Performance of a New Kit for a Modified Nijmegen-Bethesda Assay: Comparison of a Chromogenic Versus a Clot-based Factor VIII Inhibitor Assay in Plasma from Persons with Hemophilia A (PwHA)

Ali Sadeghi-Khomami, Marc Boylan: Precision BioLogic Inc., Dartmouth, NS, Canada
David C. Chen, Joanne I. Adamkewicz: Genentech Inc., South San Francisco, CA, USA

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Background/Objectives

- International proficiency studies on FVIII inhibitor titers revealed coefficients of variation as high as 50% between laboratories.¹
- Different reagents and methods used across labs (e.g. plasma sources, absence of or variations in heat deactivation procedures, use of buffered vs. non-buffered plasma) may contribute to the high variability.
- Chromogenic endpoint assays have better specificity than one-stage clot-based assays since the latter depends on fibrin clot formation, which is impacted by the presence of heparin, lupus anticoagulants and inhibitors of coagulation factors other than FVIII.
- Thus, there is a need for standardization and improvement of the FVIII inhibitor assay.

Conclusions

- In this study, the Chromogenic MNBA showed superior reproducibility compared to the one-stage clot-based assay.
- The MNBA kit shows promise for laboratories seeking a standardized inhibitor assay suitable for clinical management or multi-center clinical studies of PwHA.

Methods

- To eliminate FVIII depleted plasma as a potential source of variation and in order to standardize inhibitor titer measurement, a kit for Modified Nijmegen-Bethesda Assay (MNBA) was developed with these components:
  - IB-PNP: Imidazole Buffered Pooled Normal Plasma (pH = 7.4, 100 mM Imidazole, FVIII 95-105%).
  - IB-BSA: Imidazole Buffered Bovine Serum Albumin (pH = 7.4, 4% w/v BSA in 50 mM Imidazole) to replace FVIII depleted plasma in the Nijmegen assay.
  - POS-Ctrl: Positive FVIII inhibitor control (~1 BU/mL, polyclonal anti-human FVIII antibody in a buffered human FVIII depleted plasma).
  - NEG-Ctrl: FVIII inhibitor-free human plasma (buffered).
  - The MNBA kit components were frozen and stored at < -80°C until testing (Figure 1).
- A total of 22 frozen plasma samples from PwHA with a history of FVIII inhibitors and 10 frozen plasma samples from normal donors were thawed, heat deactivated, and centrifuged. The supernatant was drawn off and stored at < 70°C until testing (Figure 2).
- A heat deactivation step was incorporated in the MNBA to prevent the likelihood of false negative FVIII inhibitor results due to remaining FVIII activity in plasma samples from PwHA.²
- After thawing the heat deactivated plasma samples and FVIII Inhibitor Kit controls (Test Samples), a 1:1 mixture of IB-PNP, with either undiluted or IB-BSA pre-diluted Test Samples, were prepared (Test Mix, 400 μL).
- A Control Mix was prepared: 1:1 mixture of IB-PNP/IB-BSA (400 μL).
- Both the Test Mix and Control Mix were incubated for 2hr at 37°C in a water bath followed by a 10 min. incubation on ice.
- FVIII activities were determined on a Siemens BC-5™XP analyzer using Siemens Factor VIII Chromogenic Assay and a one-stage clot based assay using Pathromtin® SL aPTT reagent.
- The closest residual FVIII activity to 60% was used to calculate the FVIII inhibitor titer in Bethesda Units (Figure 3).

Results

- A strong correlation in FVIII inhibitor titer was observed between the chromogenic and clot-based MNBA (Figure 4), indicating that the new MNBA kit has potential for both assay systems. However, it is possible that additional discrepant results between chromogenic and clot-based MNBA may be seen in a clinical setting where the presence of interfering conditions is more likely for the clot-based MNBA.
- Inhibitor titers obtained by the clot based MNBA were mostly higher than those determined by the chromogenic assay (Figure 5, Figure 6).
- Application of a cut off of 0.6 BU/mL a consensus recommendation by ISTH-SSC指导下 only one discrepant result out of 22 samples. This result was borderline positive by the one-stage clot based assay, i.e. 0.6 BU/mL compared to 0.1 BU/mL by chromogenic MNBA (Table 1).
- Analysis of plasma samples from normal donors (n=30) and kit controls revealed that variation of results was 2-3 times smaller for the chromogenic MNBA as compared to the clot-based MNBA (Figure 6).

References


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Table 1

<table>
<thead>
<tr>
<th>FVIII Inhibitor detection in plasma samples from PwHA (n=22)</th>
<th>Clot-based MNBA</th>
<th>Chromogenic MNBA</th>
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<tbody>
<tr>
<td>Positive</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Negative</td>
<td>1</td>
<td>7</td>
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Agreement

<table>
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<tr>
<th>Percent</th>
<th>95% CI</th>
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<tr>
<td>Positive Percent Agreement (PPA)</td>
<td>97%</td>
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<tr>
<td>Negative Percent Agreement (NPA)</td>
<td>100%</td>
</tr>
<tr>
<td>Total Percent Agreement (TPA)</td>
<td>96%</td>
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*0.6 BU/mL cut off