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# Bacteriology and antibiotics treatment of maxillary sinusitis: a prospective study

**Santosh Malashetti[1]*, Abhay Havle[2], Rajesh Karembelkar[2]**

[1]Department of ENT, S. Nijalingappa Medical College and HSK Hospital, Navanagar, Bagalkot, Karnataka, India
[2]KIMS, Karad, Maharashtra, India

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***Correspondence:**
Dr. Santosh Malashetti,
E-mail: drsantoshpm77@gmail.com



## ABSTRACT

**Background:** Sinusitis is one of the commonest causes of patients visit to the otorhinolaryngologist, around one in five cases. The prevalence of sinusitis (146/1000) has been reported. Estimates suggest that clinical condition of sinusitis is more widespread than arthritis and/or hypertension. Sinusitis significantly impacts quality of life, even in comparison to chronic debilitating diseases such as diabetes and congestive heart failure. Sinusitis is the fifth most common medical diagnosis for which antibiotics are prescribed. Sinusitis is usually managed with a 10 days complete course of appropriate sensitive antibiotics. To achieve this goal, there should be some diagnostic modalities which guide towards exact diagnosis as well as safe intervention and cost effective. Over past decade, X-ray paranasal sinuses (Water's view) and nasal endoscopy have been used successfully as diagnostic modalities in sinus disease.
**Methods:** 100 patients presenting with complaints of sinusitis to the ENT, OPD, KIMSDU, Karad, Maharashtra, India were selected randomly (more than 12 yrs of age). All of them were examined clinically and subjected to X-ray PNS (Water's view) and diagnostic nasal endoscopy [DNE]. Antral lavage was done for all the patients and returning fluid sent for culture and sensitivity. Results were evaluated by statistical analysis using Chi square test and evaluating p value tabulated and compared. Appropriate antibiotics were advised orally for 10 days, on the basis of culture reports, such as Amoxcillin-Clavulinate 625 mg BD, Cefpodoxime proxetil 200 mg BD, Levofloxacin 500 mg OD, Ciprofloxacin-Tinidazole (500:600 mg) BD.
**Results:** Majority of the patients were in the age group of 20-29 years (46%) and females (53%). Most common organisms causing maxillary sinusitis was- *S. aureus* (coagulase+29%). It was found that Amoxicillin-Clavulinate has highest efficacy as compared to other antibiotics.
**Conclusions:** According to our study, most common organisms causing acute maxillary sinusitis in this study are *S. aureus* (coagulase+), *S. pnemoniae* and Enterobacteriacae. Most common organisms isolated are anaerobic *Peptostreptococcus*, coagulase positive *S. aureus* and *Fusobacterium* in chronic rhinosinusitis. Efficacy of Amoxicillin-Clavulinic acid was 96% clinically, 94% based on results on DNE findings and 87% by radiological success rate which is statistical more significant than other class of antibiotics. So Amoxicillin-Clavulinic acid can be considered as first line of drug for treating bacterial rhinosinusitis.

**Keywords:** Water's view, DNE, Antral lavage, Efficacy, Amoxicillin-Clavulinate

## INTRODUCTION

Sinusitis is generally triggered by a viral upper respiratory tract infection, with only 2% of cases being complicated by bacterial sinusitis.[1] About 90% of patients in the United States are estimated to receive an antibiotic from their general practitioner, yet in most cases the

condition resolves without antibiotics, even if it is bacterial in origin.[2]

The mainstay of treatment for acute rhinosinusitis is symptomatic relief with analgesics; little evidence supports the use of antihistamines, intranasal steroids, nasal douches, or decongestants.[3]

Some evidence supports the use of antibiotics, with a 3-5% difference in cure rate compared with placebo, especially in cases where symptoms are severe, persistent (>5 days), or progressive.[4] Evidence suggests benefit with Amoxicillin or Co-amoxiclav, as well as with Cephalosporins or macrolides. Resolution rates for these drugs are reported to be similar, although Cephalosporins and macrolides may have fewer adverse effects.[3]

Chronic rhinosinusitis: Oral antibiotics with anaerobic and gram negative cover may be required, although the European Academy of Allergology and Clinical Immunology found limited evidence to support their use. They may be considered in patients who have failed to respond to initial intranasal steroid therapy or in those who have severe symptoms with evidence of persistent nasal sepsis. Symptom relief can be achieved in both acute and chronic rhinosinusitis with the use of topical saline douches and sprays.[5]

Hence in this study, we assessed efficacy of different class of antibiotics in treatment of maxillary sinusitis and treatment response assessed with help of diagnostic endoscopic findings and radiologically by X-ray PNS Water's view findings.

### *Objectives*

We conducted this study with following main objectives

1) To study the bacteriology of maxillary sinusitis.
2) To compare efficacy and safety of different antibiotics in the treatment of maxillary sinusitis.

## METHODS

100 patients presenting with complaints of maxillary sinusitis to the ENT, OPD, KIMSDU, Karad, Maharashtra, India were selected randomly (more than 12 years of age). All of them were examined clinically and subjected to X-ray PNS (Water's view) and Diagnostic Nasal Endoscopy [DNE]. Antral lavage was done for all the patients and returning fluid sent for culture and sensitivity. For acute maxillary sinusitis- endoscopic guided middle meatus secretion were collected for microbiological examination, followed by antral puncture which was undertaken with antibiotic coverage.

### *Statistical analysis*

Results were evaluated by statistical analysis using Chi square test and evaluating p value tabulated and compared.

Culture specific appropriate antibiotics were advised orally for 10 days such as

- Amoxcillin-Clavulinate 625 mg BID.
- Cefpodoxime proxetil 200 mg BID.
- Levofloxacin 500 mg OD.
- Ciprofloxacin-Tinidazole (500:600 mg) BD.

### *Inclusion criteria*

Patients presenting with clinical features (>7 days) related maxillary sinusitis of all age groups and sexes.

Nasal obstruction and nasal discharge, headache, postnasal drip, sinusitis pain, facial pain, anosmia, malaise, fever and cough, purulent secretion in the nasal cavity, discharge in the pharynx and tenderness on sinus tapping.

### *Exclusion criteria*

Exclusion criteria were age less than 12 years, allergy to study medications, pregnancy and breast feeding; previous paranasal surgeries, clinical suspicion of frontal sinusitis or pansinusitis, cases with complications due to spread of the infection to surrounding areas; space occupying lesions in nasal cavities.

## RESULTS

### *Sex incidence*

In present study, females were most affected 53%, followed by males- 47%.

### *Age distribution*

Highest age incidence was in the third decade i.e. 20-29 age groups. Least commonly affected were elderly more than 50 years.

**Table 1: Distribution of cases according to age.**

| Age in years | No. of patients | Percentage (%) |
|---|---|---|
| **<20** | 14 | 14 |
| **20-29** | 46 | 46 |
| **30-39** | 18 | 18 |
| **40-49** | 15 | 15 |
| **>50** | 07 | 07 |
| **Total** | 100 | 100 |

### *Clinical diagnosis*

Chronic rhinosinusitis (45%) was the most common diagnosis followed by acute rhinosinusitis (39%).

### *Symptomatological index*

Among the major factors for diagnosis of rhinosinusitis, commonest symptoms noted were nasal discharge (66%),

nasal obstruction (48%), followed by and facial pain (39%). Of the minor factors, commonest symptoms were headache (27%) followed by dental pain and halitosis (18% each).

**Table 2: Symptomatological index.**

| Major factors | No. of patients (%) | Minor factors | No. of patients (%) |
|---|---|---|---|
| **Facial pain/ pressure** | 39 (39) | Headache | 27 (27) |
| **Facial congestion/ fullness** | 18 (18) | Fever (non-acute cases) | 3 (3) |
| **Nasal obstruction/ blockage** | 48 (48) | Halitosis | 18 (18) |
| **Nasal discharge /purulence/ discoloured postnasal drip** | 66 (66) | Fatigue | 3 (3) |
| **Hyposmia/ anosmia** | 12 (12) | Dental pain | 18 (18) |
| **Purulence in nasal cavity on examination** | 30 (30) | Cough | 3 (3) |

***Radiographic appearance of Maxillary sinuses (Pre-treatment)***

The maxillary antra in 13% cases were radiologically clear, and hazy in 18%, opaque in 15%, air-fluid level in 24% and 30% had mucosal thickening.

**Table 3: X-ray PNS findings of maxillary sinus.**

| X-ray findings | Total | Percentage (%) |
|---|---|---|
| **Clear** | 13 | 13 |
| **Haziness** | 18 | 18 |
| **Opacity** | 15 | 15 |
| **Air-fluid level** | 24 | 24 |
| **Mucosal thickening** | 30 | 30 |
| **Total** | 100 | 100 |

***Diagnostic nasal endoscopic (DNE) findings***

Based on Lund-Kennedy endoscopic scoring system the diagnostic endoscopy of the middle meatus in all cases revealed no middle meatal discharge in 10%, thin secreations in 29%, thick and purulent discharge in 61%.

***Results of antral lavage***

Of all the sinuses irrigated, 28% returns obtained were clear. Among the abnormal returns, most common type was the purulent returning fluid in 53%, mucoid and mucopurulent in 8% and 11% respectively (Table 4).

**Table 4: Results of antral lavage (proof puncture).**

| Returning fluid | Total | Percentage (%) |
|---|---|---|
| **Clear** | 28 | 28 |
| **Mucoid** | 8 | 8 |
| **Mucopurulent** | 11 | 11 |
| **Purulent** | 53 | 53 |

***Comparison of lavage findings with radiographic appearance of maxillary sinuses***

i. Of the 18 cases having hazy X-rays, 10 yielded abnormal secretions on antral lavage showing accuracy of 56%. Amongst the cases with abnormal returning fluid 5 were purulent in nature, 2 were mucopurulent and 3 were mucoid.
ii. Out of the 15 X-rays showing opacity, 10 yielded abnormal on lavage showing accuracy of 67%. Amongst these 10, 5 were purulent, 2 were mucoid, 3 were mucopurulent.
iii. Of the cases having Air-fluid level on X-rays all proof puncture yielded abnormal purulent returning fluid. Thus showing 100% accuracy.
iv. Out of the total 30 X-rays showing mucosal thickening, 25 yeilded positive lavage showing an accuracy of 83%.
v. $X^2$ value= 59.47, $p<0.05$. So comparison was statistically significant.

***Comparison of lavage findings with diagnostic nasal endoscopic findings***

1) Out of the total, 10 patients showing NO discharge on DNE, all 10 gave positive lavage (no secretion) showing an accuracy of 100%.
2) Of the 29 patients showing thin secretions on DNE, 19 yielded secretions on irrigation. Accuracy was 66%.
3) Of the 61 patients on DNE showing thick and purulent, 53 yielded mucopurulent/purulent secretion on irrigation. Accuracy was 92%.

$X^2$ value= 72.42, $p<0.0001$. So comparison was statistically significant.

***Bacteriology of maxillary sinusitis***

Most common organisms causing acute maxillary sinusitis in this study are- coagulase positive *S. aureus* (17.77%)**,** *S. pnemoniae* (7.77%), *Enterobactiaceae* (7.77%) and *H. influenza* (5.55%).

Most common organisms causing chronic maxillary sinusitis in this study are- anaerobic *Peptostreptococcus* (16.66%), *S. aureus* (11.11%) and *Fusobacteriu*m (6.66%).

Overall most common organisms causing maxillary sinusitis in this study are - coagulase positive *S. aureus* (28.88%), *Peptostreptococcus* (18.8%), *S. pnemoniae* (8.8%) and *H. influenza* (6.6%).

**Table 5: Returning fluid compared with radiographic appearance.**

| X-ray findings | | Lavage findings | | | | % of reliability for a positive proof puncture |
|---|---|---|---|---|---|---|
| | No of X-ray | Clear | Mucoid | Mucopurulent | Purulent | |
| **Clear** | 13 | 10 | 3 | 0 | 0 | 23 |
| **Haziness** | 18 | 8 | 3 | 2 | 5 | 56 |
| **Opacity** | 15 | 5 | 2 | 3 | 5 | 67 |
| **Air-fluid level** | 24 | 0 | 0 | 0 | 24 | 100 |
| **Mucosal thickening** | 30 | 5 | 0 | 6 | 19 | 83 |
| | 100 | 28 | 8 | 11 | 53 | |

**Table 6: Efficacy of antibiotics under study.**

| Efficacy of antibiotics | Clinical cure rate (%) | Results based on endoscopic findings (%) | Radiological success rate (%) |
|---|---|---|---|
| **Amoxicillin-Clavulinate** | 96 | 94 | 87 |
| **Cefpodoxime** | 92 | 91 | 73 |
| **Levofloxacin** | 89 | 89 | 68 |
| **Ciprofloxacin-Tinidazole** | 85 | 87 | 63 |

**Table 7: Adverse effects of each antibiotics under study.**

| Antibiotics | Amoxy-Clav (%) | Cefpodoxime (%) | Levofloxacin (%) | Cipro-Tinidazole (%) |
|---|---|---|---|---|
| **Adverse effects** | Nausea/vomiting (1) | Nausea/vomiting (3) | Nausea/vomiting (4) | Nausea/vomiting (6) |
| | Diarrhoea (6) | Diarrhoea (4) | Diarrhoea (5) | Diarrhoea (1) |
| | Abdominal pain (1) | Abdominal pain (1) | Abdominal pain (2) | Abdominal pain (1) |
| | | | | Metallic taste (4) |

***Sensitivity pattern of antibiotics under study***

In Table 6, out of 100 cases 10 (10%) yielded no growth on culture, whereas 90% yielded growth of different organisms.

Out of 90 cases Amoxy-Clav was sensitive in 66 (87%), Cefpodoxime in 59 (78%), levofloxacin in 52 (60%) and Ciprofloxacin-Tinidazole in 43 (57%).

All aerobes are sensitive to Amoxy-Clav, Cephalosporin, Levofloxacin except Alpha *Hemolytic strepotococci resistant to* Levofloxacin, Cephalosporin.

All anaerobes are sensitive to Amoxy-Clav, Ciprofloxacin-Tinidazole, and resistant to Cephalosporin and Levofloxacin.

All patients received different antibiotics for 10 days on the basis of sensitivity pattern.

33 patients received Amoxy-Clav, 22 patients received Cefpodoxime, 19 patients received levofloxacin, 16 patients received Ciprofloxacin-Tinidazole based on highest sensitivity to particular drug.

Antibiotic efficacy was assessed by improvement of clinical features as per Task Force definitions of rhinosinusitis, X-ray PNS Water's view, and by diagnostic endoscopy.

***The safety outcomes***

The safety outcomes of the study were evaluated by total adverse events (Table 7).

## DISCUSSION

This study was conducted in the department of Otorhinolaryngology, KIMSDU, Karad, Maharashtra, India during the period- November 2011 to May 2013.

100 cases diagnosed clinically as maxillary sinusitis were subjected to radiological examination (Water's view PNS) and diagnostic nasal endoscopy [DNE].

Out of these 100 cases, 87 had abnormal X-rays findings and 90 had abnormal findings at DNE. Antral lavage was done in all cases. The findings were noted, tabulated, compared.

The results of the present study are compared with the previous studies.

***Comparison of sex incidence***

As per Revonta et al, McNeil et al and Arruda et al the incidence of maxillary sinusitis was seen more in females, while as per Kurien et al it was more in males.[6,8,11,15] In present study females were more commonly affected.

***Age distribution***

Highest age incidence was in the third decade i.e. 20-29 age groups. Least commonly affected were elderly more than 50 years.

***Age incidence***

According to Vourinen et al, Axelsson et al, Kurien et al, and also the present study, highest incidence was seen in the 20-29 age group (3rd decade).[7,10,15] While as per McNeil et al, maximum age incidence was in 4th decade.[8]

***Symptomatological index***

Of the major factors for diagnosis of rhinosinusitis, most common complaint in this study was nasal discharge (66%), nasal obstruction (48%), followed by and facial pain (39%).

Among the minor factors, most common symptom was headache (27%) followed by dental pain and halitosis each (18%)

***Radiological appearance of maxillary antra***

Sen et al studied 200 abnormal X-rays.[13] They categorized X-ray findings as slight haziness (n=47), haziness (n=122), opacity (n=20) and mucosal thickening (n=13).

In McNeil et al's study, most common radiographic finding was mucosal thickening (n=25) followed by opacity and haziness.[8] While in Arruda et al study, maximum showed clear antra (n=42).[11] In the studies by Kurien et al and Sen et al, the commonest finding was haziness.[13,15] In the present study most common radiographic finding was mucosal thickening (30%) followed by air fluid level (24%) and haziness (18%).

***Antral lavage findings***

In the study by Kurien et al, commonest return was Purulent in nature.[15] While in Sen et al study and also in the present study most commonly it was clear returning fluid.[13]

***Radiological appearance with antral wash findings***

Opaque X-rays show a high reliability for predicting lavage effluent as found in the studies of Evans et al (94%), Kurien et al (100%), Ezeanolue et al (96%), Vourinen et al (86%), McNeil et al (81%), Sen et al (80%) and Elwamy et al (75%).[8,10,12-16] Similar observation was made in the present study (80%) also.

Air-fluid level in radiograph also showed a good positive predictive value as shown in studies of Elwamy et al (100%), Ezeanolue et al (87.5%), Kurien et al (73.7%) and Vourinen et al (73.6%).[10,14-16] Same result was obtained in the present study (100%) also.

When X-ray showed haziness, only McNeil et al's study reported a high percentage of positive lavage i.e. 87%.[8] Less reliability was shown in studies of Sen et al (49%), Kurien et al (40%), Ezeanolue et al (29.4%) and Samy Elwamy et al (12.5%).[13-16] The present study (56%) also showed comparable findings.

In the case of mucosal thickening in X-ray, only Elwamy et al found a good predictability of 62.5%.[16] While low predictability was shown in the studies of McNeil et al (37%), Ezeanolue et al (36.7%), Vourinen (36.4%), Evans et al (26%) and Hinde (16%).[8-10,12,14] The present study showed a predictability of 83%.

***DNE findings***

In present study thin secretions found in 29% and thick mucopurulent in 61%. The study conducted by Kumar et al found mucopurulent discharge in 63.04% whereas Shahizon et al found mucopurulent discharge in 24%.[17,18]

***Bacteriology of maxillary sinusitis***

According to Brook most common organisms causing acute maxillary sinusitis are *S. pnuemoniae* (31%), *H. influnzae* (21%), *M. catarrhalis* (8%), *Enterobactiaceae* (7%) and *S. aureus* (4%) and chronic maxillary sinusitis caused mainly by anaerobes *Peptostreptococcus spp (*56%), *P. acne (*19%), *Fusobacterium spp (*17%), *Prevotella, Porphyronas* and *B. fragilis* (47%) and *S. pyogens* (6%).[19]

Most common organisms causing acute maxillary sinusitis in this study are- coagulase positive *S. aureus* (17.77%), *S. pnemoniae* (7.77%), *Enterobactiaceae* (7.77%) and *H. influenza* (5.55%).

Most common organisms causing chronic maxillary sinusitis in this study are- anaerobic *Peptostreptococcus* (16.66%), *S. aureus* (11.11%) and *Fusobacterium* (6.66%).

Overall most common organisms causing maxillary sinusitis in this study are coagulase positive *S. aureus* (28.88%), *Peptostreptococcus* (18.8%), *S. pnemoniae* (8.8%), and *H. influenza* (6.6%).

In present study aerobes (48%) are most common organisms responsible for acute maxillary sinusitis, whereas as anaerobes (29%) are more responsible for causing chronic maxillary sinusitis.

***Efficacy of each antibiotics by clinical cure rate***

According to Kapan 100% clinical cure rate seen with Amoxy-Clav, 87.3% by Adeglass study and 74.5% by

Luterman study, whereas in present study clinical cure rate of 96% seen with Amoxy-Clav.[20]

According to Stefansson 89% clinical cure rate seen with Cefpodoxime, 88.4% by Shiegert study and 92.2% by Namyslowski study, whereas in present study clinical cure rate of 92% seen with Cefpodoxime.[20]

According to Adeglass 88.4% clinical cure rate seen with levofloxacin, 93.9% by Lesko study and 91.2% by Joreoncharsri study, whereas in present study clinical cure rate of 89% seen with Levofloxacin.[20]

According to Klapan 100% clinical cure rate seen with Ciprofloxacin-TZ, 87.3% by Adeglass study and 74.5% by Luterman study, whereas in present study clinical cure rate of 76% seen with Ciprofloxacin-Tinidazole.[20]

***The safety***

The safety outcomes of the study were total adverse events.[20] Adverse effects were negligible and tolerable in all individuals.

Diarrhoea (6%) is most common adverse effect of Amoxicillin-Clavulinic acid seen in this study, similarly diarrheoa (11.6%) noted by Adeglass and (14%) noted by Sher studies.[20]

Diarrhoea (6%) is most common adverse effect of Cefpodoxime seen in this study, similarly diarrheoa (6%) noted by Siegert and (6.2%) noted by Burke studies.[20]

Diarrhoea (5%) is most common adverse effect of Levofloxacin seen in this study, similarly diarrheoa (9%) noted by Adelglass and (1.3%) noted by Adelglass studies.[20]

Nausea/vomiting (12%) are most common adverse effect followed by metallic taste (6%) seen with ciprofloxacin-tinidazole in this study. Change in taste sensation (2.5%) most common adverse effect noted by Weiss 1999 study whereas Clifford noted overall GI side effects in 20.6%.[20]

## CONCLUSION

According to our study, most common organisms causing acute maxillary sinusitis in this study are *S. aureus (coagulase +), S. pnemoniae* and *Enterobacteriacae.*

Most common organisms isolated are anaerobic *Peptostreptococcus*, coagulase positive *S. aureus* and *Fusobacterium* in chronic rhinosinusitis. Efficacy of Amoxicillin-Clavulinic acid was 96% clinically, 94% based on results on DNE findings and 87% by radiological success rate which is statistical more significant than other class of antibiotics. So, Amoxicillin Clavulinic acid can be considered as first line of drug for treating bacterial rhinosinusitis.

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