EXTENDED REPORT

Value of IgA anticardiolipin and anti-β₂-glycoprotein I antibody testing in patients with pregnancy morbidity

S Carmo-Pereira, M L Bertolaccini, A Escudero-Contreras, M A Khamashta, G R V Hughes

Objective: To study the prevalence of IgA antiphospholipid antibodies, particularly anticardiolipin antibodies (aCL) and anti-β₂-glycoprotein I (aβ₂GPI), in a cohort of patients with pregnancy morbidity.

Patients and methods: Serum samples from four groups of patients were studied by an in house enzyme linked immunosorbent assay (ELISA). Group I: 28 patients with primary antiphospholipid syndrome (PAPS) (median age 32.5 years, range 25–34). Twelve patients had a history of thrombosis. All were positive for IgG/M aCL or lupus anticoagulant (LA), or both. Group II: 28 patients with unexplained pregnancy morbidity (median age 35 years, range 23–48). Seven had history of thrombosis. Nine patients were positive for IgG/M aCL. None from this group fulfilled Sapporo criteria for APS. Group III: 28 patients with systemic lupus erythematosus (SLE) (median age 34 years, range 25–52). Eleven had a history of thrombosis. Twenty one patients had IgG/M aCL and/or LA, but only 19 fulfilled Sapporo criteria for APS.

Results: IgA aCL were found in 12, 6, and 14 patients from the groups with PAPS, unexplained pregnancy morbidity, and SLE, respectively. Most patients had these antibodies together with IgG/M aCL. Three patients from the group with unexplained pregnancy morbidity and two with SLE had IgA aCL alone. IgA aβ₂GPI was present in one patient from each group. All IgA aβ₂GPI were present together with IgG and/or IgM aβ₂GPI.

Conclusions: The prevalence of IgA aCL is high in patients with pregnancy morbidity, although IgA aCL are usually present together with IgG and/or IgM aCL. IgA aβ₂GPI are not useful in identifying additional women with APS and pregnancy morbidity.

The antiphospholipid antibody (aPL) family includes a heterogeneous population of autoantibodies whose specificity is directed against phospholipids and their complex with plasma proteins. It is recognised that the presence of IgG and IgM antiphospholipid antibodies (aCL) and lupus anticoagulant (LA) is associated with thrombosis and pregnancy loss, making the presence of these antibodies essential to classify a patient as antiphospholipid syndrome (APS). It has also been demonstrated that these antibodies are directed to plasma proteins bound to anionic phospholipids. The phospholipids may induce some conformational changes in the protein structure, and thus many of the antibodies against phospholipid binding proteins can be detected basically in the presence of phospholipids. So far, β₂-glycoprotein I (β₂GPI) and prothrombin are the best known and characterised phospholipid binding proteins. β₂GPI is a glycoprotein with a molecular weight of 50 kDa and high affinity towards negatively charged phospholipid surfaces. The binding of aPL to β₂GPI is dependent on oxidised irradiated surfaces or membranes containing anionic phospholipids.

The association between IgA aPL and clinical manifestations of the APS is controversial. Some studies showed a higher frequency of these antibodies in patients with systemic lupus erythematosus (SLE) or APS, or both, suggesting that their detection, particularly IgA aβ₂GPI, may be of value as a method for assessing the risk in these patients. In contrast, some series showed that the IgA aCL isotype is uncommon and not helpful in diagnosing APS.

Recently, IgA anti-β₂GPI (aβ₂GPI) have been found in patients with unexplained recurrent pregnancy loss and no other aPL, suggesting that these antibodies may be related to pregnancy morbidity. We designed this study to investigate whether IgA aβ₂GPI are raised in women with a history of unexplained recurrent miscarriage, fetal death, or premature birth in an attempt to confirm whether there might be a correlation between these antibodies and pregnancy morbidity.

Patients and Methods

Patients

This study comprised 84 patients with history of pregnancy morbidity, defined by ≥3 miscarriages before the 10th week of gestation, ≥1 fetal death beyond the 10th week of gestation, and/or ≥1 premature birth before the 34th week of gestation due to severe pre-eclampsia or eclampsia, severe placental insufficiency, as established by Wilson et al; 100 apparently healthy controls were also studied. Patients were included in three groups: 28 women with well defined primary APS (PAPS) according to the international consensus criteria (median age 32.5 years, range 25–34); 28 women with unexplained pregnancy morbidity, (median age 35 years, range 23–48); 28 women fulfilling at least four of the American College of Rheumatology criteria for SLE (median age 34 years, range 25–52).

Of the patients with PAPS, 12 had a history of thrombosis (five arterial, six venous, and one patient both arterial and venous events). All patients from this group were positive for IgG/M aCL and/or LA, according to the 1999 Sapporo criteria, and 13 for IgG/M aβ₂GPI. In the group with unexplained pregnancy morbidity, seven patients had a history of
thrombosis (one arterial and six venous). Only nine patients were positive for IgG/M aCL and eight for IgG/M αβ2GPI at low titres. Therefore, none of these patients fulfilled Sapporo criteria for the classification of APS. Thrombosis occurred in 11 patients with SLE (four arterial and seven venous). IgG/M aCL and/or LA antibodies were present in 21 patients, but only 19 patients with SLE (four arterial and seven venous) fulfilled Sapporo criteria for the APS.

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean age (range)</th>
<th>Thrombotic history</th>
<th>Arterial events</th>
<th>Venous events</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Years</td>
<td>No (%)</td>
<td>No (%)</td>
<td>No (%)</td>
</tr>
</tbody>
</table>

All patients were female. PAPS, primary antiphospholipid syndrome; SLE, systemic lupus erythematosus.

Table 2

<table>
<thead>
<tr>
<th>Group</th>
<th>aPL positive No (%)</th>
<th>aCL No (%)</th>
<th>IgG aCL No (%)</th>
<th>IgM aCL No (%)</th>
<th>LA No (%)</th>
<th>αβ2GPI No (%)</th>
<th>IgG αβ2GPI No (%)</th>
<th>IgM αβ2GPI No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAPS (n=28)</td>
<td>28 (100)</td>
<td>26 (93)</td>
<td>14 (50)</td>
<td>25 (89)</td>
<td>15 (54)</td>
<td>13 (46)</td>
<td>12 (43)</td>
<td>4 (14)</td>
</tr>
<tr>
<td>Unexplained pregnancy morbidity (n=28)</td>
<td>9 (32)</td>
<td>9 (32)</td>
<td>2 (7)</td>
<td>8 (29)</td>
<td>0 (0)</td>
<td>8 (29)</td>
<td>7 (25)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>SLE (n=28)</td>
<td>21 (75)</td>
<td>21 (75)</td>
<td>20 (71)</td>
<td>20 (71)</td>
<td>5 (18)</td>
<td>11 (39)</td>
<td>10 (36)</td>
<td>4 (14)</td>
</tr>
</tbody>
</table>

PAPS, primary antiphospholipid syndrome; SLE, systemic lupus erythematosus; aPL, antiphospholipid antibodies; aCL, anticardiolipin antibodies; LA, lupus anticoagulant.

Methods

aCL ELISA

All IgG and IgM aCL were determined in our laboratory according to the standardised aCL enzyme linked immunosorbent assay (ELISA). IgA aCL were tested as previously reported.

αβ2GPI ELISA

IgG and IgM αβ2GPI were detected by ELISA using irradiated ELISA plates (Nunc Maxisorp, Denmark) as previously described. IgA αβ2GPI were detected by an in house ELISA. Briefly, microtitre ELISA plates (Maxisorp, Nunc, Denmark) were coated with 4 μg/ml human βGPI (Yamasa Co, Choshi, Japan) in phosphate buffered saline (PBS) or PBS alone and incubated overnight at 4°C. After blocking with 1% bovine serum albumin (BSA; Sigma), 0.1% Tween 20 (Sigma) in PBS (1%BSA-0.1%Tween-PBS), serum diluted 1:100 in 1%BSA-0.1%Tween-PBS was added in duplicate. After incubation and washes with PBS-0.1%Tween, alkaline phosphatase conjugated goat antichimpanzee IgG was added in the appropriate dilution. Colour was developed by adding 100 μl of 1 mg/ml of p-nitrophenylphosphate disodium in 1 M diethanolamine buffer (pH 9.8). The IgA αβ2GPI titre of each sample was derived from the standard curve according to the dilutions of a positive IgA control which showed high IgA binding to βGPI but low binding to a control well without antigen, suggesting that IgA antibody was appropriately detected, and converted to units. The cut off point for the IgA αβ2GPI assays was established as the mean + 5SD of 100 controls.

Lupus anticoagulant

Data for LA were those historically present in the patients’ clinical records before starting anticoagulation treatment. LA was screened using activated partial thromboplastin time (aPTT) and dilute Russell’s viper venom time (dRVVT), and confirmed according to the guidelines recommended by the Subcommittee on Lupus Anticoagulant/Phospholipid dependent Antibodies.

Statistical analysis

Statistical analysis was performed using the SPSS 7.5 program. Differences between medians were analysed by Mann-Whitney test. Categorical comparisons between patient groups were expressed as relative risk with its 95% confidence interval. All p values were determined by Fisher’s exact test. A p value of <0.05 was considered significant.

RESULTS

Obstetric characteristics

Patients from the group with unexplained pregnancy morbidity had a significantly higher number of pregnancies than those with PAPS (median 4 (range 1–17) vs median 3 (range 1–7), p=0.04). No differences in the number of pregnancies were found between the groups with PAPS and SLE (median 3 (range 1–7) vs median 3 (range 1–15), p=0.9) and between the groups with unexplained pregnancy morbidity and SLE (median 4 (range 1–17) vs median 3 (range 1–15), p=0.06). Patients from the group with unexplained pregnancy morbidity had a higher number of miscarriages (median 1.5 (range 0–10)) than patients from the groups with PAPS or SLE (median 0 (range 0–6) and median 0 (range 0–7), respectively) but the differences were not statistically significant. The numbers of fetal deaths and cases of prematurity did not differ between groups. Table 3 summarises all these data.

IgA aCL and association with other isotypes

Overall, IgA aCL were present in 32/84 (38%) patients with pregnancy morbidity. These antibodies were found in 12, 6, and 14 patients from the groups with PAPS, unexplained pregnancy morbidity and SLE, respectively. Although the prevalence of IgA aCL was higher in patients with PAPS (43%) and SLE (50%) than in the group with unexplained pregnancy
Traditionally, obstetric complications are thought to be due to placental and/or spiral artery thrombosis, a mechanism supported by some but not all biopsy findings. Although aPL may induce thrombosis in several ways (that is, endothelial cell activation), some experimental work suggests that IgA aCL are as prothrombotic as the IgG or IgM isotypes.

Although first reports failed to show an association between IgA aβ2GPI and recurrent fetal loss or recurrent spontaneous abortions and unexplained fetal deaths, subsequent studies showed that IgA aβ2GPI were significantly raised in women with pregnancy morbidity, suggesting that testing for these antibodies may help in identifying additional women with APS who are not identified by traditional testing.

Yamada et al screened 36 patients with unexplained recurrent spontaneous abortion. IgA aβ2GPI levels were higher in these patients than in the healthy non-pregnant controls. They also found that the frequency of IgA aβ2GPI was higher in patients with recurrent spontaneous abortion (13.9%) than in the controls (0%). Lee et al showed that IgA aβ2GPI were more frequent in women with recurrent spontaneous abortion or fetal death than in fertile controls. In a recent study, we evaluated the prevalence and clinical significance of IgA aCL and IgA aβ2GPI, and antiprothrombin antibodies as alternative additive risk factors for the well-established IgG and/or IgM aCL and LA in a large cohort of patients with SLE. However, we failed to demonstrate an association between the presence of IgA aβ2GPI and arterial/venous thrombosis or pregnancy loss in that cohort.

In this study IgA aβ2GPI were present in three (4%) of the entire pregnancy morbidity group of 84 patients, with no differences in the distribution between groups (one patient from each group was found to be positive for IgA aβ2GPI). Moreover, these antibodies were present together with IgG and/or IgM aβ2GPI and aCL.

In our study IgA aCL were usually present together with either IgG and/or IgM isotypes except in three patients with unexplained pregnancy morbidity and two patients with SLE, raising the question as to whether IgA aCL might be important in the pathogenesis of pregnancy morbidity.

**Table 3** Obstetric history of patients with PAPS, patients with unexplained pregnancy morbidity, and patients with SLE

<table>
<thead>
<tr>
<th></th>
<th>PAPs No (median range)</th>
<th>Miscarriages No (median range)</th>
<th>Fetal death No (median range)</th>
<th>Prematurity No</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAPS</td>
<td>95 (3 [1–7])</td>
<td>30 (6 [0–10])</td>
<td>25 (1 [0–1])</td>
<td>7</td>
</tr>
<tr>
<td>Unexplained pregnancy morbidity</td>
<td>142 (4 [1–17])</td>
<td>55 (15 [0–10])</td>
<td>27 (1 [0–1])</td>
<td>1</td>
</tr>
<tr>
<td>SLE</td>
<td>111 (3 [1–15])</td>
<td>38 (0 [0–7])</td>
<td>24 (1 [0–1])</td>
<td>6</td>
</tr>
</tbody>
</table>

PAPS, primary antiphospholipid syndrome; SLE, systemic lupus erythematosus.

All numbers given are total number of events. Obstetric history was defined according to 1999 Sapporo criteria for APS.
IgA antiphospholipid antibodies in pregnancy morbidity


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