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Radiological Diagnosis of Intra-Cranial Complication of Sinusitis

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Abstract:

Background: Intracranial Complications of Paranasal sinusitis are comparatively rare in the antibiotic era but may be fatal ; however, a significant proportion of patients (5–40%) can be affected by intracranial Complications of sinusitis and the condition may be fatal in(50%), mostly due to the delayed diagnosis of the disease.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 study included twenty four patients with chronic sinusitis with intracranial complications. The study was done in Otorhinolaryngology Department in Zagazig University Hospitals from August 2021 to February 2022. Patient age ranged from 19 to 70 years with a mean of 52.6 ± 10.68. They were 6 males and 18 females. All the patients had radiological investigation CTPNs 'brain, MRI PNS ' Brain**. Results**:showed that 2 male patients had temporal lobe abscess with mean age of 66.3 years they presented with facial pain and edema, fever, proptosis, nasal obstruction, nausea, vomiting and headache. 2 patients had Subdural empyema, 1 of them is male and other female with mean 22.3 years, they presented with fever, headache and vomiting and personality changes. 2 patients had cerebellar abscess one of them are male with age 45 and other female with age 45 and 57 years respectivly they presented with fever ,chills, vomiting , headache ,seizure,vertigo, nystagmus and imbalance. 2 male patients had extradural inflammatory abscess with frontal lobe with mean age of 21.3 years they presented with low grade fever, vomiting ,headache and frontal manifestation. All patients undergo surgical debridement of diseased tissues. Drilling and tabing of the abscess done by neurosurgeon in neurosurgery department. One patient died (50%). **Conclusions:**Although CT is excellent for imaging the bone, selective use of MRI and MRV based on history and exam findings are recommended to definitively rule out intracranial extension.

Keywords: Sinusitis, Meningitis, Empyema, Intracranial complication

INTRODUCTION

Intracranial involvement in complicated sinusitis is a rare but potentially fatal process. It was estimated that approximately 3% of patients hospitalized for sinusitis have an intracranial

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complication. Fortunately, the mortality of this condition has declined since the introduction of antibiotics and has continued to decrease over the past few decades. In 1980, the mortality rate of sinugenic subdural empyema was reported to be 40%[(1)].

However, the present study revealed 50% mortality rate of these complication.Non-specific symptoms such as fever and headache appear to be the most common presenting symptoms, while neurological symptoms such as seizures and focal neurologic deficits have been reported in 18% - 45% of patients[(2,3,4)].

Long-term neurologic sequelae such as paresis, aphasia, and seizures remain to be a concern, with the aforementioned systematic review reporting an average morbidity rate of 27% across 16 studies[(3)].

Furthermore, patients with intracranial complications of sinusitis are subject to long hospital admissions with reported hospitalization times over the past 10 years of up to 40 days. Late recognition of this condition and delay in treatment can increase morbidity and mortality rates[(5)].This study is 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 complication during the period from June 2021 to January 2022.

All patients were subjected to demographic data taking, clinical examination, The patients were tested for hypoesthesia or anesthesia, 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 haemorrhage, papilloedema 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 such as, mucosal thickening, hypoattenuatingopacification of the sinus, soft tissue attenuation, bone destruction which may be extensive or very subtle or even inapparent (extension through intact bone via vascular invasion), fat stranding outside the sinus perimeter such as intra-orbital fat.

MRI PNS and brain: MRI is the modality of choice to assess soft tissue extension. The findings within the sinus itself were variable, and range from mucosal thickening, to complete opacification of the sinus. In T1: intermediate low signal, T2: fungal mass is of intermediate to low signal, often associated with fluid or blood elsewhere in the paranasal sinuses. T1-weighted images with contrast: absent sinus mucosal enhancement suggests necrosis; invasion outside the sinus appears as increased enhancement. Particular attention should be paid to assessment of invasion beyond the sinuses. Early invasion should be sought, and findings that are particularly important include stranding of the periantral fat, intraorbital fat, masticator space,

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pterygopalatinefossa, subtle enhancement (T1 C+ fat-sat), leptomeningeal enhancement and intracranial granulomas: low signal on both T1 and T2.

Each patient with suspected intracranial sinusogenic complications was treated as an emergency case requiring immediate intervention involving diagnostics and treatment. Consultations by a neurologist, neurosurgeon, ophthalmologist and other specialists were performed according to accompanying diseases. The most important aims of the intervention were to diagnose the disease, and establish appropriate empirical intravenous antibiotic therapy.

Statistic analysis

All data were collected, tabulated and statistically analyzed using the IBM SPSS (Statistical Package for the social sciences). p-value< 0.05 was considered statistically significant (S), p-value < 0.001 was considered highly statistically significant (HS), and p-value ≥ 0.05 was considered statistically insignificant (NS)..

RESULTS:-

Table 1; showed that 2 male patients had temporal lobe abscess with mean age of 66.3 years they presented with facial pain and edema, fever, proptosis, nasal obstruction, nausea, vomiting and headache. Of the study patients there were 2 patient with temporal lobe abscess. Presented with facial pain, edema nasal obstruction, nausea, vomiting, headache and proptosis. CT PNS and brain**:**pansinusitis, partialyopacified sinuses, mucosal thickening, diffuse bone erosion invading alveolar margin and skull base and ill definedhypodense lesion with apical and intraconal extension. MRI Brain: will defined temporal abnormal signal intensity lesion and no midline shifting. All patients undergo surgical debridement of diseased tissues. Drilling and tabing of the abscess done by neurosurgeon in neurosurgery department. One patient died (50%).

Table (1): Clinically and radiological findings of temporal lobe abscess.

Temporal lobe abscess	
	N=2
Age	**66.3 ± 2.5**
Sex	**(2) 100%** **(0) 0.0%**
History **Fever** **Headache** **Nausea & vomiting**	 **2 (100%)** **2 (100%)** **2 (100%)**
Presentation Fascial pain and edema Nasal obstruction Nausea, vomiting Headache proptosis	 **2 (100%)** **2 (100%)** **2 (100%)**

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CT PNS and Brain:	
- **Pansinusitis**	**2 (100%)**
- **Partialyopacified sinuses**	**2 (100%)**
- **Mucosal thickening**	**2 (100%)**
- **Diffuse bone erosion invading alveolar margin and skull base**	**2 (100%)**
- **illdefinedhypodense lesion with apical and intraconal extension**	**2 (100%)**
MRI Brain:	
- **Will defined temporal abnormal signal intensity lesion**	**2 (100%)**
- **No midline shifting**	**2 (100%)**

Table 2; showed that 2 patients had subdural empyema, 1 of them is male and other female with mean 22.3 years, they presented with fever, headache , vomiting and personality changes. Of the studypatients there were 2 patients with subdural empyema. Presented with fever, nausea, vomiting ,headachepersonality changes and frontal manifestation.CT PNS: Bilateral frontal sinuses mucosal thickening. Mid centeralseptal deviation. CT Brain: Rt Low density lesion with peripheral enhancement. MRI Brain: abnormal ill-defined hypodense lesion in left frontal lobe with subdural extension. All patients undergo surgical debridment of diseased tissues**.**Drilling and tabing of the abscess done by neurosurgeon in neurosurgery department. 1patient died.

Table (2): Clinically and radiological findings of subdural empyema.

Subdural empyema	
	N=2
Age	**22.3 ± 1.76**
Sex	**(1) 50%** **(1) 50%**
History	
Acute sinusitis	**2 (100%)**
Fever	**2 (100%)**
Headache	**2 (100%)**
Disturbed conscious level	**2 (100%)**
Presentation	
Fever	**2 (100%)**
Nausea,vomiting	**2 (100%)**
Headache,personality changes and frontal manifestation.	**2 (100%)**
CT PNS:	
- **Bilateral frontal sinuses mucosal thickening**	**2 (100%)**
- **Mid centeralseptal deviation.**	**2 (100%)**
CT Brain:	**2 (100%)**
- **Rt Low density lesion with peripheral enhancement**	

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MRI Brain:	
Abnormal ill definedhypodense lesion in left frontal lobe with subdural extension.	**2 (100%)** **2 (100%)**

Table 3; showed that 2 patients had cerebellar abscess one of them are male with age 45 and other female with age 57 years they presented with fever ,chills, vomiting, headache, imbalance, vertigo, nystagmus and seizure. Of the study patients there were 2 patients with cerebellar abscessPresented with fever, chills, nausea, vomiting headache and seizures, imbalance, vertigo and nystagmus.CT PNS:Totallyobliterated ethmoidal and sphenoidal sinuses**,** septal deviation, ill-defined hypodense lesion in maxillary sinus.

CT Brain: Rt low density lesion with peripheral enhancement in Rt cerebellum. MRI brain**:**Rt cerebellar mass lesion (high T2 signal centrally and thin regular rim of contrast peripherally), central restricted diffusion is present.

All patients undergo surgical debridement of diseased tissues.Drilling and tabing of the abscess done by neurosurgeon inneurosurgery department. One patients died (50%).

Table (3): Clinically and radiological findings of cerebellar abscess.

Cerebellar abscess	
	N=2
Age	
Sex	**(1) 50%** **(1) 50%**
History	
Fever	**2 (100%)**
Headache	**2 (100%)**
Acute sinusitis	**2 (100%)**
Presentation	
Fever & chills	**2 (100%)**
Nausea,vomiting,vertigo ,nystagmus and imbalance.	**2 (100%)**
Headache	**2 (100%)**
Seizures	
CT sinuses:	
Totally obliterated ethmoidal and sphenoidal sinuses	**2 (100%)**
- **septal deviation**	**2 (100%)**
- **ill definedhypodense lesion in maxillary sinus.**	**2 (100%)**
CT Brain:	
- **Rt low density lesion with peripheral enhancement in Rt cerebellum.**	**2 (100%)**
MRI Brain:	
Rt cerebellar mass lesion (high T2 signal centrally and thin regular rim of contrast peripherally)	**2 (100%)**
Central restricted diffusion is present	**2 (100%)**

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Table 4; showed that 2 male patients had extradural inflammatory abscess with frontal lobe abscess with mean age of 21.3 years they presented with low grade fever, vomiting,frontal headache and personality changes.Of the study patients there were 2 patients with Frontal lobe abscess with extradural inflammatory abscess. Presented with low grade fever, vomiting,headache and personality changes. CT PNS and brain: Obliteration of both maxillary frontal ethmoidal and sphenoidal sinuses, Bifrontal abnormal brain parenchymal edema, Ill-defined frontal hypodense lesion and Deficient maxillary medial wall, middle turbinate and nasal septum. MRI brain: Intracranial epidural hyperintesnse collection in supraorbital region.
All patients undergo surgical debridment of diseased tissues**.**Drilling and tabing of the abscess done by neurosugon in neurosurgery department. One patient died (50%).

Table (4): Clinically and radiological findings of Frontal lobe abscess with extradural abscess.

Frontal lobe abscess with extradural inflammatory abscess	
	N=2
Age	**21.4 ± 2.33**
Sex	**(2) 100%** **(0) 0.0%**
History **Post covid 19** **Rhinosinusitis with headache & fever**	 **4 (33.3%)** **8 (66.7%)**
Presentation **Low grade fever** **Vomiting** **Headache and personality changes.**	 **2 (100%)** **2 (100%)** **2 (100%)**
CT PNS and Brain: **-Obliteration of both maxillary frontal ethmoidal and sphenoidal sinuses** **- Bifrontal abnormal brain parenchymal edema** **- Ill-defined frontal hypodense lesion** **- Deficient maxillary medial wall middle turbinate and nasal septum**	 **2 (100%)** **2 (100%)** **2 (100%)** **2 (100%)**
MRI Brain: - **Intracranial epidural hyperintesnse collection in supraorbital region**	 **2 (100%)**

DISCUSSION:

In the present study, there was 2 patients had meningitis, one male and other female with mean age of 41 years. They presented with Convulsion, fever and headache. Their CT show sphenoidal sinusitis with mucosal thickening and MRI show leptomeningeal enhancement, distention of subarachnoid space, widening of interhemispheric fissure.

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Sivaswamy and Ang[6] found that sinusogenic bacterial meningitis as acute purulent infection within the subarachnoid space was associated with inflammatory reaction of the meninges causing impairment in consciousness, epileptic seizures and increase in intracranial pressure. In cases in which focal neurological symptoms were observed, MRI scans were crucial while looking for lesions within the central nervous system. The course of meningitis was milder in cases in which it was accompanied by other intracranial complications.

In the current study, there was 2 male patients had temporal lobe abscess with mean age of 66.3 years they presented with facial pain and edema, Fever, Proptosis, Nasal obstruction, Nausea, vomiting and headache. Their CT show pansinusitis, partialyopacified sinuses, mucosal thickening, diffuse bone erosion invading alveolar margin and skull base, ill-defined hypodense lesion with apical and intraconal extension. MRI show ill-defined temporal abnormal signal intensity lesion with no midline shifting.

Wax et al.[7]in their case report experienced headache, confusion, and generalized seizures one day after starting antibiotic treatment for a 7-day history of sinusitis. Computerized tomography showing left maxillary and ethmoid sinusitis, and a 2.3-cm diameter ring enhancing left temporal lobe mass consistent with an abscess. The latter finding was subsequently confirmed by magnetic resonance imaging. In the current study, there was 2 cases with subdural empyema. Their CT finding shows totally obliterated ethmoidal and sphenoidal sinuses, septal deviation,

ill-defined hypodense lesion in maxillary sinus. The MRI shows abnormal ill-defined hypodense lesion in left frontal lobe with subdural extension. The basic clinical symptoms of this complication included fever, nausea, vomiting and headache and frontal manifestation.

Sivaswamy and Ang[6]found that epidural empyemas, observed between the internal surface of the posterior osseous wall of the frontal sinus and the dura mater, were observed in the area in which the osseous wall adhered tightly to dura mater. This inflammatory contact led to the transmission of the infection to dura mater with the development of empyema within the epidural and/or subdural space. Epidural space is a potential space and does not exist in physiological conditions. Physiologically, dura mater adheres to the surface of skull bones and separates from the bone as infection develops. The observed epidural empyemas were generally not that extensive, and their clinical symptoms were less eventful. The basic clinical symptoms of these complications included increased body temperature, headaches, epileptic status and focal negative symptoms, while 2 patients exhibited edema of the forehead. In CT, the empyemas were visible as hypodense lentoid-shaped foci, whereas in MRI they were visible as fluid cisterns.

Patel et al.[3]reported a case of subdural empyema. Computed tomography (CT) of the head and sinuses without contrast showed near-complete opacification of the frontal sinuses and diffuse bilateral mucosal thickening of all the sinuses. A 4 mm collection was seen in the anterior right frontal lobe of the brain subjacent to the right frontal sinus. Magnetic resonance imaging (MRI) of the brain with and without contrast showed a right frontal sinus opacification and a 24 mm × 10.2 mm × 15.8 mm subdural empyema adjacent to the posterior aspect of the right frontal sinus.

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Bruner et al.[8]found that clinical features of subdural empyema include the persistence of fever despite treatment of underlying meningitis, focal seizures, and symptoms and signs of increased intracranial pressure, such as headache, depressed level of consciousness, vomiting, and papilledema. Occasionally, an empyema can present with stroke-like features and should be considered when the patient has systemic symptoms such as fever in addition to hemiparesis or focal limb weakness.

Sivaswamy and Ang[6]found that magnetic resonance imaging of the brain characteristically demonstrates bright lesions on diffusion weighted imaging, owing to edema of the underlying structures.

Subdural empyema in inflammatory lesions is a container of pus found between the parietal and visceral layer of the arachnoid, which form the arachnoid space, bordering directly with subarachnoid space. Subdural empyema usually develops through the inflammation of the frontal or another sinus, it may also spread from epidural empyema. It should be underlined that the evolution of this complication of sinusitis in the presented material was extremely violent, and the state of the patient got worse every hour. Subdural space is vast and contains few barriers that would stop the infection from spreading. Both layers of the arachnoid, which form the borders of this space, can limit the purulent process and stop the spread of infection by reacting to pathogens from the adjacent osseous focus and by forming adhesions. Inflammatory lesions within the subdural space usually developed in superior and anterior parts of the frontal lobe within one hemisphere[9].

In one retrospective cohort, a contrast-enhanced head CT or brain MRI was able to diagnose a sinogenic intracranial empyema but nonenhanced CT and axial imaging alone was not sufficient for diagnosis[10].

In the present study, 2 patients had cerebellar abscess one of them was male and the other female with age 45-57 years respectivly they presented with fever and chills vomiting, headache and seizure. Their CT show bilateral frontal sinuses mucosal thickening, mid centeralseptal deviation, right low density lesion with peripheral enhancement in Rtcerebellum . MRI shows right cerebellar mass lesion (high T2 signal centrally and thin regular rim of contrast peripherally) and central restricted diffusion is present.

In the present study, there was 2 male patients had extradural inflammatory abscess with frontal lobe with mean age of 21.3 years they presented with low grade fever, vomiting and frontal headache and personality changes. Their CT show obliteration of both maxillary frontal ethmoidal and sphenoidal sinuses, bifrontal abnormal brain parenchymal edema, ill-defined frontal hypodense lesion and deficient maxillary medial wall middle turbinate and nasal septum. MRI shows intracranial epidural hyperintesnse collection in supraorbital region.

Yong et al. [11]reported a casepresented with intermittent vomiting, fever, frontal headache and slowly progressive, tender swelling over the forehead. Post contrast CT brain was performed showed a frontal extradural abscess associated with left frontal sinusitis and dehiscence of the anterior and posterior frontal sinus walls.

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Sinusogenic brain abscesses, usually within the frontal and parietal lobes, constitute the focal infections in the cerebral tissue. They constitute 10-13% of all brain abscesses. They were observed in fewer cases than otogenic abscesses; nevertheless, the former surpassed the latter when it comes to severity[12]**.** In immunocompetent patients, tight brain-blood barrier and good vascularization of the meninges makes cerebral tissue relatively highly resistant to infection. However, in case of bacterial invasion, brain tissue reacts in a certain way[13]**.** In the first stage, cerebral tissue inflammation (cerebritis) develops **Roos and Tyler**[14]**,**and finally, an organized and encapsulated abscess develops.

Sivaswamy and Ang[6]found that brain abscess was characterized by the presence of a growing intracranial mass-type lesion and inflammation. The evolution of subjective and objective symptoms was varied, and the complaints reported by the patient lasted from a few days to a few weeks. The clinical manifestation of the abscess depended on its location within the frontal or parietal lobe, the time of development, the type of infection, the increase in intracranial pressure and the coexistence of other intracranial complications. The symptoms observed most frequently for this location included headache, usually constant and dull, low-grade fever, negative neurological symptoms, epileptic states, personality changes, impairment in orientation, stupor and sleepiness. Contralateral hemiplegia was observed in brain abscesses that were diffuse and located deeper within the frontal and parietal lobes. Brain MRI scans made it possible to determine the location of the abscess, its shape (simple, multiloculated, multiple abscesses), the state of its capsule, the edema of the brain cerebral tissue surrounding the abscess, the presence of accompanying epidural and subdural empyemas, and to monitor treatment efficacy. MRI was superior over CT in the visualization of abscesses at their early stages of development. A mature abscess exhibited an enhancing capsule which surrounded the hypodense center and which was surrounded by a hypodense picture of the brain edema.

CONCLUSION:

Although CT is excellent for imaging the bone, selective use of MRI and MRV based on history and exam findings are recommended to definitively rule out intracranial extension.

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