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Retrospective Study of Radiological Diagnosis of Intra-Cranial Complication of Sinusitis

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ABSTRACT

Background: Intracranial involvement in complicated sinusitis is a rare but potentially fatal process. This study aimed to assess the role of radiological diagnosis in assessment and timing of surgical intervention in sinusitis patients complicated with intracranial complications. **Patients and Methods:** This retrospective cross sectional study was conducted in ENT and Radiology Departments, Faculty of Medicine, Zagazig University on 24 cases with sinusitis complicated with intracranial complications. **Results**: Included 12 patients had cavernous sinus thrombosis 50% of them were males with mean age of 65.4 years. They were presented with facial pain, facial edema, fever, proptosis, nasal obstruction and headache. 2 male patients had lateral sinus thrombosis with mean age of 61.4 years, they were presented with headache. 2 patients had meningitis, one male and other female with mean age of 41 years. They were presented with convulsion, fever and headache. CT of paranasal sinuses (PNS) showed sphenoidal sinusitis with mucosal thickening. CT Brain was irrelevant. MRI brain showed leptomeningeal enhancement, distention of subarachnoid space and widening of interhemispheric fissure. All patients underwent surgical debridement of diseased tissues with anticoagulant therapy. One patient died (50%). **Conclusions:** Both CT scan and MRI of the sinuses are mandatory in any patient presenting with features suggestive of intracranial complicated sinusitis.

Keywords: Paranasal sinusitis, Orbital involvement, Radiological.

INTRODUCTION

Complications of paranasal sinusitis are comparatively rare in the antibiotic era; however, a significant proportion of patients (5–40%) can be affected by sinusitis, mostly due to the delayed diagnosis of the disease[(1)]**.** Among paranasal sinuses, frontal sinusitis is the most common predisposing pathology leading to brain abscess where the frontal lobe is mostly affected because of its proximal location. Parietal abscess can be found in patients suffering from sphenoid sinusitis, and temporal lobe abscess is very rare. Sinusitis is presumed to be the underlying cause of 10% of all intracranial abscesses. Patients in the adolescent age group get frequently affected by unwanted complications[(2)]**.** Orbital involvement is the most common complication of sinusitis (accounting for 80% of all complications) because of its close anatomical relationship to the paranasal sinuses. If intraorbital complications are not treated in time, they can progress to life-threatening complications such as optic neuritis, cavernous sinus thrombophlebitis or intracranial complications[(3,4)] .

Based upon the anatomical sites and the degree of involvement, the patient can have various presentations in complicated sinusitis. Along with a proper history and clinical examination, extensive radiological evaluation (computed tomography [CT] scan/magnetic resonance imaging [MRI] of the paranasal sinus and brain) is always mandated in patients with suspected complications. Conservative treatment is offered as the first line of treatment for all complicated sinusitis. Endoscopic/open surgical drainage is warranted in progressive disease which does not respond to medical treatment[(5)].

Sinusitis can be caused by a virus, bacteria, or fungus (invasive fungal sinusitis) that swells and blocks the sinuses. A few specific causes include the common cold, nasal and seasonal allergies, including allergies to mold, polyps (growths), a deviated septum; the septum is the line of cartilage that divides your nose, a deviated septum means that it isn't straight, so that it is closer to the nasal passage on one side of the nose, causing a blockage, and a weak immune system from illness or medications[(6)].

This study aimed to assess the role of radiological diagnosis in assessment and timing of surgical intervention in sinusitis patients complicated with intracranial complications.

PATIENTS AND METHODS

This retrospective cross sectional study was conducted in ENT and Radiology Departments, Faculty of Medicine, Zagazig University on 24 cases with sinusitis complicated with intracranial complications.

Inclusion criteria: Gender: male and female. Patients with sinusitis complicated with intracranial complications.

Exclusion criteria: Postoperative intracranial infections. Post-traumatic intracranial infections.

Each patient's data set was thoroughly evaluated for age, gender, occupation, residence, nasal symptoms such as nasal obstruction, mucous-purulent rhinitis, impairment in olfaction or anosmia or hyposmia, crust formation, epistaxis, discharge, facial pain, headache, fever, facial fullness or edema, nausea and vomiting. History of ocular manifestations such as; decreased visual acuity, diplopia, proptosis, ophthalmoplegia, exophthalmos and swelling of the eyelids, neurological

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symptoms included; focal or generalized epileptic seizures. History also included hemiplegia, neck stiffness, facial hypoesthesia or anesthesia, cranial nerve defects, disturbed consciousness level, palatal symptoms including regurgitation of food or fluid from the nose, palatal hypoesthesia or anesthesia, and nasal tone of voice. The clinical examination for studied patients included diagnostic nasal endoscopy to assess the color of mucosa. Patients were examined for the presence of crusts or discharge, either anterior or posterior and for the presence of polyps or masses or any abnormality in the anatomy of the nose. The patients were tested for hypoesthesia or anesthesia by assessing the sensory function of the maxillary nerve.

An oral examination was performed for every patient to assess gangrenous areas in the palate or areas with changed color, palatal necrosis or ulcers, hypoesthesia or anesthesia, gingivitis and dental caries, especially in patients with diabetes.

Ocular examinations were conducted for patients to assess visual acuity, retinal hemorrhage, papilledema and central retinal artery occlusion, proptosis if present along with its degree and ptosis or ophthalmoplegia with its type, whether internal or external.

The radiological assessment of patients CT-PNS and brain: to identify suspicious criteria for infectious sinusitis. MRI PNS and brain: MRI is the modality of choice to assess soft tissue extension. Each patient with suspected intracranial sinusogenic complications was treated as an emergency case requiring immediate intervention involving diagnostics and treatment.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistic analysis

All data were collected, tabulated and statistically analyzed using the IBM SPSS (Statistical Package for the Social Sciences) statistics for windows, version 23.0 IBM Corp., Armonk, NY: USA. Quantitative data were expressed as the mean ± SD and qualitative data were expressed as frequency and percentage.

RESULTS

Table 1 shows that 12 patients had cavernous sinus thrombosis; 50% of them were males with mean age of 65.4 years. They were presented with facial pain, facial edema, fever, proptosis, nasal obstruction, headache, eyelid edema, ecchymosis, conjunctival edema, redness, III, IV ophthalmoplegia, blurred vision and papilledema.

Table (1): Clinically and radiological findings of cavernous sinus thrombosis

Cavernous sinus thrombosis	
	N=12
Age	65.4±4.15
Sex	
Male	(6) 50%
Female	(6) 50%
History	
Post COVID 19	4 (33.3%)
Rhinosinusitis with headache and fever	8 (66.7%)
Presentation:	
Facial pain	8 (66.7%)
Facial edema, eyelid edema, ecchymosis, conjunctival edema, redness, III, IV ophthalmoplegia.	9 (75%)
Fever	6 (50%)
Proptosis	6 (50%)
Nasal obstruction	4 (33.3%)
Headache	3 (25%)
Blurred vision and papilledema.	3 (25%)
CT sinuses:	
-Maxillary ethmoidal and sphenoidal opacity.	12 (100%)
-Destruction of both turbinate.	12 (100%)
-Septal deviation.	10 (83.3%)
-Ill-defined hypodense mass lesion in maxillary sinus.	12 (100%)
-Bone erosion of maxillary wall and inferior orbital wall.	10 (83.3%)
CT brain:	
Thickening of superior ophthalmic vein and irregular filling defect in cavernous sinus.	12 (100%)
MRI:	
Absent flow void (filling defect).	12 (100%)
Hyperintensity of cavernous sinus.	12 (100%)
Diffuse thickening of extraocular muscles.	12 (100%)
Diffuse sinusitis with soft tissue invasion.	12 (100%)
Complete obliteration of internal carotid artery.	3 (25%)
MR venogram:	
Deformity of internal carotid artery within cavernous sinuses.	12 (100%)
Ovios signal hyperintensity within thrombosed cavernous sinuses.	12 (100%)

Table 2 shows that 2 male patients had lateral sinus thrombosis with mean age of 61.4 years, they were presented with headache. CT and MRI findings are shown in the table. All patients underwent surgical debridement of diseased tissues with anticoagulant therapy. One patient died (50%).

Table (2): Clinically and radiological findings of lateral sinus thrombosis

Lateral sinus thrombosis	
	N=2
Age	61.4 ± 2.33
Sex:	
Male	(2) 100%
Female	(0) 0.0%
History	
Acute sinusitis	2 (100%)
Headache	2 (100%)
Presentation	
Headache	2 (100%)
CT brain:	
• Perisinus dural enhancement	2 (100%)
• Lateral sinus filling defect	2 (100%)
CT PNS:	
• Ethmoiditis and sphenoiditis	
MRI brain:	
-Thrombus appear as soft tissue signal in the lateral sinus	2 (100%)
-vascular bright appearance of dural wall	2 (100%)
-Delta sign	2 (100%)

Table 3 shows that 2 patients had meningitis, one male and other female with mean age of 41 years. They were presented with convulsion, fever and headache. CT and MRI findings are shown in the table. The 2 patients underwent surgical debridement of diseased tissues with anticonvulsant therapy. One patient died (50%).

Table (3): Clinically and radiological findings of meningitis

Meningitis	
	N=2
Age	41.4 ± 3.25
Sex	
Male	(1) 50%
Female	(1) 50%
History	
Fever	2 (100%)
Headache	2 (100%)
Nausea and vomiting	2 (100%)
Presentation	
Fever	2 (100%)
Convulsions	2 (100%)
Headache	2 (100%)
CT PNS	
- Sphenoidal sinusitis with mucosal thickening.	2 (100%)
- CT Brain: Irrelevant.	
MRI Brain:	
-Leptomeningeal enhancement.	2 (100%)
-Distention of subarachnoid space.	2 (100%)
-Widening of interhemispheric fissure	2 (100%)

DISCUSSION

In the present study, among 24 patients with intracranial sinusogenic complications, 12 cases had cavernous sinus thrombosis, 2 cases had lateral sinus thrombosis, 2 cases had meningitis, 2 cases had temporal lobe abscess, 2 cases had subdural empyema, 2 cases had cerebellar abscess and 2 cases had extradural abscess. **Brook[7],** reported that intracranial complications include meningitis, subdural empyema, epidural empyema, dural venous thrombosis, and brain abscess. Defects in the frontal sinus communicate with the anterior cranial fossae leading to intracranial complications. **Lerner *et al.* [8]** found that intracranial complications include epidural abscess, subdural empyema, meningitis, encephalitis, intracerebral abscess, and dural sinus thrombosis. **Sivaswamy and Ang[9]** reported that among 21 patients with intracranial sinusogenic complications, 9 cases were of frontal lobe abscesses (43%), 5 cases of epidural empyemas (24%), 4 cases of subdural empyemas (19%), 1 case of cavernous sinus thrombosis (5%), 2 cases of (10%) primary meningitis without other pathology within the central nervous system were observed. Among 9 patients with frontal lobe abscesses, purulent meningitis was observed in 2 of them, 1 of whom had multiple abscesses within the frontal and parietal lobe. Frontal lobe abscess was accompanied by multiple epidural and subdural empyemas, the empyema within the area of falx cerebri, and meningitis. Subdural empyema was observed in one patient with epidural empyema. Cavernous sinus thrombophlebitis was accompanied by meningitis. **Patel *et al.* [10]** reported that the most common intracranial complications were subdural empyema (49%), epidural abscess (36%), cerebral abscess (21%) and meningitis (10%). Less common complications included cavernous sinus thrombosis (5.6%), frontal bone osteomyelitis (3.3%), encephalitis (1.7%) and cerebral infarct (1.1%).

Din-Lovinescu *et al.* [11] reviewed MR images of all patients including T1 weighted, T2 weighted, T1 weighted with gadolinium, and diffusion weighted sequences. Intracranial complications identified included the following: 5 epidural abscesses (EA), 4 subdural abscesses (SA), 3 intraparenchymal abscesses (PA), 1 isolated pneumocephalus, and 1 patient with cvernous sinus thrombosis (CST) and superior sagittal sinus thrombosis. Two patients had both an epidural and intraparenchymal component. The rest had only isolated lesions. Four patients had findings localized to the left side. In the current study, there was 12 patients had cavernous sinus thrombosis 50% of them were male with mean age of 65.4 years. They were presented with facial pain, facial edema, fever, proptosis, nasal obstruction and headache. Their CT showed maxillary ethmoidal and sphenoidal opacity, hypertrophied both turbinate, septal deviation, ill-defined hypodense mass lesion maxillary sinus and bone erosion of maxillary wall and inferior orbital wall. MRI showed hyperintensity of cavernous sinus wall with loss of flow signal void (filling defect), Diffuse thickening of extraocular muscles diffuse sinusitis with soft tissue invasion and complete obliteration of internal carotid artery. **Dankbaar *et al.* [12]** found that the cornerstone of diagnosis is an MRI, demonstrating absence of

venous flow in the affected cavernous sinus. High resolution CT scan with contrast can also show filling defects. **Schupper *et al.* [13] and Hansen *et al.* [14]** found that proptosis, ptosis diplopia, chemosis, involvement of the eye motor nerves and impairment in the ophthalmic and maxillary branches of cranial nerve V(1) (ophthalmic nerve neuralgia) papilledema and signs of meningeal irritation associated with spiking fevers and prostration establish the diagnosis. Symptoms start in one eye and progress to the other. **Selvadurai and Virk [15]** reported a 64 year old female, who recently suffered from COVID-19 infection, with no other significant past medical history, presented to the emergency department with sudden onset, maximal severity frontal headache with associated emesis. She had a normal neurological examination, but was found to have chemosis and proptosis of her left eye with no other ophthalmic involvement. Computed Tomography (CT) demonstrated opacification of the left posterior ethmoid sinus and sphenoid sinus, with local dehiscence of its superolateral wall, in close proximity to the optic canal. Left sided proptosis was seen, with evidence of pre-septal edema. CT venogram confirmed bilateral CST, more prominent on the left.

In the present study, there was 2 male patients had lateral sinus thrombosis (LST) with mean age of 61.4 years, they were presented with headache. Their CT showed peri-sinus dural enhancement and lateral sinus filling defect. MRI showed soft tissue signal, vascular bright appearance of dural wall and delta sign.

Manolidis and Kutz[16] found that all patients underwent computed tomographic scanning with contrast of the head and temporal bones yielded a 72% true-positive and a 28% false-negative rate, whereas magnetic resonance imaging (MRI)/magnetic resonance angiography (MRA) and magnetic resonance venography (MRV) were able to detect 100% of the LST and additionally define the extent of the thrombus as well as the collateral venous circulation.

Irving *et al.* [17] found that CT scan with contrast may demonstrated the classic "delta sign" of perisinus dural enhancement in addition to a filling defect. The sensitivity of CT imaging with contrast in LST diagnosis has dramatically improved in the last two decades such that it is now a cost effective screening tool for patients with suspected disease. MRI, magnetic resonance venography and angiography with venous phase are the most definitive techniques for demonstrating LST. However, the use of angiography has been tempered by the risk of throwing off emboli and causing embolic stroke. MRI carries the advantage of sparing pediatric patients exposure to potentially large doses of ionizing radiation if they require serial imaging to monitor thrombosis progression[18]. **Au *et al.* [19]** found that the most frequent symptoms upon presentation were fevers, headaches, vomiting, and otalgia. Otorrhea, abducens nerve palsy, papilledema, postauricular tenderness, and neck rigidity were common findings on exam.

CONCLUSION

Both CT scan and MRI of the sinuses are mandatory in any patient presenting with features suggestive of intracranial complicated sinusitis.

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