

ORIGINAL ARTICLE

Imaging Features of Sinusitis and its Complications

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ABSTRACT**Objective:** To study the radiological features of sinusitis, its intracranial and orbital complications.**Study Design:** A case series design.**Place and Duration of Study:** Radiology Department, Shifa International Hospital, from March 16, 2016, to June 28, 2018.**Materials and Methods:** A total of 7 patients were selected from the radiology database retrospectively from March 16, 2016, to June 28, 2018. Of these patients had their MRI and CT scans done at Shifa International Hospital. CT scan was performed on Toshiba Aquilion1, double detector 320 slices, and MRI was performed on Toshiba-titan 1.5 tesla. The literature review was also done to identify different complications of sinusitis.**Result:** Out of 7 patients, 3 patients showed pansinusitis with meningitis and intra-orbital extension causing cellulitis and inflammation, all of them showed bony erosions and developed cavernous sinus thrombosis. Amongst these a 32-year-old female patient developed left cavernous sinus thrombosis, with ophthalmic vein occlusion with loss of the left eye and was followed by enucleation, she developed left ICA thrombosis with watershed ischemic infarcts in the left cerebral hemisphere. The remaining 4 patients had pansinusitis with intra-orbital and intracranial extension, without cavernous sinus thrombosis. One amongst the 7 patients had severe sphenoid sinusitis with evidence of fungal infection on MRI with intracranial and intra-orbital extension.**Conclusion:** Imaging plays a vital role in the diagnosis of sinusitis. It displays all the details of paranasal sinuses and surrounding structures including orbits and the brain. Though CT scan depicts the involvement of the bones, yet MRI is more accurate for the extension of the disease into the orbital apex, cavernous sinus, and brain.**Key Words:** Sinusitis, Complications, Imaging Modalities.**Introduction**

Inflammation of the mucosa of any of the paranasal sinuses is called sinusitis. It can be acute, subacute or chronic, depending on the duration of symptoms.¹ Symptoms include nasal blockage and discharge associated with fever and headache.² If left untreated, this can lead to various complications.³ These complications can be intracranial or intraorbital.⁴ The sinusitis itself though very common rarely presents with life-threatening complications which can be local like erosion through bone, subperiosteal abscess or intracranial like meningitis, encephalitis, subdural empyema, subdural abscess, cavernous sinus thrombosis or intra-orbital like preseptal cellulitis, subperiosteal abscess, orbital cellulitis, and orbital abscess.⁵ Different imaging

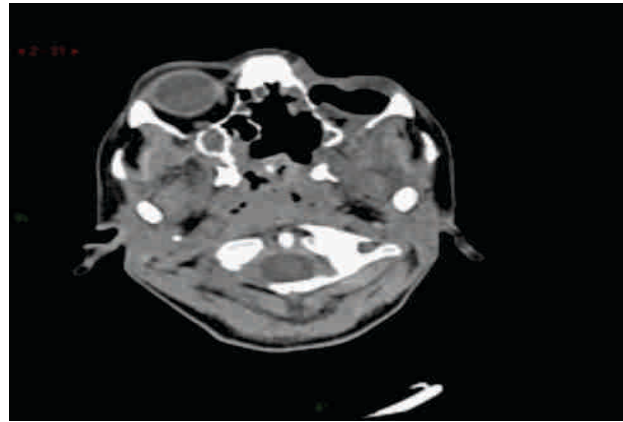
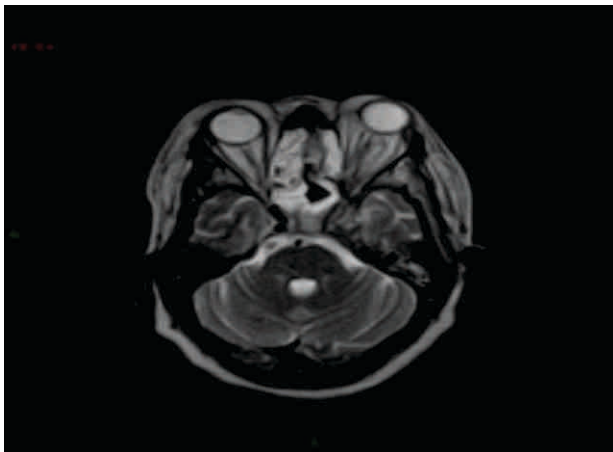
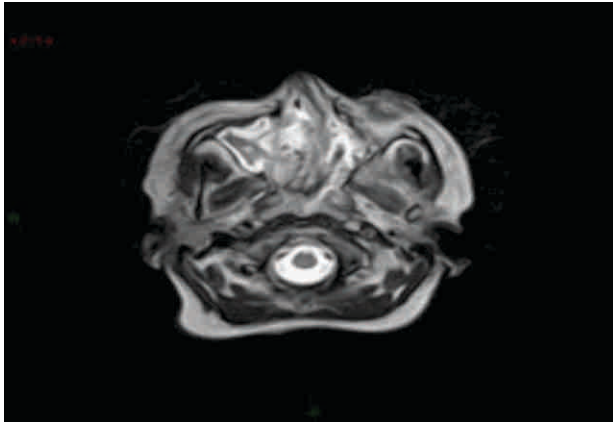
modalities can be used for diagnosing sinusitis and complications of sinusitis. Plain radiograph talks only about the presence of sinusitis yet has no role in detecting its complications.⁶ CT scan is the modality of choice for detection of bony complications whereas MRI gives a detailed assessment of intra-orbital and intra-cranial complications of sinusitis.⁷ Many diseases can mimic sinusitis clinically. Thus, radiology through its imaging modalities can assist the clinician to diagnose accurately.⁸

Materials and Methods

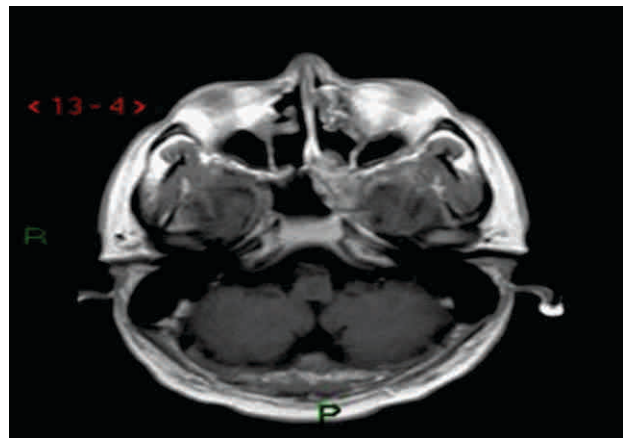
A Case series study in which total of 7 patients were selected from the radiology database retrospectively in radiology Department, Shifa International Hospital, from March 16, 2016, to June 28, 2018. All these patients had their MRI and CT scans done at Shifa International Hospital. CT scan was performed on Toshiba Aquilion1, double detector 320 slices, and MRI was performed on Toshiba-titan 1.5 tesla. The literature review was also done to identify different complications of sinusitis. Ethical review letter from the institutional review board was taken.

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Case Presentation Case 1: A 32-year-old female who presented with left orbital cellulitis and uncontrolled gestational diabetes, shows extensive soft tissue opacification involving nasal cavity and paranasal sinuses. (Figure 1). Her follow up imaging showed loss of signal void of cavernous part of left ICA, consistent with thrombosis. (Figure 2). Patient then underwent enucleation. Biopsy was done which revealed mixed fungal infestation.

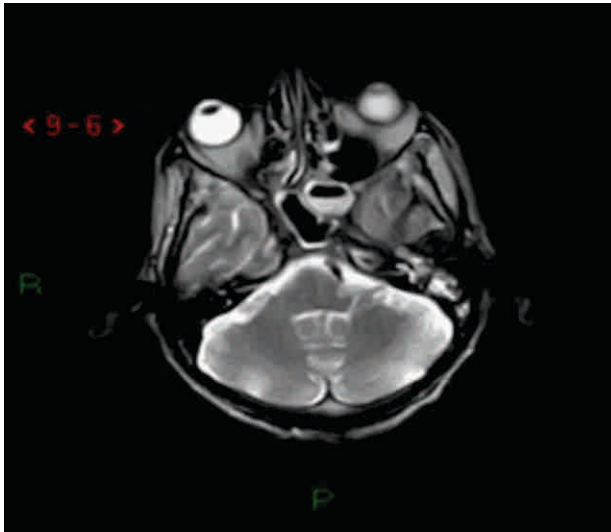


Case 2: A 42-year-old male came to our hospital with active complaints of left sided body numbness and dizziness for 5 days. MRI brain was ordered which showed multiple bright T2 and FLAIR signal foci in watershed distribution in right cerebral hemisphere. Patient is status post FESS with extensive opacification of ethmoid, left frontal and left sphenoid sinuses with intracranial extension of the infective process resulting in thickening and enhancement of dura and meninges in floor of anterior and middle cranial fossa on left as well as abnormal enhancement of the cavernous sinuses. Further workup by contrast enhanced CT paranasal sinuses confirmed these findings. The patient then underwent medical as well as surgical management.

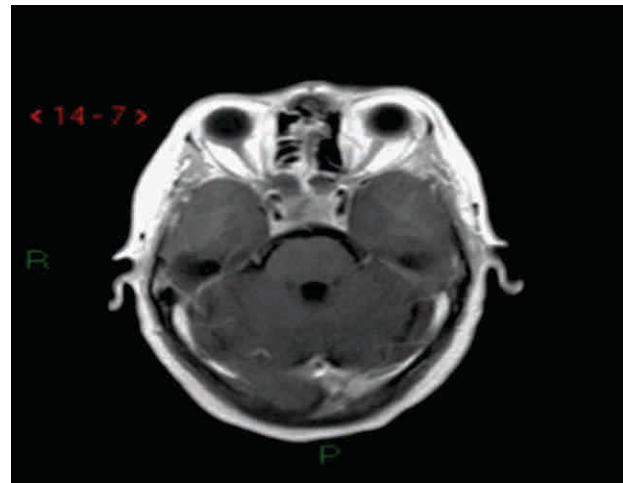


Case 3: A 58-year-old male who presented with history of headache for 6 weeks associated with weight loss, vertigo and dizziness. Ethmoid, sphenoid sinus and mastoid mucosal disease suggesting acute sinusitis and mastoiditis bilaterally with fluid levels in left mastoid air cells. T2/FLAIR high signal foci in peri ventricular and subcortical white matter, left temporal lobe, midbrain and pons

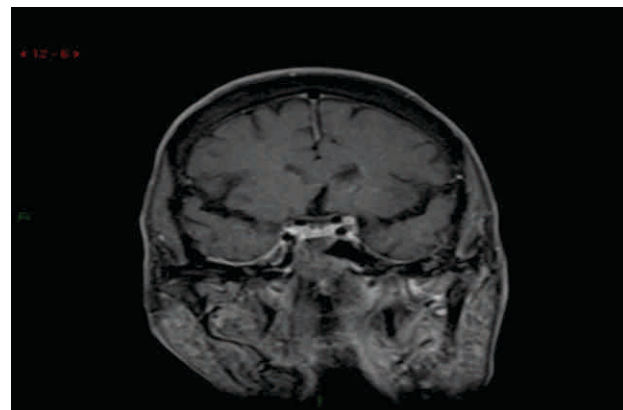
could be suggestive of chronic microvascular angiopathy. However, osmotic demyelination was kept in mind. Enhancement of leptomeninges in left temporal fossa, cavernous/paracavernous region, orbital apices, more on the left and left subtemporal soft tissues consistent with intracranial extension of sinus and mastoid disease process causing leptomeningitis. The patient was managed medically with IV amphotericin.



Case 4: A 58-year-old female showing abnormal accentuated post contrast enhancement of leptomeninges at cavernous, para cavernous region and orbital apices. Extensive paranasal sinus disease was seen with T2 low signal containing retention cyst in sphenoid sinus which seems to be extending laterally eroding pterygoid plates and reaching medial inferior temporal fossae. Abnormal appearing accentuated postcontrast enhancement of leptomeninges at cavernous, paracavernous region and orbital apices was noted. Accentuated enhancing venous channels noted at vertex passing through diploic space. Relatively small sized ventricles and partially empty sella was seen, raising suspicion of increased intracranial pressure. Numerous T2/FLAIR bright signal foci in bilateral periventricular and subcortical white matter suggesting microvascular angiopathy. Overall findings may be sequelae of intracranial extension of sinus disease and requires further confirmation with clinical correlation, analysis of CSF and additional workup including post contrast CT. The patient was confirmed to have fungal infection and non-surgical treatment was initiated.



Case 5: A patient with history of stroke, showing extensive mucosal thickening in the right maxillary, sphenoid, ethmoid and the frontal sinus with hypointense signal with post contrast enhancement. Asymmetric dural enhancement along the right temporal lobe was seen suggesting sinusitis with intracranial extension. IV amphotericin was the main line of treatment initiated in this patient.



Case 6: A 50-year-old female with CLD and history of right maxillary swelling, pain and epistaxis. MRI showed extensive opacification involving the right maxillary sinus, bilateral ethmoid, sphenoid and frontal sinus more so of right with soft tissue edematous changes in the premaxillary and infratemporal region also extending to pre-septal soft tissues on right. Mild right proptosis with retrobulbar involvement of disease process with edematous changes and thickening of extraocular muscles more so of medial rectus; the constellations of findings were more in favor of overall infective sinonasal disease process with right intraorbital extension and soft tissues as described above. Ill-

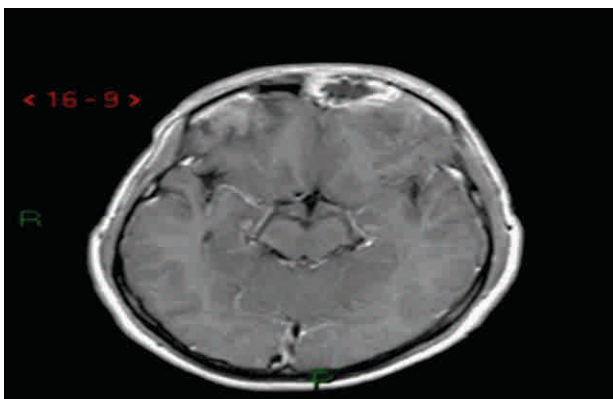
defined high signal foci in the right anterior basifrontal lobe as well likely suggested intracranial extension of the disease process. The patient was managed surgically in ENT department.



Case 7: A 20-year-old male came to our hospital with active complains of severe left sided headache, visual disturbances, nausea and vomiting.

CT Brain outside facility showed no evidence of abnormal leptomeningeal enhancement. H/o frontal sinus abscess. IV antibiotics were given in hospital. Ultrasound face showed preseptal soft tissue swelling and subcutaneous edema around left orbit, upper nose and forehead. Complained of severe left sided headache, visual disturbances, nausea and vomiting.

MRI revealed complete opacification and marginal enhancement of the maxillary, ethmoid and frontal sinuses suggesting acute sinusitis. Moderate pachymeningeal enhancement in left frontal region with a small subdural empyema indenting the left frontal lobe was seen. Subtle loss of normal signal void of left lamina papyracea and impingement of medial rectus muscle raised suspicion for intraorbital extension of the disease process. Medical management with drainage of abscess/ empyema remained the initial treatment.



Discussion

Inflammation of the mucosa of any of the paranasal sinuses is called sinusitis. Many complications are known to it, which can be intracranial or intraorbital.⁵ Different modalities like plain radiograph, CT scan and MRI help in different ways in identifying these complications.^{6,9} It can be acute or chronic depending upon the duration. Acute sinusitis can occur following an upper respiratory tract infection or it can spread via oral/dental infection. Recurrent infections in cystic fibrosis and those having allergic sinusitis, immuno-compromised states, and diabetes mellitus predispose an individual to complications. The incidence of intracranial complications is reported to have decreased in recent years to only 3.7 % in patients admitted for acute or chronic sinusitis.¹⁰ For reasons not known it has been observed that males are more prone to develop intracranial complications than females the ratio roughly being 2:1.^{11,13,14,15} Its complication is said to have occurred when the disease process spreads beyond the confines of the sinus cavity to involve the sinus wall and/or surrounding structures like the brain or orbit. It usually presents with fever, headache, nasal congestion, postnasal discharge, and an altered sense of smell^{16,17}. The complicated case can be asymptomatic or can present with neurological deficit, blurring of vision, altered state of consciousness, fits, or even coma.^{18,19}

Though with prompt use of antibiotics, the complications of sinusitis have become rare, yet when they occur, they are potentially life-threatening¹⁰. The complications are mainly divided into three groups; local complications, intracranial complications which include subdural empyema, epidural and intracerebral abscess, meningitis, and venous sinus thrombosis¹¹, and intra-orbital complications which include pre-septal cellulitis, subperiosteal abscess, orbital cellulitis, and orbital abscess.

Different imaging modalities have a different management role in diagnosing sinusitis and complications. Plain radiograph assessment gives only about the presence of sinusitis yet has no role in detecting its complications.⁶ CT is the modality of choice in the detection of bony complications whereas MR being the modality of choice gives a detailed assessment of intra-orbital and intracranial

complications. Xray's are the first modality that is used in patients who present with non-complicated sinusitis, which shows opacification of sinuses and air-fluid levels. But it does not tell about the extent of the disease.⁶ CT Scan gives a better idea about disease extent and complications. It is more sensitive than plain radiography for detecting sinus pathology, especially within the sphenoid and ethmoid sinuses.⁹ Features suggesting sinusitis are peripheral mucosal thickening, air-fluid level, gas bubbles within the fluid and obstruction of the ostiomeatal complexes, and in complicated cases pressure erosion/deossification of bones. MRI is the modality of choice to look for intracranial as well as intra-orbital extension.^{16,17,18,19}

Conclusions

The imaging plays a crucial role in the diagnosis of sinusitis it displays all the details of paranasal sinuses and surrounding structures including orbits and brain. Though CT scan depicts the involvement of the bones, yet MRI is more accurate for the extension of the disease into the orbital apex, cavernous sinus, and brain.

REFERENCES

- DeBoer DL, Kwon E. Acute sinusitis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021. PMID: 31613481.
- Wilson M, Wilson PJ. Acute Sinusitis. *Close Encounters of the Microbial Kind. Everything You Need to Know About Common Infections.* Publishing; Springer, Cham. 1st ed 2021 (pp. 213-224). DOI.org/10.1007/978-3-030-56978-5
- Kim M, Pearlman A, Kacker A, Stewart MG. Acute Sinusitis, and Its Complications. *Textbook of Clinical Otolaryngology.* Springer, Cham. https://doi.org/10.1007/978-3-030-54088-3_23 2021:253-9.
- Ziegler A, Patadia M, Stankiewicz J. Neurological complications of acute and chronic sinusitis. *Current neurology and neuroscience reports.* 2018;18(2):1-8.
- Dankbaar JW, van Bemmel AJ, Pameijer FA. Imaging findings of the orbital and intracranial complications of acute bacterial rhinosinusitis. *Insights into imaging.* 2015;6(5):509-18.
- Mafee MF, Tran BH, Chapa AR. Imaging of rhinosinusitis and its complications. *Clinical reviews in allergy & immunology.* 2006;30(3):165-85.
- Waqar S, Ameer S, Naeem M, Bajwa MA, Bajwa SM, Bajwa GR. Diagnostic accuracy of magnetic resonance imaging for diagnosis of acute invasive fungal sinusitis taking histopathology as a gold standard. *Pakistan Armed Forces Medical Journal.* 2020 Dec 16;70(6):1810-4.
- McCann MR, Kessler AT, Bhatt AA. Emergency radiologic approach to sinus disease. *Emergency Radiology.* 2021 May 19:1-8.
- Okuyemi KS, Tsue T. Radiologic imaging in the management of sinusitis. *American family physician.* 2002 ;66(10):1882.
- Germiller D, Monin DL, Sparano et al: Intracranial complication of sinusitis in children and adolescents and their outcomes. *Arch Otolaryngol Head Neck Surg* 2006; 132:969–976.
- Kombogiorgas D, Seth R, Athwal R et al: Suppurative intracranial complications of sinusitis in adolescence. Single institute experience and review of literature. *Br J Neurosurg* 2007; 21:603–609.
- Clayman GL, Adams GL, Paugh DR et al: Intracranial complications of paranasal sinusitis: A combined institutional review. *Laryngoscope* 1991; 101:234–239.
- Blumfield E, Misra M: Pott's puffy tumor, intracranial, and orbital complications as the initial presentation of sinusitis in healthy adolescents, a case series. *Emerg Radiol* 2011; 18:203–210.
- Hicks CW, Weber JG, Reid JR et al: Identifying and managing intracranial complications of sinusitis in children: A retrospective series. *Pediatr Infect Dis J* 2011; 30:222–226.
- Younis RT, Lazar RH, Anand VK: Intracranial complications of sinusitis: A 15-year review of 39 cases. *Ear Nose Throat J.* 2002; 81:636–644.
- Cornelius RS, Martin J, Wippold FJ, Aiken AH, Angtuaco EJ, Berger KL et al. ACR appropriateness criteria sinonasal disease. *Journal of the American College of Radiology.* 2013;10(4):241-6.
- Yousem DM. Imaging of sinonasal inflammatory disease. *Radiology.* 1993 188(2):303-14.
- Sadhu VK, Handel SF, Pinto RS, Glass TF. Neuroradiologic diagnosis of subdural empyema and CT limitations. *American Journal of Neuroradiology.* 1980;1(1):39-44.
- Miller ES, Dias PS, Uttley D. Management of subdural empyema: a series of 24 cases. *Journal of Neurology, Neurosurgery & Psychiatry.* 1987;50(11):1415-8.