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Short report

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## Peripheral blood complete remission after splenic irradiation in Mantle-Cell Lymphoma with 11q22-23 deletion and ATM inactivation

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### Abstract

Mantle Cell Lymphoma (MCL) is a well-known histological and clinical subtype of B-cell non-Hodgkin's Lymphomas. It is usually characterized by an aggressive disease course, presenting with advanced stage disease at diagnosis and with low response rates to therapy. However few cases of indolent course MCL have been described. We herein report a case of MCL with splenomegaly and peripheral blood involvement as main clinical features. The patient underwent moderate dose splenic radiation therapy and achieved spleen downsizing and peripheral blood complete remission. Splenic irradiation has been extensively used in the past as palliative treatment in several lymphoproliferative disorders and a systemic effect and sometimes peripheral blood complete remissions have been observed. Mainly advocated mechanisms responsible for this phenomenon are considered direct radiation-induced apoptotic cell death, immune modulation via proportional changes of lymphocyte subsets due to known differences in intrinsic radiosensitivity and a radiation-induced cytokine release. The peculiar intrinsic radiosensitivity pattern of lymphoid cells could probably be explained by well-defined individual genetic and molecular features. In this context, among NHLs, MCL subtype has the highest rate of ATM (Ataxia Teleangiectasia Mutated) inactivation. While the ATM gene is thought to play a key-role in detecting radiation-induced DNA damage (especially Double Strand Breaks), recent in vitro data support the hypothesis that ATM loss may actually contribute to the radiosensitivity of MCL cells. ATM status was retrospectively investigated in our patient, with the tool of Fluorescence In Situ Hybridization, showing a complete inactivation of a single ATM allele secondary to the deletion of chromosomal region 11q22-23. The presence of this kind of cytogenetic aberration may be regarded in the future as a potential predictive marker of radiation response.

### Full text

Mantle-Cell Lymphoma (MCL) has been clearly recognized as a distinct histological and clinical subtype of B-

cell non-Hodgkin's Lymphomas. Typical of the elderly, it has an estimated incidence of 2–3/100,000/year and accounts for 8% of all NHLs [1]. Diagnostic work-up usu-

ally demonstrates advanced stage disease, often associated with spleen enlargement, bone marrow and peripheral blood involvement [2]. Important clinical prognostic factors are poor PS, splenomegaly, anemia and age [3]. While MCL is generally considered an aggressive disease, with median survivals of 2–3 years, few cases with a fairly indolent disease course are described in the medical literature [4]. We herein report the case of a 90 years-old female referred to our institution hospital, with a history of active phase chronic C-Hepatitis and a 4-yrs established diagnosis of MCL, made upon bone marrow biopsy. The specimen examination demonstrated a nodular pattern of cleaved and small to medium sized cells without residual germinal centres and with loosely structured meshwork of follicular dendritic cells. Immunohistochemistry findings on bone marrow at diagnosis were as follows: CCND1 +, CD 5 +, CD 19 +, CD 20 +, CD 22 +, CD 3 - CD 10 -, CD 23 -, HLA DR +, Surface Membrane IgM-D/K. Flow Cytometry revealed a dual stained population CD5+/CD19 +, CD20+/CD 23 -, CD19 +/CD10 -, FMC7 +. Taking into account those data, especially CCND1 positivity, we reasonably thought to deal with MCL, instead of other B-cell indolent lymphoproliferative disorders such as Splenic Marginal Zone Lymphoma/Splenic Lymphoma with Villous Lymphocytes. Clinically, her disease course was characterized by a modest splenomegaly, with peripheral blood involvement with marked leucocytosis and lack of lymph node enlargement, and therefore she was repeatedly treated with single-agent chemotherapy (Chlorambucil) with spleen downsizing and normalization of WBC values. At the time of our observation she complained of abdominal pain, anorexia and progressive weight loss. ECOG PS was 1 to 2. Total Body CT scans revealed a massive splenomegaly (25 cm in diameter) without lymph nodes more than 1 cm in diameter at any site. A modest hepatomegaly was also present. CBC resulted as follows: WBC 30.000/mm<sup>3</sup> (75 % lymph; 20 % ANC); Hb 12,3 g/dl ; HCT 39 %; PLTs 60.000/mm<sup>3</sup>.

In order to obtain symptomatic relief, we considered radiation therapy and chose to treat the whole spleen to a total dose of 15 Gy in 10 fractions during 2 weeks time, with 6 MV Photons and anterior-posterior parallel opposite fields. Radiation treatment was very well tolerated, without recordable acute toxicity. At clinical and radiological evaluation 3 weeks after RT, complete pain relief was achieved, with reduction in spleen diameter (18 cm at U.S. examination) and, surprisingly (even if already reported), a peripheral blood complete remission. CBC showed: WBC 2100/mm<sup>3</sup>; (ANC 67 %; 19 % Lymph); Hb 12,1 g/dl; HCT 37 %; PLT 61.000/mm<sup>3</sup>. Circulating malignant lymphoid cells were absent at peripheral blood smears and at Flow Cytometry examination. A second bone marrow biopsy was not performed due to patient's age and PS. The latest follow-up performed one year after

radiotherapy showed a continuous unmaintained complete peripheral response.

Splenic Irradiation (SI) has been extensively used in the past as palliative treatment in several haematological malignancies such as chronic myeloproliferative disorders [chronic myelogenous leukaemia (CML), essential thrombocythemia (ET), polycythemia vera (PV) and agnastic myeloid metaplasia (AMM)], chronic lymphoproliferative disorders [chronic lymphocytic leukaemia (CLL), prolymphocytic leukaemia (PLL), hairy cell leukaemia (HCL) and splenic marginal zone lymphoma (SMZL)] and even acute myelogenous leukemia [5-11]. Previously reported high response rates could be explained by different mechanisms of action, but the main event is thought to be a direct radiation-induced apoptotic cell death that leads to the elimination of malignant cells located in the spleen (since lymphocytes undergo radiation-induced apoptosis even at very low doses)[12]. A systemic effect and sometimes peripheral blood and even bone marrow complete remissions (CRs) have been observed in several clinical situations [5,13-15], most frequently CLL, PLL and HCL. To our knowledge, no CRs are described during myeloproliferative disorders. Different doses and fraction sizes have been delivered (daily, weekly, three times a week schedules with doses ranging mostly from 5 Gy to 15 Gy). Anyway, the arising question appears to be how SI could clear the bone marrow, removing MCL clones. Several biological mechanisms have been hypothesized by different authors to explain this effect [5]. At first, a direct radiation-induced killing of splenic neoplastic cells has been mentioned, acting through the clearance of a potential source of circulating lymphoma cells [16]. Secondly, an immune modulation via proportional changes of lymphocyte subsets has been advocated as a key event: in this case the differential cell killing of normal lymphocytes (due to known differences in intrinsic radiosensitivity) is believed to cause a redistribution of circulating lymphoid subpopulations with subsequent reduction of normal T-suppressor lymphocytes and increased anti-tumour activity [17,18]. Thirdly, a radiation-induced release of cytokines, such as TNF $\alpha$  or IL-2, is believed to potentially stimulate a secondary immune modulation, enhancing anti-neoplastic cell-mediated effects [19]. In this context, another radiation-induced cell killing mechanism to be considered is the so-called "bystander effect", well described in several experimental studies and anecdotal clinical findings: this phenomenon consists of a biological response of unirradiated neighbours or distant cells after target cells irradiation. When considering distant effects produced by local radiation therapy, it is also known as 'abscopal effect' [20,21]. This event seems to be particularly significant after radiation exposure at low doses and has been advocated to play some kind of role in radiation-induced

cancer, radiation damage to healthy tissues and radiation-induced bystander tumor cells killing [22].

The peculiar intrinsic radiosensitivity pattern of lymphoid cells and the above briefly mentioned mechanisms could probably explain the known radiation response phenotype of many lymphoproliferative disorders, but more individual genetic and molecular features could certainly offer more details about some unusual responses of specific patients. Among NHLs, MCL subtype has the highest rate of ATM (Ataxia Teleangiectasia Mutated) inactivation, due to the presence of deletions or mutations in up to 40–50% of patients [23–25]. The ATM gene is thought to play a key-role in detecting radiation-induced DNA damage (especially Double Strand Breaks) and it is known to be affected by germline mutations (truncation) in patients with Ataxia Teleangiectasia, an autosomal recessive disease characterized by cerebellar ataxia, immunodeficiency, predisposition to lymphoproliferative malignancies and a highly increased sensitivity to ionizing radiations. MCL patients bearing ATM inactivation seem not to have a worse prognosis, while recent in vitro data suggest that ATM loss may actually contribute to radiosensitivity of MCL cells [26]. ATM status was retrospectively investigated in our patient, with the tool of Fluorescence In Situ Hybridization (FISH) on bone marrow biopsy at diagnosis, showing a complete inactivation of a single ATM allele secondary to a deletion of chromosomal region 11q22-23. We suggest that the presence of this kind of cytogenetic aberration, recently reported [27], could be considered as one of the possible explanations of high radiosensitivity profiles of some MCLs, and be regarded in the future as a potential predictive marker of response.

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