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Successful rapid rituximab desensitization in an adolescent patient with nephrotic syndrome: Increase in number of Treg cells after desensitization

To the Editor:

Rituximab is a chimeric mAb against CD20 that induces a profound depletion of B cells in the peripheral blood of patients. The infusion of this mAb may cause transient pruritus, urticaria, angioedema, hypotension, hypoxia, and bronchospasm, which can occur within 30 to 120 minutes of infusion.[1] In 5% to 10% of the cases, the reactions are clinically consistent with immediate hypersensitivity (IHS).[2] Rapid desensitization, a procedure for graded drug administration, allows for the safe readministration of a medication after certain types of IHS reactions and is indicated in cases in which there are no reasonable therapeutic alternatives. Desensitization to rituximab has been described in adult patients with hematologic malignancies and certain connective tissue diseases.[3,4] Although the protocols have been remarkably successful, the molecular basis of desensitization has not been completely elucidated.

We report the case of a 16-year-old boy who has been followed by our nephrology department for steroid-resistant nephrotic syndrome (NS) for 4 years. The patient developed pruritic papular urticarial eruptions, angioedema, throat tightness, cough, nausea, vomiting, abdominal pain, and tachycardia at 90th minute of infusion of rituximab (MabThera 500 mg/50 mL; F. Hoffmann-La Roche Ltd, Basel, Switzerland) when 180 mg of the drug had been infused. The infusion was stopped immediately; the patient was treated with intravenous (IV) antihistamines (H1-blocker diphenhydramine and H2-blocker ranitidine) and IV methylprednisolone and observed for several hours. The patient had not been treated with other monoclonal therapeutics previously. The anaphylaxis-like reaction to rituximab occurred on the first exposure of the patient. Two days after the IHS reaction, the patient was re-treated with rituximab by using a desensitization protocol. Written informed consent was obtained from the parents. Prick test was performed with rituximab (10 mg/mL); intradermal tests were performed with 0.03 mL of 1:100 and 1:10 dilution of the mAb. The results of these tests were negative. Rituximab was administered by using a 12-step rapid desensitization protocol[4] with minor modifications. The desensitization procedure was performed thrice at 1-week intervals without any reactions. Lymphocyte studies were performed by using flow cytometry 24 hours after the IHS reaction and 24 hours after the first and the last desensitization procedures. Anti-human CD4 fluorescein isothiocyanate, anti-human CD25 phycoerythrin (BD Biosciences, San Jose, Calif; cat. no. 333170), and anti-human FoxP3 phycoerythrin (BD Biosciences, Pharmingen; cat. no. 560046) were used to identify T cells by flow cytometry. We demonstrated an increase in $CD4^+CD25^+$ and CD4CD25FoxP3 regulatory T (Treg) cells at the lymphocyte subset analysis of peripheral blood after compared with before desensitization. We also detected an increase in the number of monocytes after the first (6.3%) and the last desensitization (23.5%) procedures compared with the level (1.2%) before desensitization (Fig 1).

The first reported series of rapid desensitization for hypersensitivity reactions to rituximab was reported by Castells et al[3] as part of a larger series of desensitizations performed in patients following hypersensitivity reactions to chemotherapeutic agents. The article described the efficacy of a 3-solution, 12-step, rapid

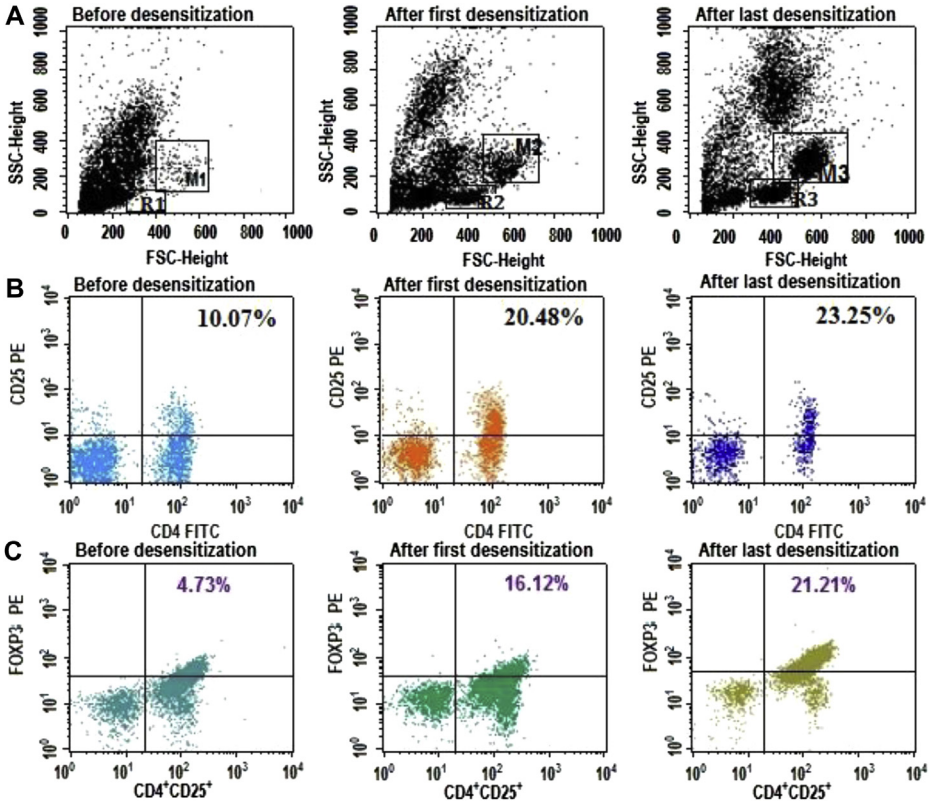

FIG 1. FACS plots show the quantitative change in $CD4^+CD25^+$ and CD4CD25FoxP3 Treg cells before desensitization, after first desensitization, and after last desentisization, respectively. **A,** Desensitization effect on the number of lymphocytes and monocytes detected by CFSE. R1, R2, and R3 refer to gated lymphocytes. M1, M2, and M3 refer to gated monocytes. **B,** An increase in $CD4^+CD25^+$ cells. **C,** An increase in CD4CD25FoxP3 cells. *CFSE*, Carboxyfluorescein diacetate, succinimidyl ester; *FACS*, fluorescence-activated cell sorting; *FSC*, forward scatter; *PE*, phycoerythrin; *SSC*, side scatter.

desensitization protocol for cancer patients who experienced hypersensitivity reactions to their first-line chemotherapy agent. Brennan et al[4] described a group of 14 additional patients who experienced hypersensitivity reactions to rituximab. As in our patient, 11 of 14 rituximab-sensitive patients developed a reaction on their first exposure and had no known prior exposure to any other mAb. The negative skin test results in our patient may not exclude an IgE antibody–mediated reaction. There are reports of initially skin test–negative patients becoming skin test–positive on treatment with mAbs.[3] Rapid desensitization may be used for both IgE-mediated and non–IgE-mediated IHS reactions.[3] We present the first report of successful IV desensitization to rituximab in an adolescent with steroid-resistant NS. Rapid desensitization is a promising method for the delivery of rituximab after IHS reactions to mAbs and should be considered in adolescent patients with NS who had IHS reactions with rituximab when there are no acceptable therapeutic alternatives.

Allergen-specific immunotherapy has been used for almost a century as a desensitization strategy by the repeated administration of increasing amounts of the causative allergen to induce a state of tolerance. The induction of peripheral T-cell tolerance through the generation of allergen-specific Treg cells represents an essential step in successful allergen-specific immunotherapy.[5] Numerous *in vitro* studies have now shown that a subset of human Treg cells has inhibitory properties.[6,7] We demonstrated an increase in $CD4^+CD25^+$ and CD4CD25FoxP3 Treg cells in our patient after desensitization.

We present the first report of successful IV desensitization to rituximab in an adolescent with NS. We demonstrated an increase in $CD4^+CD25^+$ and CD4CD25FoxP3 Treg cells by flow cytometry performed on peripheral blood lymphocyte obtained after desensitization. Treg cells may have a role in the mechanism of desensitization to rituximab.

The patient has been followed by the physicians of the Division of Pediatric Nephrology, Kocaeli University. We thank Prof Dr Gülfem Çelik for her contribution in desensitization.

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Are leukocytes in asthmatic patients aging faster? A study of telomere length and disease severity

To the Editor:

Asthma is a chronic inflammatory disease characterized by episodic and reversible airflow obstruction, airway hyperresponsiveness, and airway wall remodeling. It is common among older adults, and it is estimated that 4% to 13% of adults older than 65 years have asthma,[1] suggesting that aging could be a risk factor and contribute to the clinical outcome of asthma in the elderly.

The normal aging process involves cellular senescence, a state of permanent growth arrest that limits tissue renewal. Cellular senescence can be characterized as either replicative senescence or stress-induced premature senescence and involves the shortening of telomeres.[2] Telomeres are terminal regions of chromosomes containing repeats of TTAGGG that protect DNA from damage.[3] When telomeres critically shorten, cells become susceptible to senescence or apoptosis, indicating that telomere length is a feature of cellular aging. Telomerase plays an important role in telomere maintenance, cell proliferation, and immortality by preventing the shortening of telomeres.[4] Telomerase contains 2 main subunits: a telomerase RNA component (TERC) and the catalytic subunit of telomerase reverse transcriptase (TERT). TERT is a core functional component of telomerase activity, and the potential roles of TERT expression and/or activity in disease pathogenesis have become a focus of active investigation in cancer, aging, and metabolic and cardiovascular diseases.[4]

Studies investigating telomere length in respiratory diseases have demonstrated correlations between telomere shortening and disease outcome. Patients with chronic obstructive pulmonary disease (COPD) have shorter telomeres in circulating leukocytes than do age-matched healthy control subjects.[5] Other studies reported a significant relationship between telomere length and airflow obstruction in patients with COPD[6] and as a risk factor for idiopathic pulmonary fibrosis.[7] While these studies suggest that analysis of telomere length is a predictor of disease progression in COPD and idiopathic pulmonary fibrosis, telomere length and telomerase expression in asthma remain unexplored. We hypothesized that cellular senescence is a marker for disease outcome in asthma and is related to asthma severity. Our aim was to investigate whether differences exist in telomere length and telomerase expression between asthmatic adults and healthy control subjects.

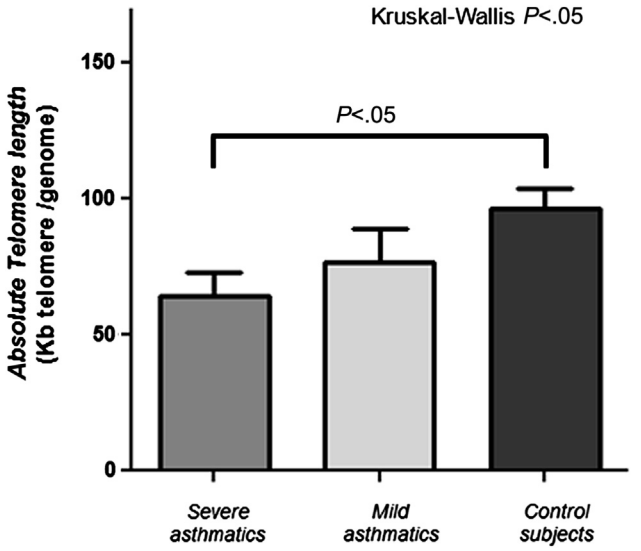

FIG 1. Comparison of absolute telomere length of peripheral blood between patients with severe asthma (n = 8), patients with mild asthma (n = 6), and control subjects (n = 15) ($P < .05$, Kruskal-Wallis; $P < .05$, patients with severe asthma vs control subjects). Kruskal-Wallis test and Dunn *post hoc* test were used for across-group comparison and between-group comparison, respectively. Results are expressed as mean ± SE.

We studied 15 healthy and 14 asthmatic adults aged 25 to 60 years who were nonsmokers. Asthmatic adults consisted of 6 with mild and 8 with severe asthma. For comparison, we also studied 7 patients with COPD aged 58 to 77 years. All patients with COPD were classified as Global Initiative for Chronic Obstructive Lung Disease (GOLD) II according to the current GOLD criteria (GOLD 2011). The mean age of study subjects was as follows: adults with severe asthma, 52.63 ± 2.12 years; adults with mild asthma, 40.83 ± 4.42 years; control subjects, 37.80 ± 2.07 years; patients with COPD, 68.14 ± 3.08 years. We used blood and bronchial biopsy tissues stored at the Tissue Bank of the Respiratory Health Network of the Fonds de la Recherche en Santé du Québec. A hospital research ethics committee approved the study protocol, and written consent was obtained from all subjects. To evaluate telomere length, genomic DNA of peripheral leukocytes was isolated from peripheral blood by using the FlexiGene DNA kit (Qiagen, Toronto, Ontario, Canada). Absolute telomere length was measured by determining the number of TTAGGG hexamer repeats by using quantitative real-time polymerase chain reaction.[8] We performed immunohistochemistry on paraffin-embedded bronchial biopsies to evaluate the localization and expression of human TERT (hTERT) protein by using a rabbit polyclonal antibody to hTERT (Santa Cruz Biotechnology, Paso Robles, Calif; sc-7212).

Telomere length measurements in peripheral blood cells can provide information about the replicative history of cells and the clinical value of telomere length assessment in asthmatic patients. This appears to be reflected in patients with severe asthma whose peripheral blood cells had significantly shorter telomeres than those of control subjects ($P < .05$, multiple comparison test after Kruskal-Wallis) (Fig 1). The mean telomere length (kb telomere/genome) was 64.3 ± 8.9 in patients with severe asthma, 76.4 ± 12.4 in patients with mild asthma, 77.9 ± 10.2 in patients with COPD, versus 96.3 ± 7.5 in control subjects. Telomere