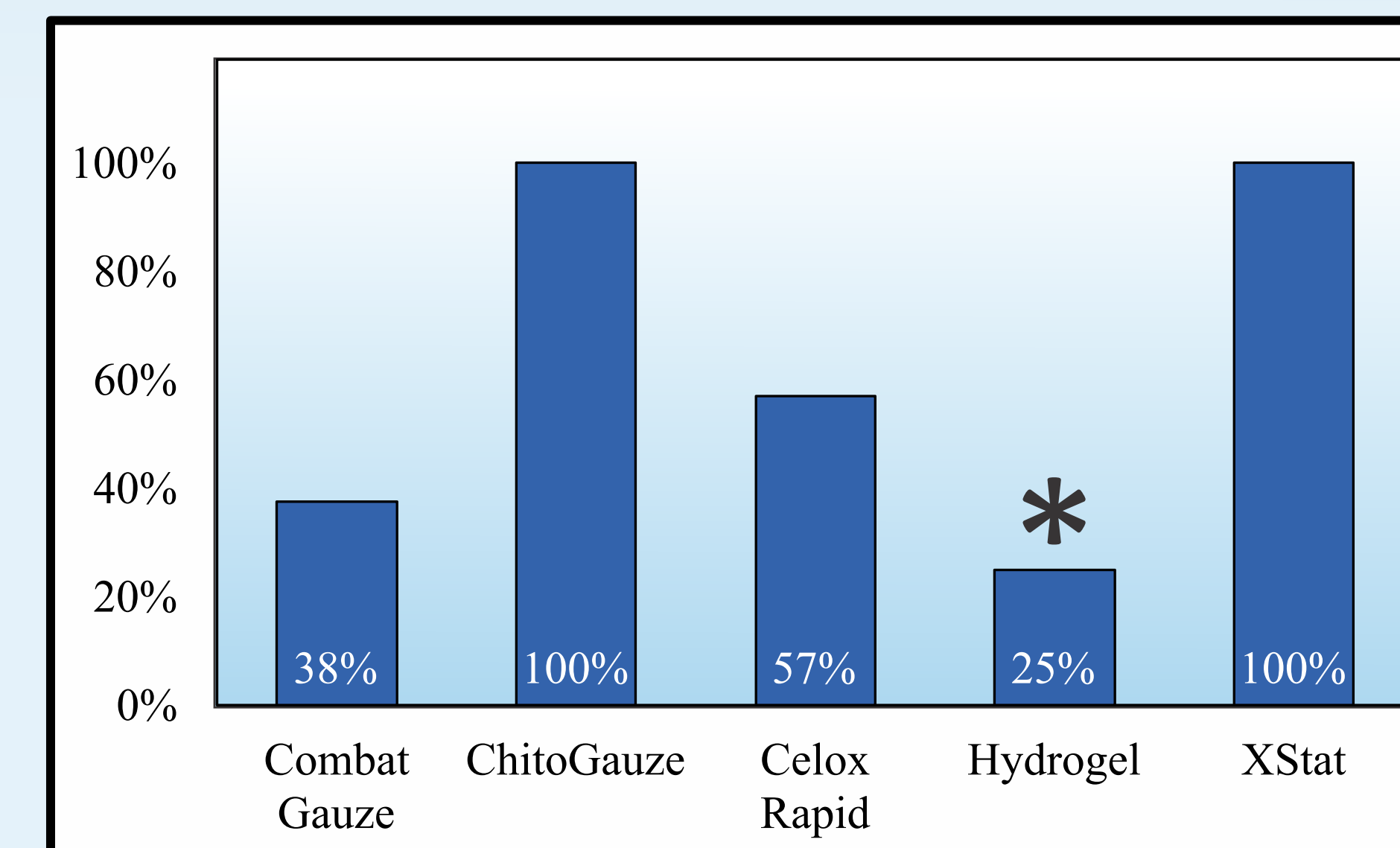
- Surgical Preparation**
  - Cannulations:
    - Carotid Artery (Vital Sign Monitoring)
    - External Jugular (Fluid Replacement)
    - Right Femoral Artery (Blood Removal)
  - Left Femoral Artery Exposure
- Induction of Coagulopathy<sup>3</sup>**
  - Replace 50% of subject blood with colloid
  - Lower core temp to 33°C (+/- 0.5°C)
  - 10 min stabilization
- Kheirabadi Femoral Artery Hemorrhage Model<sup>4,5</sup>**
  - 6mm arterial punch, left femoral artery
  - 45 sec free bleed
- Treatment**
  - Application of agent with 3 minutes of pressure
- Observation for 2.5 hours**

## Hypotheses

- No statistically significant difference between groups in:
  - Survival (H1) (Fisher's Exact Test)
  - Blood loss (H2) (Kruskal-Wallis; Mann-Whitney)
  - Primary Hemostasis (H3) (Fisher's Exact Test)
  - Rebleed (H4) (Fisher's Exact Test)
- Each at the  $p < .05$  statistical significance threshold

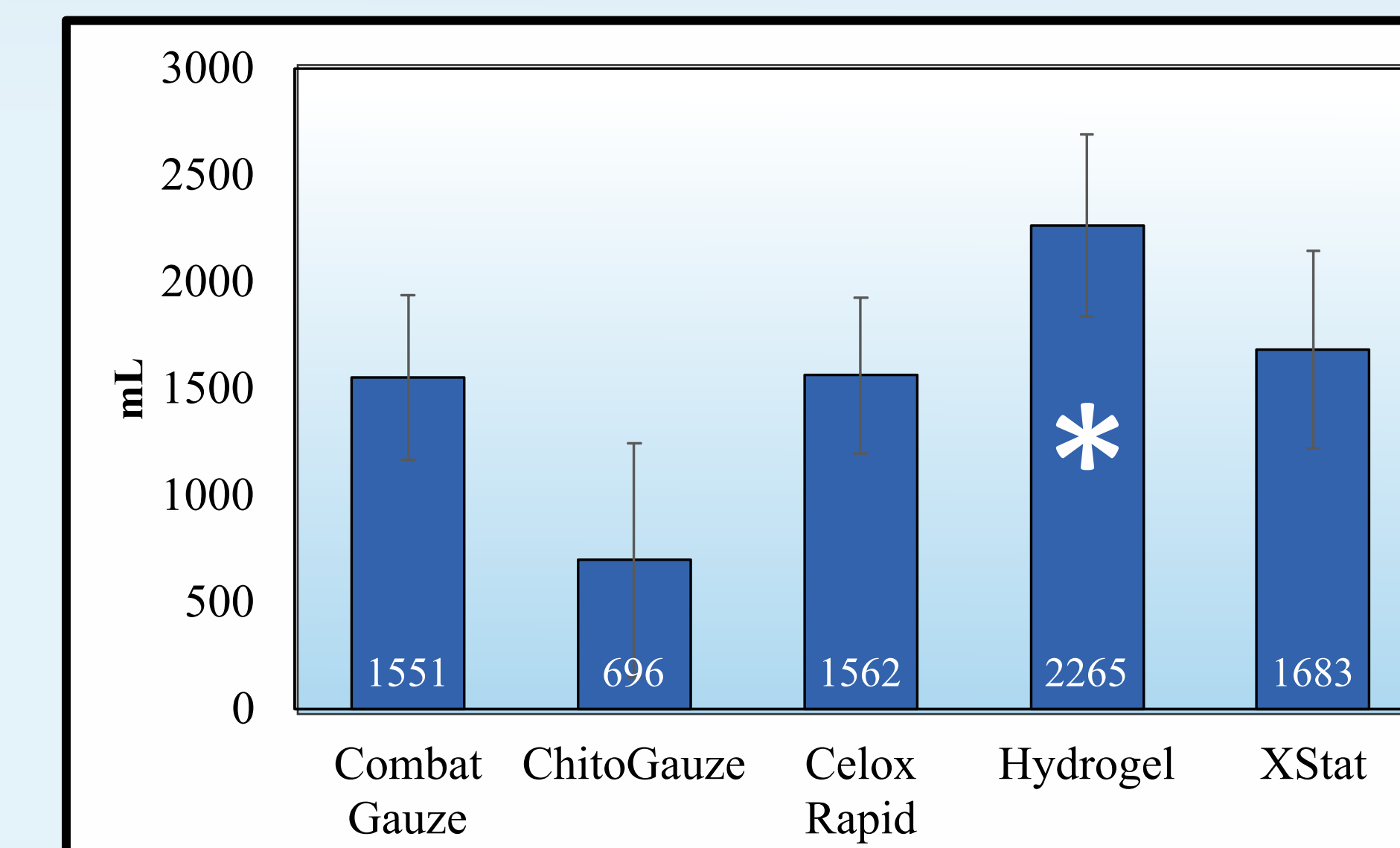
## Results

### H1: Survival



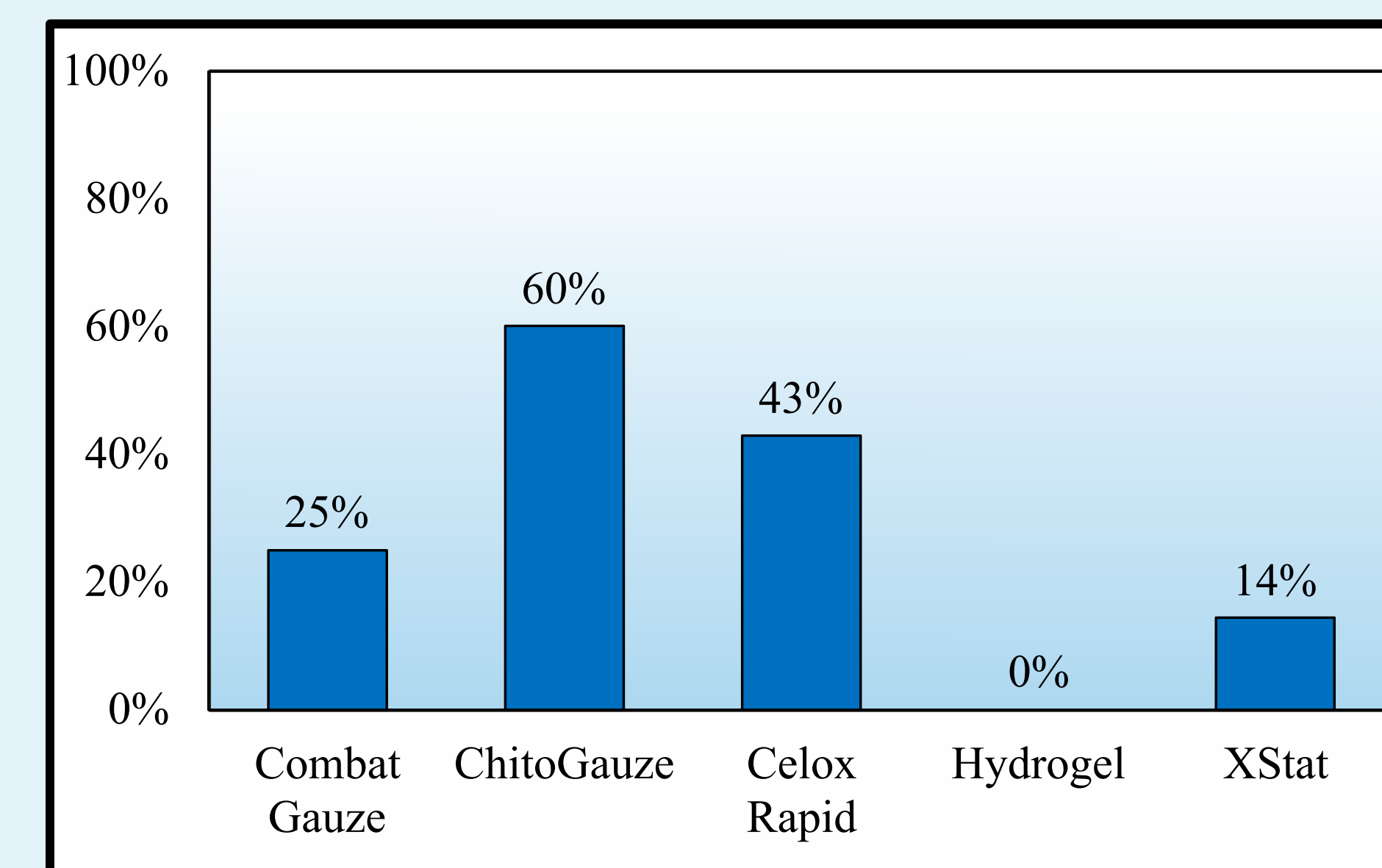
\* $p < .02$  vs ChitoGauze and XStat

### H2: Post Treatment Blood Loss



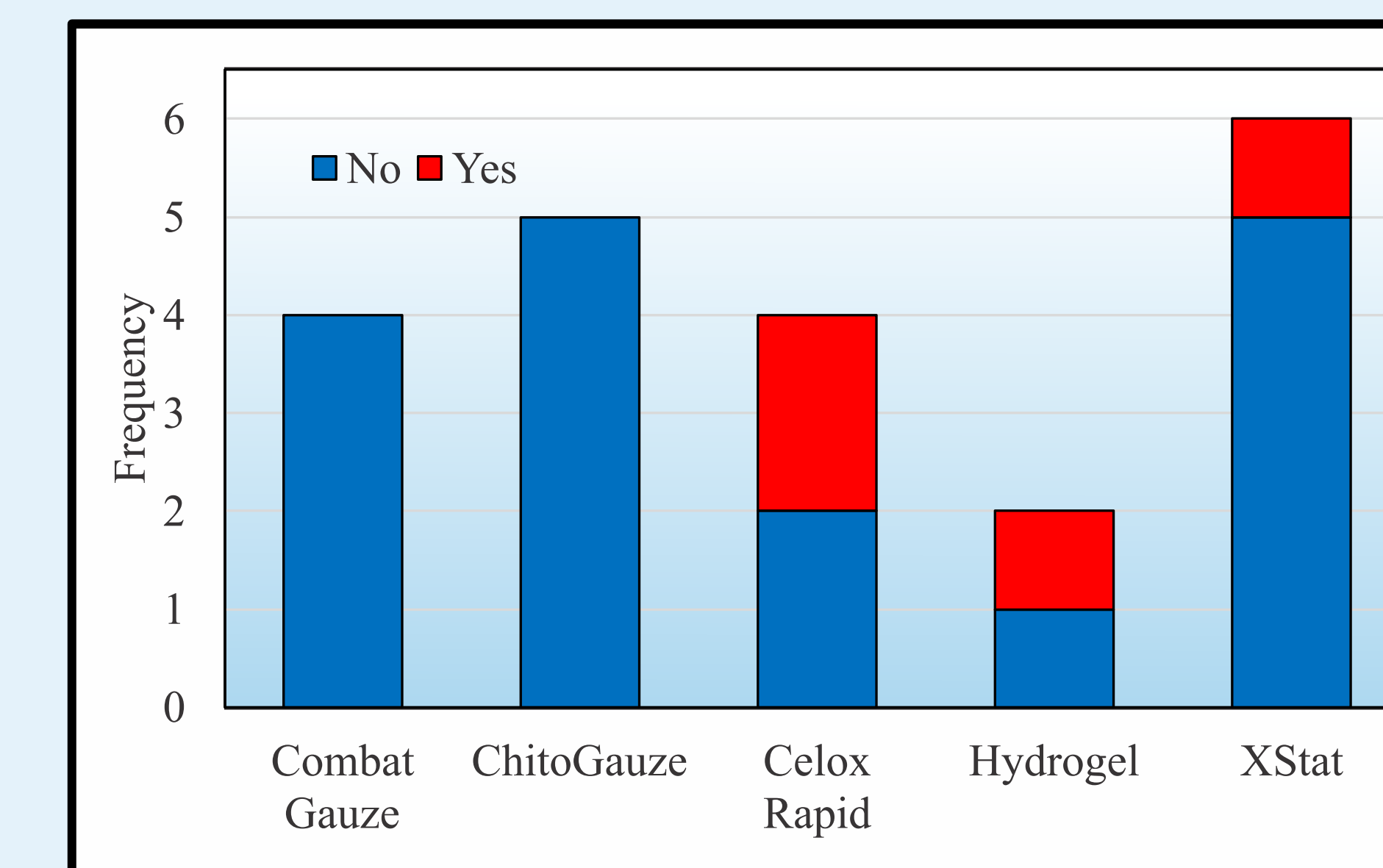
\* $p < .04$  vs ChitoGauze

### H3: Primary Hemostasis



$p = .07$ ; Hydrogel vs ChitoGauze

### H4: Rebleed



$p = .21$

## Discussion

### Implications

- Xstat → Can Save Lives in Combat
  - 100% Survival
  - Intermediate Blood Loss, Hemostasis, Rebleed
- HydroGel → Will Not Save Lives in Combat
  - 25% Survival
  - High Blood Loss, Rebleed; 0% Hemostasis

### Limitations

- Modest Sample Size
- One swine groin coagulopathy model
  - May not generalize to
    - Other wound locations / severity
    - Irregular wounds
- Laboratory setting only

## Future Research

- Replication!
  - Larger sample sizes
  - Other wound models
- Contrast with other modalities (e.g. junctional tourniquet)
- Testing in combat / simulated combat settings

## Conclusion

XStat has the potential to save lives on the battlefield, while Hydrogel does not appear to be an effective hemostatic agent for severe hemorrhagic coagulopathy

## Bibliography

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