Retraction Notice

Title of retracted article:	**An Uncommon Case of Secondary Cardiac Lymphoma Manifested through Pre-Syncope, Syncope Episodes and Atrial Flutter**
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Email:	mbobos@icloud.com
Journal:	Journal of Cancer Therapy (JCT)
Year:	2016
Volume:	7
Number:	13
Pages (from - to):	986 - 993
DOI (to PDF):	http://dx.doi.org/10.4236/jct.2016.713096
Paper ID at SCIRP:	8902457
Article page:	http://www.scirp.org/journal/PaperInformation.aspx?PaperID=72613
Retraction date:	2017-05-31

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☐ Some of the authors:
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- **X** Journal owner (publisher)
- ○ Institution:
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Date initiative is launched: 2017-05-31

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Expression of Concern:
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Correction:
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cardiac tumors are benign, with atrial myxomas to account for 75% of all primary cardiac tumors [5]. Secondary (metastatic) cardiac tumors are about twenty times more common than primary cardiac tumors [6] and are frequently diagnosed at later stages, since are manifested without pathognomonic symptoms or characteristic signs. The clinical presentation of the tumor is determined by several factors as anatomic location, size, growth rate, extent of invasiveness, and tumor friability [7].

Cardiac lymphoma, primary or secondary, is a rare disease, with the B cell non-Hodgkin lymphoma (NHL) to represent the vast majority of even[illegible]. DLBCL followed by Burkitt lymphoma and CLL/SLL are the most commonly repo[illegible]ed histologic types of cardiac NHL, both in primary and metastatic setting [8].

Primary renal lymphoma (PRL) accounts for 0.7% [illegible] all extr[illegible]nodal l[illegible]phomas, with less than 40 cases that fulfill the criteria of PRL, be[illegible] re[illegible]rted in the literature. PRL represents less than 1% of all renal lesions a[illegible] bilateral [illegible]esenta[illegible]on is seen in 10% to 20% of the cases [9]. The most common P[illegible]L [illegible]e is high gr[illegible] B-cell NHL, particularly the large B-cell variant [9]. PRL spreads rapidly a[illegible] up to 2/3 of the patients die within a year of diagnosis.

Cardiac involvement by lym[illegible]oma may occur in three pathways: a) direct extension

Figure 3. Representative illustrations from the renal lymphoma (a, c, e) and heart invasion (b, d, f). The neoplastic lymphoid cells were medium and large sized, mainly with centroblastic appearance (a, b), expressed CD20 (c, d) and PAX5 (e), whereas were negative for CD10 (f). a, b: H & E, magnification ×200. (c)-(f): Immunohistochemistry, magnification ×200.

from intrathoracic lesions through the parietal pericardium and then the heart; b) via lymphatic circulation along coronary arteries and epicardium; and c) by hematogenous-dissemination [2]. Lymphomatous infiltration can affect sinoatrial node and the atrio-ventricular system, and initiate conduction abnormalities which can drive to recurrent episodes of pre syncope and syncope, as presented in our patient. The syncope may also be due to SVC syndrome, cardiac involvement by the NHL and obstruction of the right atrium by the tumor mass.

Cardiac involvement by NHL is extremely uncommon, and symptoms are often sub-clinical or nonspecific [1]. As reported, in the largest case study of autopsy-proved cardiac lymphoma, only 32% of the cases involved a clinical cardiac manifestation [10]. The more common clinical symptoms of cardiac involvement include dyspnea, congestive heart failure, chest pain, pericardial effusion, Superior Vena Cava Syndrome, stroke, cardiac arrhythmias, nonspecific electrocardiographic abnormalities and sudden death [1] [8]. Other rare symptoms are abdominal pain, dizziness, sepsis, hemoptysis and pulmonary embolism [8].

Laboratory abnormalities such as elevated lactate dehydrogenase (LDH), erythrocyte sedimentation rate, and serum beta-2 microglobulin (B2M) are usually detected in NHLs, whereas raise in cardiac enzymes, as troponins and CPK are indicators of acute myocardial damage. In patients with aggressive NHL, the serum B2M level was reported to be increased in 40% - 55% of patients, whereas B2M level was elevated in 23% - 29% Hodgkin lymphoma [11].

Certain noninvasive examinations allow a quick assessment for cardiac disease. Three-dimensional echocardiography is a useful tool that may provide additional information or better visualization of intracardiac masses, whereas transthoracic echocardiogram is also a sensitive method for the identification of cardiac involvement by malignant tumors, which more commonly present as nodular or polypoid masses in right chambers, with variable myocardial infiltration, often with a pericardial effusion [2]. Cross-sectional imaging as computed tomography (CT) and magnetic resonance imaging (MRI), with the improved tissue and contrast resolution that offer, allow enhanced assessment of tissue on the basis of attenuation or signal intensity [1]. At CT, lymphoma commonly appear as an infiltrating epicardial or myocardial mass that is often isoattenuating to hypoattenuating relative to myocardium and commonly seen as a large, nodular mass that is isointense or hypointense relative to myocardium on both T1- and T2-weighted images which show heterogeneous enhancement after administration of gadolinium [1] [7]. The myocardial and pericardial infiltration is better depicted with MR imaging, however, it requires the patient's hemodynamic stability. Masses can be relatively hypointense on T1-weighted images and hyperintense on T2-weighted images however the appearance can be variable, and the presence of isointense signal relative to cardiac muscle is not uncommon [1].

For the final diagnosis of cardiac masses, and especially sarcomas and lymphomas, pathologic diagnosis is essential, since treatment varies for different tumor subtypes. Thoracotomy or less invasive procedures such as percutaneous endomyocardial biopsy

and fluoroscopy-guided endomyocardial biopsy can be used for obtaining tissue for pathological examination, whereas, in case of pericardial effusion, cytological examination is a useful tool for diagnosis.

The prognosis for patients with either primary or secondary cardiac lymphoma is usually poor, due to diagnostic delay and advanced stage of organ infiltration being major factors affecting the outcome. In the literature are included cases with treatment combinations including chemotherapy, chemotherapy plus radiation therapy, radiation therapy, surgery, surgery plus chemotherapy, and surgery plus chemotherapy plus radiation therapy [1]. Cases of complete remission after autologous stem cell transplantation were also reported [1]. The main chemotherapy regimen for cardiac lymphomas is CHOP, while the BACOP protocol (bleomycin, doxorubicin, cyclophosphamide, vincristine, and prednisone) was also used [1]. The surgical resection and radiation therapy are less used as a primary choice of treatment in patients with cardiac lymphoma. Recently, the monoclonal CD20 antibody (rituximab) added with the standard CHOP protocol have provided higher survival rates in CD20-positive patients [1].

4. Conclusion

Though uncommon, the diagnosis of cardiac lymphoma, primary or secondary should be kept in mind in patients presenting with symptomatic right-sided inflow lesions, pre-syncope, syncope episodes and arrhythmias. The elevated LDH and serum beta-2 microglobulin levels, as well as high ratios of myocardial enzymes, would be considered alarming signs of cardiac involvement by lymphoma, as early diagnosis may be lifesaving and a chance for durable remissions or even cure.

Authors' Contributions

GK: Cooperated in the clinical case, collected the data and reviewed the manuscript. MB: Analyzed the data and drafted the manuscript. CS: Cooperated in the clinical case and reviewed the manuscript. TK: Cooperated in the clinical case. KK & AKF: Cooperated in the clinical case and interpreted the MRI and CT examinations. TZ & IK: Involved in histopathologic diagnosis of heart, renal and BM biopsies. VP: Cooperated in the clinical case and collected the laboratory data. SH: Cooperated in the clinical case and performed the endomyocardial biopsy. All authors read and approved the final manuscript.

Conflict of Interests

The authors declare that they have no conflict of interests.

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