American College of Radiology
ACR Appropriateness Criteria®
Staging and Follow-up of Melanoma

Variant: 1 Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
Lymphoscintigraphy area of interest	Usually Appropriate	Varies
Radiography chest	Usually Not Appropriate	☢
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
CT head and neck with IV contrast	Usually Not Appropriate	☢☢☢
CT head and neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head and neck without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT whole body	Usually Not Appropriate	☢☢☢☢

Variant: 2 Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
FDG-PET/CT whole body	Usually Appropriate	☢☢☢☢
US area of interest	May Be Appropriate	O
MRI abdomen and pelvis without and with IV contrast	May Be Appropriate	O
MRI abdomen and pelvis without IV contrast	May Be Appropriate	O
MRI head without and with IV contrast	May Be Appropriate	O
CT abdomen and pelvis with IV contrast	May Be Appropriate	☢☢☢
CT chest with IV contrast	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
MRI head without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢

CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
Lymphoscintigraphy area of interest	Usually Not Appropriate	Varies

Variant: 3 Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head without and with IV contrast	May Be Appropriate	O
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/CT whole body	May Be Appropriate	☢☢☢☢
US area of interest	Usually Not Appropriate	O
Radiography chest	Usually Not Appropriate	☢
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 4 Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.

Procedure	Appropriateness Category	Relative Radiation Level
MRI head without and with IV contrast	Usually Appropriate	O
CT chest with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT whole body	Usually Appropriate	☢☢☢☢
US area of interest	May Be Appropriate	O
CT abdomen and pelvis with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
MRI abdomen and pelvis without and with IV contrast	Usually Not Appropriate	O
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢

CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 5 Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.

Procedure	Appropriateness Category	Relative Radiation Level
US area of interest	Usually Appropriate	O
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	O
MRI head without and with IV contrast	Usually Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Appropriate	☢☢☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT whole body	Usually Appropriate	☢☢☢☢
CT chest without IV contrast	May Be Appropriate (Disagreement)	☢☢☢
Radiography chest	Usually Not Appropriate	☢
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 6 Adult. Ocular melanoma. Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI abdomen and pelvis without and with IV contrast	Usually Appropriate	O
MRI head without and with IV contrast	Usually Appropriate	O
FDG-PET/CT whole body	Usually Appropriate	☢☢☢☢
US abdomen	May Be Appropriate	O
CT abdomen and pelvis with IV contrast	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
MRI abdomen and pelvis without IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT chest with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Panel Members

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Summary of Literature Review

Introduction/Background

Malignant melanoma refers to the abnormal proliferation of melanocytes in either the skin, mucous membranes, or the uvea of the eye and is the highest cause of death among cutaneous malignancies. Rates of new melanoma cases doubled from 1965 to 2011, in which there were 65,647 new cases, and are projected to increase to 110,000 by 2030, costing $1.6 billion annually in treatment of new cases. It is currently the fifth most common malignancy overall in the United States and higher rates are associated with increased ultraviolet exposure, especially from sunbathing and tanning booths [1].

According to the American Joint Committee on Cancer, melanoma is T-staged according to the depth of involvement, called the Breslow thickness. In particular, T1 is <1 mm thick, T2 is 1 to 2 mm, T3 is 2 to 4 mm, and T4 is >4 mm. Each of these are subdivided on the basis of a) no ulceration or b) ulceration. Overall stage is determined by the T stage, and presence of nodal metastases (which gives a stage IIIA to IIIC) and presence of distant metastases (which automatically result in stage IV) [2]. For uveal melanoma, T stage is determined based on involvement of ocular structures. T1 tumors only involve the iris. T2 tumors involve the choroid or ciliary body. T3 tumors involve the sclera. T4 tumors involve the outside of the eyeball.

Melanoma most commonly metastasizes to the nearest lymph node drainage basin. In a study of 53 patients with melanoma with histologically proven lymph node metastases, ultrasound (US) was used to map the location of lymph node metastases by body region. In all patients, metastatic lymph nodes were found in the primary drainage area. In 5 of 53 patients, lymph nodes were also found in at least 1 additional drainage area. In 8 of 53 patients, lymph node metastases were found within or immediately around the scar of the primary melanoma [3]. The major drainage areas include the axilla, which drains the upper extremity, upper torso, and lower neck; the groin, which drains the lower extremities, perineum, anus, scrotal skin, vulva, and skin of the abdomen; and the cervical lymph nodes, which drain the head and neck.

There is general agreement that imaging should be obtained, either preoperatively or postoperatively for patients with suspected metastases (due to physical examination, symptoms, or abnormal laboratory values). There is also general agreement that all patients undergo regular clinical follow-up and self examination to monitor for skin lesions. However, there is disagreement over the need for surveillance or initial imaging in asymptomatic patients.

The National Comprehensive Cancer Network (NCCN) recommends surveillance imaging workup in patients with stage III or higher disease or with clinical signs of metastatic disease. A large review of 109,971 patients with melanoma, using the Surveillance, Epidemiology and End Results database

was used to evaluate NCCN guidelines. They researchers found that surveillance imaging as a whole had an excellent negative predictive value (99.8%), but a poor positive predictive value (2.9% for chest imaging and 1.9% for abdominal imaging) [4]. Another cohort study of 473 patients with stage III melanoma compared short interval surveillance imaging (3-6 months) with annual surveillance. Metastases were detected earlier in the short-term surveillance cohort, but there was no difference in survival [5].

The 2019 guidelines for management of melanoma from the American Academy of Dermatology are relatively conservative recommending initial imaging workup only in patients with stage III or IV melanoma or in patient's with symptoms or signs of metastatic disease. US is suggested in patients in whom physical examination is equivocal for lymphadenopathy. The guidelines recommend against surveillance imaging in asymptomatic low-risk patients (stages I or IIA). They recommend optional surveillance imaging in patients with high-risk localized disease but recommend against surveillance past 3 to 5 years given that most recurrence occurs in the first 3 years [6].

According to clinical guidelines from the Cancer Council of Australia, definitive management of cutaneous melanoma consist of wide local excision with a safety margin involving the skin and subcutaneous tissue. Sentinel lymph node (SLN) biopsy is recommended for melanomas 1 mm or thicker, or 0.8 mm with other high-risk, features and should be performed prior to wide local excision to determine need for other preoperative staging workup [7].

Some modern guidelines advocate for more extensive surveillance imaging in certain asymptomatic patients citing improved systemic treatment methods such as immunotherapy, which may confer greater benefit to early diagnosis of metastatic disease. In addition, there is some data that a more aggressive surveillance regimen may benefit some patients. In a study of 580 patients with stage II melanoma, 158 patients had recurrence. Of the patients with recurrence, 60.1% were first detected by the patient, 27.3% by imaging, and 12% by physician clinical examination. The most common sites of distant metastasis were lung (36.3%), brain (21.3%), intraabdominal (11.3%), and osseous (7.5%) [8].

Consensus guidelines from the 2020 Canadian Melanoma Conference recommends surveillance for a period of 5 years after diagnosis for high-risk melanoma defined as stage IIB or higher, with intense surveillance in the first 2 years [9].

The 2022 European consensus-based interdisciplinary guideline for melanoma recommends no imaging in melanomas up to 0.8 mm, US in stage IB and higher, and distant staging for stage IIC or higher [10].

Special Imaging Considerations

When performing PET/CT for oncologic imaging, the most common field of view includes the skull base to the upper thighs. Although some protocols have advocated including head and lower extremities for melanoma, there are limited data to support this. In a study of 173 patients with melanoma who received a total of 296 PET/CT scans including head and lower extremities, 2 new brain metastases were diagnosed; however, these patients already had known stage IV disease with metastases elsewhere. New findings suspicious for malignancy were only detected in the lower extremities in 8 scans (2.7%), and in all of these patients, other distant metastases were

found in the standard skull base to upper-thigh field-of-view images [11]. In another study of 461 whole body PET/CT scans obtained for melanoma, 109 scans (23.6%) showed positive or indeterminate findings in the lower extremities, but 21 findings (4.6%) persisted on follow-up. In all cases of malignant lesions detected in the lower extremities, there were other metastases in the standard skull base to upper thigh field of view [12]. In a study of 153 patients with melanoma receiving 213 PET/CT scans, findings were detected in the legs in 53 patients; however, in only 1 patient was it a finding isolated to the legs (without other metastases) not previously known about [13]. Therefore, although head to lower extremity imaging may detect more lesions in patients with melanoma, there is little evidence that it changes clinical management.

PET/CT is generally performed without intravenous (IV) contrast. One study of 50 patients with metastatic melanoma investigated on a per-lesion basis whether adding IV contrast improved the accuracy of PET/CT. Sensitivity was slightly higher (100% in the PET/CT with IV contrast, 97% in the group without IV contrast), and specificity was identical (93% in both cases). Stage of disease did not change in any case from adding contrast [14].

Two studies have investigated the use of contrast-enhanced US in staging melanoma. In a study of 47 patients, contrast-enhanced US was used to identify SLNs, finding true positive metastases in 7 patients (15%). Sensitivity was 70% and specificity was 97.3% [15]. In another study of 15 patients with cutaneous melanoma, contrast-enhanced US found positive or suspicious findings in 11 patients, 6 of which were true positives. Sensitivity was 100%, but specificity was relatively poor at 61.5% [16]. Given mixed results and the existence of a reference standard for diagnosis—lymphoscintigraphy with SLN biopsy—the usefulness of contrast-enhanced US remains unclear.

The use of hepatobiliary phase MRI contrast agent, gadoxetic acid, has been advocated by some in detecting metastases in the liver, including in melanoma. This contrast agent is taken up by hepatocytes but not tumor cells. Malignant lesions appear hypointense to liver parenchyma on the hepatobiliary phase, typically obtained 20 minutes after injection. There are currently no data specific to melanoma on whether this contrast agent improves detection of metastases; however, it is used in many centers [17].

There are limited data or even consensus on imaging of melanoma in children (<18 years of age), so standard guidelines for adults are generally applied in children with conventional melanoma. However, a small research study demonstrated that less imaging maybe required in spitzoid melanoma, a rare variant that occurs in children and young adults. In a study of 11 patients with spitzoid melanoma who underwent imaging surveillance for 6 years, 1 metastasis was detected. In this same study, 10 pediatric patients with conventional malignant melanoma were followed, and 3 patients developed metastases [18].

Discussion of Procedures by Variant

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.

This variant concerns imaging obtained after newly diagnosed cutaneous or muco-cutaneous melanoma without signs or symptoms of metastatic disease or pathological evidence of regional

nodal metastases. The goal of imaging is to determine whether there is metastatic disease, either regional or distant, prior to surgical resection of the primary tumor. If metastases are present, then there may be modifications to the surgical plan or consideration for initial systemic therapy.

In the discussion below, an area of interest can refer to the following: abdomen, chest, head, lower extremity, neck, pelvis, and upper extremity.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
A. Bone scan whole body

There is no literature to support the use of whole body bone scan to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
B. CT abdomen and pelvis with IV contrast

CT abdomen pelvis with IV contrast is not helpful for staging in this clinical scenario. In a study of 146 patients with at least 1 positive metastatic SLN but who were otherwise asymptomatic, patients received an abdomen and pelvis CT with IV contrast. No metastases were detected in asymptomatic patients [25]. In another study of 132 asymptomatic patients with stage IIB melanoma, metastasis was detected in only 1 patient [29].

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
C. CT abdomen and pelvis without and with IV contrast

There is no literature to support the use of CT abdomen and pelvis without and with IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
D. CT abdomen and pelvis without IV contrast

There is no literature to support the use of CT abdomen and pelvis without IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
E. CT chest with IV contrast

CT chest is not useful in this clinical scenario given its very low probability of finding metastatic disease. In a study of 142 patients with at least 1 positive SLN for metastatic lesion but who were otherwise asymptomatic, patients received a CT chest with IV contrast. No metastases were detected in asymptomatic patients [25].

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.

F. CT chest without and with IV contrast

There is no literature to support the use of CT chest without and with IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
G. CT chest without IV contrast

There is no literature to support the use of CT chest without IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
H. CT head and neck with IV contrast

There is no literature to support the use of CT head and neck with IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
I. CT head and neck without and with IV contrast

There is no literature to support the use of CT head and neck without and with IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
J. CT head and neck without IV contrast

There is no literature to support the use of CT head and neck without IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
K. FDG-PET/CT whole body

FDG-PET/CT has not typically been used in staging asymptomatic melanoma without evidence of nodal metastases. Although limited data have suggested that it may detect metastases in some patients with greater Breslow thickness, the yield is relatively low. In a study of 149 patients with melanoma 1 mm or thicker, without symptoms or evidence of nodal disease, PET/CT detected positive findings in 41 patients (28%), but 85% of these were false positives and only 6 (4%) were true positives [30]. In a study of 165 patients with clinically node-negative head and neck melanoma, there were 0 true positive metastases identified on PET/CT and 2 false negatives. [31]. In another study of 347 patients undergoing baseline staging for melanoma, 11 patients (3.1%) had a PET/CT positive for metastasis. Of these patients, 10 of 11 had a Breslow thickness of 5 mm or greater [32]. In a study of 367 patients with melanoma prior to lymph node biopsy or excision, PET/CT had a poor sensitivity of 34.6% in detecting regional lymph node metastases but a good specificity of 95.4% [33].

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
L. Lymphoscintigraphy area of interest

Lymphoscintigraphy is standard of care to evaluate for regional nodal metastasis in the initial diagnosis of melanoma stage IB or higher prior to surgery. In a study of 36 patients with stage I or II melanoma, lymphoscintigraphy was used to map SLNs and intraoperative gamma probe was used to identify them during surgery for resection. SLN metastasis was identified in 8 of 36 dissected lymph nodes (20.5%) [19]. In a study of 68 patients with cutaneous melanoma, lymphoscintigraphy was performed twice to evaluate reproducibility. In every patient, at least 1 SLN was identified. In 96% of patients, the location was similar between the 2 lymphoscintigraphy studies. In 3 patients the location was different: 2 on the trunk and 1 in the head and neck. In 28% of patients, there were lymph nodes identified in more than 1 basin [20]. In a study of 111 patients with melanoma, lymphoscintigraphy followed by SLN biopsy identified an SLN in 100% of patients, and metastases were found in 17 patients (15%) [21]. And in a study of 79 patients undergoing baseline staging for melanoma, lymphoscintigraphy identified an SLN in 77 (97%) [22]. Intraoperative portable gamma probes have been previously validated to correlate well with traditional planar imaging; for instance, there was a 96% concordance in a study of 40 patients [23].

During the acquisition of lymphoscintigraphic images, 1 study has investigated whether dynamic images should be obtained in addition to static images, finding slightly improved detection of metastatic lymph nodes when adding the dynamic phase (38 of 220 patients or 17%) compared with static images only (35 of 220 patients or 16%) [24].

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
M. MRI abdomen and pelvis without and with IV contrast

There is no literature to support the use of MRI abdomen and pelvis without and with IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
N. MRI abdomen and pelvis without IV contrast

There is no literature to support the use of MRI abdomen and pelvis without IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
O. MRI head without and with IV contrast

MRI of the head without and with IV contrast rarely identifies metastatic disease. In a study of 113 patients with asymptomatic melanoma who underwent brain MRI at the time of initial staging, 93.7% of patients had a negative scan and 6.3% of patients had indeterminate findings; however, these were all determined to be false positives on subsequent imaging as well as pathology in 2 patients [25]. Despite this, some groups recommend brain MRI in patients with thick melanoma

(stage IIB or higher indicating Breslow thickness >2 mm with ulceration, or >4 mm with or without ulceration), for instance the European consensus guidelines [28].

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
P. MRI head without IV contrast

There is no literature to support the use of MRI head without IV contrast to evaluate for metastatic disease.

Variant 1:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. No signs or symptoms of regional or metastatic disease. No pathologic evidence of regional nodal metastases. Initial staging.
Q. Radiography chest

Chest radiography is not useful for baseline staging of melanoma. In a study of 534 asymptomatic patients with melanoma, chest radiography performed at the time of diagnosis identified 23 false positives and only 1 true positive (0.2%) finding [25]. In another study of 383 patients who received a preoperative chest radiograph for baseline staging of melanoma, there were 3 false positives and 0 true positives [26]. And in a study of 227 patients undergoing preoperative baseline staging for melanoma, there were 11 false positives (5%) and 0 true positives [27].

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.

For patients with melanoma and suspected or confirmed regional lymph node metastases, or microscopic satellite, further imaging is warranted, with the goal of assessing the extent of regional involvement, as well as determining if distant metastases are present. In some cases this may result in modifications to the surgical plan, consideration for metastasectomy, or for systemic therapy. Detecting metastases prior to resection of the primary tumor also helps to avoid futile surgeries.

In the discussion below, an area of interest can refer to the following: abdomen, chest, head, lower extremity, neck, pelvis, and upper extremity.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
A. Bone scan whole body

There is no literature to support the use of bone scan whole body to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
B. CT abdomen and pelvis with IV contrast

Evidence is mixed on the usefulness of CT abdomen and pelvis with IV contrast in detecting metastatic disease. In a study of 146 patients with melanoma and at least 1 positive SLN,

metastasis was identified on an abdomen and pelvis CT in only 1 patient (0.7%) [25]. In another study of patients with melanoma and a positive SLN biopsy, there were positive findings in 3 of 65 patients who received an abdomen CT (4.6%) and 1 of 60 patients who received a pelvis CT (1.7%). All of these patients had both a thick melanoma (defined as Breslow thickness of at least 3 mm) and macrometastasis within the SLN, so an imaging strategy targeted to this group may be reasonable [54].

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
C. CT abdomen and pelvis without and with IV contrast

There is no literature to support the use of CT abdomen and pelvis without and with IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
D. CT abdomen and pelvis without IV contrast

There is no literature to support the use of CT abdomen and pelvis without IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
E. CT chest with IV contrast

Evidence is mixed on the usefulness of CT chest with IV contrast in identifying metastatic disease. In a study of 142 patients with melanoma and at least 1 positive SLN, metastasis was identified on a chest CT in only 1 patient (0.7%). Indeterminate findings were found in 27 patients, 22 of which were assumed to be false positives based on subsequent imaging and 3 of which were determined to false positives after surgery [25]. In another study of patients with melanoma and a positive SLN biopsy, there were positive findings in 2 of 64 (3.1%) patients who received a chest CT. Indeterminate findings were found in 26 patients (41%); however, these were not associated with the subsequent development of confirmed metastases. Additionally all of these patients had both a thick melanoma and macrometastasis within the SLN, so an imaging strategy targeted to this group may be reasonable [54].

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
F. CT chest without and with IV contrast

There is no literature to support the use of CT chest without and with IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or

sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
G. CT chest without IV contrast

There is limited evidence to support the use of CT chest without IV contrast [54]. In a study of patients with melanoma and a positive SLN biopsy, there were positive findings in 2 of 64 (3.1%) patients who received a chest CT. IV contrast is not needed for identification of lung nodules/metastasis, but it is helpful in the evaluation of soft tissue metastases, therefore, chest CT with IV contrast is generally preferred.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
H. CT head with IV contrast

There is no literature to support the use of head CT with IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
I. CT head without and with IV contrast

There is no literature to support the use of CT head without and with IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
J. CT head without IV contrast

There is no literature to support the use of CT head without IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
K. FDG-PET/CT whole body

In high-risk patients with melanoma with confirmed or suspected regional lymph node metastases, FDG-PET/CT has generally been found to be a useful diagnostic modality in detecting metastatic disease and is more sensitive than CT alone. In a study of 103 patients with clinical stage IIc, III, or IV melanoma, FDG-PET/CT was positive in more patients compared with CT; in particular, both scans were positive in 18 patients, 17 were positive in only FDG-PET, and 6 were positive in only CT. Of the 17 patients with positive PET scans and negative CT scans, 76% had true-positives based on clinical and radiologic follow-up. In the 6 patients with positive CT scans and negative PET scans (67%), all 6 results were true-positives. Imaging results led to changes in management in 35% of patients, most often canceling surgery due to detection of occult metastases [34]. In another study of 32 patients with stage III or IV melanoma at baseline, PET/CT was performed after conventional

CT and detected new metastases in 4 of 33 patients, which changed management, and there were false-positives in 3 patients [35]. In a study of 64 patients with stage III or IV melanoma, FDG-PET/CT was performed after CT, and there was a change in management in 59% of patients based on the PET results compared with the initial plan based on CT only. The most common change, in 18 patients, was to downstage from suspected disease to no residual metastatic disease [36]. In another study of 70 patients with melanoma with palpable and biopsy proven regional lymph node metastasis, FDG-PET/CT detected previously undiagnosed metastases in 26 patients (37%), which were confirmed on pathology or imaging follow-up, along with 1 false-positive [37]. In a study of 39 patients with melanoma and positive SLN biopsies, true-positive metastases were detected in 15 patients, with a sensitivity of 63% [38]. In another study of 25 patients with melanoma undergoing initial staging, PET/CT detected metastases in 4 patients (16%), with a sensitivity of 58% and specificity of 83% [39]. In a study of 252 patients with stage III melanoma, PET/CT detected metastases in 79 patients (31%); however, this study did not assess for true-positives versus false-positives [40]. In a study of 145 patients with stage III melanoma undergoing baseline staging, PET/CT detected metastases in 7 patients (4.8%) [41]. For assessing lymph nodes in particular, PET/CT was compared with US in a study of 264 patients with melanoma. PET/CT had a sensitivity of 83% compared with 6% for US. Specificity of PET/CT was slightly less at 91%, compared with 98% for US [42].

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.

L. Lymphoscintigraphy area of interest

There is no role for lymphoscintigraphy in patients with established lymph node metastases.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.

M. MRI abdomen and pelvis without and with IV contrast

There is limited evidence to support the use of MRI abdomen and pelvis without and with IV contrast in detecting metastases in baseline cases. In a study of 28 patients with malignant melanoma, abdominal MR without IV contrast was more sensitive at detecting metastases compared with FDG-PET/CT, 100% versus 97%. On MRI, true disease was detected in 5 of 28 patients, and there was 1 false-positive. Diagnosis was based primarily on the T1 sequence as melanoma metastases are usually intrinsically T1 hyperintense due to melanin content [52]. However, given that some melanoma lesions are not T1 hyperintense but can be seen on postcontrast sequences [53], contrast is likely appropriate to administer to improve sensitivity.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.

N. MRI abdomen and pelvis without IV contrast

There is limited evidence to support the use of MRI abdomen and pelvis without IV contrast in detecting metastases in baseline cases. In a study of 28 patients with malignant melanoma, abdominal MR without IV contrast was more sensitive at detecting metastases compared with

FDG-PET/CT, 100% versus 97%. On MRI, true disease was detected in 5 of 28 patients, and there was 1 false-positive. Diagnosis was based primarily on the T1 sequence because melanoma metastases are usually intrinsically T1 hyperintense due to melanin content [52]. However, given that some melanoma lesions are not T1 hyperintense but can be seen on postcontrast sequences [53], contrast is likely appropriate to administer to improve sensitivity.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
O. MRI head without and with IV contrast

There is mixed evidence on the usefulness of MRI head without and with IV contrast in detecting metastases. In a study of 112 patients with melanoma and a positive SLN, brain MRI detected 0 metastases and 7 false positives based on imaging and clinical follow-up [25]. However, in a study of 70 patients with melanoma with palpable lymph node metastases, brain MRI without and with IV contrast detected metastases in 5 patients (7%) [37]. The decision to perform a brain MRI should be made based on level of risk. For patients with a single asymptomatic SLN metastasis, brain MRI may not be needed. But for patients with clinically evident or more extensive regional metastasis, brain MRI is likely useful.

In a study of 224 patients with confirmed brain metastases, quantitative image analysis was used to determine lesion conspicuity on different MRI sequences. A conspicuity score was assigned based on whether the lesion signal intensity was different than the surrounding brain parenchyma, with 0 indicating no difference in signal intensity. Contrast-enhanced T1-weighted images had the highest lesion conspicuity out of the sequences evaluated, and every lesion could be identified on this sequence. Diffusion-weighted imaging was the least sensitive, with 37% of lesions having a conspicuity score of 0. The other sequences, T1 noncontrast, T2, fluid-attenuated inversion-recovery, and susceptibility-weighted imaging were in between. Of note, for every sequence there were multiple lesions for which the conspicuity score was highest on that sequence. Hence multisequence imaging remains the mainstay of MRI [53].

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
P. MRI head without IV contrast

There is no evidence to support the use of MRI head without IV contrast to evaluate for metastatic disease.

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.
Q. Radiography chest

Evidence is mixed on the usefulness of chest radiography in identifying metastasis. In a study of 993 patients with melanoma, 1,938 chest radiographs were performed. Positive or indeterminate findings were identified in 8.6% (155) of patients, and 3.4% of these were false positives. However, many of these patients had known stage IV metastatic disease. In 4% of patients, stage IV

metastasis was established though chest radiograph; however, it was not stated whether any of these patients had evidence of regional nodal metastases or whether these were obtained during initial staging [55]. In a study of 534 asymptomatic patients with melanoma with SLN metastasis, chest radiography performed at time of diagnosis identified 23 false positives and only 1 true positive (0.2%) finding [25].

Variant 2:Adult. Newly diagnosed cutaneous or muco-cutaneous melanoma. Microscopic satellite in primary lesion biopsy specimen, or positive lymph nodes on wide excision or sentinel lymph node biopsy, or suspected regional lymph node involvement based on signs or symptoms. Initial staging.

R. US area of interest

Most studies have found that US is a useful modality for detecting regional metastases; however, sensitivity varies significantly across studies. In a study of 1,288 patients with melanoma, 4,435 USs were performed over a period of 5 years [43]. Suspicious lymph nodes were identified in 504 examinations across 235 patients. In 263 patients, lymph nodes were surgically removed, revealing metastatic disease in 239 patients (90%). Additionally, 28.6% of confirmed metastatic lymph nodes were nonpalpable prior to US. In another study of 67 patients with melanoma, US of the regional lymph node basin was performed in addition to lymphoscintigraphy to determine whether sonographic features could identify a SLN. In the inguinal region, there was perfect agreement between US and lymphscintigraphy in identifying SLN. In the axilla, there was 72% agreement [44]. In a study of 53 patients with melanoma with histologically proven lymph node metastases, US was used to map the location of lymph node metastases by body region. In all instances, lymph nodes were found in the primary drainage area. In 5 of 53 patients, lymph nodes were also found in at least 1 additional drainage area. In 8 of 53 patients, lymph node metastases were found within or immediately around the scar of the primary melanoma [3]. In a meta-analysis of 12 studies over 6,642 patients, US was superior to palpation in the detection of metastatic lymph nodes with an odds ratio of 1,755 versus 21 [45]. In another study of 110 patients with melanoma receiving US to detect regional lymphadenopathy, positive fundings were found in 8 patients, 5 of which were true-positives on pathology, and there were 2 false-negatives, with a sensitivity of 71% and a specificity of 97% [46]. Another study of 125 patients with melanoma 1 mm or thicker undergoing baseline staging with US found that US had a sensitivity of 39% and a specificity of 100% [47]. Some studies have found poorer sensitivity of US in detecting malignant lymph nodes, which may reflect the user dependence of US as a modality. In a large multicenter study of 2,859 patients undergoing preoperative US for melanoma staging, US was positive in 87 patients (3%), with a sensitivity of 6.6% (95% confidence interval (CI), 4.6-8.7) and a specificity of 98.0% (95% CI, 97.5-98.5) [48]. One study of 20 patients with melanoma undergoing preoperative US for the detection of SLNs showed a poor sensitivity of US, which detected only 2 of 17 (11.7%) of metastatic lymph nodes [49]. In another study of 221 patients undergoing initial staging for melanoma with both US and lymphoscintigraphy plus SLN biopsy, US had a sensitivity of 13.6% and a specificity 96.9% when using pathology as the reference standard [50].

Concerning the interpretation of lymph node US, a study of 650 patients undergoing baseline staging for melanoma separately analyzed specific US features of lymph nodes. The best features for detecting malignancy were peripheral vascularity (sensitivity of 77% and specificity of 82%), loss of central echoes (sensitivity of 60% and specificity of 92%), and balloon shape (sensitivity of 30% and specificity of 100%). An additional feature was echo poor islands, which demonstrated a poor sensitivity (21%) but good specificity (96%) [51].

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.

In patients who have had definitive surgical treatment of their primary melanoma, and no regional lymph node or other metastatic disease, surveillance imaging has not been recommended historically. The goal of imaging is to detect recurrent disease prior to symptoms so that it can be treated earlier. However with relatively low probability of recurrence in this patient population, true positives are uncommon. However, an article has suggested the use of whole body FDG-PET/CT specifically for patients with a high-risk primary tumor, and another article has suggested that mucosal melanomas have a higher risk of recurrence warranting surveillance with chest CT.

In the discussion below, an area of interest can refer to the following: abdomen, chest, head, lower extremity, neck, pelvis, and upper extremity.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
A. Bone scan whole body

There is no literature to support the use of whole body bone scan in detecting metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
B. CT abdomen and pelvis with IV contrast

CT abdomen and pelvis with IV contrast is not generally performed for this clinical scenario due to its low yield. In a study of 82 patients with stage II melanoma undergoing whole body CT for surveillance, metastases were detected in 32 patients (39%) but only 2 patients were asymptomatic [64].

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
C. CT abdomen and pelvis without and with IV contrast

There is no literature to support the use of CT abdomen and pelvis without and with IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
D. CT abdomen and pelvis without IV contrast

There is no literature to support the use of CT abdomen and pelvis without IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
E. CT chest with IV contrast

Limited data suggest that CT chest with IV contrast may be helpful for detecting metastases specifically in patient's with mucosal melanoma. In a study of 19 patients with mucosal melanoma undergoing surveillance with a combination of CT and PET/CT, 16 of 19 patients were found to have metastases in the lungs [57]. Contrast is not necessary for detecting lung nodules, although it may be helpful for detecting additional soft tissue findings.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.

F. CT chest without and with IV contrast

There is no literature to support the use of CT chest without and with IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
G. CT chest without IV contrast

Chest CT has historically not been recommended for surveillance in the absence of symptoms; however, limited data suggest that it could be helpful for detecting metastases specifically in patient's with mucosal melanoma. In a study of 19 patients with mucosal melanoma undergoing surveillance with a combination of CT and PET/CT, 16 of 19 patients were found to have metastases in the lungs [57]. Although IV contrast is not needed for detecting lung nodules it is helpful for detecting additional soft tissue findings.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
H. CT head with IV contrast

There is no literature to support the use of CT head with IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
I. CT head without and with IV contrast

There is no literature to support the use of CT head without and with IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
J. CT head without IV contrast

There is no literature to support the use of CT head without IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
K. FDG-PET/CT whole body

There are limited data on whether asymptomatic patients with node negative disease should undergo surveillance imaging. In a study of 36 patients with stage IIB disease and 15 with IIC disease undergoing routine surveillance, PET/CT detected metastases in 6 patients with IIB disease (11%) and 8 patients with IIC disease (40%) [58]. In a study of 322 asymptomatic patients with stage I or II melanoma, PET/CT detected true positive metastases in 37 patients (11%), false positives in 14 patients (4%), and positive lesions in 23 patients who were lost to follow-up and could not be characterized. The majority of true positive lesions, 33 of 37, were in regional lymph nodes. Higher Breslow thickness was associated with higher chance of metastases [59]. In a study of 66 patients with stage I or II disease undergoing routine yearly PET/CT surveillance, 6 developed true positive metastases detected on PET/CT and all of these were stage II at baseline [60].

One study has shown that mucosal melanoma has a relatively high chance of metastasizing. In a study of 19 patients with mucosal melanoma being staged with a combination of CT and PET/CT, 16 of 19 patients were found to have metastases in the lungs and 12 of 19 patients had metastases to the liver [57].

PET/CT may be useful in patients with node negative disease but high-risk primary tumor (IIB or higher), including mucosal tumors.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
L. MRI abdomen and pelvis without and with IV contrast

There is no literature to support the use of MRI abdomen and pelvis without and with IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
M. MRI abdomen and pelvis without IV contrast

There is no literature to support the use of MRI abdomen and pelvis without IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
N. MRI head without and with IV contrast

Limited data suggest that brain MRI may be helpful in patients with high-risk localized disease (stage IIB or higher). One prospective cohort study of 290 patients with stage IIB, IIC, or III melanoma, 115 patients had recurrence while under surveillance. Of these, 7.6% of patients had asymptomatic metastases detected via brain MRI [56]. It was not stated how many brain metastases occurred in stage II versus stage III disease; however, the overall rates of recurrence were similar between stage II and stage III.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
O. MRI head without IV contrast

There is no literature to support the use of MRI head without IV contrast to detect metastases.

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
P. Radiography chest

Chest radiography has a low yield in detecting metastases. In a study of 315 patients with malignant melanoma with a baseline chest radiograph, true positive metastases were detected in 0 patients and there were 20 false positives [62]. In another study of 369 patients with melanoma, 76 of whom were followed with chest radiographs, chest radiography detected metastases in 2 patients; however, sensitivity was only 50% and there was no survival benefit to chest radiography surveillance [63].

Variant 3:Adult. Cutaneous or muco-cutaneous melanoma. Negative clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
Q. US area of interest

There is no literature to support the use of US. In a prospective study of 1,149 patients with stage IB and IIA melanoma, 48% received clinical follow-up and 52% received clinical and US follow-up. There was no difference in survival at 10 years [61].

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.

In patients who have had initial treatment of melanoma, with known metastases either regional or distant, the goal of routine surveillance imaging is to detect recurrent disease prior to symptoms so that it can be treated either with systemic therapy or surgery. Historically, surveillance imaging has not been uniformly recommended in asymptomatic patients; however, most societies and authors recommend routine surveillance in patients with high-risk disease. Some of the most common sites of metastases are the brain, lungs, liver, and regional lymph nodes, so surveillance imaging should cover at minimum the head, chest, abdomen, and lymph node drainage area of the primary tumor.

In the discussion below, an area of interest can refer to the following: abdomen, chest, head, lower extremity, neck, pelvis, and upper extremity.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
A. Bone scan whole body

There is no literature to support the use of whole body scan to detect metastases.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
B. CT abdomen and pelvis with IV contrast

CT abdomen and pelvis with IV contrast may be helpful for surveillance. In a study of 290 patients with stage IIB, IIC, or III melanoma, receiving routine whole body CT surveillance at regular 6-month intervals, 7.9% (23) developed abdominal organ metastases on CT, half of which (11) were in the liver. All patients were asymptomatic and 1 patient had abnormal laboratory values [66].

For CT of the abdomen, a single portal venous phase is the protocol of choice for detecting hepatic metastases from melanoma. In a prospective study of 98 patients with melanoma, 46 of whom had hepatic metastases, blinded reviewers compared dual-phase scans (arterial and portal venous) to portal venous phase only. Portal venous phase was just as sensitive for detecting metastases, with a sensitivity of 98% compared to 96% for dual-phase. Additionally, every lesion was rated as more conspicuous on portal venous phase than arterial phase [76].

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
C. CT abdomen and pelvis without and with IV contrast

There is no literature to support the use of CT abdomen and pelvis without and with IV contrast to detect metastases.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
D. CT abdomen and pelvis without IV contrast

There is no literature to support the use of CT abdomen and pelvis without IV contrast to detect metastases.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
E. CT chest with IV contrast

There is some evidence that chest CT with IV contrast is a useful modality for detecting lung metastases. In a study of 290 patients with stage IIB, IIC, or III melanoma, receiving routine whole

body CT surveillance at regular 6-months interval, 7.9% (23) developed lung metastases detected by CT, and all but 1 patient were asymptomatic [66].

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
F. CT chest without and with IV contrast

There is no literature to support the use of CT chest without and with IV contrast to detect metastases.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
G. CT chest without IV contrast

There is some evidence that chest CT is a useful modality for detecting lung metastases. In a study of 290 patients with stage IIB, IIC, or III melanoma, receiving routine whole body CT surveillance at regular 6-month intervals, 7.9% (23) developed lung metastases detected by CT, and all but 1 patient were asymptomatic [66]. Contrast is not needed to detect lung metastases, although it may help detect other soft tissue findings.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
H. CT head with IV contrast

Head CT with IV contrast rarely identifies metastatic disease, and brain MRI is a superior modality for detecting metastases. In a study of 25 patients with stage IIB to IIIC melanoma who received a head CT, there was 1 false-positive case and 0 true-positive cases [78]. In another study of 199 asymptomatic patients with stage IIC, III, or IV melanoma undergoing routine surveillance, 367 head CTs were obtained, and true positive metastases were present in 8 patients (2.1%) [79].

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
I. CT head without and with IV contrast

There is no literature to support the use of CT head without and with IV contrast to detect metastases.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
J. CT head without IV contrast

There is no literature to support the use of CT head without IV contrast to detect metastases.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
K. FDG-PET/CT whole body

Historically, there has been controversy as to whether surveillance imaging should be performed routinely or only upon signs or symptoms of recurrent disease. Currently, PET/CT is generally recommended for restaging high-risk disease even in the absence of symptoms. In a retrospective study of 170 patients with stage III melanoma who received PET/CT scans, 57 (35%) had suspicious findings on PET; however, 45 patients had no symptoms and their scans were determined to be true-positives [67]. In a retrospective study of 1,480 patients with stage IIB to IIID melanoma, 2 cohorts were analyzed: cohort 1, in which FDG-PET/CT was only obtained if there was clinical suspicion of recurrence, and cohort 2, in which surveillance PET/CTs were obtained routinely on a

predefined schedule. More instances of recurrence were detected in cohort 2 (32.3%) compared with cohort 1 (27.5%). This was only true of distant metastases; the rate of detection of locoregional recurrence was similar [68]. In another study of 158 asymptomatic patients with stage IIB to IIIA melanoma who underwent routine surveillance, there were 6 true-positives and 13 false-positives [69]. In a study of asymptomatic patients with stage III or higher melanoma who had at least 1 surveillance PET/CT, 2 of 20 patients with microscopic disease developed metastases on PET/CT, and 4 of 20 patients with macroscopic disease developed metastases [70]. In a study of 110 patients with stage IIB to IIIB melanoma, metastases were detected in 45 patients (41%), 11 of which were asymptomatic (10%); however, there was no survival benefit to detecting occult metastases [71]. In a study of 299 patients with stage III to IV melanoma undergoing surveillance PET/CT, 98 patients (33%) developed clinically occult metastases, detected by PET/CT, and 64 patients (21%) developed metastases that were detected clinically. However, there were many false-positives detected by PET/CT, with a positive predictive value of only 37% [72]. In a study of 18 asymptomatic patients receiving PET/CT surveillance for stage III or IV melanoma, true-positives were detected in 9 patients, and a false-positive was detected in 1 patient [56].

PET/CT is less helpful in restaging of the primary site of melanoma. In a study of patients with IIIB or IIIc extremity melanoma, PET/CT detected residual metabolic activity in 13 of 32 (41%) of patients of complete histologic response and only correctly identified complete response in 19 of 32 (59%) of patients [73].

Given the risk of false-positives, the decision to perform routine surveillance should likely be driven by risk of recurrence.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
L. MRI abdomen and pelvis without and with IV contrast

There is no literature to support the use of MRI abdomen and pelvis without and with IV contrast to detect metastatic disease.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
M. MRI abdomen and pelvis without IV contrast

There is no literature to support the use of MRI abdomen and pelvis without IV contrast to detect metastatic disease.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
N. MRI head without and with IV contrast

MRI of the head without and with IV contrast is helpful in surveillance of melanoma. In a study of 60 patients with metastatic melanoma and without brain metastases at baseline, who underwent surveillance brain MRI scans, 17 patients (28%) developed brain metastases diagnosed on MRI, and 11 were asymptomatic [65].

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
O. MRI head without IV contrast

There is no literature to support the use of MRI head without IV contrast to detect metastatic

disease.

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
P. Radiography chest

Chest radiography has relatively poor accuracy in detecting metastases, with no proven benefit to patients. In a study of 108 patients with melanoma and a SLN metastasis, surveillance chest radiographs were obtained for 5 years. True-positive metastases were detected by chest radiograph in 11 patients (10.2%), and there were 19 false-positives, with a sensitivity of 48% and a specificity of 78%. Additionally, there was only a change in management in 3 patients, who were referred for surgical resection; however, outcomes were poor [77].

Variant 4:Adult. Cutaneous or muco-cutaneous melanoma. Positive clinical or surgical regional lymph nodes or metastatic disease at initial diagnosis. Surveillance.
Q. US area of interest

There is mixed evidence on whether routine US surveillance is beneficial to patients compared with clinical examinations. In a study of 373 patients with melanoma, routine US and clinical examinations were performed. US was more sensitive at detecting metastatic lymphadenopathy compared with clinical examination (92.9% versus 71.5%) but was slightly less specific (97.8% versus 99.6%). However, only 7.2% of patients benefited from US, and 8.3% of patients were negatively affected due to false positive or indeterminate findings, leading to delays in surgery, unnecessary procedures, or follow-up examinations [74]. In another study of 225 patients with a positive SLN biopsy but no lymph node dissection undergoing routine surveillance, US was used concurrently with PET/CT and/or CT. There were 24 patients (11%) with lymph node recurrence on any modality. All metastatic lymph nodes detected by US were also detected by CT or PET/CT [75].

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.

In patients with suspected recurrent or metastatic disease based on clinical signs, symptoms, physical examination findings, or laboratory values, imaging is recommended with the goal of assessing for the presence of metastases and extent of disease. If metastases are found, then a treatment plan can be developed. Imaging should cover the suspected site of recurrence; however, given that melanoma commonly metastasizes to multiple locations, it is likely appropriate to expand the anatomy imaged to include the brain, chest, abdomen, and regional lymph node drainage area of the primary tumor.

In the discussion below, an area of interest can refer to the following: abdomen, chest, head, lower extremity, neck, pelvis, and upper extremity.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
A. Bone scan whole body

There is no literature to support the use of whole body bone scan to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
B. CT abdomen and pelvis with IV contrast

CT abdomen and pelvis may be helpful for the detection of metastases. In a study of 290 patients with stage IIB, IIC, or III melanoma receiving routine whole body CT surveillance at regular 6-month

intervals, 7.9% (23) developed abdominal organ metastases on CT, half of which (11) were in the liver. All were asymptomatic, and 1 had abnormal laboratory values [66]. In another study of 146 patients with head and neck melanoma, 7% of patients developed metastases in the pelvis, and there were no cases in which there were isolated pelvic metastases. This suggests that imaging of the pelvis can be excluded in head and neck melanoma [85].

For CT of the abdomen, a single portal venous phase is the protocol of choice for detecting hepatic metastases from melanoma. In a prospective study of 98 patients with melanoma, 46 of whom had hepatic metastases, blinded reviewers compared dual-phase scans (arterial and portal venous) to portal venous phase only. Portal venous phase was just as sensitive for detecting metastases, with a sensitivity of 98% compared to 96% for dual-phase. Additionally, every lesion was rated as more conspicuous on portal venous phase than arterial phase [76]

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
C. CT abdomen and pelvis without and with IV contrast

There is no literature to support the use of CT abdomen and pelvis without and with IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
D. CT abdomen and pelvis without IV contrast

There is no literature to support the use of CT abdomen and pelvis without IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
E. CT chest with IV contrast

There is some evidence that chest CT is a useful modality for detecting lung metastases. In a study of 290 patients with stage IIB, IIC, or III melanoma, receiving routine whole body CT surveillance at regular 6-month intervals, 18.3% developed lung metastases detected by CT, and all but 1 patient were asymptomatic [66].

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
F. CT chest without and with IV contrast

There is no literature to support the use of CT chest without and with IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
G. CT chest without IV contrast

There is some evidence that chest CT is a useful modality for detecting lung metastases. In a study of 290 patients with stage IIB, IIC, or III melanoma, receiving routine whole body CT surveillance at regular 6-month intervals, 18.3% developed lung metastases detected by CT, and all but 1 patient were asymptomatic [66]. Contrast is not necessary to detect lung metastases; however, it may be helpful to detect other soft tissue findings.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.

H. CT head with IV contrast

There is no literature to support the use of CT head with IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
I. CT head without and with IV contrast

There is no literature to support the use of CT head without and with IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
J. CT head without IV contrast

There is no literature to support the use of CT head without IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
K. FDG-PET/CT whole body

FDG-PET/CT is a useful modality for detecting metastases after recurrent disease. In a study of 78 patients with local, regional, or distant recurrent disease, FDG-PET changed management in 27% of patients, and 5 of 23 (22%) patients with established local or regional disease were upstaged to distant disease. Sensitivity and specificity based on subsequent follow-up were both 95% [86]. In another study of 74 patients who had previous surgical management of melanoma and had clinically suspected recurrence, PET/CT detected metastases in 27 patients, 24 of which were true-positives, and changed management in 18 patients. Sensitivity was 82%, and specificity was 93% [87]. In a study of 107 patients with established stage III or IV melanoma being considered for metastasectomy, PET/CT changed management in 79 patients (74%). In 20 patients (19%), PET/CT demonstrated resolution of metastases, and in 32 patients (30%), surgery was deemed ineffective due to new metastases. In the rest of the patients, there were either modifications to the surgical plan or changes to a different treatment modality, namely radiotherapy [88]. In a meta-analysis of 11 studies involving the restaging of melanoma with PET/CT, the sensitivity of PET/CT was 0.94 (95% CI, 0.90-0.97), and specificity was 0.91 (95% CI 0.88-0.93) [89]. PET/CT has also been shown to be more accurate than CT in distinguishing complete response from partial response in treated tumors. In a study of 26 patients receiving both CT and PET/CT for restaging of melanoma, 10 had partial response on CT but complete response on PET/CT. None of these patients relapsed at 9 months of follow-up. No patients had complete response on CT but partial response on PET/CT [90]. IIn a multicenter study of 319 patients with stage II, III, or IV disease undergoing restaging, PET/CT upstaged 56 patients (17%) from M0 to M1 disease [91]. In a study of 39 patients with stage III or IV melanoma undergoing PET/CT staging, 16 patients (41%) were upstaged and 5 (12.8%) were downstaged [92].

In ocular melanoma in particular, most patients who develop metastases will have metastatic disease in the liver. In a study of 20 patients with choroidal melanoma with suspected metastases, PET/CT detected metastases in 8 patients (40%). All 8 had liver metastases, and there were 0 false-positives [93]. In a study of 22 patients with ocular melanoma undergoing restaging, 18 patients had a positive PET/CT for metastasis. In 17 patients there were metastases to the liver [94]. For this reason, liver MR is favored by some over PET/CT for ocular melanoma staging because it is highly sensitive for detecting liver metastases and greater than PET/CT in several studies.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected

regional recurrence or metastatic disease. Staging.
L. MRI abdomen and pelvis without and with IV contrast

MRI abdomen and pelvis without and with IV contrast is helpful in detecting metastases, particularly in patients with ocular melanoma due to its high propensity for metastasizing to the liver, and is more sensitive than PET/CT for detecting liver metastases. In a study of 188 patients with high-risk ocular melanoma, abdominal MRI detected metastases in 48% (90) of patients, and 92% of these (83) were asymptomatic [81]. In a study of 10 patients with ocular melanoma and a total of 108 liver metastases, MRI and FDG-PET/CT were compared for each metastasis. MRI was more sensitive than FDG-PET/CT in which 31% of lesions were detected on both, 65% of lesions were detected on MRI only, and 4% on PET/CT only. [82] In a study of 33 patients with high-risk ocular melanoma (T2 stage or higher), 8 patients (21.6%) developed liver metastases detected by CT or MRI [83].

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
M. MRI abdomen and pelvis without IV contrast

There is no literature to support the use of MR abdomen and pelvis without IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
N. MRI head without and with IV contrast

MRI of the head without and with IV contrast is likely helpful in restaging of melanoma. In a study of 60 patients with metastatic melanoma and without brain metastases at baseline, who underwent surveillance brain MRI scans, 17 patients (28%) developed brain metastases diagnosed on MRI, and 11 were asymptomatic [65]. In a study of 100 patients with melanoma, 11 were found to have brain metastases in brain MRI. In this study, 5 patients were asymptomatic, and all 11 patients already had established stage IV disease at time of diagnosis [84].

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
O. MRI head without IV contrast

There is no literature to support the use of MRI head without IV contrast to detect metastases.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
P. Radiography chest

Chest radiography has a poor accuracy in the detection of metastatic disease with no proven benefit to patients. In a study of 993 patients with melanoma, 1,938 chest radiographs were performed. Positive or indeterminate findings were identified in 8.6% (155) patients, and 3.4% of these were false positives [55]. Additionally, there was no survival benefit to those who had stage IV disease diagnosed via chest radiography versus those who had already established stage IV disease.

Variant 5:Adult. Recurrent cutaneous, muco-cutaneous, or ocular melanoma. Suspected regional recurrence or metastatic disease. Staging.
Q. US area of interest

US is helpful in confirming locally recurrent lymph nodes. In a study of 460 patients after primary treatment of melanoma, 37 patients were found to have recurrent regional lymph nodes on US

with a sensitivity of 100% and a specificity of 93% [80].

Variant 6:Adult. Ocular melanoma. Initial staging.

For patients with ocular melanoma, the goal of imaging is to assess for distant metastatic disease. If metastases are present, then patients may benefit from systemic therapy or local therapies such as intraarterial liver chemotherapy. Imaging should include the liver given the high propensity of ocular melanoma for metastasizing to this organ.

Variant 6:Adult. Ocular melanoma. Initial staging.
A. Bone scan whole body

There is no literature to support the use of whole body bone scan to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
B. CT abdomen and pelvis with IV contrast

There is limited literature on the usefulness of CT abdomen and pelvis with IV contrast in detecting metastases from ocular melanoma. In a study of 215 patients with uveal melanoma, CT detected more metastases than US in 34% of patients, but fewer than MRI. However, this study's goal was to evaluate US in comparison with CT and MRI; the overall sensitivity and specificity of CT were not provided, and many of these scans were surveillance rather than initial staging [102].

Variant 6:Adult. Ocular melanoma. Initial staging.
C. CT abdomen and pelvis without and with IV contrast

There is no literature to support the use of CT abdomen and pelvis without and with IV contrast.

Variant 6:Adult. Ocular melanoma. Initial staging.
D. CT abdomen and pelvis without IV contrast

There is no literature to support the use of CT abdomen and pelvis without IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
E. CT chest with IV contrast

There is no literature to support the use of CT chest with IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
F. CT chest without and with IV contrast

There is no literature to support the use of CT chest without and with IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
G. CT chest without IV contrast

There is no literature to support the use of CT chest without IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
H. CT head with IV contrast

There is no literature to support the use of CT head with IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
I. CT head without and with IV contrast

There is no literature to support the use of CT head without and with IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
J. CT head without IV contrast

There is no literature to support the use of CT head without IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
K. FDG-PET/CT whole body

Uveal melanoma has a high propensity for metastasizing to the liver, and both PET/CT and liver MRI have been used in initial staging, with several studies suggesting superior sensitivity of liver MRI compared with PET/CT. In a small study of 15 patients with uveal melanoma, prior to treatment, FDG-PET/CT was less sensitive than liver MRI in detecting liver metastases (41% compared to 67%). Positive predictive value was 100% for PET/CT and 95% for MRI [95]. In a study of 10 patients with uveal melanoma and a total of 108 liver metastases, MRI and FDG-PET/CT were compared for each metastasis. MRI was more sensitive than FDG-PET/CT in which 31% of lesions were detected on both, 65% of lesions were detected on MRI only, and 4% were detected on PET/CT only [82]. In a study of 108 patient's with uveal melanoma undergoing both PET/CT, only 3 patients were found to have metastases, and only 2 of these were detected by PET/CT. However, 10 patients had incidentally detected second malignancies [98]. In a study of 52 patients with choroidal melanoma undergoing initial staging, PET/CT detected metastases in 2 patients (3.8%), both of whom had liver metastases, and false positives in 3 patients [99]. In a study of 333 patients with choroidal melanoma undergoing PET/CT for initial staging, 7 patients had confirmed metastases (2.1%), and 28 had synchronous second malignancies. All 7 patients with metastases had liver metastases. In 6 of 7 had T4 disease, and 1 of 7 had T3 disease. No patients with T1 or T2 disease had metastases [100]. In a study of 14 patients with conjunctival melanoma, 7 with a new diagnosis and, 7 previously treated, FDG-PET/CT detected no metastases; however, this study was limited by its small sample size [101].

Variant 6:Adult. Ocular melanoma. Initial staging.
L. MRI abdomen and pelvis without and with IV contrast

Due to ocular melanoma's propensity for metastasis to the liver, and superior sensitivity of MRI compared with other modalities, MRI is a useful modality for detecting metastases. In a small study of 15 patients with uveal melanoma, prior to treatment, FDG-PET/CT was less sensitive than liver MRI in detecting liver metastases (41% compared to 67%). Positive predictive value was 100% for PET/CT and 95% for MRI [95]. In a study of 10 patients with uveal melanoma and a total of 108 liver metastases, MRI and FDG-PET/CT were compared for each metastasis. MRI was more sensitive than FDG-PET/CT in which 31% of lesions were detected on both, 65% of lesions were detected on MRI only, and 4% were detected on PET/CT only [82].

Variant 6:Adult. Ocular melanoma. Initial staging.
M. MRI abdomen and pelvis without IV contrast

There is no literature to support the use of MRI abdomen and pelvis without IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
N. MRI head without and with IV contrast

MRI head without and with IV contrast may be indicated for local staging of ocular melanoma. Local staging is primarily done via comprehensive eye examination by an ophthalmologist. However, MRI can be a useful adjunct modality to determine the location of the tumor, any extension into the orbit, and for planning and restaging after radiotherapy [96, 97].

Variant 6:Adult. Ocular melanoma. Initial staging.
O. MRI head without IV contrast

There is no literature to support the use of MRI head without IV contrast to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
P. Radiography chest

There is no literature to support the use of chest radiography to detect metastases.

Variant 6:Adult. Ocular melanoma. Initial staging.
Q. US abdomen

There is limited literature on the usefulness of abdominal US in detecting metastases from ocular melanoma. In a study of 215 patients with uveal melanoma, US detected metastases in 95% of patients who had metastases found on CT or MRI. Although CT and MRI detected more metastases in 29% of patients, US detected more metastases in 7% of patients. [102]. However, many of these were surveillance scans. As a baseline staging tool, there is no specific literature.

Summary of Highlights

This is a summary of the key recommendations from the variant tables. Refer to the complete narrative document for more information.

- Variant 1: For initial staging and imaging of newly diagnosed cutaneous or mucocutaneous melanoma, without evidence of regional or metastatic disease, lymphoscintigraphy is the modality of choice followed by SLN biopsy to determine nodal status.
- Variant 2: For staging and imaging of newly diagnosed cutaneous or mucocutaneous melanoma, with microscopic satellite in the primary lesion and, confirmed or suspected lymph node involvement, FDG PET/CT is the modality of choice for detecting metastases, and the most sensitive overall. MRI head without and with contrast may be appropriate to detect brain metastases. US may be appropriate to detect regional lymphadenopathy. CT chest with contrast plus CT abdomen and pelvis with contrast or MRI abdomen and pelvis may be appropriate for staging patients if FDG PET/CT is not available.
- Variant 3: For surveillance of cutaneous or mucocutaneous melanoma, with no nodal or other metastatic disease, imaging may be appropriate in select scenarios. FDG PET/CT and MRI head without and with contrast may be helpful in patients with high risk localized disease (stage IIB or IIC). CT chest is likely appropriate in patients with mucosal melanoma.
- Variant 4: For surveillance of cutaneous or mucocutaneous melanoma with positive lymph nodes or other metastases at baseline, surveillance is recommended with FDG PET/CT and MRI head without and with contrast. There is evidence that CT chest and CT abdomen and pelvis with contrast can be used to diagnose metastatic disease; however, FDG PET/CT is likely more sensitive. US may be used to assess for regional recurrence but is likely not necessary in addition to CT or PET/CT.
- Variant 5: For staging of suspected recurrent or metastatic melanoma, there are several options for imaging. FDG PET/CT, MRI head without and with contrast, CT abdomen and pelvis with contrast, CT chest, MRI abdomen and pelvis without and with contrast, and US of the area of interest are all appropriate choices, depending on the site of suspected recurrence.
- Variant 6: For initial staging and imaging of ocular melanoma, MRI head without and with

contrast and MRI abdomen and pelvis without and with contrast are recommended. FDG PET/CT, US abdomen (focusing on the liver), and CT abdomen and pelvis with contrast are reasonable alternatives to MRI abdomen and pelvis.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation

dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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