

Thyroid Abscess as a Manifestation of Invasive Aspergillosis in a Chronic Granulomatous Disease Patient

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Radiology Case. 2026 April; 20(4):1-15 :: DOI: 10.3941/jrcr.5932

AUTHOR CONTRIBUTIONS

RZ was responsible for the drafting of the manuscript, whilst all listed authors contributed to the numerous revisions of the text and clinical images.

DISCLOSURES

The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors. There are no competing interests to declare.

CONSENT

The Alfred Hospital Ethics Committee has granted a waiver of consent, in accordance with the criteria in section 2.3.10 (a) to (i) of the National Statement on Ethical Conduct in Human Research (2023) of Australia.

HUMAN AND ANIMAL RIGHTS

Not applicable.

ABSTRACT

A young adult male with background chronic granulomatous disease presented with a subacute history of fatigue, dyspnoea, abdominal pain, fevers and intermittent neck pain. The right thyroid lobe was enlarged with a heterogeneous fluid collection on ultrasound, with microbiological analysis demonstrating an *Aspergillus felis* abscess. Combined with other abscesses in the liver and spleen, the clinical picture was consistent with angioinvasive aspergillosis.

CASE REPORT

BACKGROUND

Thyroid abscesses are rare but documented pathologies often involving immunosuppressed patients. We present a rare case of fungal thyroid abscess as the sentinel presentation of angioinvasive aspergillosis in a chronic granulomatous disease patient. The relative ease of thyroid biopsy in combination with the documented manifestation in this draft aims to contribute to the knowledge and management of chronic granulomatous disease.

CASE REPORT

A young adult male presented to the emergency department with a subacute history of fatigue, dyspnoea, abdominal pain and fevers. He also noted a right anterior neck mass that was intermittently tender. His medical history was relevant for autosomal recessive chronic granulomatous disease (CGD) diagnosed in early childhood following an episode of *Aspergillus*

pneumonia 11 years prior to presentation. At presentation, he was on prophylactic trimethoprim/sulfamethoxazole but had ceased prophylactic itraconazole several years prior. He had a medical history of thalassaemia minor and childhood asthma.

The patient was thin and febrile to 38.1°C but had no respiratory distress on presentation, although pallor was noted. The chest was clear on auscultation and the abdomen was soft but distended. The patient had a liver >20cm by palpation and the spleen was tippable. He had a right anterior cervical node on palpation and notably a fluctuant, 6cm x 8cm, intermittently tender right neck swelling.

Imaging findings

A computed tomography (CT) of the chest, abdomen and pelvis revealed multiple hepatosplenic abscesses, largest of which approximately measuring 2.5cm x 2.8cm x 3cm,

anteroposterior x craniocaudal x mediolateral (AP x CC x ML) (Figure 1) and a small pulmonary nodule in the right middle lobe, approximately 0.3cm x 0.5 cm x 0.4cm, AP x CC x ML (Figure 2). Of significance, a hypodense region in the thyroid, approximately 2.6cm x 3.3cm x 1cm, AP x CC x ML (Figure 3) was visualised that required ultrasound (US) characterisation. The lesions were presumed to be abscesses, with the pulmonary micronodule concerning for fungal aetiology in this setting.

On ultrasound assessment of both the liver and thyroid, a decision was made post discussion with the treating team to aspirate the thyroid lesion instead as the septated, heterogenous fluid collection was consistent with an abscess and it would be a safer procedure (Figure 4).

Subsequent fungal microscopy, culture and sensitivity (MCS) post fluid MCS demonstrated *Aspergillus* species ultimately identified as *Aspergillus felis*.

Management

Empirical meropenem was commenced in conjunction with voriconazole post thyroid ultrasound and the patient was planned for aspiration of liver abscess for targeted antimicrobial therapy.

The patient also had an ultrasound-guided aspiration of the segment IV liver abscess, which also isolated *Aspergillus felis*. An ¹⁸F-fluorodeoxyglucose positron emission tomography (¹⁸F-FDG PET) scan demonstrated disseminated disease involving the thyroid, liver, spleen, and omentum with prominent mediastinal and abdominal lymph nodes (figure 5).

After an antimicrobial plan was confirmed, the patient was discharged after a 20-day inpatient stay with immunology and infectious disease follow up.

Ultimately, the patient succumbed to the disseminated *Aspergillus* 18 months later despite a number of attempted treatments, the details of which are beyond the focus of this manuscript, with progressive hepatic, as well as intracranial abscesses approximately 0.5cm x 0.4cm x 0.7cm and 1.4cm x 1.1cm x 1.4cm respectively, AP x CC x ML (figure 6) leading to hepatic failure and respiratory arrest.

DISCUSSION

Aetiology and demographics

Chronic granulomatous disease

CGD, formerly known as fatal granulomatous disease of childhood, is a primary immunodeficiency disorder characterised by severe bacterial and/or fungal infections and a predisposition to develop non-infectious inflammatory granulomas [1]. The condition is caused by genetic defects in proteins involved in the phagocyte nicotinamide dinucleotide phosphate (NADP) complex, critical to generate the necessary reactive oxygen species required for phagocyte-mediated microbicide [1,2]. Phagocytes are thus unable to destroy certain microbes,

generally catalase-positive organisms including *Staphylococcus aureus*, *Burkholderia*, *Nocardia*, *Aspergillus* as well as others. As its inheritance pattern can be either X-linked recessive or autosomal recessive, it affects more males than females of approximately 6:1 ratio [3]. It is a rare disease with an incidence of approximately 1 in 200,000 [1].

Aspergillosis

Aspergillosis is a disease caused by the *Aspergillus* genus that ranges in extent of involvement and clinical severity, preferentially involving the pulmonary system. An opportunistic infection, it is frequently seen in immunosuppressed patients and is the most common fungal organism isolated in CGD patients [4]. It should also be noted that among immunodeficiency conditions, CGD patients have the highest rates of invasive fungal infections [5] and aspergillosis is in fact the leading cause of mortality in CGD patients [3]. However, such infections typically begin in the pulmonary system that then spread to ribs, chest wall and/or spine [3,5]. Literature searches conducted did not find any cases of *Aspergillus* thyroid abscesses in CGD patients since 1972, which was a case of *Aspergillus fumigatus* thyroid abscess in an 11 year old boy [6].

Thyroid abscess

The thyroid gland's resistance to infection stems from its high iodine content, hydrogen peroxide production, rich lymphatic and vascular supply, as well as its encapsulated location. Postmortem studies reveal that 12% of extrapulmonary aspergillosis cases involve the thyroid, typically found incidentally, as most cases are asymptomatic [7]. Acute suppurative thyroiditis thus is a rare pathology with a suggested incidence of less than 0.1% [8]. Lafontaine et al. found bacteria (tuberculous species were listed separately), fungal and parasitic to be causative organisms [8]. In particular, the presence of fungal suppurative thyroiditis was most associated with immunosuppression and disseminated infection at 94% and 83% respectively, with mortality second only to parasitic infections for which there are two documented cases of *Toxoplasma* and *Nippostrongylus* [8]. Immunosuppressed conditions documented include solid organ transplant recipients, systemic lupus erythematosus patients, Crohn's disease patients; haematological malignancies such as myelodysplastic syndromes, acute and chronic lymphoblastic leukaemia, lymphoma, post allogeneic stem cell transplant; and acquired immunodeficiency syndrome [8]. Pyriform sinus fistulae are the second most significant risk factor for bacterial thyroid infections, particularly in children [8]. Of note, whilst there was a roughly equal male to female distribution in total, 14 of the 18 fungal thyroid abscesses were male [8].

Clinical and imaging findings

Chronic granulomatous disease

Despite the uncommon presentation of CGD, it is significant due to the life threatening infections including fungal pneumonia, abscesses, osteomyelitis as well as others [3]. Gastrointestinal and intracranial abscesses are remarkably rare

[4]. Notably, abscesses in the thyroid have not been reported as a specific sequelae recently [3, 9, 10, 11, 12, 13, 14] but fungal infections, with *Aspergillus* genus being the most common fungal pathogen, were noted to be the most common cause of mortality [3,9].

Aspergillosis

The five subcategories of aspergillosis are saprophytic aspergillosis/aspergilloma, allergic bronchopulmonary aspergillosis, semi-invasive/chronic necrotising aspergillosis, airway-invasive aspergillosis and angioinvasive aspergillosis/invasive aspergillosis [15]. Of these, invasive aspergillosis is the most severe form, involving extrapulmonary organ manifestations almost seen exclusively in patients with immunocompromise such as CGD, with rates ranging from 25-40% [3]. Invasive aspergillosis often leads to haemorrhagic infarcts, characteristically seen as nodules with halos of ground glass attenuation (“halo sign”) and wedge shaped areas of consolidation based around the pleura on computed tomogram (CT). There can also be separation of fragments of necrotic lung from the parenchyma, leading to air crescents or the “air crescent sign” [15]. Abdominal involvement of invasive aspergillosis can include hypodense lesions representing abscesses, concentric bowel wall thickening or infiltration of the peritoneum which can be diffuse or nodular, infiltration of the peritoneum [16], with further characterisation and monitoring of metabolic progress possible on ¹⁸F-FDG PET [17]. *Aspergillus* brain abscesses are rare but typically demonstrates T1 isointensity and T2 hypointensity as well as restricted central diffusion on diffusion weighted imaging (DWI) and intralésional dark spots on susceptibility weight imaging (SWI) [18]. In this study, the relevant lesions are actually hyperintense on T2 FLAIR and possibly represents a greater degree of water content or necrotic components; this suggests a degree of variability in fungal intracranial abscess presentations.

Thyroid abscess

Neck pain, then fever, are the most common symptoms of acute suppurative thyroiditis, albeit more indolent with fungal organisms [8]. CT findings include hypodense areas within the thyroid, suggesting necrosis or abscess, with rim enhancement and thyroid enlargement due to inflammation. Adjacent fat stranding may indicate inflammatory spread beyond the thyroid capsule, and reactive cervical lymphadenopathy may also be present [19].

Thyroid and neck US is a recommended modality for the evaluation of incidental thyroid nodules identified on cross-sectional imaging, such as CT, to provide further characterisation, as in this case [20]. The right thyroid lobe was enlarged, measuring approximately 2.7 cm x 2.5 cm x 1.4 cm, AP x CC x ML, with a hypoechoic fluid-filled structure of well-defined margins. There were no calcifications nor increased vascularity.

Ultrasound typically reveals hypoechoic or mixed echogenic regions in the thyroid, ranging from inflamed tissue to abscesses with fluid content. Surrounding hyperaemia is often seen on colour doppler, although abscessed or necrotic areas may lack vascularity. This patient had reduced vascularity of the lesion compared to some of the bacterial abscesses in the thyroid, but this can be also due to differing stages of inflammation and is not a reliable predictor of organism. However, bacterial and fungal MCS of the aspirate can be helpful if technically feasible to provide targeted antimicrobial therapy given its relatively superficial location compared to the abdominal organs.

Treatment and prognosis

Chronic granulomatous disease

The management for CGD is lifelong antibacterial and antifungal prophylaxis, with a strong consideration for curative allogeneic transplantation [21]. Prophylactic immunomodulatory therapy with interferon gamma may be of value in some patients with CGD but remains contentious [1,21]. Haemopoietic stem cell transplantation may be curative; gene therapy/repair has been trialled in a limited number of patients [1,22]. With appropriate management, there have been documented cases of CGD patients living into their 6th decade of life [3].

Aspergillosis

Treatment often involves systemic antifungal therapy such as voriconazole and amphotericin B [5].

Thyroid abscess

In the stable patient, needle aspirate guided antibiotic therapy is recommended, with further needle aspiration if clinically worsening. Fungal thyroid abscesses carry a higher mortality (33%) than thyroid abscesses overall (7.8%), presumably due to the largely immunocompromised patient population [8]. This prognosis is second only to parasitic thyroid abscesses.

Differential diagnosis

Ultrasound imaging features such as parenchyma, echogenicity, margins, calcifications, vascularity can help differentiate thyroid abscesses from other lesions such as thyroid neoplasm, Hashimoto’s thyroiditis as well as others [8]. The imaging features described above, at this age group and in context of fever, tender thyroid, and underlying CGD, were most consistent with a thyroid abscess with little room for differentials.

TEACHING POINTS

CGD patients can present with infectious changes and abscess formations in locations traditionally thought to be immunoprotected. The value of a thorough clinical exam is not to be underestimated in the immunosuppressed population

presenting with indolent symptoms and imaging modalities like CT and US can be used to further characterise clinical findings.

QUESTIONS

Applies to article: Segal BH, Leto TL, Gallin JI, Malech HL, Holland SM. Genetic, biochemical, and clinical features of chronic granulomatous disease. *Medicine* [Internet]. 2000 May 1;79(3):170–200. doi:10.1097/00005792-200005000-00004

Question 1: What is the pathophysiology of chronic granulomatous disease (CGD)?

1. Failure of leukocyte adhesion to endothelium due to mutations in the β chain of CD11/CD18 integrins.
2. Defects in the nicotinamide dinucleotide phosphate (NADP) complex that is required to generate the reactive oxygen species required for phagocyte-mediated microbicide. (applies)
3. Depletion of CD4+ helper T cells from infection.
4. Failure in development of thymus.
5. Extracellular deposits of proteins that are prone to aggregate and form insoluble fibrils.

Explanation:

1. This is the pathophysiology of leukocyte adhesion deficiency type 1.
2. This is the pathophysiology of chronic granulomatous disease.
3. This is the pathophysiology of human immunodeficiency virus infection.
4. This is the pathophysiology of DiGeorge Syndrome.
5. This is the pathophysiology of amyloidosis.

Applies to article: Segal BH, Leto TL, Gallin JI, Malech HL, Holland SM. Genetic, biochemical, and clinical features of chronic granulomatous disease. *Medicine* [Internet]. 2000 May 1;79(3):170–200. doi:10.1097/00005792-200005000-00004

Question 2: What is NOT a known management strategy of CGD?

1. Lifelong antibacterial and antifungal prophylaxis.
2. Prophylactic immunomodulatory therapy with interferon gamma.
3. Antiretroviral drug therapy. (applies)
4. Haemopoietic stem cell transplantation.
5. Gene therapy or gene repair.

Explanation

1. Trimethoprim- sulfamethoxazole and itraconazole prophylaxis are recommended in CGD patients.
2. Prophylactic interferon gamma is recommended in CGD patients.
3. Antiretroviral drug therapy is not recommended in CGD patients.
4. Haemopoietic stem cell transplantation is a potentially curative management strategy of CGD.
5. Gene therapy is being researched as a management strategy for CGD.

Applies to article: Franquet T, Müller NL, Giménez A, Gümbe P, de La Torre J, Bague S. Spectrum of

pulmonary aspergillosis: histologic, clinical, and radiologic findings. *Radiographics*. 2001;21(4):825-837. doi:10.1148/radiographics.21.4.g01j103825

Question 3: Which subcategory of aspergillosis is the most severe?

1. Saprophytic aspergillosis/aspergilloma.
2. Allergic bronchopulmonary aspergillosis.
3. Semi-invasive/chronic necrotising aspergillosis.
4. Airway-invasive aspergillosis.
5. Angioinvasive aspergillosis/invasive aspergillosis. (applies)

Explanation

1. Aspergillosis does not have tissue invasion and is not the most severe.
2. Allergic bronchopulmonary aspergillosis most commonly manifests in patients with long standing asthma and is not the most severe.
3. Chronic necrotising aspergillosis has tissue necrosis and granulomatous inflammation; however it is not the most severe form.
4. Airway-invasive aspergillosis invades the airway basement membrane and can be associated with patients with acquired immunodeficiency syndrome; however it is not the most severe form.
5. Angioinvasive aspergillosis has a high mortality rate and occurs almost exclusively in immunocompromised patients; it is the most severe form of aspergillosis.

Applies to article: Winkelstein JA, Marino MC, Johnston RB, Boyle J, Curnutte J, Gallin JI, et al. Chronic Granulomatous Disease: Report on a National Registry of 368 Patients. *Medicine*. 2000 May;79(3):155–69. doi:10.1097/00005792-200005000-00003

Question 4: What is the most common location of aspergillosis in CGD patients?

1. Spine.
2. Cardiac system.
3. Central nervous system.
4. Pulmonary system. (applies)
5. Thyroid.

Explanation

1. Whilst osteomyelitis of spinal vertebrae is known, it is usually from contiguous spread from a primary pulmonary infection or adjacent ribs.
2. Pericarditis from aspergillosis is rare and not the most common location.
3. Intracranial fungal abscesses are rare but documented manifestations of aspergillosis.
4. Invasive infection of the lungs and chest wall are the most common manifestations of aspergillosis.
5. Thyroid aspergillosis was not a known manifestation in this review article.

Applies to article: Lafontaine N, Learoyd D, Farrel S, Wong R. Suppurative thyroiditis: Systematic review and clinical guidance. *Clin Endocrinol (Oxf)*. 2021;95(2):253-264. doi:10.1111/cen.14440

Question 5: what is most common presentation of acute suppurative thyroiditis?

1. Neck pain. (applies)
2. Fever.
3. Dysphagia
4. Dysphonia
5. Erythema

Explanation

1. Neck pain was the most common presenting complaint of acute suppurative thyroiditis at 89% of patients.
2. Fever was the second most presenting complaint at 82%.
3. Dysphagia was not the most common presenting complaint at 46% of patients.
4. Dysphonia was not the most common presenting complaint at 15% of patients.
5. Erythema was not the most common presenting complaint at 38% of patients.

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FIGURES

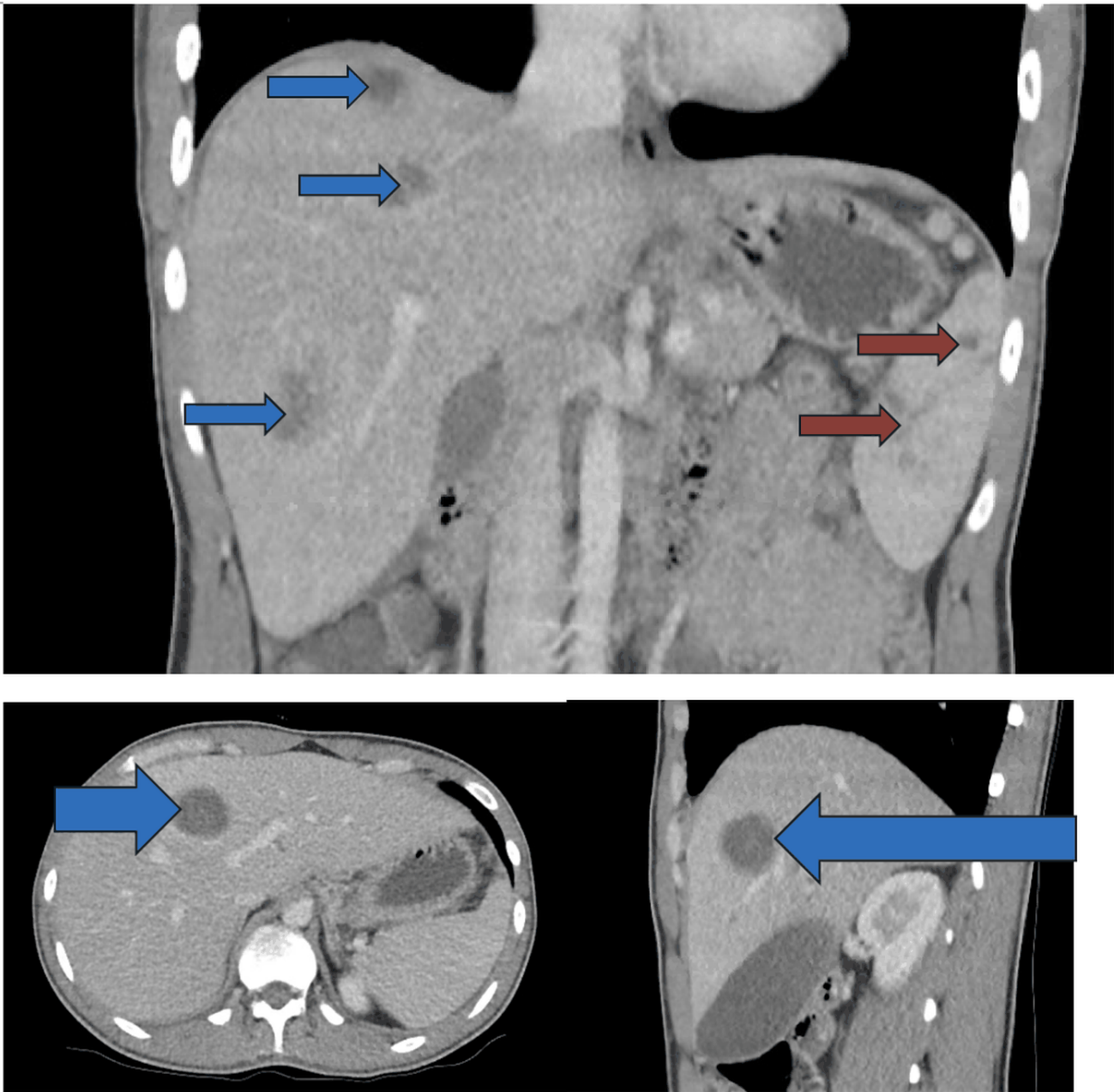


Figure 1: hepatosplenic abscesses. FINDINGS: CT abdomen portal venous phase demonstrating multiple hypodense lesions with surrounding hyperaemia in liver (blue arrows), largest of which is approximately 2.5cm x 2.8cm x 3cm, AP x CC x ML, and spleen (red arrows) consistent with abscesses. TECHNIQUE: Axial, sagittal and coronal sections of CT abdomen, 100kV, 5mm slice thickness

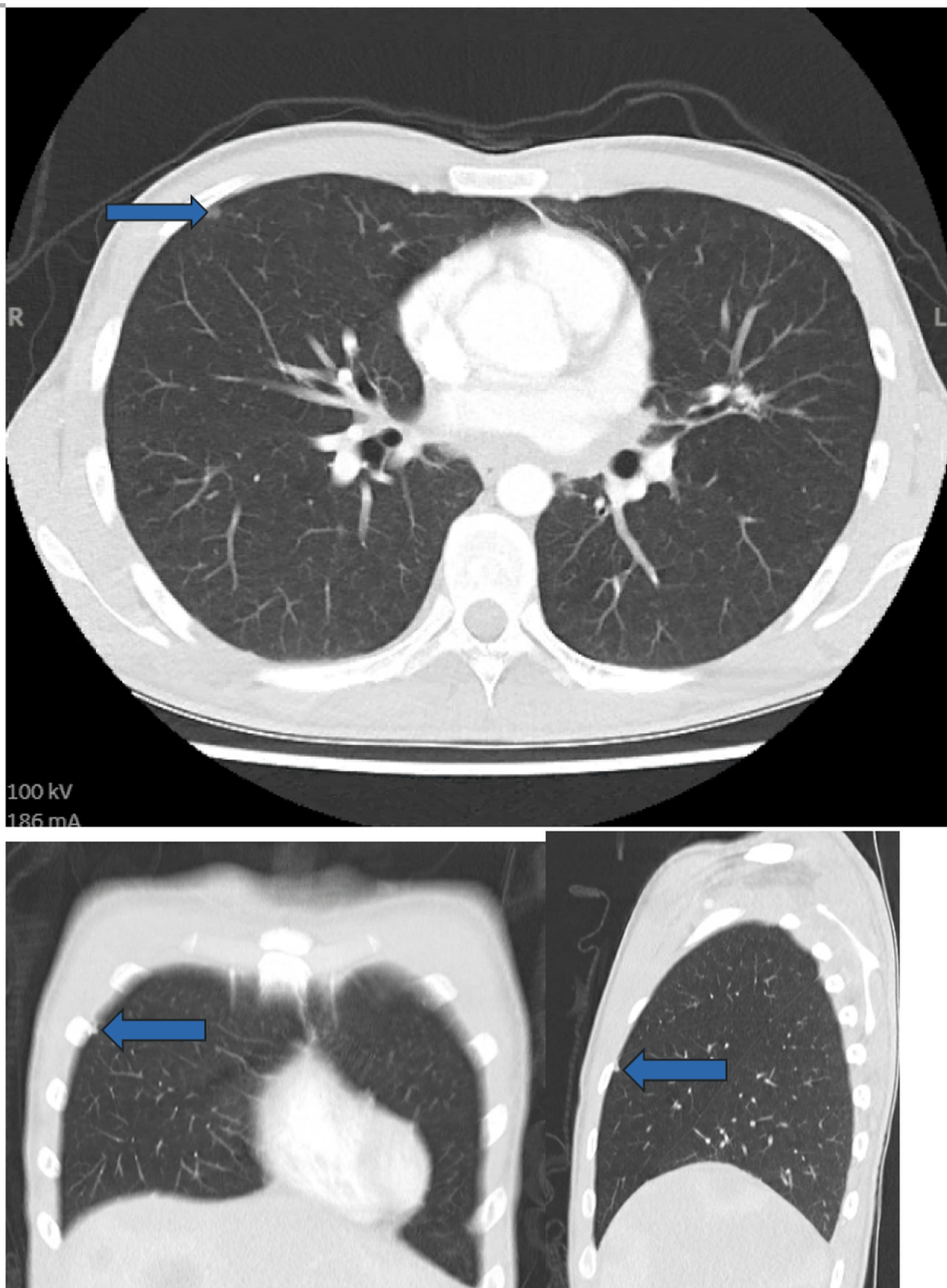


Figure 2: nodule. FINDINGS: CT contrast enhanced chest, lung windows, demonstrating a subtle pulmonary nodule 0.3cm x 0.5 cm x 0.4cm AP x CC x ML in the right middle lobe (blue arrow). TECHNIQUE: Axial, coronal and sagittal sections of CT chest lung windows, 100 kV, 5mm slice thickness.

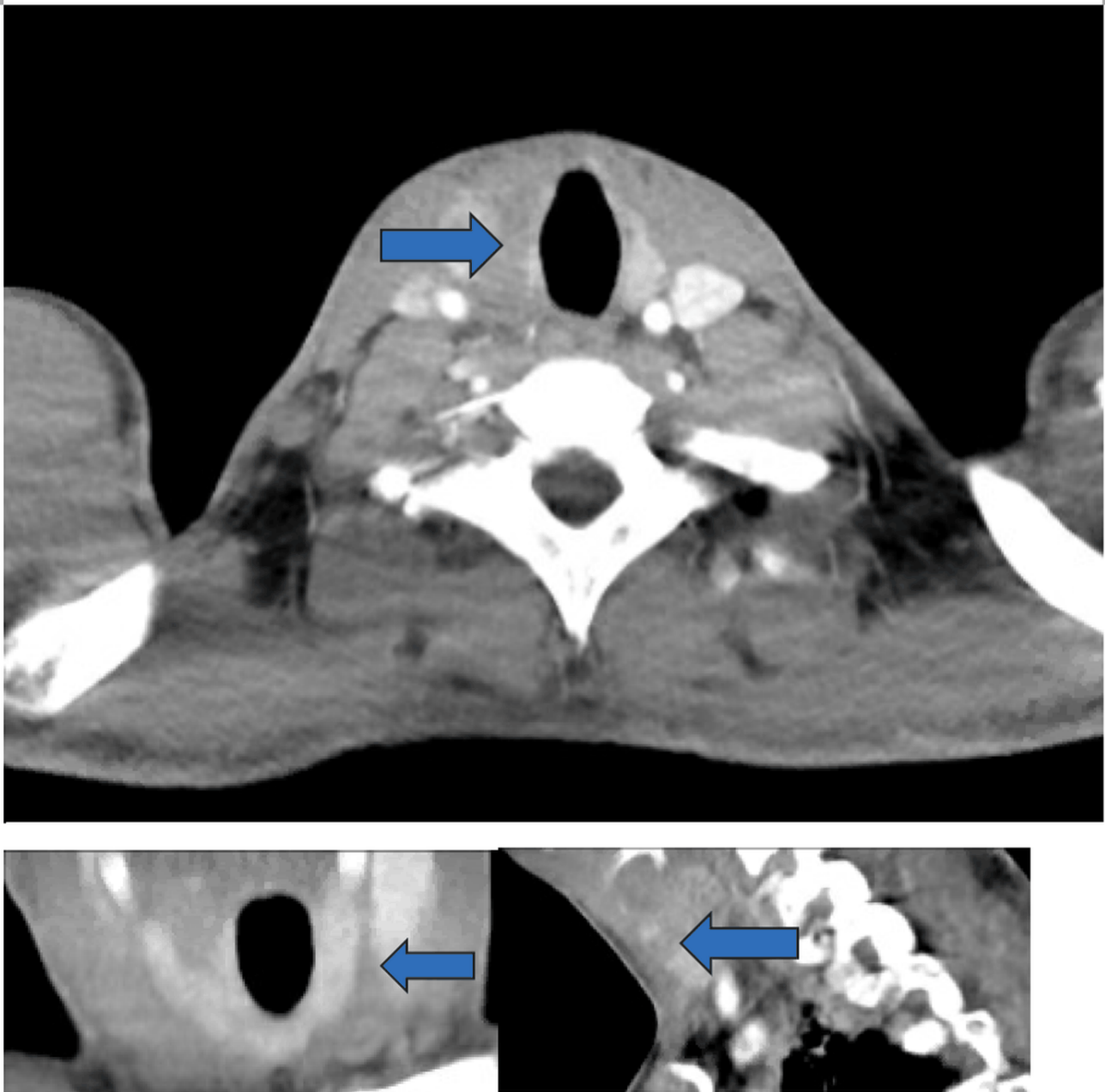


Figure 3: thyroid abscess. FINDINGS: CT contrast enhanced chest demonstrating ill-defined hypodense area approximately 2.6cm x 3.3cm x 1cm, AP x CC x ML, affecting the right thyroid lobe (blue arrow). TECHNIQUE: Axial, coronal and sagittal sections of CT chest, 100kV, 5mm slice thickness.

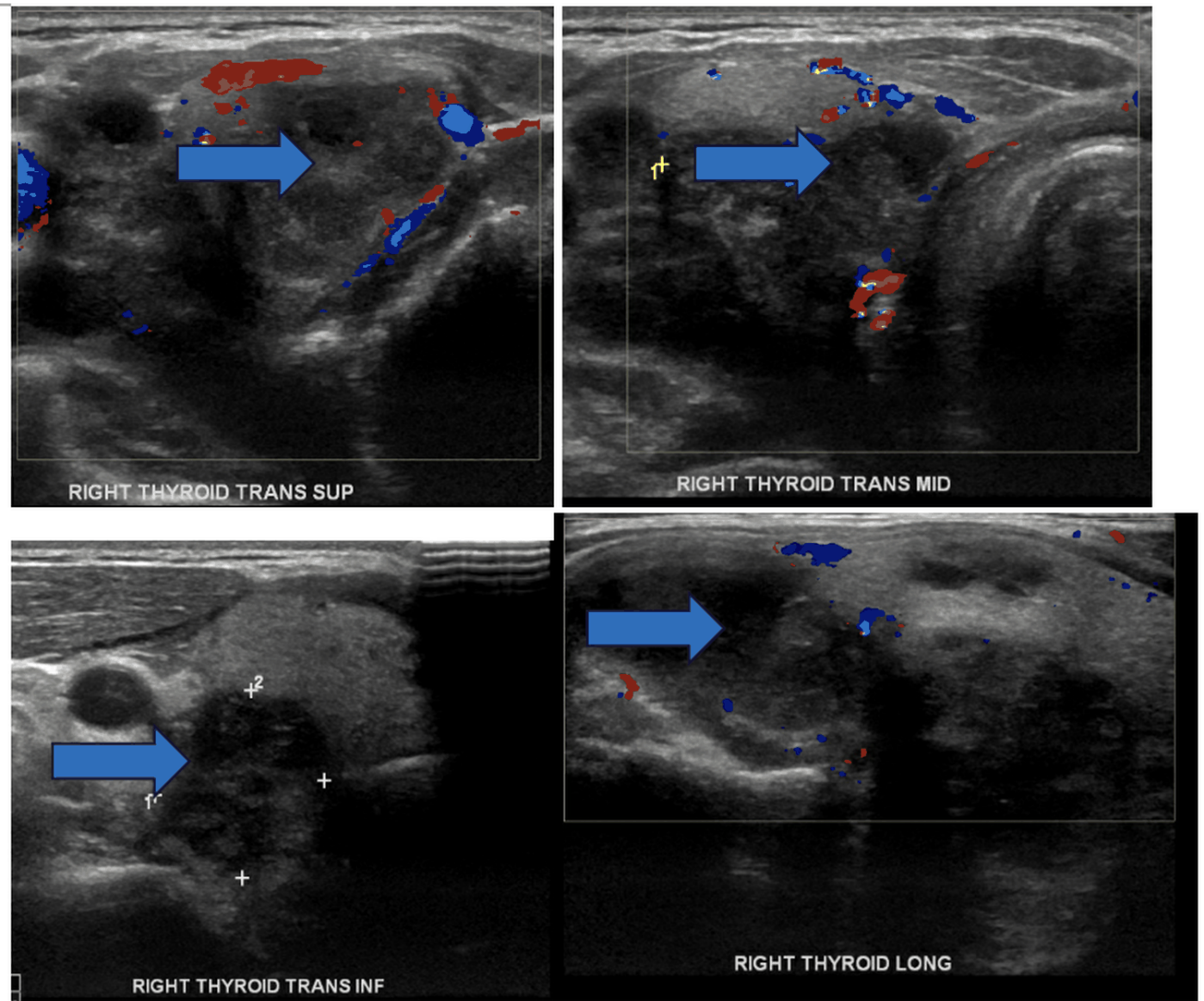
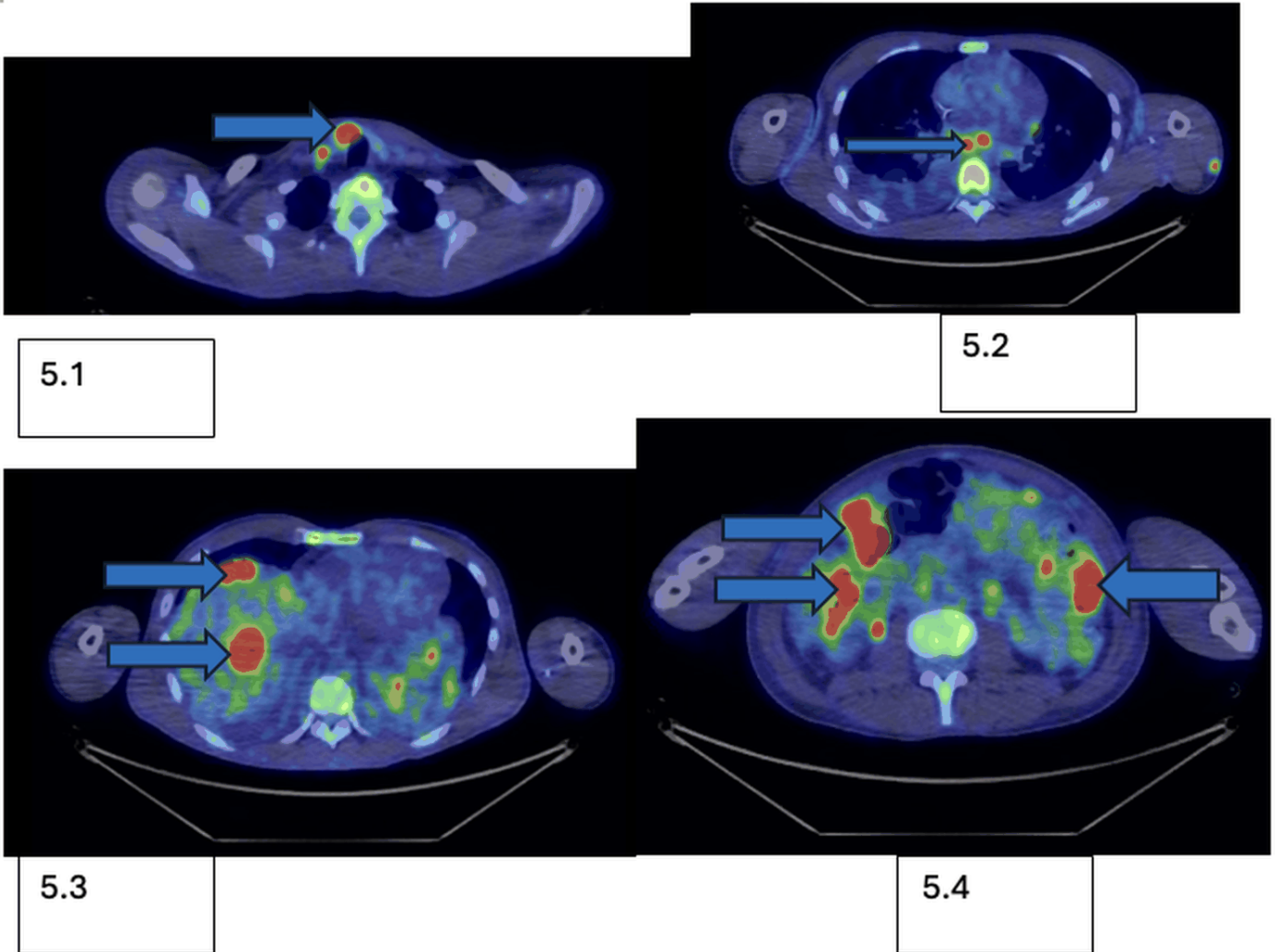


Figure 4: thyroid abscess. FINDINGS: right thyroid lobe on neck ultrasound demonstrated a heterogeneous fluid collection approximately 2.7 cm x 2.5 cm x 1.4 cm, AP x CC x ML (blue arrows). Approximately 5 mls of pus was aspirated from the superior aspect of said collection with a 19G needle. TECHNIQUE: B mode and colour Doppler ultrasound images.



5.1

5.2

5.3

5.4

Figure 5: angioinvasive aspergillosis. FINDINGS: ¹⁸F-FDG PET body demonstrated avidity in the right thyroid lobe and right supraclavicular lymph node (5.1); mediastinal lymph nodes (5.2), liver and spleen (5.3) and extensive peritoneal and omental avidity (5.4), shown by the blue arrows. TECHNIQUE: 202 MBq of Fluorine-18 fluorodeoxyglucose administered after greater than 6 hours of fasting.

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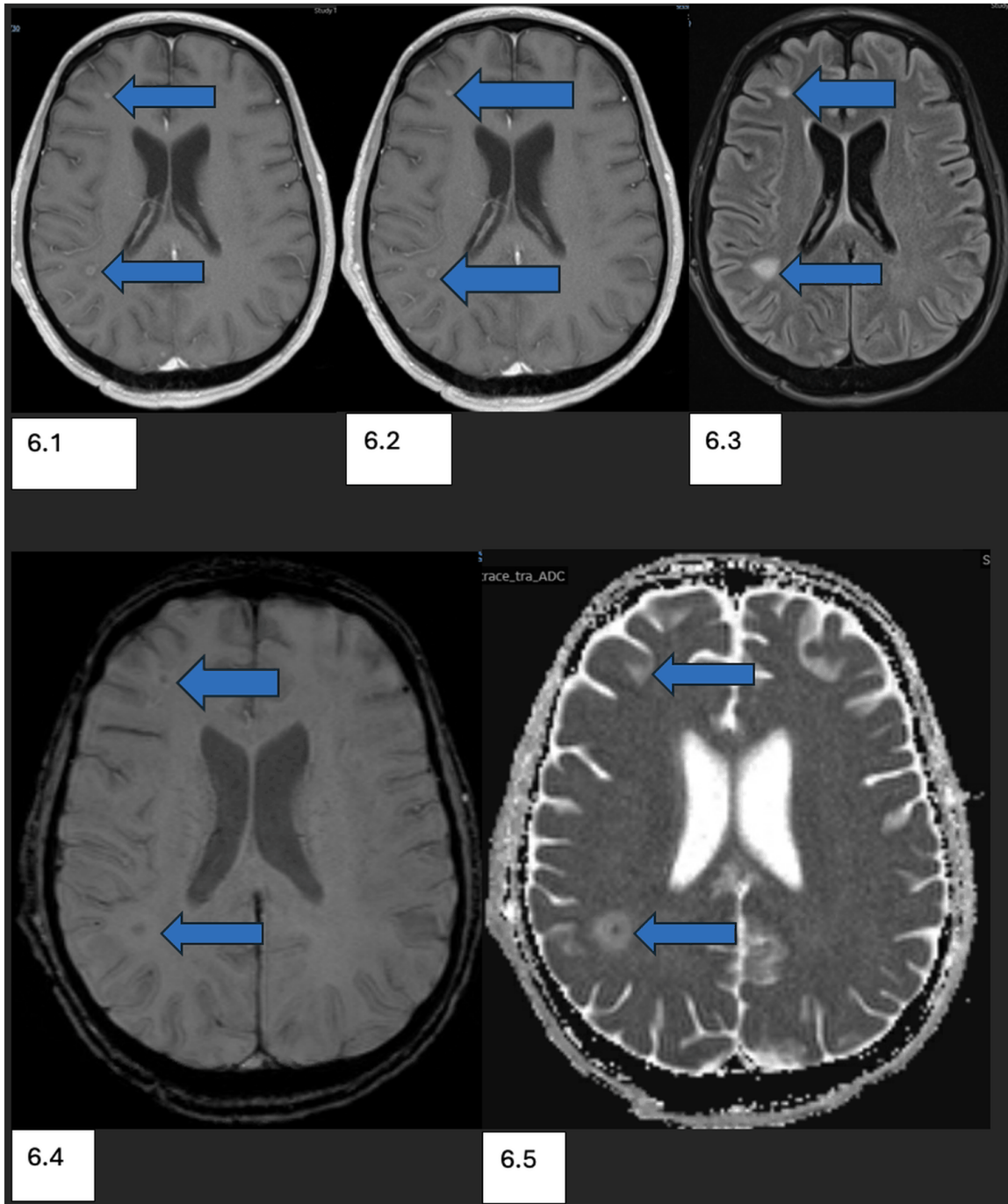


Figure 6: intracranial abscesses. FINDINGS: MRI brain with contrast demonstrating right frontal and parietal lobe intracranial abscesses, measuring approximately 0.5cm x 0.4cm x 0.7cm and 1.4cm x 1.1cm x 1.4cm respectively, AP x CC x ML (blue arrows). Slices provided of T1 axial (6.1), T1 axial with contrast (6.2), T2 FLAIR axial (6.3), SWI axial (6.4) and DWI axial (6.5), demonstrating progressive invasive aspergillosis involving the central nervous system. TECHNIQUE: MRI brain with T1 (TR 240 ms, TE 2.5ms), T1 with contrast (250 ms, TE 2.7 ms), FLAIR (8000 ms, TE 119ms), SWI (TR 27 ms, TE 20 ms) and DWI (TR 5780ms, TE 68ms) sequences in axial sections.

Summary table

Table 1: Summary of CGD and thyroid abscess

	CGD	Thyroid abscess
Aetiology	Defects in gene encoding proteins for nicotinamide dinucleotide phosphate complex required to generate reactive oxygen species	Bacterial, fungal, tuberculous, parasitic
Incidence	Approximately 1 in 200,000	Less than 0.1%
Gender ratio	Male greater than female, approximately 6:1	Overall, 1:1 Fungal aetiology: 7:2
Age predilection	Childhood	None
Risk factors	Genetic defects	Immunosuppression, pyriform sinus fistula
Treatment	Antimicrobial prophylaxis, prophylactic interferon gamma, haemopoietic stem cell transplant, gene therapy	Needle aspiration, culture guided antibiotics
Prognosis	Up to 6 th decade of life	Overall mortality: 7.8% Fungal aetiology mortality: 33%
Imaging findings	Presentation dependent- refer to differential table	Refer to differential table

Differential table

Table 2: Imaging findings and differentials for thyroid abscess and angioinvasive aspergillosis

	Thyroid abscess	Angioinvasive aspergillosis
US	Hypoechoic or mixed echogenicity Surrounding hyperaemia with areas of hypovascularity	When involving the thyroid gland Hypoechoic or mixed echogenicity Surrounding hyperaemia with areas of hypovascularity
CT	Hypodense area with rim enhancement	<u>Pulmonary system:</u> “Halo sign”: haemorrhagic infarcts seen as nodules with halos of ground glass attenuation in lungs “Air crescent sign”: separation of fragments of necrotic lung from the parenchyma with air crescents in between <u>Gastrointestinal system:</u> hypodense lesions representing abscesses, concentric bowel wall thickening or diffuse or nodular infiltration of the peritoneum
MRI	Non-routine investigation	Intracranial abscesses: restricted central diffusion on diffusion weighted imaging (DWI) and intralesional dark spots on susceptibility weight imaging
PET	Increased avidity in the thyroid gland and possibly in surrounding lymph nodes	Increased avidity in involved areas
Differentials	Acute suppurative thyroiditis without walled off collection	Other invasive fungal infections e.g. mucormycosis

Appendix 1

Thyroid abscess as a manifestation of disseminated aspergillus in a chronic granulomatous disease patient: a case report (MEDLINE)

	Concept 1 Chronic granulomatous disease exploded	Concept 2 Thyroid manifestation	Concept 3 Disseminated aspergillus (OR aspergillosis OR aspergillus) exploded
Search term 1	Chronic granulomatous disease	Thyroid disease	Aspergillus species (listed in search)
Search term 2	CGD	Thyroid abscess	
Search term 3			Invasive aspergillus (invasive pulmonary aspergillosis OR invasive fungal infections) exploded
Search term 4			
Search term 5			

Appendix 2

Antifungal prophylaxis and invasive aspergillus in CGD patients (MEDLINE)

	Concept 1 Chronic granulomatous disease exploded	Concept 2 Disseminated aspergillus (OR aspergillosis OR aspergillus) exploded	Concept 3 Antifungal	Concept 4 Prophylaxis
Search term 1	Chronic granulomatous disease	Aspergillus species (listed in search)		
Search term 2	CGD			
Search term 3		Invasive aspergillus (invasive pulmonary aspergillosis OR invasive fungal infections) exploded		
Search term 4				
Search term 5				

Appendix 3

BMT in CGD patients with disseminated aspergillus (MEDLINE)

	Concept 1 Chronic granulomatous disease exploded	Concept 2 Bone marrow transplantation	Concept 3 Disseminated aspergillus (OR aspergillosis OR aspergillus) exploded
Search term 1	Chronic granulomatous disease	Haematopoietic stem cell transplantation	Aspergillus species (listed in search)
Search term 2	CGD		
Search term 3			Invasive aspergillus (invasive pulmonary aspergillosis OR invasive fungal infections) exploded
Search term 4			
Search term 5			

Appendix 4

Thyroid abscess search terms (MEDLINE)

	Concept 1 Thyroid abscess	Concept 2 Disseminated aspergillus (OR aspergillosis OR aspergillus) exploded
Search term 1	Thyroid abscess.mp	exp Aspergillus oryzae/ or exp Aspergillus nidulans/ or aspergillus.mp. or exp Aspergillus fumigatus/ or exp Aspergillus niger/ or exp Aspergillus flavus/ or exp Aspergillus/ or exp Aspergillus ochraceus/
Search term 2	Thyroiditis, suppurative	exp Aspergillosis/ or dissem* aspergillus.mp. or exp Aspergillus/
Search term 3		exp Invasive Pulmonary Aspergillosis/ or exp Invasive Fungal Infections/ or invas* aspergillus.mp.

KEYWORDS

Chronic granulomatous disease; Invasive aspergillosis; Aspergillus abscess; Thyroid abscess; Acute suppurative thyroiditis.

ABBREVIATIONS

CGD = CHRONIC GRANULOMATOUS DISEASE
NADP – NICOTIN AMIDE DINUCLEOTIDE PHOSPHATE
CT= COMPUTED TOMOGRAM OR COMPUTED TOMOGRAPHY
AP X CC X ML – ANTERO POSTERIOR X CRANIO CAUDAL X MEDIO LATERAL
18F=FDG PET = 18F=FLUORO DEOXY GLUCOSE POSITRON EMISSION TOMOGRAPHY
SWI = SUSCEPTIBILITY WEIGHTED IMAGING
DWI = DIFFUSION WEIGHTED IMAGING
US – ULTRA SOUND
MCS = MICROSCOPY, CULTURE AND SENSITIVITY

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