

# Tocilizumab in treatment-naïve patients with Takayasu arteritis: TOCITAKA French prospective multicenter open-labelled trial

**Arsene Mekinian** (✉ [arsene.mekinian@aphp.fr](mailto:arsene.mekinian@aphp.fr))

Sorbonne Université Faculté de Médecine Campus Saint-Antoine

**David Saadoun**

Sorbonne Université Faculté de Médecine Campus Pitié-Salpêtrière

**Eric Vicaut**

Hôpital Lariboisière Centre Viggo Petersen

**Sarah Thietart**

Hôpital Saint-Antoine

**Bertrand Lioger**

Sri Sathya Sai University

**Patrick Jégo**

Rennes School of Business

**Alexandre Bleibtreu**

Sorbonne Université Faculté de Médecine Campus Pitié-Salpêtrière

**Nicolas Limal**

Hôpitaux Universitaires Henri Mondor

**Jerome Connault**

Université de Nantes Institut d'Administration des Entreprises de Nantes-Economie et Management

**Jacques-Eric Gottenberg**

Université de Strasbourg

**Pauline Lhorte**

Fourth Military Medical University

**Jean Bertola**

Hôpital Tenon

**Juliette Delforge**

Hôpital Tenon

**Ferreira-Maldent Nathalie**

Université de Tours Institut Universitaire de Technologie de Tours

**Antoinette Perlat**

Rennes School of Business

**Zohra Talib**

Groupe Hospitalier Saint-Louis Lariboisière et Fernand-Widal

**Mathieu Vautier**

tenon

**Lea Savey**

Hôpital Tenon

**Isabelle Quere**

Université de Montpellier

**Patrice Cacoub**

Sorbonne Université Faculté de Médecine Campus Pitié-Salpêtrière

**Olivier Fain**

Sorbonne Université Faculté de Médecine Campus Saint-Antoine

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## Research article

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# Abstract

## Objectives

To assess long term efficacy of tocilizumab in treatment-naïve patients with Takayasu arteritis (TAK).

## Methods

Prospective open-labelled trial in naïve patients with TAK who received steroids at the dose of 0.7 mg/kg/day and 7 infusions of 8 mg/kg/month of tocilizumab. The primary endpoint was the number of patients which discontinued steroids after 7 infusions of tocilizumab. Secondary endpoints included disease activity and the number of relapses during an 18-month follow-up.

## Results

Thirteen patients with TAK were included, with a median age of 32 years [19-45] and 12 (92%) females. Six (54%) patients met the primary end-point. A significant decrease of disease activity was observed after 6 months of tocilizumab therapy: decrease of median NIH scale (3 [3-4] at baseline, versus 1 [0-2] after 6 months;  $p < 0.001$ ), ITAS-2010 score (5 [2-7] versus 3 [0-8];  $p = 0.002$ ), and ITAS-A score (7 [4-10] versus 4 [1-15];  $p = 0.0001$ ). During the 12 months follow-up after tocilizumab discontinuation, a relapse occurred among 5 patients (45%) out of 11 in which achieved remission after 6 months of tocilizumab.

## Conclusion

Tocilizumab seems an effective steroid sparing therapy in TAK but maintenance therapy is necessary.

## Key Messages

What is already known about this subject?

- Tocilizumab is an effective sparing therapy for refractory and steroid dependent Takayasu arteritis

What does this study add?

- This is the first trial of biologics, in particular tocilizumab in treatment naïve Takayasu patients, with steroid discontinuation strategy after 6 months of combined therapy

How might this impact on clinical practice?

- Tocilizumab addition to steroids in treatment naïve Takayasu patient's is highly effective, but maintenance therapy is necessary.

## Introduction

Takayasu arteritis (TAK) is a chronic primary vasculitis that affects large vessels, particularly the aorta and its main branches<sup>1</sup>. Its main complications are consecutive to vascular inflammation, which could lead to arterial stenosis, aneurisms and thrombosis. The best therapeutic strategy in TAK remains to be determined. Indeed, steroids are the cornerstone of treatment for TAK, with only 40% of sustained remission (defined by a use of less than 10 mg/day of prednisone)<sup>2</sup>. Data on the benefit of biological-targeted therapies and Disease Modifying Anti-Rheumatic Drugs (DMARDs) is growing, with small case-series describing the use of steroid-sparing agents such as azathioprine, methotrexate or mycophenolate mofetil<sup>3 4 5</sup>. We recently reported a French multicenter study showing the benefit of biologic-targeted treatments in refractory TAK, with higher relapse-free and vascular event-free survivals comparatively with DMARDs<sup>6</sup>.

Increasing evidence suggests that interleukin-6 plays a role in the pathogenesis of TAK. Presence of vascular inflammatory infiltrates rich in T-cells producing interleukin-6 was found in aortic wall samples of patients with TAK<sup>7</sup>.

Rapid and sustained remission under tocilizumab therapy has been described, notably among patients with refractory TAK<sup>8-13</sup>. These findings should be interpreted with caution, as most studies were case-reports or small series, and vascular progression under tocilizumab treatment has also been described<sup>8-13</sup>. A recent randomized trial failed to demonstrate the benefit of tocilizumab, compared to placebo, on relapse-free survival among patients with refractory TAK<sup>14</sup>. Efficacy of biological-targeted therapies, such as TNF $\alpha$  antagonists and tocilizumab, was mainly reported in patients with refractory TAK. The effect of tocilizumab on patients with treatment-naïve TAK remains unclear.

In this multicenter, prospective, open-labelled trial, we aim to evaluate the benefit of adding tocilizumab to steroids in treatment-naïve patients with TAK, on discontinuation of steroids after 6 months of tocilizumab treatment, and to assess relapse-free survival following tocilizumab discontinuation.

## Patients And Methods

Patients were enrolled if they were aged of 18 years or older, with a diagnosis of TAK (according to the ACR criteria and/or Ishikawa criteria modified by Sharma) established between October 2014 and July 2017. All patients were treatment-naïve or free from any immunosuppressive therapy (DMARDs and biological-targeted therapies) for at least 4 months. If previously initiated, steroids must have been started within the month preceding inclusion.

The trial is registered on ClinicalTrials (NCT02101333), and could be find at <https://clinicaltrials.gov/ct2/show/NCT02101333?cond=takayasu&draw=2&rank=8>; registration date 02/04/2014, registration number **NCT02101333**. All patients gave written informed consent and also consent for publication. The trial conformed the ethical guidelines of the Declaration of Helsinki and was approved by the Institutional Review Boards of the Ethic committee of "Cochin Hospital University" (CPP Ile de France, Cochin Hospital, 02/02/2014)(N° ID-RCB 2017-AO3380-53).

## Study design

This prospective open-labelled trial was designed to evaluate the effect of tocilizumab to discontinue steroids after 6 months of tocilizumab therapy, among treatment-naïve patients with TAK. Induction therapy consisted of corticosteroids at a dose of 0.7 mg/kg/day and 7 infusions of tocilizumab at a dose of 8 mg/kg/month. Steroids were decreased using a predefined regimen schedule over the first 6 months of tocilizumab therapy (**Supplementary Table 1**).

## Assessment and definitions

The primary endpoint was the number of patients that achieved steroid discontinuation after 7 infusions of tocilizumab.

Secondary endpoints included disease activity, clinical, biological and radiological responses at 3, 6, 9, 12, 15 and 18 months, rates of sustained remission, number of relapses, time with sustained remission, cumulative steroid doses, frequency of ischemic vascular complications and interventions, and safety.

Clinical response was defined as the absence of new symptoms and/or disappearance of all previous symptoms. Biological response was defined as normalization of all acute-phase reactants, including erythrocyte sediment rate (ESR), C-reactive protein (CRP) and fibrinogen, or a minimum 50% decrease of at least 2 of these markers. Radiological response was defined as the absence of arterial progression at repeated imaging at 6 months after tocilizumab initiation as compared to baseline. Disease activity was defined using NIH and ITAS-2010 scales. Briefly, disease was considered as active if NIH score was of 2 or more, and inactive otherwise; sustained remission was defined as a NIH <2 with a prednisone dosage <10 mg/day. Disease activity was also subjectively evaluated as active, stable or remission, using practitioner's judgment, independently from NIH scale and other objective laboratory markers. Relapse was defined as the occurrence, among patients that achieved remission, of disease activity requiring a change in treatment regimen. Ischemic vascular events and/or the need for a vascular intervention were recorded during the 18 months follow-up.

Safety was assessed as the incidence and severity of adverse events (AEs), drug reactions and alterations of laboratory findings.

## Statistical analysis

Response rates were of 70% using tocilizumab in patients with refractory TAK. We hypothesized that remission would be achieved among 50% of patients after 6 months of tocilizumab therapy, with an estimated precision of  $\pm 25\%$ .

Data are presented as medians with ranges for continuous variables and frequencies with percentages for qualitative variables. Fisher's exact test was used to compare qualitative variables and the Wilcoxon rank test to compare continuous variables. All tests were two-sided and a p-value < 0.05 was considered as statistically significant. Statistical analyses were performed using R software (version 3.1.0).

## Results

### Patient characteristics

Thirteen patients with TAK were included, with a median age of 32 years [19-45], and 12 (92%) females. Patients' geographical origins included 7 (54%) Caucasians, 4 (31%) North-Africans and 2 (15%) of other origins. Baseline cardiovascular risk factors were arterial hypertension in 2 patients (15%), hyperlipidemia in 2 patients (15%), tobacco use in 3 patients (23%), with no type 2 diabetes nor cardiovascular heredity. Median body mass index was 25 kg/m<sup>2</sup> [20-32]. Two patients had an associated autoimmune disease, which were systemic lupus erythematosus and a Graves' disease. All patients were treatment-naïve; except for 4 patients which previously received DMARDs therapy (2 patients under azathioprine and 2 under methotrexate), but were free of DMARDs for at least 24 months and never received any other therapies, in particular biologics. These 4 patients not treated since more than 2 years have relapsing active TAK disease. Median time between diagnosis and inclusion was 8 months [0.7-185].

### Efficacy of tocilizumab at 6 months

Among 11 (85%) patients which achieved remission at 6 months, 6 (54%) have reached primary endpoint. Among the 5 remaining patients which continued steroids, 3 had a prednisone-equivalent dosage < 5mg/day. Eleven patients (85%) achieved sustained remission rates after 6 months, with a NIH <2 and prednisone doses <10 mg/day, and among them 9 patients (69%) had prednisone doses <7.5 mg/day. Patients undergoing steroid therapy significantly decreased between baseline (13 patients, 100%) and 6 months of tocilizumab therapy (6 patients, 54%,  $p = 0.015$ ), as shown in **Figure 1A**. NIH scales also significantly decreased between baseline and 6 months of tocilizumab therapy (3 [3-4] at baseline versus 1 [0-2] at 6 months;  $p < 0.001$ ), as well as ITAS-2010 (5 [2-7] versus 3 [0-8];  $p = 0.002$ ), and ITAS-A score (7 [4-10] versus 4 [1-15];  $p = 0.0001$ ). Baseline practitioners' subjective scale evaluated that 13 patients (100%) had active TAK, versus 2 patients (15%) after 6 months ( $p < 0.001$ ) (**Table 1**). Acute-phase reactants significantly decreased after 6 months of tocilizumab therapy (**Table 1**).

### Outcome after tocilizumab discontinuation from 6 to 18 months

All patients discontinued tocilizumab after 7 infusions, and no other immunosuppressive drugs was introduced, except for 1 patient which received methotrexate. After 9 and 12 months, respectively 7 (54%) and 6 (50%) patients achieved remission with less than 7.5 mg/day of prednisone, and 9 (69%) and

9 (75%) with doses <10 mg/day (**Table 1**). After 12 months of tocilizumab initiation, among patients who discontinued steroid-therapy, 2 (33%) had an active disease and 3 (50%) had biological activity, whereas none of the patients which continued steroid therapy had disease or biological activity (**Supplementary Table 2**).

Among the 11 patients which achieved 6-month remission, a relapse occurred within 12 months of tocilizumab discontinuation among 5 patients (45%): 3 during the first 3 months and 2 within 6 months after the last tocilizumab infusion (**Figure 1B**). During 18-month follow-up, 4 patients (36%) remained free from any treatment, 2 (18%) were treated with steroids alone with doses under 7.5 mg/day, all others were received tocilizumab or other therapies (**Table 1**).

Among the 2 patients which were non-responders after 6 months of tocilizumab therapy, 1 achieved remission after switching to infliximab and methotrexate, and the other achieved remission after switching to several others biological-targeted therapies. No significant vascular complications or interventions were noted during follow-up.

## Safety

Adverse effects were reported in 9 patients (69%) during the 6 months tocilizumab therapy: rhinopharyngitis and otitis (n = 3), viral gastroenteritis (n = 2), asymptomatic neutropenia (>500 /mm<sup>3</sup>), urinary tract infection, thoracic zona and acute pancreatitis (n = 1 for each). No severe AEs were considered related to study treatment and none required tocilizumab interruption or dose reduction. No deaths have occurred during the study period.

## Discussion

To our knowledge, this is the first prospective trial aiming to evaluate the benefit of a combination of biological-targeted therapy with steroids, to allow steroid discontinuation among treatment-naïve patients with TAK. The 2 key messages are: 1) tocilizumab combined to steroids in treatment-naïve patients with TAK is highly effective, with an 85% remission rate and 54% of steroid discontinuation after 6-months of therapy; 2) despite the high remission rates obtained using tocilizumab, relapse rates were of 45% after discontinuation. These findings should be considered with caution in the absence of randomized placebo-controlled group treated by steroids alone.

Previous studies on tocilizumab efficacy mainly reported data on patients with refractory TAK. The only randomized trial which compared 36 patients who received subcutaneous tocilizumab versus placebo, showed that time to remission was not significantly different, but relapse time was longer in the tocilizumab group<sup>14</sup>. Other retrospective studies have reported efficacy of tocilizumab, but once again mainly in patients with refractory TAK<sup>15-18</sup>. A recent literature review of 105 patients with TAK treated by tocilizumab reported overall clinical and radiological response rates of 85.7% and 65.2%, respectively<sup>16</sup>. We recently reported data from a French nationwide study describing the use of infliximab and tocilizumab, and similar risks of vascular complications were found<sup>6</sup>. Overall incidence of vascular complications reached more than 50% after 5 years of follow-up of patients with TAK treated with DMARDs<sup>19</sup>. However, no vascular events occurred in our study during follow-up. Here, we report for the first time data on tocilizumab for treating patients with treatment-naïve TAK, and we show a good remission rate, with 54% of steroid-free patients after 6 months. Considering treatment-naïve patients with TAK, the overall response rate using tocilizumab in addition to steroids in our study seemed higher than with steroids alone from previous literature data (85% versus 40-60%, respectively)<sup>1</sup>.

Relapse is a particularity challenging issue, and occurred among 45% of patients with TAK, despite high initial remission rates. After remission induced by tocilizumab, 36% remained treatment-free during 18-month follow up. Literature has mainly reported studies on steroid-dependent or refractory patients with TAK, which makes it difficult to evaluate relapse-free survival rates of treatment-naïve patients. Maintenance regimen therapies still need to be determined and well-designed prospective studies on patients with treatment-naïve TAK are necessary.

Safety of tocilizumab is well-established in several autoimmune conditions. In our study, adverse effects occurred in 69% of patients, but none were severe, nor have induced tocilizumab discontinuation, or therapy-related deaths<sup>16</sup>.

Our study has several limitations, such as the small number of included patients and the absence of a double-blinded placebo control group. Despite these limitations, this trial is the first to show that a high response rate can be achieved by adding tocilizumab to conventional steroids, and that 36% of patients with TAK will remain without treatment during at least 18 months.

## Conclusion

This multicenter study is the first trial to assess, in treatment-naïve patients with TAK, the value of adding tocilizumab to steroids. However, the high steroid-free remission rates after 6 months of tocilizumab therapy should be balanced by high relapse rates and should consider the absence of randomized placebo-controlled group. Further studies among treatment-naïve patients with TAK are necessary to determine the best maintenance therapy strategy.

## Table

**Table 1. Patients' characteristics at initiation of tocilizumab and during follow-up.**

	At initiation of tocilizumab N= 13	At 1 month N=13	At 2 months N=13	At 3 months N=13	At 4 months N=12	At 5 months N=13	At 6 months N= 13	At 9 months N=13	At 12 months N= 12	At 15 months N=10	At 18 months N= 11
<b>Vascular manifestations</b>	13 (100)	9 (69)	10 (100)	8 (62)	4 (33)	7 (54)	7 (54)	7 (54)	7 (58)	4 (40)	4 (36)
- Arm claudication	5 (38)	3 (23)	4 (30)	2 (15)	2 (15)	4 (30)	3 (23)	4 (30)	2 (17)	2 (20)	2 (18)
- Limb claudication	3 (23)	1 (8)	0	1 (8)	0	0	1 (8)	2 (15)	0	0	0
- Anisotension	7 (54)	7 (54)	8 (62)	4 (30)	3 (23)	5 (38)	4 (30)	4 (30)	5 (42)	3 (30)	3 (27)
- Carotidodynia	9 (69)	1 (8)	3 (23)	1 (8)	0	2 (15)	3 (23)	3 (23)	3 (23)	2 (20)	1 (9)
<b>Constitutional manifestations</b>	5 (38)	2 (15)	3 (23)	1 (8)	2 (17)	2 (15)	4 (33)	1 (8)	1 (8)	2 (20)	0
- Arthomyalgias	3 (23)	0	1 (8)	1 (8)	0	1 (8)	2 (15)	4 (31)	0	0	0
- Fever / asthenia	3 (23)	2 (15)	1 (8)	1 (8)	2 (15)	2 (15)	4 (31)	1 (8)	1 (8)	1 (8)	0
<b>Radiological activity</b>											
<b>NIH score</b>	3 [3-4]	-	-	1 [0-2]	-	-	1 [0-2]	1 [0-3]	1 [0-4]		1 [0-3]
<b>ITAS 2010 / ITAS-A</b>	5 [2-7] / 7 [4-10]	-	-	2 [0-5] / 2 [0-5]	-	-	3 [0-8] / 4 [1-15]	3 [0-8] / 4 [0-11]	2 [0-4] / 2.5 [0-34]		1 [0-7] / 3
<b>Subjective disease activity by practionner</b>	-	5 (38)	5 (38)	7 (54)	7 (54)	9 (69)	8 (62)	7 (54)	7 (58)	6 (60)	7 (64)
<b>-Remission</b>	13 (100)	0	0	1 (8)	0	2 (15)	2 (15)	3 (23)	2 (16)	4 (40)	4 (36)
<b>-Active</b>	-	7 (54)	7 (54)	5 (38)	6 (50)	2 (15)	2 (15)	3 (23)	3 (25)	0	0
<b>-Stable</b>											
<b>C-reactive protein (mg/L)</b>	16 [3-98]	1 [0-14]	1 [0-10]	0 [0-2]	1 [0-17]	1 [0-17]	1 [0-12]	4 [0-53]	3 [0-28]	10 [0-42]	14 [0-45]
<b>Fibrinogen (g/l)</b>	5 [2.8-8]	2 [1-5]	2 [2-6]	2 [0-4.5]	2 [1.5-5]	2 [1.5-5]	2 [1-3]	3 [2-7]	3 [1-5]	4 [2-7]	5 [2-6]
<b>Prednisone (n; %)</b>	13 (100)	13 (100)	13 (100)	13 (100)	12 (100)	13 (100)	7 (54)	7 (54)	6 (50)	7 (70)	7 (64)
<b>Prednisone (mg/day)</b>	45 [35-65]	25 [15-40]	20 [15-30]	10 [10-25]	7.5 [5-17.5]	5 [2.5-30]	5 [0-10]	3 [0-30]	2.5 [0-15]	3.5 [0-10]	3 [0-10]
<b>Immunosuppressive drugs</b>	0	0	0	0	0	0	0	MTX (n=2) /Ada (n=1) /Inf (n=1)	MTX (n=2) /Ada (n=1) /Toci (n=1)	MTX (n=2) /MTX+Ada (n=1) /MTX+Inf (n=1) /Toci (n=2)	MTX +Adi (n=2) /Uste (n=1) /MT (n=1) /Toc (n=2) /Aza
<b>NIH&lt;2</b>											
<b>+prednisone &lt;7.5 mg/day</b>	-	-	-	-	-	-	9 (69)	7 (54)	6 (50)	9 (90%)	4 (36)
<b>&lt;10 mg/day</b>							11 (85)	9 (69)	9 (75)	10 (100)	6 (55)

Values are presented as medians [ranges] and numbers (frequencies). Inf: infliximab; Toci: tocilizumab; Uste: ustekinumab; Ada: adalimumab; Aza: azathioprine; MTX: methotrexate.

\*p<0.0001 between baseline and all visits during the follow-up (Kruskall Wilis tests or Fisher test)

## Abbreviations

CRP - C-reactive protein

DMARDs - Disease Modifying Anti-Rheumatic Drugs

ESR - Erythrocyte Sediment Rate

ITAS – International Takayasu arteritis scale

MTX - Methotrexate

NIH - National Institutes of Health

TAK - Takayasu arteritis

## Declarations

### Ethics approval and consent to participate

All patients gave written informed consent and also consent for publication. The trial conformed the ethical guidelines of the Declaration of Helsinki and was approved by the Institutional Review Boards of the Ethic committee of "Cochin Hospital University" (CPP Ile de France, Cochin Hospital, 02/02/2014)(N° ID-RCB 2017-AO3380-53).

### Availability of data and materials

Not applicable

### Competing interests

None

### Funding

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### AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article. Arsène Mekinian had full access to all of the data in the study and is responsible for the integrity of the data and the accuracy of data analysis.

### Data sharing statement

Data are available to request 6 months after the indication studied has been approved and after primary publication acceptance, whichever is later. No expiration date of data requests is currently set once they are made available. Access is provided after a proposal has been approved by an independent review committee identified for this purpose and after receipt of a signed data sharing agreement. Data and documents, including the study protocol, statistical analysis plan, clinical study report, blank or annotated case report forms, will be provided in a secure data sharing environment for up to 2 years per proposal. For details on submitting a request, see the instructions provided at [www.clinicalstudydatarequest.com](http://www.clinicalstudydatarequest.com).

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## Figures

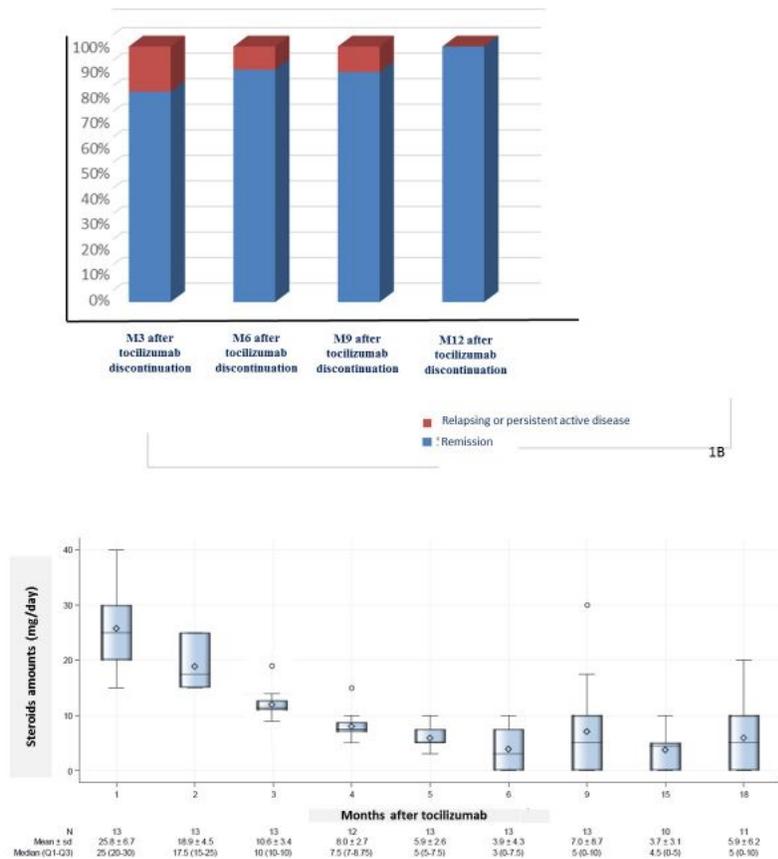


Figure 1

TOCITAKA trial data of steroids sparing effect and relapse rates after 6-month tocilizumab therapy. A: Steroids amounts during the 18 months follow-up in TOCITAKA trial; B: frequencies of relapse after 6-months tocilizumab induction therapy, represented as number of patients in remission and with relapsing-persistent TAK disease at Month3, 6, 9 and 12 after the tocilizumab discontinuation.

## Supplementary Files

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