Cutaneous Malignant Melanoma: Uniquely Suited for Evaluation with FDG-PET/CT

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Abstract
Evaluation with combined FDG-PET/CT increases detection of occult metastatic foci in Cutaneous Malignant Melanoma (CMM). This review of the myriad appearance of CMM illustrates the importance of combined PET/CT evaluation with specific case examples. Comparative anatomic images highlight the difficulty of accurate lesion characterization without the addition of functional evaluation. Potential pitfalls in diagnosis based on either anatomic or functional imaging alone demonstrate the subtlety of some lesions.

CMM is one of the most lethal and unpredictable cancers with a recent alarming increasing incidence (2). Survival is affected by site of metastases, with hope for a surgical cure if the disease is caught early. Accurate staging of cutaneous melanoma is critical for determination of management and prognosis (1), with the ultimate goal of improving lesion detection and patient care.

Methods
A systematic review of the literature was conducted to assess the published data on accuracy of various imaging methods in CMM.

Our institution, PET/CT has been used to evaluate CMM for approximately 10 years. Select images from our experience are presented. Briefly, our institution utilizes a dual modality PET/CT acquisition which includes full body PET and intravenous contrast-enhanced CT imaging from the vertex of the skull to the toes.

Results
The superiority of combined PET/CT in comparison to anatomic or functional imaging alone has been supported by multiple small “narrative” reviews as well as pooled data from recent meta-analyses (3). Comparison of the increased accuracy of PET/CT versus CT or FDG-PET is presented in Table 1. Metabolically active but small lesions may be missed on CT. Lesions “missed” on PET are often seen in the lungs, subcutis and musculature (6).

Table 1: N-stage assessment in CMM by modality*  
<table>
<thead>
<tr>
<th>Modality</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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<tbody>
<tr>
<td>CT</td>
<td>0.844</td>
<td>0.872</td>
<td>0.747</td>
<td>0.926</td>
<td>0.863</td>
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<tr>
<td>FDG-PET</td>
<td>0.924</td>
<td>0.975*</td>
<td>0.948*</td>
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<td>0.946*</td>
<td>0.986*</td>
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* Adapted from (5) based on data from 250 patients. 

The following imaging examples are presented arranged by organ system and integrated with potential teaching points and pitfalls in diagnosis. Unless otherwise noted, each set of images consists of axial CT, attenuation corrected FDG-PET, and fused PET/CT images.

Brain
Melanoma is the 3rd most common cause of brain metastases, which are the 2nd most common cause of mortality after lung disease (4). PET/CT is not well suited secondary to intense background glucose uptake by normal brain. The brain is included on our scans regardless to provide baseline information and assess for large lesions.

Lungs
Excluding skin, subcutaneous tissue and lymph nodes, the lungs are the most common site of metastases and carry slightly better prognosis than other distant sites.

Liver, other solid abdominal organs
PET alone can be insensitive given the high level of glucose metabolism within the background liver. Single contrast phase CT may also not visualize lesions seen on MRI or multiphase study. Splenic, adrenal and other abdominal organ involvement is rare but more common in CMM versus other solid cancers.

Bone and spinal canal
PET may detect metabolically active lesions before they become apparent anatomically. Osseous CMM is primarily lytic and expansile.

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