BJR


Received: 08 February 2022 | Revised: 04 October 2022 | Accepted: 13 October 2022 | Published online: 28 November 2022

https://doi.org/10.1259/bjr.20220164

Cite this article as:
McQueen A, Al-Zuhir N, Ali T. Incidentalomas in the head & neck. *Br J Radiol* (2023) 10.1259/bjr.20220164.

REVIEW ARTICLE

# Incidentalomas in the head & neck

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## ABSTRACT

Incidental findings (IFs) in the head & neck are a frequent challenge to the reporting radiologist. A combination of complex anatomy, widely varied imaging techniques and the high prevalence of benign pathology, makes safe and appropriate management of head & neck IFs problematic. The non-head & neck radiologist is unlikely to have prior personal experience of the relevant specialties or current involvement with the pertinent multidisciplinary teams, creating unfamiliarity with both the clinical aspects of head & neck disease and the value of examination techniques. This triumvirate of complex anatomy, pathology and imaging creates the perfect environment for excessive investigation and overdiagnosis. In this article, the most frequently encountered and clinically relevant head & neck IFs are summarised. To reflect daily clinical practice, we will firstly consider anatomic abnormalities identified on cross-sectional imaging and ultrasound, followed by a review of PET-CT incidental findings.

## INTRODUCTION

An incidental finding (IF) can be defined as an asymptomatic and unexpected lesion, identified on imaging performed for unrelated clinical reasons. IFs are frequently identified in the head and neck and pose a considerable challenge to the reporting radiologist. The anatomy is complex with intimately related but functionally distinct subsites and a wide range of physiological and pathological imaging appearances are encountered. Benign findings are ubiquitous and should not lead to unnecessary investigation; conversely, the early identification of significant incidental disease is rare but achievable - if specific radiological and clinical characteristics are understood. The non-head & neck radiologist starts at a clinical disadvantage: they are unlikely to have prior personal experience of the relevant specialties (*e.g.,* ENT, thyroid) or current involvement with the relevant multidisciplinary teams; therefore, opportunities for feedback and case outcome discussions are limited. Consequently, the reporter may be unfamiliar with both the clinical presentations of head & neck disease and the value of examination techniques (*e.g.,* fibreoptic nasendoscopy, otoscopy). In addition, IFs are often detected on imaging that is not optimised for the head & neck and this triumvirate of challenging anatomy, pathology and imaging creates the perfect environment for excessive investigation and overdiagnosis. Radiological uncertainty can expose the patient with a head & neck IF to unwarranted referral and investigation with potentially enormous implications of excessive IF imaging and clinical investigation.[1] Review of prior imaging is a simple first step to see if an "incidentaloma" is longstanding or new - this can help narrow the differential diagnosis considerably and guide appropriate management.

In addition to the IFs encountered in conventional imaging, the increase in utilisation of FDG PET-CT in medical imaging is increasingly exposing radiologists to a myriad of incidental findings. 18F-Fluorodeoxy glucose (FDG) is a marker for glucose uptake and glycolysis. Increased glucose metabolism is a feature seen in a wide variety of malignant and benign processes. The routine whole-body acquisition, often used for PET-CT imaging, frequently results in the identification of unexpected findings, unrelated to the primary pathological process intended for interrogation. As a result, managing incidental FDG PET-CT findings is becoming a growing part of patient care pathways. Radiologists and treating clinicians therefore should be familiar with the significance and impact of different incidental PET-CT findings. In this article we aim to address the most frequently encountered and clinically relevant head & neck IFs seen on anatomic imaging and FDG PET-CT.

## THYROID

Thyroid incidentaloma can be defined as "an asymptomatic and unexpected thyroid lesion identified incidentally on imaging performed to investigate conditions unrelated to the thyroid itself".

With improvement in the technical aspects of radiological modalities and the increased use of imaging overall, the detection of thyroid incidentalomas has increased in the last two decades.[2] As thyroid nodules are very common in the general population with reported prevalence up to 65% in autopsy data[3] - which is comparable to their prevalence on ultrasound (US) - the continued growth of imaging means that management of incidental thyroid nodules is a common issue for the reporting radiologist. The estimated probability of detecting a thyroid incidentaloma is one in every ten cross-sectional imaging studies which cover the lower neck[4,5]

Heterogeneity in reporting thyroid incidentalomas was observed among different study modalities and reporting radiology groups[6] with Computerised Tomography (CT) identified as the most common source of detection (94%) compared with Magnetic Resonance Imaging (MRI) (6%). Higher incidence of reporting thyroid incidentalomas was observed in Chest and Neurological related imaging reports.[6] The recommended further work up for thyroid incidentalomas varied between multiple radiology disciplines, imaging clinical indication and the reporting radiologist experience.[6] Also, patients who had imaging for other malignancies were less likely to have further work up recommendation for the thyroid incidentalomas.[6]

CT and MRI imaging do not provide the spatial resolution to identify features that can predict malignant potential and the signal characteristics of both benign and malignant thyroid nodules on MRI sequences do not accurately predict nodule type.[7]

Thyroid cancer incidence in the United Kingdom (UK) has risen in the last two decades[8] in both males and females and across all age groups. Whilst this trajectory is predicted to continue, there is very high variability in the thyroid cancer incidence globally between different countries with the highest rises in thyroid cancer incidence seen in countries with greatest access to healthcare resources, especially radiology.[8] However, the mortality age-standardised rates (ASR) from thyroid cancer particularly for the male population in the UK is projected to become slightly less (−0.27%) and only small projected increase in the mortality ASR within the female population is predicted (0.52%).[9] Some studies tried to link the increase incidence of thyroid cancer to overdiagnosis on imaging[10] but other studies did not show any statistical significance regarding that.[11,12] The basic principle that incidental cancer detection confers improved prognosis due to the early diagnosis and management does not appear to be the case with thyroid cancer in general. Studies comparing the oncological outcome of immediate thyroid surgery and active surveillance for papillary microcarcinoma of the thyroid gland were similarly excellent.[13] Supporting this indolent behaviour is the finding that subclinical thyroid cancer was detected at least in 36% of autopsy data in a study in Finland.[14]

Further diagnostic work up for the thyroid incidentaloma is mostly if not exclusively performed by US.[15] Certain features on US that are concerning for thyroid malignancy such as the presence of microcalcifications (Figure 1), markedly hypoechoic nodules (Figure 1), nodules with irregular and nodular margins (Figure 1) and a taller than wider thyroid nodule (Figure 1).

However, it is not practical and even maybe harmful to further investigate each thyroid incidentaloma detected on cross-sectional imaging[16] but there are certain features that when present on cross-sectional imaging raise likelihood of thyroid malignancy. These include abnormal lymph nodes adjacent to thyroid lesions in the absence of other visible primary lesion (Figure 2) or if the thyroid lesion appears infiltrative on cross-sectional imaging or associated with vocal cord palsy changes (Figure 3). While fine needle aspiration of the thyroid nodule itself carries very minimal risk to the patient, cytology won't necessarily be able to establish a benign diagnosis with certainty and may put the patient at risk of further repeat biopsy or diagnostic hemithyroidectomy for benign nodules particularly with follicular neoplasm as the differentiation between follicular carcinoma and adenoma and/or hyperplastic nodules would only be definitively feasible on histopathology performed on a hemithyroidectomy specimen.[17]

With all the above into consideration, Hoang et al[18] suggested adopting a unified approach to these thyroid incidentalomas detected on anatomical imaging depending on the presence of certain concerning features summarised (Table 1).

## THYROID (PET IFs)

Thyroid gland uptake is a frequent finding on FDG PET-CT and the pattern of uptake can be diffuse or focal (Figure 4). Diffuse uptake indicates a process involving the entire gland and is often attributed to thyroiditis. Chen et al found diffuse thyroid gland uptake in 1.8% of 2594 PET studies.[19] Chronic thyroiditis was diagnosed in all patients who proceeded to thyroid function test and US to investigate their diffuse FDG uptake.[19] Kurata described a similar incidence of diffuse thyroid uptake of 1.53%.[20] All subjects with diffuse thyroid uptake in this series were subsequently diagnosed with Hashimoto's thyroiditis.

Focal thyroid gland uptake is often more significant. A large systematic review found the thyroid gland to be the second most common site for incidental focal uptake seen on FDG PET-CT, second only to incidental colonic uptake.[21] Tamburello reported a pooled prevalence of focal thyroid gland uptake ranging from 1 to 2.46%. Focal FDG uptake at the thyroid gland can be seen with both malignant and benign nodules: the reported risk of malignancy varies in the literature with some studies reporting risk as low as 8%[22] to as high as 64%.[19] The significant variation is likely related to a combination of study design, different population characteristics and background risk of thyroid cancer related to a geographical area. Tamburello reported a pooled risk of malignancy ranging from 33.2–37%. Another large meta-nalysis, looking at more than 147,000 PET studies, described a pooled malignancy risk of 34.6% for FDG avid incidental thyroid nodules.[23] Consequently, the American Thyroid Association

Figure 1. Showing concerning and suspicious US features. (a) Multiple punctate hyperechoic foci indicating microcalcifications. (b) Markedly hypoechoic thyroid nodule (c.f. muscles). (c) Irregular and lobulated nodule margins. (d) Taller-than-wider thyroid nodule.

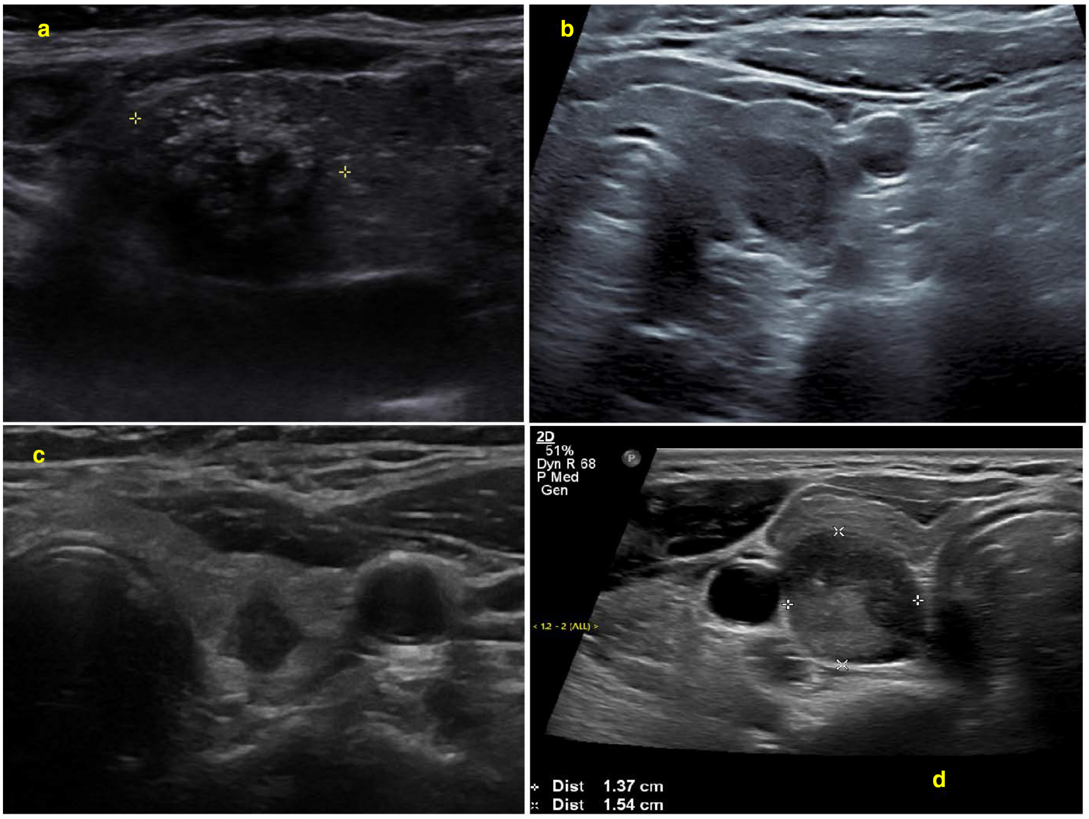
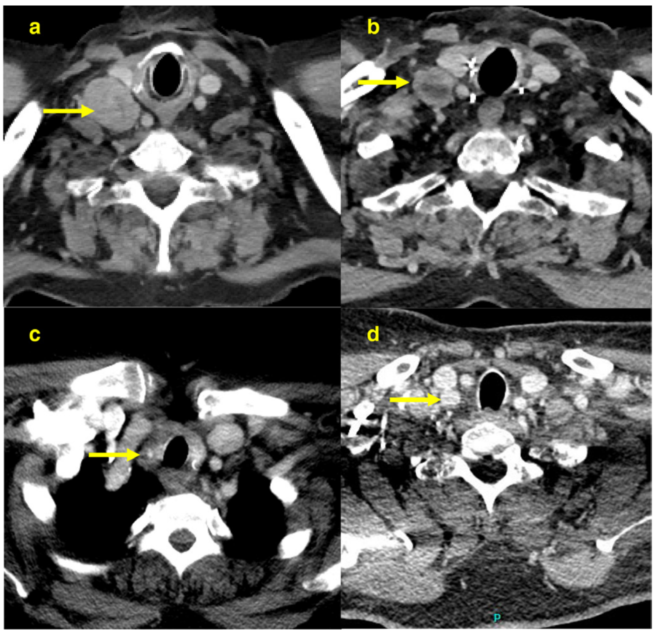



Figure 2. Abnormal lower neck lymph nodes on CT. (a) Enlarged lymph node (arrow). (b) Lymph node with central hypodense region indicating cystic change (arrow). (c) Lymph node with central hyperdense focus on indicating calcification (arrow). (d) Hyperenhancing lymph node with enhancement similar to the adjacent vessels (arrow)




guidelines address this by recommending clinical evaluation and FNA for all FDG avid thyroid nodules > 1 cm.[24] For FDG avid thyroid nodules < 1 cm, that do not meet the guidelines' FNA criteria, the authors advised that these nodules should be monitored similarly to nodules with high-risk sonographic pattern that do not meet FNA criteria.

It is clear from the evidence that approximately 1 in 3 FDG avid thyroid nodules turn out to be malignant and - in isolation - it is easy to conclude that aggressive investigation and management is appropriate for these patients. However, it is important to recognise the contextual setting specific to each scenario. Most patients undergoing FDG PET-CT have an underlying malignant process.

Figure 3. CT features of thyroid malignancy. (a) Irregular margins along the sternomastoid muscle (arrow) and the posterior thyroid capsule (dotted arrow). (b) Features of vocal cord palsy showing dilated laryngeal ventricle/sail sign (arrow) and ipsilateral pyriform sinus (asterisk).

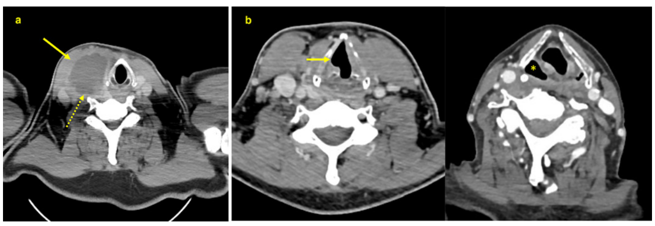


Table 1.

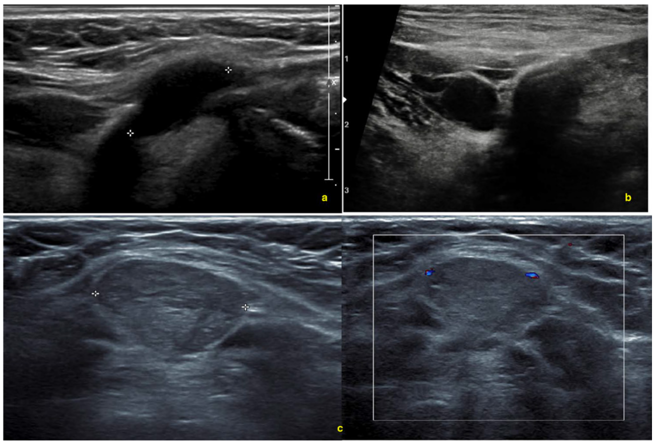
| Modality | Concerning/Suspicious Features |
|---|---|
| CT/MRI | 1. Abnormal cervical lymph nodes: (Figure 1)<br>• Enlarged<br>• Cystic changes<br>• Calcification<br>• Increased enhancement<br>2. Thyroid lesion invasive margins (Figure 2)<br>3. Ipsilateral vocal cord palsy (Figure 2) |
| US | 1. Microcalcifications (Figure 3)<br>2. Marked hypoechogenicity (Figure 3)<br>3. Lobulated or irregular margins (Figure 3)<br>4. Taller-than-wide on transverse plane (Figure 3) |

Often this primary malignancy will be more aggressive than the incidental, potentially malignant thyroid lesion. A study looking at 362 patients with incidental focal thyroid uptake, assessed for primary outcome and thyroid cancer specific survival, found a median overall survival from the primary cancer of 20 months.[25] 50% of the patients died during the period of the study with most patients succumbing to the primary malignancy (92.2%) or other non-cancer related causes (7.2%). Only one patient was believed to have died from an incidentally discovered medullary thyroid cancer (0.6%). This highlights the importance of a contextual holistic approach to investigating incidental thyroid uptake in patients with pre-existing non-thyroid malignancy to determine if further investigations are appropriate given that the potential benefits for any thyroid specific interventions may not be realised.

## THYROGLOSSAL DUCT CYSTS

Thyroglossal duct cysts are the most common congenital central neck lesion. A failure of involution and atrophy of the thyroglossal tract after migration of the primitive thyroid tissue to its normal location inferiorly is the cause behind these cysts. They vary in size between 0.5–6 cm with most being between 1.5 and 3 cm.[26]

Figure 5. Examples of a thyroglossal duct cyst. (a) Well-defined, simple and entirely anechoic. (b) Fine septations within an anechoic cyst. (c) Appearances of a pseudosolid cyst, note the posterior acoustic enhancement (left) and the lack of colour Doppler signal (right).

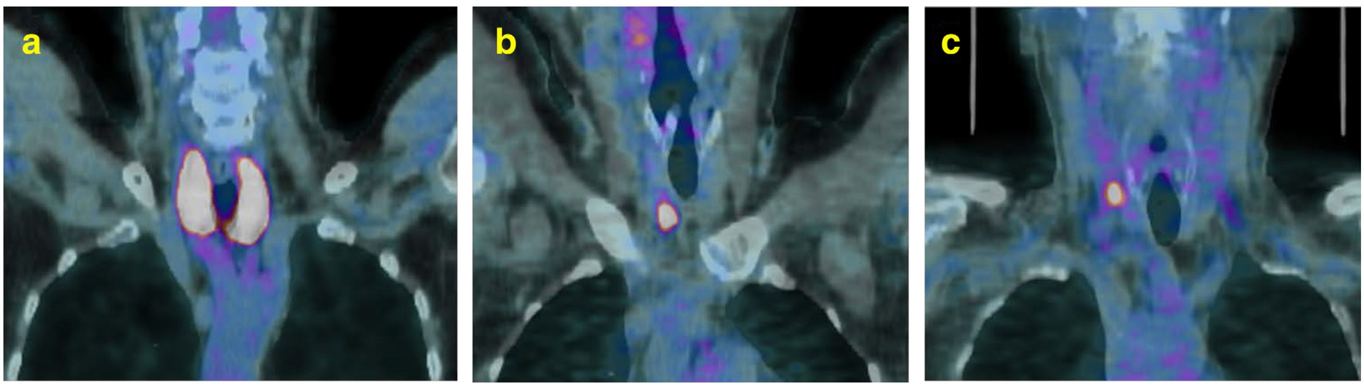


It is estimated that 7% of the general population has a persistent remnant of the thyroglossal duct[27] and 15% of adult autopsy findings in a study which examined 80 cadavers.[28]

Sometimes these are difficult to identify on CT and MRI due to their small size and can be overlooked when imaging the neck with US. They can be in an infra or suprahyoid position and sometimes slightly lateral to the midline if in an infrahyoid position. They can appear completely cystic and anechoic (Figure 5), complex/septated (Figure 5) and occasionally heterogeneous or pseudosolid (Figure 5).

Follow up study conducted on a cohort of adults during comprehensive health screening examination over 6 years showed that the vast majority (>90%) of these cysts either decreased in size or remained unchanged,[29] therefore asymptomatic thyroglossal duct cysts are often managed conservatively. Previous studies demonstrated that the complex appearances sometimes

Figure 4. FDG PET-CT images for different patients showing incidental FDG uptake at the thyroid gland. (a) Diffuse FDG uptake throughout the thyroid gland (thyroiditis). (b) Focus of marked FDG uptake at the right lobe of the thyroid (biopsy confirmed papillary thyroid carcinoma). (c) Focus of marked FDG uptake at the right lobe of the thyroid (U2 benign appearance on US - stable on US surveillance).



encountered on US can be attributed to the proteinaceous content which are secreted by the cyst lining.[30]

## SALIVARY

A salivary incidentaloma (SI) can be defined as "any focal salivary lesion, independent of size, discovered by any imaging method… in the absence of known salivary disease".[31] SIs most commonly occur in the parotid gland with submandibular and sublingual lesions far less frequently encountered. Islands of salivary parenchyma are present throughout the head and neck (minor salivary glands) but are not identified on most imaging techniques; SIs can arise from these sites but are rare. Most of the literature regarding SI incidence and outcomes relates to parotid lesions and primarily involves salivary tumours, although sialolithiasis and ductal obstruction can also be identified incidentally. The rate of parotid SI detection is related to imaging technique with an incidence of 0.26% on unenhanced 1.5T brain MRI in a population of 73-year-olds,[32] 1.2% of contrast enhanced brain MRI studies[33] and 2.5% of patients undergoing brain CT angiography for acute stroke intervention.[34] The disparity in MRI detection appears related to MRI technique with the vast majority of incidentally detected parotid lesions in the higher incidence study identified on a single contrast-enhanced 3D rather than 2D non-contrast brain sequence,[33] likely due to the more detailed extracranial soft tissue characterisation with this sequence. Parotid SIs measure 1.5 cm in average size at detection and are typically benign with a malignancy rate of 5–8% in studies with pathology outcomes.[33,35,36] With continued growth in CT & MRI performance, detection of parotid SIs has understandably risen significantly. As a proportion of all patients undergoing parotid surgery over the period 1994–2013, a US study of 771 patients found that the proportion of patients with SIs rose from 4 to 10%.[37]

Although pleomorphic adenoma is the most common symptomatic salivary neoplasm, Warthin's tumour is consistently identified as the most common SI neoplasm on anatomic imaging – indicating a sizeable subclinical population with this form of salivary tumour.[36] As Warthin's tumours occur as multifocal and/or bilateral parotid lesions in up to 20% of cases,[38] the finding of bilateral parotid SIs (especially when located in the inferior part of the gland) is highly suggestive of this diagnosis. For the radiologist encountering an SI on diagnostic imaging, the typical approach is to recommend further investigation with ultrasound +- ultrasound guided FNA, where clinically appropriate. Ultrasound is likely to determine whether the SI is non-neoplastic (*e.g.,* focal sialadenitis, intraparotid lymph node) or a tumour. Performing FNA then provides cytological material to characterise neoplasia further and guide management under ENT surgical care (Figure 6). Unlike other head and neck IFs, surgical resection is often indicated for benign salivary tumours (*e.g.,* incidental pleomorphic adenoma) as malignant transformation is a well-recognised long term risk. Patients who are managed conservatively usually undergo clinical & ultrasound surveillance.

### SALIVARY (PET IFs)

Incidental focal uptake at the parotid gland is an occasional occurrence in FDG PET-CT. A metanalysis found a pooled prevalence for focal incidental parotid uptake of around 0.6%.[39] The pooled risk for malignancy ranged from 9.6 to 20.4%.[39] PET-CT is often unable to differentiate between malignant and benign parotid lesions. In fact, benign parotid lesions often demonstrate higher maximum standardised uptake values (SUVmax) than malignant lesions. A study showed a mean SUVmax for malignant parotid lesions of 8.4 compared to 10.3 for benign parotid lesions.[40] As a result, SUVmax values cannot be used to differentiate between benign and malignant lesions (Figure 7).

The parotid gland and intraparotid lymph nodes are a recognised site for metastases from head and neck cancers. This suggests a higher risk of malignant parotid nodules in these patients. A study looking at the incidence of focal parotid uptake in patients with head and neck malignancy found a prevalence of 2.1%.[41] This is higher than the reported overall incidence of parotid uptake in other series. In this study, 33.3% of patients who underwent pathological confirmation or imaging follow up, had a malignant lesion (all metastases). The study also showed no significant difference in SUVmax between the benign and malignant lesions. Another series found a similarly high parotid metastases incidence of 36.4%.[41] 75% of these patients had malignant melanoma metastases. The copresence of FDG avid cervical lymph nodes also suggest a higher probability for the

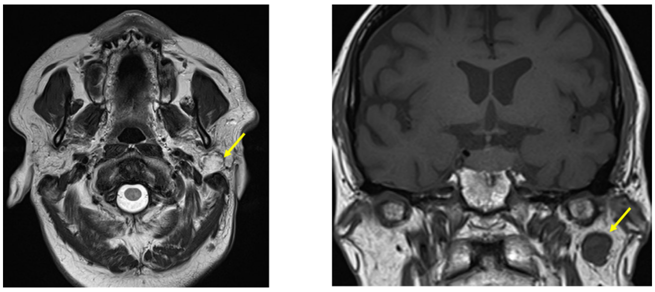


Figure 6. Incidental left parotid lesion on axial T2 (left) and coronal T1 (right) brain MRI. US guided FNA was consistent with pleomorphic adenoma. Management = surgical resection with superficial parotidectomy.

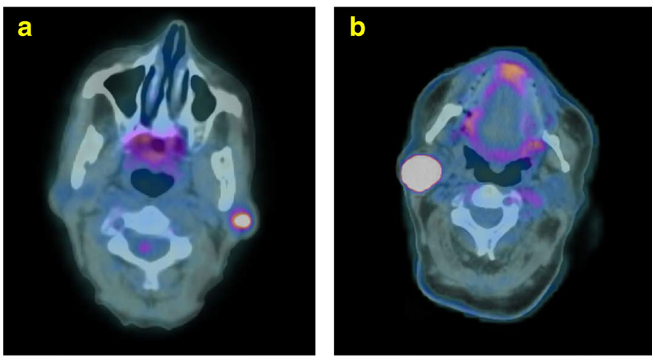
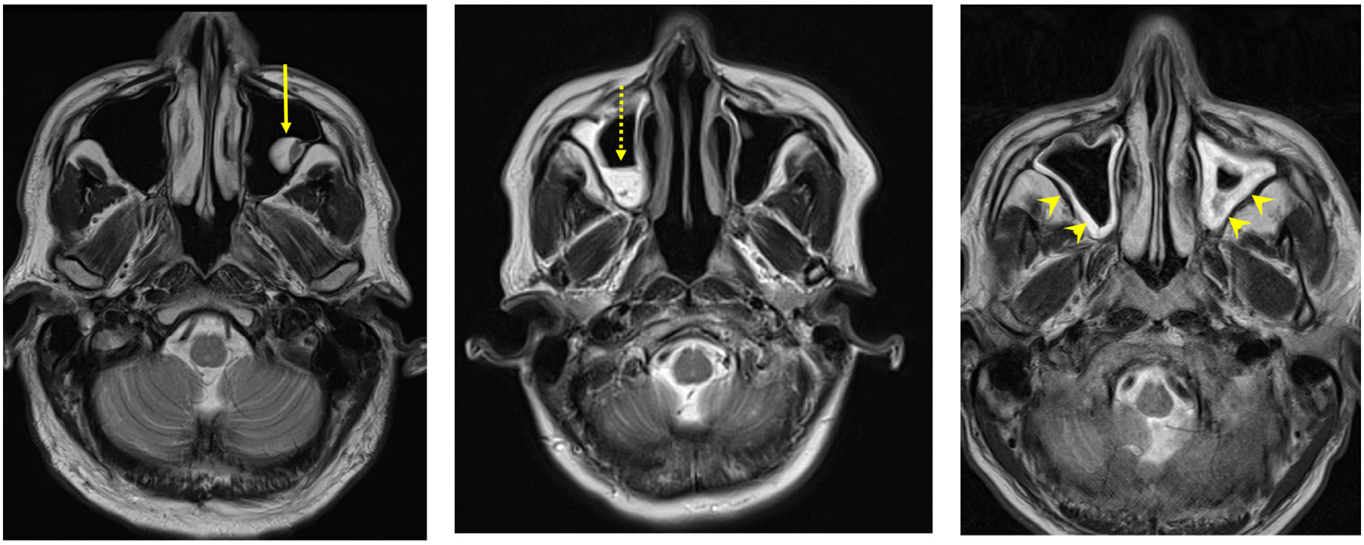



Figure 7. FDG PET-CT images for different patients showing FDG avid nodules in the parotid gland. (a) Focus of marked uptake at small nodule in the left parotid gland (SUVmax 5.1). Biopsy confirmed Warthin's tumour. (b) Intense FDG uptake at a large nodule in the right parotid gland (SUVmax 24.9). Biopsy confirmed malignant melanoma metastasis.

Figure 8. Common benign sinus IFs on axial T2 MRI. Left – Convex, well defined mucous retention cyst in antrum (arrow), without secretions or mucosal thickening. Middle – Layer of bubbly secretions in right antrum (dotted arrow).Right – Bilateral, asymmetric antral mucosal thickening (arrowheads).



parotid lesions to be malignant. Mabray found 78% malignant parotid lesions in patients with coexisting FDG avid cervical nodes compared to 30% in patients with no FDG avid neck nodes.[40]

Although most FDG avid incidental parotid lesions are benign, the risk of malignancy is not negligible and this warrants further investigation, especially in the setting of head and neck cancer, melanoma or coexisting FDG avid cervical lymph nodes. As is the case with anatomic imaging, it is important to emphasise that active intervention will frequently be indicated for benign parotid lesions identified on FDG PET CT due to the long-term risk of malignant transformation.[42]

## PARANASAL SINUSES

Imaging of the brain, skull base and cervical spine often includes the nasal cavity and paranasal sinuses with the advent of cone beam CT (CBCT) in dentomaxillofacial imaging providing a source of detailed, but often partial sinus visualisation. Sinonasal IFs are extremely common with mucosal thickening, retention cysts and secretions frequently identified within the paranasal sinuses. A systematic review of IFs on CBCT identified sinus opacification/mucosal thickening in 41.7% of patients, despite the small field of view often covered with this technique.[43] In a large population-based MRI study of 982 healthy volunteers, sinus opacification was identified in 66% and mucosal thickening in 49%.[44] The maxilla was the most frequently involved sinus and

Figure 9. Axial T2 MRI (left) showing bilateral nasal cavity masses with antral opacification. ENT referral led to fibreoptic nasendoscopy demonstrating bilateral nasal polyps. Coronal CT sinuses (right) showed grade 2 inflammatory nasal polyps with pan sinus opacification.

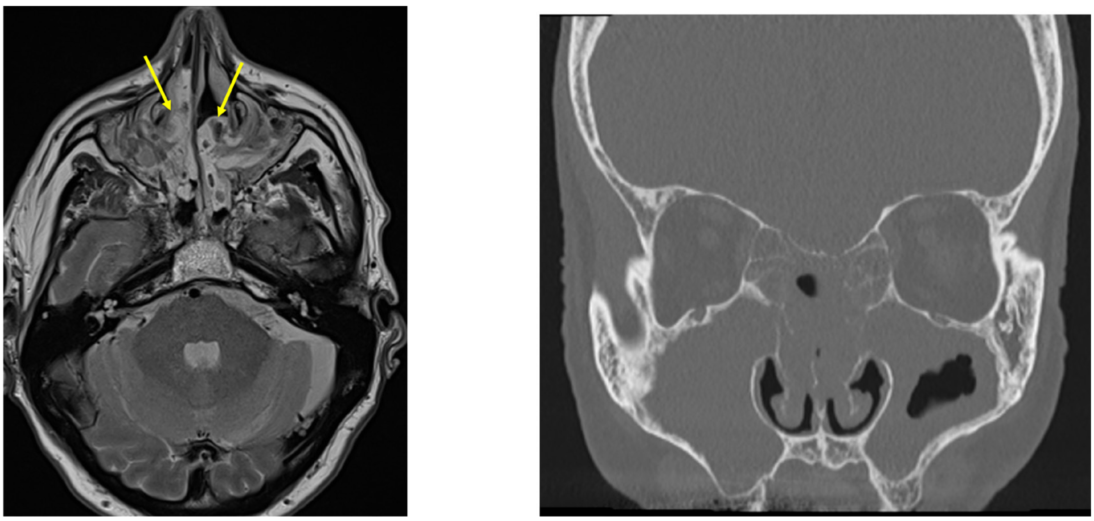
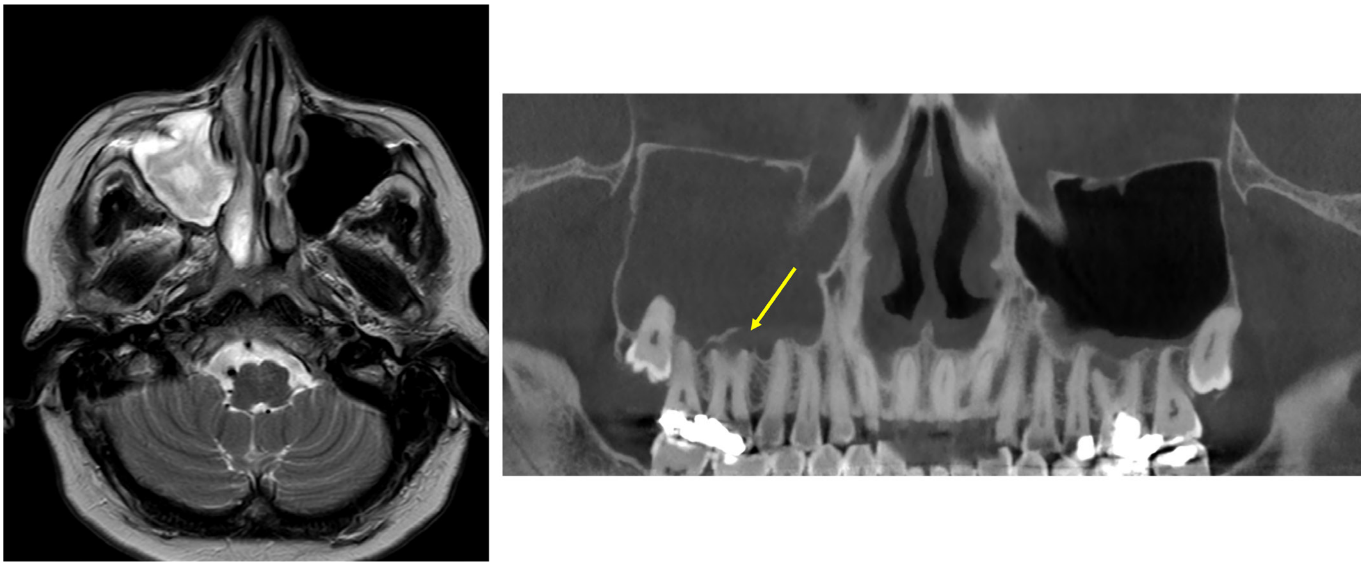
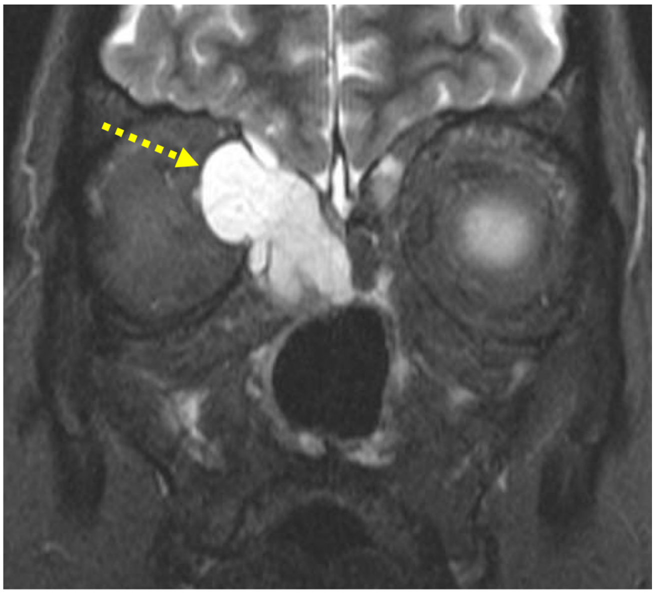


Figure 10. Completely opacified right antrum on T2 axial MRI (left) in a patient with facial pain. Panoramic reconstruction CBCT (right) demonstrated an opacified maxillary antrum with periapical inflammatory lucency at the restored upper right 6 breaching the antral floor (arrow). Diagnosis = odontogenic sinusitis.



incidental findings more commonly occurred in males. Importantly, the presence of sinus opacification and mucosal thickening is a **very poor predictor of underlying sinus disease,** despite the relatively high incidence of chronic rhinosinusitis (CRS) in the background population. Using a grading system to objectively measure the extent of opacification on sinus CT[45] and a patient questionnaire to assess CRS symptoms, only 20% of patients with current CRS symptoms had significant sinus opacification on CT whilst more than 40% of patients with extensive sinus opacification had no symptoms at all (*e.g.,* imaging findings were incidental). 7.5% of males and 1.6% of females did have significant symptoms and supporting imaging evidence of CRS.[46]

Figure 11. 52 year old female with headache and retro-orbital pain. Coronal fat suppressed T2 MRI shows fluid expansion of the right ethmoid sinus with herniation through the lamina papyracea (dotted arrow), indicating mucocoele formation. The patient had a history of Granulomatous Polyangitis (GPA) - note the absent nasal septum due to sinonasal GPA.



Comprehensive clinical assessment of sinonasal disease involves symptom evaluation and fibreoptic nasendoscopy by an ENT clinician – primarily to identify pathology within the nasal cavity (rhinitic mucosa, polyps, etc). For the reporting radiologist, asymptomatic IFs within the paranasal sinuses will be encountered with extreme regularity and do not warrant ENT referral or further imaging in most cases. Common examples (Figure 8) include well-defined, convex retention cysts - which can contain mucinous, proteinaceous fluid - whilst dependent and/or bubbly secretions are frequently seen in patients with mild sinus inflammation with or without symptoms. The identification of clinically significant, benign inflammatory disease (CRS, polyps) and rare,

Figure 12. CT neck & body performed for general malaise. Unilateral opacified right maxilla with medial expansion into nasal cavity and bone loss (arrow). MRI sinuses demonstrated an enhancing mass in the medial antrum (asterisk) with obstructed secretions laterally (dotted arrow). Biopsy = extranodal non Hodgkin's lymphoma.

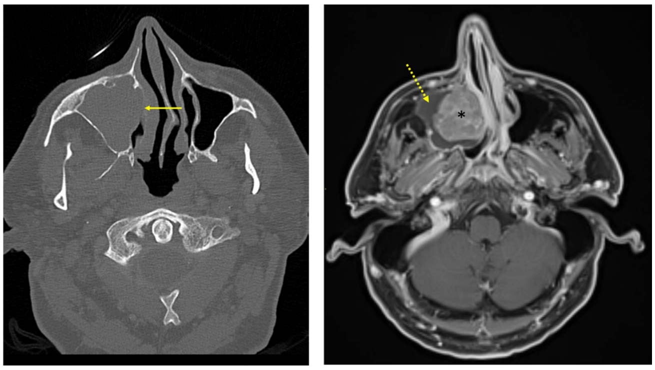


Figure 13. Mild inflammatory hypertrophy of palatine tonsils on axial T2 MRI in a young adult. The lymphoid tissue yields T2 hyperintense, striated signal (arrow) with preserved hypointense constrictor muscle and posterior tonsillar pillar (dotted arrows).

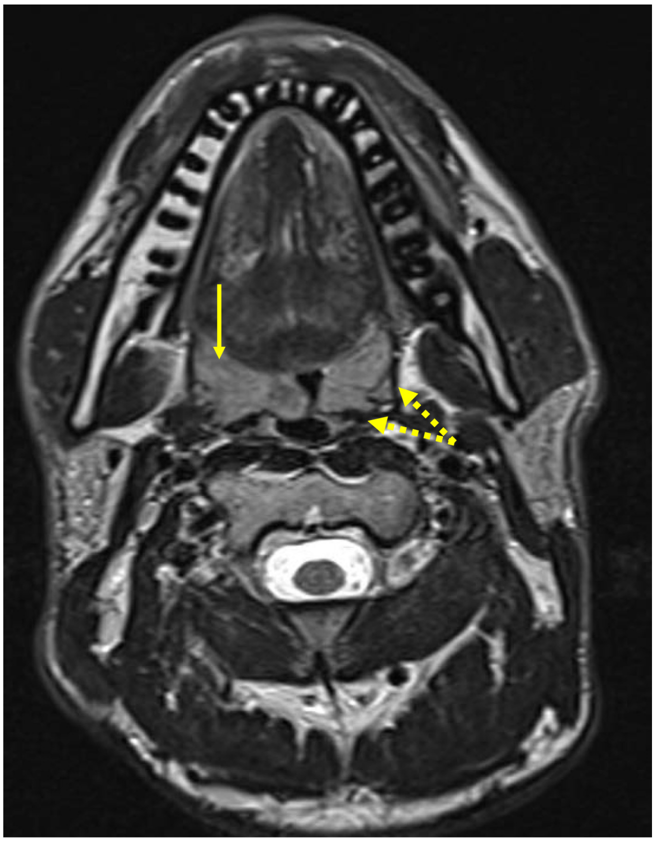


Figure 14. Contrast enhanced CT neck in a 44 year old trauma patient. Bilateral calcific foci in the lateral oropharynx are due to incidental palatine tonsilloliths (dotted arrows).

incidental sinonasal tumours is challenging but familiarity with key imaging features can allow the radiologist to recommend appropriate ENT referral (Figure 9). Localised mucosal thickening in the floor of the maxillary antrum is most commonly due to upper dental disease with unilateral, complete maxillary opacification being the classic appearance of odontogenic sinusitis (Figure 10), warranting inspection of the upper dentition on imaging and dental assessment.[47] The finding of multi sinus opacification involving a specific drainage pathway suggests an obstructing mucosal lesion such as a polyp or neoplasm, whilst sinus expansion into adjacent structures (*e.g.,* orbit, anterior cranial fossa) is a feature of mucocoele formation. This 'IF' is important to recognise, as it can be the extracranial cause of neurological symptoms such as headache and visual symptoms, typically in the setting of CRS/polyps (Figure 11). The finding of bone erosion and enhancing soft tissue (particularly if there is soft tissue extension beyond the sinus walls) is rare but suspicious for malignancy; urgent ENT referral and further imaging with sinus protocol CT & MRI are warranted in this setting (Figure 12).

Figure 15. FDG PET-CT for a 72 years old male, performed for staging of a newly diagnosed bronchogenic carcinoma (right). Incidental asymmetric marked FDG uptake identified at the left glossotonsillar groove (left). Associated FDG avid cervical lymph node was also seen in level II (dotted arrow). Tongue base biopsy = Squamous Cell Carcinoma.

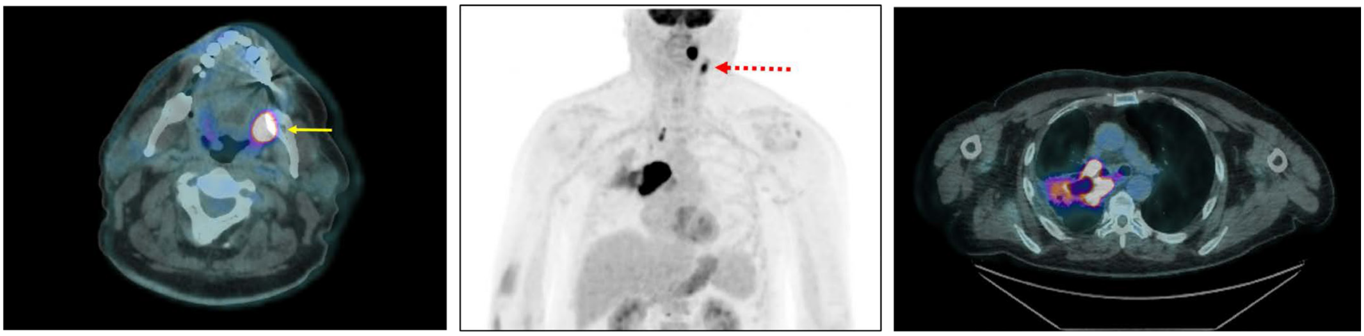
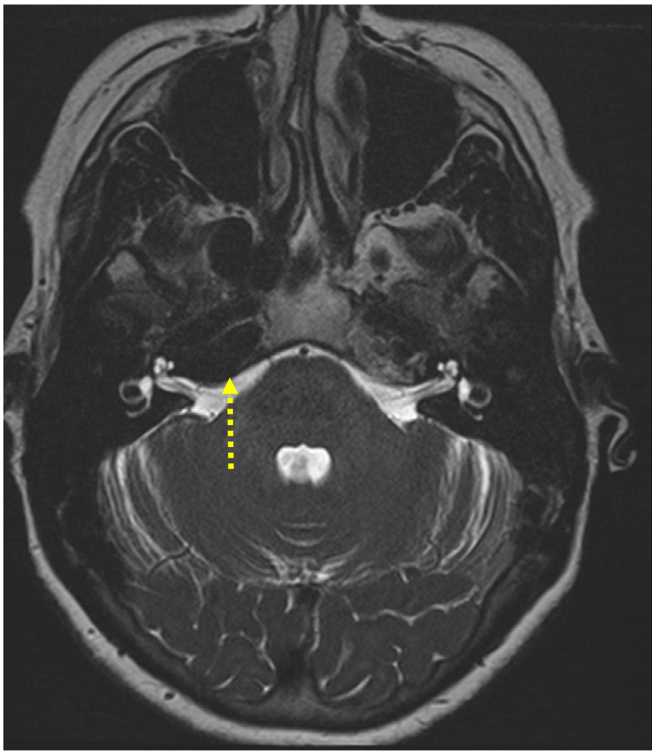


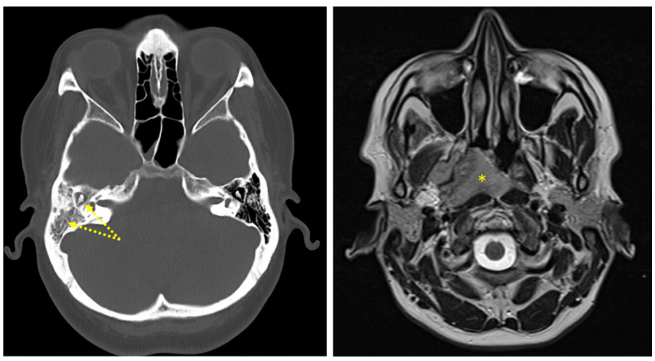
Figure 16. Axial T2 brain image showing signal loss in right skull base marrow due to normal variant petrous apex pneumatisation (dotted arrow).



## UPPER AERODIGESTIVE TRACT

The upper aerodigestive tract (UAT – oral & nasal cavity to trachea & oesophagus) is often fully or partially included in imaging of the brain, cervical spine, and thorax. The appearance of the UAT alters with respiration (vocal cords adduct in held inspiration) and is very sensitive to patient motion *e.g.,* swallowing, tongue movement. The UAT mucosal surface is largely amenable to direct clinical inspection (intra-oral or FNE) but the tongue base, larynx and hypopharynx may require examination under anaesthesia (EUA) for full clinical assessment. Benign IFs are common and include mucous retention cysts and lymphoid tissue hypertrophy– seen as symmetrical, bulky adenoid, palatine, and lingual tonsils with typical benign characteristics (Figure 13). Chronic tonsillar inflammation can lead to stone formation (tonsilloliths) and these are most commonly seen in the palatine tonsils (Figure 14): in a population of 125 patients undergoing CT neck for varied ENT and non-ENT indications, 25% demonstrated at least one palatine tonsillolith.[48] Incidental detection of serious pathology in the UAT on anatomic imaging is rare: in the setting of an indeterminate finding, it is important for the diagnostic radiologist to understand the value of clinical assessment (history, ENT examination) as the next investigative step. Support from a head & neck radiology colleague can be extremely helpful in UAT findings, typically to confirm benignity but also to guide appropriate further investigation in specific cases.

Figure 17. CT brain (left) in a 34 year old man with headache, facial pain and hearing loss. Unilateral middle ear and mastoid fluid (dotted arrows) indicating Eustachian tube obstruction. Subsequent axial T2 MRI (right) shows asymmetric nasopharyngeal soft tissue mass (asterisk). Biopsy confirmed nasopharyngeal carcinoma.



## UPPER AERODIGESTIVE TRACT (PET IFs)

Physiological FDG uptake is commonly seen in the upper aerodigestive tract. This is mostly observed at the lymphoid tissue of Waldeyer's ring. This is typically more notable in young patients due to the abundance of lymphoid tissue in this group. Uptake at the vocal cords and the tongue are also common and often associated with the act of phonation. The high level of physiological uptake in these sites makes interrogation difficult, increasing the likelihood of false positives. Evidence specifically looking at incidental FDG uptake at the upper aerodigestive tract is unfortunately scarce. Bujoreanu et al described incidental upper aerodigestive tract uptake in 0.88% of all PET-CT studies in their series.[49] The tonsils were the commonest site for incidental FDG uptake (55.9%) followed by the base of tongue (31.4%). The vast majority of the lesions were benign with only 1.9% of upper aerodigestive tract foci uptake harbouring malignancy, a reassuringly low rate that is supported by other studies – including one that did not identify malignancy in any incidental FDG focus within Waldeyer's ring.[50] Asymmetric uptake is often described on PET-CT reports as a reason for heightened suspicion for significant upper aerodigestive tract uptake. One study showed that asymmetric uptake without a visible CT abnormality is commonly seen in Waldeyer's ring (33%), oral cavity floor (43%) and in the larynx (30%).[51] None of the patients with asymmetric upper aerodigestive tract uptake went on to develop a corresponding carcinoma during the study period.

At such low yields for a malignant diagnosis following incidental focal FDG uptake of the upper aerodigestive tract, a measured approach should be adopted. Asymmetric FDG uptake is common and is not necessarily an indicator of malignancy *per se* if no associated anatomical abnormality is seen. Delay to the treatment of any index primary or unnecessary investigations in patients with advanced malignancy should be avoided due to the likely low impact to the patients' overall outcome. A risk-stratification model for patients with unexpected upper aerodigestive tract uptake is lacking but is clearly needed. Direct visualisation and clinical assessment remain important as the presence of symptoms or associated structural abnormalities will almost certainly lead to an increased likelihood of malignancy. There is likely to be a role for additional interrogation with contrast enhanced CT or MRI for selected patients, again with the aim of identifying any associated structural abnormality. Patient related risk factors should also be considered when tailoring individual approaches. Considerable risk factors for upper aerodigestive tract carcinoma like tobacco and alcohol consumption are well established. Specific data for the role of SUVmax is lacking but it is largely accepted that SUVmax, despite its variability, has been shown to be high in true malignancy of the oral cavity and oropharynx (Figure 15). The SUVmax value therefore should be taken into consideration. However, an accurate and practical risk stratification model for managing incidental upper aerodigestive track uptake requires more work and is clearly needed.

## TEMPORAL BONE

Normal development of the temporal bone results in aerated mastoid cells and antrum with the Eustachian tube (ET) passing from the middle ear to lateral nasopharynx. Additional pneumatisation of the petrous apex and zygomatic arch are common anatomical variants; asymmetric marrow signal due to unilateral petrous apex pneumatisation is one of the most common incidental skull base findings and should be recognised as a normal anatomic variant (Figure 16). The presence of fluid/secretions within the mastoid bone is a very common IF with incidental mastoid opacification (IMO) identified on 8.4% of CT & MRI studies in a meta-analysis of 246,288 patients *without* clinical evidence of mastoid or otological disease.[52] In IMO patients where ENT referral is advised by the reporting radiologist, subsequent clinical assessment reveals middle ear/mastoid disease in only 8.8–11% of patients,[53,54] highlighting that imaging features alone are a poor predictor of clinical disease. In a study of 160 patients where IMO or 'mastoiditis' was present in a radiological report, 11.6% received antibiotic treatment despite most patients having no clinical evidence of otologic or mastoid disease on subsequent ENT review. To avoid inappropriate ENT consultation and/or treatment, it is important that the radiologist recognises that 'mastoiditis' is a clinical diagnosis and **should not be used to describe incidental mastoid opacification**.

An infrequent but clinically significant, incidental temporal bone finding is the finding of unilateral middle ear & mastoid effusion (complete opacification) in an adult. ET obstruction at nasopharynx level is relatively common in children due to anatomic development and frequent enlargement of adenoid lymphoid tissue, however unilateral ET obstruction in an adult requires careful imaging assessment of the skull base and nasopharynx to exclude an obstructing mass (Figure 17). Nasopharyngeal carcinoma is relatively uncommon in the UK but can present as an 'IF' on brain CT/MRI when symptomatic: skull base symptoms (headache, cranial neuropathy) may be more prominent than ENT signs and symptoms at presentation. The key features of malignancy are asymmetric nasopharyngeal soft tissue, bone marrow signal abnormality, cortical erosion, and retropharyngeal lymphadenopathy - urgent ENT referral is warranted in this setting.

## SUMMARY

Head and Neck incidentalomas are a frequent & regular feature of modern anatomic imaging and FDG PET CT. Whilst the vast majority of IFs are benign, each anatomic subsite carries its own combination of clinical features, malignant risk and options for further investigation. Navigating this area of imaging is challenging, but the reporting radiologist can utilise specific imaging and clinical features to recognise common, clinically insignificant head and neck IFs and avoid unnecessary investigation and referral for a very large patient group. Using the same clinicoradiological principles, the rare, but clinically significant IF can be appropriately investigated further, with the potential to improve patient outcomes by the early detection of clinically occult head and neck disease.

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