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CASE REPORT

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Case report of LVEF derived from gated FDG-PET: potential to streamline cardiotoxic surveillance in melanoma patients

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ABSTRACT

Background: Advances in cancer therapy have improved patient outcomes, but cardiotoxicity remains a significant risk. In melanoma patients treated with BRAF and MEK inhibitors, monitoring left ventricular ejection fraction (LVEF) during treatment is recommended to detect cardiac dysfunction. Despite the widespread use of FDG-PET in oncology, its potential for concurrent cardiac assessment remains underexplored.

Methods: A 42-year-old male undergoing treatment for disseminated melanoma underwent measurements of LVEF using four modalities: 3D-MUGA, 3D echocardiography, Rb-PET, and gated FDG-PET.

Results: LVEF was within the normal range across all modalities: 60% (3D-MUGA), 61% (3D echocardiography), 63% (Rb-PET), and 65% (FDG-PET).

Conclusion: This case presents an estimation of LVEF derived from a clinically indicated, FDG-PET scan, performed alongside three conventional modalities on the same day. This approach may be particularly useful in melanoma patients who undergo frequent FDG-PET scans. While the findings are promising, broader validation is needed.

ARTICLE HIGHLIGHTS

- Cardiotoxicity is a known complication of BRAF/MEK inhibitors in melanoma patients, necessitating regular monitoring of cardiac function.
- This case explores the feasibility of deriving left ventricular ejection fraction (LVEF) from a routine FDG-PET scan.
- A 42-year-old male with metastatic melanoma underwent same-day LVEF assessment using four modalities: 3D echocardiography, 3D-MUGA, Rb-82 PET, and gated FDG-PET.
- All imaging techniques produced normal LVEF values, with minor variations in estimated ventricular volumes – most notably between the nuclear methods and 3D echocardiography.
- The approach required only minor additional steps; a 5-minute gated acquisition and ECG electrode placement – without altering the standard FDG-PET protocol.
- While promising, the method is dependent on sufficient myocardial FDG uptake and requires further studies.
- This strategy could be particularly useful in melanoma care, where patients routinely undergo serial FDG-PET scans for disease monitoring and are at risk of treatment-related cardiotoxicity.
- If validated in larger studies, FDG-PET–based LVEF assessment could streamline cardio-oncology workflows, reduce redundant imaging, and improve resource use.

ARTICLE HISTORY

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Gated FDG-PET; Left Ventricular Ejection Fraction (LVEF); Cardiotoxicity; Melanoma; Oncology Imaging

Introduction

Targeted therapies, particularly MEK and BRAF inhibitors, have significantly improved outcomes for melanoma patients [1]. However, these treatments carry a well-documented risk of cardiotoxicity [2,3]. Monitoring cardiac function, especially left ventricular ejection fraction (LVEF), is therefore recommended during therapy [4].

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Advances in imaging have established ^{18}F-fluorodeoxyglucose positron emission tomography (FDG-PET) as a key tool in managing melanoma patients. In Denmark FDG-PET combined with diagnostic CT is routinely used to monitor disease during and after treatment for melanoma [5].

Despite the widespread use of FDG-PET, cardiac function assessment traditionally requires separate appointments and procedures. Current European guidelines recommend three-dimensional echocardiography (3D-echo) as the primary method for LVEF assessment. When echocardiography is inconclusive and cardiac MRI unavailable, equilibrium radionuclide angiography (ERNA or MUGA scan) is advised as a third-line option [6].

Given that patients already undergo FDG-PET imaging, leveraging these scans to simultaneously assess LVEF could reduce patient burden, save resources, and streamline care without additional procedures.

This case illustrates the potential to derive LVEF from a routine, clinically indicated FDG-PET scan in a patient receiving cardiotoxic therapy for melanoma. The imaging was performed alongside three conventional LVEF modalities on the same day, enabling informal comparison. This report explores the overlooked opportunity to extract LVEF from routine FDG-PET scans in patients for whom LVEF estimation is already clinically indicated.

Case summary

A 42-year-old man with disseminated malignant melanoma was referred for routine LVEF assessment due to ongoing treatment with BRAF and MEK inhibitors (dabrafenib and trametinib).

He was included in our ongoing cardiac imaging study, which provides same-day LVEF assessment using three modalities: An enhanced type of 3D-MUGA [7], rubidium-82-PET (Rb-PET), and 3D-echo. Coincidentally, an FDG-PET scan was scheduled the same day. This allowed for a gated acquisition to also quantify LVEF during FDG-PET.

Timeline:

- *July 2021:* Primary melanoma removed from the back. Sentinel node scintigraphy positive; two metastatic lymph nodes excised. Baseline FDG-PET-CT showed no extracranial disease.
- *2021–2022:* During adjuvant nivolumab treatment (13 cycles, completed September 2022), four interim FDG-PET-CT scans were performed. All confirmed absence of extracranial disease.
- *August 2023:* At one-year post-treatment follow-up, a fifth FDG-PET-CT raised suspicion of intracranial disease. MRI confirmed multiple brain metastases with mass effect and midline shift. No extracranial disease detected. Started dabrafenib and trametinib.
- *September 2023:* Planned switch to ipilimumab + nivolumab. Developed immune-mediated hepatitis after one cycle; treatment paused.
- *December 2023:* Underwent stereotactic radiosurgery for progressing brain metastases.
- *January 2024:* Restarted dabrafenib and trametinib due to CNS progression.
- *2024:* Four additional clinical FDG-PET-CT scans were performed throughout the year, including one in September 2024. All scans confirmed continued absence of extracranial disease.
- *September 2024:* Enrolled in cardiac imaging study for LVEF assessment using 3D-MUGA, Rb-PET, and 3DE.
- *October 2024:* Further CNS progression noted.

At the time of cardiac imaging, the patient was fasting in preparation for his afternoon FDG-PET scan. He had no prior history of cardiovascular disease before the onset of his melanoma or its treatment.

LVEF from FDG-PET was derived using ECG-triggered acquisition with three electrodes connected directly to the PET scanner. A 5-minute gated acquisition over the thorax was performed, divided into 8 bins per cardiac cycle. The resulting dataset was interpreted using commercially available software for dynamic cardiac analysis.

Results

Left ventricular measurements from the four modalities are summarized in Table 1, with Figures 1–4 presenting representative images from the analysis software for 3D-MUGA, 3D-echo, Rb-PET, and gated FDG-PET, respectively.

All imaging modalities estimated normal LVEF values. The ventricular volumes estimated from the nuclear medicine modalities were smaller than those estimated from 3D-echo.

Discussion

This case demonstrates that LVEF can be successfully derived from routine, FDG-PET imaging in a patient with melanoma – with only minor additional steps. This technique is already in clinical use for viability assessment in patients with chronic coronary syndrome and previous studies have reported good to excellent correlation between FDG-PET and cardiac MRI for LVEF estimation [8–12], particularly in cases with homogeneous myocardial uptake. To our knowledge, only one abstract has compared LVEF from FDG-PET with 2D-echocardiography, reporting good agreement [13].

This is in line with the results presented in this report. The FDG-PET–derived LVEF closely matched the reference techniques; 3D-echo (Figure 2) and 3D-MUGA (Figure 1), as summarized in Table 1. Although Rb-PET

Table 1. Cardiac measurements from each imaging modality.

Modality	EDV (mL)	ESV (mL)	LVEF (%)
Rb-PET	92	34	63
3D-MUGA	77	31	60
3D-echo	121	47	61
FDG-PET	80	28	65

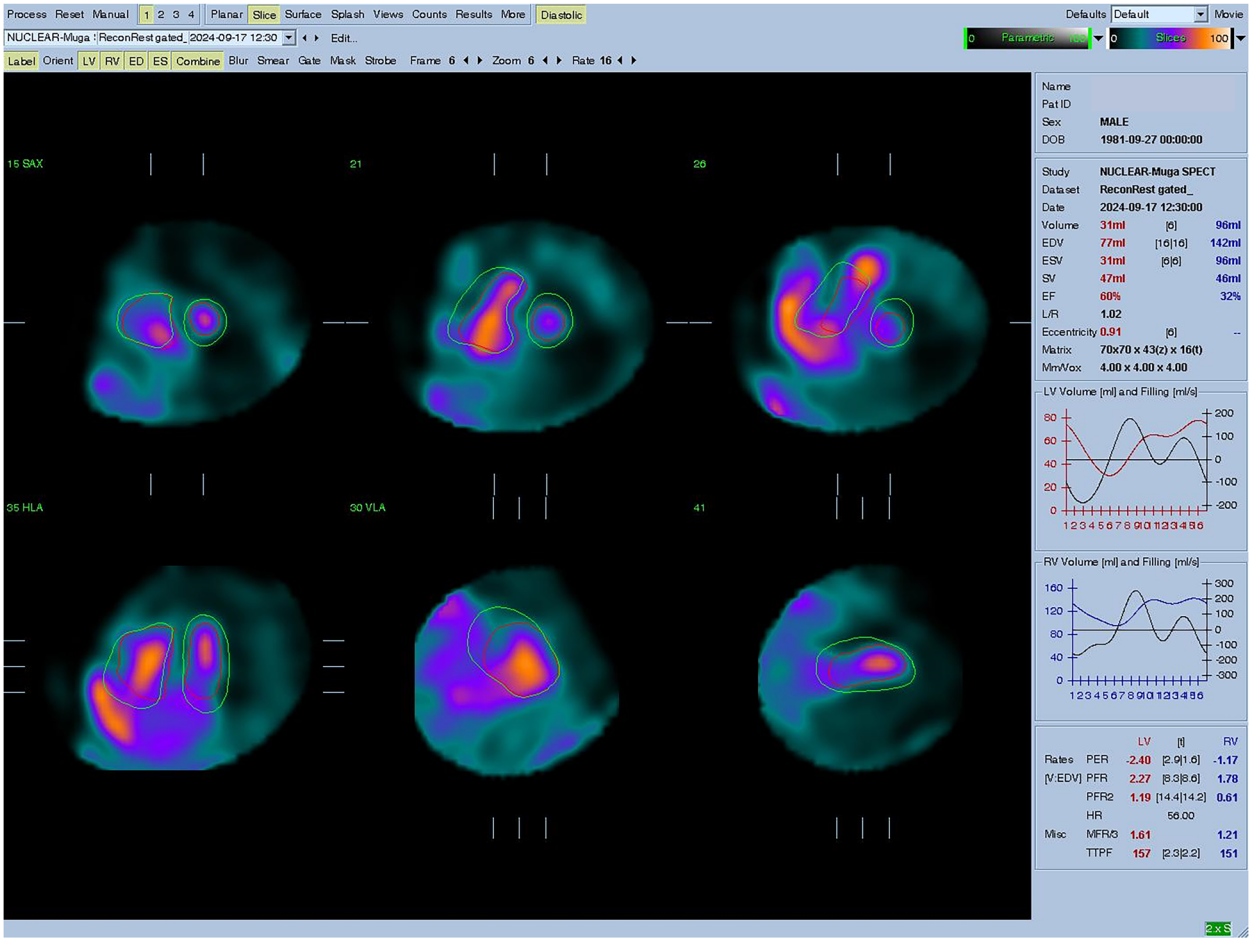

Figure 1. 3D-MUGA (GE discovery NM 530c) acquisition analyzed with Quantitative Blood Pool SPECT. The displayed frame represents end-systole. The top row shows three short-axis (SAX) slices; the second row includes a horizontal long-axis view (left) and two vertical long-axis views (middle and right), corresponding to the right and left ventricles, respectively. Red contours denote end-systolic regions of interest (ROI), while green contours represent end-diastolic ROIs.

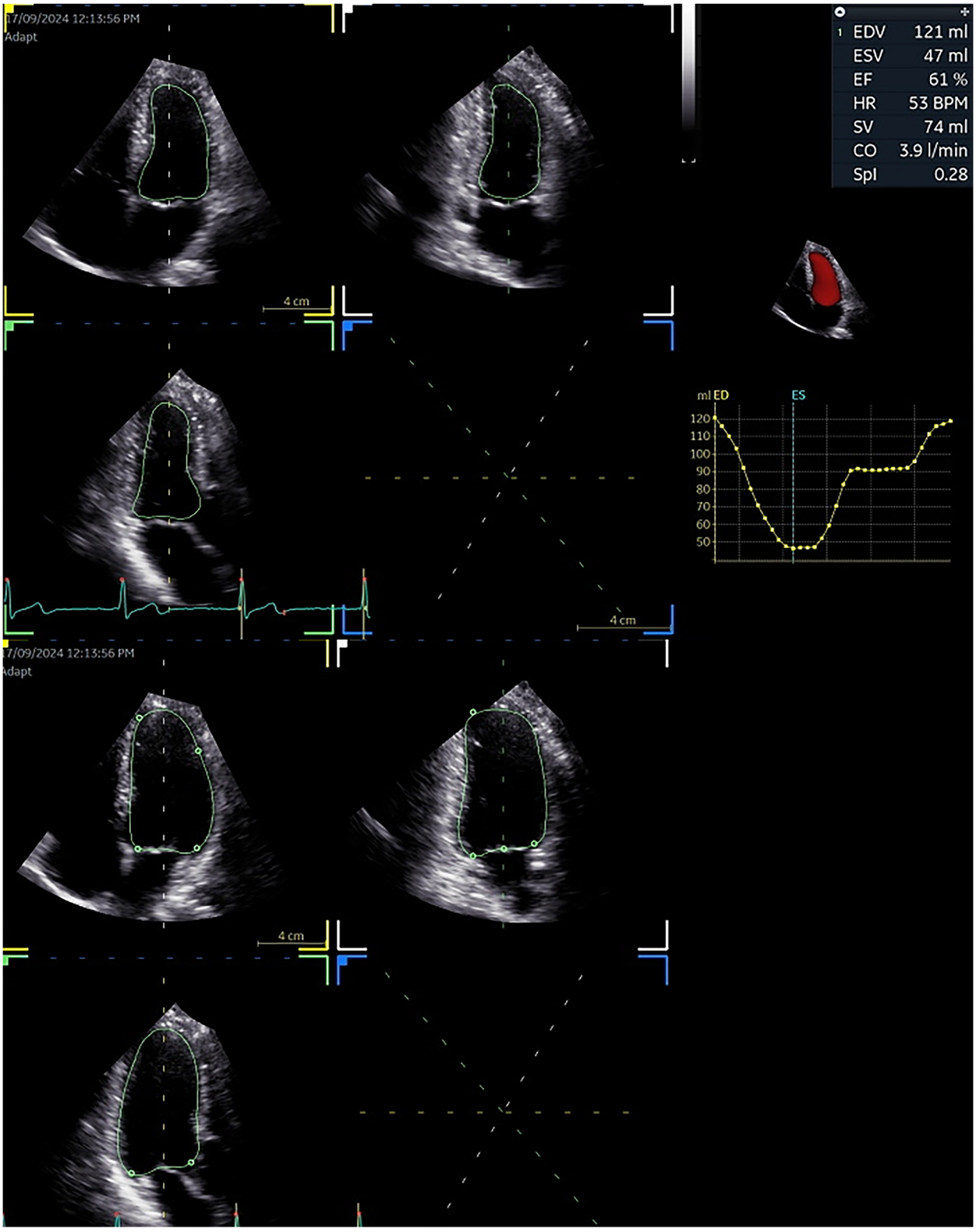

Figure 2. 3D-echo acquisition (GE Healthcare, Vivid E95) analyzed with EchoPAC software. The top three panels display apical views at end-systole, while the bottom panels show corresponding views at end-diastole. The volume–time curve demonstrates frame-by-frame volume changes throughout the cardiac cycle.

(Figure 3) is primarily used for perfusion imaging and not considered a standard for measuring LVEF, its estimate was also in line with the other modalities. Estimated cardiac volumes were smaller with the nuclear imaging techniques compared to 3DE – a finding similar to previous studies [8,14,15].

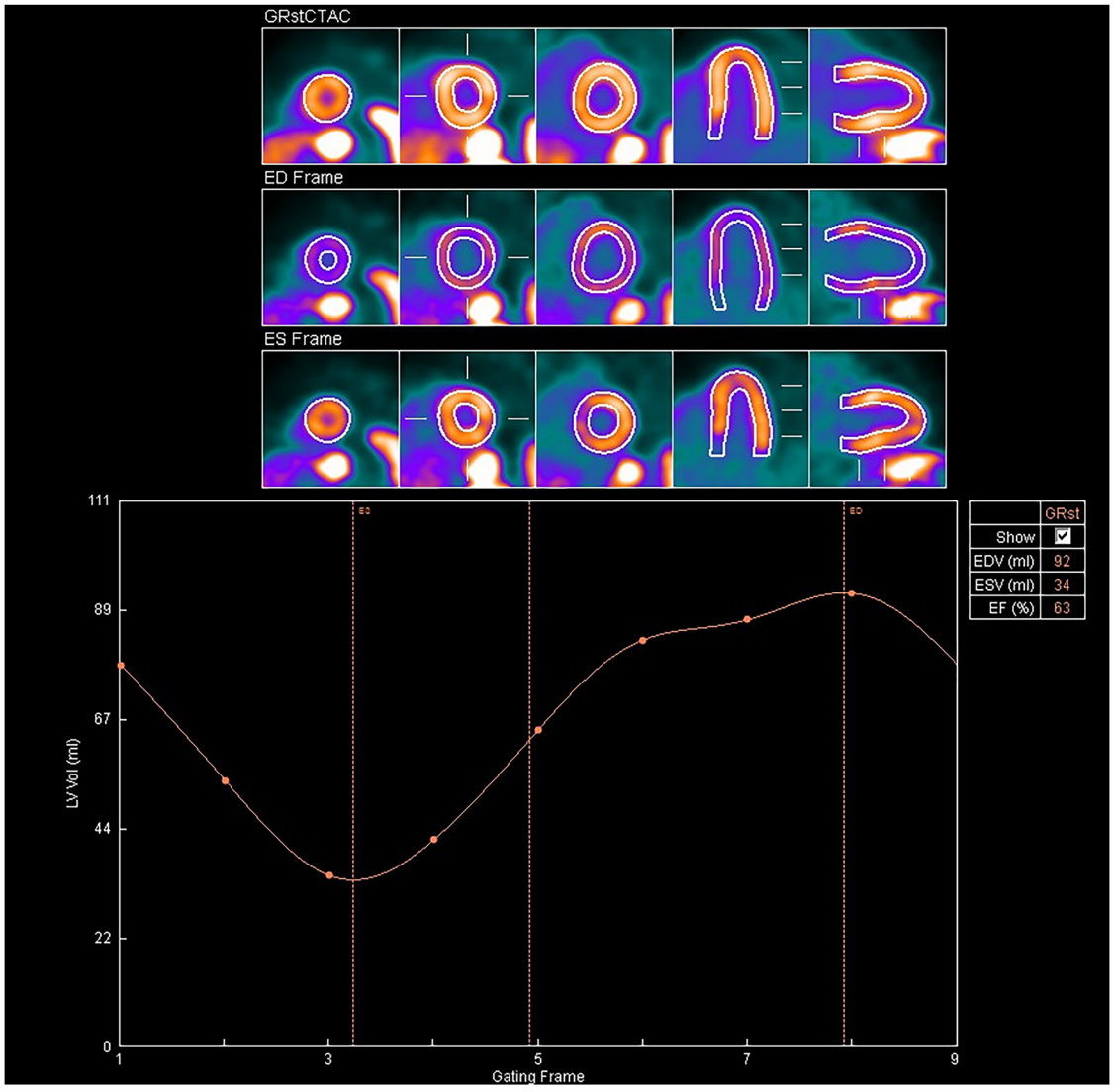

Figure 3. Rb-82 PET acquisition analyzed with 4DM-Corridor software. The top row presents summed myocardial images, the middle row displays the end-diastolic (ED) frame, and the bottom row shows the end-systolic (ES) frame. The lower panel illustrates the volume–time curve reconstructed from gated data acquired over several minutes, representing averaged ventricular volume changes across multiple cardiac cycles.

Several limitations warrant consideration. Myocardial FDG uptake can vary depending on fasting status and patient-specific factors, which may affect the ability to accurately assess cardiac volumes. In this patient, myocardial uptake was sufficient for volumetric analysis (Figure 4), but this may not always be achievable. Prior work has reported diffuse cardiac uptake patterns in over one-third of patients without known heart disease [16], suggesting that under standard fasting protocols, accurate LVEF quantification may be feasible in at least a third of cases – and likely more when interpreted by clinicians experienced in nuclear cardiology. Finally, as a single case report, this finding does not establish accuracy or generalizability across broader patient populations, scanner types, or clinical settings.

When FDG-PET is already clinically indicated, adding a brief gated acquisition during the same session offers an efficient opportunity to assess cardiac function without requiring separate imaging appointments or additional procedures. This approach is time-efficient, cost-neutral, and imposes minimal extra burden on patients or staff. It may be particularly valuable in melanoma patients, who often undergo serial FDG-PET scans for disease surveillance and are exposed to therapies associated with potential cardiotoxicity. As such, gated FDG-PET offers a unique opportunity to expand the clinical utility of an already established imaging modality in oncology.

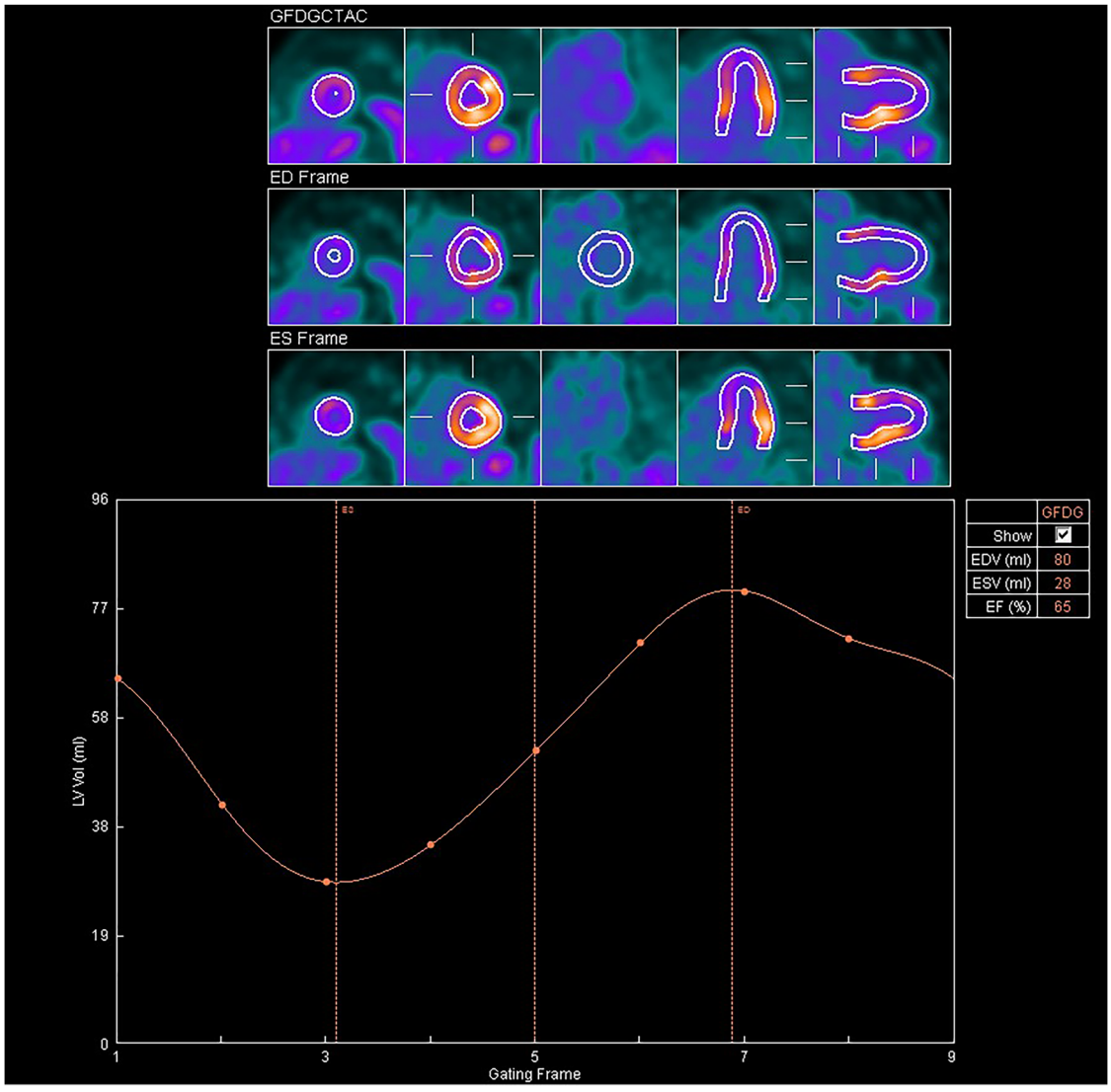

Figure 4. Gated FDG-PET acquisition analyzed with 4DM-Corridor software. Image layout mirrors Figure 3: the top row shows summed myocardial images, the middle row displays the end-diastolic frame, and the bottom row shows the end-systolic frame. The corresponding volume–time curve is shown below.

Conclusion

This case illustrates the potential of gated FDG-PET to provide LVEF assessment during routine oncologic imaging. While the findings are promising, further research is needed to evaluate the reliability and broader applicability. If validated, integrating cardiac assessment into standard FDG-PET workflows could streamline imaging protocols, optimize resource use, and improve care – particularly in melanoma patients receiving therapies with known cardiotoxic risks.

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Generative AI was used for proofreading and improving the manuscript, but the authors take full responsibility for its content and conclusions.

Disclosure statement

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties. No writing assistance was utilized in the production of this manuscript.

Ethical approval

The patient provided written informed consent to participate in the study, which was approved by the Danish Research Ethics Committee (reference number H-24021875). All procedures performed followed the ethical standards of institutional and national research committees, as well as the principles outlined in the Helsinki II Declaration.

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