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Acute presentation of locally advanced squamous cell carcinoma of frontal sinus—imaging findings of a rare entity: case report

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Abstract

Background The squamous cell carcinoma is the most common subtype of malignant sinonasal tumours, predominantly involving the maxillary sinuses and nasal cavities in 70 to 80% of cases, and the frontal sinus is extremely rarely involved, in less than 1% of cases. Early clinical and radiological diagnosis is difficult due to overlap of findings with inflammatory sinonasal disease.

Case presentation A 55-year-old Caucasian male patient had presented to the emergency department with three-month history of progressive right frontal swelling, acute frontal pain, recent exacerbation of right eye vision impairment and new lid swelling. There was no recent history of trauma and no neurological deficit on examination. Contrast-enhanced CT head was performed which demonstrated large bony destruction of frontal sinus with partly enhancing necrotic-looking tumour within the sinus. There was further intraorbital and intracranial extension of disease. Subsequent MRI confirmed these findings with better demonstration of intracranial and intraorbital component of the disease. The PET imaging did not reveal any avid disease elsewhere. Histopathology confirmed squamous cell carcinoma.

Conclusions Frontal sinus squamous cell carcinoma is a rare and the least common site within the paranasal sinuses. Early clinical and imaging diagnosis could be challenging; however, the index of suspicion should be high with indeterminate imaging findings. CT and MRI are the complimentary imaging techniques.

Keywords SCC, Frontal sinus, MRI, Case report

Background

The sinonasal malignancies are overall rare, comprising only 3% of head and neck malignancies. A wide variety of malignant tumours originate from the paranasal sinuses due to the presence of various tissues like mucosal epithelium, vessels, lymphoid tissue, neuroectodermal tissue, cartilage, bone and odontogenic structures [1–3]. The squamous cell carcinoma (SCC) is the most common histological subtype of sinonasal cancers accounting for over 50% of cases, to be followed by adenocarcinoma (10 to 20%) and the lymphomas. The other less common primary sinonasal malignancies are adenoid cystic carcinoma, sinonasal undifferentiated carcinoma, plasmacytoma, olfactory neuroblastoma, melanoma and rhabdosarcoma [1–4].

Maxillary sinus is the most common site of SCC (60%); approximately 20% of SCC occur in the nasal cavities, followed by ethmoid sinuses (10–15%), and only 1% of SCC is found in sphenoid and frontal sinuses. The frontal sinus is rarely the site of primary carcinoma; it constitutes only 0.3% carcinomas of paranasal sinuses [3–5].

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The paranasal sinuses can be also the sites for metastatic disease, extension from nasal malignancies and secondarily involvement by intracranial tumours like meningioma, chordoma and craniopharyngioma [6].

Case presentation

A 55-year-old Caucasian male patient had presented to the emergency department of our hospital with three-month history of progressive right frontal swelling, acute frontal and facial pain, features of progressive opthalmoplegia with recent exacerbation of right eye vision impairment, new lid swelling, watering of eyes and right-sided exophthalmos. There was no recent history of trauma, fever, epistaxis, altered sensorium or cranial nerve dysfunction. However, patient was having ongoing history of cough due to chronic obstructive pulmonary disease. Patient had thirty-year history of cigarette smoking. There was no history of any other chronic medical condition.

There was no neurological deficit on examination. Ophthalmic review showed reduced vision in right eye with features of opthalmoplegia and retrobulbar swelling. The left eye was normal clinically. Initial biochemical investigations revealed elevated inflammatory markers (C-reactive protein, ESR and total cell count). X-ray chest did not reveal any consolidation; however, it showed hyperinflated lung fields with marked centriacinar emphysematous changes. Clinical assessment raised the likelihood of complicated acute sinus disease with orbital and intracranial complications or the other possibility of underlying frontal sinus malignancy with superadded infection and intraorbital extension of the disease.

CT of head and paranasal sinuses with contrast was performed initially (Fig. 1A–D), followed by contrast-enhanced MRI examination of paranasal sinuses and head (Fig. 2A–C). The CT imaging demonstrated expansile lytic destruction of right frontal sinus with large full-thickness bony defects at the anterior and posterior bony wall of sinus and lateral aspect of the frontal bone (Fig. 1B

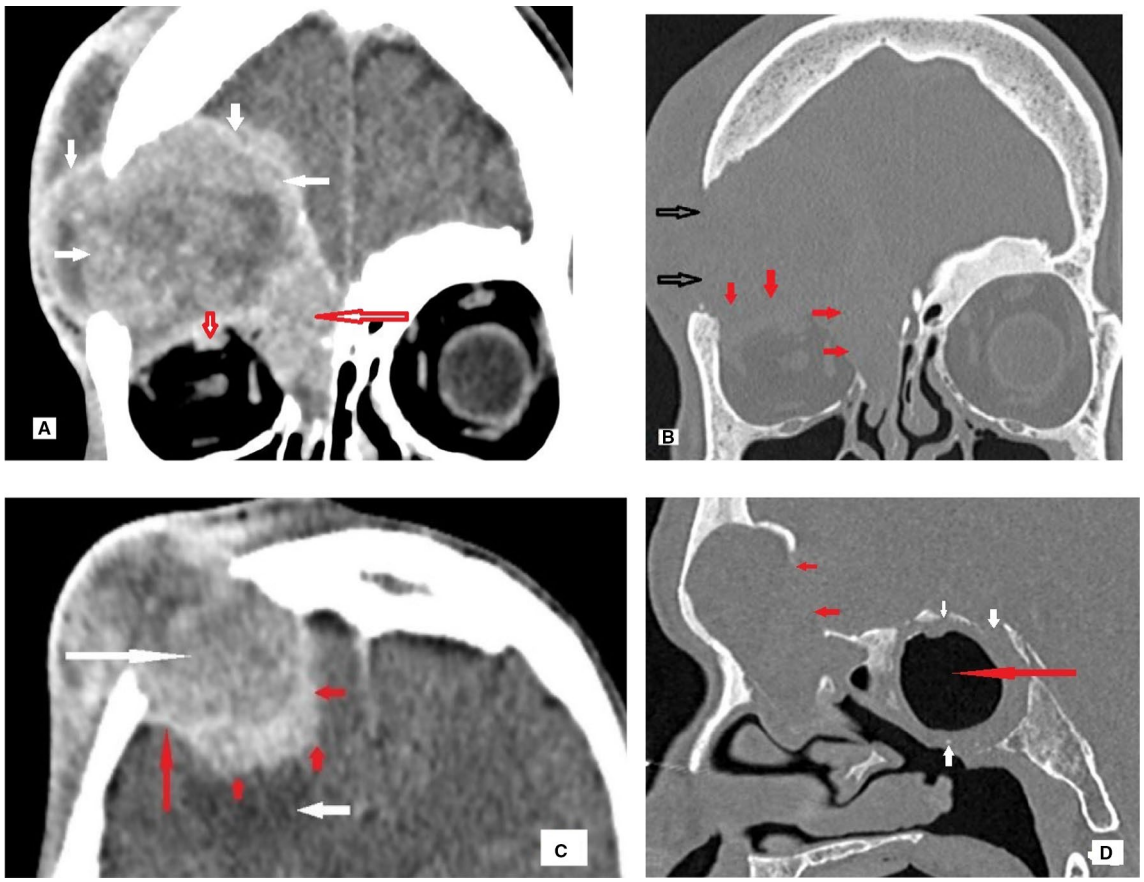

Fig. 1 A 55-year-old male patient with a histopathologically proven frontal sinus squamous cell carcinoma. Contrast-enhanced CT head shows large heterogeneously enhancing right frontal sinus tumour (small white arrows; **A**), intraorbital extension with invasion of superior rectus muscle (small red arrow; **A**) and invasion of right ethmoid air cells (large red arrow). Intracranial extension of tumour (**C**). Loss of bony roof of right orbit (**C**) and large bony defect at posterior wall of sinus (**B**). Sphenoid sinus shows chronic osteitis changes (**D**)

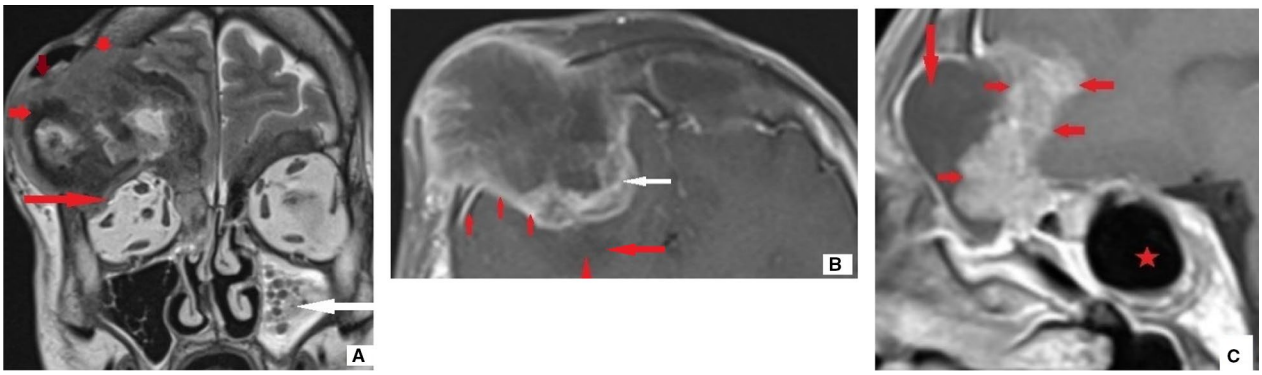

Fig. 2 T2-flair coronal MRI (**A**) shows the large right frontal sinus tumour with extension into subcutaneous tissues (small arrows) and intraorbital extension (long red arrow), invading right anterior ethmoid air cells. The left maxillary sinus shows opacification with fluid and bubbly secretions. Fig. **B** (post-contrast axial) and **C**: (post-contrast sagittal) MR image shows solid tumour invading the dura and brain parenchyma with focal brain oedema (long red arrow; b)

and D). There was large soft tissue tumour (7×6×5 cm) within the destroyed right frontal sinus cavity which showed partly enhancing irregular inhomogeneous solid component, mixed with non-enhancing smaller irregular cystic necrotic areas (Fig. 1A and C). There was extension of tumour into subcutaneous tissues and involving the skin (Figs. 2, 3A). CT images also demonstrate bony loss of superomedial orbital wall with invasion of the right anterior ethmoid air cells (Fig. 1A, C). Further, with the demonstration of complete loss of the bony roof of right orbit with intraorbital extraconal extension of tumour with infiltration of periorbital fat and invasion of right lacrimal gland (Fig. 2A), the superior rectus muscle showed relative thickening and enhancement suggesting tumour invasion, however, without evidence of intraconal extension or involvement of orbital apex (Fig. 1A).

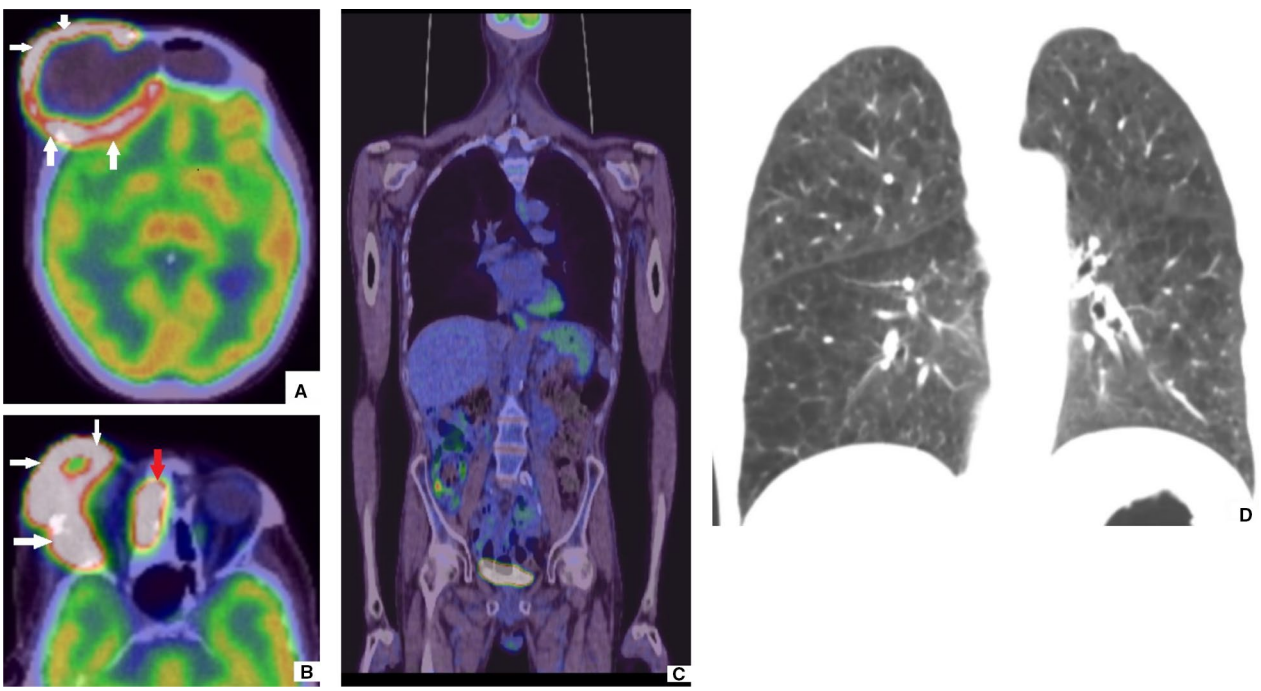

Fig. 3 The axial PET-CT image (**A**) shows the right frontal bone tumour component with intense peripheral FDG activity and central photopenia. The axial PET-CT image (**B**) shows avid tumour within right upper nasal cavity (small red arrow) and large solid avid tumour within destroyed right frontal sinus (white arrows). There was no focus of avid uptake on PET imaging in thorax, abdomen or pelvis on coronal PET-CT (**C**). The lung window coronal image of CT thorax shows severe centriacinar emphysematous changes (**D**)

The reminder of paranasal sinuses, nasal cavities and post-nasal spaces did not demonstrate any mass lesion. Left frontal sinus and the left maxillary showed complete opacification due to fluid (Fig. 2B, C). The sphenoid sinus was well aerated, with features of chronic osteitis (Fig. 1D, 2C). The MRI did not reveal any diagnostic features of fungal sinus disease or skull base abnormality.

The contrast-enhanced MR images showed excellent demonstration of the tumour with invasion of right anterior ethmoid air cells and right orbit (Fig. 2a). Both CT and MRI demonstrated intracranial extension of tumour with dural thickening with enhancement and brain parenchymal invasion with oedema which was, however, better visualized on MR images (Figs. 1A, C, 2B, C). Remainder of intracranial structures and left orbit were within normal limits. The cortical venous sinuses and the cavernous sinuses were patent.

The PET imaging revealed avid disease within destroyed right frontal bone with intense peripheral FDG activity and central part was glucose inavid (Fig. 3A; small white arrows). Further FDG avid disease noted within eroded right anterior ethmoid air cells and right upper nasal cavity (Fig. 3B; red arrow). No FDG avid disease was demonstrated in neck, thorax, abdomen or pelvis (Fig. 3C). The body CT did not reveal any other primary tumour or metastatic disease. The CT thorax showed severe centriacinar emphysematous changes without any consolidation or atelectasis (Fig. 3D). Histopathology confirmed the diagnosis of well differentiated SCC.

The CT and MRI head studies were reported by the Consultant Radiologists with Radiology experience of ten to fifteen years, and these images were further reviewed by the Consultant Head and Neck Radiologist (with twenty eight years of experience) for the multidisciplinary meeting. PET-CT was reported by senior Consultant Radiologist with subspecialty interest in oncological/PET imaging).

Discussion

Early clinical diagnosis of sinonasal SCC is challenging due to nonspecific early clinical presentation with nasal obstruction, rhinorrhea, facial pain and headache which can mimic inflammatory sinus mucosal disease [2, 4, 7], whereas advanced disease with intraorbital, intracranial and skull base invasion would present with exophthalmos, visual disturbance, olfactory symptoms and cranial nerve dysfunction (divisions of fifth nerve). Even the imaging findings of frontal sinus SCC in early stage can be misinterpreted as infective mucosal disease, osteomyelitis or mucocele [1–3, 6, 7].

CT is the most common initial modality for investigating the paranasal sinus disease and is extremely sensitive to establish bone destruction, subtle erosions, chronic benign changes, calcification and chondral tumour matrix [2, 3, 6]. As reported in literature [2, 4–6], the MR findings of our case were similar; mild T1 hypointensity, mild–moderate T2-hyperintensity, association of tumour necrosis, heterogeneous contrast enhancement and less pronounced restriction of diffusion. SCC of paranasal sinuses shows higher likelihood of extension beyond the sinuses into orbits, intracranial structures, pterygopalatine fossa, infratemporal fossa, masticator space, skull base with aggressive bony destruction [1, 3–5]. Zang et al. [2] and Gerlinger et al. [5] described in their case reports about the significant radiological findings of intraorbital and intracranial extension of the frontal sinus SCC with destruction of anterior skull base which were highly diagnostic of frontal sinus malignancy. Similar imaging findings were demonstrated in our case as well.

On imaging differentiation of adenocarcinomas from SCC is difficult, although adenocarcinoma can show occasional calcifications on CT and varying MR signal due to the presence of mucin or haemorrhage [3]. The sinonasal lymphomas mostly involve the maxillary sinuses and nasal cavities and tend to result in bulky enhancing soft tissue masses or infiltrative pattern, with lytic bony destruction or bony remodelling [3, 4]. Sinonasal plasmacytoma presents as more discrete polypoidal enhancing soft tissue masses with medullary expansion and bony erosion and can mimic lymphoma on imaging, although bone destruction is less marked [4, 6]. Mucocele most commonly affects the frontal sinus which result from obstruction of the drainage recess, causing chronic mucus retention and expansion of the sinus cavity with smooth thinning of bony wall and possible bony erosions and defects [3, 7].

The imaging findings of our case suggested the most likely possibility of aggressive primary carcinoma of the frontal sinus and unlikely metastasis (considering body CT and PET findings as well). The CT and MRI findings did not support the other possibilities of mucocele, lymphoma or plasmacytoma.

Conclusions

SCC of the frontal sinus is a rare disease entity. Early clinical and imaging findings can overlap with inflammatory sinus disease. Recognition of the imaging pattern of locally advanced frontal sinus SCC with associated aggressive bony destruction is crucial to differentiate it from other imaging mimics.

Abbreviations

SCC	Squamous cell carcinoma
CT	Computed tomography
MRI	Magnetic resonance imaging

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Author contributions
All authors contributed sufficiently. ASL performed case selection, preparing manuscripts, reviewing literature, and reviewing and preparing the images and legends. Authors KS and DMMS helped in preparing manuscripts, reviewing the manuscript and literature review. This is to certify that "all the authors have read and approved the manuscript".

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Declarations

Ethics approval and consent to participate
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Consent for publication
Currently, we do not have the written consent. However, the entire text, figures and written material are completely anonymized.

Competing interests
This is to confirm there are no competing interests.

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