# Complete resolution of alopecia totalis following chemotherapy treatment for B-cell acute lymphoblastic leukemia

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**Abstract**

Alopecia totalis (AT) is a chronic disease that results in non-scarring hair loss of the entire scalp. This results from an autoimmune reaction involving the hair follicles due to genetic and environmental factors. The clinical course of AT is highly unpredictable. There are limited effective durable treatment options. Resolution of alopecia has been reported post-autologous and allogenic hematopoietic stem cell transplantation (HSCT). However, no cases of AT remission following chemotherapy alone have been described. Here, we present a case of complete remission of AT following chemotherapy for B-cell acute lymphoblastic leukemia (B-ALL) in a pediatric patient.

## INTRODUCTION

Alopecia areata is a chronic condition characterized by non-cicatricial hair loss. Alopecia totalis (AT) is a subtype involving total scalp hair loss. The pathophysiology of alopecia areata is not completely understood[1] but is thought to result from a T-cell mediated inflammatory attack of the hair follicle unit secondary to collapse of the hair follicles' immune privilege.[2,3]Genetic predisposition and environmental factors may also contribute to this autoimmune process.[3]

Hair loss can result in significant impairment of quality of life in young people, affecting well-being, social functioning and mental health.[4] Pediatric patients with alopecia areata have higher rates of depressive and anxious symptoms and experience a higher prevalence of bullying.[5,6] Unfortunately, therapeutic options that result in durable remission of alopecia are limited.[7]

Therapeutic modalities used include topical, intralesional and systemic corticosteroids, as well as topical and systemic immunotherapy. In some cases, patients with alopecia areata have achieved short-term remission while receiving immunosuppressive therapy for other comorbid conditions and these have been reported in the literature.[8]Resolution of alopecia universalis, a subtype of alopecia areata with total body hair loss, has been described in patients receiving hematopoietic stem cell transplant (HSCT).[9,10]However, this carries significant risks. There have been no reported cases of complete sustained resolution of AT following standard-dose chemotherapy.

Here, we describe complete and sustained resolution of AT in a pediatric patient who was treated with chemotherapy for B-cell acute lymphoblastic leukemia (B-ALL).

## CASE DESCRIPTION

An otherwise well, developmentally normal, 3-year-4-month-old female with a history of AT, presented with fever, abdominal pain, anorexia, weakness, weight loss and nocturnal sweating. She underwent a bone marrow biopsy and aspirate and was diagnosed with B-ALL. Her past medical history was significant for severe alopecia areata involving 80% of her scalp which began at 11 months of age. This was treated with intermittent topical fluocononide 0.05% ointment, intermittent topical clobetasol 0.05% ointment, 2%

minoxidil solution and topical diphenylcyclopropenone (DPCP) 0.01%. The family elected to stop topical therapy after 19 months due to a limited clinical response. The alopecia progressed to involve the entire scalp with sparing of the eyebrows, eyelashes and body hair.

The patient's B-ALL was treated with chemotherapy as per the Children's Oncology Group (COG) protocol AALL 0932 (average risk arm) as a registered study patient. She achieved full morphologic and minimal residual disease (MRD) remission at the end of induction, which included intrathecal cytarabine and methotrexate, intravenous vincristine and PEG-asparaginase and oral dexamethasone. Thereafter, she received the consolidation, interim maintenance I and II, and delayed intensification cycles of chemotherapy. Theses cycles included oral 6-mercaptopurine, intrathecal and intravenous methotrexate, intravenous vincristine, oral 6-thioguanine, oral dexamethasone, intravenous cytarabine, intravenous cyclophosphamide, intravenous doxorubicin, and intravenous PEG-asparaginase. She was subsequently randomized to Arm-C of the protocol, which included daily oral 6-mercaptopurine, weekly oral methotrexate, and intrathecal methotrexate, intravenous vincristine and a 5-day oral dexamethasone pulse given every 12 weeks.

Chemotherapy was well tolerated and there were no unexpected toxicities. Treatment was completed in July 2013.

Prior to initiation of chemotherapy, the patient had hair loss involving the entire scalp and had not undergone treatment for her AT for 6 months. Two months after the start of maintenance chemotherapy, her hair began to re-grow with complete remission and no recurrence of the AT despite chemotherapy completion for more than 6 years. Aside from keratosis pilaris on her arms and one episode of molluscum contagiosum, she has not had any new dermatologic concerns and remains in remission from AT and B-ALL.

## DISCUSSION

Here we report a case of complete resolution of AT following chemotherapy. The response of this patient's AT to chemotherapeutic agents supports the theory that autoimmune dysfunction is a driver of the pathogenesis of alopecia areata. The resolution and sustained remission in this case suggests that the intensive immunosuppression from chemotherapy may have played a role in resetting her immune system. While it is also possible that this patient's hair regrew as part of the natural history of alopecia areata, most patients with AT remain stable or worsen with time.[11] This patient has no evidence of relapse of AT 6 years following chemotherapy completion. The prolonged remission along with the timing of hair regrowth during chemotherapy treatment suggests the possibility of a durable cure of AT with chemotherapy.

Prior to this case, there were two reported cases of sustained resolution of alopecia universalis following hematopoietic stem cell transplant (HSCT) for systemic malignancy. Seifert et al[9] described complete resolution of alopecia universalis in a 40 year-old male patient following allogenic HSCT for chronic myeloid leukemia. Subsequently, Feher et al[10]reported a similar case in a 48 year-old male patient with alopecia universalis who was treated with chemotherapy and autologous HSCT for follicular lymphoma. In both of these cases, the authors hypothesized that myeloablative conditioning and autologous HSCT with immune reconstitution resulted in remission of the autoimmunity and resolution of this patient's alopecia. In contrast, complete myeloablation and immune reconstitution was not part of this patient's leukemia treatment, although we postulate that the standard dose chemotherapy-induced immune suppression she received played a role in the resolution of her AT.

Chemotherapy given in the context of systemic malignancy has previously been reported to coincide with resolution of other autoimmune dermatologic diseases such as psoriasis[12] and hidradenitis suppurativa.[13] Systemic autoimmune conditions, such as systemic lupus erythematous[14] and rheumatoid arthritis[15], have also been in remission following chemotherapy for cancer treatment. While the risks inherent with chemotherapy usually outweighs the morbidity of AT, the sustained remission of the AT following chemotherapy helps shed some light into the pathogenesis of and potential future therapeutic targets for this cosmetically debilitating and enigmatic disease. It would be worth reviewing the clinical course of other oncology patients who have concomitant alopecia areata and their long-term response to chemotherapy.

We highlight a case of sustained resolution of AT following chemotherapy for B-ALL in a pediatric patient. This case highlights the role of autoimmunity in the pathogenesis of AT and demonstrates that a reset of the host immune system using chemotherapy may provide a durable cure for AT.

## CONFLICTS OF INTEREST

The authors have no conflicts of interest related to this article.

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