Original article

Indication and outcome of lupus anticoagulant and antiphospholipid antibodies testing in routine clinical practice

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Abstract

Objectives Lupus anticoagulans (LACs) and aPLs, both further summarized as aPL, are frequently assessed in routine daily clinical practice in diagnostic workups for suspected autoimmune diseases or to test for underlying risk factors in patients with thrombosis or obstetric complications. The aim of this study was to determine the prevalence of aPL positivity in patients with an indication for aPL testing in routine clinical practice.

Methods In this retrospective single-centre study, indication for aPL testing, aPL test results and clinical data were collected for patients tested between June 2015 and April 2018.

Results During the study period, 16 847 single aPL tests were performed in 2139 patients. In 212 patients one or more positive aPL test was found, confirmed in 43.9% with a second positive test. Indications for aPL testing were diagnostic workup/follow-up of autoimmune diseases (33.6%), thrombosis (21.4%) and obstetric complications (28%). Seventy-four patients (3.5% of all patients) fulfilled the criteria of APS, of whom 51% were newly diagnosed. Second positive aPL titres and titres of APS patients were significantly higher compared with positive aPL titres at the first measurement ($P < 0.05$). Patients with indications of arterial thrombosis and diagnostic workup/follow-up of autoimmune diseases had significantly higher levels of aCL IgG and anti-$\beta 2$ glycoprotein I ($\beta 2$GPI) IgG compared with patients with other indications.

Conclusion The prevalence of one or more positive aPL test was 9.9% and APS was diagnosed in 3.5% of the patients. Patients with arterial thrombosis had significantly higher anti-$\beta 2$GPI IgG and aCL IgG, which should be confirmed in future studies.

Key words: aPL, antiphospholipid syndrome, blood coagulation disorders, obstetric complications, thrombosis

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Key messages

- Indications for aPL testing were diagnostic workup/follow-up of autoimmune diseases, thrombosis and obstetric complications.
- The prevalence of a first positive aPL was 9.9%, confirmed in 43%; APS was diagnosed in 3.5%.
- Arterial thrombosis was associated with significantly high anti-$\beta 2$GPI IgG and aCL IgG titres.

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CLINICAL SCIENCE

Introduction

Lupus anticoagulants (LACs) and other aPLs are a family of autoantibodies that can interact with phospholipids, phospholipid-binding proteins or both [1]. LACs are phospholipid-dependent inhibitors of the *in vitro* coagulation and a result of aPL binding to plasma proteins, mainly β2-glycoprotein, that have affinity for the negatively charged phospholipids [1–3]. The most commonly detected aPLs are aCL antibodies (IgG and IgM) and anti-β2-glycoprotein Ib (anti-β2GPIb) antibodies (IgG and IgM) [1]. In this article, the term aPL includes LACs, aCL antibodies and anti-β2GPI antibodies.

The presence of aPL is associated with an increased risk of thrombosis (venous and arterial) and/or obstetric complications [4]. aPL positivity can result in various clinical presentations: asymptomatic 'aPL carriers', classic APS with recurrent thrombotic events, APS linked to obstetric complications (obstetric APS) or aPL-positive patients presenting with 'non-criteria' clinical manifestations (i.e. thrombocytopenia, haemolytic anaemia, livedo reticularis, valvular heart disease, acute thrombotic microangiopathy or cognitive dysfunction) [5–8]. APS is a systemic autoimmune disease clinically characterized by thrombotic and/or obstetric events that occur in a small percentage of patients with persistent positive aPL [4, 6, 7]. The diagnosis of APS is based on the revised Sapporo criteria, in which persistent positive aPLs are defined as positive aPL on two or more occasions at least 12 weeks apart [4]. Thrombotic events are divided into arterial and/or venous thrombosis. Pregnancy-related morbidity is defined as foetal death beyond the 10th week of gestation, recurrent pregnancy loss before week 10 of gestation and premature births before the 34th week of gestation due to severe pre-eclampsia (PE) or placental insufficiency [4, 9].

Furthermore, APS can be found in subjects without an underlying systemic autoimmune disease (primary APS) or may be associated with other systemic autoimmune diseases, especially SLE [10]. In addition, the prevalence of aCL and anti-β2GPI antibodies has been observed to be significantly higher in patients with Behçet's disease and patients with systemic sclerosis compared with controls [11, 12]. Therefore aPLs are routinely measured to assess underlying risk factors for obstetric and/or thrombotic complications or in the diagnostic workup for suspected autoimmune diseases [13]. However, data on the prevalence of aPL positivity and characteristics of patients with positive aPL are scarce, due to the heterogeneity of aPL-related clinical manifestations and differences in laboratory testing [14]. It is important to realize this heterogeneity since the wide variation in aPL testing and incomplete testing may lead to underrecognition of diagnoses such as APS.

The aim of this study is to analyse indications and outcomes of aPL testing in routine clinical practice and to determine the prevalence of aPL positivity in a large cohort of patients. In addition, we aim to compare aPL-positive patients with and without APS concerning their clinical and aPL characteristics.

Methods

Patients

The Erasmus MC University Medical Center Rotterdam is an academic hospital where ∼1000 aPL tests are performed annually in, on average, 770 patients per year, of which ∼240 tests are positive (Supplementary Table S1, available at *Rheumatology Advances in Practice* online). In this retrospective single-centre study, indication for aPL testing was collected for all patients tested for aPL between June 2015 and April 2018. Subsequently all patients were selected who tested positive at least once for one or more of the following aPLs: aCL IgG or IgM, anti-β2GPI IgG or IgM or LACs [assessed using dilute Russell's viper venom time (dRVVT) and a LA-sensitive activated partial thromboplastin time (APTT-lupus)]. Data concerning age, sex, characteristics of aPL tests, haemoglobin, platelet and leucocyte counts, anticoagulant therapy, specialty of physicians who requested the aPL test and clinical symptoms were collected retrospectively from the patient files. A diagnosis of APS was based on the revised Sapporo criteria for APS [4]. Persistent aPLs were defined as one or more positive aPL test result, confirmed on a minimum of two occasions with an interval of at least 12 weeks within the study period 2015–2018. Some first aPL tests were performed in the acute phase after a thrombotic event. However, second confirmation aPL tests were not. Anticoagulation use was only noted when the anticoagulant was used during both aPL measurements. Patients who met the classification criteria for APS were compared with the patients who did not meet the classification criteria. This study was approved by the local medical ethical committee (METC Erasmus Medical Center; MEC-2019-0606).

Laboratory assays

LACs were detected using functional assays [3, 15]. For LACs measurement, the dRVVT (screening reagent LA1 and LA2; Siemens, Munich Germany) and the APTT-lupus with Actin FSL and Actin FS (Siemens) on the Sysmex CS5100 (Sysmex, Singapore) were used. dRVVT reagent contained heparin inhibitor. In patients on vitamin K antagonist (VKA), the anticoagulant intensity at the time of testing for LACs was measured using the international normalized ratio (INR). Diagnostic tests were mixed with normal pooled plasma to correct for anticoagulant therapy with VKA (INR 1.5–3). In addition, in case of heparin use, LACs testing was performed after incubation of plasma with heparinase. The plasma glycoprotein β2GPI in complex with the anionic phospholipid cardiolipin is recognized by aCL antibodies [16–18], whereas anti-β2GPI antibodies recognize β2GPI with or without cardiolipin binding. In our study, the antibodies were determined using the HemoSIL AcuStar aCL IgG and IgM and HemoSIL AcuStar anti-β2GPI IgG and IgM assays on the ACL AcuStar (Werfen, Barcelona, Spain). Cut-off values were determined based on the 99th percentile according to the International

Society on Thrombosis and Haemostasis Scientific and Standardization Subcommittee guidelines [19, 20].

Statistical analysis

Continuous variables are summarized as mean (s.D.) and range. Categorical variables are presented as total count or percentage. Differences in aPL levels and clinical characteristics between the patients with and without APS were analysed using the non-parametric Mann–Whitney test if not normally distributed or Student's *t*-test when normally distributed. Categorical variables were analysed using the chi-squared test. *P*-values <0.05 were considered significant. All analyses were performed using SPSS version 25 (IBM, Armonk, NY, USA).

Results

Indications and outcome of aPL testing in routine clinical practice

Between June 2015 and April 2018, 16 847 aPL tests were performed in 2139 patients (Fig. 1). In 212 patients (9.9%), one or more positive aPL test result was found. From these patients, aPL positivity was confirmed in 93 patients on the second measurement occasion (43.9%). Of the 93 patients with a confirmed positive aPL test result, 86 patients were positive for the same aPL and 7 had a different positive aPL.

The main indications for aPL testing were diagnostic workup for suspected autoimmune diseases or follow-up of autoimmune diseases [719 (33.6%); including APS], thrombosis [456 (21.4%), of which 200 (9.4%) had arterial and 256 (12.0%) had venous thrombosis] and obstetric complications [600 (28.0%), of which 227 (10.6%) had recurrent pregnancy loss and 373 (17.4%) were for screening or follow-up of PE or haemolysis–elevated liver enzymes–low platelets (HELLP) syndrome]

(Table 1). Patients with an indication of venous and arterial thrombosis tested positive at the first aPL measurement in 14.5% (37 patients) and 9.0% (18 patients), respectively. aPL positivity was confirmed in 6.3% (16 patients) and 4.5% (9 patients), respectively. Patients with an obstetric indication had a first positive aPL test result in 5.9% (22 patients with an indication of PE/HELLP) and 7.0% (16 patients with recurrent pregnancy loss), which was confirmed in 2.7% (10 patients with an indication of PE/HELLP) and 2.2% (5 patients with recurrent pregnancy loss), respectively. Of all the patients with a diagnostic workup or follow-up of autoimmune diseases as an indication for testing, 12.5% (90 patients) and 5.4% (39 patients) tested positive at the first and second aPL measurement, respectively (Table 1).

Characteristics of aPL-positive patients

The clinical and laboratory characteristics of the 212 patients with one or more positive aPL test result are described in Table 2. The mean age of included patients was 39.6 years (s.D. 18.1) and 75.0% were female, which was similar for patients with and without a confirmed positive aPL test (*P* = not significant). aPL tests were mainly requested by immunologists/haematologists and rheumatologists (68.4%), obstetricians (17.5%) and neurologists (12.3%). Interestingly, 81.1% of the patients with a positive aPL test at the first measurement and 65.6% of the patients with confirmed aPL positivity were newly diagnosed (Table 2). Of the 212 patients with a positive first aPL test, 72 patients (33.9%) met the revised Sapporo criteria for APS [4] and 57 of the 93 patients (61.3%) with a positive second aPL test met the criteria. The other patients with APS did not have two positive tests with a >12 week interval in the study period, but they were diagnosed with APS before the study period according to the revised Sapporo criteria for APS classification [4] and therefore were also classified as APS patients.

Fig. 1 CONSORT diagram
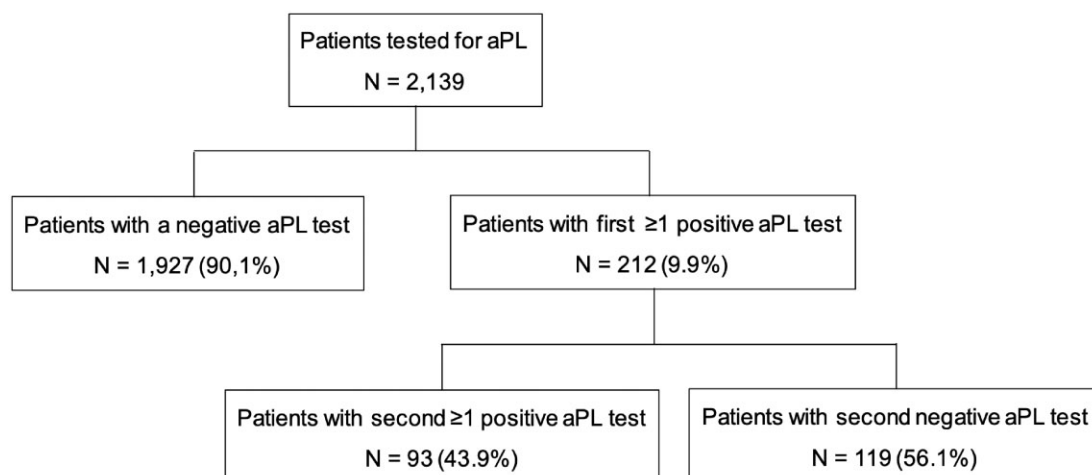
aPL including LACs (APTT-lupus ratio and/or dRVVT ratio), aCL (IgG or IgM) and anti-β2GPIb antibodies (IgG or IgM).

TABLE 1 Indications for aPL testing

Indication	Total (N = 2139)	Negative aPL (n = 1927)	First aPL positive (n = 212)	Second aPL positive (n = 93)	APS (n = 74)
Thrombosis, n (%)					
Venous thrombosis	256	219 (85.5)	37 (14.5)	16 (6.3)	14 (18.9)
Arterial thrombosis	200	182 (91.0)	18 (9.0)	9 (4.5)	10 (13.5)
Obstetric, n (%)					
PE/HELLP, n (%)	373	351 (94.1)	22 (5.9)	10 (2.7)	10 (13.5)
Recurrent pregnancy loss, n (%)	227	211 (93.0)	16 (7.0)	5 (2.2)	7 (9.5)
Diagnostic workup/follow-up of autoimmune disease, n (%)	719	629 (87.5)	90 (12.5)	39 (5.4)	25 (33.8)
Other, n (%)	218	197 (90.4)	21 (9.6)	10 (4.6)	5 (6.8)
Unknown, n (%)	140	133 (95.0)	7 (5.0)	3 (2.1)	2 (2.7)
Combination, n (%)	6	5 (83.3)	1 (16.7)	1 (16.7)	1 (1.4)

aPL including LACs (APTT-lupus ratio and/or dRVVT ratio), aCL (IgG and IgM) and anti-β2GPIb (IgG and IgM). APS according to the Sapporo criteria [4].

TABLE 2 Demographic, clinical and laboratory characteristics of aPL-positive patients

Characteristics	First positive aPL (n = 212)	Second positive aPL (n = 93)	APS (n = 74)
Age, years, mean (S.D.)	39.6 (18.1)	41.3 (15.6)	40.0 (13.4)
Haemoglobin, mmol/l [g/dl], mean (S.D.)	7.8 (1.2) [13 (1.9)]	8.0 (1.1) [13 (1.8)]	8.1 (1.0) [13 (1.6)]
Platelet count (×10⁹/l), mean (S.D.)	269.6 (119.8)	236.3 (88.4)	252.1 (86.4)
Leucocyte count (×10⁹/l), mean (S.D.)	9.0 (6.3)	7.6 (4.6)	7.5 (2.7)
Sex, n (%)			
Male	53 (25.0)	18 (19.4)	14 (18.9)
Female	159 (75.0)	75 (80.6)	60 (81.1)
Speciality, n (%)			
Obstetrics	37 (17.5)	19 (20.4)	19 (25.7)
Internal medicine	145 (68.4)	61 (65.6)	45 (60.8)
Neurology	26 (12.3)	12 (12.9)	10 (13.5)
Other	3 (1.4)	0 (0.0)	0 (0.0)
Unknown	1 (0.5)	1 (1.1)	0 (0.0)
Antibody, n (%)			
No known antibodies	172 (81.1)	61 (65.6)	38 (51.4)
Antibodies known	39 (18.4)	31 (33.3)	36 (48.6)
Unknown	1 (0.5)	1 (1.1)	0 (0.0)
aPL, n (%)			
Single	55 (25.9)	24 (25.8)	19 (25.7)
Double	21 (9.9)	15 (16.1)	12 (16.2)
Triple	19 (9.0)	11 (11.8)	16 (21.6)
Incomplete	117 (55.2)	43 (46.2)	27 (36.5)
Anticoagulant therapy, n (%)			
PAI	18 (8.5)	10 (10.8)	10 (13.5)
VKA	23 (10.8)	16 (17.2)	16 (21.6)
Heparin	6 (2.8)	3 (3.2)	3 (4.1)
DOAC	6 (2.8)	1 (1.1)	1 (1.4)
Combination	5 (2.4)	2 (2.2)	2 (2.7)
None	154 (72.6)	61 (65.6)	42 (56.8)

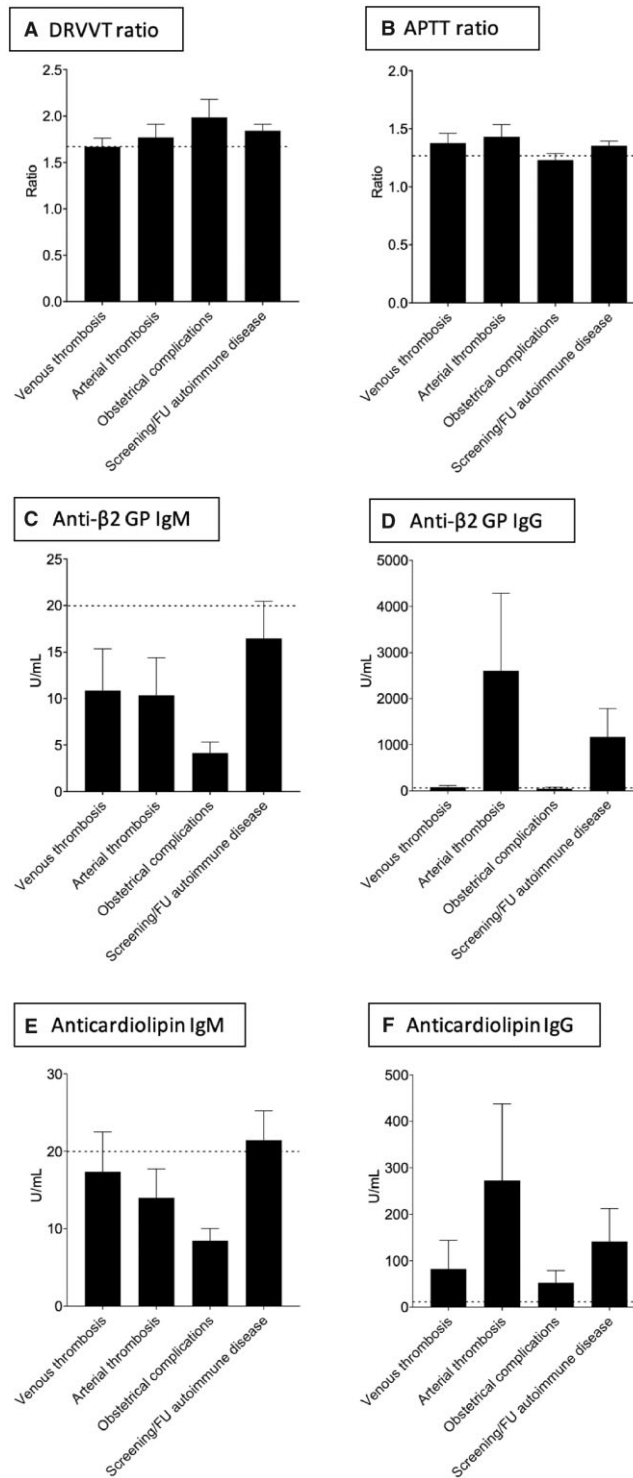aPL including LACs (APTT-lupus ratio and/or dRVVT ratio), aCL (IgG and IgM) and anti-β2GPIb antibodies (IgG and IgM). APS according to the Sapporo criteria [4]. PAI: platelet aggregation inhibitors; VKA: vitamin K antagonists; DOAC: direct oral anticoagulants.

Approximately half of the APS patients (51.4%) were newly diagnosed with APS at the time of the laboratory evaluation of aPL. The characteristics of patients with APS are shown in Table 2. Indications for aPL testing in patients with APS were venous thrombosis [14 (18.9%)], arterial thrombosis [10 (13.5%)], PE/HELLP [10 (13.5%)],

Fɪɢ. 2 Levels of positive aPL in aPL-positive patients and first positive aPL in APS patients
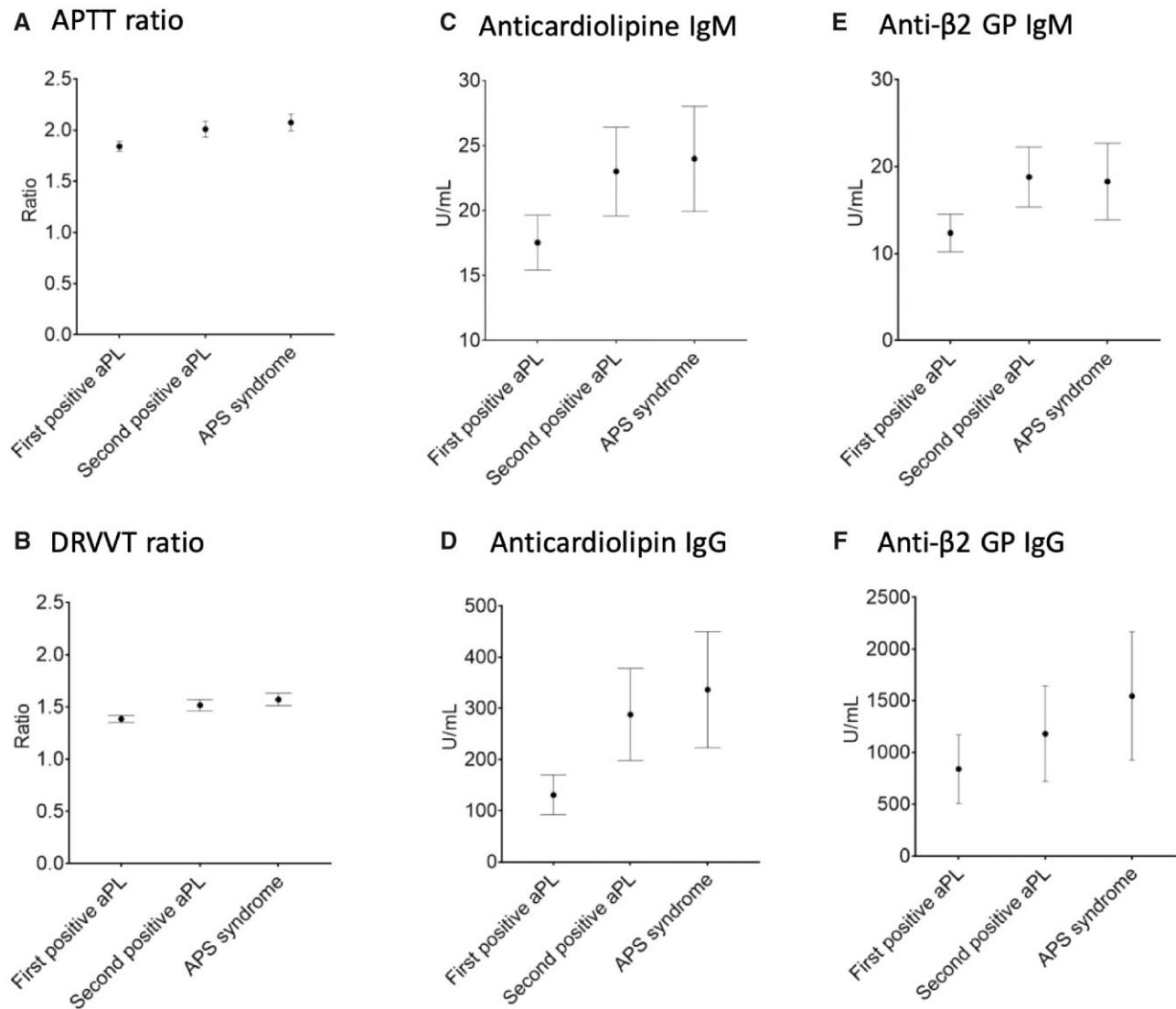
Mean and s.ᴇ.ᴍ. levels of aPL of the first and second measurement in aPL-positive patients and first measurement in APS patients. Patients with a second positive aPL test and patients with APS had significantly higher titres compared with patients with a first positive aPL test. aPL including LACs (APTT-lupus ratio and/or dRVVT ratio), aCL antibodies (IgG and IgM) and anti-β2GPIb antibodies (IgG and IgM). APS according to the Sapporo criteria [4].

recurrent pregnancy loss [7 (9.5%)], diagnostic workup/follow-up of autoimmune diseases [25 (33.8%), which included follow-up of APS], other [5 (6.8%)], unknown [2 (2.7%)] or a combination [1 (1.4%)] (Table 1). From the patients with a positive first aPL test, 27.4% were using anticoagulation therapy during testing, as were 43.2% of the APS patients (Table 2).

aPL panel characteristics

The mean levels of positive first and second aPL tests as well as positive first aPL levels of APS patients are shown in Fig. 2A–F. Positive aPL levels of the second measurement were significantly higher than positive first

aPL levels ($P < 0.05$). In addition, patients with APS had significantly higher positive first aPL levels compared with aPL-positive patients without APS ($P < 0.05$). Levels of the positive first aPL test results in all aPL-positive patients are shown for the different indications for aPL testing in Fig. 3A–F. The percentage of positive LACs tests were comparable for the different indications. Interestingly, patients with arterial thrombosis as an indication for aPL testing had significantly higher levels of aCL IgG and anti-β2GPI IgG compared with patients with other indications for aPL testing (Fig. 3D and F). Moreover, patients with an indication diagnostic workup or follow-up of autoimmune diseases also had significantly higher levels of aCL IgG and anti-β2GPI IgG

FIG. 3 Mean aPL levels and different indications for aPL testing

Mean and s.e.m. levels of the positive first aPL test in all aPL-positive patients for the different indications of aPL testing. Patients with arterial thrombosis and diagnostic workup/follow-up of suspected autoimmune diseases as an indication for testing had significantly higher levels of aCL IgG and anti-β2GPI IgG compared with patients with other indications for aPL testing. Dashed lines are normal values. aPL including LACs (APTT-lupus ratio and/or dRVVT ratio), aCL (IgG and IgM) and anti-β2GPIb antibodies (IgG and IgM).

TABLE 3 Indication and aPL positivity

Indication, n (%)	Single aPL (n = 55)	Double aPL (n = 21)	Triple aPL (n = 19)
Venous thrombosis	9 (16.4)	3 (14.3)	2 (10.5)
Arterial thrombosis	4(7.3)	3 (14.3)	3 (15.8)
PE/HELLP	11 (20.0)	3 (14.3)	0 (0)
Recurrent pregnancy loss	8 (14.5)	0 (0)	1 (5.3)
Diagnostic workup/follow-up of autoimmune disease	12 (21.8)	12 (57.1)	9 (47.4)
Other	8 (14.5)	0 (0)	3 (15.8)
Combination	1 (1.8)	0 (0)	0 (0)
Unknown	2 (3.6)	0 (0)	1 (5.3)

aPL including LACs (APTT-lupus ratio and/or dRVVT ratio), aCL (IgG and IgM) and anti-β2GPIb (IgG and IgM). PE: pre-eclampsia; HELLP: haemolysis-elevated liver enzymes-low platelets.

compared with patients with other indications for testing ($P < 0.05$; Fig. 3D and F). Of all patients with one or more positive aPL test result at the first measurement, 55.2% were not tested on the complete aPL panel (i.e. no measurement of LACs with dRVVT and APPT-lupus and/or aCL and/or anti-β2GPI). Of the patients tested on the complete aPL panel at the first measurement, 57.9% were single positive, 22.1% double positive and 20.0% triple positive (Table 2). Data regarding the complete aPL panel in the confirmation round were lacking in 46.2% of patients. Of the patients who were tested on the complete aPL panel at the second measurement, 48.0% were single positive, 30.0% double positive and 22.0% triple positive. Indications and aPL positivity are shown in Table 3. Although the number was small, single positivity was most often seen in patients with a thrombotic or obstetric indication for testing, whereas double and triple positivity were mostly seen in patients tested because of diagnostic workup or follow-up of autoimmune disease.

Discussion

LACs and aPLs are frequently determined in routine daily clinical practice. We showed in a large cohort of patients who had a clinical indication for aPL testing, a prevalence of aPL positivity of 9.9%, which was confirmed in 43.9% of the patients, and 3.5% of the patients were diagnosed with APS. The most common indications for aPL testing were thrombosis, obstetric complications and diagnostic workup or follow-up of autoimmune diseases (83% of indications). In addition, second positive aPL titres were significantly higher compared with positive aPL titres at the first measurement.

The prevalence of aPL in healthy individuals ranges from 1 to 5% and increases with age [7, 21]. In our well-described cohort of patients with a clinical indication for aPL testing, prevalence was more than two times higher compared with healthy individuals. This could be partly explained by the higher pretest probability of a positive test result attributed to the clinical indication for aPL testing. There is wide variation in aPL testing due to the large number of available tests and the lack of a gold standard, which hampers the comparison of clinical studies [3]. In our study, measurement of the complete aPL panel (defined as LACs measured with either dRVVT or APTT-lupus and measurement of aCL IgG/IgM and anti-β2GPI IgG/IgM) at the first measurement was available in 44.8% of the patients and in 53.8% of the patients at the second aPL measurement. Although our results are higher than the 11% in a systematic review by Andreoli et al. [22], it still reinforces the problem with aPL testing in routine clinical practice and the necessity for improvement. In our study, follow-up of autoimmune diseases was the most common indication for aPL testing and often only LACs are measured during clinical follow-up instead of the complete aPL panel. In addition, incomplete aPL testing could also be partly attributed to high INR ($n = 4$). Incomplete aPL testing could possibly lead to underrecognition and underdiagnosis of APS. Moreover, the lack of complete data may have led to an underestimation of the prevalence of aPL. To improve aPL testing, the International Society for Thrombosis and Hemostasis has proposed guidance for aPL testing to standardize these tests [23].

Most published data on aPL-positive patients include either patients with persistent positive aPL or patients diagnosed with APS [14, 22], which represents 4.3% of our study population. In our study, ∼81% of all patients tested positive on one or more aPL test at the first measurement and 66% of patients with a confirmed positive aPL were newly diagnosed with aPL positivity. We showed that diagnostic workup/follow-up of an autoimmune disease was the major indication for aPL testing in routine clinical practice. In addition, the frequency of confirmed aPL positivity in patients with thrombosis and obstetric complications as an indication for aPL screening was 5.5% and 2.5%, respectively. Moreover, positive aPL antibody levels of the second measurement were significantly higher compared with positive first aPL levels, which may indicate that patients with persistent positive aPL have higher levels of aPL compared with patients with only transient elevated aPL levels.

In our study, of the aPL-positive patients in whom a complete aPL panel was performed at the first measurement, 57.9% were single, 22.1% were double and 20.0% were triple positive. Single positivity was mostly seen in

patients with a thrombotic or obstetric indication for testing, whereas double and triple positivity were most often seen in the patients tested because of diagnostic workup or follow-up of an autoimmune disease. Interestingly, patients with arterial thrombosis as an indication for testing and diagnostic workup/follow-up of an autoimmune disease had significantly higher levels of aCL IgG and anti-β2GPI IgG compared with patients with other indications. This is in line with a recent systematic review, which found more significant correlations with thrombotic complications for the IgG isotype aPL than for the IgM isotype [24]. In addition, a recently published multicentre study on the diagnostic and clinical value of anti-β2GPI and aCL IgM antibodies found that IgM positivity was associated with pregnancy morbidity, but was not independently associated with arterial or venous thrombosis [25]. We found that only 2.7% and 2.2% of patients tested for aPL because of screening/follow-up of PE or HELLP syndrome or recurrent pregnancy loss, respectively, had a confirmed positive test for one or more aPL within the study period. Several studies reported a higher frequency of confirmed aPL positivity (median 10% in patients with recurrent pregnancy loss and 7% in patients with PE) [22]. However, the number of included patients in these studies was low.

The estimated incidence and prevalence of APS determined in a population-based study was 2.1 per 100 000 population per year and 50 per 100 000 population, respectively [26]. In our study 3.5% of the tested patients were diagnosed with APS, of whom more than half were newly diagnosed. The 5 year cumulative incidence of APS diagnosis in patients referred to the hospital with a suspicion of APS (e.g. patients with either thrombosis or obstetric complications and at least one positive aPL) was 16.4%, of whom 51.4% fulfilled the updated Sapporo classification criteria for APS [4, 27]. In addition, the prevalence of APS in a community-based cohort of patients 18–50 years of age with a first unprovoked venous thromboembolism was 9.0% [28]. Several studies have shown various non-criteria manifestations of aPL positivity, e.g. thrombocytopenia, renal microangiopathy, heart valve disease and livedo reticularis, which could explain the lower prevalence of APS found in our study [3, 6]. In addition, missing data on aPL may also have led to an underestimation of the prevalence of APS, since in some patients aPLs were measured only once during the study period.

A limitation of our study is the retrospective study design. The previously described small number of complete aPL panel tests may have led to an underestimation of aPL prevalence. As the diagnosis of APS is defined by two positive measurements with >12 weeks in between, we may have missed the first measurement of the first included patients and the second measurement of the last included patients due to the fixed time period of our study. In addition, to correct for the anticoagulant effects of VKA, diagnostic tests were mixed with normal pooled plasma. However, this method could result in both false-negative and false-positive LA results [29, 30]. Similarly, LACs testing during the acute phase after a thrombotic event should be interpreted with caution because of possible false-negative and false-positive LA results [19, 20, 31]. However, often not only LACs, but also testing of other aPLs (aCL and anti-β2GPI) was performed, which are unaffected by anticoagulation [29]. Also, confirmation aPL tests were not performed during the acute phase after an event.

Conclusion

In conclusion, we found a prevalence of one or more positive aPL test of 9.9% and APS was diagnosed in 3.5% of the patients, of whom half were newly diagnosed. Patients with arterial thrombosis had significantly higher anti-β2GPI IgG and aCL IgG levels compared with patients with other indications, which should be confirmed in future studies. Further improvement and awareness in aPL testing in routine clinical practice are necessary.

Data availability statement

The data underlying this article will be shared on reasonable request to the corresponding author.

Supplementary data

Supplementary data are available at *Rheumatology Advances in Practice* online.

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