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Case Report

Lymphoma with cardiac and renal involvement: Report of a case imaged by CT with cinematic rendering ☆

Muhammad Umair, MD[a,*], *Stefan L. Zimmerman, MD*[b], *Elliot K. Fishman, MD*[b]

[a] *Feinberg School of Medicine, Department of Radiology, Northwestern University, 676 N St Clair St, Chicago, IL 60611, USA*

[b] *Russell H. Morgan Department of Radiology and Radiological Science,Johns Hopkins Hospital, North Wolfe Street, Baltimore, MD, USA*

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ABSTRACT

Myocardial lymphoma can be seen in the setting of primary or secondary involvement, more common in later. Both primary and secondary involvement is usually seen in the setting of diffuse large B cell lymphoma. We describe a case of a 47-year-old man in cardiogenic shock due to refractory ventricular tachycardia (VT) necessitating intubation, extracorporeal membrane oxygenation (ECMO) and an intra-aortic balloon pump with diffuse thickening of the left ventricular myocardium on CTA chest and subtle infiltrative ill-defined perirenal hypodensities with renal enlargement on CT of abdomen and pelvis. Post-processing with cinematic rendering clearly showed improved tissue contrast and/or differentiation with better demarcation of both the myocardial and renal lesions. A myocardial biopsy demonstrated diffuse large B-cell lymphoma (DLBCL). The patient was treated for ventricular tachyarrhythmias, cardiogenic shock, DCBCL, and numerous complications during 6-month long hospitalization with significant improvement of systolic function at discharge. Myocardial lymphoma is an uncommon cardiac malignancy with common CT imaging appearances of multiple circumscribed iso-attenuating masses or diffuse ill-defined infiltrative myocardial thickening. These findings are better assessed with cinematic rendering due to accentuated depth perception and photorealistic appearance of this post processing modality.

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* Corresponding author.
E-mail address: Muhammad.umair@northwestern.edu (M. Umair).

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Introduction

Cardiac lymphomas are rare tumors, most commonly in the setting on diffuse large B-cell lymphoma, with common imaging features including diffuse ill-defined infiltrative mass with tendency to extend along the epicardial surfaces including along the right atrioventricular groove and encasing the coronary arteries or the aorta [1]. Right atrium is the most common site of involvement and pericardial effusions are common association. On imaging, the primary, and secondary involvement appear indistinguishable. There is an association with conduction disorders and tachyarrhythmias [1]. The prognosis remains poor due to advanced presentation and rapid progression. Associated oncological and treatment related complications need prompt recognition and timely management. We describe a case of 47-year-old man with diffuse left ventricular involvement and bilateral renal involvement on CT scan. This case demonstrates the utility of cinematic rendering as a valuable post-processing tool for cardiac mass evaluation. Cinematic rendering (CR) is a relatively novel post-processing technique for 3D volumetric rendering, different than conventional volume rendering (VR) with more complex lighting models for 3D projection of the dataset. This results into better lighting and/or shadowing of the rendered image volume, better image depth perception, and a more photorealistic appearance [2].

Case description

A 47-year-old man with a history of hypertension, presenting with worsening systolic function (ejection fraction at admission 10%-15%) was transferred to the coronary care unit (CCU) for cardiogenic shock and refractory ventricular tachycardia (VT), necessitating intubation, mechanical circulatory support by way of extracorporeal membrane oxygenation (ECMO) and an intra-aortic balloon pump. A CTA of the chest with pulmonary artery protocol and CT of the abdomen and pelvis was performed for further evaluation.

Axial CT images (Fig. 1) and coronal cinematic rendering (CR) images (Fig. 3) demonstrated diffuse thickening of the left ventricular myocardium, which is most severe in the lateral wall, measuring greater than 2 cm in thickness. Compared to the grayscale images, CR improves the differentiation between the myocardium, trabeculations, and the blood-pool. Increased depth perception accentuates the findings and images appear more photorealistic [2].

The CT scan of the abdomen (Fig. 2) demonstrated ill-defined hazy perirenal hypodensities, which enhance less than the surrounding renal parenchyma, enlarging the kidneys bilaterally without distorting its reniform morphology, indicating an infiltrative process. These findings are subtle to appreciate on the contrast enhanced CT abdomen and pelvis images, while on cinematic rendering, the findings are clearly seen as separate lesions (Fig. 4). Given the imaging findings, the differential considerations included secondary lymphomatous involvement of the myocardium, or other systemic processes with myocardial involvement eg, amyloidosis or Erdehim-Chester syndrome. Hypertrophic cardiomyopathy was additional consideration although does not explain the renal involvement in this case.

A myocardial biopsy was performed demonstrating diffuse large B-cell lymphoma (DLBCL) with the immunophenotype consistent with the non–germinal center B-cell subtype of diffuse large B-cell lymphoma. Fluorescence in-situ hybridization (FISH) analysis demonstrated no MYC rearrangement and no fusion of MYC and IGH, making unlikely the possibility of a high-grade B-cell lymphoma with MYC and BCL2 and/or BCL6 rearrangements.

For the ventricular tachyarrhythmias, the patient was treated with IV amiodarone and lidocaine, with the later discontinued due to concern for toxicity. He was eventually transitioned to oral amiodarone and subsequently remained electrically quiescent. For DLBCL, he is treated with high dose methotrexate, rituximab, and additional chemotherapy regimen etoposide, vincristine, doxorubicin, cyclophosphamide, and prednisone (EPOCH). His CCU course was complicated with influenza A (post treatment with oseltamivir), septic shock due to E. faecalis bacteremia, Pseudomonas bacteremia secondary to urinary tract infection, and vancomycin resistant enterococcus (VRE) bacteremia secondary to perforated cholecystitis (post cholecystostomy tube placement), besides additional complications. Eventually, he recovered from these complications during hospitalization, remained electrically quiescent for the remaining hospitalization and recovered the systolic function to 45%-50% from 10%-15% on admission, 6 months later at the time of discharge. He was discharged home in a stable condition on beta-blocker, ACE-inhibitor and

Fig. 1 – Thickening of the left ventricular myocardium seen on axial chest CT images.

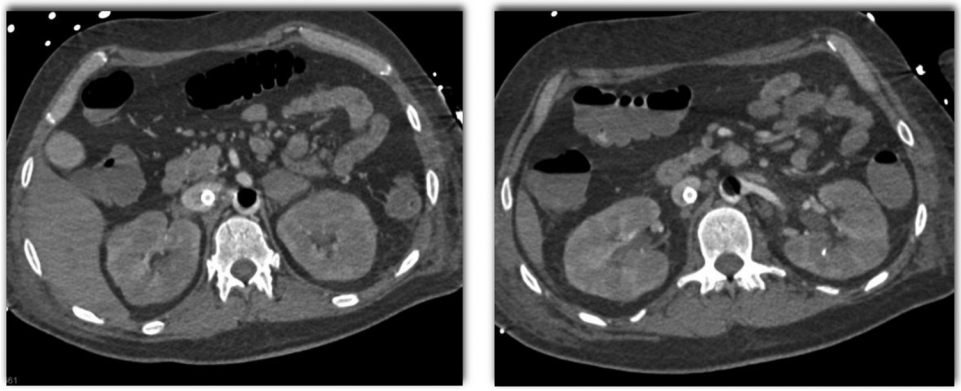

Fig. 2 – Mild bilateral renal enlargement with preservation of the reniform shape and mild ill-defined hypodensities in the renal parenchyma representing lymphomatous involvement.

Fig. 3 – Coronal cinematic rendering reconstruction of the CT dataset demonstrates the differential thickening of anterolateral wall compared with inferior wall in more details and the distinction between the myocardium, trabeculations and/or papillary muscles and the blood pool is more obvious. The images have a "photorealistic appearance." The 2 images below represent same volume of data but with application of different trapezoidal function on voxel histograms to accentuate the infiltration of the myocardium in the image on the left compared to the image on the right. Adjustment of trapezoids is one way to accentuate tissue differences and is basically a form of texture mapping in CR.

furosemide on as required basis with a follow-up set up with cardiology.

Discussion

The involvement of myocardium with the lymphoma can be primary, which is very rare, or secondary (both usually in the setting of DLBCL), again uncommon but more common than primary involvement [3,4]. The most common site of involvement is determined to be right atrium [3]. This case is an unusual presentation of this entity due to left ventricular and concurrent renal involvements. The typical appearance includes multiple circumscribed masses iso-attenuating to myocardium or diffuse ill-defined infiltrative pattern [1,5] with myocardial thickening (as in this case). Among cases of isolated cardiac involvement, the imaging distinction between the primary vs secondary involvement is impossible, and most of the time, this distinction even remains indeterminate on biopsy. Given advanced presentation and rapid progression, sometimes cardiac lymphoma can be an oncological emergency and the prognosis remains poor, with management including a combination of chemotherapy, radiation, and surgery besides management of associated complications [1].

Our case also demonstrates the clinical applications of the 3D image rendering with cinematic rendering (CR) in cardiac CT imaging. Cinematic rendering (CR) is a novel, complex, and more advanced 3D volumetric rendering technique compared to volume rendering (VR). Besides similarities with VR in 3D volumetric reconstruction including assigning color and transparency based on tissue attenuation thresholds [2,6], CR additionally uses much more sophisticated lighting model based on simulations of light interactions in real world objects, including a unique global lighting model that also accounts for the indirect effects of light interaction with the rendered volume utilizing Monte Carlo technique. This leads to better depth perception, more realistic presentation of the surfaces, and more realistic shadowing of the 3D volume when

Fig. 4 – Compared to 2D CT images, the 3D cinematic rendering represents photorealistic appearance with more obvious appearing renal lymphomatous lesions.

compared to the VR [2,6]. However, this improved volumetric presentation comes at the cost of more computational power needed for image rendering and leads toward limited availability of the modality [6]. With recent improvements in computation and given the photorealistic appeal associated with this modality, CR has recently been applied to cardiovascular imaging for improved visualization of complex angiographic and cardiac CT datasets with helpful diagnostic insights [6].

At our institution, the use of CR is reserved for most complex and selected pre-operative cardiovascular cases among other applications in medical imaging beyond the scope of this discussion. The aforementioned factors of time and computational power needed for rendering are the bigger constraints toward widespread application of this valuable post-processing modality.

Patient consent

The patients reported in the manuscript signed the informed consent/authorization for participation in research which includes the permission to use data collected in future research projects including presented case details and images used in this manuscript.

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