

Case Report

Evaluation and management of nosocomial sinusitis in Intensive Care Unit patients for pyrexia of unknown origin: Case report and review of literature

Aggarwal S.K^{1*}, Azim A², Baronia A.K², Kumar R¹

¹Department of Neurosurgery, ²Department of Critical Care Medicine, SGPGIMS, Lucknow-226014, India

*Corresponding author: doc.sushil.pgi@gmail.com

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ABSTRACT

Background: Diagnosing nosocomial sinusitis (NS) in Intensive Care Unit (ICU) is difficult as the patient is usually on ventilator and the usual clinical signs and symptoms of acute or chronic rhinosinusitis cannot be confirmed from the patient. **Aim:** Authors want to highlight that nosocomial sinusitis as the cause of fever in ICU patients should be explored. A detailed review of literature on evaluation and management of nosocomial sinusitis is also presented in this article. **Findings:** In this article, we emphasize how to evaluate and diagnose nosocomial sinusitis in ICU patients using a case of a 38-year old patient who was treated for nosocomial sinusitis. Nosocomial sinusitis can be treated successfully in most of the patients if it is diagnosed early and managed properly. Hence, an index of suspicion should be kept for nosocomial sinusitis in a case of pyrexia of unknown origin in ICU settings. **Conclusion:** Nosocomial sinusitis in ICU setting presenting with fever needs to be diagnosed early in patients having risk factors for this entity and should be managed aggressively to prevent life threatening complications like ventilator-associated pneumonia and sepsis. Early endoscopic clearance of all the sinuses along with culture sensitivity-based antibiotics should be the standard management protocol in all such cases.

Key words: Nosocomial sinusitis, management, ICU, pyrexia

INTRODUCTION

Rhinosinusitis is an inflammatory process involving the nasal mucosa and one or more sinuses.^[1] Rhinosinusitis may be caused by genetic predispositions such as defects in mucociliary clearance (Kartegener's syndrome), increased viscosity of mucous (cystic fibrosis), or acquired from viral, bacterial, fungal or protozoal infection,

allergy, chemical or gaseous intoxication, septal deviation, neoplastic and physical trauma, or fractures.^[1,2,3]

Diagnosing nosocomial sinusitis (NS) in Intensive Care Unit (ICU) setting is difficult as the patient is usually on ventilator with endotracheal tube in situ and the usual clinical signs and symptoms of acute or chronic rhinosinusitis cannot be confirmed from the patient. The only modality to diagnose

nosocomial sinusitis in ICU setting is Contrast-Enhanced Computed Tomography (CT) scan which shows unilateral or bilateral soft tissue hypodensity present in one or more sinuses of the patient. The underlying pathophysiology is the obstruction of sinus ostia drainage at the osteomeatal complex from inflammatory edema, impaired mucociliary clearance, followed by stasis of exudates and secondary bacterial infection.^[1,2,3]

Authors want to highlight based on a case that nosocomial sinusitis should be kept in all ICU patients presenting with high-grade fever and early aggressive intervention should be the norm for all such cases for better outcome.

CASE STUDY

A 38-year old female patient presented to emergency department of our tertiary care institute with chief complaints of continuous fever of a week duration and altered sensorium for a day. There was no history of seizures, decreased urine output, abdominal distension, bleeding from any site or difficulty in breathing.

On examination, patient was febrile, icteric and pale. Her pulse was 122 beats/ min and she was hypotensive (BP was 90/60mm Hg). She was taking irrelevant and was in altered sensorium state. Icterus and pallor were present. Abdominal, Cardiovascular and Respiratory system examination were normal. On central nervous system (CNS) examination, patient was not responding to verbal commands as she was disoriented completely. All deep reflexes were present and pupils were of normal size and reacting to light. Patient was transferred to the ICU and was put on ventilatory support due to low GCS(<8) along with vasoactive drugs like noradrenaline (0.3micrograms/kg/min), intravenous i.v. mannitol, i.v. antibiotics covering gram-positive, negative and anaerobic bacteria and i.v. fluids.

Her liver function tests were found to be deranged and viral markers were positive for anti- HEV IgM and anti- HAV IgM when investigated. The patient showed clinical improvement from her primary illness after 10 days of management. Her CNS status also got improved and gradually she was weaned off the ventilator after regaining consciousness.

On 11th day in ICU, she developed new onset of high grade fever with raised total leucocyte count

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(TLC) and elevated procalcitonin. Her blood, urine, CSF and tracheal cultures were negative. Magnetic resonance imaging (MRI) brain and subsequently contrast-enhanced computed tomography (CT) paranasal sinuses (PNS), nose and orbit was done as routine work-up for pyrexia of unknown origin, which showed mild increase in meningeal enhancement and bilateral ethmoidal (Figure 1) and maxillary sinusitis respectively. MRI

brain was done to look for intracranial pathology as cause of fever but incidental sinusitis was detected on MRI. Hence, to see the volume of the disease in sinuses, CT scan was done. Endoscopic clearance of disease was done by ENT surgeon and tissue was sent for bacterial and fungal culture as well as for histopathological examination (HPE).

HPE report came out to be inflammatory polyps but bacterial culture showed the growth of *Acenitobacter baumannii* sensitive only to carbapenem. Fungal culture was negative. Patient was given routine post-operative care and she recovered dramatically after surgery and administration of culture-based antibiotics. She was discharged after 5 days with normal temperature, heart rate of 80 bpm and BP of 130/70mmHg. At present, patient is on regular follow-up under gastroenterologist and ENT specialist.

DISCUSSION

Acute purulent sinusitis is a significant cause of fever and sepsis in the ICU.^[4] It is often overlooked as a source of infection in the critically ill patient. The incidence depends on the patient population and the definition of sinusitis used.^[5] In some studies, a sinus CT scan that shows the presence of air-fluid levels or opacification within the sinuses has been considered enough to confirm this diagnosis.^[6] This is what some investigators call 'radiographic sinusitis.'^[7] 35% to and 38% of patients in the ICU who have radiographic findings of sinusitis may actually develop infection.^[8] Conversely, other investigators accept the diagnosis of acute nosocomial sinusitis NS only if they are able to recover micro-organisms on culture of the exudates that are obtained by aspiration of one or both maxillary sinuses.^[5] To complicate this issue even further, some investigators have defined acute sinusitis as the presence of macroscopic purulent material in the aspirate that is obtained from the involved sinus, even in the absence of positive cultures.^[7]

Our patient presented to us as new onset of fever on 11th day of ICU stay when she had already received antibiotics for her primary illness and was recovering. Contrast-Enhanced Computed Tomography (CECT) of pns, nose and orbit was done which showed extensive sinusitis. Endoscopic surgical clearance of all the sinuses was done and the tissue culture came out to be positive for MDR *Acenitobacter baumannii*. Culture-sensitive antibiotics were started and patient recovered after surgery.



Figure 1: Contrast-Enhanced Computed Tomography of (CECT) paranasal sinuses, nose and orbit showing ethmoidal sinusitis.

Several studies suggested that nasotracheal intubation^[4,10] and the use of nasogastric tubes^[4,11] are risk factors for the development of NS. A prospective study of 162 patients who were mechanically ventilated,^[12] identified nasal placement and duration of endotracheal or gastric intubation as risk factors for the development of radiologic sinusitis. In this series, analysis of the subgroup of patients who had normal maxillary sinuses by CT scan within 48 hours of admission showed that after 7 days of nasotracheal intubation and nasogastric tube placement, 95% of patients demonstrated radiologic pansinusitis, whereas after 7 days of orotracheal intubation and orogastric tube placement, 25% of the patients had evidence of radiologic pansinusitis.^[12] Less than 40% of the cases of 'radiographic sinusitis' were of infectious origin. This high incidence of sterile cultures in

patients who had radiographic sinusitis may be due to the widespread use of broad spectrum antibiotics in the ICU, which may attenuate the clinical presentation of many cases of NS. Other risk factors for NS include nasal colonization with enteric GNB, feeding by way of nasogastric tube, sedation, and a Glasgow coma score of 7 or less.^[5]

Nosocomial sinusitis has been associated with ventilator-associated pneumonia (VAP), with similar pathogens often cultured from sinus and bronchial samples.^[9,12] In one prospective study, multivariable statistical analysis suggested that NS increases the risk of VAP by 3.8 times.^[9] Patients who had NS that was due to *P aeruginosa*, *A baumannii*, and *S aureus* were at a higher risk of developing VAP than those who had NS that was due to other pathogens.^[13] In our case, feeding was being done by nasogastric tube and patient was being kept on ventilator for long duration. Thus, both these may be the risk factors for development of nosocomial sinusitis in our case.

To achieve the diagnosis of NS, we use noninvasive and invasive techniques. Noninvasive methods include physical examination, rhinoscopy, radiography, B-mode ultrasound (US), and CT scan. The invasive techniques include antral puncture and endoscopic tissue culture. Although we can arrive at the presumptive (clinical or radiologic) diagnosis of NS by using the noninvasive techniques, an effort should be made to achieve microbial diagnosis using one of the invasive methods. In our case, diagnosis was made on CT scan and was confirmed during endoscopic clearance and on tissue culture report.

Non-invasive methods

In the ventilated and sedated patient, the usual clinical signs and symptoms of sinusitis such as facial pain, headache, and local swelling are frequently absent.^[3] Therefore, the patient needs a thorough bedside examination including a rhinoscopy to look for purulence in the middle meatus.^[8] A retrospective study of 122 critically ill patients who were evaluated for NS found that the most important factor in predicting a positive result with antral lavage is the presence of purulence in the middle meatus on physical examination, in conjunction with the presence of sinus disease on CT.^[8] When these two findings were present, 92.3% of the antral lavages gave positive results. Furthermore, Vandebussche *et al.* found that simple anterior rhinoscopy could reduce the need for antral puncture.^[7] Only two patients of the 25

that had purulent secretions in the maxillary sinuses had a completely normal result on rhinoscopy in this series; only 8% of punctures in patients who had a normal clinical examination were positive.^[7] When compared with antral puncture, the sensitivity and predictive value of the rhinoscopy as a test was 92%.

Although plain films were once the modality of choice for evaluating patients who had NS, current experience shows that this modality is inaccurate in assessing the extent of inflammation.^[14] CT scan of the sinuses was superior to plain films in evaluating pathologic conditions of the sinuses in patients in the ICU,^[8] and is now considered the imaging modality of choice for the radiologic diagnosis of sinusitis.^[14] This procedure implies transportation of critically ill patients to the CT scanner, which places them at additional risk. For this reason, multiple efforts have been made to develop new radiologic diagnostic techniques that can be performed at the bedside. In a prospective study that involved 30 critically ill patients, Puidupin *et al.*^[15] compared B-mode ultrasound (USS) of paranasal sinuses with CT scan or radiography for the radiologic diagnosis of maxillary NS.^[15] When compared with CT scan and radiography, the sensitivity of the ultrasound was 50%, the specificity was 100%, positive predictive value PPV was 100%, and negative predictive value NPV was 93.7%.^[15]

In summary, rhinoscopy is still a valuable diagnostic tool and should be performed in all the patients who are suspected to have NS. Although CT scan is the radiologic procedure of choice for the diagnosis of NS, B-mode USS is a noninvasive, less expensive and reliable diagnostic technique. B-mode US could be used as a first-line diagnostic test in patients who are suspected of having NS, when we want to avoid transportation to the CT scanner.

Invasive methods

A suspected diagnosis of NS should be established by puncture of the sinuses. Antral puncture is a simple, fast, safe, inexpensive, and effective procedure for the immediate diagnosis of acute NS in patients in the ICU.^[7] The procedure is performed following disinfection of the nares to avoid contamination of the sinus cavities, which may lead to overestimation of the diagnosis of NS.^[16] Conversely, an infectious process that is developing or established in the antral mucosa can be missed (false negative), if only secretions are used for bacterial cultures.^[16] Westergren *et al.*^[16] described patients who had negative secretion cultures,

endoscopic signs of infection or inflammation, and positive antral mucosal cultures. The main disadvantage of the sinus puncture is that it is limited to the maxillary sinus. In case of a positive puncture, a CT scan should be performed (if not already done) to evaluate the frontal, ethmoidal, and sphenoidal sinuses in patients who have NS.^[7] Antral puncture has been proven to be a safe procedure.^[7] Rare complications include bleeding within the maxillary sinus cavity or upper lip anesthesia that results from traumatic injury of the infraorbital nerve.^[17]

Casiano *et al.*^[17] studied the use of endoscopic tissue culture of the osteomeatal complex as a safer alternative technique for the diagnosis of NS. They stated that a culture from the maxillary sinus does not necessarily correlate with that of other sinuses and that an endoscopically-guided biopsy of the common drainage area of the anterior ethmoids, maxillary, and frontal sinuses may yield more pathogenic organisms.^[17] They studied 20 patients in the trauma ICU who had fever of unknown origin with evidence of sinusitis on CT. A total of 29 sinuses underwent simultaneous tap and endoscopic tissue culture.^[17] There seemed to be a concordance between both techniques in only 60% of the patients. Kountakis and Skoulas^[18] prospectively studied the use of endoscopically-guided middle meatal cultures on 18 febrile patients in the ICU who were suspected of having NS. Endoscopically-guided middle meatal cultures yielded the same pathogen as cultures of the lavage aspirate in only 21% of these cases.^[18] Six of these febrile patients had positive bacterial cultures (BCs), however, and three of the six died. In two of the three patients who died, the same pathogen was grown from the middle meatal and antral aspirate cultures.^[18] This diagnostic technique could be an option for coagulopathic septic patients who are not candidates for an antral puncture. Further studies with larger populations of patients are required to validate these techniques.

Management

Nosocomial sinusitis is a life threatening condition that requires aggressive treatment.^[4, 8] The frequent failure of medical treatment that is seen in these patients is probably, at least partially, due to the delays in diagnosis and antimicrobial therapy.^[4] After we have performed a puncture of the sinus, empiric antibiotic therapy must be started if macroscopic purulent secretions are obtained or if there is enough clinical and radiologic evidence for NS.

To be able to select appropriate empiric antibiotic therapy we have to be familiar with the etiologic agents that are frequently associated to NS. Sinus cultures in NS are frequently polymicrobial,^[4,5,7,13] and the bacteria seen are different than those that are seen in nonhospital-acquired sinusitis.^[4] The most frequently found organisms are gram-negative bacteria (GNB) (*Acinetobacter spp*, *P aeruginosa*, and *E coli*), and gram-positive cocci (*S aureus*, *coagulase-negative staphylococci*, and *streptococci spp*).^[5,12,7,9,10,13,17,18] *Candida albicans* is the most common organism among the yeasts.^[18] Although several studies reported low percentages of anaerobic bacteria isolation in patients in the ICU who have NS.^[5,7,12] Le Moal *et al.*^[19] isolated anaerobes in up to 60% of cases of documented NS, using appropriate transport conditions and bacteriologic analysis. Anaerobic bacteria were frequently isolated from nasal puncture in patients who had neurologic disorders on admission and in patients who had nasogastric tubes.^[19] In our case, the pathogen isolated was *Acinetobacter baumannii*, a gram-negative bacterium.

Antimicrobials that can be used as empiric therapy for NS include an antipseudomonal β -lactam/ β -lactamase inhibitor combination such as piperacillin/tazobactam, or ticarcillin/clavulanate, a fourth generation cephalosporin such as cefepime, a carbapenem such as imipenem or meropenem, or combination therapy with ceftazidime and vancomycin. The use of fluconazole should be considered if the gram stain of the aspirate reveals the presence of yeasts. Antibiotics should be based on the susceptibility of the bacteria in the antral samples after microbiologic results are obtained. Changes in the antibiotic regimen on the basis of culture findings give a better outcome.^[20] Ramadan *et al.*^[20] retrospectively reviewed 42 patients in the ICU who had findings that were suggestive of sinusitis on plain films or CT scans and underwent an antral puncture. When the antibiotics were changed, 83% of these patients had resolution of fever, whereas only 42% of the patients who did not have the antibiotics changed had clinical improvement.^[20] In our case, the patient improved dramatically after putting her on culture sensitive antibiotics after 2 weeks.

Administration of nasal decongestants, positioning in the semirecumbent position, and removal of foreign bodies are complementary therapeutic interventions that should be used in all patients who have NS. Frequent flushing with saline solution may

be enough treatment for cases of non-purulent secretions.^[7] If signs of sepsis are present, however, the empirical use of antibiotics is warranted, even in the absence of a purulent aspirate. Surgical intervention or sinus drainage is required in cases of medical treatment failure.^[4, 7] If the patient presents with sign of sepsis and other sources of infection are not identified, surgical drainage should be considered early in the hospital course. Prospective trials to evaluate the efficacy of these therapeutic modalities in the treatment of NS are required.

CONCLUSION

Nosocomial sinusitis in ICU setting is an important entity and needs to be diagnosed early and managed aggressively to prevent complications like VAP and sepsis. Patients with risk factors should be identified early and worked up for nosocomial sinusitis. Early endoscopic clearance of all the sinuses along with culture sensitivity-based antibiotics should be the standard management protocol in all such cases.

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