

CLINICAL REPORT

Mycosis Fungoides: A Retrospective Study of 44 Swedish Cases

Yvonne EKLUND¹, Annika ARONSSON¹, Artur SCHMIDTCHEN¹ and Thomas RELANDER²

¹Section of Dermatology and Venereology, Department of Clinical Sciences, and ²Department of Oncology, Lund University, Skåne University Hospital, Lund, Sweden

Mycosis fungoides (MF) is a primary cutaneous T-cell lymphoma with slow disease progression. There is a lack of descriptive data from Sweden concerning patients with this diagnosis. This study extracted data on patients admitted to the dermatology department at Lund University Hospital, Sweden from 1996 to 2010. Forty-four patients with clinically and histopathologically verified MF were identified during the period, with a mean follow-up time of 5.6 years. Median age at initial diagnosis was 64 years. In several cases other skin diseases preceded MF onset, such as non-specific dermatitis (32%) and parapsoriasis (30%). The majority of patients (86%, $n=38$) had limited-stage (IA–IB) disease at the time of diagnosis. Overall response rate to psoralen plus ultraviolet A (PUVA) treatment was 81%. In adnexal MF, a trend to higher rate of progression to an advanced stage was observed when compared with non-adnexal disease (40% and 21%, respectively). Increased levels of soluble interleukin-2 (IL-2) receptor correlated with disease stage, being elevated in advanced stages or adnexal disease, but almost never elevated in early non-adnexal limited-stage disease. Overall mortality was 25%, but only 11% could be verified as caused by MF. Key words: mycosis fungoides; cutaneous T-cell lymphoma; sIL-2r.

Accepted Jan 14, 2016; Epub ahead of print Jan 18, 2016

Acta Derm Venereol 2016; 96: 669–663.

Yvonne Eklund, Section of Dermatology and Venereology, Skåne University Hospital, SE-221 85 Lund, Sweden. E-mail: yvonne.eklund@skane.se

Mycosis fungoides (MF) is a cutaneous T-cell lymphoma (CTCL) with a worldwide incidence of approximately 0.36–0.64/100,000 and a median age range at diagnosis of 55–58 years. Of all primary CTCL, MF comprises 44–62% (1–4). At present, MF is an incurable disease, and the most common treatments for achieving remission or avoidance of progression include psoralen plus ultraviolet A (PUVA), ultraviolet B (UVB), topical mustine (not available in Sweden), topical corticosteroids, photodynamic therapy (PDT), oral retinoids and chemotherapy in addition to radiotherapy. Newer agents include histone deacetylase inhibitors, such as vorinostat and romidepsin, and further denileukin diftitox, a recombinant fusion protein (5–8). Due to the indolent

disease course, there is a divergence between incidence and prevalence of MF. MF patients display a chronic disease, lasting from years to decades, and many patients die from age and intercurrent diseases unrelated to the lymphoma. Published registry data on lymphoma indicate that approximately 25% of patients with MF die of their disease (9). However, retrospective studies indicate less than 10% disease-specific mortality (4).

In MF, routine blood analyses are of limited value. Lactate dehydrogenase (LDH) is a non-specific marker of tumour burden associated with poor prognosis (9, 10). There is less data available on T-cell-specific soluble IL-2 receptor (sIL-2r), but it may serve as a potential marker for disease activity and prognosis in CTCL, similar to LDH (11). As sIL-2r has been routinely evaluated at our department, it enabled us to study this factor's relationship with MF and the severity of disease.

The aim of this retrospective study was to investigate the demographics, the dermatological diagnoses preceding MF, time from onset of symptoms until diagnosis of MF, choice of therapy, and the time to progress to a more advanced stage (stages II–IV) and the overall survival of the study population. A further aim was to determine whether sIL-2r could be used to evaluate the severity of the disease.

MATERIALS AND METHODS

From the patient record system at the Department of Dermatology, Lund, Sweden, we identified all patients who had been registered from January 1996 to December 2010 with an initial diagnosis of CTCL. Data collection was approved by the regional ethics committee (number 2013/212). Patient records with International Classification of Diseases 10th revision (ICD-10) diagnosis, starting with C84 (CTCL) and specifically C84.0 (MF), were examined. A total of 73 patients were registered as having CTCL and MF. Twenty-nine patients were excluded due to other histology, questionable clinical picture or having a CTCL-diagnosis other than MF. Since Sezary's syndrome (SS) is a diagnosis of its own, patients with SS ($n=5$) were also excluded from the study. A final total of 44 patients with clinically and histologically verified MF were included in the study.

Staging of the disease was made according to the European Organization of Research and Treatment of Cancer (EORTC), latest revision 2007 (12), using descriptions of the efflorescence (patch, plaque, tumour, erythroderma) and of the extent of the disease. This, together with patient photographs, yielded an estimate of the percentage of skin area engaged when registering according to the tumour-node-metastasis-blood (TNMB) classification and staging.

A histopathology re-assessment was included to ensure the correct diagnosis and was also analysed for identifying progression into tumour stage or large-cell transformation. Analysis of T-cell receptor clonality was performed from 2002 onwards using multiplex polymerase chain reaction (PCR) (13). Furthermore, results from magnetic resonance imaging (MRI) or computed tomography (CT) investigation for nodal/systemic spread were taken into account. In cases with nodal involvement, fine-needle aspiration cytology examination was performed, and considered in the initial staging as well as at progression. Assessment of treatment response was limited to phototherapy plus radiation and could only be described in terms of overall or no response. Systemic therapy could only be evaluated in general terms, such as clinical benefit, stable disease or disease progression. As part of the routine laboratory analyses, levels of sIL-2r were determined in blood samples from most patients at the time of diagnosis of CTCL.

The data was statistically handled in Excel 2013 as descriptive table charts (Microsoft) and in SPSS 17.0 for Windows as box-plots (SPSS, Chicago, IL, USA). Mann–Whitney test was used for comparing the sIL-2r patient groups. The significance limit was set to $p < 0.05$.

RESULTS

A total of 44 patients with clinically and histopathologically verified MF were identified. The histopathological pattern comprised immunohistochemically confirmed CD3⁺/CD4⁺ positive cells, with visual atypia and epidermotropism. True Pautrier's abscesses were seen in 32% ($n = 14$) of cases. Not uncommonly, despite cells and histology typical of MF, CD30⁺ cells and eosinophils were often present to a minor degree.

In all, 29 patients underwent analysis of T-cell receptor gene rearrangement with multiplex PCR and, of these, 28 were positive. Five patients had β -receptor clonality, 7 had γ -receptor clonality, 12 had both γ - and β - and δ -receptor gene rearrangement, and 4 had δ -receptor clonality with a combination of either γ - or β -receptor gene rearrangement.

The median age at diagnosis was 64 years, age range 30–85 years. The median time from onset of symptoms until established diagnosis was 4 years ($n = 39$, mean 7.6 years). The male to female ratio was 1.6:1.

Preceding MF, 14 patients were diagnosed with dermatitis (histopathologically classified as non-specific) and 13 with parapsoriasis. Of those with parapsoriasis, 10 patients were registered as large plaque variant, confirmed with biopsy, and the remaining 3 were not specified. The diagnosis of large plaque parapsoriasis was made based on the typical clinical presentation of irregular or oval scaly patches in combination with a histopathological pattern of superficial lymphoid dermal infiltrate, some degree of lymphocytes in epidermis but absence of atypical T cells. Two patients with MF had a history of lymphomatoid papulosis, and, in both cases, were clinically and histopathologically typical for the disease (Fig. 1).

At the time of diagnosis, 86% ($n = 38$) had limited stage of MF. Fifty percent were in stage IA and 36%

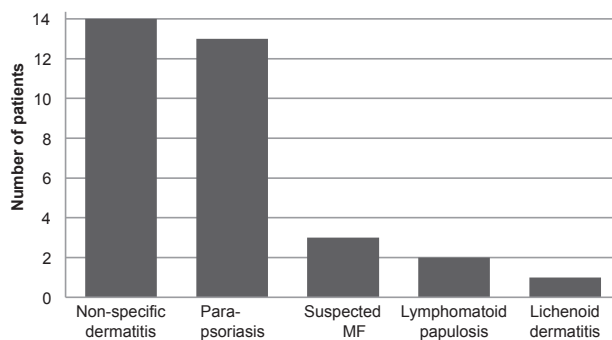


Fig. 1. Histopathologically verified diagnoses preceding mycosis fungoides (MF) in 33 patients ($n = 33/44$).

had stage IB with a cutaneous involvement of $> 10\%$. Among these patients with limited stage MF, 32% ($n = 12$) presented with patches and 68% ($n = 26$) with patches/plaque.

Fourteen percent ($n = 6$) had an advanced stage IIA–III. No patient had stage IV at initial diagnosis (Fig. 2).

Progression and survival

The mean follow-up time was 67 months (5.6 years). Disease progression from early stages of MF (IA–IB) to advanced stages with at least nodal involvement (II–IV) was seen in 25% including all subtypes of MF, with a median time to progression of 41 months (mean time 50 months). Among stage IB patients with cutaneous involvement of more than 10% of body surface, progression to advanced stage was more common than in stage IA patients; 44% vs. 18% (Fig. 2). Three patients progressed to stage IVB with lung and liver involvement ($n = 1$), meningeal infiltration ($n = 1$) and involvement of lymphoma in parotid gland ($n = 1$). The latter had parotid infiltration combined with positive cell clonality in enlarged lymph nodes and more than 50% atypical CD4⁺ cells in blood.

Overall mortality was 25% ($n = 11$) with an age range of 65–82 years, median age 75 years. In 5 patients, death was caused by lymphoma (11% of MF cohort), while in 6 patients the cause of death was of unclear aetiology or due to other diseases (Fig. S1¹).

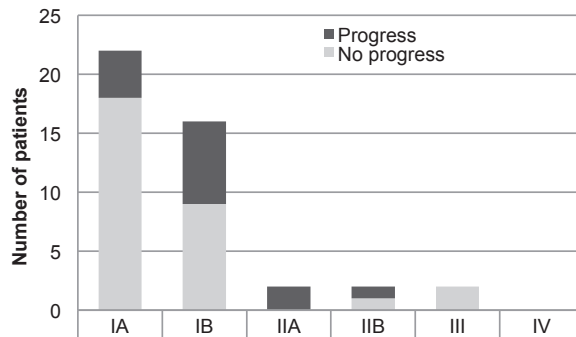


Fig. 2. Staging at initial diagnosis of mycosis fungoides and progression or not to more advanced stages during the study period.

Adnexal mycosis fungoides

Eleven patients had an adnexal subtype of MF: 8 patients had a folliculotropic subtype, 2 patients had a syringotropic variant and 1 had both folliculotropic and syringotropic lesions with a histological pattern of atypical CD4⁺ cells infiltrating the adnexal structure. This adnexal MF group ($n=11$) was compared with non-adnexal MF patients ($n=33$). The groups were not large enough to allow for any statistical comparisons; however, the following was noted: there was a higher male:female ratio of 2.7:1 ($n=8/3$). Those with adnexal MF stage IA–IB ($n=10$) had a higher likelihood of progression to advanced stages (4/10, 40%) than did patients with similar stages in the non-adnexal MF group (6/28, 21%). Three patients developed large-cell transformation, while in the group with non-adnexal MF, only one patient experienced large-cell transformation. The majority of those with adnexal disease had increased levels of sIL-2r at initial diagnosis; 67%, compared with 15% of non-adnexal MF patients. Almost half of the patients with adnexal MF died within the study period (45%, $n=5$) (Fig. S1¹).

Topical treatments

All patients were treated with topical corticosteroids, usually clobetasol 0.05% and an emollient, mostly in combination with phototherapy. Five patients received additional treatment with topical tacrolimus. One patient received adapalene for follicular changes in the face and chest area with almost complete remission of all lesions.

UV, PDT and radiation therapy

Twenty-six patients (59%) were treated with PUVA and 5 (11%) with narrowband UVB (nbUVB) as first-line therapy. PUVA was administered twice a week to a total of 24–30 times. The majority (85%, $n=22$) receiving PUVA therapy showed a response to treatment. UVB was given as narrowband UVB 3 times weekly with a similar number of treatments as PUVA. Patients treated with nbUVB had stage IA–IB, mainly with patches, and all responded to treatment.

Photodynamic treatment was used for localized recalcitrant plaques in 4 patients, with a response in all of them. Twelve patients received radiation therapy for either localized tumorous MF ($n=10$) or refractory plaques ($n=2$) with subtotal or total clearance. Two patients (stage IIA and IIB) were treated with total skin electron beam radiation (TSEB) with only a short period of remission and with considerable side-effects.

Systemic treatment and chemotherapy

In total, 41% ($n=18$) of the patients received systemic therapy and/or chemotherapy (Tables SI and SII¹). The most common systemic treatment comprised retinoids, such as acitretin, isotretinoin and bexarotene ($n=11$; 25%). The majority of the patients with retinoid treatment would eventually need chemotherapy (7/11). Only 2 patients received interferon alpha treatment and this was given in conjunction with PUVA.

Five patients were treated with acitretin combined with PUVA and all except one continued with systemic treatment of acitretin after phototherapy since they appeared to have a clinical benefit, keeping the disease in a steady state and, in risk-patients, to prevent development of squamous cell carcinoma after several treatment cycles of PUVA.

Six patients were treated with isotretinoin; this was given to patients with side-effects due to acitretin, or if they had adnexal involvement. Isotretinoin appeared to keep the disease stable in the majority of these patients for a mean of 12 months.

Bexarotene was given to 3 patients in dosages slightly below the target dosage of 300 mg/m² per day, resulting in stable disease in 1 of the patients.

Thirty-two percent of the MF patients ($n=14$) received one or more chemotherapeutic agent. Methotrexate was the most common first-line chemotherapy ($n=10/14$). Three patients did not respond at all, while stable disease was seen in 7 patients ($n=7/10$). Chlorambucil combined with tapering dosages of prednisolone or prednisone was administered to 4 MF patients. No treatment response was seen in any of these patients; however, 2 patients stopped treatment after only 3–4 weeks due to infections (Table SII¹).

Five patients received one or more of the following chemotherapeutic agents: CHOP standard regimen (cyclophosphamide, doxorubicin, vincristine, prednisone), gemcitabine and pegylated doxorubicin (Tables SI and SII¹). All of the patients had either lack of effect or showed signs of progressive disease during therapy or within 4 months of treatment. Finally, the monoclonal antibody alemtuzumab was given to 4 patients. One patient showed stable disease during therapy, but had an immediate relapse after cessation of treatment, while 3 patients had no response, possibly owing to shortened treatment due to adverse effects (infections).

Out of all 14 patients treated with chemotherapy, 7 died (disease-specific death $n=5$) and of the remaining surviving patients the majority ($n=5$) had disease progression by the end of the study period and were planned for subsequent systemic treatment.

sIL-2r analysis

Out of the 44 patients with MF, 28 were analysed for their serum levels of sIL-2r at initial diagnosis (6/28 had

¹<https://doi.org/10.2340/00015555-2337>

adnexal disease). Nine had an increased sIL-2r (>700 kU/l) and, of these, 4 had adnexal disease, 2 had erythroderma, 2 had lymphadenopathy and 1 had widespread plaque disease that advanced to tumorous stage within 6 months. Thus, all patients with increased sIL-2r value had either adnexal disease or advanced stage of MF (Fig. 3).

Out of the remaining 19 patients with normal sIL-2r levels, 16 (85%) had limited non-adnexal disease stage IA–IB. Only 3 patients with normal sIL-2r levels had advanced stage MF or adnexal disease: 2 patients with adnexal MF (IA–IB) (518–695 kU/l) and 1 patient with MF in tumorous stage (571 kU/l). Interestingly, these patients had no further disease progression during the study period.

DISCUSSION

The median age at initial diagnosis in this study was 64 years, which is higher than previously reported median ages in the range 54–59 years (1, 3, 14), probably reflecting the population-based catchment area of our academic centre, at which almost all patients with CTCL are admitted from other clinics. Coherent with earlier studies time from onset of symptoms to established diagnosis of MF was considerable (median 4 years). Similarities with international data were also seen in the case of sex proportions, with MF being more common in men (1.6:1) and especially in adnexal MF (2.7:1) (15, 16).

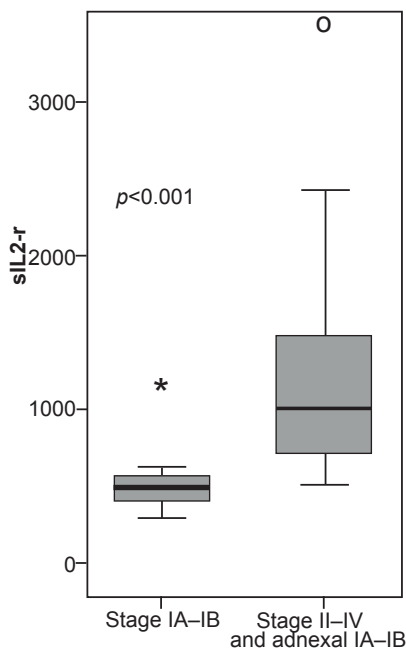


Fig. 3. Levels (kU/l) of soluble interleukin-2 receptor (sIL-2r) among patients with mycosis fungoides at initial diagnosis with limited disease stages (IA–IB) ($n=17/28$), (median=495, mean=511 kU/l $*=1,158$) vs patients with advanced stages (II–IV) and adnexal disease ($n=5+6/28$), (median=1,009, mean=1,313 kU/l $*=3,507$). There is a significant difference in levels of sIL-2r between the 2 groups; $p=0.001$.

The most common dermatological diagnoses preceding MF were non-specified dermatitis and parapsoriasis. It is possible that the dermatitis diagnosis was related to the existence of pre-MF, even though no atypical T cells were seen in the biopsies from the patients. However, chronic eczema cannot be ruled out, since some reports have suggested an association between chronic inflammation in the skin and subsequent development of CTCLs (17, 18). In cases of preceding parapsoriasis, it is plausible that these patients, both clinically and histopathologically, had this diagnosis *per se* and not an early variant of MF. It is known from other data that 7.5–35% of patients with parapsoriasis will be diagnosed with MF over time (19, 20). In many cases, the development of MF is preceded by other dermatoses without evident histopathological atypia. However, clonal T-cell receptor rearrangement might be detected before atypical lymphocytes can be identified by histopathology, at least in the case of parapsoriasis (21). This supports hypotheses on the pathogenesis of MF, that constantly activated T-lymphocytes might eventually give rise to an atypical T-cell clone (22). Some researchers have noticed a possible connection with microbial colonization/infection and MF (23–25). Interestingly, in at least 4 patients in our study, we observed a temporary clinical improvement in the current MF disease stage when bacterial infections were treated.

Lymphomatoid papulosis has been seen to proceed to MF in a few percent of the cases, and similar figures were found in our, albeit small, clinical cohort. Lymphomatoid papulosis has been described to proceed to MF in 4–25% of cases (26–28).

MF is considered an indolent disease and most studies show that patients with stage IA have a normal life expectancy (29). Even though the majority of patients in the study had MF confined to the skin at initial diagnosis, we noticed that 25% progressed to more advanced stages. Poor prognostic factors among MF stage IA–IB patients were widespread disease (IB) and adnexal disease. In agreement, reports on the latter subtype being more aggressive and having a worse outcome, have been published during the last 10 years (16, 30).

Since a quarter of the patients with MF stage IA–IB in the current study progressed to stage IIA–IVB, this portion could be considered to have a poorer outcome considering survival data of advanced stages from other studies (28). This is consistent with cohort data indicating approximately 25% disease-specific mortality (9, 31). However, those figures are derived from lymphoma registry studies. Other follow-up studies indicate a disease-specific mortality of less than 10%, which is quite similar to our present data (4). This discrepancy indicates the difficulty of assessing the exact influence of MF on mortality, and thus whether the patient dies of MF or other diseases.

PUVA with topical steroid treatment was the most frequently used first-line therapy (59%). The response

rate was satisfactory, but, as shown by others, recurrence almost always occurs, with a mean time to relapse of 17–20 months (32). UVB is an alternative treatment of MF, but with less effect on infiltrated lesions, such as plaques, and with shorter remission duration than for PUVA treatment (32).

Soluble IL-2r is not specific for CTCL and can therefore not be used for diagnostic purposes. However, earlier data from Vonderheid et al. (33) point to the possibility of using of sIL-2r as a prognostic marker of possibly better specificity than LDH. Our study indicates that sIL-2r may be a clinically useful marker of disease severity. Notably, in the majority of patients with increased levels at the time of MF diagnosis, advanced-stage disease or adnexal MF histology was seen. Therefore, it is possible that strategies using evaluation of this marker at the time of diagnosis and then continuously during follow-up to evaluate disease progression, may be beneficial.

It is important to point out that this is a retrospective study from a single centre. The number of included patients is limited and a potential selection bias regarding the included patients cannot be ruled out. In addition, several choices of treatments, such as systemic treatment and chemotherapy, could not be satisfactorily evaluated in this retrospective analysis. New prospective studies are mandated incorporating clinical status and new possible markers in relation to given treatments. However, the strength of this study is the thoroughly descriptive data from patient records, including photographs and histopathological assessment, together with evaluation of sIL-2r at initial diagnosis in the majority of patients.

In conclusion, this is the first retrospective study reported from Sweden on demographic data and overall outcome of patients with MF. The majority had early stage IA–IB disease at diagnosis. More than a quarter progressed to an advanced stage within a time-period of 5.6 years. Twenty-five percent of all patients with MF died during the study period, but less than half of the deaths could be attributed to the lymphoma. Adnexal subtype of MF showed a trend to a poorer outcome, and increased levels of s-IL2r at initial diagnosis indicated a more advanced stage or adnexal disease.

The authors declare no conflicts of interest.

REFERENCES

- Assaf C, Gellrich S, Steinhoff M, Nashan D, Weisse F, Dippel E, et al. Cutaneous lymphomas in Germany: an analysis of the Central Cutaneous Lymphoma Registry of the German Society of Dermatology (DDG). *J Dtsch Dermatol Ges* 2007; 5: 662–668.
- Criscione V, Weinstock M. Incidence of cutaneous T-cell lymphoma in the United States, 1973–2002. *Arch Dermatol* 2007; 143: 854–859.
- Willemze R, Jaffe ES, Burg G, Cerroni L, Berti E, Swerdlow SH, et al. WHO-EORTC classification for cutaneous lymphomas. *Blood* 2005; 105: 3768–3785.
- Talpur R, Singh L, Daulat S, Liu P, Seyfer S, Trynosky T, et al. Long-term outcomes of 1,263 patients with mycosis fungoides and Sezary syndrome from 1982 to 2009. *Clin Cancer Res* 2012; 18: 5051–5060.
- Whittaker SJ, Marsden JR, Spittle M, Russell Jones R. Joint British Association of Dermatologists and UK Cutaneous Lymphoma Group guidelines for the management of primary cutaneous T-cell lymphomas. *Br J Dermatol* 2003; 149: 1095–1107.
- Stadler R, Assaf C, Klemke CD, Nashan D, Weichenthal M, Dummer R, et al. Short German guidelines: cutaneous lymphomas. *J Dtsch Dermatol Ges* 2008; 6 Suppl 1: S25–31.
- Prince HM, Whittaker S, Hoppe RT. How I treat mycosis fungoides and Sézary syndrome. *Blood* 2009; 114: 4337–4353.
- Jawed SI, Myskowski PL, Horwitz S, Moskowitz A, Querfeld C. Primary cutaneous T-cell lymphoma (mycosis fungoides and Sézary syndrome): part II. Prognosis, management, and future directions. *J Am Acad Dermatol* 2014; 70: 223.e1–223.e17.
- Agar N S, Wedgeworth E, Crichton S, Mitchell TJ, Cox M, Ferreira S, et al. Survival and prognostic factors in mycosis fungoides/Sézary syndrome: validation of the revised International Society for Cutaneous Lymphomas/European Organisation for Research and Treatment of Cancer staging proposal. *J Clin Oncol* 2010; 28: 4730–4739.
- Vidulich KA, Talpur R, Bassett RL, Duvic M. Overall survival in erythrodermic cutaneous T-cell lymphoma: an analysis of prognostic factors in a cohort of patients with erythrodermic cutaneous T-cell lymphoma. *Int J Dermatol* 2009; 48: 243–252.
- Wasik MA, Vonderheid EC, Bigler RD, Marti R, Lessin SR, Polansky M, et al. Increased serum concentration of the soluble interleukin-2 receptor in cutaneous T-cell lymphoma. Clinical and prognostic implications. *Arch Dermatol* 1996; 132: 42–47.
- Olsen E, Vonderheid E, Pimpinelli N, Willemze R, Kim Y, Knobler R, et al. Revisions to the staging and classification of mycosis fungoides and Sezary syndrome: a proposal of the International Society for Cutaneous Lymphomas (ISCL) and the cutaneous lymphoma task force of the European Organization of Research and Treatment of Cancer (EORTC). *Blood* 2007; 110: 1713–1722.
- Dictor M, Warenholt J, Isinger A. Resolving T-cell receptor clonality in two and genotype in four multiplex polymerase chain reactions. *Haematologica* 2005; 90: 1524–1532.
- Quaglino P, Pimpinelli N, Berti E, Calzavara-Pinton P, Alfonso Lombardo G, Rupoli S, et al. Time course, clinical pathways, and long-term hazards risk trends of disease progression in patients with classic mycosis fungoides: a multicenter, retrospective follow-up study from the Italian Group of Cutaneous Lymphomas. *Cancer* 2012; 118: 5830–5839.
- van Doorn R, Scheffer E, Willemze R. Follicular mycosis fungoides, a distinct disease entity with or without associated follicular mucinosis: a clinicopathologic and follow-up study of 51 patients. *Arch Dermatol* 2002; 138: 1911–1918.
- Lehman JS, Cook-Norris RH, Weed BR, Weenig RH, Gibson LE, Weaver AL, et al. Folliculotropic mycosis fungoides: single-center study and systematic review. *Arch Dermatol* 2010; 146: 607–613.
- Tuyp E, Burgoyne A, Aitchison T, MacKie R. A case-control study of possible causative factors in mycosis fungoides. *Arch Dermatol* 1987; 123: 196–200.
- Fletcher CL, Orchard GE, Hubbard V, Whittaker SJ, Edelson RL, Russell-Jones R. CD30(+) cutaneous lymphoma in association with atopic eczema. *Arch Dermatol* 2004;

- 140: 449–454.
19. Väkevä L, Sarna S, Vaalasti A, Pukkala E, Kariniemi AL, Ranki A. A retrospective study of the probability of the evolution of parapsoriasis en plaques into mycosis fungoides. *Acta Derm Venereol* 2005; 85: 318–323.
 20. Sarveswari KN, Yesudian P. The conundrum of parapsoriasis versus patch stage of mycosis fungoides. *Indian J Dermatol Venereol Leprol* 2009; 75: 229–235.
 21. Leloup PI, Nguyen JM, Quéreux G, Saint-Jean M, Peuvrel L, Brocard A, et al. Predictive value of T-cell clone and CD13 antigen in parapsoriasis. *J Eur Acad Dermatol Venereol* 2014; 28: 516–524.
 22. Tan RS, Butterworth CM, McLaughlin H, Malka S, Samman PD. Mycosis fungoides: a disease of antigen persistence. *Br J Dermatol* 1974; 91: 607–616.
 23. Talpur R, Bassett R, Duvic M. Prevalence and treatment of *Staphylococcus aureus* colonization in patients with mycosis fungoides and Sézary syndrome. *Br J Dermatol* 2008; 159: 105–112.
 24. Mirvish ED, Pomerantz RG, Geskin LJ. Infectious agents in cutaneous T-cell lymphoma. *J Am Acad Dermatol* 2011; 64: 423–431.
 25. Mirvish JJ, Pomerantz RG, Falo LD Jr, Geskin LJ. Role of infectious agents in cutaneous T-cell lymphoma: facts and controversies. *Clin Dermatol* 2013; 31: 423–431.
 26. Bekkenk MW, Geelen FA, van Voorst Vader PC, Heule F, Geerts ML, van Vloten WA, et al. Primary and secondary cutaneous CD30(+) lymphoproliferative disorders: a report from the Dutch Cutaneous Lymphoma Group on the long-term follow-up data of 219 patients and guidelines for diagnosis and treatment. *Blood* 2000; 95: 3653–3661.
 27. Kadin ME. Current management of primary cutaneous CD30+ T-cell lymphoproliferative disorders. *Oncology* 2009; 23: 1158–1164.
 28. Whittaker SJ, Mackie RM. Cutaneous lymphomas and lymphocytic infiltrates. In: Burns T, Breathnach S, Cox N, Griffiths C, editors. *Rook's text book of dermatology*, 7th edn. Oxford; Blackwell Publishing: 2004. p. 54.2–54.13.
 29. Kim YH, Jensen RA, Watanabe GL, Varghese A, Hoppe RT. Clinical stage IA (limited patch and plaque) mycosis fungoides: a long-term outcome analysis. *Arch Dermatol* 1996; 132: 1309–1313.
 30. Gerami P, Rosen S, Kuzel T, Boone S L, Guitart J. Folliculotropic mycosis fungoides: an aggressive variant of cutaneous T-cell lymphoma. *Arch Dermatol* 2008; 144: 738–746.
 31. Ji J, Försti A, Sundquist J, Lenner P, Hemminki K. Survival in non-Hodgkin's lymphoma by histology and family history. *J Cancer Res Clin Oncol* 2009; 135: 1711–1716.
 32. Trautinger F. Phototherapy of mycosis fungoides. *Photodermatol Photoimmunol Photomed* 2011; 27: 68–74.
 33. Vonderheid EC, Zhang Q, Lessin SR, Polansky M, Abrams JT, Bigler RD, et al. Use of serum soluble interleukin-2 receptor levels to monitor the progression of cutaneous T-cell lymphoma. *J Am Acad Dermatol* 1998; 38: 207–220.