

Off-label use of rituximab for systemic lupus erythematosus in Europe

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ABSTRACT

Objectives: Rituximab (RTX) is a biological treatment used off-label in patients with systemic lupus erythematosus (SLE). This survey aimed to investigate the off-label use of RTX in Europe and compare the characteristics of patients receiving RTX with those receiving conventional therapy.

Methods: Data on patients with SLE receiving RTX were taken from the International Registry for Biologics in SLE retrospective registry and complemented with data on patients with SLE treated with conventional therapy. For nationwide estimates of RTX use in patients with SLE, investigators were asked to provide data through case report forms (CRFs). Countries for which no data were submitted through CRFs, published literature and/or personal communication were used, and for European countries where no data were available, estimates were made on the assumption of similarities with neighbouring countries.

Results: The estimated off-label use of RTX in Europe was 0.5%–1.5% of all patients with SLE. In comparison with patients with SLE on conventional therapy, patients treated with RTX had longer disease duration, higher disease activity and were more often treated with immunosuppressives. The most frequent organ manifestations for which either RTX or conventional therapy was initiated were lupus nephritis followed by musculoskeletal and haematological. The reason for treatment was, besides disease control, corticosteroid-sparing for patients treated with conventional therapy.

Conclusions: RTX use for SLE in Europe is restrictive and appears to be used as a last resort in patients for whom other reasonable options have been exhausted.

INTRODUCTION

Systemic lupus erythematosus (SLE) is an inflammatory autoimmune disease with a

wide spectrum of clinical manifestations. This diversity is a reflection of the dysregulation of several components of the immune system, resulting in B-cell hyperactivity and production of autoantibodies.¹

Most therapies for SLE are off-label. Thus, conventional immunosuppressants (IS) such as azathioprine, methotrexate and mycophenolate mofetil are widely used, but are not approved for this disease. Not even the ‘gold standard’ treatment for severe lupus and lupus nephritis (LN), cyclophosphamide (CYX), has been approved by either the Food and Drug Administration (FDA) or European Medicines Agency (EMA), although in some countries the indications may be listed in the prescribing information. In addition, these therapies can be associated with severe adverse effects, and few patients reach durable full remission.²

The development of biological therapies has dramatically changed the treatment for inflammatory autoimmune diseases such as rheumatoid arthritis (RA), Crohn’s disease, psoriasis and multiple sclerosis. Therefore, biological therapies may offer new ways of treating SLE. As a consequence, experimental use of biologics targeting B-cell activity has escalated during the past decade, in particular rituximab (RTX) (MabThera, Rituxan) and belimumab (Benlysta).

Belimumab is a B-cell directed anticytokine agent, leading to downregulation of B-cell activity and hence lower levels of Ig, including autoantibodies. Positive results with belimumab led to approval for treatment of SLE by both EMA and FDA.^{3 4}



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RTX is an antibody directed to CD20, a B-cell surface marker, which has been shown to be effective in depleting B cells in vivo and is approved for treatment of B-cell malignancies and for autoimmune diseases such as RA⁵ and ANCA-associated vasculitis.^{6,7} Over the past several years, off-label use of RTX in SLE has emerged as one of the biological therapies used in clinically challenging cases. Two controlled trials with RTX performed in the USA failed to meet their primary endpoints when RTX was added to conventional therapy as compared with the addition of placebo to the same.^{8,9} The patients in the trials had active SLE but were not required to have failed prior conventional therapy. However, in the renal lupus trial, many exploratory endpoints at 78 weeks were met, both serological and clinical. Multiple, mostly uncontrolled observational, studies have suggested that RTX provides significant benefits when given to patients with severe or refractory SLE, sometimes in conjunction with CYX.^{10–20} Thus, as RTX is not approved for treatment of SLE, these reports raised the question of how widely RTX is used in SLE and for what specific indications.

The use of registries, where data are collected systematically on well-characterised patient populations treated with specific agents, is an important source of information about real-life efficacy and safety. The European registries, ARTIS (Sweden),²¹ BSRBR (UK),²² DAN-BIO (Denmark)²³ and GRAID (Germany),²⁴ just to name a few, have contributed to the knowledge of both positive and negative aspects of studied agents in the treatment of rheumatic diseases. Therefore, we have initiated the International Registry for Biologics In SLE (IRBIS), in which data are collected retrospectively and prospectively on patients with lupus treated with biologics. The IRBIS registry was approved by the Systemic Lupus International Collaborating Clinics (SLICC) group in 2009.

The objective of this study was to investigate the extent of off-label use of RTX in SLE in Europe, and for what specific indications. It is a compilation of data from the European dataset in IRBIS, published material and data provided by participating investigators.

METHODS

Data collection

We used data submitted by the European contributors to the IRBIS registry on RTX-treated patients (demographic, disease-specific and treatment). Contributors were asked to provide additional information on the number of patients with SLE at their centres, on patients with SLE within their region and estimates for the whole country in specific case report forms (CRFs). As a control, data were also collected on patients who were started on conventional IS therapy not including corticosteroids and antimalarials. Any patient on RTX or conventional treatment from 2010 to 2013 was allowed for inclusion.

Data from the CRFs were complemented with published data and by personal communication with

participating investigators. Twenty-nine centres from 12 countries participated (table 1).

The hierarchy of data was: (1) data from the participating investigators' registries; (2) data from CRFs; (3) data from published studies; (4) data provided through direct contact with participating physicians.

For countries not represented in the IRBIS collaboration, and where therefore no data were available, estimates were made on the assumption of similarities with neighbouring countries.

Patients

All patients fulfilled the revised and/or updated American College of Rheumatology (ACR) criteria. Ethical approval for the study was obtained in countries where this was required and all patients gave their oral and/or written consent.

The anonymity of participating patients was maintained in accordance with Good Clinical Practice (GCP) guidelines. For data collection and management purposes, patients were identified by a patient number only. Documents identifying the patient were not submitted to the registry centre.

Statistics

For the descriptive data, means and SDs were calculated. For comparisons between groups, unpaired t-test or Mann-Whitney U test was used for normally distributed and non-parametric data, respectively, using SPSS (no 21).

RESULTS

Estimates of number of patients with SLE and the use of RTX in Europe

Contributing centres and patient referrals

We inquired which patient subsets were seen at the participating centres and how these patients were referred

Table 1 Countries and centres that provided information for this study

| Country | Sites/ country | Site/region represented |
|-----------------|-------------------|--|
| Belgium | 1 | Belgium |
| Denmark | 1 | Copenhagen |
| France | 1 | Paris |
| Germany | 1 | Central Germany |
| Greece | 1 | Crete |
| Hungary | 1 | Southeast Hungary |
| Italy | 4 | Tuscany (2), Veneto, Lazio |
| Spain | 13 | Bizkaia, Andalucia (2), Madrid, Catalonia (3), Balearic Islands, Asturias, Jaen, Valencia, Zaragoza, Granada |
| Sweden | 2 | Stockholm, Lund |
| The Netherlands | 2 | Leiden, Amsterdam |
| Turkey | 1 | Istanbul |
| UK | 1 | London |

to the site. For most centres (17 out of 29), patients with SLE were seen from a well-defined region, or from the whole country, and referred to them by the primary physician.

Participating investigators were asked to provide information on the number of centres within their own region where patients with SLE were likely to be treated with RTX. Centres within the same region and with similar treatment strategies ranged from 1 to 20; only five centres responded that they were the sole centre where patients with SLE were treated with RTX in their region.

Patients with SLE at each participating centre

Most of the rheumatology (SLE) specialty centres represented in this study had 200–300 patients with SLE, of whom generally <5% were treated with RTX, with some notable exceptions (table 2). It can be seen that there was a wide range in the proportion of patients treated with conventional therapies, and data provided from Spain and Italy, where there are several sites, showed clear regional variation.

Estimates of patients with SLE and RTX use in 31 European countries

To address the prevalence of SLE and the use of RTX in patients with SLE in Europe, participating centres were asked to provide data about the number of patients with SLE and the number of patients with SLE treated with RTX in their country. These data were complemented with the data from published medical journal articles and publicly available healthcare sources.

The prevalence of SLE in countries with contributing centres ranged from 1 to 13 per 10 000. For some of the

countries, the distribution of ethnical groups within the country's population may account for higher prevalence in some regions, since people with Afro-Caribbean and Asian origins have been shown to have a higher SLE prevalence than Caucasians.^{25–27} Based on these data, we calculated that 0.6%–1.6% of patients with SLE were treated with RTX (table 3).

To get an estimate for the prevalence of SLE and RTX use in countries under the jurisdiction of the EMA, the remaining EU countries and the EFTA countries, Iceland, Liechtenstein and Norway, were included. For these countries, no data or information through personal communication are available. Instead, estimates were made on the assumption of similarities with neighbouring countries (table 3).

With a population of around 573 million, we estimated that the incidence of patients with SLE is roughly between 156 000 and 269 000, giving an overall prevalence of 4.1–7.1/10 000, subject to significant nationwide and regional variabilities. Out of these patients, our analyses indicate that between 0.5% and 1.5% were treated with RTX at the time of data collection (table 3).

Analysis of RTX-treated patients

After estimation of the prevalence of SLE and RTX use in Europe, we wanted to investigate on what premises RTX is prescribed.

Demographics of patients with SLE

One hundred and three RTX-treated patients and 72 conventional IS-treated patients were included in this analysis, and their demographics are listed in table 4. The majority (93% and 91%, respectively) was Caucasian, and smaller proportions were Latino/South African, Asian/Indian, Southeast Asian, African-American, Afro-Caribbean or other (each ≤5%). Most patients were non-smokers. In both groups, most patients were female. Mean age was numerically higher in the RTX group.

SLE disease characteristics

Disease duration when RTX was initiated was 9.1 ±7.1 years, as compared with the significantly shorter duration for patients treated with conventional IS, 4.1 ±6.6 years (table 5).

The major organ manifestations leading to treatment for both groups were LN, musculoskeletal and haematological (table 5). Controlling the disease was significantly higher as the main reason for treatment in the RTX group, while steroid sparing (and disease control) was more prevalent in the control group (table 5).

Both SLE Disease Activity Index (SLEDAI) and SLICC-damage index (DI) were significantly higher at the start of treatment in the RTX group compared with conventional IS (table 5). SLEDAI was 12.2±7.1 vs 9.4 ±7.0 and SLICC-DI was 1.6±3.4 vs 0.6±1.0. SLEDAI was significantly higher in LN than in non-LN patients, for both treatment groups.

Table 2 Patients with SLE on different treatments at participating sites, sorted by country

| Country | Patients with SLE | Patients with SLE on RTX (%) | Patients with SLE on conventional immunosuppressive therapy (%) |
|-----------------|-------------------|------------------------------|---|
| Belgium* | 5000 | 1 | 30 |
| Denmark | 250 | 2 | 50 |
| France* | 22 500 | 1.6† | – |
| Germany | 325 | 4 | 92 |
| Greece | 500 | 3 | – |
| Hungary | 250 | 1 | 40 |
| Italy | 200–400 | 3–4 | 20–62 |
| Spain | 5–900 | 0–11 | 19–70 |
| Sweden | 250–350 | 4–20 | 40–65 |
| The Netherlands | 200–275 | 1–4 | 20–25 |
| Turkey | 600 | 4 | 42 |
| UK | 450 | 7 | 85 |

*Figures are representative for the whole country.

†Derived from the number of patients (160) in the nationwide Autoimmunity and Rituximab (AIR) registry, which represents about 50% of patients with SLE on RTX.

RTX, rituximab; SLE, systemic lupus erythematosus.

Table 3 Estimates of the overall number of patients with SLE, and patients on RTX, by country

| Country | Population | Patients with SLE * | SLE/ 10.000† | Patients with SLE on RTX‡ | Reference§ |
|---|-------------|---------------------|-----------------|------------------------------|-------------------------|
| Belgium | 10 839 905 | 5000 | 7.0 | 52 (1.0%) | PC |
| Denmark | 5 511 000 | 1000 | 2.7 | 10 (1.0%) | CRF ³⁵ |
| France | 61 538 322 | 22 500 | 5.5 | 360 (1.6%) | PC |
| Germany | 82 217 837 | 5000–30 000 | 0.9–5.5 | 150 (0.5%–3.0%) | CRF ³⁶ |
| Greece | 10 760 136 | 2800–7800 | 4–11 | 80–100 (1.0%–3.5%) | PC ^{37 38} |
| Hungary | 10 045 000 | 3000–4500 | 4.5–6.8 | 15 (0.3%–0.5%) | CRF |
| Italy | 58 133 509 | 5500–30 000 | 1.4–7.8 | 70–150 (0.2%–2.7%) | CRF, PC |
| Spain | 46 030 109 | 15 000–40 000 | 4.9–13.2 | 150–450 (0.4%–3.0%) | CRF ^{39 40} |
| Sweden | 9 471 174 | 3000–4000 | 4.8–6.4 | 80–135 (2%–4.5%) | CRF ⁴¹ |
| The Netherlands | 16 594 107 | 3000–4500 | 2.7–4.1 | 16–120 (0.4%–4.0%) | CRF |
| Turkey | 73 723 000 | 27 700–34 000 | 4.6–7.0 | 40 (0.1%) | CRF ⁴² |
| UK | 61 113 210 | 25 000 | 6.2 | 150–300 (0.6%–1.2%) | CRF ^{27 43 44} |
| Total | | 118 500–208 300 | | 1173–1882 (0.6%–1.6%) | |
| <i>Remaining EEA countries¶</i> | | | | | |
| Austria** | 8 400 000 | 500–3000 | 0.9–5.5 | 15 (0.5%–3%) | |
| Bulgaria†† | 7 504 868 | 2200–3400 | 4.5–6.8 | 11 (0.3%–0.5%) | |
| Cyprus‡‡ | 854 000 | 225–600 | 4–11 | 6–8 (1.0%–3.6%) | |
| Czech Republic†† | 10 327 000 | 3100–4600 | 4.5–6.8 | 15 (0.3%–0.5%) | |
| Estonia†† | 1 338 000 | 400–600 | 4.5–6.8 | 2 (0.3%–0.5%) | |
| Finland§§ | 5 399 090 | 1700–2300 | 4.8–6.4 | 46–77 (2.0%–4.5%) | |
| Iceland§§ | 320 000 | 100–135 | 4.8–6.4 | 3–5 (2.2%–3.7%) | |
| Ireland¶¶ | 4 459 300 | 1800 | 6 | 11–22 (0.6%–1.2%) | 45 |
| Latvia†† | 2 263 000 | 700–1000 | 4.5–6.8 | 3 (0.3%–0.4%) | |
| Liechtenstein** | 33 717 | 2–12 | 0.9–5.5 | 0 | |
| Lithuania†† | 3 338 700 | 1000–1500 | 4.5–6.8 | 5 (0.3%–0.5%) | |
| Luxembourg** | 465 000 | 30–150 | 1–5 | 1 (0.7%–3.3%) | |
| Malta‡‡ | 417 608 | 110–300 | 4–11 | 3–4 (1.0%–3.6%) | |
| Norway§§ | 4 920 300 | 1600–2100 | 4.8–6.2 | 42–70 (2.1%–4.5%) | |
| Poland†† | 38 038 000 | 11 300–17 100 | 4.5–6.8 | 57 (0.3%–0.5%) | |
| Portugal*** | 10 605 870 | 4100–9200 | 5.9–13.2 | 35–104 (0.4%–2.5%) | |
| Romania†† | 21 462 186 | 6400–9600 | 4.5–6.8 | 32 (0.3%–0.5%) | |
| Slovakia†† | 5 411 000 | 1600–2400 | 4.5–6.8 | 8 (0.3%–0.5%) | |
| Slovenia†† | 2 010 347 | 600–900 | 4.5–6.8 | 3 (0.3%–0.5%) | |
| Total for countries under EMA jurisdiction | 573 545 295 | 155 967–268 997 | 4.1–7.1 | 1471–2324 (0.5%–1.5%) | |

*Data obtained from CRFs or journal references.

†Prevalence of SLE was calculated from the information provided in the CRFs and calculated from the adult population (adults=66% of the total population) or journal references.

‡Figures obtained from the CRFs or journal references.

§Source of information is CRF, personal communication (PC) or journal reference.

¶Croatia is not included, as it was not a member of EU or EEA (European Economic Area) when data were collected.

**Assumed similar to Germany.

††Assumed similar to Hungary.

‡‡Assumed similar to Greece.

§§Assumed similar to Sweden.

¶¶Assumed similar to UK.

***Assumed similar to Spain.

CRF, case report forms; EMA, European Medicines Agency; RTX, rituximab; SLE, systemic lupus erythematosus.

Details of treatment in patients with SLE

Among the RTX-treated patients, data on previous treatments were available for 95 patients of whom 82 (86%) had previously received ISs and 13 had not. The previous ISs included CYX (46%), mycophenolate mofetil (40%), azathioprine (35%), methotrexate (12%) and other ISs (21%, mainly ciclosporin A and intravenous Ig) (table 6). Most patients (69%) had been treated with one or two different ISs prior to RTX, and 17% had been treated with three or more.

Previous treatments for the conventional IS-treated patients included azathioprine (28%), CYX (26%), mycophenolate mofetil (17%), methotrexate (10%) and other ISs (6%). Many patients in this group (49%) had not been previously treated with any ISs, and among those who had, the majority had one or two different ISs.

Two different dosing regimens for RTX were used: 375 mg/m²×4 (36%) and 1000 mg×2 (64%). Concomitant CYX was used in 40% of patients, most with LN (data not shown). At the time of RTX initiation,

Table 4 Demographics of patients with SLE

| | RTX | N | IS | N | p Value |
|----------------|--|-----|---|----|----------------|
| Gender | 91% Female | 103 | 89% Female | 72 | NS |
| Age, mean±SD | 36.5±12.0 | 101 | 33.7±11.6 | 72 | 0.124 |
| Smoking status | 69% Never 14% Past 17% Current | 72 | 74% Never 12% Past 14% Current | 72 | NS NS NS |
| Ethnicity | 93% Caucasian 5% African-American 1% Southeast Asian 1% Other | 103 | 91% Caucasian 3% Latino/South African 3% Asian/Indian subcontinent 1% Southeast Asian 1% Caribbean/Afro-Caribbean 1% Other | 72 | NS |

IS, immunosuppressive; NS, not significant; RTX, rituximab; SLE, systemic lupus erythematosus.

Table 5 SLE disease characteristics for patients with SLE treated with RTX and conventional IS

| | RTX | N | IS | N | p Value |
|---------------------------------|---------------------|----------|---------------------|----------|---------------------------------------|
| Disease duration years, mean±SD | 9.1±7.1 | 101 | 4.1±6.6 | 72 | <0.0001 |
| Organ manifestation (%) | | 103 | | 72 | |
| Renal (LN) | 58 | | 53 | | NS |
| Musculoskeletal | 11 | | 22 | | 0.038 |
| Haematological | 15 | | 11 | | NS |
| Skin | 6 | | 6 | | NS |
| CNS | 7 | | 3 | | NS |
| Other | 3 | | 5 | | NS |
| Reason for treatment (%) | | 103 | | 72 | |
| Controlling disease | 77 | | 44 | | <0.0001 |
| Steroid-sparing | 1 | | 14 | | <0.0001 |
| Both | 22 | | 42 | | 0.006 |
| Disease activity | | | | | |
| SLEDAI, mean±SD | 12.2±7.1 | 102 | 9.4±7.0 | 72 | 0.010 |
| SLICC-DI, mean±SD | 1.6±3.4 | 96 | 0.6±1.0 | 72 | 0.014 |
| SLEDAI, LN vs non-LN* | 14.6±6.2 vs 9.0±6.9 | 59 43 | 12.5±7.6 vs 5.9±4.3 | 38 34 | <0.0001 (within groups treatments) |

*SLEDAI between groups, treatments: LN, NS; non-LN $p=0.029$.

CNS, central nervous system; IS, immunosuppressive; LN, lupus nephritis; NS, not significant; RTX, rituximab; SLE, systemic lupus erythematosus; SLICC, Systemic Lupus International Collaborating Clinics.

concomitant glucocorticoids were used in 68% of the patients. For patients treated with conventional IS, concomitant glucocorticoids were used in 94% of the patients. The most commonly initiated IS was mycophenolate mofetil (45%), followed by azathioprine (24%), CYX (8%) and methotrexate (6%).

DISCUSSION

We have performed a large European survey to assess the off-label use of RTX for the treatment of SLE, specifically investigating the extent to which rheumatologists use RTX compared with conventional ISs to treat patients with SLE. We have also looked at the characteristics of RTX-treated patients compared with patients treated conventionally.

One should keep in mind that treatment duration for RTX is poorly defined, because the biological effect may

last from months to years.²⁸ For this survey, we collected data for RTX treatment during a given time, and may therefore have missed a small number of patients given the treatment before that time and still benefiting from its effects.

Our study indicates that RTX is used off-label in European countries in 0.5%–1.5% of all patients with SLE. Because this study was limited to rheumatology specialty centres, the true usage of RTX may be somewhat higher but likely to remain in the same single-digit percentage range, indicating that the use of RTX is restrictive. Significant heterogeneity in the off-label use of RTX was also observed. In some countries, off-label use is discouraged through regulatory or reimbursement mechanisms rendering use impossible in practical terms. In other European countries, off-label use can be both permitted and fully reimbursed when motivated by the clinical situation. Such is the case in Sweden, where this

Table 6 Previous conventional immunosuppressives

| Previous ISs | RTX | | IS | | p Value |
|-----------------------|-----|------|-----|------|---------|
| | (%) | N=95 | (%) | N=72 | |
| Cyclophosphamide | 46 | | 26 | | 0.009 |
| Mycophenolate mofetil | 40 | | 17 | | 0.001 |
| Azathioprine | 35 | | 28 | | NS |
| Methotrexate | 12 | | 10 | | NS |
| Other | 21 | | 6 | | 0.005 |
| No ISs | 14 | | 49 | | <0.0001 |

| Number of previous ISs | RTX | | IS | | p Value |
|------------------------|-----|------|----|------|---------|
| | % | N=95 | % | N=72 | |
| 0 | 14 | | 49 | | <0.0001 |
| 1–2 | 69 | | 41 | | <0.0001 |
| 3–5 | 17 | | 10 | | NS |

IS, immunosuppressive; NS, not significant; RTX, rituximab.

report originated and where the off-label use of RTX in SLE was the highest among the countries surveyed (table 3). However, this may change, in part because RTX is now recommended in both European League Against Rheumatism (EULAR) and ACR guidelines for refractory LN, and in part because less expensive biosimilars for RTX may become available.

A comparison between patients treated with RTX and those treated with conventional ISs was made to analyse similarities and differences between the two groups. Patients treated with RTX were on average somewhat older and had longer disease duration. The characteristics of patients treated with RTX in this study suggest a clear focus on patients with high disease activity (table 5). As measured by the SLEDAI, where 10 or greater is usually considered 'severe' disease, the average disease activity of the RTX-treated patients was 12.2 compared with 9.4 in the control group. For the RTX group, the average SLICC-DI was 1.6 compared with 0.6 for the control group. Longitudinal studies have demonstrated that even a single point on this damage scale associates with significantly lower quality of life, higher rates of flares and end-organ complications, as well as shorter life expectancy.^{29–31} Both findings support the hypothesis that RTX is chosen for patients with more severe lupus.

The organ systems for which RTX and the conventional agents were chosen did not differ as much as might have been expected. LN was present in about half the patients in each group (table 5). This is the organ manifestation by far the most studied and for which the evidence is most clear that aggressive immunosuppressive or immunomodulatory treatment can be beneficial. It has been shown for early LN to have a substantial corticoid sparing effect.³² Musculoskeletal manifestations were under-represented among patients treated with RTX compared with those treated with conventional ISs. This may be explained by the fact that one of the ISs used, methotrexate, is by far the most widely used anti-rheumatic agent for patients with inflammatory

arthritides. Therefore, rheumatologists may be more inclined to use this drug for patients with musculoskeletal lupus. Also, the use of RTX for musculoskeletal SLE was strongly discouraged by the negative results of the EXPLORER trial.³³ In contrast to musculoskeletal lupus, there was a small numerical over-representation of haematological manifestations (thrombocytopenia and/or haemolytic anaemia) in patients treated with RTX, which may be explained by the strong link between haematological lupus and autoantibodies and the impression that autoantibody-mediated lupus manifestations may be particularly susceptible for RTX treatment.

The proportion of patients with predominant mucocutaneous lupus was strikingly lower than that would be expected based on the prevalence of such manifestations in the overall SLE population, suggesting that neither immunosuppressive is perceived as effective for mucocutaneous lupus. Indeed, there is only limited evidence for their efficacy.

While RTX was typically identified by the clinician as a treatment to control disease activity, conventional ISs were used primarily for corticosteroid-sparing purposes, consistent with recent emphasis in lupus therapeutics on minimising corticosteroid exposure³⁴ (table 5). In this group, the start of conventional IS treatment was often accompanied by high glucocorticoid dosages. Although not specifically queried, we believe this reflects the clinician's concern that conventional ISs are slow-acting agents, requiring several months or more to achieve disease control. Highly active SLE must therefore initially be controlled through the addition of moderate-high glucocorticoid dosages ('bridging therapy').

Patients treated with RTX had a history of more use of conventional ISs than the control group. This supports the view that RTX is used after conventional therapeutic options have been exhausted (table 6).

This study was based on various sources of information, and the hierarchy of evidence was assigned in the following order: registry-based datasets, CRFs submitted by the participating investigators, published data from the literature and responses to specific queries. Each of these sources carries some limitations. Common to all is that data were collected, collated and analysed retrospectively.

The overall methodology is, in large part, 'sensible extrapolation'. Thus, most of the primary data reflect the situation in individual centres, regions, or, in some instances, countries. From these data, countrywide estimates of RTX use for SLE were derived, which—except for the few countries that provided countrywide data—entailed extrapolation. In order to make this as reliable as possible, additional support was taken from the literature and from direct contact with investigators. Estimates obtained for some of the EU countries were extrapolated to countries that were not represented in the datasets for this study. Countries used for this extrapolation were chosen based on cultural and geographical similarities. Finally, the results obtained may not be applicable

to all countries, as most patients in the study are Caucasian.

Another significant limitation was the focus on the rheumatology specialty. Because patients with more severe SLE are usually treated by rheumatology specialists, our initial approach seemed reasonable. Since RTX has been proposed in the literature as a potential alternative in the treatment of LN, and since LN can exist almost completely in isolation in the individual patient (ie, without other significant lupus manifestations), it is conceivable that some patients with LN are treated with RTX solely by nephrologists. Therefore, it may be more accurate to say that this study estimates the use of RTX for SLE within the rheumatology specialty. The possibility that other specialists (eg, dermatologists, neurologists, haematologists) would treat patients with SLE with RTX without the involvement of a rheumatologist is more remote.

In summary, this study on the off-label use of RTX in SLE has provided a number of insights into hitherto underexplored lupus therapeutics. The pattern of RTX use suggests that it is limited to specialised, tertiary care centres. The fact that currently only a relatively small proportion of patients are treated with RTX, and that these patients in general have been treated with multiple immunosuppressives previously, suggests that RTX is chosen only for patients for whom all reasonable conventional options have been exhausted. Moreover, RTX is used in patients with high disease activity and a significant burden of SLE-related damage. As such, the current usage of RTX in SLE may be considered conservative, representing an appropriately used medication of last resort for those with the highest medical need within the larger patient population with SLE.

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