Supplementary data

Table S1: Patient characteristics

	Healthy (n=15)	**SLE (n=36)**	**P value**
Age	33 (21-60)	40 (20-63)	0.34
Male/female	2/13 (87% female)	6/30 (83% female)	1.0
Ethnicity (self-identified)			**0.0011**
African-American	1 (7%)	17 (47%)	
Hispanic	1 (7%)	11 (31%)	
Caucasian	7 (47%)	4 (11%)	
Asian	4 (27%)	3 (8%)	
Other	2 (13%)	1 (3%)	

Characteristics of SLE patients and healthy subjects. Age is shown as median and range in brackets. Male/female and ethnicity is shown as number of subjects and frequency in brackets. P values are obtained from Mann Whitney U test (age), Fisher's exact test (male/female) and Chi-square test (ethnicity).

Table S2: SLE patient characteristics by cluster

	No PC expansion "Cluster 0" (n=14)	PC expansion (n=22)		P value "Cluster 0 vs PC expansion"	P value "Cluster 1 vs 2"
		"Cluster 1" (n=8)	"Cluster 2" (n=14)		
Age (years)	40 (21-60)	38 (20-48)	40 (23-63)	0.75	0.34
Male/female	1/13 (93% female)	3/5 (63% female)	1/13 (93% female)	0.63	0.12
Ethnicity (self-identified)					
African-American	4 (29%)	5 (63%)	8 (57%)		
Hispanic	6 (43%)	2 (25%)	3 (21%)	0.33	0.48
Caucasian	2 (14%)	0 (0%)	2 (14%)		
Asian	2 (14%)	0 (0%)	1 (7%)		
Other	0 (0%)	1 (13%)	0 (0%)		
Disease duration (yrs)	7.5 (1-36)	7.5 (1-23)	10.5 (4-29)	0.57	0.25
Age at diagnosis (yrs)	25 (7-51)	22.5 (16-41)	29 (17-56)	0.71	0.58
SLEDAI-2K scores	3 (0-16)	5 (0-30)	2 (0-14)	0.87	0.23
Clinical symptoms (any)	5 (36%)	6 (75%)	7 (50%)	0.31	0.25
Mucocutaneous	3 (21%)	5 (63%)	4 (29%)		
Arthritis	2 (14%)	1 (13%)	2 (14%)		
Renal	4 (29%)	2 (25%)	2 (14%)		
Other	0 (0%)	3 (38%)	2 (14%)		
Previous renal disease	10 (71%)[1] Class III, IV, V	3 (38%) Class III, IV/V	6 (43%) Class IV, V	0.097	1.0
Current medications					
PDN	8 (57%)	7 (88%)	4 (29%)	0.74	**0.021**
HCQ	10 (71%)	7 (88%)	11 (79%)	0.68	0.60
Immunosuppressants[2]	9 (64%)	6 (75%)	4 (29%)	0.32	0.076
Anti-dsDNA IgG					
IU/mL	68.5 (<12-623)	93 (<12 - >1000)	50 (<12-574)	0.91	0.42
% positive	10 (71%)	6 (75%)	9 (69%)	1.0	1.0
C3 (mg/dL)	96.5 (49-188)	111 (44-142)	101.5 (70-176)	0.87	0.97
C4 (mg/dL)	21 (4-48)	15 (9-31)	20 (14-32)	0.47	0.12
% low C3/C4	3 (21%)	3 (38%)	1 (8%)	1.0	0.26
WBC					

x10e3/uL	5.3 (3.7-10.7)	3.7 (2.5-5.8)	4.3 (2.4-6.7)	**0.022**	0.37
% low (<3)	0 (0%)	1 (13%)	2 (14%)	0.27	1.0
Lymphocytes					
x10e3/uL	1.5 (0.7-3.2)	0.9 (0.5-1.7)	1.4 (0.7-2.7)	0.36	0.10
% low (<1)	5 (38%)	4 (50%)	3 (21%)	1.0	0.34

Characteristics of SLE patients by their clustering. The characteristics shown here are obtained during their initial assessment. Patients who were assessed twice are shown in more detail in Table S4. All parameters are shown as the median and range or frequency within the patient group. Medication is shown as the frequency of the patient group that uses the indicated drug and the range of daily doses. None of the patients had used cytoxan or rituximab in the preceding 12 months.

[1] One of these patients had a history of proteinuria without classification through biopsy.

[2] These immunosuppressants include MMF, Azathioprine and Methotrexate.

No data was available on levels of anti-dsDNA in 1 patient, levels of C3 and C4 in 2 patients, and WBC and lymphocytes in 1 patient.

Statistical testing was done using Mann Whitney U test test for linear parameters, chi-square test for for categorical parameters with more than 2 categories and Fisher's exact test for categorical parameters with 2 categories.

MMF: Mycophenolate mofetil, PDN: Prednisone, HCQ: Hydroxychloroquine, WBC: white blood cell count.

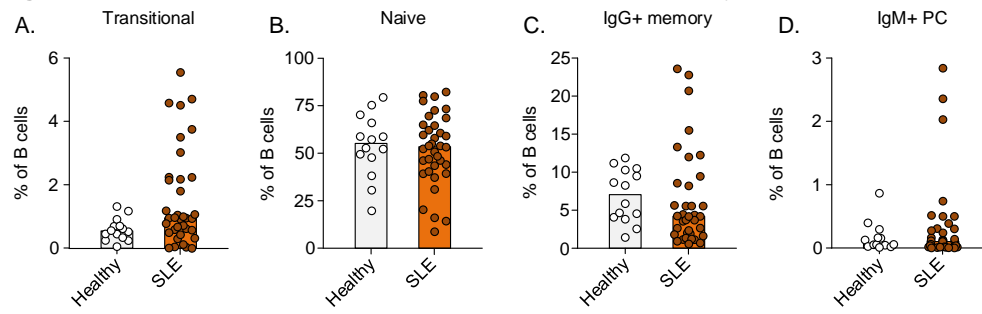**Table S3**: Clinical characteristics for patients assessed at multiple timepoints

	Time between measurements	SLEDAI-2K	Clinical activity	Medication
No PC expansion				
SLE 25	1 mo	16 → 6	Renal, Arthritis, Mucocutaneous → Renal	MMF 3 → 3 g PDN 10 → 40 mg HCQ 400 →400 mg
SLE 26	2 mo	0 → 0	None → none	PDN 2 → 2g HCQ 400 → 400 mg
Cluster 1				
SLE 05	1 yr	4 → 14	Mucocutaneous (no flare) → Mucocutaneous, Vasculitis (flare)	MMF 2 → 2 g PDN 0 → 20 mg HCQ 400 → 400 mg
SLE 07	2 mo	0 → 4	None (no flare) → Mucocutaneous (flare)	MMF 3 → 3 g PDN 5 → 5 mg HCQ 400 → 400 mg
SLE 11	2 mo	0 → 0	None → None	MMF 1 → 1 g PDN 5 → 4 mg HCQ 400 → 400 mg
SLE 19	2 mo	9 → 5	Mucocutaneous, Hematological (flare) → Hematological (no flare)	PDN 10 → 20 mg HCQ 400 → 400 mg
SLE 32	1 yr	19 → 14	Renal, Mucocutaneous, Fever (flare) → Renal, Mucocutaneous (no flare)	MMF 3 → 0 g PDN 10 → 50 mg HCQ 400 → 0 g None → Cytoxan 500 mg/2wks
Cluster 2				
SLE 01	1 yr	14 → 7	Renal, Mucocutaneous → Renal, Hematological	PDN 0 → 2.5 mg HCQ 400 → 400 mg[1]
SLE 03	1 yr → 3 mo	2 → 2 → 2	None → None → None	PDN 5 → 10 → 10 mg
SLE 09	1 yr	2 → 2	None → None	PDN 0 → 5 mg HCQ 400 → 200 mg
SLE 20	1 yr	1 → 1	Hematological → Hematological	HCQ 400 → 400 mg

| SLE 23 | 2 mo | 2 → 2 | None → None | MMF 1.5 → 1.5 g
HCQ 400 → 400 mg |
| SLE 27 | 1 yr | 8 → 8 | Arthritis, Mucocutaneous →
Arthritis, Mucocutaneous | None → None |

Clinical characteristics of SLE patients that were assessed at multiple timepoints. The classification for SLE 19 and SLE 23 changed over time, the other patients showed a stable phenotype.
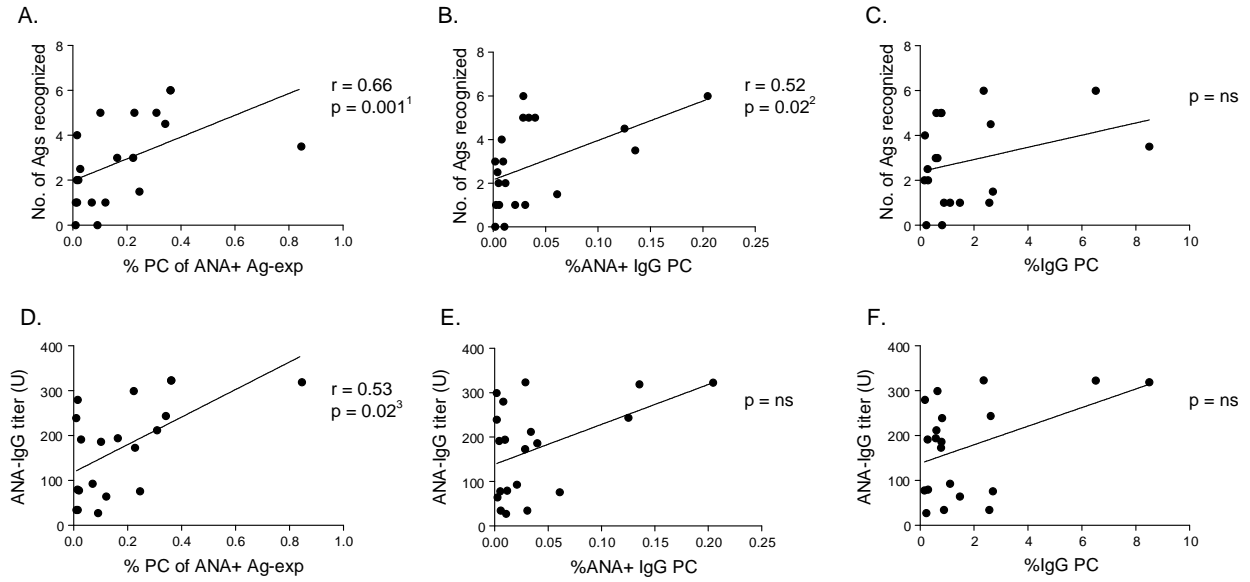
[1] This patient received Cytoxan in between the two assessments, ending ~9 months prior to the second assessment.

MMF: Mycophenolate mofetil, PDN: Prednisone, HCQ: Hydroxychloroquine.

Figure S1: Frequencies of B cell subsets in SLE patients and healthy controls.

A-D) Frequencies of total B cell subsets in healthy controls (n=15) and SLE patients (n=36). Each dot indicates an individual, and the bars represent the median. No significant differences were found using Mann-Whitney test.

Figure S2: Correlation of serum autoantibodies with flow cytometry data.

Correlation of the relative proportion of PCs among ANA+ antigen-experienced cells (A,D), % ANA+ IgG PC (B,E), or % total IgG PC (C,F) with number of nuclear antigens recognized by serum IgG (A-C) or total ANA-IgG titer in serum (D-F). Each dot indicates an individual, and the line represents the linear correlation. P values and r shown were obtained using Spearman's rank correlation.

[1,3]The correlation remained significant after removing the outlier.

[2]The correlation was no longer significant after removing the outlier.