

Metastatic malignant melanoma revisited

Poster No.: C-2446
Congress: ECR 2010
Type: Educational Exhibit
Topic: Musculoskeletal
Authors: C. Paulino, B. Gonçalves, P. Marques, M. Gonçalo, F. Caseiro-Alves; Coimbra/PT
Keywords: melanoma, metastases, CT
DOI: 10.1594/ecr2010/C-2446

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org

LEARNING OBJECTIVES

To present an organ-by-organ review of the various CT appearances of malignant melanoma in the head and neck, chest, abdomen, and musculoskeletal system.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Background

BACKGROUND

- Beside all the efforts of public health campaigns, incidence rate of malignant melanoma has been *increasing* in Europe over the past decades.
- Malignant melanoma is an aggressive neoplasm that *can involve virtually every organ system*, assuming a wide variety of appearances.
- The most common sites of metastases are the *lungs, liver, and central nervous system*.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

PATHOPHYSIOLOGY

- Initially melanoma spreads *locally* and then to *regional lymph nodes* in a predictable fashion.
- **Haematogenous metastatic disease** occurs via vertical local spread to blood vessels in the dermis or via lymphatic spread to blood vessels in local lymph nodes.
- *There is often a long latent period between the time of diagnosis of the primary tumor and the development of metastasis (as late as 15-20 years, although the majority of metastases are seen within 2-5 years of initial diagnosis).*
- ***Even years after resection of skin melanoma, the possibility of metastases should be considered in the symptomatic patient and imaging arranged accordingly.***

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

STAGING

- *Initial staging is surgically defined following wide local excision.*
- **US** can be used early to assess regional draining lymph nodes and to guide fine needle aspiration.
- **Sentinel node lymphoscintigraphy** allows identification and precise localisation of potentially involved lymph node basins.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

STAGING

- *In tumors ≥ 4 mm at initial presentation, or thinner tumors with clinical evidence of nodal spread, an **enhanced CT Chest/Abdomen/Pelvis** is required for further evaluation.*
- *If disseminated disease is suspected then **CT of the brain and neck** is also performed.*
- CT is the most widely used modality for tumour staging and follow-up. However, other techniques can be useful in difficult cases.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

STAGING

- **FDG-PET** is most useful in the evaluation of patients with advanced-stage melanoma or in recurrent disease.
- FDG-PET is more accurate than CT alone in re-staging and follow up.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Imaging findings OR Procedure details

1. LYMPH NODES

- *The nodal distribution usually depends on the location of the patient's primary tumor and its lymphatic drainage.*
- *Often, the distribution and extent of nodal involvement can simulate that of lymphoma.*
- Metastatic nodal disease is manifest as enlarged rounded nodes with loss of the normal fatty hilum and abnormal vascularity.
- These features are demonstrated on both **US** and **CT**.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

1. LYMPH NODES



Figure 1. US and axial CT demonstrating a metastatic left submandibular node in a patient with melanoma of the left face.

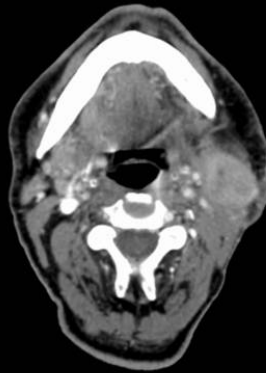


Figure 2. Axial CT demonstrating abnormal left axillar nodes in a patient with melanoma of the left forearm.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

2. HEAD AND NECK

HEAD

- *Melanoma metastatic to the head can involve virtually any intracranial or extracranial structure, including the meninges, orbit, nasopharynx, internal auditory canal, choroid plexus, bone, and muscle. However, the brain is the most common site of metastases to the head from melanoma.*

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

2. HEAD AND NECK

BRAIN

- Melanoma is associated with hemorrhagic brain metastases.
- The **CT** features usually consist of single or multiple nodules of increased attenuation that enhance after contrast.
- These metastases are often located in the gray matter or at the subcortical gray-white matter junction surrounded by varying amounts of edema.

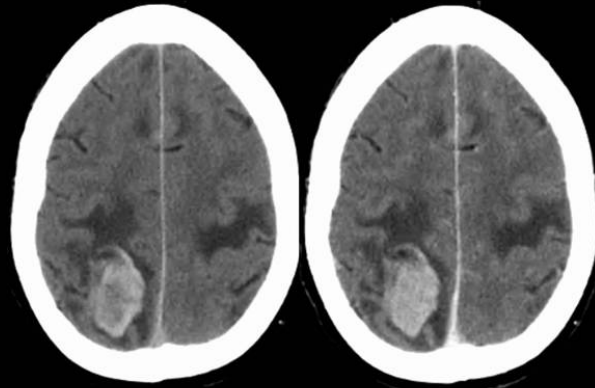


Figure 3. Axial pre and postcontrast CT images demonstrating areas of increased attenuation in the precontrast scan that enhanced after contrast infusion.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

2. HEAD AND NECK

BRAIN

- On **MRI**, two classic imaging patterns have been described for melanoma metastatic to the brain based on signal intensity characteristics:
 - the melanotic form is characterized by T1 hyperintensity and T2 hypointensity;
 - the amelanotic form is characterized by T1 hypointensity and T2 hyperintensity.
- Other patterns include small and rapidly growing metastases, miliary metastases, and subependymal metastases.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

2. HEAD AND NECK

BRAIN

- *The differential diagnosis for an intraparenchymal hematoma in a melanoma patient includes:*
 - *primarily hypertensive hemorrhage;*
 - *vascular anomalies (including arteriovenous malformation and cavernous malformation);*
 - *hemorrhagic infarction;*
 - *amyloid angiopathy;*
 - *trauma;*
 - *other hemorrhagic neoplasms (e.g. lung, breast, thyroid, renal cell and choriocarcinoma).*

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

2. HEAD AND NECK

BRAIN

- *Imaging features on **MRI** that suggest hemorrhagic neoplasm rather than benign intraparenchymal hematoma includes:*
 - *a heterogeneous or mixed intensity pattern;*
 - *an incomplete hemosiderin rim;*
 - *disproportionately large amount of edema compared with hematoma size, persistence of or increase in the edema over several days or weeks;*
 - *persistence of T2 hypointensity beyond the expected time for a nonneoplastic hematoma;*
 - *initial appearance of T1 hyperintensity (subacute methemoglobin) centrally or eccentrically in the hematoma.*

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

2. HEAD AND NECK

THYROID

- Metastases to the thyroid are rare.
- *Metastatic disease hasn't a characteristic sonographic appearance, but it should be considered when a solid thyroid nodule is identified in a patient with a known extrathyroidal malignancy.*

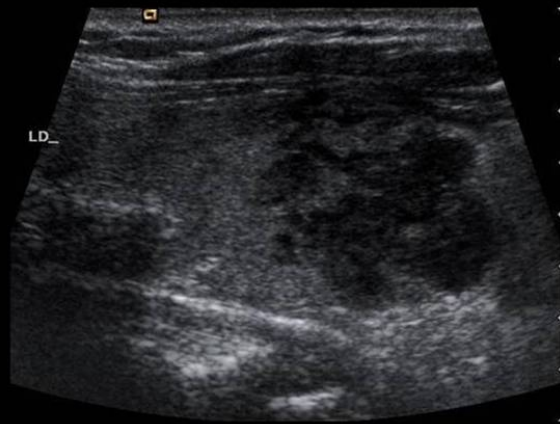


Figure 4. Longitudinal view of the right lobe of the thyroid shows a slightly lobulated solid predominately hypoechoic nodule. This patient had a history of melanoma and fine-needle aspiration confirmed metastatic melanoma to the thyroid.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

LUNG

- *Malignant melanoma has a high propensity for metastases to the lung. Respiratory failure caused by replacement of lung tissue by tumor is in fact the most common cause of death from malignant melanoma.*
- The **CT** appearance of lung metastases is variable. Although most lesions are in the range of 1-2 cm, others are less than 0,6 cm or more than 5 cm in size.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

LUNG

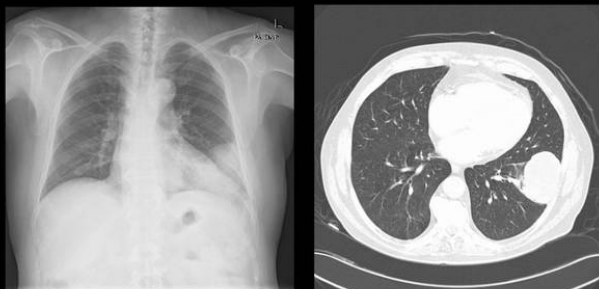


Figure 5. Frontal chest radiograph and axial CT image demonstrating a large left lung metastases.

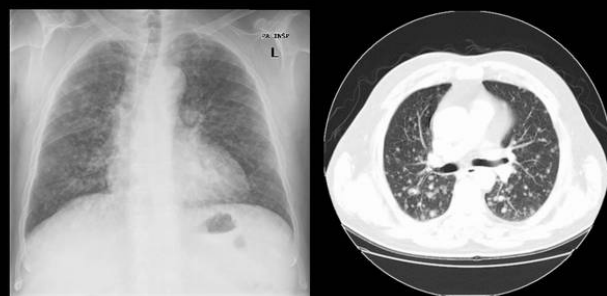


Figure 6. Frontal chest radiograph and axial CT image demonstrating multiple smooth nodules.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

PLEURA

- Metastatic disease to the pleura commonly causes irregular or lobulated pleural thickening, usually in association with a pleural effusion.



Figure 7. Axial CT image shows pleural metastases with lobulated pleural thickening.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

BREAST

- Breast metastases from nonmammary primary tumors are uncommon, representing 0.5-2.0% of all breast malignancies.
- *The most common primary cancer to produce breast metastases is melanoma.*

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

BREAST

- At **mammography**, metastases may manifest as single or multiple masses or as diffuse skin thickening (edema pattern).
- Metastases usually appear as round masses with circumscribed or ill-defined borders.
- Irregular shape, spiculations, and microcalcifications may be seen but are rare.

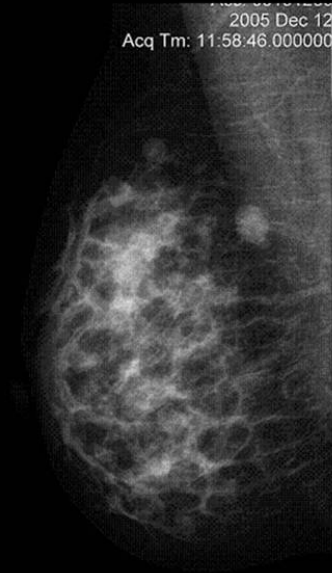


Figure 8. Metastatic melanoma: left mediolateral oblique mammogram shows a round mass with circumscribed borders.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

BREAST

- At **US**, metastases tend to have circumscribed margins with low-level internal echoes and, occasionally, posterior acoustic enhancement.

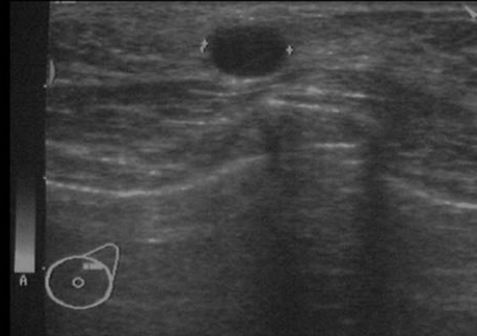


Figure 9. Metastatic melanoma: ultrasound image a hypoechoic nodule with circumscribed margins.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. THORAX

BREAST

- *Metastatic lesions are much more likely to be multiple or bilateral than primary cancers.*
- *Metastases are often found in the subcutaneous fat, whereas primary breast cancers develop in the glandular tissue.*
- *Metastases do not tend to cause retraction of the skin or nipple.*
- *At palpation, metastases feel similar in size to their appearance at mammography; in contrast, primary breast cancers tend to feel larger than their mammographic appearance.*

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

LIVER

- *The liver is the most frequent site of visceral involvement with metastatic melanoma.*
- Lesions can be single or multiple and variable in size (5 mm to 15 cm). Metastases can be solid or cystic and may be partly calcified. Larger lesions are often necrotic.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

LIVER

- **US** shows predominantly hypoechoic lesions within the liver. However, these appearance are non-specific.
- **Contrast-enhanced US** can be helpful, demonstrating early arterial phase enhancement.

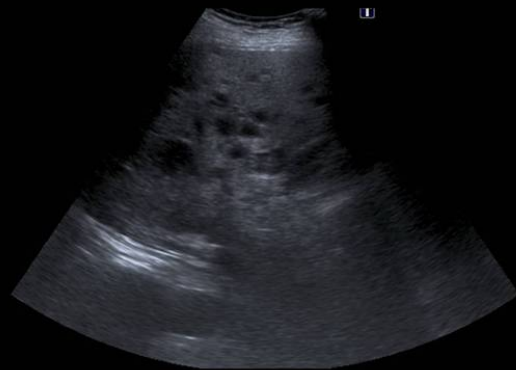


Figure 10. Transversal greyscale ultrasound image demonstrating numerous diffuse hypoechoic lesions.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

LIVER

- Hepatic metastases are usually detected as low attenuation lesions on portal venous phase CT.
- A proportion of these hypervascular lesions are only visible on arterial phase CT and remain undetected if the liver is only scanned in the portal venous phase.



Figure 11. Axial CT image demonstrating a large necrotic melanomatous deposit within the right lobe of the liver and other smaller diffuse lesions. In addition there are bilateral adrenal deposits.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

LIVER

- *The differential diagnosis for a solitary hypervascular liver lesion in a melanoma patient includes: melanoma metastasis, haemangioma, hepatocellular carcinoma, focal nodular hyperplasia, hepatic adenoma and other hypervascular metastases (e.g. islet cell tumours, carcinoid, renal cell carcinoma and breast carcinoma).*
- In patients without involvement of regional draining nodes, melanoma metastases are rare and further investigation with standard or dynamic contrast-enhanced MRI is recommended.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

LIVER

- Melanoma deposits are typically hyperintense on T1 W sequences due to their melanin content.
- *However, the lack of melanin does not exclude a melanomatous deposit (e.g. amelanocytic melanoma, undifferentiated tumours).*
- Metastases typically demonstrate avid arterial enhancement on dynamic imaging.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

SPLEEN

- Splenic metastases are usually multiple, can be cystic or solid and range in size from a few millimetres to over 8 cm.



Figure 12. Axial post-contrast CT imaging demonstrating a large necrotic melanomatous deposit within the spleen.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

KIDNEY

- *Melanoma is the third most common metastasis found in the kidney (after lung and breast).*
- Renal metastases are typically small, multiple and cortical in position.
- Spread to the urothelium (collecting system or bladder) is seen less frequently.

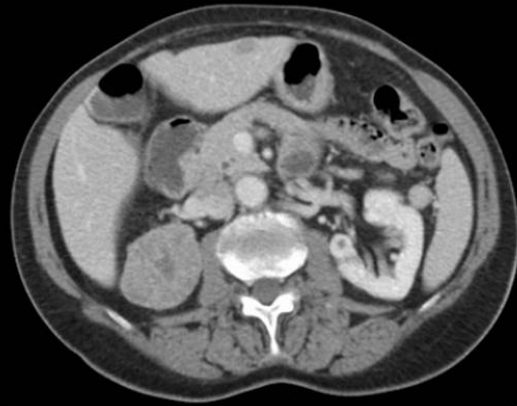


Figure 13. Axial post-contrast CT image demonstrating a large melanomatous deposit within the upper pole of the right kidney.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

ADRENALS

- Adrenal metastases may be unilateral or bilateral and can be variable in size but are usually in the range of 4-6 cm.
- Adrenal metastases appear as non-specific, lobulated masses with heterogeneous enhancement on CT.



Figure 14. Axial and coronal CT images demonstrating enhancing lobulated bilateral adrenal deposits.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

ADRENALS

- *Adrenal metastases can be differentiated from adrenal adenomas on MRI.*
- Adrenal adenomas demonstrate signal drop-out on out-of-phase MRI when compared to in-phase imaging.
- Melanoma metastasis demonstrate no loss of signal on out-of-phase MRI.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

GALLBLADDER

- Metastatic involvement of the gallbladder in melanoma is rare, but constitutes the most common metastatic lesion involving this organ.
- *The differential diagnosis includes adenomatous, hyperplastic, and cholesterol polyps; carcinoid tumor, gallbladder carcinoma and a hematoma within the gallbladder.*

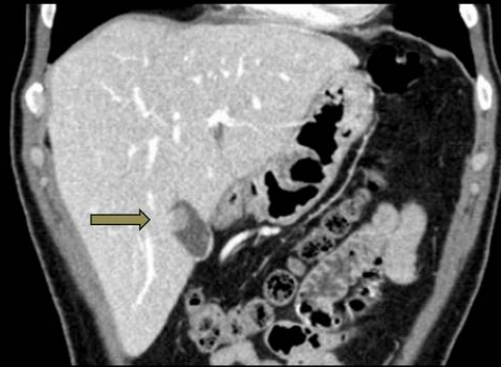


Figure 15. Coronal CT image demonstrating a polypoid mass within the gallbladder.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

GASTROINTESTINAL TRACT

- Metastasis to the GI tract are relatively uncommon, with the **stomach** and **small bowel** being most frequently affected.

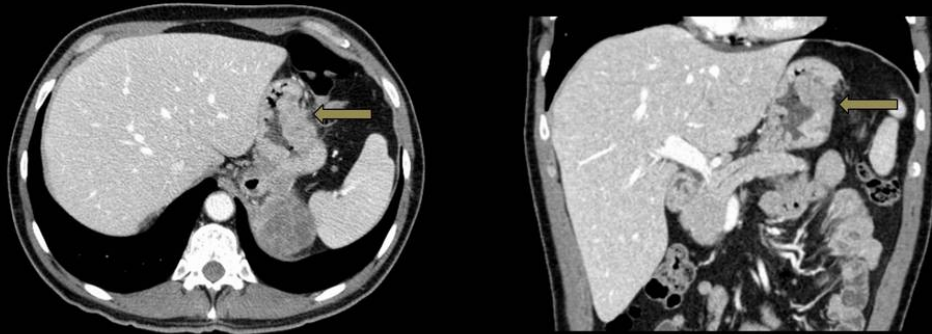


Figure 16. Axial and coronal CT images in a patient with metastatic disease involving the stomach, demonstrating diffuse infiltration with wall thickening.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

SMALL BOWEL

- *The lesions are more common in the distal jejunum or ileum than in the proximal small bowel.*
- Metastases classically manifest as enhancing mural nodules protruding into the intestinal lumen or as focal thickening of the intestinal wall.
- Small bowel metastases can act as a lead point for intussusception, cause obstruction or haemorrhage.



Figure 17. Axial post-contrast CT image demonstrating a small bowel metastase acting as a lead point for intussusception.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

MESENTERY

- Deposits in the mesentery results in masses that vary in size and can measure as large as 25 cm.
- *The mesenteric masses seen in melanoma incite little desmoplastic response, unlike carcinoid or small bowel adenocarcinoma. In certain instances, therefore, lymphoma enters the differential diagnosis.*

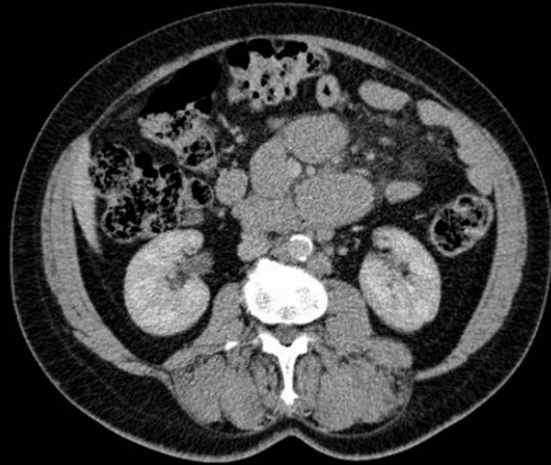


Figure 18. Axial post-contrast CT image demonstrating mesenteric metastasis.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

PERITONEUM

- The preferential sites for tumor implantation are the pelvic cul-de-sac, right paracolic gutter, and the greater omentum.
- CT demonstrates tumor nodules on peritoneal surfaces which displace bowel away from the anterior abdominal wall, tumor nodules in the mesentery, thickening and nodularity of the bowel wall owing to serosal implants, and ascites that is commonly loculated.



Figure 19. Axial post-contrast CT image shows solid tumor implanted on the omentum creating “omental cake”.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

3. ABDOMEN AND PELVIS

PELVIS

- The **uterus** and **ovaries** are more commonly and extensively involved with metastatic disease than the male genital tract.
- The commonest sites are the **ovaries** with unilateral or bilateral deposits which can be solid, cystic or mixed.



Figure 20. Axial post-contrast CT image shows bilateral ovarian deposits.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

4. MUSCULOSKELETAL SYSTEM

BONE

- Bone metastases are a frequent finding in patients with disseminated disease.
- The **axial skeleton** is most commonly affected.
- Metastasis are generally osteolytic, with or without an associated soft-tissue mass.

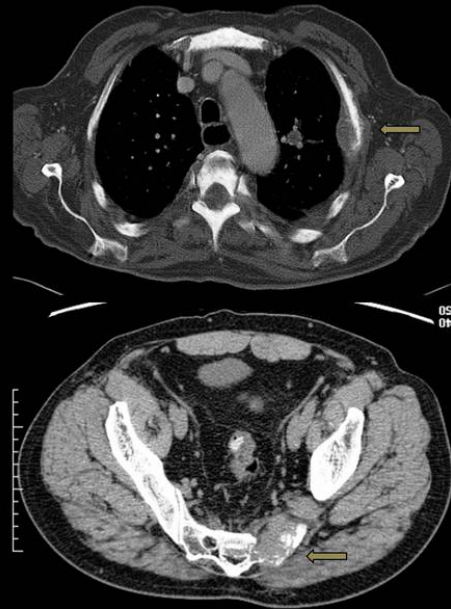


Figure 21. Axial CT images showing destructive, osteolytic metastasis involving one left rib (in addition there is a pulmonary metastase) and the sacrum.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

4. MUSCULOSKELETAL SYSTEM

MUSCLE

- Metastatic melanoma may arise in or extend directly into underlying muscle.
- On contrast-enhanced CT scans, these lesions may appear hyperattenuated relative to normal muscle.



Figure 22. Axial CT images showing a metastasis involving the right gluteus muscle.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

4. MUSCULOSKELETAL SYSTEM

CUTANEOUS / SUBCUTANEOUS DEPOSITS

- Cutaneous and subcutaneous deposits are frequent.
- The primary lesion is often associated with satellite lesions or early cutaneous metastasis.
- **US:** hypoechoic, smooth or lobulated masses with distal acoustic enhancement +/- internal arterial flow.

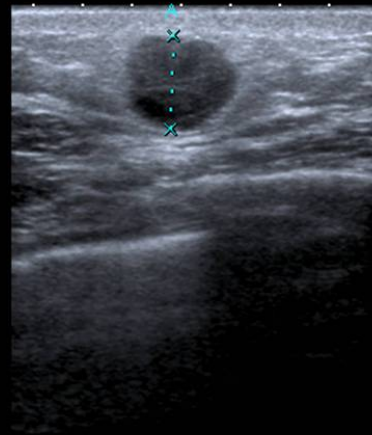


Figure 23. Ultrasound image demonstrating a subcutaneous nodule.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

4. MUSCULOSKELETAL SYSTEM

CUTANEOUS / SUBCUTANEOUS DEPOSITS

- CT: non-specific, well defined, enhancing soft-tissue density nodules.

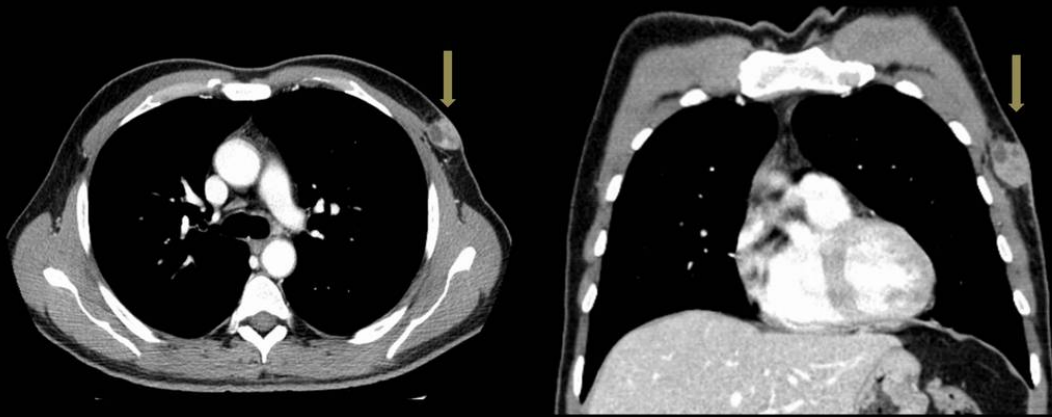


Figure 24. Axial and coronal CT images illustrating a subcutaneous deposit in left thoracic wall.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Conclusion

CONCLUSION

Metastatic malignant melanoma can have a wide variety of appearances in the head and neck, chest, abdomen, and the musculoskeletal system. Awareness of these various appearances and their potential overlap with those of other disease states allows a more precise staging. In light of the introduction of newer therapeutic regimens in melanoma, accurate staging is critical in the proper treatment of the patient.

Fig.

References: C. Paulino; Serviço de Imagiologia, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Personal Information

Cláudia Paulino (claudia_paulino@hotmail.com)

Belarmino Gonçalves

Pedro Marques

Manuela Gonçalo

Filipe Caseiro-Alves

Serviço de Radiologia

References

Skeletal muscle metastases: primary tumours, prevalence, and radiological features.

Surov A, Hainz M, Holzhausen HJ, Arnold D, Katzer M, Schmidt J, Spielmann RP, Behrmann C.

Eur Radiol. 2009 Aug 26.

Lymphoscintigraphy in cutaneous melanoma: an updated total body atlas of sentinel node mapping.

Intenzo CM, Truluck CA, Kushen MC, Kim SM, Berger A, Kairys JC.

Radiographics. 2009 Jul-Aug;29(4):1125-35.

Role of PET in the initial staging of cutaneous malignant melanoma: systematic review.

Krug B, Crott R, Lonneux M, Baurain JF, Pirson AS, Vander Borgh T.

Radiology. 2008 Dec;249(3):836-44.

Imaging of metastatic malignant melanoma to the head: self-assessment module.

Jayashankar A, Sabourin SM, Mullins ME.

AJR Am J Roentgenol. 2008 Sep;191(3 Suppl):S22-4.

Mesenteric neoplasms: CT appearances of primary and secondary tumors and differential diagnosis.

Sheth S, Horton KM, Garland MR, Fishman EK.

Radiographics. 2003 Mar-Apr;23(2):457-73.

A variety of appearances of malignant melanoma in the head: a review.

Escott EJ.

Radiographics. 2001 May-Jun;21(3):625-39.

Liver metastases from melanoma: detection with multiphasic contrast-enhanced CT.

Blake SP, Weisinger K, Atkins MB, Raptopoulos V.

Radiology. 1999 Oct;213(1):92-6.

Superficial melanoma metastases: appearances on gray-scale and color Doppler sonography.

Nazarian LN, Alexander AA, Kurtz AB, Capuzzi DM Jr, Rawool NM, Gilbert KR, Mastrangelo MJ.

AJR Am J Roentgenol. 1998 Feb;170(2):459-63.

Malignant melanoma metastatic to the gastrointestinal tract.

McDermott VG, Low VH, Keogan MT, Lawrence JA, Paulson EK.

AJR Am J Roentgenol. 1996 Apr;166(4):809-13.

Metastases: mechanisms, pathways, and cascades.

Morgan-Parkes JH.

AJR Am J Roentgenol. 1995 May;164(5):1075-82.

Visceral metastases from melanoma: findings on MR imaging.

Premkumar A, Sanders L, Marincola F, Feuerstein I, Concepcion R, Schwartzentruber D.

AJR Am J Roentgenol. 1992 Feb;158(2):293-8.

CT evaluation for pulmonary metastases in patients with extrathoracic malignancy.

Davis SD.

Radiology. 1991 Jul;180(1):1-12.

CT of malignant melanoma in the chest, abdomen, and musculoskeletal system.

Fishman EK, Kuhlman JE, Schuchter LM, Miller JA 3rd, Magid D.

Radiographics. 1990 Jul;10(4):603-20.

Metastases from malignant melanoma to the axial skeleton: a CT study of frequency and appearance.

Patten RM, Shuman WP, Teefey S.

AJR Am J Roentgenol. 1990 Jul;155(1):109-12.

CT in differential diagnosis of diffuse pleural disease.

Leung AN, Müller NL, Miller RR.

AJR Am J Roentgenol. 1990 Mar;154(3):487-92.

Subcutaneous metastases from malignant melanoma: prevalence and findings on CT.

Patten RM, Shuman WP, Teefey S.

AJR Am J Roentgenol. 1989 May;152(5):1009-12.