Primary oesophageal melanoma

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ABSTRACT

Melanomas arise from unregulated proliferation of melanocytes. Most commonly, they are cutaneous. They can, however, also arise from the visceral organs. Primary oesophageal melanoma is a rare entity, accounting for less than 0.1-0.2 % of primary oesophageal neoplasms. It is often diagnosed late and has a poor prognosis. We illustrate a case of biopsy-proven primary oesophageal melanoma, as well as a review of the literature addressing its clinical and imaging features, treatment, prognosis and differential diagnoses.

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CASE REPORT

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An 87-year-old female was referred to a head and neck specialist for blood-tinged sputum of 3-4 months duration and long-standing dysphagia. She reported a loss of weight of 10kg over 4 years. Her medical history included a previously surgically resected benign brain tumour (histology unknown) for which she was on phenytoin for post-resection seizures. Clinical examination revealed a right sided goitre and enlarged 2cm right submandibular and anterior neck lymph nodes. A bedside nasoendoscopy was done that showed pooling of old blood in the piriform sinuses although no discrete mass was visualized. In view of sedation risks, the patient was referred for a barium swallow.

The barium swallow revealed a long segment, large, irregular, polypoidal and expansile filling defect in the proximal to mid oesophagus (Figure 1). The patient subsequently underwent an oesophagogastroduodenoscopy (OGD) that visualised a black pigmented fungating soft and fleshy tumour along the proximal to mid oesophagus (Figure 2). Histology of tissues showed an infiltrative malignant tumour with morphological and immunohistochemical features consistent with melanoma (Melan A, HMB45, SOX10 and S100 stains were diffusely positive) (Figure 3).

The patient was then sent for a staging Fluorodeoxyglucose Positron Emission Tomography- Computed Tomography (FDG PET-CT) scan which showed extensive metastatic disease involving multiple organs, including the bones, lymph nodes, spine, lungs, pericardium, liver, peritoneum as well as subcutaneous tissues (Figure 4). The case was discussed at a multidisciplinary tumour board and the decision was made for palliative chemotherapy and best supportive care.

The patient eventually succumbed to the disease and demised within 3 months of the initial barium swallow.

DISCUSSION

Aetiology and Demographics

Cutaneous melanomas constitute the most common manifestation of melanomas, accounting for up to 90% of disease. Visceral melanomas, on the other hand, are very rare, with oesophageal melanomas making up about 0.1-0.2% of all malignancies of the oesophagus and less than 200 cases have been reported in the literature [1,2]. Primary oesophageal melanomas arise from melanin cells of the oesophageal mucosal epithelial basal layer [3]. It is an aggressive disease often with a dismal prognosis [4]. The mean age of diagnosis is 60.5 years old with a male to female incidence ratio of 2:1 [5] . There is no known risk factor associated with this rare disease.

Clinical & Imaging

The most common presenting symptom is dysphagia in up to 70% of the cases. This was also the presenting symptom for our patient in this report [6]. Other common presenting symptoms include epigastric pain [8%] and gastrointestinal tract bleeding (8%) [2]. However, up to 10% of patients have no symptoms at the time of presentation [2].

Definitive diagnosis of primary oesophageal melanoma is made by histology and immunohistochemistry, as well as exclusion of other sites of primary disease typically by imaging.

Utility of barium studies have declined in recent years due to the wide availability of cross-sectional imaging modalities and endoscopies. Nevertheless, it remains important that radiologists are able to identify and diagnose such pathologies when presented [7]. Previous case series have been published illustrating primary melanomas of the oesophagus on barium studies [3,8,9]. They often appear as bulky, polypoid intraluminal masses that focally expand the oesophagus without causing obstruction [10,11]. Our presented case mirrors these reports. This characteristic appearance has been purported to be related to its growth pattern, as malignant melanomas tend to grow longitudinally and intraluminally along the oesophagus. These described findings are also seen on other modalities such as computed tomography (CT) of the thorax and magnetic resonance imaging (MRI). This growth pattern allows us to differentiate melanomas from the more prevalent squamous cell carcinoma and adenocarcinoma of the oesophagus on imaging.

CT is one of the preferred cross-sectional modalities for the assessment of primary oesophageal melanoma. The primary lesion will appear as a hyperdense, broad-based, polypoidal intraluminal mass that is usually non-obstructive. It tends to have well-circumscribed boundary and smooth surface [12]. It also shows peak enhancement in the arterial phase [12].

Metastatic disease can also be assessed on CT. The most common sites of metastasis are the lymph nodes (73.6%), lungs (71.3%), liver (58.3%), brain (49.1%), bone (48.6%), heart (47.2%), adrenal glands (46.8%), and gastrointestinal tract (43.5%) [13]. Pulmonary metastases are often multiple with large size variation and hepatic metastases are often hypervascular in the arterial phase and hypodense or isodense in the portal venous phase. Metastatic lesions to the small bowel may cause mural thickening or small nodular deposits that may cause intussusception or small bowel obstruction.

FDG PET-CT can be superior to CT or MRI alone in identifying metastatic disease for primary oesophageal melanoma, which is an FDG-avid tumour [14]. A study comparing utility of sonography, CT, PET or PET-CT in melanoma demonstrated that PET/CT is superior in detecting metastases, with sensitivity of 86% and specificity of 91% [15]. Another meta-analysis of advanced stage cutaneous melanoma also finds PET/CT to have sensitivity ranging from 68 to 87% and specificity ranging from 92 to 98% in detecting metastases [16].

Magnetic resonance imaging (MRI) is the modality commonly used to assess for intracranial metastases and meningeal involvement. Cranial metastasis can be generally characterised into four groups: melanotic, amelanotic, indeterminate mixed and haematoma patterns [17,18]. Classically, the melanotic pattern shows T1-weighted hyperintensity, T2-weighted hypointensity and proton density- weighted isointensity to hyperintensity due to innate melanin content . Amelanotic pattern, as its name suggest, lack melanin. Therefore, lesions appear T1-weighted hypointense to isointense and T2-weighted hyperintense to isointense. The indeterminate mixed pattern shows characteristics that do not conform to either of the above two categories. Finally, the haematoma pattern is due to internal haemorrhage and these are well depicted as having susceptibility artefact ("blooming") with susceptibility-weighted imaging. In meningeal melanoma, involvement of the leptomeninges occurs more commonly than the dura. Post-contrast, these lesions will demonstrate enhancement.

On OGD, primary oesophageal melanoma appears pedunculated, polypoidal, variably pigmented (dependent on the amount of melanin) and do not usually ulcerate [19].

Histologically, presence of melanin and melanocytes with irregular, fusiform growth pattern and junctional peri-epithelial components are characteristic. Pagetoid involvement of the overlying squamous epithelium may be seen [20]. In 20-50% of the cases, melanin granules may not be detected in the cytoplasm [5]. Due to the variety of cytomorphological variants of melanomas, immunohistochemical staining for melanocytic differentiation markers is essential for diagnosis. Commonly used immunohistochemical stains include positive staining for S-100 protein, HMB-45, Melan A and Sry-related HMG-Box gene 10 (SOX10) [21]. These with concurrent negative cytokeratin and CEA can confirm the diagnosis of melanoma while excluding carcinoma. It has also been shown that higher Melan-A and lower S100 expression are associated with significantly lower risk of mortality [2].

For our patient described, immunohistochemical staining of S100 protein, HMB45, Melan A, and SOX10 were positive.

HMB-45 recognises a 100 kD glycoprotein known as premelanosome protein (Pmel), Pmel17, gp100, or SILV. Pigmented lesions show proportional amounts of staining with HMB45. The sensitivity is around 66 to 97 %, with decreased sensitivity in metastatic compared to primary lesions [22].

Melan-A is a more recently identified melanocyte differentiation marker expressed in the cytoplasm of both melanocytes, melanoma, and retinal pigmented epithelium. It has been found to be highly specific in distinguishing metastatic melanomas from other lesions such as poorly differentiated carcinomas, sarcomas and high-grade lymphomas [23].

SOX10 is a nuclear transcription factor important for melanocytic cell differentiation. It is recognised as a sensitive marker for melanomas including spindle and desmoplastic subtypes and can be used in both primary and metastatic lesions [24].

S100 protein is a cytoplasmic protein specific to the nervous system. It is also present in the cell lines of malignant melanomas. S100 protein level can be used to differentiate between poorly differentiated amelanotic malignant melanoma and tumours of obscure histological origin. Immunofluorescence studies with anti-S100 is also helpful in detecting lymphatic involvement in micrometastatic disease [25].

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Treatment and Prognosis

Standard of care for patients with primary oesophageal melanoma requires a multi-disciplinary team, involving surgeons, oncologists, radiation oncologists, radiologists, pathologists, specialty nurses and dieticians. Treatment options include surgery, chemotherapy and radiotherapy. Personalised treatment plans are made with the intent of cure versus palliation based on the patient's disease burden.

As primary oesophageal melanoma is a very rare disease, there remains no clear consensus on treatment strategies. However, numerous case reports have been published showing good long-term survival after oesophagectomy with complete surgical excision for localised/early-stage oesophageal melanoma [26]. Primary oesophageal melanoma tends to disseminate through the lymphatic route, with 66% of cases having regional lymphadenopathies at the time of presentation [27]. It is therefore essential to consider extended lymphadenectomy in planning of surgical approach. Literature suggests that lymph node metastasis is the only independent prognostic factor for mortality [28]. Surgery typically involves total or subtotal oesophagectomy with lymphadenectomy of the peri-oesophageal, mediastinal and coeliac lymph nodes [1]. For tumours situated at the gastro-oesophageal junction, further extended gastrectomy and extended lymphadenectomy should be considered [29, 30].

A recent review of mucosal melanoma in the head and neck has also suggested that immunotherapy and targeted molecular therapy have the potential to further improve outcomes [31]. Various regimes of adjuvant chemotherapy as well as immunotherapy have been described, including dacarbazine, nimustine, vincristine, cisplatin as well as interferon [2]. No standard adjuvant therapy has yet been proposed.

For patients with metastatic and recurrent disease, treatment is geared towards palliation. Chemotherapy is often employed to prolong survival. As patients often suffer from dysphagia, interventions that are able to provide symptomatic relief such as external beam radiotherapy, intraluminal brachytherapy, endoscopic stenting with self-expanding metal stents or repeated endoscopic dilatations should be considered [32].

Despite radical surgical approach, survival with primary oesophageal melanoma remains poor. In study by Sabanatahn et al, 5-year survival was found to be at 4.5 % (with median survival of 10 months) [5]. Another more recent study by Gao et al demonstrated overall survival was 18.1 months [33]. Major contributors of poor survival include vague presenting symptoms, aggressive nature of the cancer and the relative late stage at which it is diagnosed.

DIFFERENTIAL DIAGNOSIS FOR PRIMARY OESOPHAGEAL MELANOMA

Oesophageal carcinomas

Squamous cell carcinomas and adenocarcinomas make up more than 90% of all malignant oesophageal neoplasms. These two common oesophageal carcinomas are often indistinguishable at imaging but there are findings that may clue us in on the diagnosis. Here, general features of both adenocarcinoma and squamous cell carcinoma will first be described, and differentiating features described thereafter. On barium swallows, early oesophageal carcinomas may appear as plaque-like lesions, small lobulated sessile polyps, or as focal wall irregularities. Advanced lesions may cause irregular narrowing of the oesophageal lumen with associated nodular or ulcerated mucosa and abrupt, well-defined proximal and distal margins.

On CT imaging, both squamous cell carcinoma and adenocarcinoma can present as soft tissue masses that cause focal thickening of the oesophageal wall. Advanced lesions tend to grow circumferentially along the oesophageal walls. Triple-phase dynamic CT has been used, with the second arterial phase shown to be optimal for visualisation of oesophageal cancers [34]. During this phase, malignant lesions show peak enhancement. Lymphadenopathy is better assessed on the venous phase.

On PET-CT, FDG-avid metastatic lesions are most commonly seen in the lymph nodes, liver, lungs, bones, and adrenal glands [35]. Promising results with the use of PET-CT in assessing response to neoadjuvant chemotherapy have also been reported [36].

Dynamic contrast-enhanced MRI has also shown efficacy in the assessment of local disease spread [37, 38] and can be used to differentiate adenocarcinomas from squamous cell carcinomas [39].

Adenocarcinomas

A feature that can differentiate adenocarcinomas from squamous cell carcinomas is the presence of Barrett's oesophagus.

In Barrett's oesophagus, there is replacement of the normal stratified squamous epithelium with columnar epithelium due to chronic inflammation. This ongoing inflammation may be related to chronic gastro-oesophageal reflux or a weakened tone of the lower oesophageal sphincter. Hence, Barrett's oesophagus occurs in the distal oesophagus, and forms a backdrop for development of adenocarcinomas [40].

Classic imaging findings of Barrett's oesophagus on barium swallow are smooth oesophageal stricture or ulcer near the distal oesophagus associated with a sliding hiatal hernia and gastro-oesophageal reflux [41]. On CT imaging, Barrett's oesophagus often shows mural thickening of the oesophagus in a symmetric circumferential manner with enhancing internal mucosa. There may be an excess of intraluminal air, potentially with air-fluid levels and residual food debris upstream to the site of a stricture [42,43].

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Squamous Cell Carcinomas

Squamous cell carcinomas, on the other hand, are associated with tobacco and alcohol consumption. Imaging findings of Barrett's oesophagus are usually absent. The site of disease involvement is also useful to differentiate the two carcinomas, as squamous cell carcinomas often arise in the mid oesophagus as opposed to adenocarcinomas, that arise in the distal oesophagus [44, 45].

As mentioned above, dynamic contrast-enhanced MRI can help in differentiating squamous cell carcinoma from adenocarcinoma. This is due to the differences in histopathology of squamous cell carcinomas and adenocarcinomas which result in differing microcirculation. This difference therefore results in different uptake patterns of contrast material as well as the changes in signal intensity over time. Oberholzer et al describes how squamous cell carcinomas, with greater vascular surface and permeability demonstrates a higher volume of contrast uptake as well as a higher contrast agent exchange rates compared with adenocarcinomas [46]. There are also characteristic differences that can differentiate squamous cell carcinoma from oesophageal melanoma. Squamous cell carcinoma demonstrates an infiltrative growth pattern with diffuse thickening while oesophageal melanoma shows a broad-based, polypoidal intraluminal mass with smooth surface and well-circumscribed boundaries [12]. Squamous cell carcinoma further demonstrates peaked enhancement in the delayed phase, while oesophageal melanoma shows maximal enhancement in the arterial phase to suggest a rich tumour blood supply [12, 47].

Leiomyomas

Leiomyomas are one of the most common benign tumours of the oesophagus and arise from smooth muscle cells. On imaging, these lesions are often visualised in the mid to distal oesophagus [48]. On barium swallow, these lesions can show smooth semilunar filling defect forming right angles or slightly obtuse angles with the oesophageal wall [49]. CT imaging will visualise a subepithelial exophytic, enhancing mass which may demonstrate areas of calcification, fat and extraluminal gas within [50]. Compared with oesophageal melanoma, leiomyoma is usually a smoothly-marginated, homogeneous mass with mild homogeneous enhancement on arterial and delayed phases [12]. On PET-CT, these lesions show a spectrum of FDG-uptake and may be confused with more aggressive lesions (51). MRI is not commonly used to assess oesophageal leiomyomas but they will appear as T1 isointense and T2 hypointense [52].

Tuberculous oesophagitis

Oesophageal tuberculosis (TB) is a rare mimic of oesophageal malignancy. On barium swallow, mucosal irregularity commonly with ulceration, oesophageal spasm, and stricture formation may be present [53]. Lymphadenopathy may result in mass effect on the oesophagus causing displacement or compression of the oesophagus [54]. Oesophageal- tracheal fistulas may also be visualised upon oral administration of contrast, with contrast seen along the fistula track and into the tracheo-bronchial tree [55]. On CT imaging, TB oesophagus will be visualised as a markedly thickened and enhancing oesophageal wall. Extrinsic mediastinal nodes, if present, may have necrotic and calcified components. Other associated findings such as pulmonary lesions, adenopathy and spondylodiscitis may be seen. On PET-CT, the presence of active pulmonary or extra-pulmonary TB disease may present as FDG-avid lesions [56]. MRI is not routinely used to assess for primary tuberculous oesophagitis, but will show diffuse mural thickening, restricted diffusion and post-contrast enhancement [57].

Fibrovascular polyps

Fibrovascular polyps are rare oesophageal tumours that commonly arise in the Laimer-Haeckermann triangle of the cervical oesophagus. On barium swallow, they can appear as a long, smooth, expansile sausage-shaped mass arising from cervical oesophagus [58]. On CT scans, they appear as heterogeneous intraluminal lesions with mixed soft tissue and fat densities. PET-CT is not used in the evaluation of fibrovascular polyps. However, as they are benign tumours and are not associated with lymphadenopathy or metastatic disease, they are not known to be associated with FDG avidity. MRI can be useful in delineating the characteristics of polyp, for example fibrous components will be T1 isointense and T2 isointense to hypointense whereas necrotic/oedematous changes will be T2 hyperintense [59].

TEACHING POINT

Primary melanoma of the oesophagus is a rare entity with dismal prognosis. Classic appearance of a hyperdense, bulky, polypoidal intraluminal lesion with maximal enhancement in the arterial phase, causing expansion of the oesophagus without obstruction should hint its diagnosis. Definitive diagnosis is through histology and immunohistochemistry, together with the exclusion of other sites as the source of primary melanoma.

AUTHOR CONTRIBUTION

Stephanie Yong, Justin Hsieh and Keefe Lai conceived the project and wrote the manuscript. Winnie Lam and Nye Thane Ngo contributed relevant imaging, histologic and endoscopic images respectively.

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QUESTION AND ANSWER

Q1: What is the classic barium swallow finding of primary oesophageal melanoma?

A. Bulky, polypoid intraluminal expansile mass which often does not cause obstruction. (applies)

B. Multiple, non-peristaltic contractions in oesophagus, i.e. "corkscrew" appearance.

C. Dilated oesophagus with tapered beak-like narrowing at the gastro-oesophageal junction.

D. Long segment concentric smooth narrowing involving the distal oesophagus.

E. Smooth sub-epithelial filling defect forming right angles or slightly obtuse angles with the oesophageal wall.

Explanation:

A. [Primary oesophageal melanoma often appear as bulky, polypoid intraluminal masses that focally expand the oesophagus without causing obstruction.]
B. Diffuse oesophageal spasm causes multiple, non-peristaltic contractions in oesophagus, i.e. "corkscrew" appearance.
C. Achalasia demonstrates dilated oesophagus with tapered beak-like narrowing at the gastro-oesophageal junction.
D. Oesophageal stricture shows Long segment concentric smooth narrowing involving the distal oesophagus.
E. Leiomyoma [shows smooth semilunar filling defect forming right angles or slightly obtuse angles with the oesophageal wall.]

Q2: What is the most common presenting symptom of primary oesophageal melanoma?

A. Weight loss
B. Dysphagia (applies)
C. Epigastric pain
D. GI bleed
E. Dyspepsia

Explanations:

A. [Up to 10% of patients have no symptoms at the time of presentation.] Some of them present only with weight loss.
B. [The most common presenting symptom is dysphagia in up to 70% of the cases.]
C. Other common presenting symptoms include epigastric pain (8%) and gastrointestinal tract bleeding (8%). However, up to 10% of patients have no symptoms at the time of presentation.]
D. Other common presenting symptoms include epigastric pain (8%) and gastrointestinal tract bleeding (8%). However, up to 10% of patients have no symptoms at the time of presentation.]
E. Dyspepsia is more likely related to an upper oesophageal pathology.

Q3: What is the classic CT finding of primary oesophageal melanoma?

A. Large enhancing, heterogenous subepithelial oesophageal mass with internal calcification, fat and extraluminal gas.
B. Non-obstructive broad-based, polypoidal intraluminal oesophageal mass with maximal enhancement in the arterial phase. (applies)
C. Well-defined expansile oesophageal lesion with soft tissue and fat densities.
D. Marked thickening of the oesophageal wall with strictures and necrotic and calcified mediastinal lymphadenopathy.
E. Normal oesophageal mucosa but with hilar and mediastinal lymphadenopathy.

Explanations:

A. Leiomyomas are Large enhancing, heterogenous subepithelial oesophageal mass with internal calcification, fat and extraluminal gas.
B. Primary oesophageal melanoma [will appear as a broad-based, polypoidal intraluminal mass that is usually non-obstructive. It tends to have well-circumscribed boundary and smooth surface, with maximal enhancement in the arterial phase]
C. Fibrovascular polyps [appear as heterogeneous intraluminal lesions with mixed soft tissue and fat densities]
D. [TB oesophagus will be visualised as a markedly thickened and enhancing oesophageal wall. Extrinsic mediastinal nodes, if present, may have necrotic and calcified components.]
E. Sarcoidosis can have normal oesophageal mucosa but with hilar and mediastinal lymphadenopathy.

Q4: immunohistochemical for PMME will be diffusely positive for which of the following stains?

A. CEA, Cytokeratin, Melan A
B. HMB-45, Melan A, SOX10, S-100 (applies)
C. Cytokeratin, Melan A, SOX10, S-100
D. CEA , HMB-45, Melan A, S-100
E. Cytokeratin, HMB-45, Melan A, SOX10

Explanations:

A to E. Commonly used immunohistochemical stains include positive staining for S-100 protein, HMB-45, Melan A and Sry-related HMg-Box gene 10 (SOX10) (21). These with concurrent negative cytokeratin and CEA can confirm the diagnosis of melanoma while excluding carcinoma.

Q5: What are some risk factors associated with PMME?

A. Gastro-oesophageal reflux disease
B. Smoking
C. Alcohol
D. Obesity
E. No known risk factors (applies)

Explanation:

A to E. No known risk factor is associated with PMME.

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FIGURES

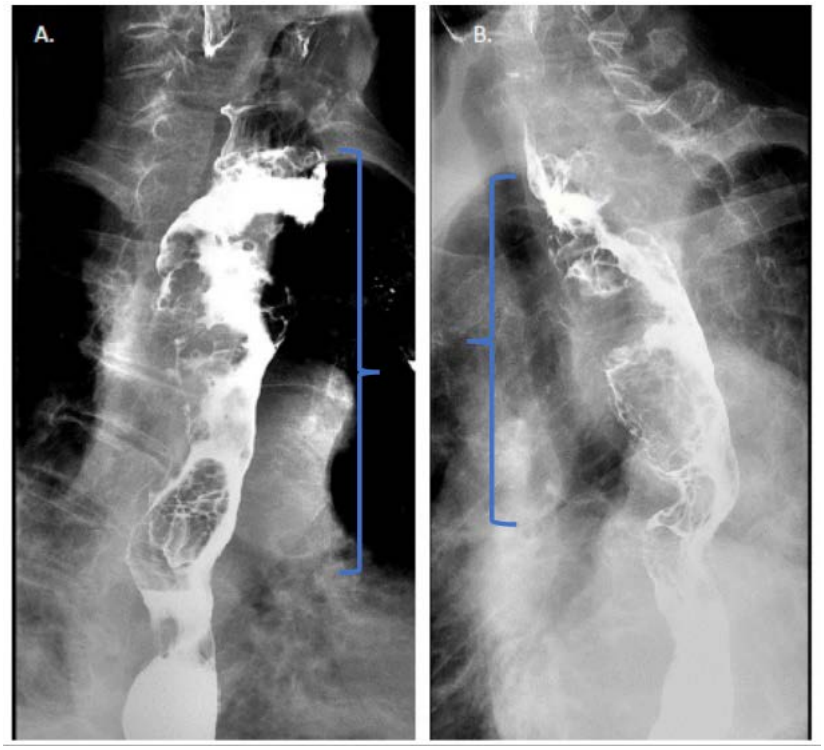

Figure 1: Barium swallow of an 87-year-old female with oesophageal melanoma. Upright (A) right anterior-oblique and (B) left anterior-oblique double contrast barium swallow images showed a large irregular polypoidal expansile filling defect in the proximal to mid oesophagus (blue brackets).

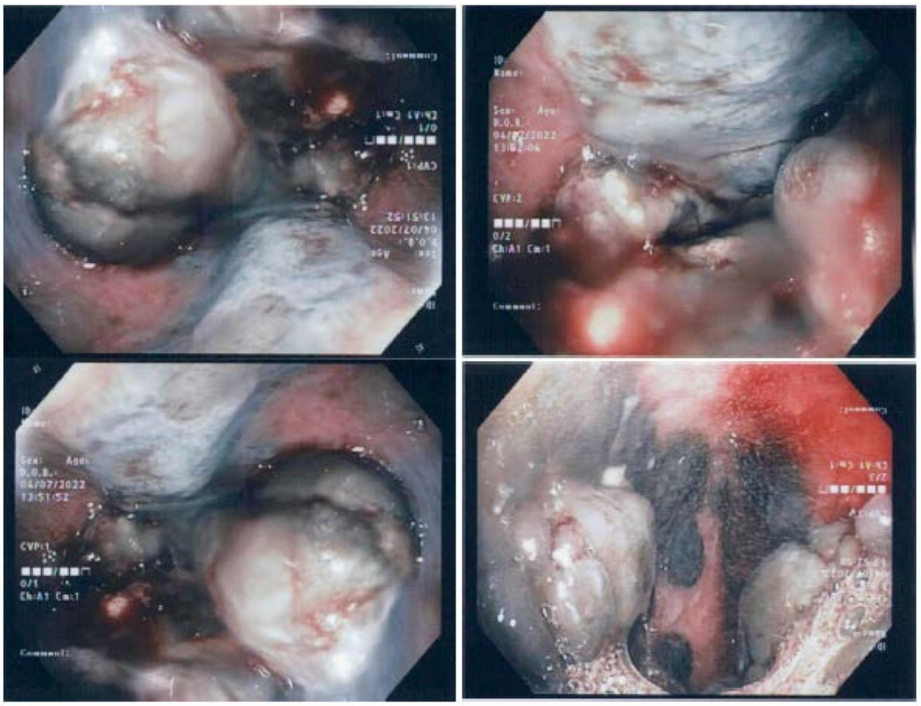

Figure 2: Oesophagogastroduodenoscopy (OGD) findings. OGD of an 87-year-old female revealed a large fungating black pigmented soft fleshy lesion along the proximal to mid oesophagus.

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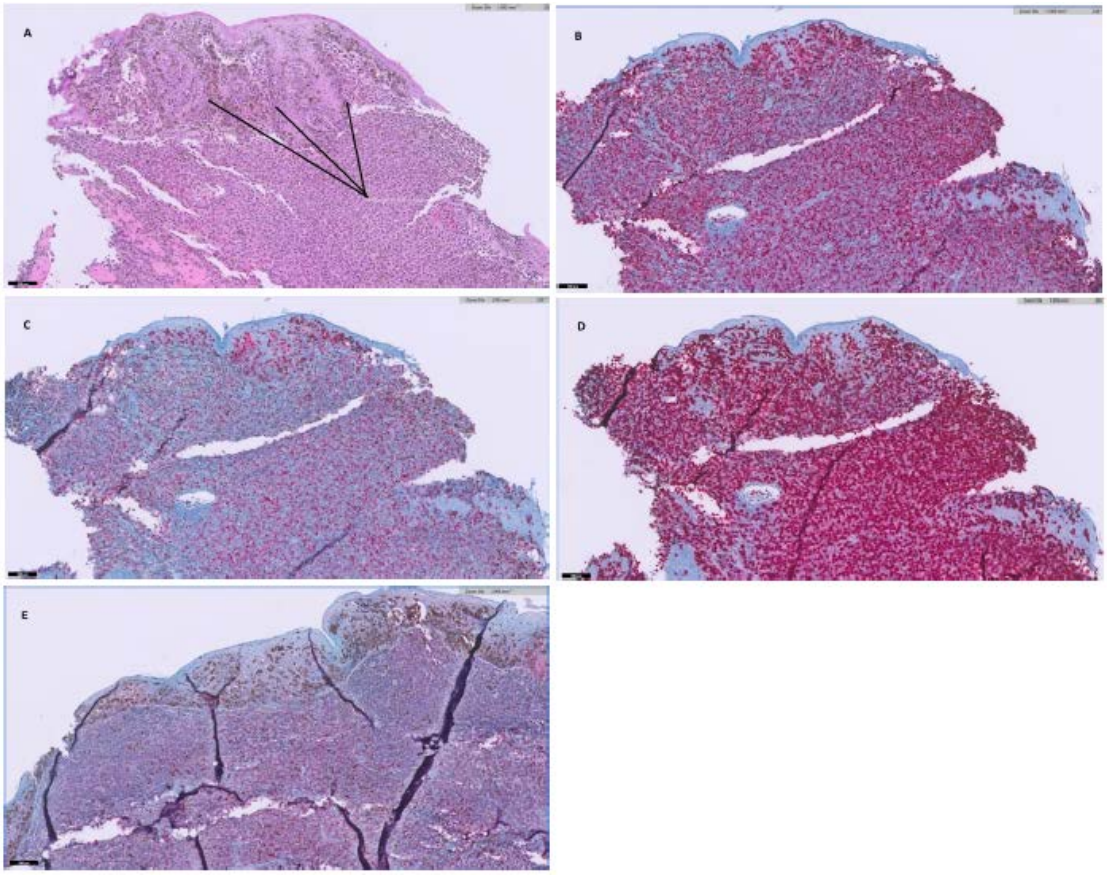

Figure 3: Histopathologic findings. Histopathology of an 87-year-old female showed primary oesophageal melanoma involving the oesophageal squamous mucosa- highlighted with black lines (A). Diffusely positive immunohistochemical findings that confirmed diagnosis of melanoma- HMB45 (B), MelanA (C), SOX10 (D) and S100 (E).

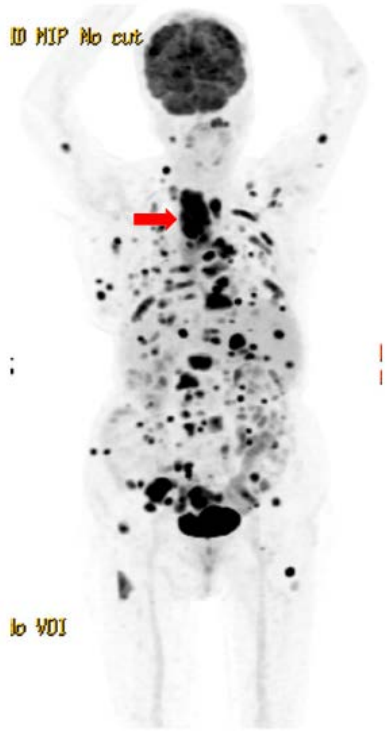

Figure 4: PET-CT, Maximum intensity Projection image of an 87-year-old female.. Lobulated eccentric mass in the proximal to mid oesophagus with intense PDG avidity, compatible with biopsy proven melanoma (red arrow). Multiple sites of FDG uptake including the bones, lymph nodes, spine, lungs, pericardium, liver, peritoneum as well as subcutaneous tissues, compatible with extensive metastatic involvement.

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SUMMARY TABLE

Aetiology	Melanin cells of oesophageal mucosal epithelial basal layer
Incidence	About 0.1-0.2% of all malignancies of the oesophagus
Gender ratio	2:1 male-to-female preponderance
Age predilection	6th and 7th decade
Site of disease	Oesophagus, with preponderance in the lower oesophagus
Risk factors	No risk factors have yet been implicated.
Immunohistology	Commonly used immunohistochemical stains include positive staining for S-100 protein, HMB-45, Melan A and SOX10. These with concurrent negative cytokeratin and CEA can confirm the diagnosis of melanoma while excluding carcinoma.
Treatment	Curative treatment for localised disease involves radical surgical resection with clear margins and often requires lymphadenectomy. Palliative treatment for metastatic disease involves chemotherapy and symptomatic relief, most commonly for dysphagia that includes external beam radiotherapy, intraluminal brachytherapy, endoscopic stenting using self-expanding metal stents or repeated endoscopic dilatations.
Prognosis	Mean survival time post-operatively of 10–14 months and a 5-year survival rate of 4.5%. Immunohistochemistry provides prognostic information regarding survival. Higher Melan-A and lower S100 expression are associated with significantly lower risk of mortality. Large, ulcerated oesophageal lesions recur more frequently.
Findings on imaging	Large hyperdense, bulky, polypoid intraluminal mass that focally expands the oesophagus without causing obstruction. It demonstrates maximal enhancement in the arterial phase, with avid FDG uptake.

DIFFERENTIALS TABLE

Diagnosis	Barium swallow	CT	PET-CT	MRI
Primary oesophageal melanoma	Bulky, polypoid intraluminal expansile mass that often does not cause obstruction.	Hyperdense, broad-based, polypoidal, expansile intraluminal mass that is usually non-obstructive. Tends to have well-circumscribed boundary and smooth surface. Shows peak enhancement in the arterial phase.	Intense FDG-avid primary lesion in the oesophagus. FDG-avid locoregional lymph nodes may also be seen. In metastatic cases, widespread multi-organ FDG uptake present. May spread to uncommon sites- e.g pericardium and subcutaneous lesions.	Commonly used to assess for intracranial metastases and meningeal involvement. Shows post-contrast enhancement. Characterised into four patterns: 1. Melanotic - T1 ↑, T2 ↓, PD ↑ 2. Amelanotic - T1 ↓, T2 ↑, PD ↑ 3. Indeterminate mixed- does not fit either of above patterns 4. Haematoma - T1/T2 dependent on age of blood, PD ↑↑ (blooming)
Carcinomas (Common features described here. Differences between adenocarcinomas and squamous cell carcinomas elaborated below)	Early oesophageal cancer may appear as a plaque-like lesion, a small lobulated sessile polyp, or focal wall irregularity. Advanced lesions may cause irregular narrowing and constriction of the oesophageal lumen associated with a nodular or ulcerated mucosa and abrupt, well-defined proximal and distal margins.	Oesophageal wall thickening, intraluminal mass, dilated oesophagus with fluid and debris upstream to lesion.	FDG uptake in primary oesophageal lesion. Tends to metastasise and show FDG uptake in lymph nodes, liver, lungs, bones, and adrenal glands.	Dynamic contrast-enhanced MRI can differentiate squamous cell carcinomas from adenocarcinomas. Squamous cell carcinomas demonstrates a higher volume of contrast uptake as well as a higher contrast agent exchange rates compared with adenocarcinomas.

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Adenocarcinoma	Reticular mucosa characteristic of Barrett's oesophagus may be seen (precursor to oesophageal adenocarcinoma), with associated hiatus hernia and smooth distal oesophageal stricture. Lesions usually involve the distal oesophagus with propensity to extend into gastric fundus.	Lesions usually involve the distal oesophagus with propensity to extend into gastric fundus.	As above (carcinomas)	As above (carcinomas)
Squamous cell carcinoma	Lesions usually involve the mid oesophagus.	Lesions usually involve the mid oesophagus. Compared with oesophageal melanoma, squamous cell carcinomas demonstrate infiltrative growth pattern with diffuse thickening. The peak enhancement is in the delayed phase.	As above (carcinomas)	As above (carcinomas)
Leiomyoma	Smooth sub-epithelial filling defect forming right angles or slightly obtuse angles with the oesophageal wall.	Subepithelial smoothly-marginated mass with areas of calcification, fat and extraluminal gas within. Compared to oesophageal melanoma, leiomyoma shows homogenous mild enhancement on arterial and delayed phases.	Shows spectrum of FDG uptake. May be confused with more aggressive lesions.	Not commonly used to assess oesophageal leiomyomas but they will appear as T1 isointense, T2 hypointense.
Tuberculosis (TB) oesophagus	Ulceration, spasm, alteration and effacement of mucosal pattern as well as stricture formation (53). TB lymphadenopathy may also cause extrinsic compression of the oesophagus. May have fistulations with adjacent organs (e.g. tracheobronchial tree).	Markedly thickened oesophageal wall with stricture.	FDG uptake in oesophageal lesions.	Not routinely used to assess for primary tuberculous oesophagitis, but will show diffuse mural thickening, restricted diffusion and post-contrast enhancement.
Fibrovascular polyps	Long, smooth, expansile, sausage-shaped mass arising from cervical oesophagus.	Well-defined solid expansile heterogenous oesophageal lesion with soft tissue and fat densities.	Not usually associated with FDG avidity.	Dependent on constitution of the polyp. Fibrous components will be T1 isointense and T2 isointense to hypointense whereas necrotic/oedematous areas will be T2 hyperintense.

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KEYWORDS

Primary oesophageal melanoma, barium swallow, fluorodeoxyglucose, positron emission tomography- computed tomography, oesophagus

ABBREVIATIONS

CT = COMPUTED TOMOGRAPHY
PET-CT = POSITRON EMISSION TOMOGRAPHY-COMPUTED TOMOGRAPHY
MRI = MAGNETIC RESONANCE IMAGING

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